

400kV AIS

	OWNER MAHAN ENERGEN LIMITED (MEL) 2x800 MW ULTRA SUPER CRITICAL THERMAL POWER PROJECT, MAHAN (PHASE-II), SINGRAULI, M.P.
	OWNER'S ENGINEER TATA CONSULTING ENGINEERS LIMITED
 Godrej & Boyce Mfg. Co. Ltd.	EPC Contractor GODREJ AND BOYCE MFG. CO. LTD

DOCUMENT TITLE	4T7 Tower Foundation Design Calculation
OWNER DOC. NO.	552H-E-EPC-SYD-DC-F-V-0042
CONTRACTOR / SUPPLIER DOC. NO.	GNB-MEL-CE-105
PACKAGE DISCIPLINE	CIVIL
PREPARED BY	JMP
REVIEWED BY	NVT
APPROVED BY	NMP

Sr. No.	Revision No.	Date	Reasons for Change
1	0	07.08.2024	First issue
2	1	18.09.2024	Revised submission

FOUNDATION DESIGN

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* **FORCES ON TOWER AT BASE PLATE LEVEL FROM STAAD OUTPUT:- FOR NODE 1, 3, 2, & 4 WITHOUT DEVIATION**

LOAD CASE FROM STAAD		(301) N.C.+WIND PLL. TO BEAM		(302) N.C.+WIND PER. TO BEAM		B/B OF TOWER
		ALONG - Z	ALONG - X	ALONG - Z	ALONG - X	
Moment @ Base Plate level	MX/MZ	-89,795	-672	-54,131	-612	LEGS IN mm LONG x TRANS 3500 x 3500
Horizontal Shear	FZ/FX	-3,936	2,957	-1,143	0	
Moment @ Base Plate level	MY	-82	-82	-1,603	-1,603	
Vertical load	FY	6,978	6,978	6,978	6,978	
Moment @ Found. Bottom Level	MX/MZ	-104752	10565	-58474	-612	
LOAD CASE FROM STAAD		(401) S.C.+WIND PLL. TO BEAM		(402) S.C.+WIND PER. TO BEAM		MAIN LEG ANGLE
		ALONG - Z	ALONG - X	ALONG - Z	ALONG - X	
Moment @ Base Plate level	MX/MZ	-1,89,470	-1,551	-1,53,806	-1,490	L 130X130X16 Angle c.g. 38.2 mm
Horizontal Shear	FZ/FX	-9,022	2,957	-6,229	0	
Moment @ Base Plate level	MY	-3,318	-3,318	-4,838	-4,838	
Vertical load	FY	6,978	6,978	6,978	6,978	
Moment @ Found. Bottom Level	MX/MZ	-223756	9687	-177478	-1490	

* **MATERIAL PROPERTIES :-**

GRADE OF CONCRETE USED

M 25 :

25

N/mm²

GRADE OF REINFORCEMENT USED

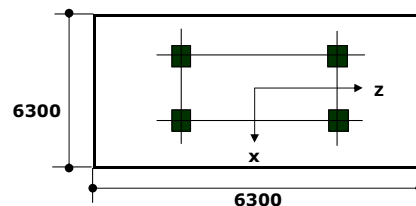
Fe 500 :

500

N/mm²

* **NOTES ON GENERAL ARRANGEMENT OF FOUNDATION SYSTEM :-**

- 1) It is proposed to provide a RAFT FOUNDATION.
- 2) Depth of Foundation 3.5 m w.r.to N.G.L.
- 3) The foundation is designed for the different load combinations as Mentioned in above ref. Table.



CHECKS :-

- 1) SAFE AGAINST OVERTURNING
- 2) CONTACT LENGTH > 70% HENCE SAFE
- 3) CONTACT WIDTH > 70% HENCE SAFE
- 4) SAFE IN SBC
- 5) SAFE IN DIRECT SHEAR STRESS
- 6) SAFE IN PUNCHING SHEAR STRESS

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* GENERAL DATA :-																												
(1) Plinth Height	=	300	mm					PCC Projection =	75 mm																			
(2) Height of col.above gr.lvl.	=	0.3	mts.					i.e. =	0.075 mts																			
(3) Height of col.below gr.lvl.	=	2.900	=	3.500	-	0.6	mts																					
(4) c.g/c.g of Struc. col. leg/	=	3423.6	x	3423.6	mm																							
c.g/c.g of R.C.C columns	=	3.4236	x	3.4236	mts																							
(5) Assume RCC Base	B X L	6300	x	6300	x	600	/	300	mm																			
Corresponding PCC Base	B1 X L1	6450	x	6450	x	75																						
(6) Assume column size equal to		800	x	800	mm																							
(7) Raft slab projection w.r.to Width of Foundation (from Column Centre)	b _c	1438.2	mm		= (	6300	-	3423.6	) / 2																			
(8) Raft slab projection w.r.to Length of Foundation (from Column Centre)	l _c	1438.2	mm		= (	6300	-	3423.6	) / 2																			
(9) Raft slab projection w.r.to Width of Foundation (from Column Face)	b _{fac}	1038.2	mm		= (	1438.2	-	400	)																			
(10) Raft slab projection w.r.to Length of Foundation (from Column Face)	l _{face}	1038.2	mm		= (	1438.2	-	400	)																			
(11) Part With Uniform Thickness	B' X L'	5423.6	x	5423.6	mm																							
* SOIL DATA :-																												
Finished grade level	=	0.000	Mts																									
Top of column above FGL	=	0.300	Mts																									
Bottom of fnd. below NGL	=	3.500	Mts																									
Lever arm w.r.to fdn. to base plate btm.	=	3.800	Mts																									
Thickness of lean conc.	=	0.075	Mts.																									
Net S.B.C. of soil	=	15.00	T/m ²																									
Max. Density of soil	=	1600	Kg/m ³																									
Density of Concrete	=	2500	Kg/m ³																									
Submerged Density of soil due to GWT	=	600	Kg/m ³																									
Ground water table depth from NGL	=	3.000	Mts																									
<table><tr><td>GROSS SBC</td><td>=</td><td>NET SBC x 25 % increase</td><td>+</td><td>Soil overburden pressure</td></tr><tr><td>15.000</td><td>x</td><td>1.250</td><td>+</td><td>3.425</td><td>x</td><td>1.600</td></tr><tr><td></td><td></td><td></td><td>=</td><td>24.230</td><td>T/m²</td><td></td></tr></table>										GROSS SBC	=	NET SBC x 25 % increase	+	Soil overburden pressure	15.000	x	1.250	+	3.425	x	1.600				=	24.230	T/m ²	
GROSS SBC	=	NET SBC x 25 % increase	+	Soil overburden pressure																								
15.000	x	1.250	+	3.425	x	1.600																						
			=	24.230	T/m ²																							
* GRAVITY LOADS :-																												
a) RCC Column below FGL																												
Volume of One RCC Column	=	0.800	x	0.800	x	(3.500	-	0.600)	= 1.856 m ³																			
Weight of One RCC Column	=	1.856	x	2500	x	1	no.s		= 4640 Kgs.																			
Volume of Four RCC Column	=	1.856	x	4.000					= 7.424 m ³																			
Weight of Four RCC Column	=	4640	x	4.000					= 18560 Kgs.																			
b) RCC Column above FGL																												
Volume of One RCC Column	=	0.800	x	0.800	x	0.300			= 0.192 m ³																			
Weight of One RCC Column	=	0.192	x	2500	x	1	no.s		= 480 Kgs.																			
Volume of Four RCC Column	=	0.192	x	4.000					= 0.768 m ³																			
Weight of Four RCC Column	=	480	x	4.000					= 1920 Kgs.																			

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

c) Raft Foundation

Area at Top	A1	=	5.424	x	5.424	=	29.415	m ²
Area at Bottom	A2	=	6.300	x	6.300	=	39.690	m ²
	$\sqrt{A1 \times A2}$	=	$\sqrt{29.415 \times 6.300}$	x	39.690	=	34.169	m ²
Area of Trapazoidal Portion		=	(29.415 + 6.300)	x	0.300	=	34.425	m ²
Area of Ractangular Portion		=	6.300	x	6.300	=	39.690	m ²
Volume Trapazoidal Portion		=	34.425	x	0.300	=	10.327	m ³
Volume Rectangular Portion		=	39.690	x	0.300	=	11.907	m ³
Total Volume of Found.		=	10.327 + 11.907			=	22.234	m ³
Total Weight of Found.		=	22.234 x 2500			=	55586	kgs

d) Rectangular Soil Overburden

Gross Volume above GWT	=	6.300	x	6.300	x	3.000	=	119.070	m ³
Gross Volume below GWT	=	6.300	x	6.300	x	0.500	=	19.845	m ³
Net Volume of soil	=	119.070	-	22.234	-	7.424	=	89.412	m ³
Weight of soil above GWT	=	1600	x	89.412			=	143059	Kgs.
Weight of soil below GWT	=	600	x	19.845			=	11907	Kgs.

* **SUMMARY OF GRAVITY LOADS:-**

Vertical Load From Structure (FY) in Kg	Pv1	Kgs.
Self Weight of Concrete in Kg	Pv2	Kgs.
Rectangular Soil Overburden in Kg	Pv3	Kgs.

* Gross Axial load (including soil overburden),
Pv4 = Pv3 + Pv2 + Pv1 (where Pv3 is Rectangluar soil overburden) Kgs.

* Mom. Along Major Plane of Found. / Column, MX (at found. Btm.) Kg-mt.
Mom. Along Minor Plane of Found. / Column, MZ (at found. Btm.) Kg-mt.

* **CHECK FOR OVERTURNING ALONG LENGTH :-**

F.O.S IN BROKEN WIRE COND. =	1.50
F.O.S IN SHORT-CICUIT COND. =	1.50
(1/2)Length of foundation =	
Overturning Moment 'Mo' = MX	Kg-mt.
Restoring Moment 'MR' = Pv4 X L/2 X 90%	Kg-mt.

F.O.S. Available =
For safety against overturning eccentricity should lie with middle third i.e. e = L/6.
Eccentricity with Soil Overburden, ex = MX / PV4
Contact length =3(L/2- ex') when eccentricity is more than L/6 otherwise CONTACT LENGTH = Length of found. mt.

* **CHECK FOR OVERTURNING ALONG WIDTH :-**

F.O.S IN BROKEN WIRE COND. =	1.50
F.O.S IN SHORT-CICUIT COND. =	1.50
(1/2)Width of foundation =	
Overturning Moment 'Mo' = MZ	Kg-mt.
Restoring Moment 'MR' = Pv4 X L/2 X 90%	Kg-mt.

F.O.S. Available =
For safety against overturning eccentricity should lie with middle third i.e. e = B/6
Eccentricity with Soil Overburden, ey = MZ / PV4
Contact width =3(B/2- ey') when eccentricity is more than B/6 otherwise CONTACT WIDTH = Width of found. mt.

LC-301	LC-302	LC-401	LC-402	REMARKS
6978	6978	6978	6978	
76066	76066	76066	76066	
154966	154966	154966	154966	
238009	238009	238009	238009	
-104752	-58474	-223756	-177478	
10565	-612	9687	-1490	
3.150	3.150	3.150	3.150	
104752	58474	223756	177478	
674756	674756	674756	674756	
6.44	11.54	3.02	3.80	
1.050	1.050	1.050	1.050	
0.440	0.246	0.940	0.746	
6.300	6.300	6.300	6.300	
3.150	3.150	3.150	3.150	
10565	-612	9687	-1490	
674756	674756	674756	674756	
63.87	INFINITE	69.66	INFINITE	
1.050	1.050	1.050	1.050	
0.044	0.003	0.041	0.006	
6.300	6.300	6.300	6.300	

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* CHECK FOR BASE PRESSURE :-							
i)	PV4 / A = P1	kg/m ²	5997	5997	5997	5997	
ii)	MX / ZX = P2	kg/m ²	2514	1403	5369	4259	
iii)	MZ / ZZ = P3	kg/m ²	254	15	232	-36	
	P4 gross (max) = P1 + P2 + P3	kg/m ²	8764	7415	11598	10220	
	ex = MX / PV4	mt.	0.440	0.246	0.940	0.746	
	ey = MZ / PV4	mt.	0.044	0.003	0.041	-0.006	
	ex / L =		0.070	0.039	0.149	0.118	
	ey / B =		0.007	0.000	0.006	-0.001	
	Factor for modified pressure from Pg.No.133 of Teng's Book, K		1.461	1.236	1.934	1.704	
	P mod.= K.Pv4 / B.L in case K >= 2.0 otherwise Pmod = P4		8764	7415	11598	10220	SAFE IN SBC
* CHECK FOR SLIDING :-							
TOTAL VERTICAL LOAD		=	238009.22	kg			
TOTAL HORIZONTAL THRUST		=	2957.18	kg			
FRICTION VALUE CONSIDERED		=	0.450				
				F.O.S. =		36 > 2	SAFE AGAINST SLIDING
* DESIGN PRESSURE & MOMENTS FOR RAFT SLAB :-							
Concrete overburden		=	2500	x	0.450	=	1125 kg/m ²
Soil Overburden		=	1600	x	3.050	=	4880 kg/m ²
Total overburden		=	1125	+	4880	=	6005 kg/m ²
			LC-301	LC-302	LC-401	LC-402	REMARKS
			2759	1410	5593	4215	
			1189	607	2410	1816	
			1189	607	2410	1816	
			2368	1210	4801	3617	
			2346	1199	4757	3584	
			2.20	2.20	1.65	1.65	
			2615	1336	3977	2997	
			2615	1336	3977	2997	
			5209	2662	7921	5969	
			5162	2637	7849	5914	
			1363	697	2764	2083	
			1397	713	2831	2133	
			2.20	2.20	1.65	1.65	
			2999	1532	4561	3437	
			3072	1570	4672	3520	

* NET BEARING PRESSURE BELOW FOUNDATION		kg/m ²
* MOMENT CALCULATIONS :-		
Positive Moment at Centre Along Length		Kg-mt.
Positive Moment at Centre Along Width		Kg-mt.
Negative Moment at Effective Span (i.e. l _{face} + d _{eff} /2) Along Length		Kg-mt.
Negative Moment at Effective Span (i.e. b _{face} + d _{eff} /2) Along Width		Kg-mt.
Partial Safety Facator		
Limit Positive Moment at Centre Along Length		Kg-mt.
Limit Positive Moment at Centre Along Width		Kg-mt.
Limit Negative Moment at Effective Span (i.e. l _{face} + d _{eff} /2) Along Length		Kg-mt.
Limit Negative Moment at Effective Span (i.e. b _{face} + d _{eff} /2) Along Width		Kg-mt.
* SHEAR FORCE CALCULATIONS :-		
Shear force at d _{eff} . From Column Face Along Length		kg
Shear force at d _{eff} . From Column Face Along Width		kg
Partial Safety Facator		
Limit Shear force at d _{eff} . From Column Face Along Length		kg
Limit Shear force at d _{eff} . From Column Face Along Width		kg

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* DESIGN OF RAFT SLAB :-											
* Top Reinforcement in Raft Slab Along Length											
Clear cover to Main Reinforcement at Top	=	50	mm								
Effective Depth of Slab d_{eff} .	=	600	-	50	-	6	=	544	mm		
Design Moment for End Projection	=	3977	Kg-mt.								
Mu / b.d.d	=	3977	x								
Mu / b.d.d	=	0.134	N/mm ²								
P _t	=	0.037	%								
A _{st}	=	0.037	x	100	x	54.40	/	100	=	2.028	cm ² /rmt
0.12 % of Agross A _{st} min.	=	7.200	cm ² /rmt								
A _{st} req.	=	7.200	cm ² /rmt								
Provide		12	mm dia.	@	15.708	cm c/c Say		15	cms c/c		
A _{st} pro.	=	7.540	cm ² /rmt								
* Top Reinforcement in Raft Slab Along Width											
Clear cover to Main Reinforcement at Top	=	50	mm								
Effective Depth of Slab d_{eff} .	=	600	-	50	-	6	-	12	=	532	mm
Design Moment for End Projection	=	3977	Kg-mt.								
Mu / b.d.d	=	3977	x								
Mu / b.d.d	=	0.141	N/mm ²								
P _t	=	0.039	%								
A _{st}	=	0.039	x	100	x	53.20	/	100	=	2.059	cm ² /rmt
0.12 % of Agross A _{st} min.	=	7.200	cm ² /rmt								
A _{st} req.	=	7.200	cm ² /rmt								
Provide		12	mm dia.	@	15.708	cm c/c Say		15	cms c/c		
A _{st} pro.	=	7.540	cm ² /rmt								

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* <u>Checking for One Way Shear at Distance d_{eff} From Face of Support Along Length</u>									
Clear Projection of Raft Slab for Shear Chacking [i.e. d_{eff} from Face of Support (i.e. l_{face})]	=	1.038	-	0.544	=	0.494	mt.		
Limit Shear force @ d_{eff} from Column face	=	4561	kg						
Actual Shear Stress @ d_{eff} from Column face (τ_v)	=	4561	/((	100	x	54.40	)		
	=	0.838	kg/cm ²						
	=	0.084	N/mm ²						
P _t pro.at Critical Section	=	0.139	%						
β	=	20.943							
Per. Shear Stress @ d_{eff} from Column face (τ_c)	=	0.281	N/mm ²	>		0.084	N/mm ²		SAFE IN DIRECT SHEAR STRESS
* <u>Checking for One Way Shear at Distance d_{eff} From Face of Support Along Width</u>									
Clear Projection of Raft Slab for Shear Chacking [i.e. d_{eff} from Face of Support (i.e. b_{face})]	=	1.038	-	0.532	=	0.506	mt.		
Limit Shear force @ d_{eff} from Column face	=	4672	kg						
Actual Shear Stress @ d_{eff} from Column face (τ_v)	=	4672	/((	100	x	53.20	)		
	=	0.878	kg/cm ²						
	=	0.088	N/mm ²						
P _t pro.at Critical Section	=	0.142	%						
β	=	20.481							
Per. Shear Stress @ d_{eff} from Column face (τ_c)	=	0.284	N/mm ²	>		0.088	N/mm ²		SAFE IN DIRECT SHEAR STRESS
* <u>Checking for Punching Shear</u>									
Limit Max. Compressive force in Pedestal	=	-13751	kg						
Two way Shear Stress	=	-13751	/((	538	x	54.40	)		
	=	-0.470	kg/cm ²						
	=	-0.047	N/mm ²						
β_c	=	1.000							
k_c	=	1.000							
τ_c	=	1.250							
Per. Shear Stress	=	1.250	N/mm ²	>		-0.047	N/mm ²		SAFE IN PUNCHING SHEAR STRESS

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)									
10) Initial Moment per Col. due to Shear										
MX = PHZ x L.A.			Kg-mt.	-3168	-1289	-7993	-6114			
MZ = PHX X L.A.			Kg-mt.	2347	-375	1590	-1131			
11) Moment due to Slenderness										
Max => Pu.D/2000 x (Lexx/D) ²			Kg-mt.	0.000	0.000	0.000	0.000			
Maz => Pu.b/2000 x (Lezz/b) ²			Kg-mt.	0.000	0.000	0.000	0.000			
12) Moment due to Min. Eccentricity										
Mex => Pu.ex			Kg-mt.	0.000	0.000	0.000	0.000			
Mez => Pu.ez			Kg-mt.	0.000	0.000	0.000	0.000			
13) Final Limit Moment per Col. due to Shear @ found. top										
Mux = { (MX or Mex) + Max } x Par. safety factor			Kg-mt.	0	0	0	0			
Muz = { (MZ or Mez) + Maz } x Par. safety factor			Kg-mt.	5162	0	3499	0			
FOR TENSION + BENDING CASE										
Mux = { (ML or Mex) } x Par. safety factor			Kg-mt.	0	0	0	0			
Muz = { (MT or Mez) } x Par. safety factor			Kg-mt.	5162	0	2624	0			
14) Check for Tension + Bending										
Pu/fckb.D				0.020	0.013	0.030	0.025			
(Muxx+Muzz)/Fck b.D.D				0.004	0.000	0.002	0.000			
p/fck from chart corresponding to d'/D		Chart 83		0.021	0.005	0.015	0.010			
(Muxx+Muzz)/Fck D.b.b				0.004	0.000	0.002	0.000			
p/fck from chart corresponding to b'/B				0.021	0.005	0.015	0.010			
Area of Steel required for average p/fck value			Sq.mm.	3360	800	2400	1600			
15) Check for Compression + Bending										
Assumed percentage of Steel in Column				0.896	0.896	0.896	0.896			
Area of Steel, Asc			Sq.mm.	5733	5733	5733	5733			
Puz = 0.45 x Fck x Ac + 0.75 x Fy x Asc			Kg	946826	946826	946826	946826			
Pu/Puz				-0.027	-0.015	-0.046	-0.036			
Factor an				1.000	1.000	1.000	1.000			
Pu/fckb.D				-0.015	-0.008	-0.026	-0.021			
p/fck				0.036	0.036	0.036	0.036			
Corresponding Mu/fckb.D.D		Chart 48		0.0100	0.018	0.0150	0.0190			
Mux1			Kg-mt.	13052	23493	19578	24799			
Muz1			Kg-mt.	13052	23493	19578	24799			
(Mux/Mux1) ^{an} +(Muz/Muz1) ^{an}				0.396	0.000	0.179	0.000			
16)CHECK FOR BUOYANCY										
BUOYANCY LOAD	=	Length x Width x Depth of water x Density								
	=	6.450 x 6.450 x (3.5-3.0) x 10								
	=	208.01								
Total Self Weight	=	Wt. of RCC Column below FGL + Wt. of RCC Column above FGL + wt. of raft								
	=	(18560+1920+55586)/100								
	=	760.66								
Ratio	=	3.66	>	1.50						
		SAFE AGAINST UPLIFT								

Provided Reinforcement

4	25 mm +
12	20 mm

Provided reinf. Area
5733 Sq.mm.
% of reinf. In column
0.896 %

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

- * **FORCES ON TOWER AT BASE PLATE LEVEL FROM STAAD OUTPUT:- FOR NODE 1, 3, 2, & 4 WITH PLAN DEVIATION CASE**

LOAD CASE FROM STAAD		(303) N.C.+WIND PLL. TO BEAM		(304) N.C.+WIND PER. TO BEAM		B/B OF TOWER
		ALONG - Z	ALONG - X	ALONG - Z	ALONG - X	
Moment @ Base Plate level	MX/MZ	-1,31,781	-1,006	-1,02,141	-996	LEGS IN mm LONG x TRANS 3500 x 3500
Horizontal Shear	FZ/FX	-5,969	3,457	-3,474	510	
Moment @ Base Plate level	MY	-669	-669	-2,353	-2,353	
Vertical load	FY	6,978	6,978	6,978	6,978	
Moment @ Found. Bottom Level	MX/MZ	-154465	12130	-115343	941	
LOAD CASE FROM STAAD		(403) S.C.+WIND PLL. TO BEAM		(404) S.C.+WIND PER. TO BEAM		MAIN LEG ANGLE
		ALONG - Z	ALONG - X	ALONG - Z	ALONG - X	
Moment @ Base Plate level	MX/MZ	-3,28,290	-2,696	-2,99,464	-2,692	L 130X130X16 Angle c.g. 38.2 mm
Horizontal Shear	FZ/FX	-15,632	2,947	-13,166	0	
Moment @ Base Plate level	MY	-6,804	-6,804	-8,487	-8,487	
Vertical load	FY	6,978	6,978	6,978	6,978	
Moment @ Found. Bottom Level	MX/MZ	-387691	8503	-349493	-2692	

- * **MATERIAL PROPERTIES :-**

GRADE OF CONCRETE USED

M 25 :

25

N/mm²

GRADE OF REINFORCEMENT USED

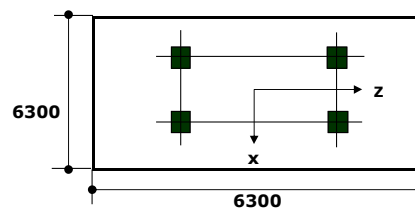
Fe 500 :

500

N/mm²

- * **NOTES ON GENERAL ARRANGEMENT OF FOUNDATION SYSTEM :-**

- 1) It is proposed to provide a RAFT FOUNDATION.
- 2) Depth of Foundation 3.5 m w.r.to N.G.L.
- 3) The foundation is designed for the different load combinations as Mentioned in above ref. Table.



CHECKS :-

- 1) SAFE AGAINST OVERTURNING
- 2) CONTACT LENGTH > 70% HENCE SAFE
- 3) CONTACT WIDTH > 70% HENCE SAFE
- 4) SAFE IN SBC
- 5) SAFE IN DIRECT SHEAR STRESS
- 6) SAFE IN PUNCHING SHEAR STRESS

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

c) Raft Foundation									
Area at Top	A1	=	5.424	x	5.424	=	29.415	m ²	
Area at Bottom	A2	=	6.300	x	6.300	=	39.690	m ²	
	$\sqrt{A1 \times A2}$	=	$\sqrt{29.415 \times 39.690}$			=	34.169	m	
Area of Trapazoidal Portion		=	(29.415 + 39.690)	x	1/3	=	34.425	m ²	
Area of Ractangular Portion		=	6.300	x	6.300	=	39.690	m ²	
Volume Trapazoidal Portion		=	34.425	x	0.300	=	10.327	m ³	
Volume Rectangular Portion		=	39.690	x	0.300	=	11.907	m ³	
Total Volume of Found.		=	10.327 + 11.907			=	22.234	m ³	
Total Weight of Found.		=	22.234 x 2500			=	55586	kgs	
d) Rectangular Soil Overburden									
Gross Volume above GWT		=	6.300	x	6.300	x	3.000	=	119.070 m ³
Gross Volume below GWT		=	6.300	x	6.300	x	0.500	=	19.845 m ³
Net Volume of soil		=	119.070	-	22.234	-	7.424	=	89.412 m ³
Weight of soil above GWT		=	1600	x	89.412			=	143059 Kgs.
Weight of soil below GWT		=	600	x	19.845			=	11907 Kgs.

* **SUMMARY OF GRAVITY LOADS:-**

Vertical Load From Structure (FY) in Kg	Pv1	Kgs.
Self Weight of Concrete in Kg	Pv2	Kgs.
Rectangular Soil Overburden in Kg	Pv3	Kgs.

* Gross Axial load (including soil overburden),
Pv4 = Pv3 + Pv2 + Pv1 (where Pv3 is Rectangluar soil overburden) Kgs.

* Mom. Along Major Plane of Found. / Column, MX (at found. Btm.) Kg-mt.
Mom. Along Minor Plane of Found. / Column, MZ (at found. Btm.) Kg-mt.

* **CHECK FOR OVERTURNING ALONG LENGTH :-**

F.O.S IN BROKEN WIRE COND. =	1.50
F.O.S IN SHORT-CICUIT COND. =	1.50
(1/2)Length of foundation =	
Overturning Moment 'Mo' = MX	Kg-mt.
Restoring Moment 'MR' = Pv4 X L/2 X 90%	Kg-mt.

F.O.S. Available =
For safety against overturning eccentricity should lie with middle third i.e. e = L/6.
Eccentricity with Soil Overburden, ex = MX / PV4
Contact length =3(L/2- ex') when eccentricity is
more than L/6 otherwise CONTACT LENGTH = Length of found. mt.

* **CHECK FOR OVERTURNING ALONG WIDTH :-**

F.O.S IN BROKEN WIRE COND. =	1.50
F.O.S IN SHORT-CICUIT COND. =	1.50
(1/2)Width of foundation =	
Overturning Moment 'Mo' = MZ	Kg-mt.
Restoring Moment 'MR' = Pv4 X L/2 X 90%	Kg-mt.

F.O.S. Available =
For safety against overturning eccentricity should lie with middle third i.e. e = B/6
Eccentricity with Soil Overburden, ey = MZ / PV4
Contact width =3(B/2- ey') when eccentricity is
more than B/6 otherwise CONTACT WIDTH = Width of found. mt.

LC-303	LC-304	LC-403	LC-404	REMARKS
6978	6978	6978	6978	
76066	76066	76066	76066	
154966	154966	154966	154966	
238009	238009	238009	238009	
-154465	-115343	-387691	-349493	
12130	941	8503	-2692	
3.150	3.150	3.150	3.150	
-154465	-115343	-387691	-349493	
674756	674756	674756	674756	
INFINITE	INFINITE	INFINITE	INFINITE	
1.050	1.050	1.050	1.050	
0.649	0.485	1.629	1.468	
6.300	6.300	4.563	5.045	
3.150	3.150	3.150	3.150	
12130	941	8503	-2692	
674756	674756	674756	674756	
55.63	717.03	79.36	INFINITE	
1.050	1.050	1.050	1.050	
0.051	0.004	0.036	0.011	
6.300	6.300	6.300	6.300	

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* **CHECK FOR BASE PRESSURE :-**

- i) $PV4 / A = P1$ kg/m²
ii) $MX / ZX = P2$ kg/m²
iii) $MZ / ZZ = P3$ kg/m²
P4 gross (max) = P1 + P2 + P3 kg/m²
 $ex = MX / PV4$ mt.
 $ey = MZ / PV4$ mt.
 $ex / L =$
 $ey / B =$

Factor for modified pressure from Pg.No.133 of Teng's Book, K

P mod.= K.Pv4 / B.L in case K >= 2.0 otherwise Pmod = P4

* **CHECK FOR SLIDING :-**

TOTAL VERTICAL LOAD = 238009.23 kg
TOTAL HORIZONTAL THRUST = 3456.84 kg
FRICTION VALUE CONSIDERED = 0.300

F.O.S. = 21 > 2

SAFE AGAINST SLIDING

* **DESIGN PRESSURE & MOMENTS FOR RAFT SLAB :-**

Concrete overburden	=	2500	x	0.450	=	1125	kg/m ²
Soil Overburden	=	1600	x	3.050	=	4880	kg/m ²
Total overburden	=	1125	+	4880	=	6005	kg/m ²

NET BEARING PRESSURE BELOW FOUNDATION

* **MOMENT CALCULATIONS :-**

Positive Moment at Centre Along Length Kg-mt.
Positive Moment at Centre Along Width Kg-mt.
Negative Moment at Effective Span (i.e. $l_{face} + d_{eff}/2$) Along Length Kg-mt.
Negative Moment at Effective Span (i.e. $b_{face} + d_{eff}/2$) Along Width Kg-mt.
Partial Safety Facator
Limit Positive Moment at Centre Along Length Kg-mt.
Limit Positive Moment at Centre Along Width Kg-mt.
Limit Negative Moment at Effective Span (i.e. $l_{face} + d_{eff}/2$) Along Length Kg-mt.
Limit Negative Moment at Effective Span (i.e. $b_{face} + d_{eff}/2$) Along Width Kg-mt.

* **SHEAR FORCE CALCULATIONS :-**

Shear force at d_{eff} . From Column Face Along Length kg
Shear force at d_{eff} . From Column Face Along Width kg
Partial Safety Facator
Limit Shear force at d_{eff} . From Column Face Along Length kg
Limit Shear force at d_{eff} . From Column Face Along Width kg

LC-303	LC-304	LC-403	LC-404	REMARKS
3989	2782	10784	9877	
1719	1199	4647	4256	
1719	1199	4647	4256	
3424	2388	9256	8477	
3393	2366	9172	8400	
2.20	2.20	1.65	1.65	
3782	2637	7668	7022	
3782	2637	7668	7022	
7533	5253	15273	13987	
7464	5205	15133	13859	
1971	1375	5330	4881	
2019	1408	5459	4999	
2.20	2.20	1.65	1.65	
4337	3025	8794	8054	
4443	3098	9007	8249	

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(PH-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)					

* **Checking for One Way Shear at Distance d_{eff} From Face of Support Along Length**

Clear Projection of Raft Slab for Shear Chacking [i.e. d_{eff} from Face of Support (i.e. l_{face})]	=	1.038	-	0.544	=	0.494	mt.
Limit Shear force @ d_{eff} from Column face	=	8794	kg				
Actual Shear Stress @ d_{eff} from Column face (τ_v)	=	8794	/ (	100	x	54.40	)
	=	1.616	kg/cm ²				
	=	0.162	N/mm ²				
P_t pro.at Critical Section	=	0.139	%				
β	=	20.943					
Per. Shear Stress @ d_{eff} from Column face (τ_c)	=	0.281	N/mm ²	>		0.162	N/mm ²

SAFE IN DIRECT SHEAR STRESS

* **Checking for One Way Shear at Distance d_{eff} From Face of Support Along Width**

Clear Projection of Raft Slab for Shear Chacking [i.e. d_{eff} from Face of Support (i.e. b_{face})]	=	1.038	-	0.532	=	0.506	mt.
Limit Shear force @ d_{eff} from Column face	=	9007	kg				
Actual Shear Stress @ d_{eff} from Column face (τ_v)	=	9007	/ (	100	x	53.20	)
	=	1.693	kg/cm ²				
	=	0.169	N/mm ²				
P_t pro.at Critical Section	=	0.142	%				
β	=	20.481					
Per. Shear Stress @ d_{eff} from Column face (τ_c)	=	0.284	N/mm ²	>		0.169	N/mm ²

SAFE IN DIRECT SHEAR STRESS

* **Checking for Punching Shear**

Limit Max. Compressive force in Pedestal	=	-29300	kg				
Two way Shear Stress	=	-29300	/ (	538	x	54.40	)
	=	-1.002	kg/cm ²				
	=	-0.100	N/mm ²				
β_c	=	1.000					
k_c	=	1.000					
τ_c	=	1.250					
Per. Shear Stress	=	1.250	N/mm ²	>		-0.100	N/mm ²

SAFE IN PUNCHING SHEAR STRESS

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* **DESIGN OF RCC COLUMN :-**

Height of Column above F.G.L	e	=	300	mm
Depth of Column below F.G.L	d	=	2900	mm
Clear Unsupported length of Column		=	3200	mm
Characteristic Strength of Concrete used		=	25	N/mm ²
Characteristic Strength of Reinf. used :		=	500	N/mm ²
Size of Column (b x b)	800	x	800	mm
Unsupported Length , L		=	3200	mm
Eff. Length @ x-x, Lexx		=	6400	mm
Eff. Length @ z-z, Lezz		=	6400	mm
Assuming Eff. cover to reinf.		=	50	
Ratio d'/D		=	0.06	
Ratio b'/B		=	0.06	
Reference table from SP16 for compression + bending		=	Chart 48	
Reference table from SP16 for Tension + bending		=	Chart 83	
Ratio's for Moment due to Slenderness				
Ratio Lexx / D		=	8.000	< 12, hence o.k.
Ratio Lezz / b		=	8.000	< 12, hence o.k.

Note : SLENDERNESS EFFECT NOT CONSIDERED FOR TENSION + BENDING CASE

Eccentricities for Moment due to Minimum eccentricity

ex => L/500 + D/30	=	33.1	mm < 0.05 x D hence neglect
ez => L/500 + b/30	=	33.1	mm < 0.05 x b hence neglect

				LC-303	LC-304	LC-403	LC-404
1) Axial load per leg, P Kgs = FY / 4				1744	1744	1744	1744
2) Moment at base plate level ' MX '			Kg-mt.	-1,31,781	-1,02,141	-3,28,290	-2,99,464
Moment at base plate level ' MZ '			Kg-mt.	-1,006	-996	-2,696	-2,692
Moment at base plate level ' MY '			Kg-mt.	-669	-2,353	-6,804	-8,487
3) Shear at base plate level per leg							
PHX1 = FX / 4			Kg	864	127	737	0
PHZ1 = FZ / 4			Kg	-1492	-869	-3908	-3291
Diagonal c/c of column	R		Kg	5	5	5	5
Due to ' MY ' = PH = (MY / 4) / (R / 2)			Kg	-69	-243	-703	-876
Angle				45	45	45	45
PHX2 = Horizontal Component of PH			Kg	-49	-172	-497	-620
PHZ2 = Horizontal Component of PH			Kg	-49	-172	-497	-620
TOTAL SHEAR PHX = PHX1 + PHX2			Kg	815	-44	240	-620
TOTAL SHEAR PHZ= PHZ1 + PHZ2			Kg	-1541	-1040	-4405	-3911
4) Axial load per leg due to moment, (+/-) P'							
a) Due to ' MX '			Kg	-19246	-14917	-47945	-43735
b) Due to ' MZ '			Kg	-147	-146	-394	-393
5) Maximum Axial Compression per col., P + P'			Kg	-17648	-13318	-46595	-42384
6) Maximum Axial pullout per col., P - P'			Kg	21137	16807	50083	45873
7) Partial Safety factors				2.20	2.20	1.65	1.65
8) Maximum Axial Compression (Lim.)			Kg	-38827	-29300	-76881	-69934
9) Maximum Axial Tension (Lim.)			Kg	46502	36976	82638	75690

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

10) Initial Moment per Col. due to Shear							
MX = PHZ x L.A.		Kg-mt.	-4932	-3329	-14095	-12516	
MZ = PHX x L.A.		Kg-mt.	2609	-142	768	-1983	
11) Moment due to Slenderness							
Max => Pu.D/2000 x (Lexx/D) ²		Kg-mt.	0.000	0.000	0.000	0.000	
Maz => Pu.b/2000 x (Lezz/b) ²		Kg-mt.	0.000	0.000	0.000	0.000	
12) Moment due to Min. Eccentricity							
Mex => Pu.ex		Kg-mt.	0.000	0.000	0.000	0.000	
Mez => Pu.ez		Kg-mt.	0.000	0.000	0.000	0.000	
13) Final Limit Moment per Col. due to Shear @ found. top							
Mux = { (MX or Mex) + Max } x Par. safety factor		Kg-mt.	0	0	0	0	
Muz = { (MZ or Mez) + Maz } x Par. safety factor		Kg-mt.	5740	0	1689	0	
FOR TENSION + BENDING CASE							
Mux = { (ML or Mex) } x Par. safety factor		Kg-mt.	0	0	0	0	
Muz = { (MT or Mez) } x Par. safety factor		Kg-mt.	5740	0	1267	0	
14) Check for Tension + Bending							
Pu/fckb.D			0.029	0.023	0.051	0.046	
(Muxx+Muzz)/Fck b.D.D			0.004	0.000	0.001	0.000	
p/fck from chart corresponding to d'/D	Chart 83		0.025	0.001	0.017	0.019	
(Muxx+Muzz)/Fck D.b.b			0.004	0.000	0.001	0.000	
p/fck from chart corresponding to b'/B			0.025	0.001	0.017	0.019	
Area of Steel required for average p/fck value		Sq.mm.	4000	80	2720	3040	
15) Check for Compression + Bending							
Assumed percentage of Steel in Column			0.896	0.896	0.896	0.896	Provided Reinforcement
Area of Steel, Asc		Sq.mm.	5733	5733	5733	5733	4 25 mm +
Puz = 0.45 x Fck x Ac + 0.75 x Fy x Asc		Kg	946826	946826	946826	946826	12 20 mm
Pu/Puz			-0.041	-0.031	-0.081	-0.074	Provided reinf. Area
Factor an			1.000	1.000	1.000	1.000	5733 Sq.mm.
Pu/fckb.D			-0.024	-0.018	-0.047	-0.043	% of reinf. In column
p/fck			0.036	0.036	0.036	0.036	0.896 %
Corresponding Mu/fckb.D.D	Chart 48		0.0150	0.0180	0.0160	0.0150	
Mux1		Kg-mt.	19578	23493	20883	19578	
Muz1		Kg-mt.	19578	23493	20883	19578	
(Mux/Mux1) ^{an} + (Muz/Muz1) ^{an}			0.293	0.000	0.081	0.000	

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* **FORCES ON TOWER AT BASE PLATE LEVEL FROM STAAD OUTPUT:- FOR NODE 1, 3, 2, & 4
WITH ELEVATION DEVIATION CASE**

LOAD CASE FROM STAAD		(305) N.C.+WIND PLL. TO BEAM		(306) N.C.+WIND PER. TO BEAM		B/B OF TOWER
		ALONG - Z	ALONG - X	ALONG - Z	ALONG - X	
Moment @ Base Plate level	MX/MZ	-1,30,867	-1,024	-95,203	-963	LEGS IN mm LONG x TRANS 3500 x 3500
Horizontal Shear	FZ/FX	-5,937	2,932	-3,144	0	
Moment @ Base Plate level	MY	-1,365	-1,365	-2,858	-2,858	
Vertical load	FY	10,404	10,404	10,404	10,404	
Moment @ Found. Bottom Level	MX/MZ	-153427	10116	-107149	-963	
LOAD CASE FROM STAAD		(405) S.C.+WIND PLL. TO BEAM		(406) S.C.+WIND PER. TO BEAM		MAIN LEG ANGLE
		ALONG - Z	ALONG - X	ALONG - Z	ALONG - X	
Moment @ Base Plate level	MX/MZ	-3,28,191	-2,710	-2,92,526	-2,648	L 130X130X16 Angle c.g. 38.2 mm
Horizontal Shear	FZ/FX	-15,628	2,932	-12,835	0	
Moment @ Base Plate level	MY	-7,217	-7,217	-8,710	-8,710	
Vertical load	FY	16,002	16,002	16,002	16,002	
Moment @ Found. Bottom Level	MX/MZ	-387578	8431	-341300	-2648	

* **MATERIAL PROPERTIES :-**

GRADE OF CONCRETE USED

M 25 :

25

N/mm²

GRADE OF REINFORCEMENT USED

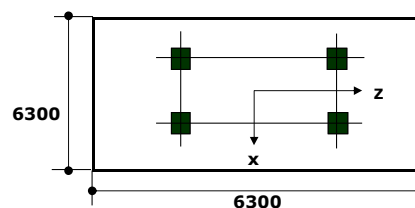
Fe 500 :

500

N/mm²

* **NOTES ON GENERAL ARRANGEMENT OF FOUNDATION SYSTEM :-**

- 1) It is proposed to provide a RAFT FOUNDATION.
- 2) Depth of Foundation 3.5 m w.r.to N.G.L.
- 3) The foundation is designed for the different load combinations as Mentioned in above ref. Table.



CHECKS :-

- 1) SAFE AGAINST OVERTURNING
- 2) CONTACT LENGTH > 70% HENCE SAFE
- 3) CONTACT WIDTH > 70% HENCE SAFE
- 4) SAFE IN SBC
- 5) SAFE IN DIRECT SHEAR STRESS
- 6) SAFE IN PUNCHING SHEAR STRESS

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

c) Raft Foundation

Area at Top	A1	=	5.424	x	5.424	=	29.415	m ²	
Area at Bottom	A2	=	6.300	x	6.300	=	39.690	m ²	
	$\sqrt{\frac{A1 \times A2}{A1 + A2}}$	=	$\sqrt{\frac{29.415 \times 39.690}{29.415 + 39.690}}$	x	39.690	=	34.169	m ²	
Area of Trapazoidal Portion		=	(29.415	+	39.690	+ 34.169)	x 1/3	= 34.425	m ²
Area of Ractangular Portion		=	6.300	x	6.300	=	39.690	m ²	
Volume Trapazoidal Portion		=	34.425	x	0.300	=	10.327	m ³	
Volume Rectangular Portion		=	39.690	x	0.300	=	11.907	m ³	
Total Volume of Found.		=	10.327	+	11.907	=	22.234	m³	
Total Weight of Found.		=	22.234	x	2500	=	55586	kgs	

d) Rectangular Soil Overburden

Gross Volume above GWT	=	6.300	x	6.300	x	3.000	=	119.070	m ³
Gross Volume below GWT	=	6.300	x	6.300	x	0.500	=	19.845	m ³
Net Volume of soil	=	119.070	-	22.234	-	7.424	=	89.412	m³
Weight of soil above GWT	=	1600	x	89.412			=	143059	Kgs.
Weight of soil below GWT	=	600	x	19.845			=	11907	Kgs.

* **SUMMARY OF GRAVITY LOADS:-**

Vertical Load From Structure (FY) in Kg	Pv1	Kgs.
Self Weight of Concrete in Kg	Pv2	Kgs.
Rectangular Soil Overburden in Kg	Pv3	Kgs.

* Gross Axial load (including soil overburden),
Pv4 = Pv3 + Pv2 + Pv1 (where Pv3 is Rectangluar soil overburden) Kgs.

* Mom. Along Major Plane of Found. / Column, MX (at found. Btm.) Kg-mt.
Mom. Along Minor Plane of Found. / Column, MZ (at found. Btm.) Kg-mt.

* **CHECK FOR OVERTURNING ALONG LENGTH :-**

F.O.S IN BROKEN WIRE COND. =	1.50
F.O.S IN SHORT-CICUIT COND. =	1.50
(1/2)Length of foundation =	
Overturning Moment 'Mo' = MX	Kg-mt.
Restoring Moment 'MR' = Pv4 X L/2 X 90%	Kg-mt.

F.O.S. Available =
For safety against overturning eccentricity should lie with middle third i.e. e = L/6.
Eccentricity with Soil Overburden, ex = MX / PV4
Contact length =3(L/2- ex') when eccentricity is
more than L/6 otherwise CONTACT LENGTH = Length of found. mt.

* **CHECK FOR OVERTURNING ALONG WIDTH :-**

F.O.S IN BROKEN WIRE COND. =	1.50
F.O.S IN SHORT-CICUIT COND. =	1.50
(1/2)Width of foundation =	
Overturning Moment 'Mo' = MZ	Kg-mt.
Restoring Moment 'MR' = Pv4 X L/2 X 90%	Kg-mt.

F.O.S. Available =
For safety against overturning eccentricity should lie with middle third i.e. e = B/6
Eccentricity with Soil Overburden, ey = MZ / PV4
Contact width =3(B/2- ey') when eccentricity is
more than B/6 otherwise CONTACT WIDTH = Width of found. mt.

LC-305	LC-306	LC-405	LC-406	REMARKS
10404	10404	16002	16002	
76066	76066	76066	76066	
154966	154966	154966	154966	
241435	241435	247034	247034	
-153427	-107149	-387578	-341300	
10116	-963	8431	-2648	
3.150	3.150	3.150	3.150	
-153427	-107149	-387578	-341300	
684470	684470	700341	700341	
INFINITE	INFINITE	INFINITE	INFINITE	
1.050	1.050	1.050	1.050	
0.635	0.444	1.569	1.382	
6.300	6.300	4.743	5.305	
3.150	3.150	3.150	3.150	
10116	-963	8431	-2648	
684470	684470	700341	700341	
67.66	INFINITE	83.07	INFINITE	
1.050	1.050	1.050	1.050	
0.042	0.004	0.034	0.011	
6.300	6.300	6.300	6.300	

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* **CHECK FOR BASE PRESSURE :-**

- i) $PV4 / A = P1$ kg/m²
ii) $MX / ZX = P2$ kg/m²
iii) $MZ / ZZ = P3$ kg/m²
P4 gross (max) = P1 + P2 + P3 kg/m²
ex = MX / PV4 mt.
ey = MZ / PV4 mt.
ex / L =
ey / B =

Factor for modified pressure from Pg.No.133 of Teng's Book, K

P mod.= K.Pv4 / B.L in case K >= 2.0 otherwise Pmod = P4

* **CHECK FOR SLIDING :-**

TOTAL VERTICAL LOAD = 247033.70 kg
TOTAL HORIZONTAL THRUST = 2931.69 kg
FRICTION VALUE CONSIDERED = 0.300

F.O.S. = 25 > 2

SAFE AGAINST SLIDING

* **DESIGN PRESSURE & MOMENTS FOR RAFT SLAB :-**

NET BEARING PRESSURE BELOW FOUNDATION kg/m²

* **MOMENT CALCULATIONS :-**

Positive Moment at Centre Along Length Kg-mt. 1725 1152 4612 4245
Positive Moment at Centre Along Width Kg-mt. 1725 1152 4612 4245
Negative Moment at Effective Span (i.e. l_{face} + d_{eff}/2) Along Length Kg-mt. 3435 2294 9186 8454
Negative Moment at Effective Span (i.e. b_{face} + d_{eff}/2) Along Width Kg-mt. 3404 2273 9102 8377

Partial Safety Facator

Limit Positive Moment at Centre Along Length Kg-mt. 3794 2533 7609 7004
Limit Positive Moment at Centre Along Width Kg-mt. 3794 2533 7609 7004
Limit Negative Moment at Effective Span (i.e. l_{face} + d_{eff}/2) Along Length Kg-mt. 7558 5046 15156 13950
Limit Negative Moment at Effective Span (i.e. b_{face} + d_{eff}/2) Along Width Kg-mt. 7488 5000 15018 13822

* **SHEAR FORCE CALCULATIONS :-**

Shear force at d_{eff}. From Column Face Along Length kg 1978 1321 5289 4868
Shear force at d_{eff}. From Column Face Along Width kg 2026 1353 5417 4986

Partial Safety Facator

Limit Shear force at d_{eff}. From Column Face Along Length kg 4351 2905 8727 8032
Limit Shear force at d_{eff}. From Column Face Along Width kg 4457 2976 8939 8227

6083	6083	6224	6224	
3682	2571	9300	8190	
243	23	202	-64	
10007	8677	15726	14350	
0.635	0.444	1.569	1.382	
0.042	0.004	0.034	-0.011	
0.101	0.070	0.249	0.219	
0.007	0.001	0.005	-0.002	
1.645	1.426	2.684	2.547	
10007	8677	16707	15855	SAFE IN SBC

Concrete overburden	=	2500	x	0.450	=	1125	kg/m ²
Soil Overburden	=	1600	x	3.050	=	4880	kg/m ²
Total overburden	=	1125	+	4880	=	6005	kg/m ²
LC-305	LC-306	LC-405	LC-406	REMARKS			
4002	2672	10702	9850				
1725	1152	4612	4245				
1725	1152	4612	4245				
3435	2294	9186	8454				
3404	2273	9102	8377				
2.20	2.20	1.65	1.65				
3794	2533	7609	7004				
3794	2533	7609	7004				
7558	5046	15156	13950				
7488	5000	15018	13822				
1978	1321	5289	4868				
2026	1353	5417	4986				
2.20	2.20	1.65	1.65				
4351	2905	8727	8032				
4457	2976	8939	8227				

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

*	<u>Bottom Reinforcement in Raft Slab Along Length</u>														
	Clear cover to Main Reinforcement at Bottom	=	50	mm											
	Effective Depth of Slab d _{eff.}	=	600	-	50	-	6	=	544	mm					
	Design Moment for End Projection	=	15156	Kg-mt.											
	Mu / b.d.d	=	15156	x	10000	/	(	544	x	544	x	1000	)		
	Mu / b.d.d	=	0.512	N/mm ²											
	P _t	=	0.127	%											
	A _{st}	=	0.127	x	100	x	54.40	/	100	=	6.890	cm ² /rmt			
	0.12 % of Agross A _{st} min.	=	7.200	cm ² /rmt											
	A _{st} req.	=	7.200	cm ² /rmt											
	Provide	12	mm dia.	@	15.708	cm c/c Say	15	cms c/c							
	A _{st} pro.	=	7.540	cm ² /rmt											
*	<u>Bottom Reinforcement in Raft Slab Along Width</u>														
	Clear cover to Main Reinforcement at Bottom	=	50	mm											
	Effective Depth of Slab d _{eff.}	=	600	-	50	-	6	-	12	=	532	mm			
	Design Moment for End Projection	=	15018	Kg-mt.											
	Mu / b.d.d	=	15018	x	10000	/	(	532	x	532	x	1000	)		
	Mu / b.d.d	=	0.531	N/mm ²											
	P _t	=	0.131	%											
	A _{st}	=	0.131	x	100	x	53.20	/	100	=	6.975	cm ² /rmt			
	0.12 % of Agross A _{st} min.	=	7.200	cm ² /rmt											
	A _{st} req.	=	7.200	cm ² /rmt											
	Provide	12	mm dia.	@	15.708	cm c/c Say	15	cms c/c							
	A _{st} pro.	=	7.540	cm ² /rmt											

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)					

* **Checking for One Way Shear at Distance d_{eff} From Face of Support Along Length**

Clear Projection of Raft Slab for Shear Chacking	=	1.038	-	0.544	=	0.494	mt.
[i.e. d_{eff} from Face of Support (i.e. l_{face})]							
Limit Shear force @ d_{eff} from Column face	=	8727	kg				
Actual Shear Stress @ d_{eff} from Column face (τ_v)	=	8727	/(	100	x	54.40	)
	=	1.604	kg/cm ²				
	=	0.160	N/mm ²				
P _t pro.at Critical Section	=	0.139	%				
β	=	20.943					
Per. Shear Stress @ d_{eff} from Column face (τ_c)	=	0.281	N/mm ²	>		0.160	N/mm ²

SAFE IN DIRECT SHEAR STRESS

* **Checking for One Way Shear at Distance d_{eff} From Face of Support Along Width**

Clear Projection of Raft Slab for Shear Chacking	=	1.038	-	0.532	=	0.506	mt.
[i.e. d_{eff} from Face of Support (i.e. b_{face})]							
Limit Shear force @ d_{eff} from Column face	=	8939	kg				
Actual Shear Stress @ d_{eff} from Column face (τ_v)	=	8939	/(	100	x	53.20	)
	=	1.680	kg/cm ²				
	=	0.168	N/mm ²				
P _t pro.at Critical Section	=	0.142	%				
β	=	20.481					
Per. Shear Stress @ d_{eff} from Column face (τ_c)	=	0.284	N/mm ²	>		0.168	N/mm ²

SAFE IN DIRECT SHEAR STRESS

* **Checking for Punching Shear**

Limit Max. Compressive force in Pedestal	=	-25176	kg				
Two way Shear Stress	=	-25176	/(	538	x	54.40	)
	=	-0.861	kg/cm ²				
	=	-0.086	N/mm ²				
β_c	=	1.000					
k_c	=	1.000					
τ_c	=	1.250					
Per. Shear Stress	=	1.250	N/mm ²	>		-0.086	N/mm ²

SAFE IN PUNCHING SHEAR STRESS

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

*

DESIGN OF RCC COLUMN :-

Height of Column above F.G.L	e	=	300	mm
Depth of Column below F.G.L	d	=	2900	mm
Clear Unsupported length of Column		=	3200	mm
Characteristic Strength of Concrete used		=	25	N/mm ²
Characteristic Strength of Reinf. used :		=	500	N/mm ²
Size of Column (b x b)	800	x	800	mm
Unsupported Length , L		=	3200	mm
Eff. Length @ x-x, Lexx		=	6400	mm
Eff. Length @ z-z, Lezz		=	6400	mm
Assuming Eff. cover to reinf.		=	50	
Ratio d/D		=	0.06	
Ratio b/B		=	0.06	
Reference table from SP16 for compression + bending		=	Chart 48	
Reference table from SP16 for Tension + bending		=	Chart 83	
Ratio's for Moment due to Slenderness				
Ratio Lexx / D		=	8.000	< 12, hence o.k.
Ratio Lezz / b		=	8.000	< 12, hence o.k.

Note : SLENDERNESS EFFECT NOT CONSIDERED FOR TENSION + BENDING CASE

Eccentricities for Moment due to Minimum eccentricity

ex => L/500 + D/30	=	33.1	mm < 0.05 x D hence neglect
ez => L/500 + b/30	=	33.1	mm < 0.05 x b hence neglect

			LC-305	LC-306	LC-405	LC-406
1) Axial load per leg, P Kgs = FY / 4			2601	2601	4001	4001
2) Moment at base plate level ' MX '		Kg-mt.	-1,30,867	-95,203	-3,28,191	-2,92,526
Moment at base plate level ' MZ '		Kg-mt.	-1,024	-963	-2,710	-2,648
Moment at base plate level ' MY '		Kg-mt.	-1,365	-2,858	-7,217	-8,710
3) Shear at base plate level per leg						
PHX1 = FX / 4		Kg	733	0	733	0
PHZ1 = FZ / 4		Kg	-1484	-786	-3907	-3209
Diagonal c/c of column	R	Kg	5	5	5	5
Due to ' MY ' = PH = (MY / 4) / (R / 2)		Kg	-141	-295	-745	-899
Angle			45	45	45	45
PHX2 = Horizontal Component of PH		Kg	-100	-209	-527	-636
PHZ2 = Horizontal Component of PH		Kg	-100	-209	-527	-636
TOTAL SHEAR PHX = PHX1 + PHX2		Kg	633	-209	206	-636
TOTAL SHEAR PHZ= PHZ1 + PHZ2		Kg	-1584	-995	-4434	-3845
4) Axial load per leg due to moment, (+/-) P'						
a) Due to ' MX '		Kg	-19113	-13904	-47931	-42722
b) Due to ' MZ '		Kg	-150	-141	-396	-387
5) Maximum Axial Compression per col., P + P'		Kg	-16661	-11444	-44326	-39108
6) Maximum Axial pullout per col., P - P'		Kg	21863	16646	52327	47109
7) Partial Safety factors			2.20	2.20	1.65	1.65
8) Maximum Axial Compression (Lim.)		Kg	-36655	-25176	-73138	-64529
9) Maximum Axial Tension (Lim.)		Kg	48099	36620	86339	77730

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

10) Initial Moment per Col. due to Shear							
MX = PHZ x L.A.			Kg-mt.	-5068	-3183	-14189	-12303
MZ = PHX x L.A.			Kg-mt.	2026	-668	659	-2035
11) Moment due to Slenderness							
Max => Pu.D/2000 x (Lexx/D) ²			Kg-mt.	0.000	0.000	0.000	0.000
Maz => Pu.b/2000 x (Lezz/b) ²			Kg-mt.	0.000	0.000	0.000	0.000
12) Moment due to Min. Eccentricity							
Mex => Pu.ex			Kg-mt.	0.000	0.000	0.000	0.000
Mez => Pu.ez			Kg-mt.	0.000	0.000	0.000	0.000
13) Final Limit Moment per Col. due to Shear @ found. top							
Mux = { (MX or Mex) + Max } x Par. safety factor			Kg-mt.	0	0	0	0
Muz = { (MZ or Mez) + Maz } x Par. safety factor			Kg-mt.	4458	0	1450	0
FOR TENSION + BENDING CASE							
Mux = { (ML or Mex) } x Par. safety factor			Kg-mt.	0	0	0	0
Muz = { (MI or Mez) } x Par. safety factor			Kg-mt.	4458	0	1087	0
14) Check for Tension + Bending							
Pu/fckb.D				0.029	0.022	0.053	0.048
(Muxx+Muzz)/Fck b.D.D				0.003	0.000	0.001	0.000
p/fck from chart corresponding to d'/D		Chart 83		0.025	0.015	0.018	0.015
(Muxx+Muzz)/Fck D.b.b				0.003	0.000	0.001	0.000
p/fck from chart corresponding to b'/B				0.025	0.015	0.018	0.015
Area of Steel required for average p/fck value			Sq.mm.	4000	2400	2880	2400
15) Check for Compression + Bending							
Assumed percentage of Steel in Column				0.896	0.896	0.896	0.896
Area of Steel, Asc			Sq.mm.	5733	5733	5733	5733
Puz = 0.45 x Fck x Ac + 0.75 x Fy x Asc			Kg	946826	946826	946826	946826
Pu/Puz				-0.039	-0.027	-0.077	-0.068
Factor an				1.000	1.000	1.000	1.000
Pu/fckb.D				-0.022	-0.015	-0.045	-0.040
p/fck				0.036	0.036	0.036	0.036
Corresponding Mu/fckb.D.D		Chart 48		0.018	0.019	0.015	0.017
Mux1			Kg-mt.	23493	24799	19578	22188
Muz1			Kg-mt.	23493	24799	19578	22188
(Mux/Mux1) ^{an} + (Muz/Muz1) ^{an}				0.190	0.000	0.074	0.000

Provided Reinforcement

4	25 mm +
12	20 mm

Provided reinf. Area
5733 Sq.mm.
% of reinf. In column
0.896 %

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

- * **FORCES ON TOWER AT BASE PLATE LEVEL FROM STAAD OUTPUT:- FOR NODE 1, 3, 2, & 4
WITH PLAN & ELEVATION DEVIATION CASE**

LOAD CASE FROM STAAD		(307) N.C.+WIND PLL. TO BEAM		(308) N.C.+WIND PER. TO BEAM		B/B OF TOWER
		ALONG - Z	ALONG - X	ALONG - Z	ALONG - X	
Moment @ Base Plate level	MX/MZ	-1,14,022	-875	-77,615	-808	LEGS IN mm LONG x TRANS 3500 x 3500
Horizontal Shear	FZ/FX	-5,166	3,368	-2,346	442	
Moment @ Base Plate level	MY	-540	-540	-2,028	-2,028	
Vertical load	FY	10,404	10,404	10,404	10,404	
Moment @ Found. Bottom Level	MX/MZ	-133652	11925	-86531	870	
LOAD CASE FROM STAAD		(407) S.C.+WIND PLL. TO BEAM		(408) S.C.+WIND PER. TO BEAM		MAIN LEG ANGLE
		ALONG - Z	ALONG - X	ALONG - Z	ALONG - X	
Moment @ Base Plate level	MX/MZ	-2,84,920	-2,352	-2,48,542	-2,286	L 130X130X16 Angle c.g. 38.2 mm
Horizontal Shear	FZ/FX	-13,559	2,927	-10,741	0	
Moment @ Base Plate level	MY	-6,120	-6,120	-7,608	-7,608	
Vertical load	FY	16,002	16,002	16,002	16,002	
Moment @ Found. Bottom Level	MX/MZ	-336445	8769	-289356	-2286	

- * **MATERIAL PROPERTIES :-**

GRADE OF CONCRETE USED

M 25 :

25

N/mm²

GRADE OF REINFORCEMENT USED

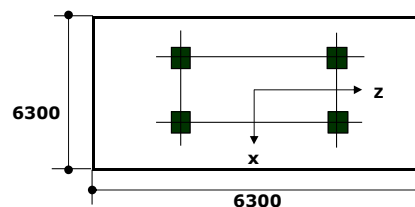
Fe 500 :

500

N/mm²

- * **NOTES ON GENERAL ARRANGEMENT OF FOUNDATION SYSTEM :-**

- 1) It is proposed to provide a RAFT FOUNDATION.
- 2) Depth of Foundation 3.5 m w.r.to N.G.L.
- 3) The foundation is designed for the different load combinations as Mentioned in above ref. Table.



CHECKS :-

- 1) SAFE AGAINST OVERTURNING
- 2) CONTACT LENGTH > 70% HENCE SAFE
- 3) CONTACT WIDTH > 70% HENCE SAFE
- 4) SAFE IN SBC
- 5) SAFE IN DIRECT SHEAR STRESS
- 6) SAFE IN PUNCHING SHEAR STRESS

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

c) Raft Foundation									
Area at Top	A1	=	5.424	x	5.424	=	29.415	m ²	
Area at Bottom	A2	=	6.300	x	6.300	=	39.690	m ²	
	$\sqrt{A1 \times A2}$	=	$\sqrt{29.415}$	x	$\sqrt{39.690}$	=	34.169	m ²	
Area of Trapazoidal Portion		=	(29.415	+	39.690	+	34.169)	x	1/3
Area of Ractangular Portion		=	6.300	x	6.300	=	39.690	m ²	
Volume Trapazoidal Portion		=	34.425	x	0.300	=	10.327	m ³	
Volume Rectangular Portion		=	39.690	x	0.300	=	11.907	m ³	
Total Volume of Found.		=	10.327	+	11.907	=	22.234	m³	
Total Weight of Found.		=	22.234	x	2500	=	55586	kgs	

d) Rectangular Soil Overburden									
Gross Volume above GWT		=	6.300	x	6.300	x	3.000	=	119.070 m ³
Gross Volume below GWT		=	6.300	x	6.300	x	0.500	=	19.845 m ³
Net Volume of soil		=	119.070	-	22.234	-	7.424	=	89.412 m³
Weight of soil above GWT		=	1600	x	89.412	=	143059	Kgs.	
Weight of soil below GWT		=	600	x	19.845	=	11907	Kgs.	

* **SUMMARY OF GRAVITY LOADS:-**

Vertical Load From Structure (FY) in Kg	Pv1	Kgs.
Self Weight of Concrete in Kg	Pv2	Kgs.
Rectangular Soil Overburden in Kg	Pv3	Kgs.

* Gross Axial load (including soil overburden), Pv4 = Pv3 + Pv2 + Pv1 (where Pv3 is Rectangluar soil overburden)	Kgs.

* Mom. Along Major Plane of Found. / Column, MX (at found. Btm.)	Kg-mt.
Mom. Along Minor Plane of Found. / Column, MZ (at found. Btm.)	Kg-mt.

* **CHECK FOR OVERTURNING ALONG LENGTH :-**

F.O.S IN BROKEN WIRE COND. =	1.50
F.O.S IN SHORT-CICUIT COND. =	1.50
(1/2)Length of foundation =	
Overturning Moment 'Mo' = MX	Kg-mt.
Restoring Moment 'MR' = Pv4 X L/2 X 90%	Kg-mt.

F.O.S. Available =

For safety against overturning eccentricity should lie with middle third i.e. e = L/6.
Eccentricity with Soil Overburden, ex = MX / PV4
Contact length =3(L/2- ex') when eccentricity is
more than L/6 otherwise CONTACT LENGTH = Length of found. mt.

* **CHECK FOR OVERTURNING ALONG WIDTH :-**

F.O.S IN BROKEN WIRE COND. =	1.50
F.O.S IN SHORT-CICUIT COND. =	1.50
(1/2)Width of foundation =	
Overturning Moment 'Mo' = MZ	Kg-mt.
Restoring Moment 'MR' = Pv4 X L/2 X 90%	Kg-mt.

F.O.S. Available =

For safety against overturning eccentricity should lie with middle third i.e. e = B/6
Eccentricity with Soil Overburden, ey = MZ / PV4
Contact width =3(B/2- ey') when eccentricity is
more than B/6 otherwise CONTACT WIDTH = Width of found. mt.

LC-307	LC-308	LC-407	LC-408	REMARKS
10404	10404	16002	16002	
76066	76066	76066	76066	
154966	154966	154966	154966	
241435	241435	247034	247034	
-133652	-86531	-336445	-289356	
11925	870	8769	-2286	
3.150	3.150	3.150	3.150	
-133652	-86531	-336445	-289356	
684470	684470	700341	700341	
INFINITE	INFINITE	INFINITE	INFINITE	
1.050	1.050	1.050	1.050	
0.554	0.358	1.362	1.171	
6.300	6.300	5.364	5.936	
3.150	3.150	3.150	3.150	
11925	870	8769	-2286	
684470	684470	700341	700341	
57.40	786.62	79.86	INFINITE	
1.050	1.050	1.050	1.050	
0.049	0.004	0.035	0.009	
6.300	6.300	6.300	6.300	

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* **CHECK FOR BASE PRESSURE :-**

- i) $PV4 / A = P1$ kg/m²
ii) $MX / ZX = P2$ kg/m²
iii) $MZ / ZZ = P3$ kg/m²
P4 gross (max) = P1 + P2 + P3 kg/m²
ex = MX / PV4 mt.
ey = MZ / PV4 mt.
ex / L =
ey / B =

Factor for modified pressure from Pg.No.133 of Teng's Book, K

P mod. = K.Pv4 / B.L in case K >= 2.0 otherwise Pmod = P4

* **CHECK FOR SLIDING :-**

TOTAL VERTICAL LOAD = 247033.71 kg
TOTAL HORIZONTAL THRUST = 3368.33 kg
FRICTION VALUE CONSIDERED = 0.300

F.O.S. = 22 > 2

SAFE AGAINST SLIDING

* **DESIGN PRESSURE & MOMENTS FOR RAFT SLAB :-**

NET BEARING PRESSURE BELOW FOUNDATION

* **MOMENT CALCULATIONS :-**

Positive Moment at Centre Along Length Kg-mt.
Positive Moment at Centre Along Width Kg-mt.
Negative Moment at Effective Span (i.e. $l_{face} + d_{eff}/2$) Along Length Kg-mt.
Negative Moment at Effective Span (i.e. $b_{face} + d_{eff}/2$) Along Width Kg-mt.
Partial Safety Facator
Limit Positive Moment at Centre Along Length Kg-mt.
Limit Positive Moment at Centre Along Width Kg-mt.
Limit Negative Moment at Effective Span (i.e. $l_{face} + d_{eff}/2$) Along Length Kg-mt.
Limit Negative Moment at Effective Span (i.e. $b_{face} + d_{eff}/2$) Along Width Kg-mt.

* **SHEAR FORCE CALCULATIONS :-**

Shear force at d_{eff} . From Column Face Along Length kg
Shear force at d_{eff} . From Column Face Along Width kg
Partial Safety Facator
Limit Shear force at d_{eff} . From Column Face Along Length kg
Limit Shear force at d_{eff} . From Column Face Along Width kg

6083	6083	6224	6224	
3207	2076	8073	6943	
286	21	210	-55	
9576	8180	14508	13112	
0.554	0.358	1.362	1.171	
0.049	0.004	0.035	-0.009	
0.088	0.057	0.216	0.186	
0.008	0.001	0.006	-0.001	
1.574	1.345	2.408	2.366	
9576	8180	14989	14726	SAFE IN SBC

Concrete overburden	=	2500	x	0.450	=	1125	kg/m ²
Soil Overburden	=	1600	x	3.050	=	4880	kg/m ²
Total overburden	=	1125	+	4880	=	6005	kg/m ²
LC-307	LC-308	LC-407	LC-408	REMARKS			
3571	2175	8984	8721				
1539	937	3872	3758				
1539	937	3872	3758				
3065	1867	7711	7485				
3037	1850	7641	7417				
2.20	2.20	1.65	1.65				
3386	2062	6388	6201				
3386	2062	6388	6201				
6743	4108	12724	12351				
6682	4070	12607	12238				
1765	1075	4440	4310				
1808	1101	4548	4415				
2.20	2.20	1.65	1.65				
3883	2365	7326	7111				
3977	2422	7504	7284				

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)					

* **Checking for One Way Shear at Distance d_{eff} From Face of Support Along Length**

Clear Projection of Raft Slab for Shear Chacking [i.e. d_{eff} from Face of Support (i.e. l_{face})]	=	1.038	-	0.544	=	0.494	mt.
Limit Shear force @ d_{eff} from Column face	=	7326	kg				
Actual Shear Stress @ d_{eff} from Column face (τ_v)	=	7326	/ (	100	x	54.40	)
	=	1.347	kg/cm ²				
	=	0.135	N/mm ²				
P _t pro.at Critical Section	=	0.139	%				
β	=	20.943					
Per. Shear Stress @ d_{eff} from Column face (τ_c)	=	0.281	N/mm ²	>		0.135	N/mm ²

SAFE IN DIRECT SHEAR STRESS

* **Checking for One Way Shear at Distance d_{eff} From Face of Support Along Width**

Clear Projection of Raft Slab for Shear Chacking [i.e. d_{eff} from Face of Support (i.e. b_{face})]	=	1.038	-	0.532	=	0.506	mt.
Limit Shear force @ d_{eff} from Column face	=	7504	kg				
Actual Shear Stress @ d_{eff} from Column face (τ_v)	=	7504	/ (	100	x	53.20	)
	=	1.411	kg/cm ²				
	=	0.141	N/mm ²				
P _t pro.at Critical Section	=	0.142	%				
β	=	20.481					
Per. Shear Stress @ d_{eff} from Column face (τ_c)	=	0.284	N/mm ²	>		0.141	N/mm ²

SAFE IN DIRECT SHEAR STRESS

* **Checking for Punching Shear**

Limit Max. Compressive force in Pedestal	=	-19475	kg				
Two way Shear Stress	=	-19475	/ (	538	x	54.40	)
	=	-0.666	kg/cm ²				
	=	-0.067	N/mm ²				
β_c	=	1.000					
k_c	=	1.000					
τ_c	=	1.250					
Per. Shear Stress	=	1.250	N/mm ²	>		-0.067	N/mm ²

SAFE IN PUNCHING SHEAR STRESS

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

* **DESIGN OF RCC COLUMN :-**

Height of Column above F.G.L	e	=	300	mm
Depth of Column below F.G.L	d	=	2900	mm
Clear Unsupported length of Column		=	3200	mm
Characteristic Strength of Concrete used		=	25	N/mm ²
Characteristic Strength of Reinf. used :		=	500	N/mm ²
Size of Column (b x b)	800	x	800	mm
Unsupported Length , L		=	3200	mm
Eff. Length @ x-x, Lexx		=	6400	mm
Eff. Length @ z-z, Lezz		=	6400	mm
Assuming Eff. cover to reinf.		=	50	
Ratio d'/D		=	0.06	
Ratio b'/B		=	0.06	
Reference table from SP16 for compression + bending		=	Chart 48	
Reference table from SP16 for Tension + bending		=	Chart 83	
Ratio's for Moment due to Slenderness				
Ratio Lexx / D		=	8.000	< 12, hence o.k.
Ratio Lezz / b		=	8.000	< 12, hence o.k.

Note : SLENDERNESS EFFECT NOT CONSIDERED FOR TENSION + BENDING CASE

Eccentricities for Moment due to Minimum eccentricity

ex => L/500 + D/30	=	33.1	mm < 0.05 x D hence neglect
ez => L/500 + b/30	=	33.1	mm < 0.05 x b hence neglect

				LC-307	LC-308	LC-407	LC-408
1) Axial load per leg, P Kgs = FY / 4				2601	2601	4001	4001
2) Moment at base plate level ' MX '			Kg-mt.	-1,14,022	-77,615	-2,84,920	-2,48,542
Moment at base plate level ' MZ '			Kg-mt.	-875	-808	-2,352	-2,286
Moment at base plate level ' MY '			Kg-mt.	-540	-2,028	-6,120	-7,608
3) Shear at base plate level per leg							
PHX1 = FX / 4			Kg	842	110	732	0
PHZ1 = FZ / 4			Kg	-1291	-587	-3390	-2685
Diagonal c/c of column	R		Kg	5	5	5	5
Due to ' MY ' = PH = (MY / 4) / (R / 2)			Kg	-56	-209	-632	-786
Angle				45	45	45	45
PHX2 = Horizontal Component of PH			Kg	-39	-148	-447	-556
PHZ2 = Horizontal Component of PH			Kg	-39	-148	-447	-556
TOTAL SHEAR PHX = PHX1 + PHX2			Kg	803	-38	285	-556
TOTAL SHEAR PHZ= PHZ1 + PHZ2			Kg	-1331	-735	-3837	-3241
4) Axial load per leg due to moment, (+/-) P'							
a) Due to ' MX '			Kg	-16652	-11335	-41611	-36298
b) Due to ' MZ '			Kg	-128	-118	-343	-334
5) Maximum Axial Compression per col., P + P'			Kg	-14179	-8852	-37954	-32632
6) Maximum Axial pullout per col., P - P'			Kg	19381	14054	45955	40633
7) Partial Safety factors				2.20	2.20	1.65	1.65
8) Maximum Axial Compression (Lim.)			Kg	-31194	-19475	-62624	-53842
9) Maximum Axial Tension (Lim.)			Kg	42638	30919	75826	67044

Project :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :	FOUNDATION DESIGN FOR 400KV GANTRY TOWER (4T7)

10) Initial Moment per Col. due to Shear							
MX = PHZ x L.A.			Kg-mt.	-4259	-2351	-12277	-10370
MZ = PHX x L.A.			Kg-mt.	2569	-121	911	-1778
11) Moment due to Slenderness							
Max => Pu.D/2000 x (Lexx/D) ²			Kg-mt.	0.000	0.000	0.000	0.000
Maz => Pu.b/2000 x (Lezz/b) ²			Kg-mt.	0.000	0.000	0.000	0.000
12) Moment due to Min. Eccentricity							
Mex => Pu.ex			Kg-mt.	0.000	0.000	0.000	0.000
Mez => Pu.ez			Kg-mt.	0.000	0.000	0.000	0.000
13) Final Limit Moment per Col. due to Shear @ found. top							
Mux = { (MX or Mex) + Max } x Par. safety factor			Kg-mt.	0	0	0	0
Muz = { (MZ or Mez) + Maz } x Par. safety factor			Kg-mt.	5651	0	2005	0
FOR TENSION + BENDING CASE							
Mux = { (ML or Mex) } x Par. safety factor			Kg-mt.	0	0	0	0
Muz = { (MT or Mez) } x Par. safety factor			Kg-mt.	5651	0	1503	0
14) Check for Tension + Bending							
Pu/fckb.D				0.026	0.019	0.046	0.041
(Muxx+Muzz)/Fck b.D.D				0.004	0.000	0.001	0.000
p/fck from chart corresponding to d'/D		Chart 83		0.022	0.0005	0.017	0.010
(Muxx+Muzz)/Fck D.b.b				0.004	0.000	0.001	0.000
p/fck from chart corresponding to b'/B				0.022	0.001	0.017	0.010
Area of Steel required for average p/fck value			Sq.mm.	3520	80	2720	1600
15) Check for Compression + Bending							
Assumed percentage of Steel in Column				0.896	0.896	0.896	0.896
Area of Steel, Asc			Sq.mm.	5733	5733	5733	5733
Puz = 0.45 x Fck x Ac + 0.75 x Fy x Asc			Kg	946826	946826	946826	946826
Pu/Puz				-0.033	-0.021	-0.066	-0.057
Factor an				1.000	1.000	1.000	1.000
Pu/fckb.D				-0.019	-0.012	-0.038	-0.033
p/fck				0.036	0.036	0.036	0.036
Corresponding Mu/fckb.D.D		Chart 48		0.0190	0.0180	0.0009	0.0190
Mux1			Kg-mt.	24799	23493	1175	24799
Muz1			Kg-mt.	24799	23493	1175	24799
(Mux/Mux1) ^{an} + (Muz/Muz1) ^{an}				0.228	0.000	1.706	0.000

Provided Reinforcement

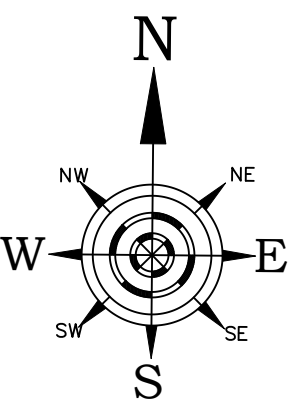
4	25 mm +
12	20 mm

Provided reinf. Area

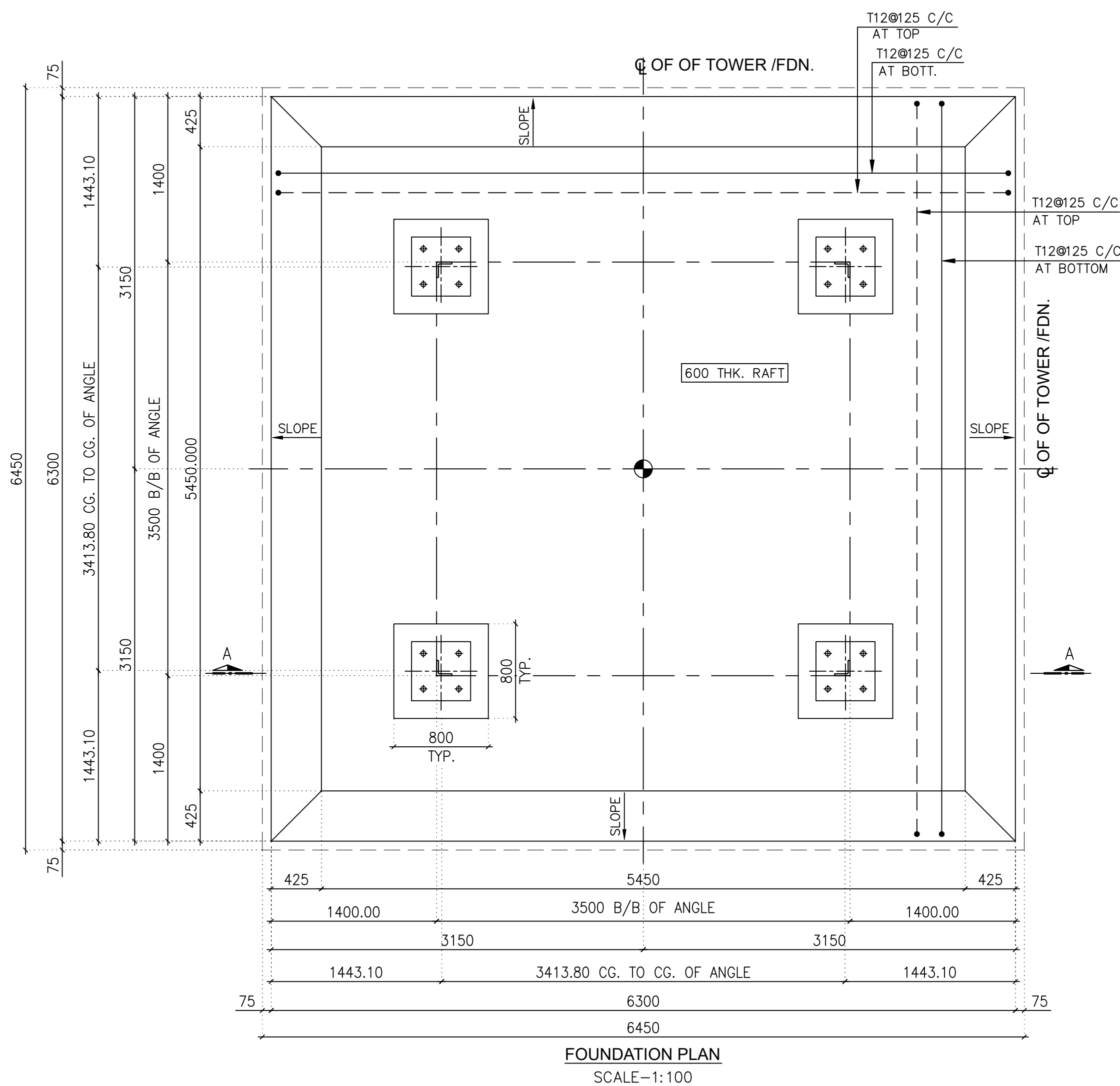
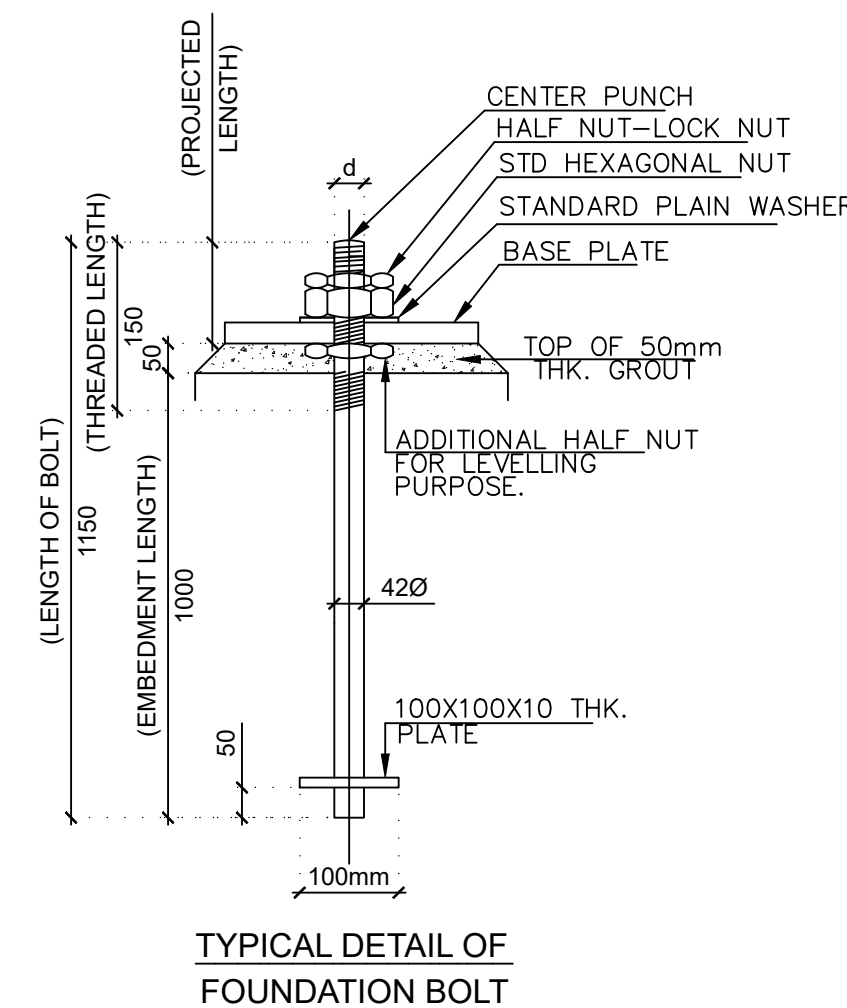
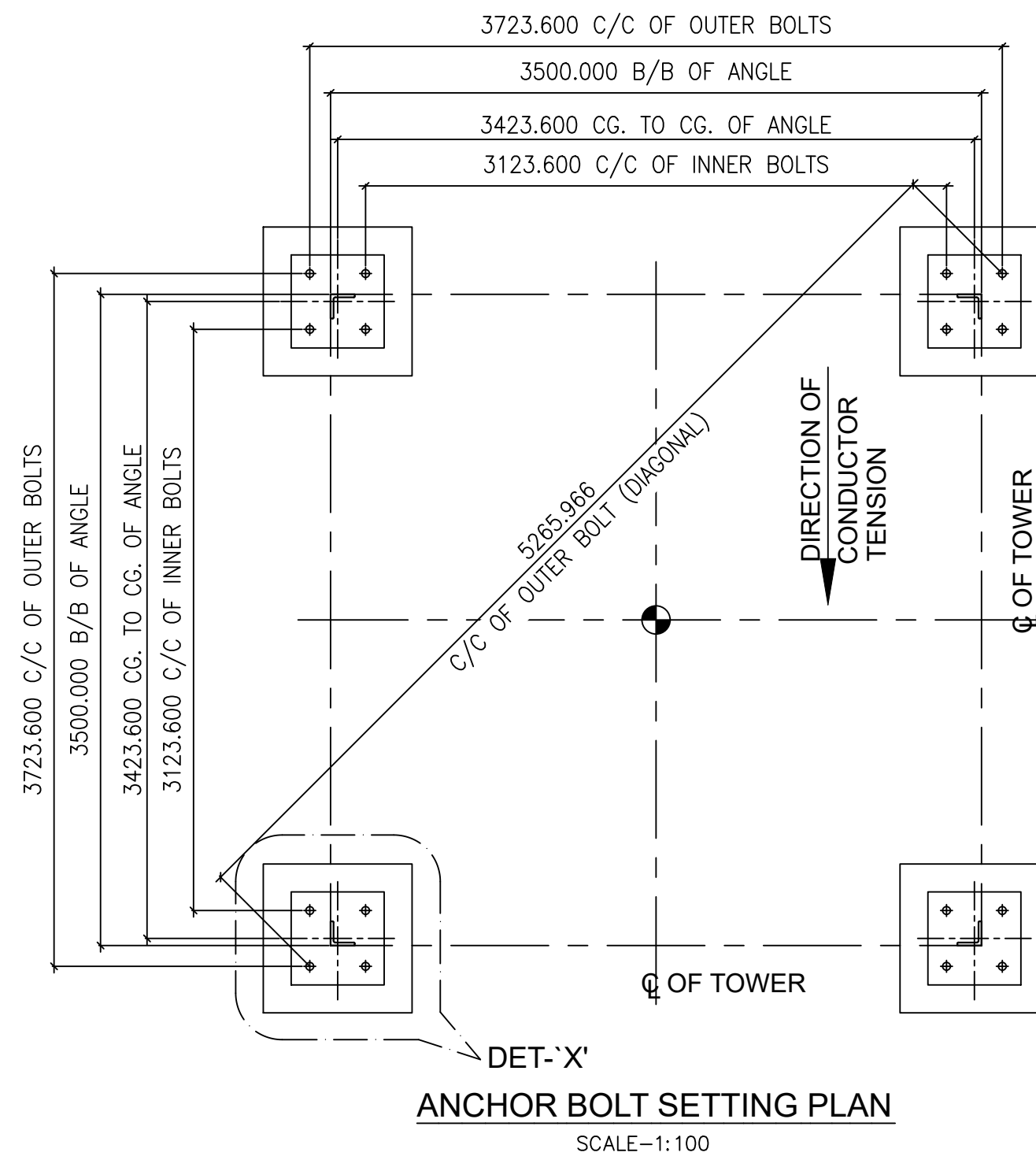
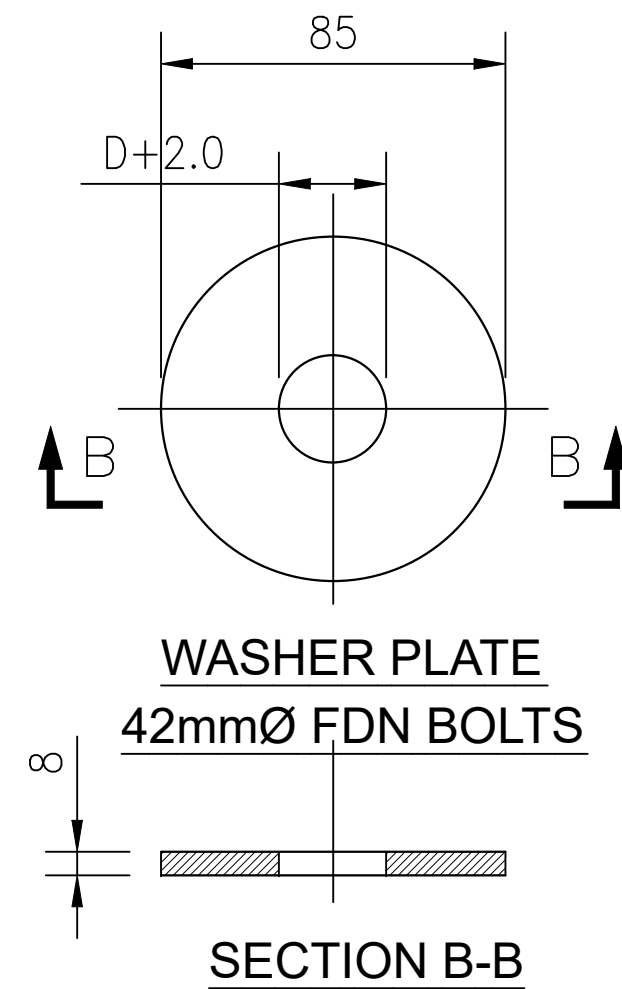
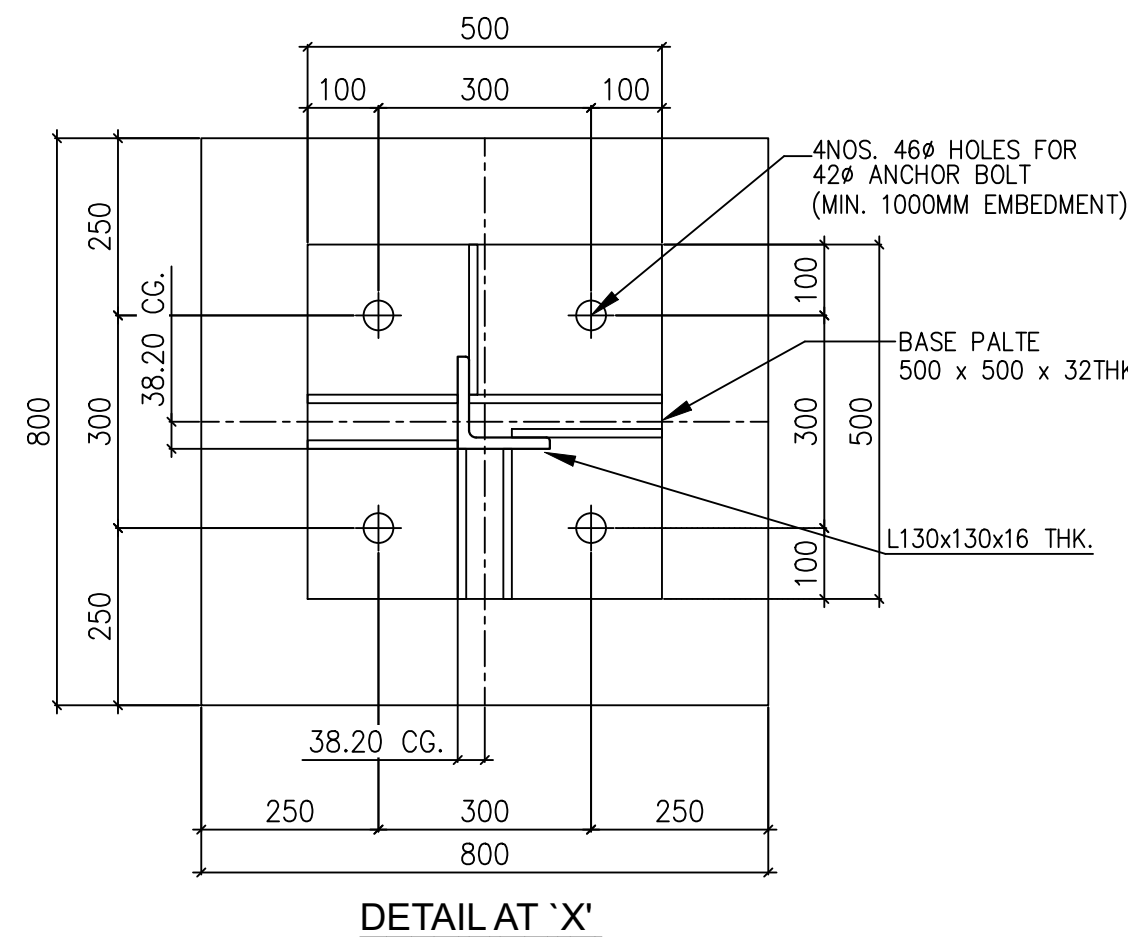
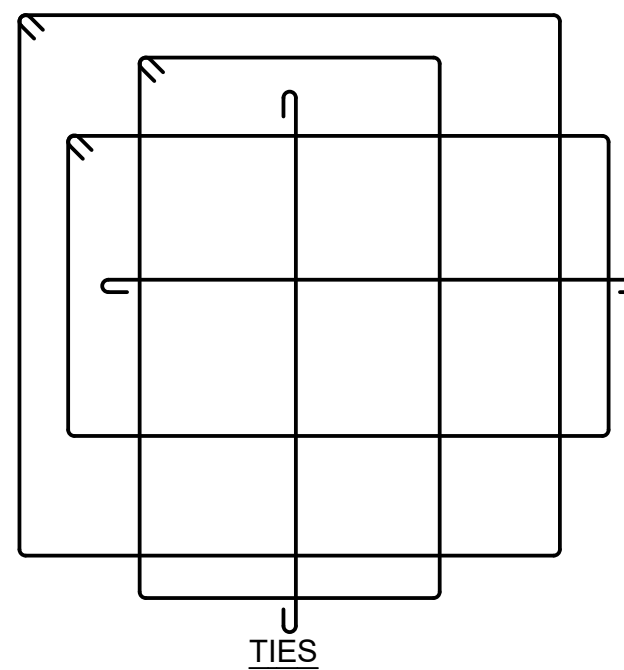
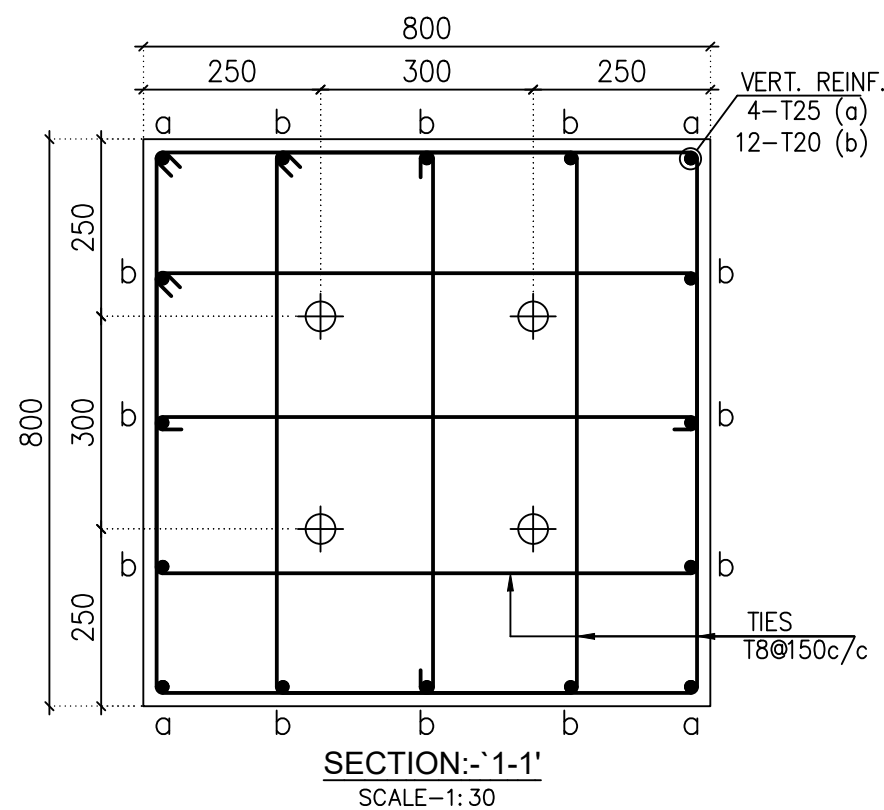
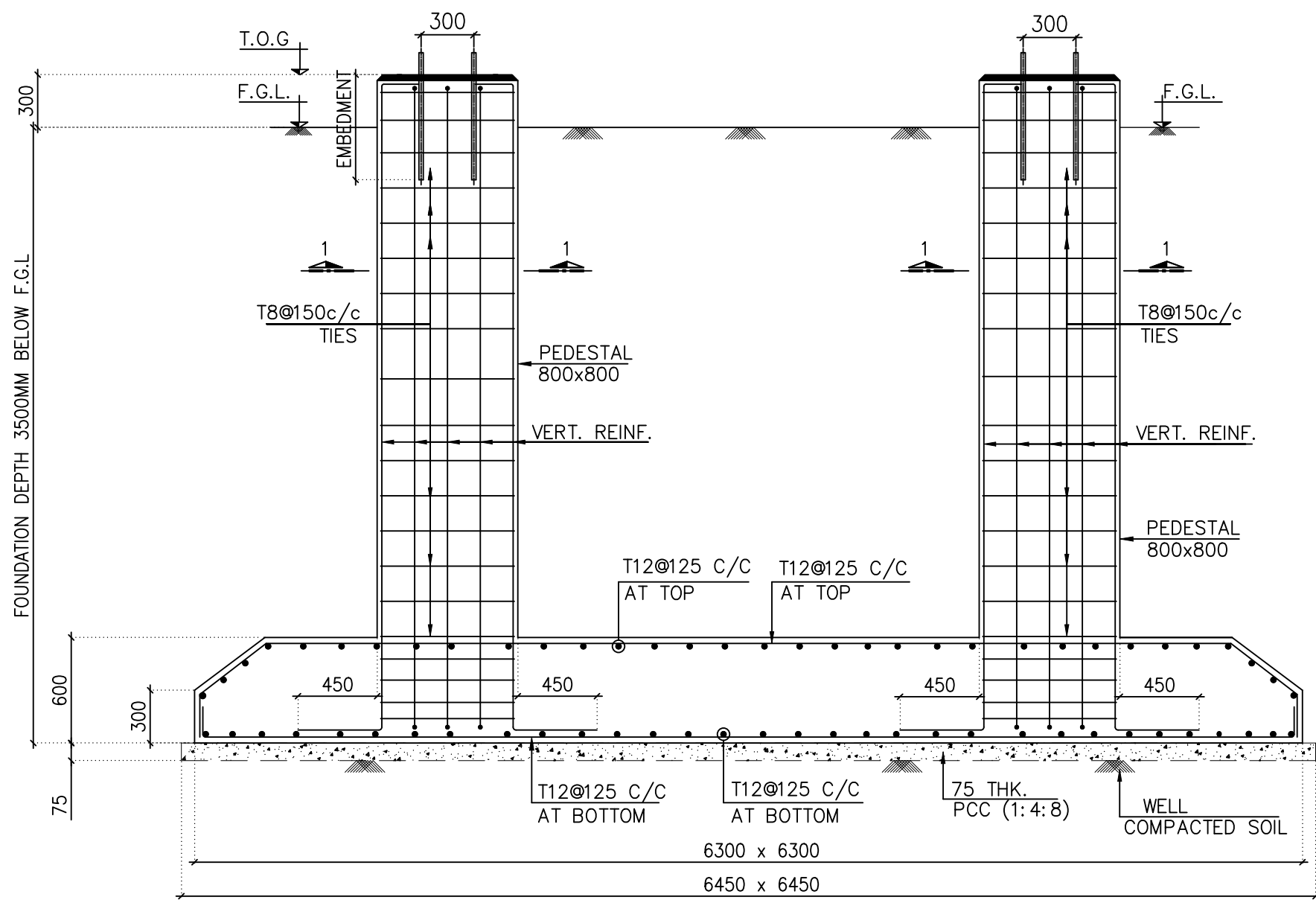
5733 Sq.mm.

% of reinf. In column

0.896 %



EL 0.00 LEVEL CORRESPONDS TO RL 338.000.



A-GENERAL

1. ALL DIMENSION ARE IN MM AND LEVELS IN M UNLESS OTHERWISE SPECIFIED.
2. THE DRAWING MUST BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWING.
3. IN CASE OF DOUBT OR DISCREPANCIES, CONTACT ENGG. CELL. NO ASSUMPTIONS TO BE MADE.
4. CLEAR COVER FOR REINFORCEMENT i) BEAM=25mm ii) COLUMN=40mm iii) FOUNDATION BOTTOM=50mm TOP & SIDE = 50mm iv) SLAB =25mm.
5. PROVIDE DEVELOPMENT LENGTH (LD)/LAP LENGTH EQUAL TO 50 X DIA OF BAR.
6. BACKFILLING SHALL BE DONE WITH NON COHESIVE SOIL,THE BACKFILLED SOIL SHALL BE COMPACTED TO ACHIEVE PROCTOR DENSITY OF 95%.
7. FOUNDATION SHALL NOT REST IN FILLED-UP SOIL OR ASH FILLED AREA.
8. THE DEPTH OF THE FOOTING SHALL BE IN NO CASE LESS THAN 3500MM FROM F.G.L.
9. SBC CONSIDERED 15.0 TON/m².

B-CONCRETE

1. ALL CONCRETE SHALL BE MACHINE MIXED,VIBRATED & CURED FOR MINIMUM 10 DAYS.
2. USE OF NEEDLE VIBRATOR IS COMPULSORY FOR ALL CONCRETE WORK.
3. PH VALUE OF THE WATER TO BE USED, SHALL NOT BE LESS THAN 6.
4. GRADE OF CONCRETE SHALL BE M-25 AND SHALL BE ACCORDING TO IS:456(LATEST)

C-REINFORCEMENT

1. LAP AT SUPPORT SECTION,JOINT SECTION & MID SPAN SHALL BE AVOIDED.
2. OVERLAPPING OF REINFORCEMENT SHALL BE STAGGERED.
3. USE HYSD BARS Fe 500 CONFIRMING TO I:S:1786 (LATEST)
4. ANCHOR BOLTS OF GRADE 5.6

NOTE:

- 1) FOR LOCATION AND ORIENTATION OF TOWER FOUNDATION REFER FOUNDATION LAYOUT PLAN.
- 2) FOUNDATION BOLT ARRANGEMENT SHALL BE CHECKED WITH RESPECTIVE STRUCTURE DRAWING BEFORE PUTTING FDN BOLT IN PLACE.
- 3) FOR CO-ORDINATES OF TOWER PLEASE REFER STRUCTURAL LAYOUT DRAWING NUMBER 552H-E-EPC-SYD-DE-L-V-0003

LEGEND

NGL. - NATURAL GROUND LEVEL
FGL. - FINISHED GROUND LEVEL
FFL. - FINISHED FLOOR LEVEL
TOC. - TOP OF CONCRETE
BOC. - BOTTOM OF CONCRETE
CL - CENTER LINE
C/C - CENTER TO CENTER
THK. - THICKNESS

REFERENCE DRAWINGS:-	
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-L-V-0002	STRUCTURAL LAYOUT PLAN & SECTION
CONTRACTOR DRAWING NO: GNB-MEL-CE-003	STRUCTURAL LAYOUT PLAN & SECTION
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-F-V-0001	FOUNDATION BOLTS DRAWING FOR TOWERS
CONTRACTOR DRAWING NO: GNB-MEL-CE-005	FOUNDATION BOLTS DRAWING FOR TOWERS
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-O-V-0015	4T7 - FABRICATION DRAWING
CONTRACTOR DRAWING NO: GNB-MEL-CE-114	4T7 - FABRICATION DRAWING

NAME OF TOWER	NO.OF.FOUNDATIONS
4T7	06 NOS.

SR.NO.	DESCRIPTION	QUANTITY	UNIT
1	PCC	3.12	CUM
2	CONCRETE	30.47	CUM
3	REINFORCEMENT	2.64	MT
4	EXCAVATION	177.69	CUM

1	18.09.24	FOR APPROVAL	JP	NT	NP
0	07.08.24	FIRST SUBMISSION	JP	NT	NP
REV.	DATE	DESCRIPTION	DRAWN	CHKD	APPD
CUSTOMER :		MAHAN ENERGEN LIMITED, BANDHAURA VILLAGE, SIGRAULI DIST, MADHYA PRADESH			
OWNER'S ENGINEER		TATA CONSULTING ENGINEERS LIMITED MUMBAI			
CONTRACTOR :		GODREJ & BOYCE MFG. CO. LTD. MAHARASTRA (INDIA).			

PROJECT :	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
LOA NO. :	4503035464 DT.06.05.2024				
DRAWN	18.09.24	JP	DRAWING TITLE: FOUNDATION DETAILS FOR 400KV TOWER TYPE-4T7		
CHKD	18.09.24	NT			
APPROVED	18.09.24	NP	CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-F-V-0046		
SHEET NO.	10F1	SCALE NTS	CONTRACTOR DRAWING NO: GNB-MEL-CE-106		
			SIZE A1	REV. 01	

400kV AIS

	OWNER MAHAN ENERGEN LIMITED (MEL) 2x800 MW ULTRA SUPER CRITICAL THERMAL POWER PROJECT, MAHAN (PHASE-II), SINGRAULI, M.P.
	OWNER'S ENGINEER TATA CONSULTING ENGINEERS LIMITED
 Godrej & Boyce Mfg. Co. Ltd.	EPC Contractor GODREJ AND BOYCE MFG. CO. LTD

DOCUMENT TITLE	4T1 Tower Structure Design SLD & Staad
OWNER DOC. NO.	552H-E-EPC-SYD-DC-U-V-0001
CONTRACTOR / SUPPLIER DOC. NO.	GNB-MEL-CE-012
PACKAGE DISCIPLINE	CIVIL
PREPARED BY	JMP
REVIEWED BY	NVT
APPROVED BY	NMP

Sr. No.	Revision No.	Date	Reasons for Change
1	0	01.08.2024	First issue
2	1	19.09.2024	Revised submission

**CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER
PROJECT AT SINGRAULI ,MP**

DESIGN FOR **400KV** GANTRY TOWER (**4T1**) & BEAM (**G1**)

INDEX

Sr.No.	Description	Page no.
1	GEOMETRY	3
2	LOAD EVALUATION	6
3	PICTORIAL VIEW OF STAAD MODEL	38
4	STAAD ANALYSIS & DESIGN	75
5	MEMBER & CONNECTION BOLT DESIGN	88
6	BASE PLATE & ANCHOR BOLT DESIGN	107

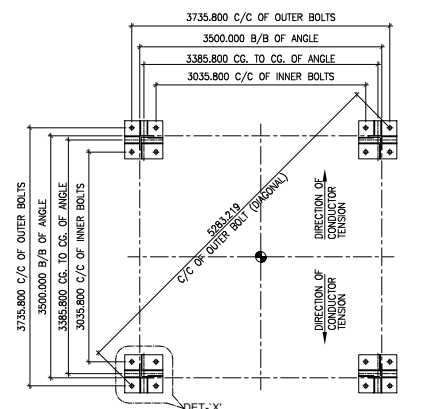
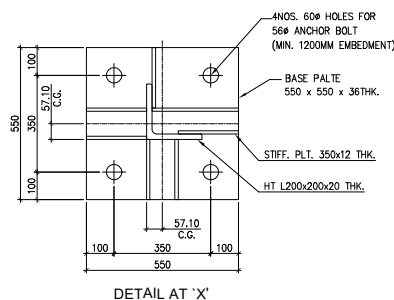
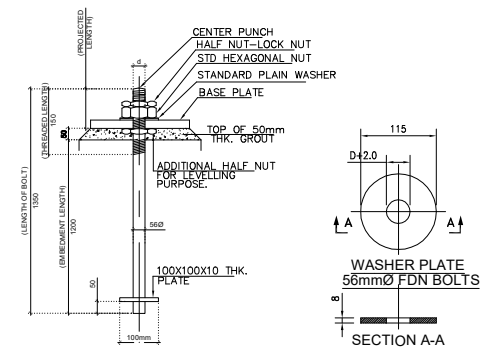
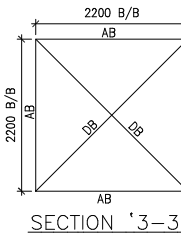
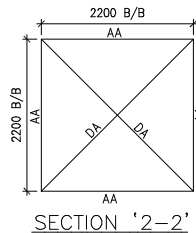
GEOMETRY

EL 0.00 LEVEL CORRESPONDS TO RL 338.000.

REFERENCE DRAWINGS:-	
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-L-V-0002	STRUCTURAL LAYOUT PLAN & SECTION
CONTRACTOR DRAWING NO: GNB-MEL-CE-003	STRUCTURAL LAYOUT PLAN & SECTION
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-F-V-0001	FOUNDATION BOLTS DRAWING FOR TOWERS
CONTRACTOR DRAWING NO: GNB-MEL-CE-005	FOUNDATION BOLTS DRAWING FOR TOWERS
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-O-V-0001	4T1 - FABRICATION DRAWING
CONTRACTOR DRAWING NO: GNB-MEL-CE-015	4T1 - FABRICATION DRAWING

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL
4T1	ANGLE SIZE	L200x200x20	L200x200x20	L150x150x20	L150x150x20	L150x150x12	L150x150x12	L150x150x12	L150x150x12	L75x75x5	L75x75x5	L75x75x5	L75x75x5
	NO. OF BOLTS	14	14	10	10	06	06	06	06	04	04	04	04

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	GA,JA	GB,JB	GC,JC	GD,JD	GE,JE	AA,AB	DA,DB
4T1	ANGLE SIZE	L90x90x6	L90x90x6	L100x100x10	L50x50x5	L45x45x5	L130x130x10	L90x90x6
	NO. OF BOLTS	04	04	05	02	01	06	02



SECTION '1-1'

ANCHOR BOLT SETTING PLAN

LEGEND: -

TOWER MARKED '4T1 TOWER' IS A END TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF GANTRY WITH CONDUCTOR TENSION OF 2.780T UNDER NORMAL CONDITION & 7.954T UNDER SHORT CIRCUIT CONDITION WITH DEVIATION.

HIGHLIGHT: -

SPAN OF GIRDER: 27.00 M.
HEIGHT OF GIRDER: 21.00 M.
HEIGHT OF TOWER: 28.00 M.
CONDUCTOR TENSION: 2.780T (NC)
7.954T (SC)

CONDUCTOR DEVIATION: 0 DEGREE IN PLAN & ELE.
30 DEG IN PLAN
30 DEG IN ELEVATION
30 DEG IN PLAN & ELE.

LOCATION: END TOWER

NOTES: -

- 1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- 3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- 4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- 5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS
16mm DIA BOLT

400kV TOWER MKD. 4T1

BEAM MKD.	ANGLE SIZE AND NO. OF BOLTS	MA	MB	SA	SB	UA	UB	SV	YH	YD	YC
G1	ANGLE SIZE	L130x130x10	L150x150x12	L90x90x6	L65x65x5	L90x90x6	L65x65x5	L100x100x10	L100x100x10	L100x100x10	L100x100x10
	NO. OF BOLTS	06	08	04	02	04	02	04	04	04	04

LEGEND: -

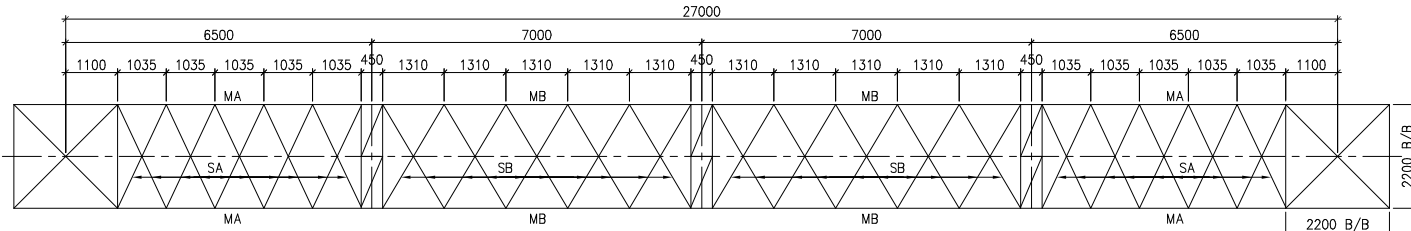
BEAM MARKED '1G' IS A BEAM OF SPAN 27.00 M. SUPPORTING THREE PHASES WITH CONDUCTOR TENSION OF 2.780T EACH UNDER NORMAL CONDITION & 7.954T EACH UNDER SHORT CIRCUIT CONDITION WITH DEVIATION OF CONDUCTOR.

HIGHLIGHT: -

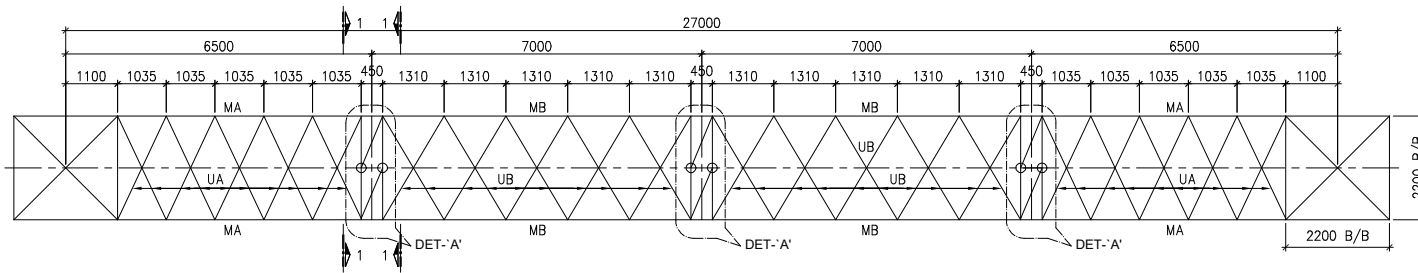
SPAN OF GIRDER: 27.00 M.
 HEIGHT OF GIRDER: 21.00 M.
 HEIGHT OF TOWER: 28.00 M.
 CONDUCTOR TENSION: 2.780T (NC)
 7.954T (SC)

NOTES: -

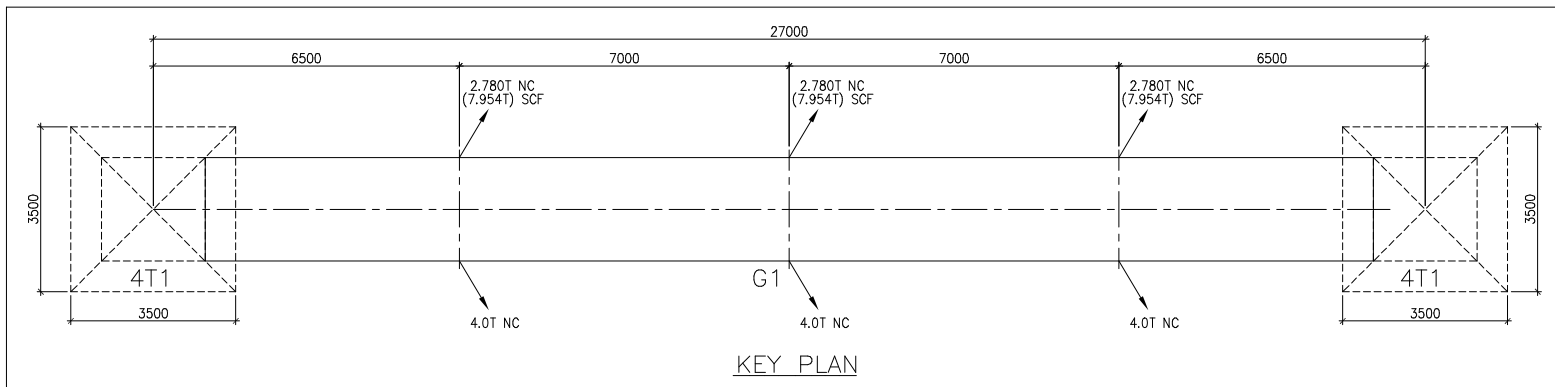
- 1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- 3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- 4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- 5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS 16mm DIA BOLT



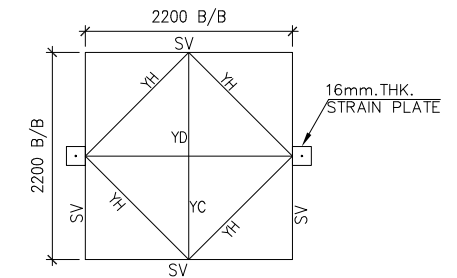
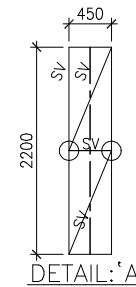
TOP & BOTTOM PLAN



ELEVATION



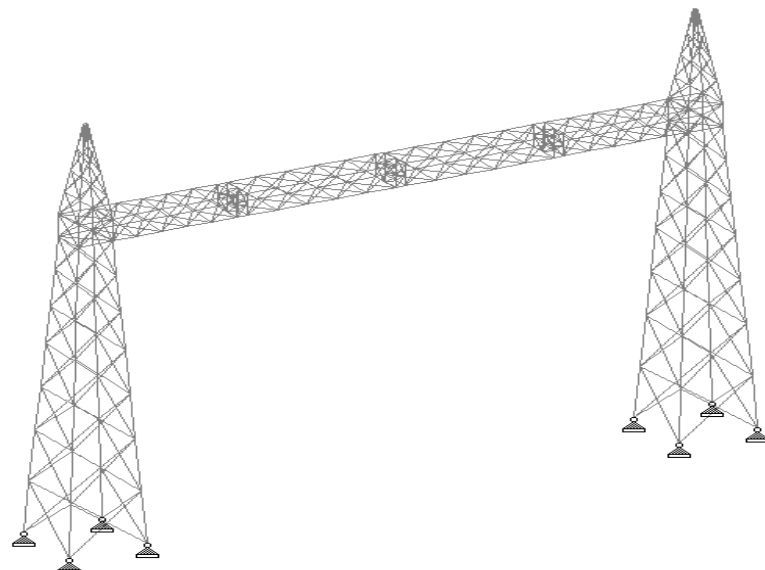
KEY PLAN



SECTION '1-1'

400kV TOWER MKD. G1

LOAD EVALUATION FOR BEAM-G1

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP			
Title :-	DESIGN OF "G1" BEAM			
* LOAD EVALUATION FOR 400 kV BEAM MKD. "G1"				
				
SUMMARY OF CONDUCTOR AND INSULATOR FORCES				
		CONDUCTOR & INSULATOR FORCES		
		TRANSVERSE LOAD (kg)	VERTICAL LOAD (kg)	LONGITUDINAL LOAD (kg)
(1) NO DEVIATION	WIND PARALLEL TO BEAM (NC)	900.00	0.00	2000.00
	WIND PARALLEL TO BEAM (SC)	900.00	0.00	3977.00
	WIND PERPENDICULAR TO BEAM (NC)	0.00	0.00	2137.20
	WIND PERPENDICULAR TO BEAM (SC)	0.00	0.00	4114.20
	SELF WEIGHT OF INSULATOR & COND. (LEFT)	0.00	488.90	0.00
	SELF WEIGHT OF INSULATOR & COND. (RIGHT)	0	488.90	0
	EARTH WIRE LOAD			

(2) 30' PLAN DEVIATION	WIND PARALLEL TO BEAM (NC)	2780.00	0.00	3465.00
	WIND PARALLEL TO BEAM (SC)	780.00	0.00	0.00
	WIND PERPENDICULAR TO BEAM (NC)	2000.00	0.00	3961.70
	WIND PERPENDICULAR TO BEAM (SC)	2000.00	0.00	542.70
	SELF WEIGHT OF INSULATOR	0.00	488.90	0.00
	SELF WEIGHT OF CONDUCTOR	0	488.90	0
	EARTH WIRE LOAD			
(3) 30' ELEVATION DEVIATION	WIND PARALLEL TO BEAM (NC)	855.00	-2000.00	3465.00
	WIND PARALLEL TO BEAM (SC)	855.00	0.00	0.00
	WIND PERPENDICULAR TO BEAM (NC)	0.00	-2000.00	3557.20
	WIND PERPENDICULAR TO BEAM (SC)	0.00	0.00	92.20
	SELF WEIGHT OF INSULATOR	0.00	488.90	0.00
	SELF WEIGHT OF CONDUCTOR	0.00	488.90	0.00
	EARTH WIRE LOAD			
(4) 30' PLAN + 30' ELEV. DEVIATION	WIND PARALLEL TO BEAM (NC)	2474.00	-2000.00	3000.00
	WIND PARALLEL TO BEAM (SC)	741.00	0.00	0.00
	WIND PERPENDICULAR TO BEAM (NC)	1733.00	-2000.00	3473.70
	WIND PERPENDICULAR TO BEAM (SC)	1733.00	0.00	473.70
	SELF WEIGHT OF INSULATOR	0.00	488.90	0.00
	SELF WEIGHT OF CONDUCTOR	0.00	488.90	0.00
	EARTH WIRE LOAD			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)				
* LOAD EVALUATION FOR 400kV BEAM MKD. "G2" (WITHOUT DEVIATION IN PLAN & ELEVATION)					
# GENERAL NOTES & WIND PRESSURE EVALUATION : -					
* LOADS					
a)	All Dead & Live Loads shall be as per	=	I.S. 802		
b)	All Wind Loads shall be as per	=	I.S. 802		
* FACTOR OF SAFETY					
a)	IN NORMAL CONDITION	=	2.0		
b)	IN SHORT-CIRCUIT CONDITION	=	1.50		
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015					
a)	Basic Wind Speed	Vb	=	39	m/s (As Per Technical Specifications)
b)	Reliability level		=	1.00	(As Per Technical Specifications)
c)	Terrain Category		=	1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s (As Per Cl. 8.3 of IS802 (P1/S1)-2015)
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm (As Per Cl. 8.4 of IS802 (P1/S1)-2015)

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)									
*	CONDUCTOR DETAILS									
a)	Description	=	ACSR MOOSE							
b)	Dia. of conductor	=	31.770	mm	(As per Electrical Input)					
c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)					
d)	Tension per phase	=	4000	Kg/phase	(Normal Condition)					
		=	7954	Kg/phase	(Short-Circuit Condition)					
f)	No. of Sub conductor per phase	=	4	(As per Electrical Input)						
g)	No. of tension insulator / phase	=	2	(As per Electrical Input)						
h)	No. of suspension insulator / phase	=	1	(As per Electrical Input)						
i)	Length of wire on left side, L1 =	=	51.20	m	(As per T.S. 2.26, Cl 7.9,) // (As Per site conditions)					
j)	Length of wire on right side, L2 =	=	100.00	m						
k)	Conductor span	=	105.60	m						
	Left side Span (50%) = (100.00)			x	0.50	=	50.00	m		
	Right side Span (50%) = (51.20)			x	0.50	=	25.60	m		
	Add 30 m for Jumpers/ droppers(ASSUMED)					=	30.00	m		
l)	Angle of Deviation									
	In plan	=	0	deg.						
	In Elevation	=	0	deg.						
*	INSULATOR DETAILS									
a)	Weight of suspension insulator string with hardware	=	65.40	Kg						
b)	Weight of tension insulator string with hardware	=	65.40	Kg						
c)	Length of tension insulator	=	4.975	m						
d)	Length of suspension insulator	=	4.975	m						
e)	Diameter of tension insulator	=	135.00	mm						
d)	Diameter of suspension insulator	=	135.00	mm						

Project :-

CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP

Title :-

DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

*

GIRDER DETAILS

a) C/C of girder

= 27.00 m

b) Length of parts being on either side being

= 5.400 & 7.000 m

c) Hamper width of tower

= 2.20 m

d) Clear span of girder

= 24.80 m

e) Width of girder

= 2.20 m

f) Depth of girder

= 2.20 m

g) Height of Girder from Plinth Level

= 19.90 m

	Vertical	Longitudial	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	4000.00	0.00
Load Due to Short Circuit Tension Due to Deviations in kg	0.00	7954.00	0.00

#

GEOMETRY FOR GIRDER :-

Part		Section		No. of pieces	Length in m
Main Leg					
Chord Central	MC	L	130x130x12	4	14.000
Chord Left	MA	L	100x100x10	4	5.400
Chord Right	MA	L	100x100x10	4	5.400
Plan					
Horizontal Belt	SV	L	60x60x5	12	2.200
Lattice Left	SA	L	60x60x5	20	2.431
Lattice Central	SB	L	50x50x5	40	2.560
Lattice Right	SA	L	60x60x5	20	2.431
Elevation					
Vertical Belt	SV	L	60x60x5	12	2.200
Lattice Left	UA	L	60x60x5	20	2.431
Lattice Central	UC	L	50x50x5	40	2.560
Lattice Right	UA	L	60x60x5	20	2.431
Connector Vertical	YD	L	60x60x5	6	2.200
Connector Horizontal	YC	L	60x60x5	6	2.200
Diamong Bracing	YH	L	60x60x5	24	1.556

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP																																																																																																	
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)																																																																																																	
# LOAD CALCULATIONS :-																																																																																																		
* VERTICAL LOADS :																																																																																																		
- Weight of Conductor																																																																																																		
a)	Length of conductor	=	50.00	+	25.60	+	30.00																																																																																											
		=	105.60	m																																																																																														
b)	Weight of conductor	=	105.60	x	2.004	x	4.00																																																																																											
		=	846.49	Kgs		Say	=	847.00	Kgs																																																																																									
- Weight of Insulator																																																																																																		
a)	Weight of tension insulators string with hardware	=	65.40	Kgs per phase																																																																																														
b)	Weight of suspension Insulator string with hardware	=	65.40	Kgs per phase																																																																																														
- Weight of line man with tools																																																																																																		
	at middle phase	=	150	Kgs																																																																																														
- Loads due to Conductor Tension																																																																																																		
a)	Normal Condition	=	0.00	Kgs																																																																																														
b)	Short Circuit Tension	=	0.00	Kgs																																																																																														
* LONGITUDINAL LOADS :																																																																																																		
- Wind Load on Girder																																																																																																		
a)	Net Surface area	Ae	=	12.07	sqm (Refer the break up below)																																																																																													
b)	Gross Surface Area	Ag	=	54.56	sqm																																																																																													
c)	Solidity Ratio	Ae/Ag	=	0.2212																																																																																														
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)																																																																																													
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)																																																																																													
f)	Wind Load $W_s = P_z \times Cdt \times Gt \times Ae$	=	2308.71	Kgs	Say	=	2310.00	Kgs																																																																																										
<table><tr><th colspan="3">Part</th><th colspan="2">Section</th><th>No. of pieces</th><th>Length in m</th><th>Solid Area in sqm</th></tr><tr><td colspan="3">Main Leg</td><td colspan="2"></td><td></td><td></td><td></td></tr><tr><td>Chord Central</td><td>MC</td><td>L</td><td>130x130x12</td><td></td><td>2</td><td>14.000</td><td>3.64</td></tr><tr><td>Chord Left</td><td>MA</td><td>L</td><td>100x100x10</td><td></td><td>2</td><td>5.400</td><td>1.08</td></tr><tr><td>Chord Right</td><td>MA</td><td>L</td><td>100x100x10</td><td></td><td>2</td><td>5.400</td><td>1.08</td></tr><tr><td colspan="3">Elevation</td><td colspan="2"></td><td></td><td></td><td></td></tr><tr><td>Vertical Belt</td><td>SV</td><td>L</td><td>60x60x5</td><td></td><td>6</td><td>2.200</td><td>0.79</td></tr><tr><td>Lattice Left</td><td>UA</td><td>L</td><td>60x60x5</td><td></td><td>10</td><td>2.431</td><td>1.46</td></tr><tr><td>Lattice Central</td><td>UC</td><td>L</td><td>50x50x5</td><td></td><td>20</td><td>2.560</td><td>2.56</td></tr><tr><td>Lattice Right</td><td>UA</td><td>L</td><td>60x60x5</td><td></td><td>10</td><td>2.431</td><td>1.46</td></tr><tr><td colspan="6">Total Area</td><td>12.07</td><td>sqm</td></tr></table>											Part			Section		No. of pieces	Length in m	Solid Area in sqm	Main Leg								Chord Central	MC	L	130x130x12		2	14.000	3.64	Chord Left	MA	L	100x100x10		2	5.400	1.08	Chord Right	MA	L	100x100x10		2	5.400	1.08	Elevation								Vertical Belt	SV	L	60x60x5		6	2.200	0.79	Lattice Left	UA	L	60x60x5		10	2.431	1.46	Lattice Central	UC	L	50x50x5		20	2.560	2.56	Lattice Right	UA	L	60x60x5		10	2.431	1.46	Total Area						12.07	sqm
Part			Section		No. of pieces	Length in m	Solid Area in sqm																																																																																											
Main Leg																																																																																																		
Chord Central	MC	L	130x130x12		2	14.000	3.64																																																																																											
Chord Left	MA	L	100x100x10		2	5.400	1.08																																																																																											
Chord Right	MA	L	100x100x10		2	5.400	1.08																																																																																											
Elevation																																																																																																		
Vertical Belt	SV	L	60x60x5		6	2.200	0.79																																																																																											
Lattice Left	UA	L	60x60x5		10	2.431	1.46																																																																																											
Lattice Central	UC	L	50x50x5		20	2.560	2.56																																																																																											
Lattice Right	UA	L	60x60x5		10	2.431	1.46																																																																																											
Total Area						12.07	sqm																																																																																											

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)		
-	Wind Load on Tension Insulator		
a)	Diameter of insulator, di	=	135.00 mm
b)	Length of insulator, Li	=	0.00 m
c)	Net area Exposed, Ai = Li.di	=	0.00 sqm
d)	Ratio of Li / di	=	0.00
e)	Drag Co-efficient for insulators	Cdi =	0.000 (As Per Cl. 9.3 of IS802 (P1/S1)-2015)
f)	Gust Response Factor	Gi =	1.960 (As Per Table-6 of IS802 (P1/S1)-2015)
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	0.00 Kgs Say = 0.00 Kgs
h)	Wind Load on Tension insulator in Longitudinal Direction	=	0.00 Kg
-	Wind Load on Suspension Insulator		
a)	Diameter of insulator, di	=	135.00 mm
b)	Length of insulator, Li	=	4.98 m
c)	Net area Exposed, Ai = Li.di	=	0.67 sqm
d)	Ratio of Li / di	=	36.85
e)	Drag Co-efficient for insulators	Cdi =	1.200 (As Per Cl. 9.3 of IS802 (P1/S1)-2015)
f)	Gust Response Factor	Gi =	1.960 (As Per Table-6 of IS802 (P1/S1)-2015)
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	90.69 Kgs Say = 91.00 Kgs
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	91.00 Kg
-	Wind Load on Conductor		
a)	Diameter of conductor, dc	=	31.77 mm
b)	Length of conductor, Lc	=	0.00 m
c)	Net area Exposed, Lc.dc	=	0.00 sqm
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000 (As Per Cl. 9.2 of IS802 (P1/S1)-2015)
e)	Gust Response Factor	Gc =	2.1000 (As Per Table-7 of IS802 (P1/S1)-2015)
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	0.00 Kg Say = 0.00 Kgs
g)	Wind Load on Conductor in Longitudinal Direction	=	0.00 Kg
-	Loads due to Conductor Tension		
a)	Normal Condition	=	4000.00 Kgs
b)	Short Circuit Tension	=	7954.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)									
*	TRANSVERSE LOADS:									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction			=	91.00	Kg				
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction			=	91.00	Kg				
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	105.60	m						
c)	Net area Exposed, Lc.dc	=	3.35	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	1617.88	Kg		Say	=	1618.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction			=	1618.00	Kg				
-	Loads due to Conductor Tension									
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)									
# SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-										
Dead load	Self Wt.		Self Wt.							
	Cond.		T-Insu.							
TOTAL FY / PHASE	=	847.00	+	65.40	=	912.40	Kgs			
FY / NODE	=	423.50	+	65.40	=	488.90	Kgs			
Dead load	Self Wt.		Self Wt.							
	Cond.		S-Insu.							
TOTAL FY / PHASE	=	0.00	+	65.40	=	65.40	Kgs			
FY / NODE	=	0.00	+	65.40	=	65.40	Kgs			
- JOINT LOAD ON NODE NO. : 4.00										
	Lineman									
	With Tool									
TOTAL FY	=	150.00			=	150.00	Kgs			
FY / NODE	=	37.50			=	37.50	Kgs			
* LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)										
- JOINT LOAD ON NODE NO. : 0.00										
Wind load	Wind on		Wind on			Wind on				
	Cond.		T-Insu.			sus.				
TOTAL FX / PHASE	=	1618.00	+	91.00	=	1709.00	Kgs	91.00	Kgs	
FX / NODE	=	809.00	+	91.00	=	900.00	Kgs	91.00	Kgs	
Cond. Tension			Conductor		Cond. Tension	Conductor		Cond. Tension	Conductor	
			Tension			Tension			Tension	
TOTAL FX / PHASE	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	4000.00 Kgs
FX / NODE	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	2000.00 Kgs
* LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)										
- JOINT LOAD ON NODE NO. : 0.00										
Wind load	Wind on		Wind on			Wind on				
	Cond.		T-Insu.			S-Insu.				
TOTAL FX / PHASE	=	1618.00	+	91.00	=	1709.00	Kgs	91.00	Kgs	
FX / NODE	=	809.00	+	91.00	=	900.00	Kgs	91.00	Kgs	
Cond. Tension			Cond.		Cond. Tension	Conductor		Cond. Tension	Tension	
			Tension			Tension				
TOTAL FX / PHASE	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	7954.00 Kgs
FX / NODE	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	3977.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP												
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)												
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>													
- JOINT LOAD ON NODE NO. : 0.00													
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.								
TOTAL FZ / PHASE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs				
FZ / NODE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs				
Cond. Tension	Cond. Tension				Cond. Tension	Conductor Tension		Cond. Tension	Conductor Tension				
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	4000.00	Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	2000.00	Kgs
- WIND LOAD ON JOINT : 0.00													
	Wind load on Str.												
TOTAL FZ	=	2310.00					=	2310.00	Kgs				
FZ / NODE	=	2310.00	/	50			=	46.20	Kgs				
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>													
- JOINT LOAD ON NODE NO. : 0.00													
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on T-Insu.								
TOTAL FZ / PHASE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs				
FZ / NODE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs				
Cond. Tension	Cond. Tension				Cond. Tension	Conductor Tension		Cond. Tension	Conductor Tension				
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	7954.00	Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	3977.00	Kgs
- WIND LOAD ON JOINT :													
	Wind load on Str.												
TOTAL FZ	=	2310.00					=	2310.00	Kgs				
FZ / NODE	=	2310.00	/	50			=	46.20	Kgs				

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
* LOAD EVALUATION FOR 400kV BEAM MKD. "G1" (WITH DEVIATION IN PLAN)										
#	GENERAL NOTES & WIND PRESSURE EVAULATION : -									
*	LOADS									
	a)	All Dead & Live Loads shall be as per	=	I.S.	802					
	b)	All Wind Loads shall be as per	=	I.S.	802					
*	FACTOR OF SAFETY									
	a)	IN NORMAL / BROKEN WIRE CONDITION	=	2.0						
	b)	IN SHORT-CIRCUIT CONDITION	=	1.50						
*	WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015									
	a)	Basic Wind Speed	Vb	=	39	m/s	(As Per Technical Specifications)			
	b)	Reliabilty level		=	1.00	(As Per Technical Specifications)				
	c)	Terrain Category		=	1.00	(As Per Technical Specifications)				
	d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)				
	e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s	(As Per Cl. 8.2 of IS802 (P1/S1)-2015)			
	f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)				
	g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)				
	h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s	(As Per Cl. 8.3 of IS802 (P1/S1)-2015)			
	i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm	(As Per Cl. 8.4 of IS802 (P1/S1)-2015)			
*	CONDUCTOR DETAILS									
	a)	Description	=	ACSR MOOSE						
	b)	Dia. of conductor	=	31.77	mm	(As per Electrical Input)				
	c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)				
	d)	Tension per phase	=	4000	Kg/phase	(Normal Condition)				
			=	0	Kg/phase	(Short-Circuit Condition)				
	f)	No. of Sub conductor per phase	=	4	(As per Electrical Input)					
	g)	No. of tension insulator / phase	=	2	(As per Electrical Input)					
	h)	No. of suspension insulator / phase	=	1	(As per Electrical Input)					
	i)	Length of wire on left side, L1 =	=	51.2	m	(As per T.S. 2.26, Cl 7.9,) / (As Per site conditions)				
	j)	Length of wire on right side, L2 =	=	100.00	m					
	k)	Conductor span	=	105.60	m					
		Left side Span (50%) = (100.00)			x	0.50	=	50.00	m	
		Right side Span (50%) = (51.20)			x	0.50	=	25.60	m	
		Add 30 m for Jumpers/ droppers					=	30.00	m	
	l)	Angle of Deviation								
		In plan	=	30	deg.					
		In Elevation	=	0	deg.					

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES				
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)				
*	INSULATOR DETAILS				
a)	Weight of tension insulator string with hardware	=	65.40	Kg	(As per Electrical Input)
b)	Length of tension insulator	=	4.98	m	(As per Electrical Input)
d)	Length of suspension insulator	=	4.98	m	(Assumed with Hardware)
c)	Diameter of tension insulator	=	135.00	mm	(As per Electrical Input)
d)	Diameter of suspension insulator	=	135.00	mm	(Assumed)
*	GIRDER DETAILS				
a)	C/C of girder	=	27.00	m	
c)	Hamper width of tower	=	2.20	m	
d)	Clear span of girder	=	24.80	m	
e)	Width of girder	=	2.20	m	
f)	Depth of girder	=	2.20	m	
g)	Height of Girder from Plinth Level	=	19.90	m	
		Vertical	Longitudial	Transverse	
Load Due to Normal Tension Due to Deviations in kg		0.00	3465.00	2000.00	
Load Due to Short Circuit Tension Due to Deviations in kg		0.00	0.00	0.00	
#	<u>GEOMETRY FOR GIRDER :-</u>				
Part		Section		No. of pieces	Length in m
Main Leg					
Chord Central	MC	L	130x130x12	4	14.000
Chord Left	MA	L	100x100x10	4	5.400
Chord Right	MA	L	100x100x10	4	5.400
Plan					
Horizontal Belt	SV	L	60x60x5	12	2.200
Lattice Left	SA	L	60x60x5	20	2.431
Lattice Central	SB	L	50x50x5	40	2.560
Lattice Right	SA	L	60x60x5	20	2.431
Elevation					
Vertical Belt	SV	L	60x60x5	12	2.200
Lattice Left	UA	L	60x60x5	20	2.431
Lattice Central	UC	L	50x50x5	40	2.560
Lattice Right	UA	L	60x60x5	20	2.431
Connector Vertical	YD	L	60x60x5	6	2.200
Connector Horizontal	YC	L	60x60x5	6	2.200
Diamong Bracing	YH	L	60x60x5	24	1.556

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
# LOAD CALCULATIONS :-										
* VERTICAL LOADS :										
- Weight of Conductor										
a)	Length of conductor	=	50.00	+	25.60	+	30.00			
		=	105.60	m						
b)	Weight of conductor	=	105.60	x	2.004	x	4.00			
		=	846.49	Kgs			Say	=	847.00	Kgs
- Weight of Insulator										
a)	Weight of tension insulators string with hardware	=	65.40	Kgs per phase						
- Weight of line man with tools										
	at middle phase	=	150	Kgs						
- Loads due to Conductor Tension										
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						
* LONGITUDINAL LOADS :										
- Wind Load on Girder										
a)	Net Surface area	Ae	=	12.07	sqm (Refer the break up below)					
b)	Gross Surface Area	Ag	=	54.56	sqm					
c)	Solidity Ratio	Ae/Ag	=	0.2212						
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)					
f)	Wind Load Ws = Pz x Cdt x Gt x Ae	=	2308.71	Kgs			Say	=	2310.00	Kgs
Part		Section		No. of pieces	Length in m	Solid Area in sqm				
Main Leg										
Chord Central	MC	L	130x130x12	2	14.000	3.64				
Chord Left	MA	L	100x100x10	2	5.400	1.08				
Chord Right	MA	L	100x100x10	2	5.400	1.08				
Elevation										
Vertical Belt	SV	L	60x60x5	6	2.200	0.79				
Lattice Left	UA	L	60x60x5	10	2.431	1.46				
Lattice Central	UC	L	50x50x5	20	2.560	2.56				
Lattice Right	UA	L	60x60x5	10	2.431	1.46				
					Total Area	12.07		sqm		

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES				
Title :-	DESIGN FOR 132KV GANTRY BEAM (G1)				
-	Wind Load on Tension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	2.49 m		
c)	Net area Exposed, Ai = Li.di	=	0.34 sqm		
d)	Ratio of Li / di	=	18.43		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	45.34 Kgs	Say =	46.00 Kgs
h)	Wind Load on Tension insulator in Longitudinal Direction	=	46.00 Kg		
-	Wind Load on Suspension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	2.49 m		
c)	Net area Exposed, Ai = Li.di	=	0.34 sqm		
d)	Ratio of Li / di	=	18.43		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	45.34 Kgs	Say =	46.00 Kgs
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	46.00 Kg		
-	Wind Load on Conductor				
a)	Diameter of conductor, dc	=	31.77 mm		
b)	Length of conductor, Lc	=	52.80 m		
c)	Net area Exposed, Lc.dc	=	1.68 sqm		
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)	
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)	
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	808.94 Kg	Say =	809.00 Kgs
g)	Wind Load on Conductor in Longitudinal Direction	=	809.00 Kg		
-	Loads due to Conductor Tension				
a)	Normal Condition	=	3465.00 Kgs		
b)	Short Circuit Tension	=	0.00 Kgs		

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
* TRANSVERSE LOADS:										
- Wind Load on Tension Insulator										
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai = of Li.di	=	0.58	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	78.54	Kgs		Say	=	79.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction			=	79.00	Kg				
- Wind Load on Suspension Insulator										
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai = Li.di	=	0.58	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	78.54	Kgs		Say	=	79.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction			=	79.00	Kg				
- Wind Load on Conductor										
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	91.45	m						
c)	Net area Exposed, Lc.dc	=	2.91	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	1401.13	Kg		Say	=	1402.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction			=	1402.00	Kg				
- Loads due to Conductor Tension										
a)	Normal Condition	=	2000.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES										
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)										
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>											
Dead load											
		Self Wt. Cond.		Self Wt. T-Insu.							
TOTAL FY / PHASE	=	847.00	+	130.80	=	977.80	Kgs				
FY / NODE	=	423.50	+	65.40	=	488.90	Kgs				
Dead load											
		Self Wt. Cond.		Self Wt. T-Insu.							
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs				
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs				
- JOINT LOAD ON NODE NO. : 4.00											
		Lineman With Tool									
TOTAL FY	=	150.00			=	150.00	Kgs				
FY / NODE	=	37.50			=	37.50	Kgs				
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load		Wind on Cond.		Wind on T-Insu.		Wind on T-Insu.					
TOTAL FX / PHASE	=	1402.00	+	158.00	=	1560.00	Kgs	79.00			
FX / NODE	=	701.00	+	79.00	=	780.00	Kgs	79.00			
Cond. Tension				Conductor Tension		Cond. Tension		Conductor Tension		Cond. Tension	
TOTAL FX / PHASE				= 2000.00 Kgs		TOTAL FY / PHASE		= 0.00 Kgs		TOTAL FZ / PHASE	
FX / NODE				= 2000.00 Kgs		FY / NODE		= 0.00 Kgs		FZ / NODE	
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load		Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.					
TOTAL FX / PHASE	=	1402.00	+	158.00	=	1560.00	Kgs	79.00			
FX / NODE	=	701.00	+	79.00	=	780.00	Kgs	79.00			
Cond. Tension				Cond. Tension		Cond. Tension		Conductor Tension		Cond. Tension	
TOTAL FX / PHASE				= 0.00 Kgs		TOTAL FY / PHASE		= 0.00 Kgs		TOTAL FZ / PHASE	
FX / NODE				= 0.00 Kgs		FY / NODE		= 0.00 Kgs		FZ / NODE	

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES										
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)										
* LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.			Wind on S-Insu.					
TOTAL FZ / PHASE	=	809.00	+	92.00	=	901.00 Kgs	46.00				
FZ / NODE	=	404.50	+	46.00	=	450.50 Kgs	46.00				
Cond. Tension	Cond. Tension			Cond. Tension		Conductor Tension		Cond. Tension		Conductor Tension	
TOTAL FX / PHASE	=	2000.00	=	2000.00 Kgs	TOTAL FY / PHASE	=	0.00 Kgs	TOTAL FZ / PHASE	=	3465.00 Kgs	
FX / NODE	=	2000.00	=	2000.00 Kgs	FY / NODE	=	0.00 Kgs	FZ / NODE	=	3465.00 Kgs	
- WIND LOAD ON JOINT : 0.00											
	Wind load on Str.										
TOTAL FZ	=	2310.00			=	2310.00 Kgs					
FZ / NODE	=	2310.00	/	50	=	46.20 Kgs					
* LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.			Wind on T-Insu.					
TOTAL FZ / PHASE	=	809.00	+	92.00	=	947.00 Kgs	46.00				
FZ / NODE	=	404.50	+	46.00	=	496.50 Kgs	46.00				
Cond. Tension	Cond Tension			Cond. Tension		Conductor Tension		Cond. Tension		Conductor Tension	
TOTAL FX / PHASE	=	0.00	=	2000.00 Kgs	TOTAL FY / PHASE	=	0.00 Kgs	TOTAL FZ / PHASE	=	0.00 Kgs	
FX / NODE	=	0.00	=	2000.00 Kgs	FY / NODE	=	0.00 Kgs	FZ / NODE	=	0.00 Kgs	
- WIND LOAD ON JOINT :											
	Wind load on Str.										
TOTAL FZ	=	2310.00			=	2310.00 Kgs					
FZ / NODE	=	2310.00	/	50	=	46.20 Kgs					

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
* LOAD EVALUATION FOR 400kV BEAM MKD. "G1" (WITH DEVIATION IN ELEVATION)										
# GENERAL NOTES & WIND PRESSURE EVALUATION : -										
* LOADS										
a)	All Dead & Live Loads shall be as per	=	I.S. 802							
b)	All Wind Loads shall be as per	=	I.S. 802							
* FACTOR OF SAFETY										
a)	IN NORMAL / BROKEN WIRE CONDITION	=	2.0							
b)	IN SHORT-CIRCUIT CONDITION	=	1.50							
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015										
a)	Basic Wind Speed	Vb	=	39	m/s	(As Per Technical Specifications)				
b)	Reliabilty level		=	1.00	(As Per Technical Specifications)					
c)	Terrain Category		=	1.00	(As Per Technical Specifications)					
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)					
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s	(As Per Cl. 8.2 of IS802 (P1/S1)-2015)				
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)					
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)					
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s	(As Per Cl. 8.3 of IS802 (P1/S1)-2015)				
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm	(As Per Cl. 8.4 of IS802 (P1/S1)-2015)				
* CONDUCTOR DETAILS										
a)	Description	=	ACSR MOOSE							
b)	Dia. of conductor	=	31.77	mm	(As per Electrical Input)					
c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)					
d)	Tension per phase	=	4000	Kg/phase	(Normal Condition)					
		=	0	Kg/phase	(Short-Circuit Condition)					
f)	No. of Sub conductor per phase	=	4	(As per Electrical Input)						
g)	No. of tension insulator / phase	=	2	(As per Electrical Input)						
h)	No. of suspension insulator / phase	=	1	(As per Electrical Input)						
i)	Length of wire on left side, L1 =	=	51.2	m	(As per T.S. 2.26, Cl 7.9,) /(As Per site conditions)					
j)	Length of wire on right side, L2 =	=	100	m						
k)	Conductor span	=	105.60	m						
	Left side Span (50%)	= (	100.00	)	x	0.50	=	50.00	m	
	Right side Span (50%)	= (	51.20	)	x	0.50	=	25.60	m	
	Add 10 m for Jumpers/ droppers						=	30.00	m	
l)	Angle of Deviation									
	In plan	=	0	deg.						
	In Elevation	=	30	deg.						

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES				
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)				
* INSULATOR DETAILS					
a)	Weight of tension insulator string with hardware	=	65.40	Kg	(As per Electrical Input)
b)	Length of tension insulator	=	4.98	m	(As per Electrical Input)
c)	Diameter of tension insulator	=	135.00	mm	(As per Electrical Input)
* GIRDER DETAILS					
a)	C/C of girder	=	27.00	m	
c)	Hamper width of tower	=	2.20	m	
d)	Clear span of girder	=	24.80	m	
e)	Width of girder	=	2.20	m	
f)	Depth of girder	=	2.20	m	
g)	Height of Girder from Plinth Level	=	19.90	m	
		Vertical	Longitudial	Transverse	
Load Due to Normal Tension Due to Deviations in kg		-2000.00	3465.00	0.00	
Load Due to Short Circuit Tension Due to Deviations in kg		0.00	0.00	0.00	
# <u>GEOMETRY FOR GIRDER :-</u>					
Part		Section		No. of pieces	Length in m
Main Leg					
Chord Central	MC	L	130x130x12	4	14.000
Chord Left	MA	L	100x100x10	4	5.400
Chord Right	MA	L	100x100x10	4	5.400
Plan					
Horizontal Belt	SV	L	60x60x5	12	2.200
Lattice Left	SA	L	60x60x5	20	2.431
Lattice Central	SB	L	50x50x5	40	2.560
Lattice Right	SA	L	60x60x5	20	2.431
Elevation					
Vertical Belt	SV	L	60x60x5	12	2.200
Lattice Left	UA	L	60x60x5	20	2.431
Lattice Central	UC	L	50x50x5	40	2.560
Lattice Right	UA	L	60x60x5	20	2.431
Connector Vertical	YD	L	60x60x5	6	2.200
Connector Horizontal	YC	L	60x60x5	6	2.200
Diamong Bracing	YH	L	60x60x5	24	1.556

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
# LOAD CALCULATIONS :-										
* VERTICAL LOADS :										
- Weight of Conductor										
a)	Length of conductor	=	50.00	+	25.60	+	30.00			
		=	105.60	m						
b)	Weight of conductor	=	105.60	x	2.004	x	4.00			
		=	846.49	Kgs		Say	=	847.00	Kgs	
- Weight of Insulator										
a)	Weight of tension insulators string with hardware	=	65.40	Kgs per phase						
- Weight of line man with tools										
	at middle phase	=	150	Kgs						
- Loads due to Conductor Tension										
a)	Normal Condition	=	-2000.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						
* LONGITUDINAL LOADS :										
- Wind Load on Girder										
a)	Net Surface area	Ae	=	12.07	sqm (Refer the break up below)					
b)	Gross Surface Area	Ag	=	54.56	sqm					
c)	Solidity Ratio	Ae/Ag	=	0.2212						
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)					
f)	Wind Load $W_s = P_z \times C_{dt} \times G_t \times A_e$	=	2308.71	Kgs		Say	=	2310.00	Kgs	

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES				
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)				
-	Wind Load on Tension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	4.98 m		
c)	Net area Exposed, Ai = 50% of Li.di	=	0.34 sqm		
d)	Ratio of Li / di		36.85		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	45.34 Kgs	Say	= 46.00 Kgs
h)	Wind Load on Tension insulator in Longitudinal Direction	=	46.00 Kg		
-	Wind Load on Suspension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	4.98 m		
c)	Net area Exposed, Ai = 50% of Li.di	=	0.34 sqm		
d)	Ratio of Li / di		36.85		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	45.34 Kgs	Say	= 46.00 Kgs
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	46.00 Kg		
-	Wind Load on Conductor				
a)	Diameter of conductor, dc	=	31.77 mm		
b)	Length of conductor, Lc	=	0.00 m		
c)	Net area Exposed, Lc.dc	=	0.00 sqm		
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)	
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)	
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	0.00 Kg	Say	= 0.00 Kgs
g)	Wind Load on Conductor in Longitudinal Direction	=	0.00 Kg		
-	Loads due to Conductor Tension				
a)	Normal Condition	=	3465.00 Kgs		
b)	Short Circuit Tension	=	0.00 Kgs		

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
*	TRANSVERSE LOADS:									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.34	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	45.34	Kgs		Say	=	46.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction			=	46.00	Kg				
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.34	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	45.34	Kgs		Say	=	46.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction			=	46.00	Kg				
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	105.60	m						
c)	Net area Exposed, Lc.dc	=	3.35	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	1617.88	Kg		Say	=	1618.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction			=	1618.00	Kg				
-	Loads due to Conductor Tension									
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>										
Dead load			Self Wt.		Self Wt.					
			Cond.		T-Insu.					
TOTAL FY / PHASE	=	847.00	+	130.80	=	977.80	Kgs			
FY / NODE	=	423.50	+	65.40	=	488.90	Kgs			
Dead load			Self Wt.		Self Wt.					
			Cond.		T-Insu.					
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs			
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs			
- JOINT LOAD ON NODE NO.			:	0.00						
			Lineman							
			With Tool							
TOTAL FY	=	150.00			=	150.00	Kgs			
FY / NODE	=	75.00			=	75.00	Kgs			
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>										
- JOINT LOAD ON NODE NO.			:	0.00						
Wind load			Wind on		Wind on		Wind on			
			Cond.		T-Insu.		S-Insu.			
TOTAL FX / PHASE	=	1618.00	+	92.00	=	1710.00	Kgs	46.00		
FX / NODE	=	809.00	+	46.00	=	855.00	Kgs	46.00		
Cond. Tension			Conductor		Cond. Tension		Conductor	Cond. Tension		Conductor
			Tension				Tension			Tension
TOTAL FX / PHASE		=	0.00	Kgs	TOTAL FY / PHASE	=	-2000.00	Kgs	TOTAL FZ / PHASE	= 3465.00 Kgs
FX / NODE		=	0.00	Kgs	FY / NODE	=	-2000.00	Kgs	FZ / NODE	= 3465.00 Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>										
- JOINT LOAD ON NODE NO.			:	0.00						
Wind load			Wind on		Wind on		Wind on			
			Cond.		T-Insu.		S-Insu.			
TOTAL FX / PHASE	=	1618.00	+	92.00	=	1710.00	Kgs	46.00		
FX / NODE	=	809.00	+	46.00	=	855.00	Kgs	46.00		
Cond. Tension			Cond.		Cond. Tension		Conductor	Cond. Tension		Tension
			Tension				Tension			
TOTAL FX / PHASE		=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	= 0.00 Kgs
FX / NODE		=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	= 0.00 Kgs

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES										
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)										
* LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.						
TOTAL FZ / PHASE	=	0.00	+	92.00	=	92.00 Kgs	46.00				
FZ / NODE	=	0.00	+	46.00	=	46.00 Kgs	46.00				
Cond. Tension	Cond. Tension			Cond. Tension	Conductor Tension	Cond. Tension		Conductor Tension			
TOTAL FX / PHASE	=	0.00	=	0.00 Kgs	TOTAL FY / PHASE	=	-2000.00 Kgs	TOTAL FZ / PHASE	=	3465.00 Kgs	
FX / NODE	=	0.00	=	0.00 Kgs	FY / NODE	=	-2000.00 Kgs	FZ / NODE	=	3465.00 Kgs	
- WIND LOAD ON JOINT : 0.00											
	Wind load on Str.										
TOTAL FZ	=	2310.00			=	2310.00 Kgs					
FZ / NODE	=	2310.00	/	50	=	46.20 Kgs					
* LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.						
TOTAL FZ / PHASE	=	0.00	+	92.00	=	92.00 Kgs	46.00				
FZ / NODE	=	0.00	+	46.00	=	46.00 Kgs	23.00				
Cond. Tension	Cond. Tension			Cond. Tension	Conductor Tension	Cond. Tension		Conductor Tension			
TOTAL FX / PHASE	=	0.00	=	0.00 Kgs	TOTAL FY / PHASE	=	0.00 Kgs	TOTAL FZ / PHASE	=	0.00 Kgs	
FX / NODE	=	0.00	=	0.00 Kgs	FY / NODE	=	0.00 Kgs	FZ / NODE	=	0.00 Kgs	
- WIND LOAD ON JOINT :											
	Wind load on Str.										
TOTAL FZ	=	2310.00			=	2310.00 Kgs					
FZ / NODE	=	2310.00	/	50	=	46.20 Kgs					

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
* LOAD EVALUATION FOR 400kV BEAM MKD. "G1" (WITH DEVIATION IN PLAN & ELEVATION)										
# GENERAL NOTES & WIND PRESSURE EVALUATION : -										
* LOADS										
a)	All Dead & Live Loads shall be as per	=	I.S. 802							
b)	All Wind Loads shall be as per	=	I.S. 802							
* FACTOR OF SAFETY										
a)	IN NORMAL / BROKEN WIRE CONDITION	=	2.0							
b)	IN SHORT-CIRCUIT CONDITION	=	1.50							
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015										
a)	Basic Wind Speed	Vb	=	39	m/s	(As Per Technical Specifications)				
b)	Reliabilty level		=	1.00		(As Per Technical Specifications)				
c)	Terrain Category		=	1.00		(As Per Technical Specifications)				
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375		(As Per IS802 (P1/S1)-2015)				
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s	(As Per Cl. 8.2 of IS802 (P1/S1)-2015)				
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00		(As Per Table-2 of IS802 (P1/S1)-2015)				
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08		(As Per Table-3 of IS802 (P1/S1)-2015)				
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s	(As Per Cl. 8.3 of IS802 (P1/S1)-2015)				
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm	(As Per Cl. 8.4 of IS802 (P1/S1)-2015)				
* CONDUCTOR DETAILS										
a)	Description		=	ACSR MOOSE						
b)	Dia. of conductor		=	31.77	mm	(As per Electrical Input)				
c)	Weight of conductor		=	2.004	Kg/m	(As per Electrical Input)				
d)	Tension per phase		=	4000	Kg/phase	(Normal Condition)				
			=	0	Kg/phase	(Short-Circuit Condition)				
f)	No. of Sub conductor per phase		=	4		(As per Electrical Input)				
g)	No. of tension insulator / phase		=	2		(As per Electrical Input)				
h)	No. of suspension insulator / phase		=	1		(As per Electrical Input)				
i)	Length of wire on left side, L1 =		=	51.2	m	(As per T.S. 2.26, Cl 7.9,)	/(As Per site conditions)			
j)	Length of wire on right side, L2 =		=	100	m					
k)	Conductor span		=	105.60	m					
	Left side Span (50%)	= (	100.00	)	x	0.50	=	50.00	m	
	Right side Span (50%)	= (	51.20	)	x	0.50	=	25.60	m	
	Add 10 m for Jumpers/ droppers						=	30.00	m	
l)	Angle of Deviation									
	In plan	=	30	deg.						
	In Elevation	=	30	deg.						

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES				
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)				
* INSULATOR DETAILS					
a)	Weight of tension insulator string with hardware	=	65.40	Kg (As per Electrical Input)	
b)	Length of tension insulator	=	4.98	m (As per Electrical Input)	
c)	Diameter of tension insulator	=	135.00	mm (As per Electrical Input)	
* GIRDER DETAILS					
a)	C/C of girder	=	27.00	m	
c)	Hamper width of tower	=	2.20	m	
d)	Clear span of girder	=	24.80	m	
e)	Width of girder	=	2.20	m	
f)	Depth of girder	=	2.20	m	
g)	Height of Girder from Plinth Level	=	19.90	m	
		Vertical	Longitudial	Transverse	
Load Due to Normal Tension Due to Deviations in kg		-2000.00	3000.00	1733.00	
Load Due to Short Circuit Tension Due to Deviations in kg		0.00	0.00	0.00	
# GEOMETRY FOR GIRDER :-					
Part		Section		No. of pieces	Length in m
Main Leg					
Chord Central	MC	L	130x130x12	4	14.000
Chord Left	MA	L	100x100x10	4	5.400
Chord Right	MA	L	100x100x10	4	5.400
Plan					
Horizontal Belt	SV	L	60x60x5	12	2.200
Lattice Left	SA	L	60x60x5	20	2.431
Lattice Central	SB	L	50x50x5	40	2.560
Lattice Right	SA	L	60x60x5	20	2.431
Elevation					
Vertical Belt	SV	L	60x60x5	12	2.200
Lattice Left	UA	L	60x60x5	20	2.431
Lattice Central	UC	L	50x50x5	40	2.560
Lattice Right	UA	L	60x60x5	20	2.431
Connector Vertical	YD	L	60x60x5	6	2.200
Connector Horizontal	YC	L	60x60x5	6	2.200
Diamong Bracing	YH	L	60x60x5	24	1.556

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES																																																																																						
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)																																																																																						
# LOAD CALCULATIONS :-																																																																																							
* VERTICAL LOADS :																																																																																							
- Weight of Conductor																																																																																							
a)	Length of conductor	=	50.00	+	25.60	+	30.00																																																																																
		=	105.60	m																																																																																			
b)	Weight of conductor	=	105.60	x	2.004	x	4.00																																																																																
		=	846.49	Kgs		Say	=	847.00	Kgs																																																																														
- Weight of Insulator																																																																																							
a)	Weight of tension insulators string with hardware	=	65.40	Kgs per phase																																																																																			
- Weight of line man with tools																																																																																							
	at middle phase	=	150	Kgs																																																																																			
- Loads due to Conductor Tension																																																																																							
a)	Normal Condition	=	-2000.00	Kgs																																																																																			
b)	Short Circuit Tension	=	0.00	Kgs																																																																																			
* LONGITUDINAL LOADS :																																																																																							
- Wind Load on Girder																																																																																							
a)	Net Surface area	Ae	=	12.07	sqm (Refer the break up below)																																																																																		
b)	Gross Surface Area	Ag	=	54.56	sqm																																																																																		
c)	Solidity Ratio	Ae/Ag	=	0.2212																																																																																			
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)																																																																																		
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)																																																																																		
f)	Wind Load Ws = Pz x Cdt x Gt x Ae	=	2308.71	Kgs	Say	=	2310.00	Kgs																																																																															
<table><tr><th colspan="3">Part</th><th>Section</th><th>No. of pieces</th><th>Length in m</th><th>Solid Area in sqm</th></tr><tr><td colspan="3">Main Leg</td><td></td><td></td><td></td><td></td></tr><tr><td>Chord Central</td><td>MC</td><td>L</td><td>90x90x6</td><td>2</td><td>14.000</td><td>3.64</td></tr><tr><td>Chord Left</td><td>MA</td><td>L</td><td>75x75x5</td><td>2</td><td>5.400</td><td>1.08</td></tr><tr><td>Chord Right</td><td>MA</td><td>L</td><td>75x75x5</td><td>2</td><td>5.400</td><td>1.08</td></tr><tr><td colspan="3">Elevation</td><td></td><td></td><td></td><td></td></tr><tr><td>Vertical Belt</td><td>SV</td><td>L</td><td>60x60x5</td><td>6</td><td>2.200</td><td>0.79</td></tr><tr><td>Lattice Left</td><td>UA</td><td>L</td><td>60x60x5</td><td>10</td><td>2.431</td><td>1.46</td></tr><tr><td>Lattice Central</td><td>UC</td><td>L</td><td>50x50x5</td><td>20</td><td>2.560</td><td>2.56</td></tr><tr><td>Lattice Right</td><td>UA</td><td>L</td><td>60x60x5</td><td>10</td><td>2.431</td><td>1.46</td></tr><tr><td colspan="5">Total Area</td><td>12.07</td><td>sqm</td></tr></table>											Part			Section	No. of pieces	Length in m	Solid Area in sqm	Main Leg							Chord Central	MC	L	90x90x6	2	14.000	3.64	Chord Left	MA	L	75x75x5	2	5.400	1.08	Chord Right	MA	L	75x75x5	2	5.400	1.08	Elevation							Vertical Belt	SV	L	60x60x5	6	2.200	0.79	Lattice Left	UA	L	60x60x5	10	2.431	1.46	Lattice Central	UC	L	50x50x5	20	2.560	2.56	Lattice Right	UA	L	60x60x5	10	2.431	1.46	Total Area					12.07	sqm
Part			Section	No. of pieces	Length in m	Solid Area in sqm																																																																																	
Main Leg																																																																																							
Chord Central	MC	L	90x90x6	2	14.000	3.64																																																																																	
Chord Left	MA	L	75x75x5	2	5.400	1.08																																																																																	
Chord Right	MA	L	75x75x5	2	5.400	1.08																																																																																	
Elevation																																																																																							
Vertical Belt	SV	L	60x60x5	6	2.200	0.79																																																																																	
Lattice Left	UA	L	60x60x5	10	2.431	1.46																																																																																	
Lattice Central	UC	L	50x50x5	20	2.560	2.56																																																																																	
Lattice Right	UA	L	60x60x5	10	2.431	1.46																																																																																	
Total Area					12.07	sqm																																																																																	

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES									
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	2.49	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.17	sqm						
d)	Ratio of Li / di		18.43							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	22.67	Kgs		Say	=	23.00	Kgs	
h)	Wind Load on Tension insulator in Longitudinal Direction	=	23.00	Kg						
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	2.49	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.17	sqm						
d)	Ratio of Li / di		18.43							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	22.67	Kgs		Say	=	23.00	Kgs	
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	23.00	Kg						
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	52.80	m						
c)	Net area Exposed, Lc.dc	=	1.68	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	808.94	Kg		Say	=	809.00	Kgs	
g)	Wind Load on Conductor in Longitudinal Direction	=	809.00	Kg						
-	Loads due to Conductor Tension									
a)	Normal Condition	=	3000.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES					
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)					
*	TRANSVERSE LOADS:					
-	Wind Load on Tension Insulator					
a)	Diameter of insulator, di	=	135.00 mm			
b)	Length of insulator, Li	=	4.31 m			
c)	Net area Exposed, Ai = 50% of Li.di	=	0.29 sqm			
d)	Ratio of Li / di		31.91			
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)		
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)		
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	39.27 Kgs	Say	=	40.00 Kgs
h)	Wind Load on Tension insulator in Transverse Direction		=	40.00 Kg		
-	Wind Load on Suspension Insulator					
a)	Diameter of insulator, di	=	135.00 mm			
b)	Length of insulator, Li	=	4.31 m			
c)	Net area Exposed, Ai = 50% of Li.di	=	0.29 sqm			
d)	Ratio of Li / di		31.91			
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)		
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)		
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	39.27 Kgs	Say	=	40.00 Kgs
h)	Wind Load on Suspension insulator in Transverse Direction		=	40.00 Kg		
-	Wind Load on Conductor					
a)	Diameter of conductor, dc	=	31.77 mm			
b)	Length of conductor, Lc	=	91.45 m			
c)	Net area Exposed, Lc.dc	=	2.91 sqm			
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)		
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)		
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	1401.13 Kg	Say	=	1402.00 Kgs
g)	Wind Load on Conductor in Transverse Direction		=	1402.00 Kg		
-	Loads due to Conductor Tension					
a)	Normal Condition	=	1733.00 Kgs			
b)	Short Circuit Tension	=	0.00 Kgs			

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES											
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)											
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>												
Dead load	Self Wt.		Self Wt.									
	Cond.		T-Insu.									
TOTAL FY / PHASE	=	847.00	+	130.80	=	977.80	Kgs					
FY / NODE	=	423.50	+	65.40	=	488.90	Kgs					
Dead load	Self Wt.		Self Wt.									
	Cond.		T-Insu.									
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs					
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs					
- JOINT LOAD ON NODE NO. : 0.00												
	Lineman											
	With Tool											
TOTAL FY	=	150.00			=	150.00	Kgs					
FY / NODE	=	75.00			=	75.00	Kgs					
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>												
- JOINT LOAD ON NODE NO. : 0.00												
Wind load	Wind on		Wind on					Wind on				
	Cond.		T-Insu.					S-Insu.				
TOTAL FX / PHASE	=	1402.00	+	80.00	=	1482.00	Kgs	40.00				
FX / NODE	=	701.00	+	40.00	=	741.00	Kgs	40.00				
Cond. Tension			Conductor		Cond. Tension	Conductor		Cond. Tension	Conductor			
			Tension			Tension			Tension			
TOTAL FX / PHASE	=		1733.00	Kgs	TOTAL FY / PHASE	=	-2000.00	Kgs	TOTAL FZ / PHASE	=	3000.00	Kgs
FX / NODE	=		1733.00	Kgs	FY / NODE	=	-2000.00	Kgs	FZ / NODE	=	3000.00	Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>												
- JOINT LOAD ON NODE NO. : 0.00												
Wind load	Wind on		Wind on					Wind on				
	Cond.		T-Insu.					T-Insu.				
TOTAL FX / PHASE	=	1402.00	+	80.00	=	1482.00	Kgs	40.00				
FX / NODE	=	701.00	+	40.00	=	741.00	Kgs	40.00				
Cond. Tension			Conductor		Cond. Tension	Conductor		Cond. Tension	Tension			
			Tension			Tension						
TOTAL FX / PHASE	=		0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	0.00	Kgs
FX / NODE	=		0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	0.00	Kgs

Project :-	CONSTRUCTION OF 132/33 KV, 2X50 MVA GIS AT LOCATIONS BURHIGAON AND ASSOCIATED TRANSMISSION LINES										
Title :-	DESIGN FOR132KV GANTRY BEAM (G1)										
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.	Wind on T-Insu.				Wind on S-Insu.					
TOTAL FZ / PHASE	=	809.00	+	46.00	=	855.00 Kgs	23.00				
FZ / NODE	=	404.50	+	23.00	=	427.50 Kgs	23.00				
Cond. Tension	Cond. Tension		Cond. Tension		Conductor Tension	Cond. Tension		Conductor Tension			
TOTAL FX / PHASE	=	1733.00	=	1733.00 Kgs	TOTAL FY / PHASE	=	-2000.00 Kgs	TOTAL FZ / PHASE	=	3000.00 Kgs	
FX / NODE	=	866.50	=	1733.00 Kgs	FY / NODE	=	-2000.00 Kgs	FZ / NODE	=	3000.00 Kgs	
- WIND LOAD ON JOINT : 0.00											
	Wind load on Str.										
TOTAL FZ	=	2310.00			=	2310.00 Kgs					
FZ / NODE	=	2310.00	/	50	=	46.20 Kgs					
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.	Wind on T-Insu.				Wind on S-Insu.					
TOTAL FZ / PHASE	=	809.00	+	46.00	=	855.00 Kgs	23.00				
FZ / NODE	=	404.50	+	23.00	=	427.50 Kgs	23.00				
Cond. Tension	Cond Tension		Cond. Tension		Conductor Tension	Cond. Tension		Conductor Tension			
TOTAL FX / PHASE	=	0.00	=	1733.00 Kgs	TOTAL FY / PHASE	=	0.00 Kgs	TOTAL FZ / PHASE	=	0.00 Kgs	
FX / NODE	=	0.00	=	1733.00 Kgs	FY / NODE	=	0.00 Kgs	FZ / NODE	=	0.00 Kgs	
- WIND LOAD ON JOINT :											
	Wind load on Str.										
TOTAL FZ	=	2310.00			=	2310.00 Kgs					
FZ / NODE	=	2310.00	/	50	=	46.20 Kgs					

* DESIGN OF BRACINGS FOR BEAM MKD. "G1"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802 (part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - SA & UA

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, L2	=	2431.00				mm
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1215.50	/	17.50	=	69.46 < 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2431.00	/	27.70	=	87.76 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	10.5000 sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts						
	$v =$	4.1700	+	5.2200	x	0.7056	= 7.8531 sqcm.
f)	Minimum guaranteed yield Stress of Material				F_y	=	250 Mpa
g)	Permissible Tensile Stress					=	2549.20 Kg/sqcm.
h)	Permissible Tensile Load					=	2549.20 x 7.8531
						=	20019.2 Kgs
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio					=	87.76
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$					=	13.28
	Actual b/t ratio					=	15.00 > 13.28
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)					=	2325.91 Kg/sqcm.
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$					=	125.66
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$					=	1758.68 Kg/sqcm.
j)	Permissible Compressive Load					=	1758.68 x 10.5000
						=	18466.2 Kgs
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=		=	3161 Kg/sqcm.
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=		=	6322 Kg/sqcm.
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$					=	6355.58 Kgs
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$				$t =$	=	6069.13 Kgs
	No. of 16mm bolts required,					=	18466.19 / 6069.13
						=	3.04 nos. Say
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing					=	11382.659 kg
	Maximum Tension in Bracing					=	11229.269 kg
m)	In Compression	=	18466.2	/	11382.66	=	1.62 > 1.0 safe
	In Tension	=	20019.2	/	11229.27	=	1.78 > 1.0 safe

4.00 no.

B DESIGN OF BRACINGS - SB & UB

- a) Angle Section tried & adopted = 65 x 65 x 5
- b) Length of Angle, L2 = 2560.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1280.00 / 12.60 = 101.59 < 200 hence o.k.
 Slenderness $L2 / r_{xx}$ = 2560.00 / 19.90 = 128.64 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 6.2500 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 2.2500 + 3.1250 \times 0.6835 = 4.3861$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 4.3861 = 11181.0 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 128.64
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 13.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [3.1415^2 \times E / \{ (KL/r)^2 \}] = 1216.24$ Kg/sqcm.
- j) Permissible Compressive Load = 1216.24 x 6.2500 = 7601.5 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
 No. of 16mm bolts required, = 7601.51 / 5057.61 = 1.50 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 5628.085 kg
 Maximum Tension in Bracing = 5790.790 kg
- m) In Compression = 7601.5 / 5628.09 = **1.35 > 1.0 safe**
 In Tension = 11181.0 / 5790.79 = **1.93 > 1.0 safe**

C DESIGN OF BRACINGS - DA, DB

- a) Angle Section tried & adopted = 90 x 90 x 6
- b) Length of Angle, L2 = 2125.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1062.50 / 17.50 = 60.71 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 2125.00 / 27.70 = 76.71 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 10.5000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 4.1700 + 5.2200 \times 0.7056 = 7.8531$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 7.8531 = 20019.2 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 76.71
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1892.49$ Kg/sqcm.
- j) Permissible Compressive Load = 1892.49 x 10.5000 = 19871.2 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 6$ mm = 6069.13 Kgs
No. of 16mm bolts required, = 19871.19 / 6069.13 = 3.27 nos. Say **4.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 3444.662 kg
Maximum Tension in Bracing = 5174.634 kg
- m) In Compression = 19871.2 / 3444.66 = **5.77 > 1.0 safe**
In Tension = 20019.2 / 5174.63 = **3.87 > 1.0 safe**

D DESIGN OF BRACINGS - YH, YC, YD, SV

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L2 = 2200.00 mm
- c) Slenderness $0.5 \times L2/r_{vv}$ = 1100.00 / 19.40 = 56.70 < 200 hence o.k.
 Slenderness $L2/r_{xx}$ = 2200.00 / 30.50 = 72.13 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2.k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 72.13
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 10.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2129.25$ Kg/sqcm.
 j) Permissible Compressive Load = 2129.25 x 19.0000 = 40455.7 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
 No. of 16mm bolts required, = $36948.80 / 9930.60 = 3.72$ nos. Say **4.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 20988.827 kg
 Maximum Tension in Bracing = 17463.633 kg
- m) In Compression = 40455.7 / 20988.83 = **1.93 > 1.0 safe**
 In Tension = 36948.8 / 17463.63 = **2.12 > 1.0 safe**

LOAD EVALUATION FOR TOWER-4T1

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)		
<u>* GEOMETRY FOR MAINBUS MKD."4T1"</u>			
TRANSVERSE FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES
LONGITUDINAL FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES

SR. NO.	LEVEL m	SEGMENT m	T. WIDTH m	L. WIDTH m	WIDTH' T m	WIDTH' L m	ANGLE T - FACE	ANGLE L - FACE
PL	28.0000	0.0000	0.1500	0.1500	0.15	0.15	0.000	0.000
PK	26.6000	1.4000	0.6364	0.6364	0.39	0.39	74.311	74.311
PJ	25.1000	1.5000	1.1576	1.1576	0.90	0.90	59.120	59.120
PI	23.6000	1.5000	1.6788	1.6788	1.42	1.42	46.605	46.605
PH	22.1000	1.5000	2.2000	2.2000	1.94	1.94	37.720	37.720
PG	19.9000	2.2000	2.2000	2.2000	2.20	2.20	45.000	45.000
PF	17.6000	2.3000	2.3503	2.3503	2.28	2.28	45.312	45.312
PE	15.3000	2.3000	2.5005	2.5005	2.43	2.43	43.480	43.480
PD	13.0000	2.3000	2.6508	2.6508	2.58	2.58	41.764	41.764
PC	10.0000	3.0000	2.8467	2.8467	2.75	2.75	47.503	47.503
PB	7.0000	3.0000	3.0427	3.0427	2.94	2.94	45.533	45.533
PA	3.5000	3.5000	3.2714	3.2714	3.16	3.16	47.949	47.949
	0.0000	3.5000	3.5000	3.5000	3.39	3.39	45.951	45.951

WIDTH' = PLAN WIDTH AT THE GIVEN LEVEL - SEGMENT HEIGHT x TAN θ

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

* SOLIDITY RATIO FOR LONGITUDINAL FACE FOR TOWER MKD."4T1"												
Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	130x130x10	2.200	100x100x10	3.111	-	0.000	100x100x10	2.200	1.485	4.840	0.307	1.700
PG	130x130x10	2.300	100x100x10	3.235	-	0.000	100x100x10	2.200	1.538	5.233	0.294	1.706
PF	130x130x10	2.300	100x100x10	3.343	-	0.000	-	0.000	1.330	5.578	0.238	1.762
PE	130x130x10	2.300	100x100x10	3.453	-	0.000	-	0.000	1.353	5.924	0.228	1.772
PD	130x130x12	3.000	75X75X5	4.069	45x45x5	3.534	-	0.000	1.794	8.246	0.218	1.782
PC	130x130x12	3.000	75X75X5	4.204	45x45x5	3.602	-	0.000	1.821	8.834	0.206	1.794
PB	150x150x16	3.500	75X75X5	4.713	45x45x5	4.107	-	0.000	2.233	11.050	0.202	1.798
PA	150x150x16	3.500	75X75X5	4.870	45x45x5	4.185	-	0.000	2.265	11.850	0.191	1.809

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.150 \times 3.5 \times 2 + 0.075 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.265
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.265 / 11.849$	=	0.191
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.13 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.330
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.329 / 5.578$	=	0.238

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

*** WIND LOAD ON LONGITUDINAL FACE FOR TOWER MKD."4T1"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliability level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/ (As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd^2
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T1" - TABLE 1								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.36	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.36	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.36	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.36	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.36	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.36	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.36	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.36	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.36	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.36	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.36	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.36	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T1" - TABLE 2								
A Segment No. from Top	B Segment Top Levels (metres)	C Design Speed Vz (metres/sec)	D Design Pressure Pz (kg/metre2)	E Gross Area of Parts Ag (metres ²)	F Solidity Ratio (Actual)	G Force co-efficient Cdt	H Gust Coefficient Gt	I Wind Load Pz x Cdt x Gt x Ae (kg)
PL	28.0000	30.6327	57.4098	0.5505	0.6779	1.6000	1.9600	67.1878
PK	26.6000	30.6327	57.4098	1.3456	0.3120	1.7000	1.9600	80.2967
PJ	25.1000	30.6327	57.4098	2.1273	0.2129	1.7871	1.9600	91.0921
PI	23.6000	30.6327	57.4098	2.9091	0.1697	1.8303	1.9600	101.6756
PH	22.1000	30.6327	57.4098	4.8400	0.3068	1.7000	1.9600	284.0587
PG	19.9000	30.6327	57.4098	5.2328	0.2940	1.7060	1.9600	295.3011
PF	17.6000	30.6327	57.4098	5.5784	0.2384	1.7616	1.8500	248.8077
PE	15.3000	30.6327	57.4098	5.9239	0.2284	1.7716	1.8500	254.5873
PD	13.0000	30.6327	57.4098	8.2462	0.2175	1.7825	1.8500	339.5977
PC	10.0000	30.6327	57.4098	8.8342	0.2062	1.7938	1.7000	318.8850
PB	7.0000	30.6327	57.4098	11.0496	0.2021	1.7979	1.7000	391.8189
PA	3.5000	30.6327	57.4098	11.8499	0.1911	1.8089	1.7000	399.8478
	0.0000							0.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T1" - TABLE 3								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	284.0587	192.8671	22.1000	4262.3640	97.0000	97.0000
PG	2.3000	19.9000	295.3011	289.6799	19.9000	5764.6299	145.0000	145.0000
PF	2.3000	17.6000	248.8077	272.0544	17.6000	4788.1571	137.0000	137.0000
PE	2.3000	15.3000	254.5873	251.6975	15.3000	3850.9715	126.0000	126.0000
PD	3.0000	13.0000	339.5977	297.0925	13.0000	3862.2024	149.0000	149.0000
PC	3.0000	10.0000	318.8850	329.2413	10.0000	3292.4133	165.0000	165.0000
PB	3.5000	7.0000	391.8189	355.3519	7.0000	2487.4636	178.0000	178.0000
PA	3.5000	3.5000	399.8478	395.8334	3.5000	1385.4168	198.0000	198.0000
	0.0000	0.0000	0.0000	199.9239	0.0000	0.0000	100.0000	100.0000
			2873.1563	2873.1563		37021.3792	1441.0000	1441.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

* SOLIDITY RATIO FOR TRANSVERSE FACE FOR TOWER MKD."4T1"												
Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	130x130x10	2.200	100x100x10	3.111	-	0.000	100x100x10	2.200	1.485	4.840	0.307	1.700
PG	130x130x10	2.300	100x100x10	3.235	-	0.000	100x100x10	2.200	1.538	5.233	0.294	1.706
PF	130x130x10	2.300	100x100x10	3.343	-	0.000	-	0.000	1.330	5.578	0.238	1.762
PE	130x130x10	2.300	100x100x10	3.453	-	0.000	-	0.000	1.353	5.924	0.228	1.772
PD	130x130x12	3.000	75X75X5	4.069	45x45x5	3.534	-	0.000	1.794	8.246	0.218	1.782
PC	130x130x12	3.000	75X75X5	4.204	45x45x5	3.602	-	0.000	1.821	8.834	0.206	1.794
PB	150x150x16	3.500	75X75X5	4.713	45x45x5	4.107	-	0.000	2.233	11.050	0.202	1.798
PA	150x150x16	3.500	75X75X5	4.870	45x45x5	4.185	-	0.000	2.265	11.850	0.191	1.809

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.150 \times 3.5 \times 2 + 0.075 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.265
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.265 / 11.849$	=	0.191
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.13 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.330
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.329 / 5.578$	=	0.238

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

*** WIND LOAD ON TRANSVERSE FACE FOR TOWER MKD."4T1"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliability level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd²
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caclulated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T1" - TABLE 1								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.3636	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.3636	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.3636	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.3636	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.3636	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.3636	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.3636	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.3636	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.3636	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.3636	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.3636	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.3636	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T1" - TABLE 3								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	284.0587	192.8671	22.1000	4262.3640	97.0000	97.0000
PG	2.3000	19.9000	295.3011	289.6799	19.9000	5764.6299	145.0000	145.0000
PF	2.3000	17.6000	248.8077	272.0544	17.6000	4788.1571	137.0000	137.0000
PE	2.3000	15.3000	254.5873	251.6975	15.3000	3850.9715	126.0000	126.0000
PD	3.0000	13.0000	339.5977	297.0925	13.0000	3862.2024	149.0000	149.0000
PC	3.0000	10.0000	318.8850	329.2413	10.0000	3292.4133	165.0000	165.0000
PB	3.5000	7.0000	391.8189	355.3519	7.0000	2487.4636	178.0000	178.0000
PA	3.5000	3.5000	399.8478	395.8334	3.5000	1385.4168	198.0000	198.0000
	0.0000	0.0000	0.0000	199.9239	0.0000	0.0000	100.0000	100.0000
			2873.1563	2873.1563		37021.3792	1441.0000	1441.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

*** EARTH WIRE LOAD EVALUATION FOR TOWER MKD."4T1"**
(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)

*** WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

*** EARTH WIRE LOADING :-**

a)	Length of wire on left side, L1 =	=	100.00	m
b)	Length of wire on right side, L2 =	=	51.20	m
c)	Earthwire Span (L1 + L2)/2	=	75.60	m
d)	Diameter of Earth Wire	=	10.980	mm
e)	Weight of Earth Wire	=	0.600	Kg/m
f)	Total Weight of Earth Wire per Tower	=	45.360	Kg
g)	Earth Wire Tension	=	1000.00	Kg
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table 27 of IS875-1987, part III)
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x 1.20 x 0.8301	
		=	57.19	Kg
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg
	Wind Load on Earth-Wire in Transverse Dirn.	=	60.00	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

k) Angle of Deviation

In Plan = 0.00 °

In Elevation = 0.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	1000.00	0.00

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn. = 60 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Say = 60 **Kg**

Vertical Loads :-

Weight of Earth-wire = 45 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Say = 45 **Kg**

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn. = 0 Kg

Load Due to Normal Tension Due to Deviation = 1000 Kg

Say = 1000 **Kg**

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)					
*	<u>WIND LOAD EVALUATION</u>					
	Design Wind Pressure, Pz	=	57.41	Kg/m ²		
*	<u>EARTH WIRE LOADING :-</u>					
a)	Length of wire on left side, L1 =	=	100.00	m		
b)	Length of wire on right side, L2 =	=	51.20	m		
c)	Earthwire Span (L1 + L2)/2	=	75.60	m		
d)	Diameter of Earth Wire	=	10.980	mm		
e)	Weight of Earth Wire	=	0.600	Kg/m		
f)	Total Weight of Earth Wire per Tower	=	45.360	Kg		
g)	Earth Wire Tension	=	1000.00	Kg		
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table30 of IS875-2015, part III)		
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x	1.20	x	0.8301
		=	57.19	Kg		
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	30.00	Kg		
	Wind Load on Earth-Wire in Transverse Dirn.	=	50.00	Kg		
k)	Angle of Deviation					
	In Plan	=	30.00	°		
	In Elevation	=	0.00	°		
		Vertical	Long.	Transverse		
	Load Due to Normal Tension Due to Deviations in kg	0.00	866.03	500.00		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)				
<u>Transverse Loads :-</u>					
Wind Load on Earth-Wire in Transverse Dirn.		=	50	Kg	
Load Due to Normal Tension Due to Deviation		=	500	Kg	
Say		=	<u>550</u>	Kg	
<u>Vertical Loads :-</u>					
Weight of Earth-wire		=	45	Kg	
Load Due to Normal Tension Due to Deviation		=	0	Kg	
Say		=	<u>45</u>	Kg	
<u>Longitudinal Loads :-</u>					
Wind Load on Earth-Wire in Longitudinal Dirn.		=	30	Kg	
Load Due to Normal Tension Due to Deviation		=	866	Kg	
Say		=	<u>896</u>	Kg	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)					
*	<u>WIND LOAD EVALUATION</u>					
	Design Wind Pressure, Pz	=	57.41	Kg/m ²		
*	<u>EARTH WIRE LOADING :-</u>					
a)	Length of wire on left side, L1 =	=	100.00	m		
b)	Length of wire on right side, L2 =	=	51.20	m		
c)	Earthwire Span (L1 + L2)/2	=	75.60	m		
d)	Diameter of Earth Wire	=	10.980	mm		
e)	Weight of Earth Wire	=	0.600	Kg/m		
f)	Total Weight of Earth Wire per Tower	=	45.360	Kg		
g)	Earth Wire Tension	=	1000.00	Kg		
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table30 of IS875-2015, part III)		
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x	1.20	x	0.8301
		=	57.19	Kg		
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg		
	Wind Load on Earth-Wire in Transverse Dirn.	=	50.00	Kg		
k)	Angle of Deviation					
	In Plan	=	0.00	°		
	In Elevation	=	30.00	°		
				Vertical	Long.	Transverse
	Load Due to Normal Tension Due to Deviations in kg			-500.00	866.03	0.00

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP			
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)			
<u>Transverse Loads :-</u>				
Wind Load on Earth-Wire in Transverse Dirn.	=	50	Kg	
Load Due to Normal Tension Due to Deviation	=	0	Kg	
Say	=	50	Kg	
<u>Vertical Loads :-</u>				
Weight of Earth-wire	=	45	Kg	
Load Due to Normal Tension Due to Deviation	=	-500	Kg	
Say	=	-455	Kg	
<u>Longitudinal Loads :-</u>				
Wind Load on Earth-Wire in Longitudinal Dirn.	=	0	Kg	
Load Due to Normal Tension Due to Deviation	=	866	Kg	
Say	=	866	Kg	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)					
*	<u>WIND LOAD EVALUATION</u>					
	Design Wind Pressure, Pz	=	57.41	Kg/m ²		
*	<u>EARTH WIRE LOADING :-</u>					
a)	Length of wire on left side, L1 =	=	100.00	m		
b)	Length of wire on right side, L2 =	=	51.20	m		
c)	Earthwire Span (L1 + L2)/2	=	75.60	m		
d)	Diameter of Earth Wire	=	10.980	mm		
e)	Weight of Earth Wire	=	0.600	Kg/m		
f)	Total Weight of Earth Wire per Tower	=	45.360	Kg		
g)	Earth Wire Tension	=	1000.00	Kg		
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table30 of IS875-2015, part III)		
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x	1.20	x	0.8301
		=	57.19	Kg		
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	25.00	Kg		
	Wind Load on Earth-Wire in Transverse Dirn.	=	45.00	Kg		
k)	Angle of Deviation					
	In Plan	=	30.00	°		
	In Elevation	=	30.00	°		
			Vertical	Long.	Transverse	
	Load Due to Normal Tension Due to Deviations in kg		-500.00	750.00	433.01	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)				
<u>Transverse Loads :-</u>					
Wind Load on Earth-Wire in Transverse Dirn.		=	45		Kg
Load Due to Normal Tension Due to Deviation		=	433		Kg
	Say	=	<u>478</u>		Kg
<u>Vertical Loads :-</u>					
Weight of Earth-wire		=	45		Kg
Load Due to Normal Tension Due to Deviation		=	-500		Kg
	Say	=	<u>-455</u>		Kg
<u>Longitudinal Loads :-</u>					
Wind Load on Earth-Wire in Longitudinal Dirn.		=	25		Kg
Load Due to Normal Tension Due to Deviation		=	750		Kg
	Say	=	<u>775</u>		Kg

PICTORIAL VIEW OF STAAD MODEL

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 1	Rev
Job Title	Part		Ref
Client	By	Date02-JULY-24	Chd
FileTOWER 4T1 & BEAM G1.STD	Date Time19-Jul-2024 15:47		

Job Information

	Engineer	Checked	Approved
Name:			
Date:	02-JULY-24		
Comments:			
Structure Type:	TRUSS		

Geometry

Entity Type	Count	Highest
Nodes	216	228
Analytical Members	692	949

Load Cases

Load Case Type	Count
Primary	19
Combination	32

Included in this printout are data for:

All	The Whole Structure

Load Case Table

Included in this printout are results for load cases:

L/C	Type	Name
1	Primary	DEAD LOAD + LIVE LOAD
2	Primary	WIND ALONG X DIRECTION(PARALLEL TO BEAM)
3	Primary	WIND ALONG Z DIRECTION (PERPENDICULAR TO BEAM)
4	Primary	NC(0P-0E) +WIND PARALLEL TO BEAM
5	Primary	SC(0P-0E) +WIND PARALLEL TO BEAM
6	Primary	NC(0P-0E) +WIND PERPENDICULAR TO BEAM
7	Primary	SC(0P-0E) +WIND PERPENDICULAR TO BEAM
8	Primary	NC(30P-0E) +WIND PARALLEL TO BEAM
9	Primary	SC(30P-0E) +WIND PARALLEL TO BEAM
10	Primary	NC(30P-0E) +WIND PERPENDICULAR TO BEAM
11	Primary	SC(30P-0E) +WIND PERPENDICULAR TO BEAM

		Job No.	Sheet No. 2	Rev
Software licensed to Anhera Enterprise Connected User: Madhusudan Patel				
Job Title		Part	Ref	
Client		By	Date 02-JULY-24	Chd
File TOWER 4T1 & BEAM G1.STD		Date Time 19-Jul-2024 15:47		

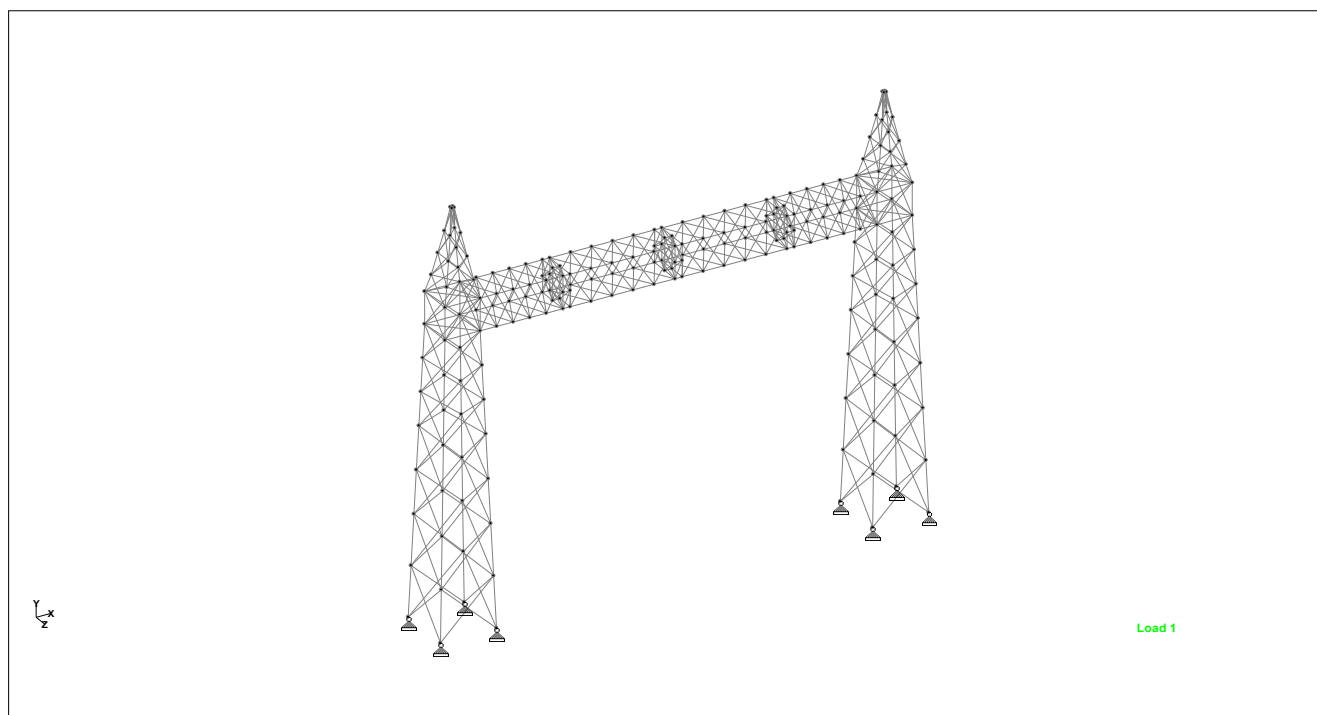
Load Case Table Cont...

L/C	Type	Name
12	Primary	NC(0P-30E) +WIND PARALLEL TO BEAM
13	Primary	SC(0P-30E) +WIND PARALLEL TO BEAM
14	Primary	NC(0P-30E) +WIND PERPENDICULAR TO BEAM
15	Primary	SC(0P-30E) +WIND PERPENDICULAR TO BEAM
16	Primary	NC(30P-30E) +WIND PARALLEL TO BEAM
17	Primary	SC(30P-30E) +WIND PARALLEL TO BEAM
18	Primary	NC(30P-30E) +WIND PERPENDICULAR TO BEAM
19	Primary	SC(30P-30E) +WIND PERPENDICULAR TO BEAM
101	Combination	2(DL + NC + WIND PARALLEL TO BEAM)
201	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
102	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
202	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
103	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
203	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
104	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
204	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
105	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
205	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
106	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
206	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
107	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
207	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
108	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
208	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
301	Combination	DL + NC + WIND PARALLEL TO BEAM
401	Combination	DL +SC + WIND PARALLEL TO BEAM
302	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
402	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
303	Combination	DL +NC + WIND PARALLEL TO BEAM
403	Combination	DL +SC + WIND PARALLEL TO BEAM

Job No.	Sheet No. 3	Rev
Job Title	Part	Ref
Client	By y	Date 02-JULY-24 Chd
File TOWER 4T1 & BEAM G1.STD	Date Time 19-Jul-2024 15:47	

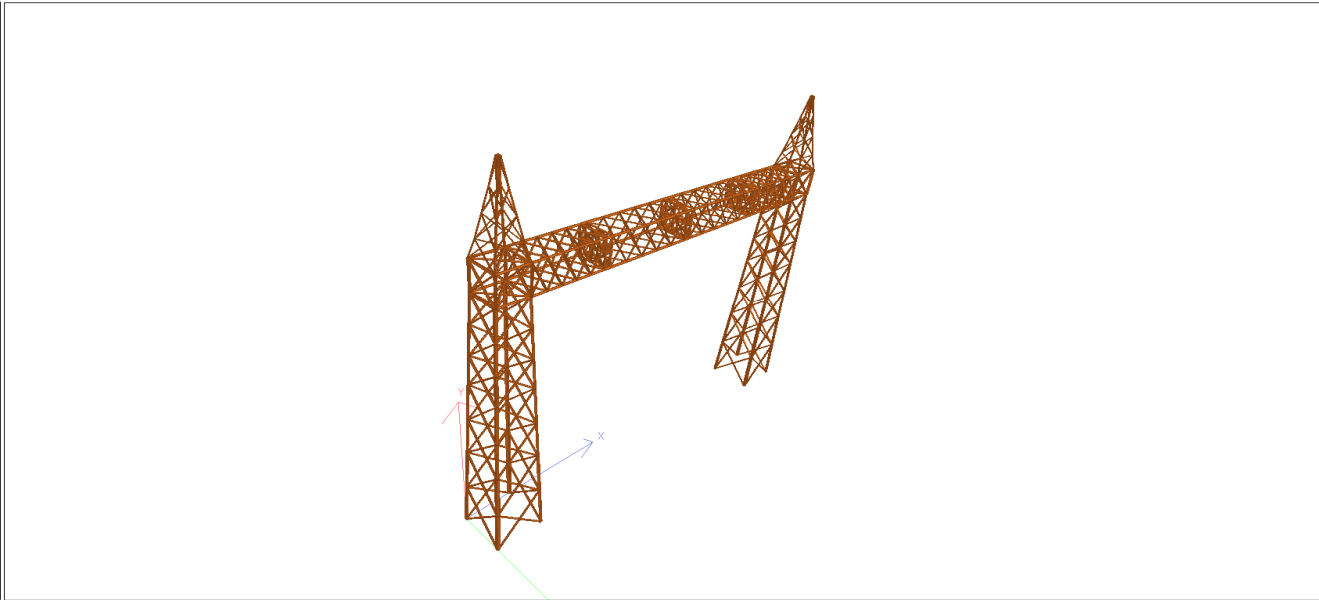
Load Case Table Cont...

L/C	Type	Name
304	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
404	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
305	Combination	DL +NC + WIND PARALLEL TO BEAM
405	Combination	DL +SC + WIND PARALLEL TO BEAM
306	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
406	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
307	Combination	DL +NC + WIND PARALLEL TO BEAM
407	Combination	DL +SC + WIND PARALLEL TO BEAM
308	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
408	Combination	DL +SC + WIND PERPENDICULAR TO BEAM

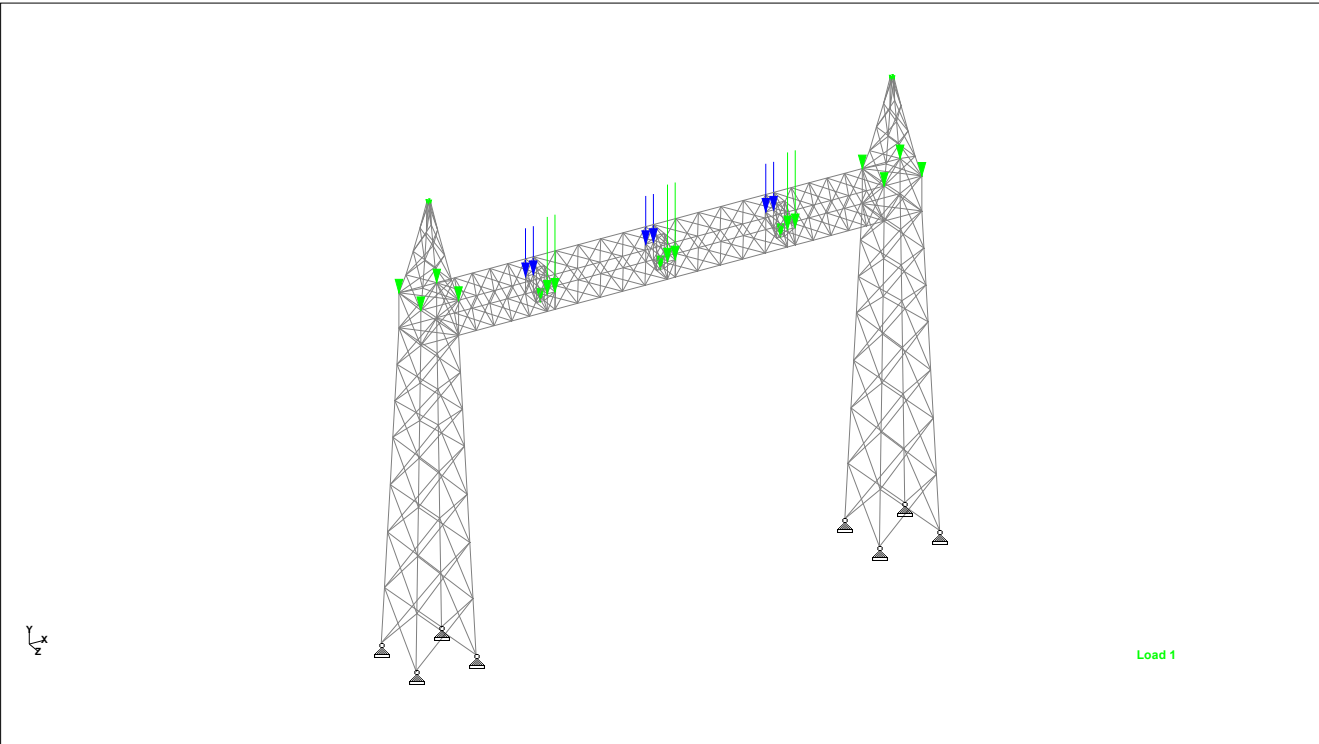


Whole Structure

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		4	
Job Title	Part	Ref	
Client	By	Date	Chd
File	Date Time		
TOWER 4T1 & BEAM G1.STD	19-Jul-2024 15:47		

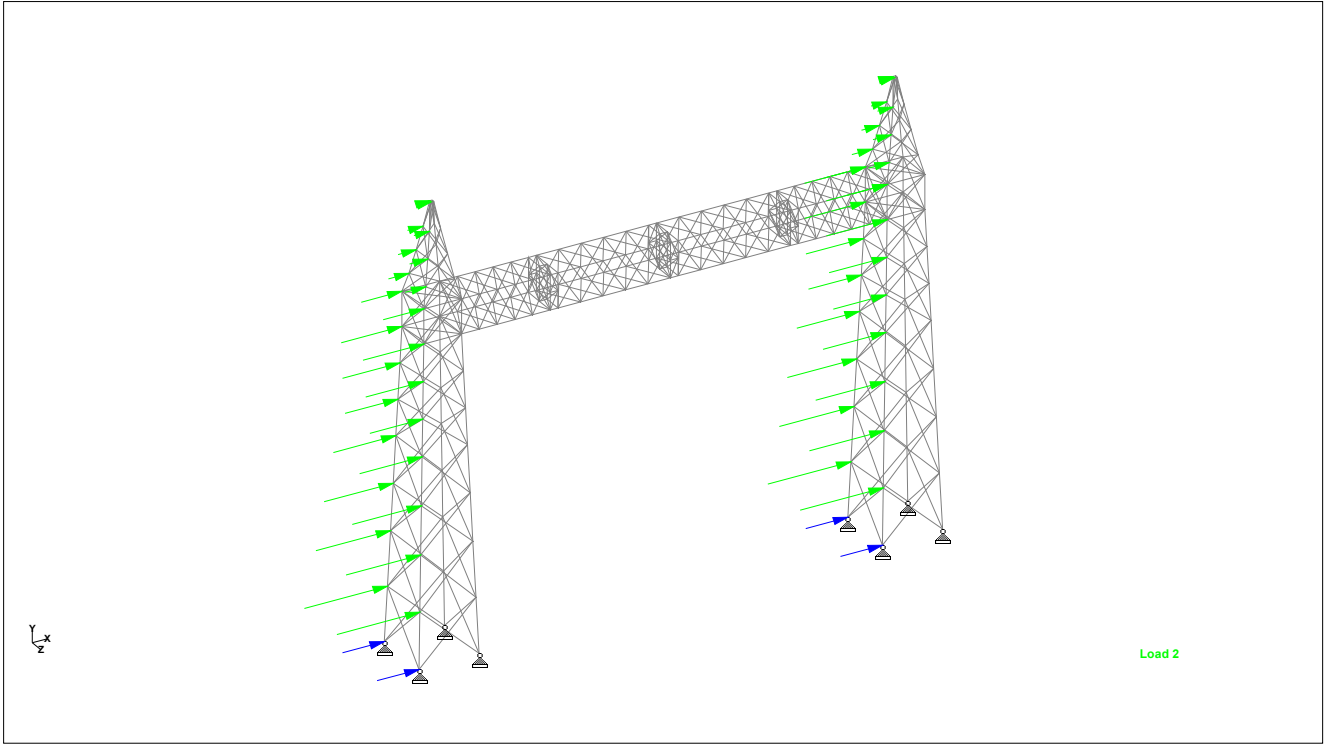


3D Rendered View

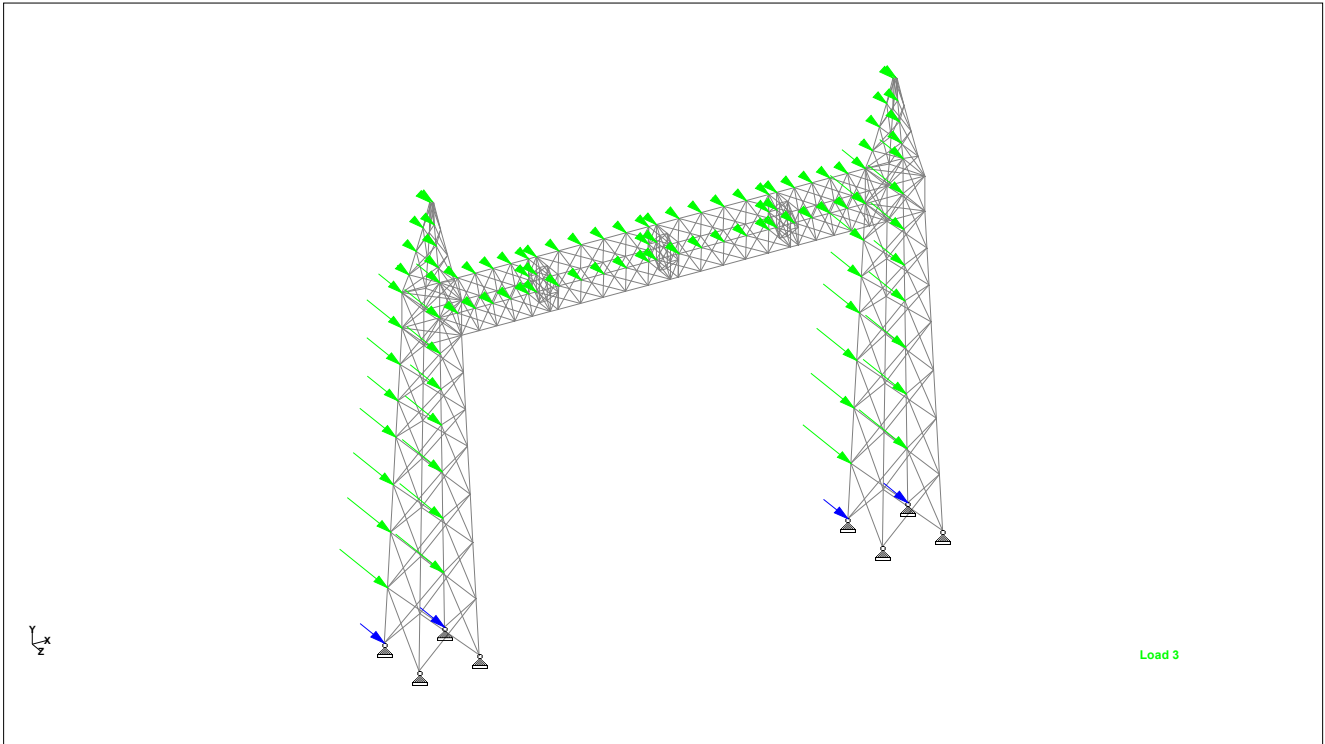


DEAD LOAD + LIVE LOAD

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		5	
Job Title	Part		Ref
Client	By	Date	Chd
File	Date Time		
TOWER 4T1 & BEAM G1.STD	19-Jul-2024 15:47		

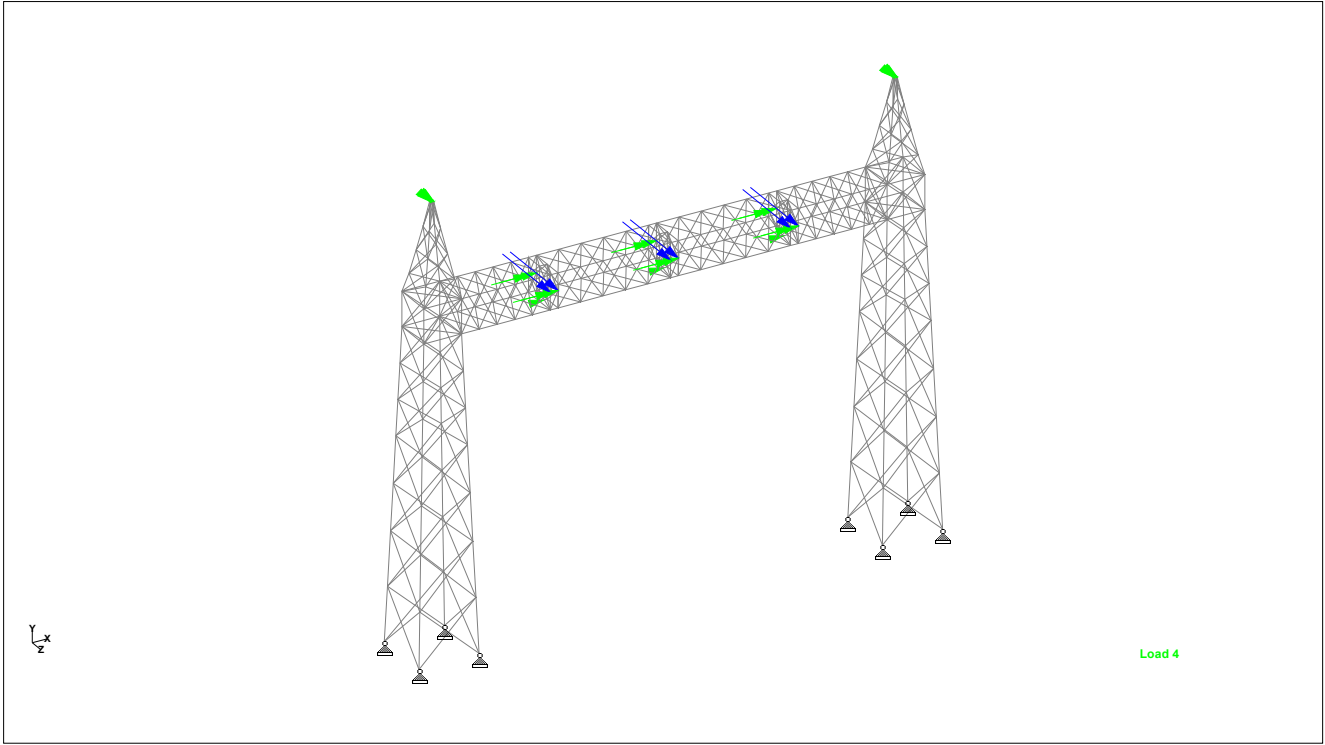


WIND ALONG X DIRECTION(PARALLEL TO BEAM)

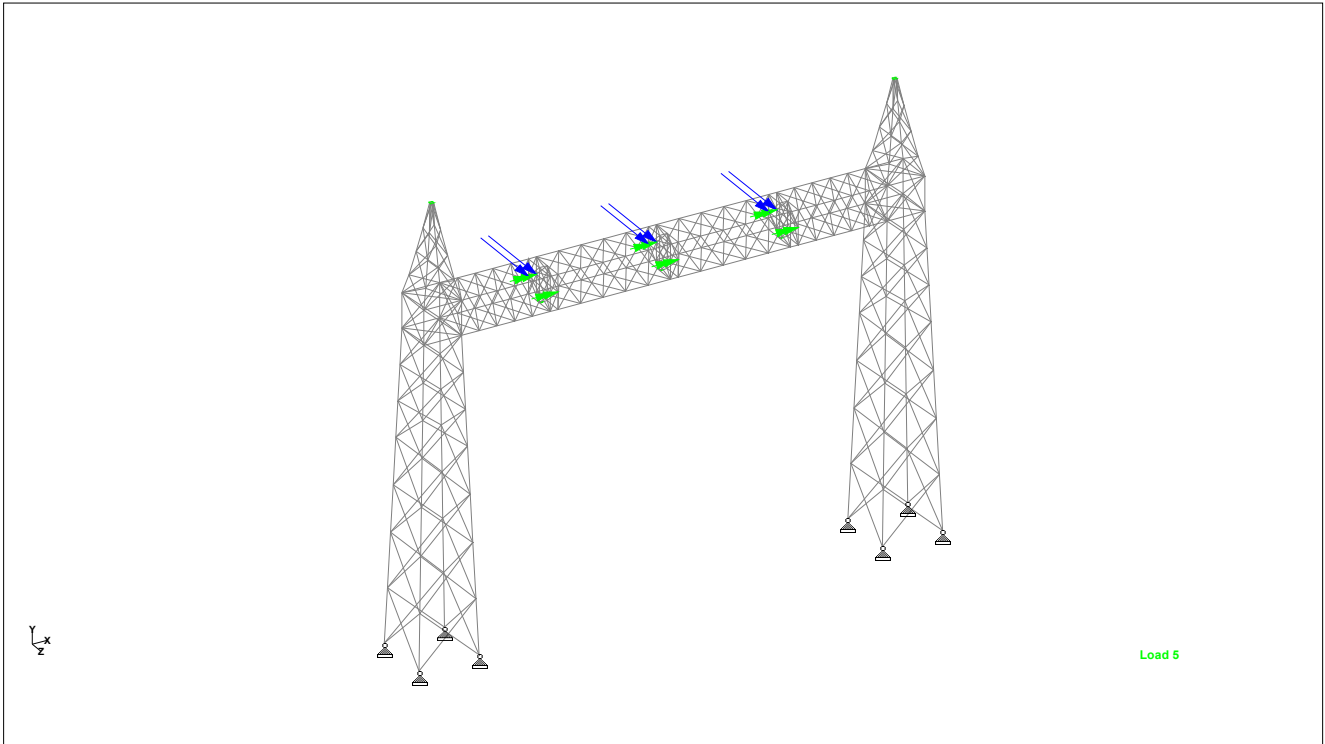


WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 6	Rev
	Part		Ref
Job Title	Client	By y	Date 02-JULY-24 Chd
File TOWER 4T1 & BEAM G1.STD		Date Time 19-Jul-2024 15:47	

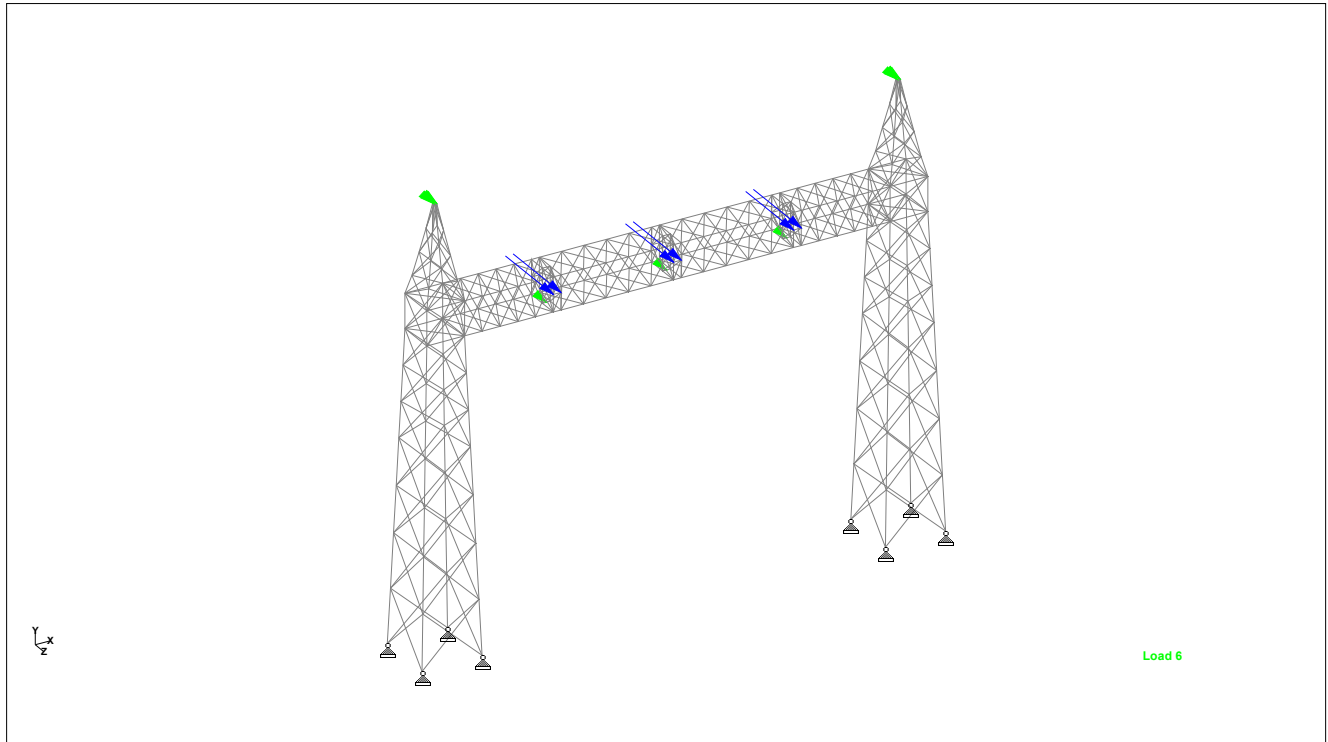


NC(0P-0E) +WIND PARALLEL TO BEAM

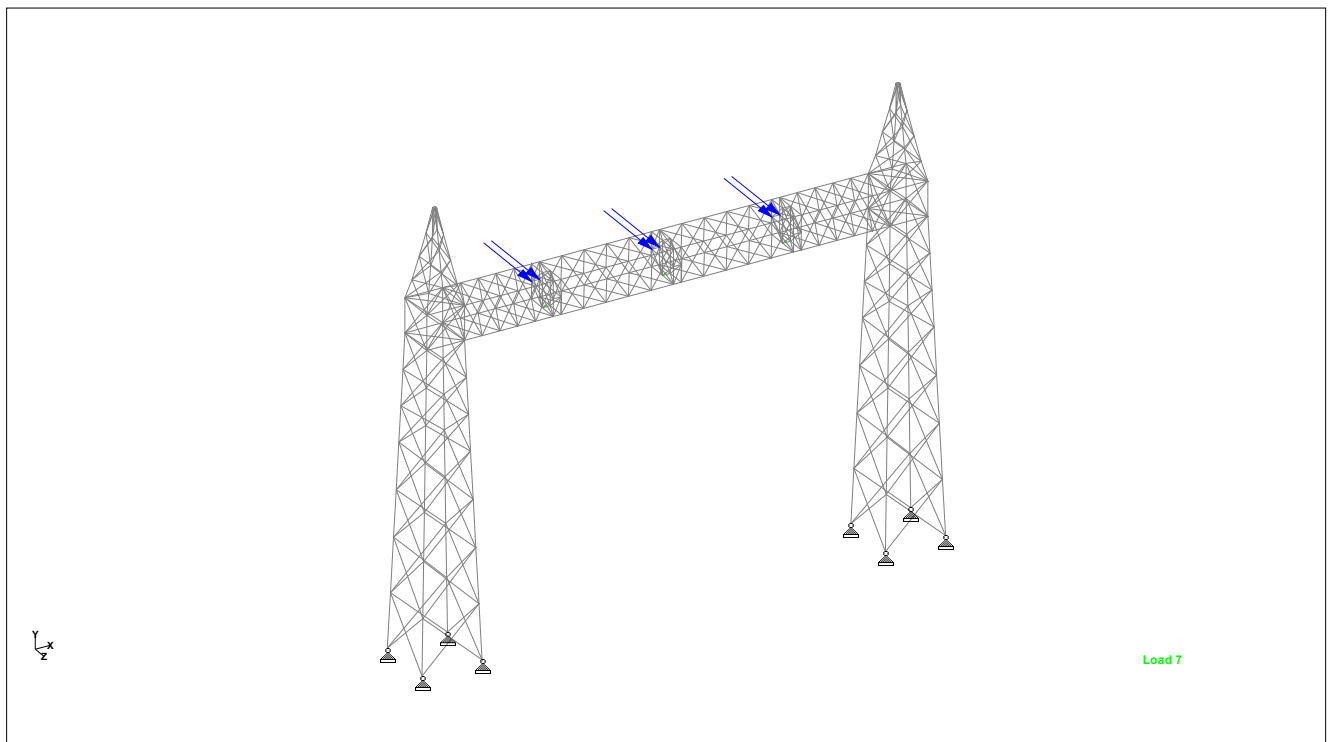


SC(0P-0E) +WIND PARALLEL TO BEAM

Job No.	Sheet No. 7	Rev
Job Title	Part	Ref
Client	By y	Date 02-JULY-24 Chd
File TOWER 4T1 & BEAM G1.STD	Date Time 19-Jul-2024 15:47	

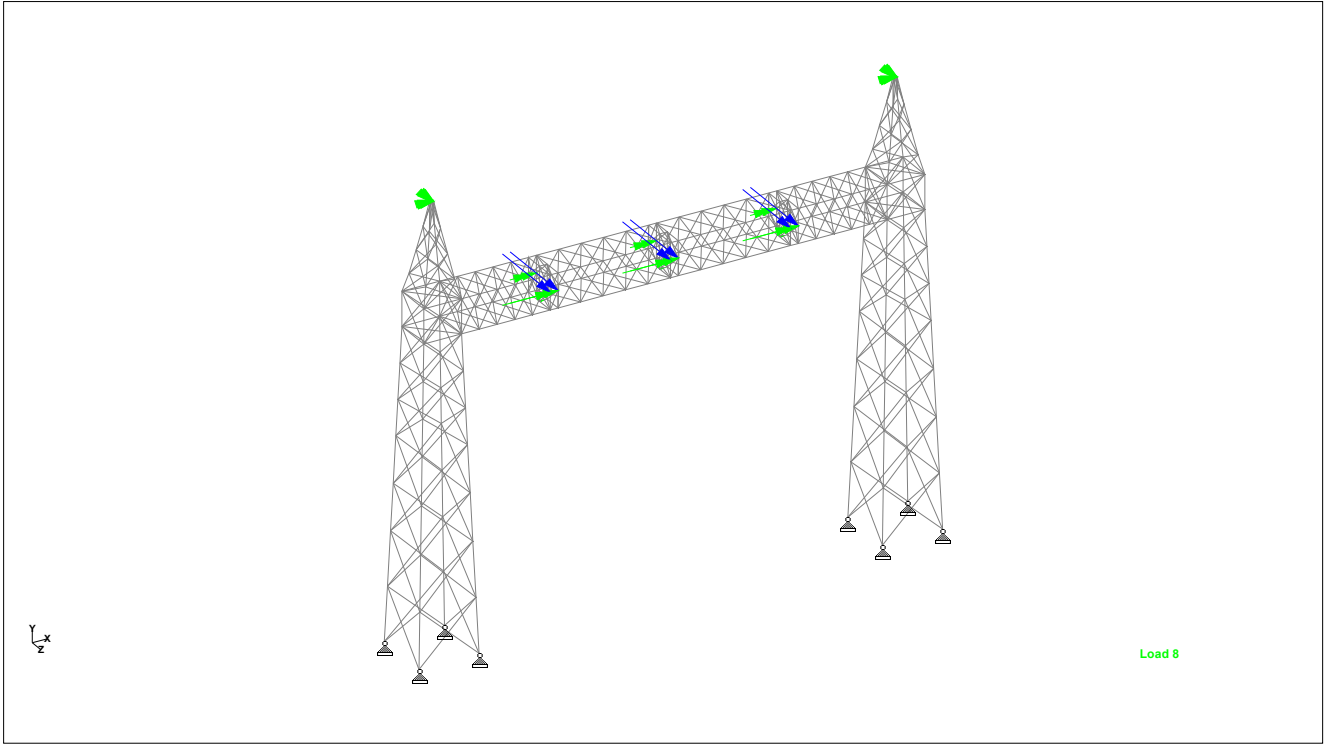


NC(0P-0E) +WIND PERPENDICULAR TO BEAM

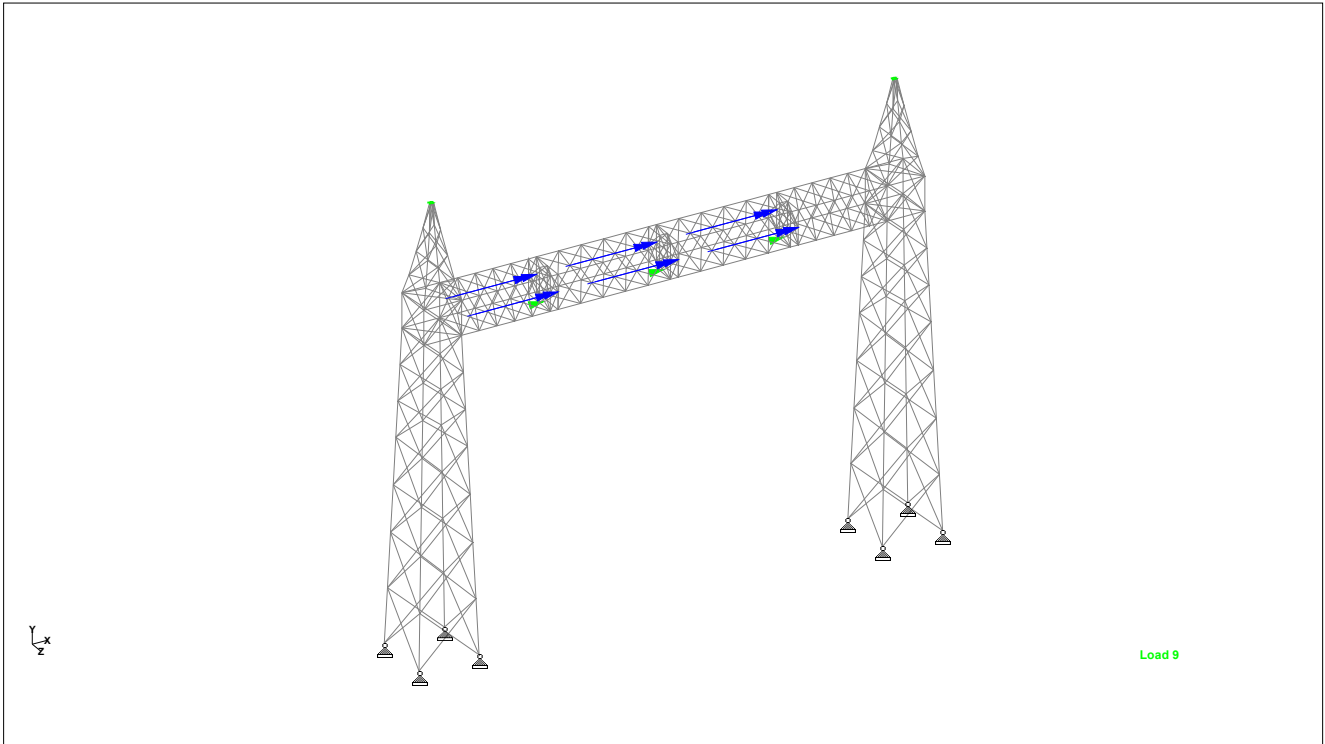


SC(0P-0E) +WIND PERPENDICULAR TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 8	Rev
	Part		Ref
Job Title	By	Date 02-JULY-24	Chd
Client	Date Time 19-Jul-2024 15:47		
File TOWER 4T1 & BEAM G1.STD			

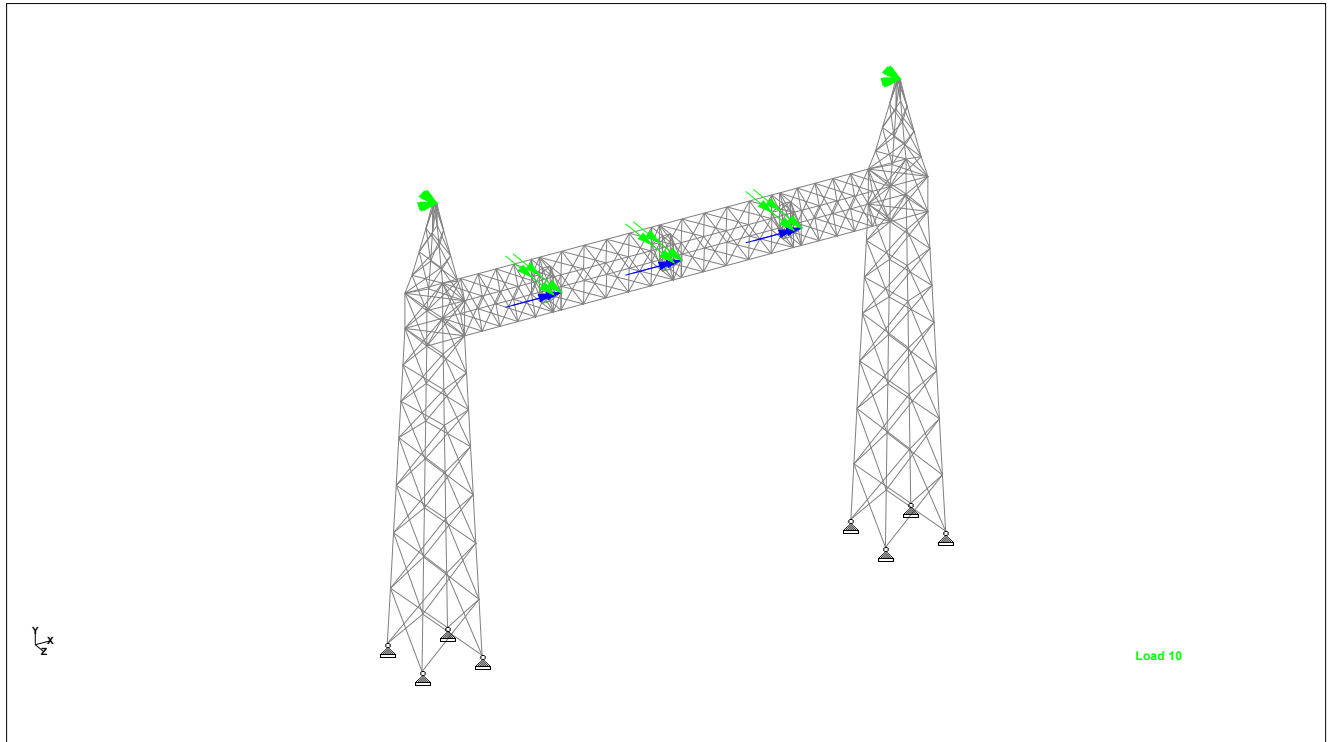


NC(30P-0E) +WIND PARALLEL TO BEAM

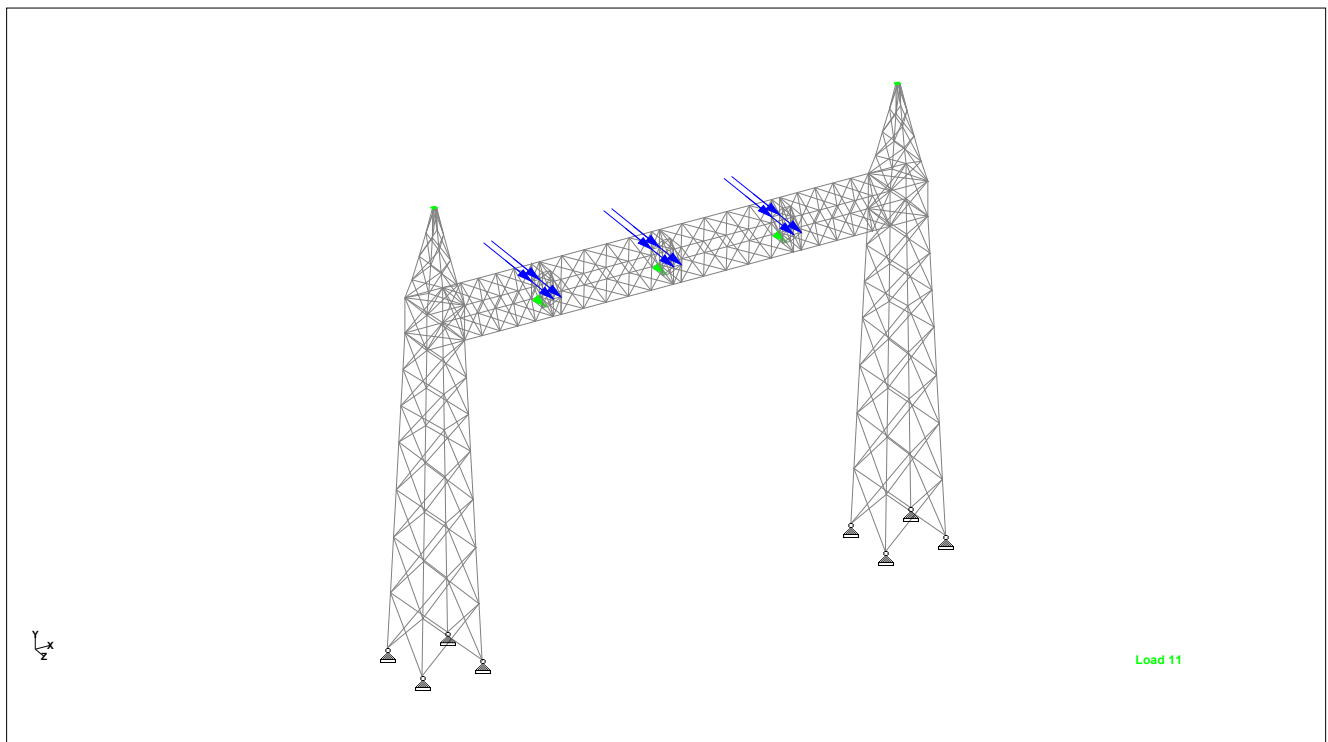


SC(30P-0E) +WIND PARALLEL TO BEAM

Job No.	Sheet No.	Rev
	9	
Job Title	Part	Ref
Client	By	Date
		02-JULY-24
File	Date Time	Chd
TOWER 4T1 & BEAM G1.STD	19-Jul-2024 15:47	

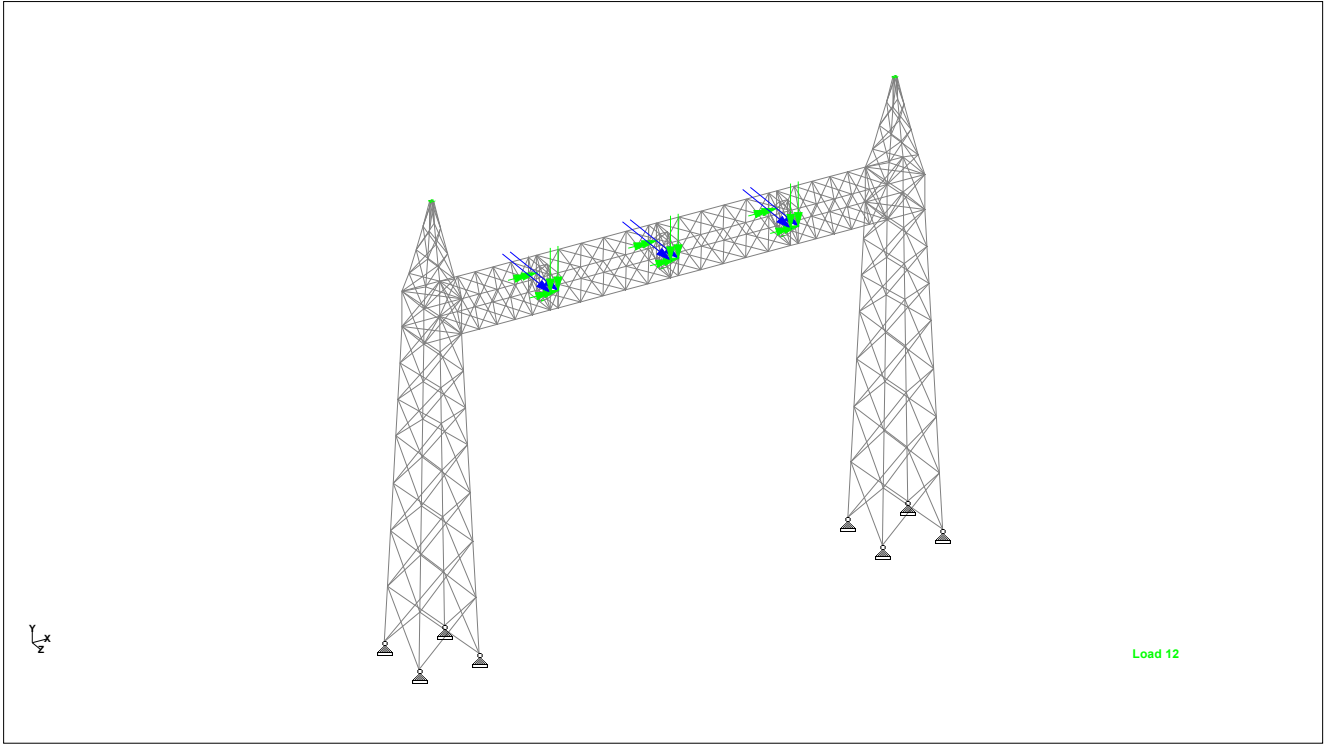


NC(30P-0E) +WIND PERPENDICULAR TO BEAM

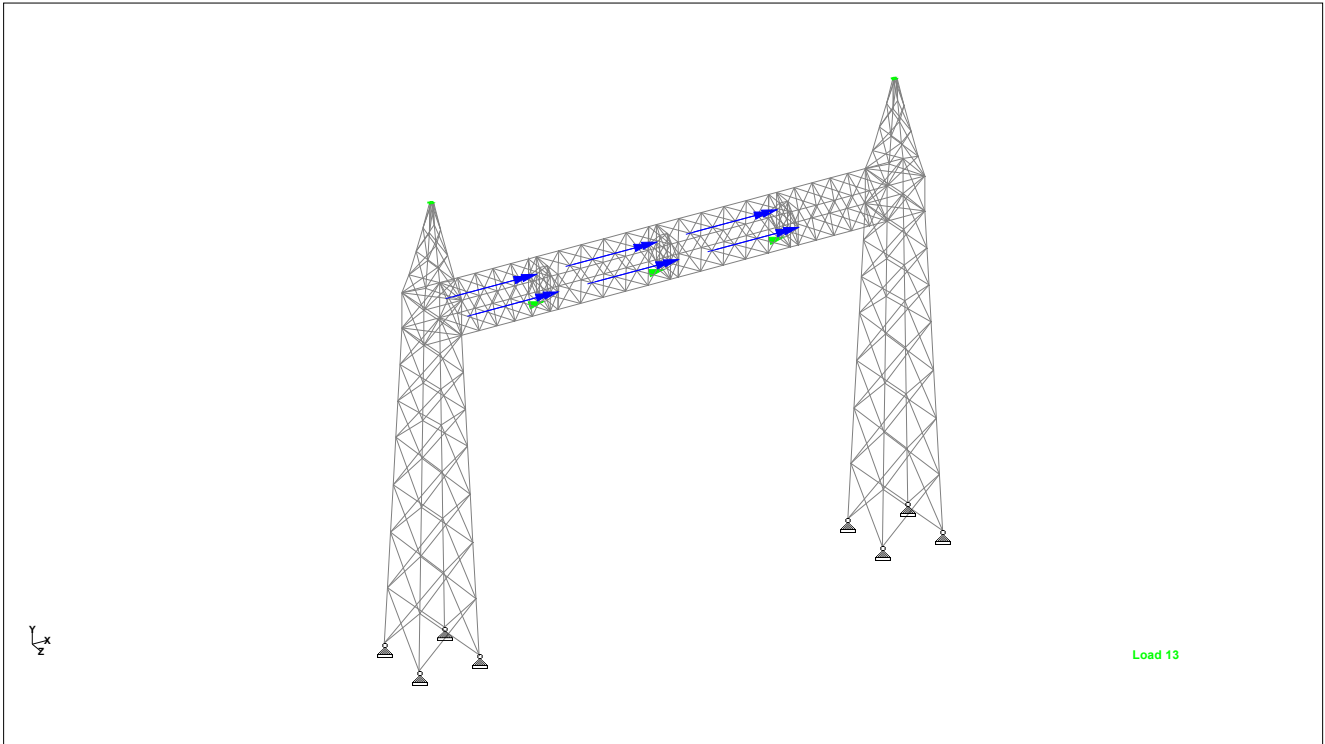


SC(30P-0E) +WIND PERPENDICULAR TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 10	Rev
	Part		Ref
Job Title	Client	By y	Date 02-JULY-24 Chd
File TOWER 4T1 & BEAM G1.STD		Date Time 19-Jul-2024 15:47	

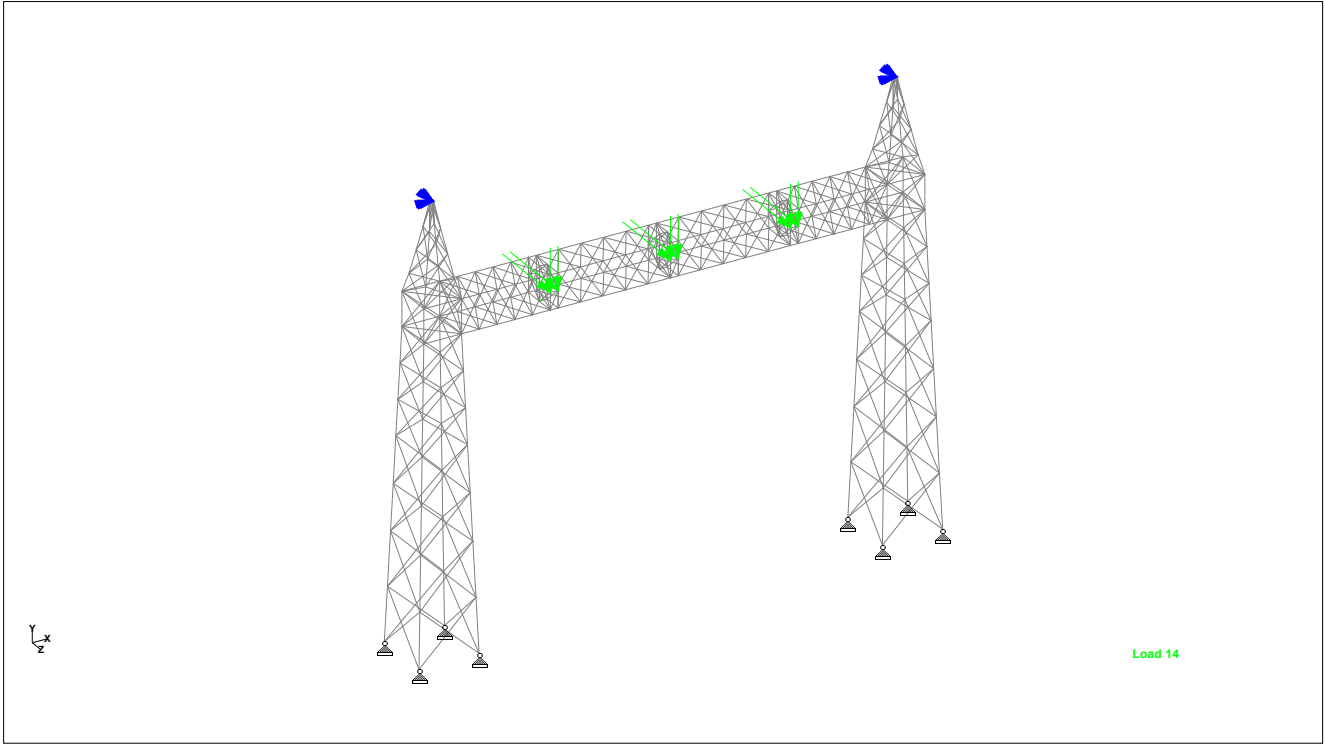


NC(OP-30E) +WIND PARALLEL TO BEAM

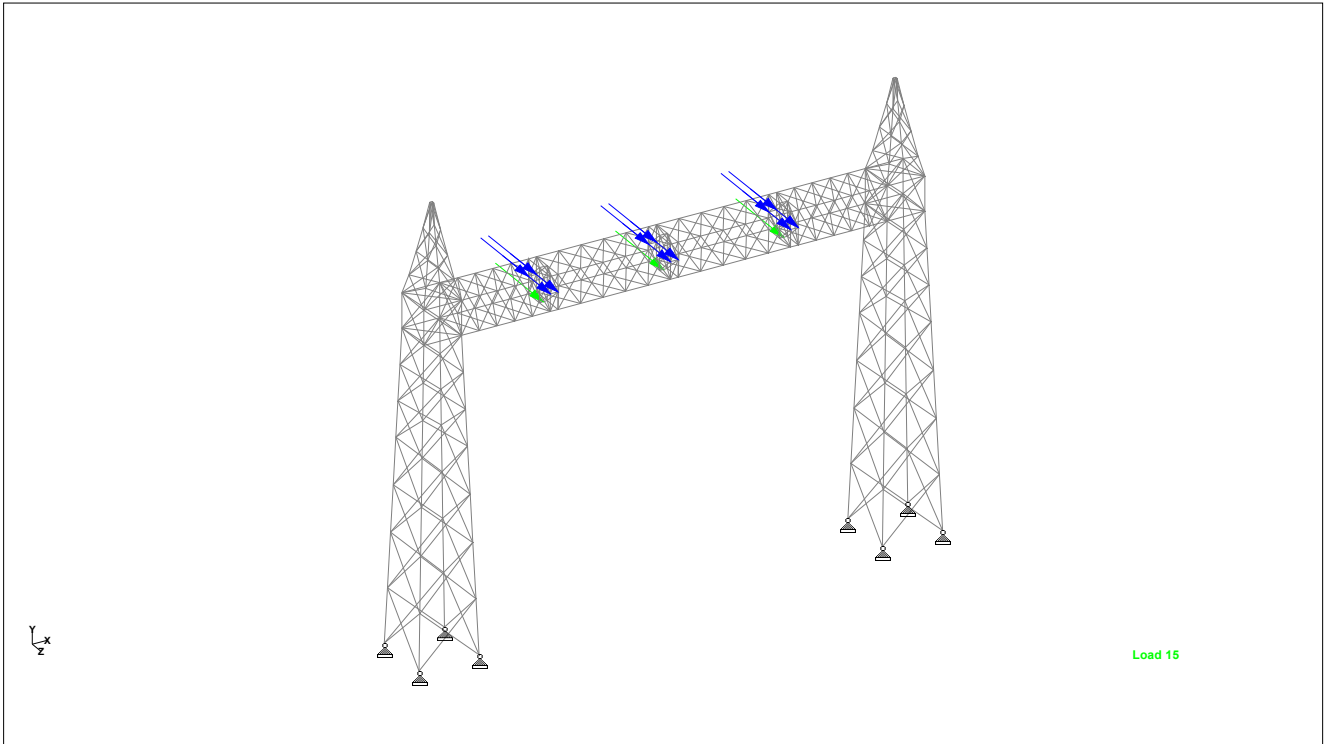


SC(OP-30E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 11	Rev
	Part		Ref
Job Title	Client	By y	Date 02-JULY-24 Chd
File TOWER 4T1 & BEAM G1.STD		Date Time 19-Jul-2024 15:47	

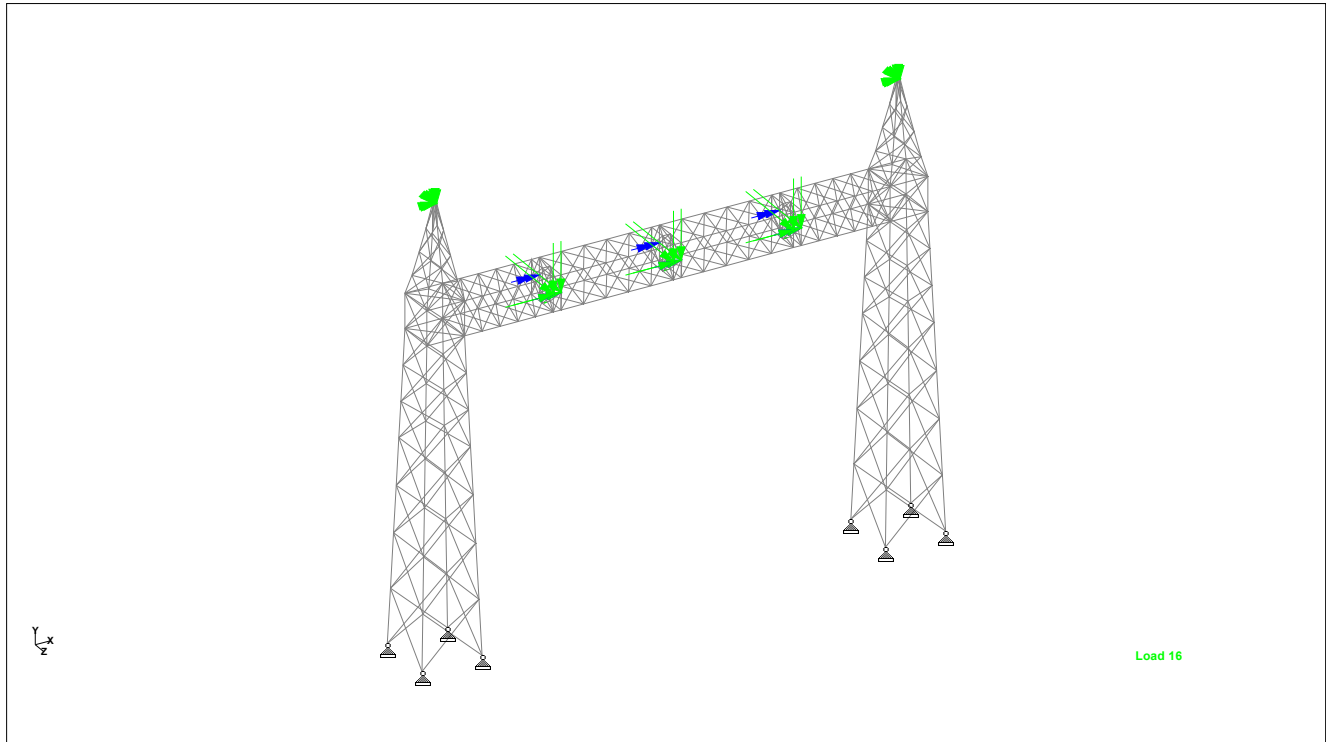


NC(OP-30E) +WIND PERPENDICULAR TO BEAM

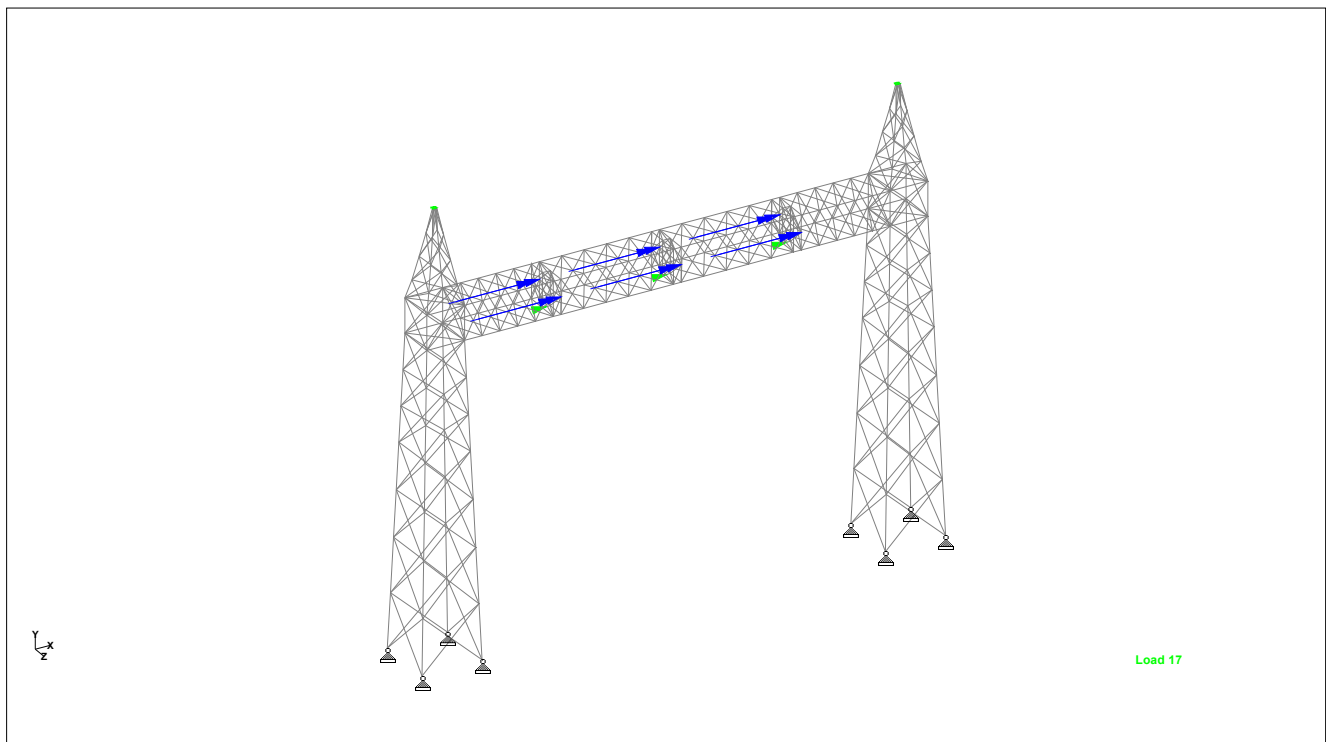


SC(OP-30E) +WIND PERPENDICULAR TO BEAM

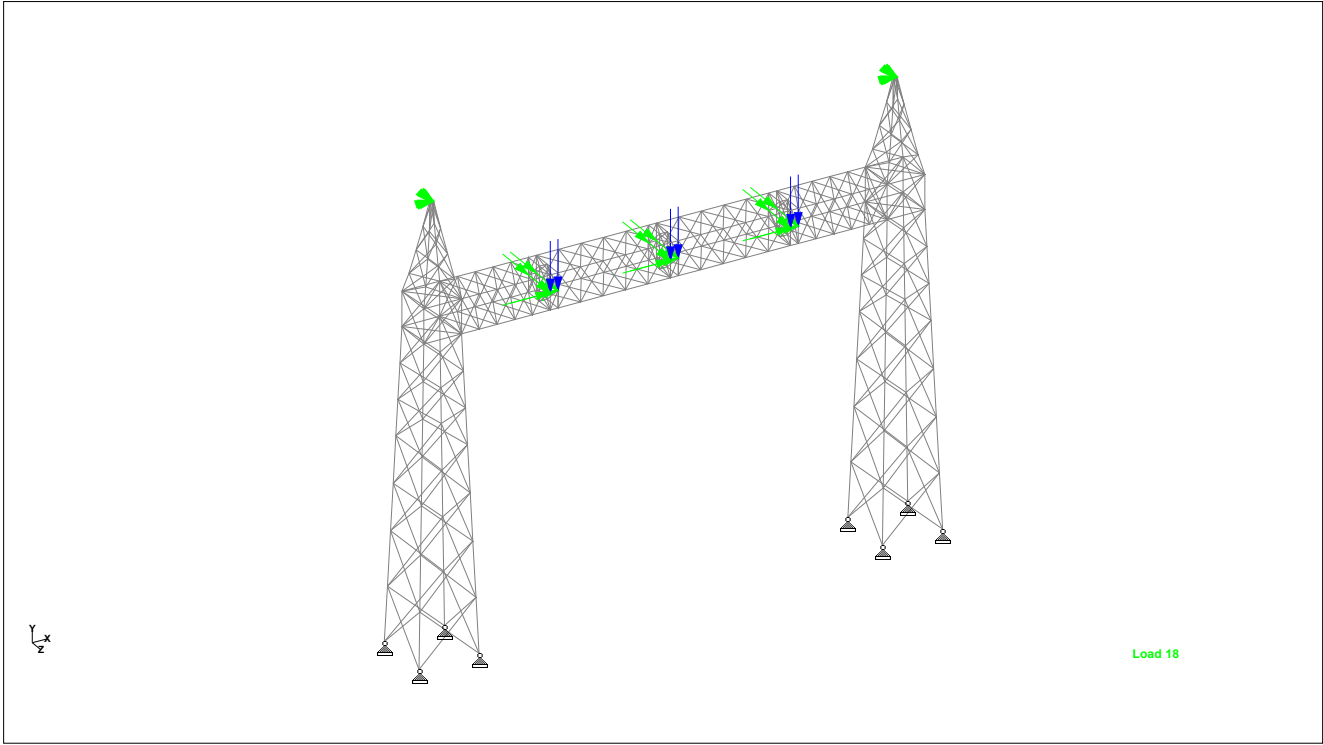
Job No.	Sheet No. 12	Rev
Job Title	Part	Ref
Client	By y	Date 02-JULY-24 24
File TOWER 4T1 & BEAM G1.STD	Date Time 19-Jul-2024 15:47	Chd



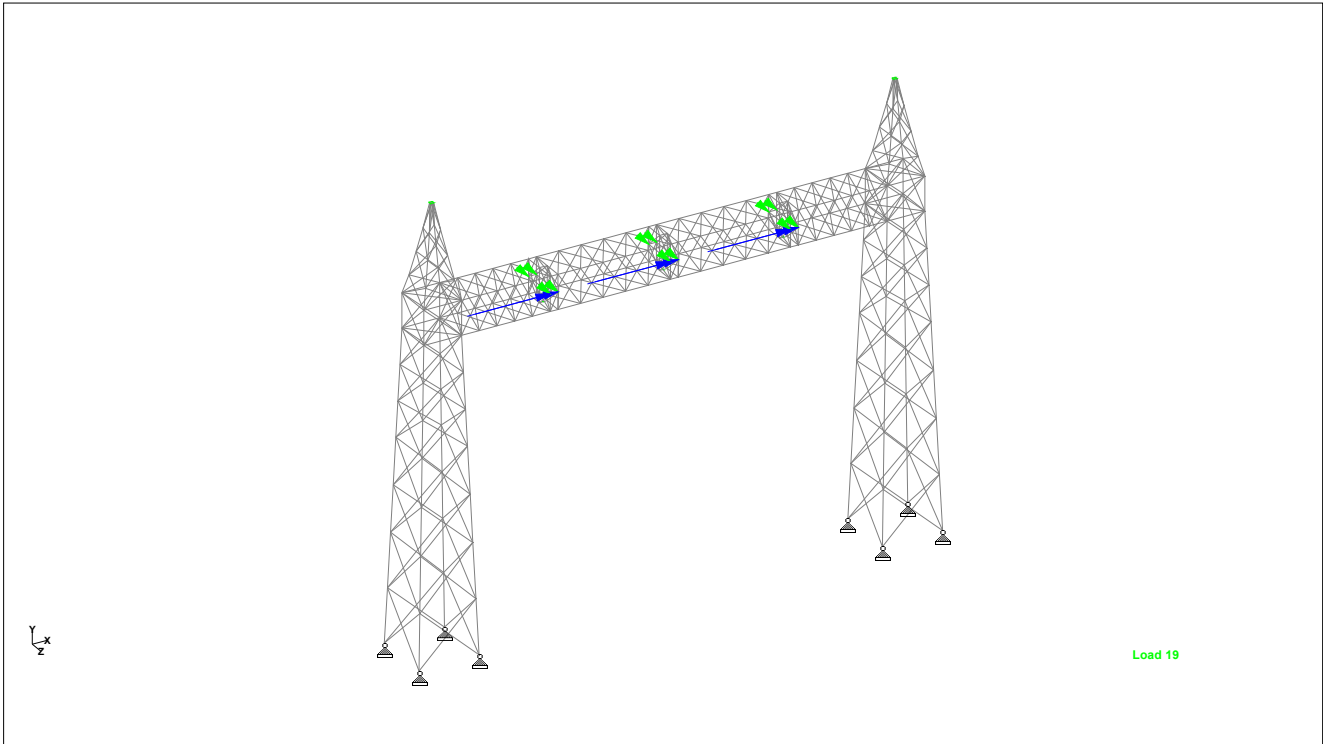
NC(30P-30E) +WIND PARALLEL TO BEAM



SC(30P-30E) +WIND PARALLEL TO BEAM



NC(30P-30E) +WIND PERPENDICULAR TO BEAM



SC(30P-30E) +WIND PERPENDICULAR TO BEAM

STAAD ANALYSIS & DESIGN

PAGE NO. 1

```

*****
*
*          STAAD.Pro 2023
*          Version  23.00.03.25
*          Proprietary Program of
*          Bentley Systems, Inc.
*          Date=    AUG 24, 2024
*          Time=    16:59:30
*
* Licensed to: Anhera Enterprise
*****

```

```

1. STAAD TRUSS
INPUT FILE: Z:\Data\PROJECTS\2024\24P041-MAHAN-GODREJ\DESIGN\400 KV TOW.. .STD
2. START JOB INFORMATION
3. ENGINEER DATE 02-JULY-24
4. END JOB INFORMATION
5. INPUT WIDTH 79
6. UNIT METER KN
7. JOINT COORDINATES
8. 1 0 0 0; 2 3.5 0 0; 3 0 0 3.5; 4 3.5 0 3.5; 5 0.65 19.9 0.65; 6 2.85 19.9 0.65
9. 7 0.65 19.9 2.85; 8 2.85 19.9 2.85; 9 0.65 22.1 0.65; 10 2.85 22.1 0.65
10. 11 2.85 22.1 2.85; 12 0.65 22.1 2.85; 13 1.675 28 1.675; 14 1.825 28 1.675
11. 15 1.825 28 1.825; 16 1.675 28 1.825; 17 0.114 3.5 0.114; 18 0.114 3.5 3.386
12. 19 3.386 3.5 0.114; 20 3.386 3.5 3.386; 21 0.227 7 0.227; 22 0.227 7 3.271
13. 23 3.271 7 0.227; 24 3.271 7 3.271; 25 0.327 10 0.327; 26 0.327 10 3.173
14. 27 3.173 10 0.327; 28 3.173 10 3.173; 29 0.425 13 0.425; 30 0.425 13 3.075
15. 31 3.075 13 0.425; 32 3.075 13 3.075; 33 0.5 15.3 0.5; 34 0.5 15.3 3
16. 35 3 15.3 0.5; 36 3 15.3 3; 37 0.575 17.6 0.575; 38 0.575 17.6 2.925
17. 39 2.925 17.6 0.575; 40 2.925 17.6 2.925; 41 0.911 23.282 0.911
18. 42 0.911 23.282 2.6; 43 2.6 23.282 2.6; 44 2.6 23.282 0.911
19. 45 1.171 24.815 1.171; 46 1.171 24.815 2.34; 47 2.34 24.815 2.34
20. 48 2.34 24.815 1.171; 49 1.432 26.347 1.432; 50 1.432 26.347 2.078
21. 51 2.078 26.347 2.078; 52 2.078 26.347 1.432; 57 3.885 19.9 2.85
22. 58 3.885 22.1 2.85; 59 3.885 22.1 0.65; 60 3.885 19.9 0.65; 61 4.92 19.9 2.85
23. 62 4.92 22.1 2.85; 63 4.92 22.1 0.65; 64 4.92 19.9 0.65; 65 5.955 19.9 2.85
24. 66 5.955 22.1 2.85; 67 5.955 22.1 0.65; 68 5.955 19.9 0.65; 69 6.99 19.9 2.85
25. 70 6.99 22.1 2.85; 71 6.99 22.1 0.65; 72 6.99 19.9 0.65; 77 9.785 19.9 2.85
26. 78 9.785 22.1 2.85; 79 9.785 22.1 0.65; 80 9.785 19.9 0.65
27. 81 11.095 19.9 2.85; 82 11.095 22.1 2.85; 83 11.095 22.1 0.65
28. 84 11.095 19.9 0.65; 85 12.405 19.9 2.85; 86 12.405 22.1 2.85
29. 87 12.405 22.1 0.65; 88 12.405 19.9 0.65; 89 13.715 19.9 2.85
30. 90 13.715 22.1 2.85; 91 13.715 22.1 0.65; 92 13.715 19.9 0.65
31. 93 8.475 19.9 2.85; 94 8.475 22.1 2.85; 95 8.475 22.1 0.65; 96 8.475 19.9 0.65
32. 97 8.025 19.9 2.85; 98 8.025 22.1 2.85; 99 8.025 22.1 0.65
33. 100 8.025 19.9 0.65; 101 15.025 19.9 0.65; 102 15.025 19.9 2.85
34. 103 15.025 22.1 0.65; 104 15.025 22.1 2.85; 109 8.025 22.1 1.75
35. 110 8.475 22.1 1.75; 111 8.025 21 2.85; 112 8.475 21 2.85; 113 8.025 21 0.65
36. 114 8.475 21 0.65; 115 8.025 19.9 1.75; 116 8.475 19.9 1.75
37. 117 27.65 19.9 0.65; 118 27.65 19.9 2.85; 119 27.65 22.1 0.65
38. 120 27.65 22.1 2.85; 121 26.615 19.9 2.85; 122 26.615 22.1 2.85

```

STAAD TRUSS

-- PAGE NO. 2

39. 123 26.615 22.1 0.65; 124 26.615 19.9 0.65; 125 25.58 19.9 2.85
40. 126 25.58 22.1 2.85; 127 25.58 22.1 0.65; 128 25.58 19.9 0.65
41. 129 24.545 19.9 2.85; 130 24.545 22.1 2.85; 131 24.545 22.1 0.65
42. 132 24.545 19.9 0.65; 133 23.51 19.9 2.85; 134 23.51 22.1 2.85
43. 135 23.51 22.1 0.65; 136 23.51 19.9 0.65; 137 20.715 19.9 2.85
44. 138 20.715 22.1 2.85; 139 20.715 22.1 0.65; 140 20.715 19.9 0.65
45. 141 19.405 19.9 2.85; 142 19.405 22.1 2.85; 143 19.405 22.1 0.65
46. 144 19.405 19.9 0.65; 145 18.095 19.9 2.85; 146 18.095 22.1 2.85
47. 147 18.095 22.1 0.65; 148 18.095 19.9 0.65; 149 16.785 19.9 2.85
48. 150 16.785 22.1 2.85; 151 16.785 22.1 0.65; 152 16.785 19.9 0.65
49. 153 22.025 19.9 2.85; 154 22.025 22.1 2.85; 155 22.025 22.1 0.65
50. 156 22.025 19.9 0.65; 157 22.475 19.9 2.85; 158 22.475 22.1 2.85
51. 159 22.475 22.1 0.65; 160 22.475 19.9 0.65; 161 15.475 19.9 0.65
52. 162 15.475 19.9 2.85; 163 15.475 22.1 0.65; 164 15.475 22.1 2.85
53. 165 22.475 22.1 1.75; 166 22.025 22.1 1.75; 167 22.475 21 2.85
54. 168 22.025 21 2.85; 169 22.475 21 0.65; 170 22.025 21 0.65
55. 171 22.475 19.9 1.75; 172 22.025 19.9 1.75; 173 15.025 21 2.85
56. 174 15.025 21 0.65; 175 15.025 22.1 1.75; 176 15.025 19.9 1.75
57. 177 15.475 21 2.85; 178 15.475 21 0.65; 179 15.475 22.1 1.75
58. 180 15.475 19.9 1.75; 181 27 0 0; 182 27.114 3.5 0.114; 183 27 0 3.5
59. 184 27.114 3.5 3.386; 185 30.5 0 0; 186 30.386 3.5 0.114; 187 30.5 0 3.5
60. 188 30.386 3.5 3.386; 189 29.85 19.9 0.65; 190 29.85 19.9 2.85
61. 191 29.85 22.1 0.65; 192 29.85 22.1 2.85; 193 27.911 23.282 0.911
62. 194 27.911 23.282 2.6; 195 29.6 23.282 2.6; 196 29.6 23.282 0.911
63. 197 28.675 28 1.675; 198 28.675 28 1.825; 199 28.825 28 1.825
64. 200 28.825 28 1.675; 201 27.227 7 0.227; 202 27.227 7 3.271
65. 203 30.271 7 0.227; 204 30.271 7 3.271; 205 27.327 10 0.327
66. 206 27.327 10 3.173; 207 30.173 10 0.327; 208 30.173 10 3.173
67. 209 27.425 13 0.425; 210 27.425 13 3.075; 211 30.075 13 0.425
68. 212 30.075 13 3.075; 213 27.5 15.3 0.5; 214 27.5 15.3 3; 215 30 15.3 0.5
69. 216 30 15.3 3; 217 27.575 17.6 0.575; 218 27.575 17.6 2.925
70. 219 29.925 17.6 0.575; 220 29.925 17.6 2.925; 221 28.171 24.815 1.171
71. 222 28.171 24.815 2.34; 223 29.34 24.815 2.34; 224 29.34 24.815 1.171
72. 225 28.432 26.347 1.432; 226 28.432 26.347 2.078; 227 29.078 26.347 2.078
73. 228 29.078 26.347 1.432
74. MEMBER INCIDENCES
75. 1 1 17; 2 3 18; 3 2 19; 4 4 20; 5 5 6; 6 6 8; 7 8 7; 8 7 5; 9 9 10; 10 10 11
76. 11 11 12; 12 12 9; 13 5 9; 14 7 12; 15 8 11; 16 6 10; 17 9 41; 18 12 42
77. 19 11 43; 20 10 44; 21 13 16; 22 16 15; 23 15 14; 24 14 13; 25 17 21; 26 18 22
78. 27 19 23; 28 20 24; 29 21 25; 30 22 26; 31 23 27; 32 24 28; 33 25 29; 34 26 30
79. 35 27 31; 36 28 32; 37 29 33; 38 30 34; 39 31 35; 40 32 36; 41 33 37; 42 34 38
80. 43 35 39; 44 36 40; 45 37 5; 46 38 7; 47 39 6; 48 40 8; 49 41 45; 50 42 46
81. 51 43 47; 52 44 48; 53 45 49; 54 46 50; 55 47 51; 56 48 52; 57 49 13; 58 50 16
82. 59 51 15; 60 52 14; 117 5 10; 118 6 9; 119 6 11; 120 8 10; 121 7 11; 122 8 12
83. 123 7 9; 124 5 12; 125 8 5; 126 7 6; 127 9 11; 128 12 10; 161 8 57; 162 11 58
84. 163 10 59; 164 6 60; 165 57 61; 166 58 62; 167 59 63; 168 60 64; 169 61 65
85. 170 62 66; 171 63 67; 172 64 68; 173 65 69; 174 66 70; 175 67 71; 176 68 72
86. 177 69 97; 178 70 98; 179 71 99; 180 72 100; 181 93 97; 182 94 98; 183 95 99
87. 184 96 100; 185 77 81; 186 78 82; 187 79 83; 188 80 84; 189 81 85; 190 82 86
88. 191 83 87; 192 84 88; 193 85 89; 194 86 90; 195 87 91; 196 88 92; 197 89 102
89. 198 90 104; 199 91 103; 200 92 101; 201 93 77; 202 94 78; 203 95 79; 204 96 80
90. 209 101 161; 210 102 162; 211 103 163; 212 104 164; 213 99 109; 214 95 110
91. 215 98 111; 216 94 112; 217 99 113; 218 95 114; 219 100 115; 220 96 116
92. 221 109 98; 222 110 94; 223 111 97; 224 112 93; 225 113 100; 226 114 96
93. 227 115 97; 228 116 93; 229 113 109; 230 109 111; 231 111 115; 232 115 113
94. 233 109 110; 234 111 112; 235 115 116; 236 113 114; 237 110 114; 238 110 112

STAAD TRUSS

-- PAGE NO. 3

95. 239 112 116; 240 116 114; 241 110 116; 242 112 114; 243 109 115; 244 111 113
96. 245 97 112; 246 111 94; 247 100 114; 248 113 95; 249 8 58; 250 57 11
97. 251 57 62; 252 61 58; 253 61 66; 254 65 62; 255 65 70; 256 69 66; 257 69 98
98. 258 97 70; 259 6 59; 260 60 10; 261 60 63; 262 64 59; 263 64 67; 264 68 63
99. 265 68 71; 266 72 67; 267 72 99; 268 100 71; 269 11 59; 270 58 10; 271 58 63
100. 272 62 59; 273 62 67; 274 66 63; 275 66 71; 276 70 67; 277 70 99; 278 71 98
101. 279 8 60; 280 57 6; 281 57 64; 282 61 60; 283 61 68; 284 65 64; 285 65 72
102. 286 69 68; 287 69 100; 288 72 97; 289 94 77; 290 93 78; 291 77 82; 292 81 78
103. 293 82 85; 294 81 86; 295 86 89; 296 85 90; 297 90 102; 298 89 104
104. 299 104 173; 300 95 80; 301 96 79; 302 80 83; 303 84 79; 304 83 88; 305 84 87
105. 306 87 92; 307 88 91; 308 91 101; 309 92 103; 310 103 174; 311 94 79
106. 312 78 95; 313 78 83; 314 79 82; 315 82 87; 316 83 86; 317 87 90; 318 86 91
107. 319 91 104; 320 90 103; 321 104 175; 322 93 80; 323 77 96; 324 77 84
108. 325 80 81; 326 81 88; 327 84 85; 328 88 89; 329 85 92; 330 92 102; 331 89 101
109. 332 102 176; 337 118 121; 338 120 122; 339 119 123; 340 117 124; 341 121 125
110. 342 122 126; 343 123 127; 344 124 128; 345 125 129; 346 126 130; 347 127 131
111. 348 128 132; 349 129 133; 350 130 134; 351 131 135; 352 132 136; 353 133 157
112. 354 134 158; 355 135 159; 356 136 160; 357 153 157; 358 154 158; 359 155 159
113. 360 156 160; 361 137 141; 362 138 142; 363 139 143; 364 140 144; 365 141 145
114. 366 142 146; 367 143 147; 368 144 148; 369 145 149; 370 146 150; 371 147 151
115. 372 148 152; 373 149 162; 374 150 164; 375 151 163; 376 152 161; 377 153 137
116. 378 154 138; 379 155 139; 380 156 140; 385 159 165; 386 155 166; 387 158 167
117. 388 154 168; 389 159 169; 390 155 170; 391 160 171; 392 156 172; 393 165 158
118. 394 166 154; 395 167 157; 396 168 153; 397 169 160; 398 170 156; 399 171 157
119. 400 172 153; 401 169 165; 402 165 167; 403 167 171; 404 171 169; 405 165 166
120. 406 167 168; 407 171 172; 408 169 170; 409 166 170; 410 166 168; 411 168 172
121. 412 172 170; 413 166 172; 414 168 170; 415 165 171; 416 167 169; 417 157 168
122. 418 167 154; 419 160 170; 420 169 155; 421 118 122; 422 121 120; 423 121 126
123. 424 125 122; 425 125 130; 426 129 126; 427 129 134; 428 133 130; 429 133 158
124. 430 157 134; 431 117 123; 432 124 119; 433 124 127; 434 128 123; 435 128 131
125. 436 132 127; 437 132 135; 438 136 131; 439 136 159; 440 160 135; 441 120 123
126. 442 122 119; 443 122 127; 444 126 123; 445 126 131; 446 130 127; 447 130 135
127. 448 134 131; 449 134 159; 450 135 158; 451 118 124; 452 121 117; 453 121 128
128. 454 125 124; 455 125 132; 456 129 128; 457 129 136; 458 133 132; 459 133 160
129. 460 136 157; 461 154 137; 462 153 138; 463 137 142; 464 141 138; 465 142 145
130. 466 141 146; 467 146 149; 468 145 150; 469 150 162; 470 149 164; 471 164 177
131. 472 155 140; 473 156 139; 474 140 143; 475 144 139; 476 143 148; 477 144 147
132. 478 147 152; 479 148 151; 480 151 161; 481 152 163; 482 163 178; 483 154 139
133. 484 138 155; 485 138 143; 486 139 142; 487 142 147; 488 143 146; 489 147 150
134. 490 146 151; 491 151 164; 492 150 163; 493 164 179; 494 153 140; 495 137 156
135. 496 137 144; 497 140 141; 498 141 148; 499 144 145; 500 148 149; 501 145 152
136. 502 152 162; 503 149 161; 504 162 180; 505 173 102; 506 174 101; 507 175 103
137. 508 176 101; 509 177 162; 510 178 161; 511 179 163; 512 180 161; 513 174 175
138. 514 175 173; 515 173 176; 516 176 174; 517 173 177; 518 176 180; 519 174 178
139. 520 175 179; 521 179 177; 522 177 180; 523 178 179; 524 178 180; 525 102 177
140. 526 173 164; 527 174 163; 528 101 178; 531 175 176; 533 178 177; 534 174 173
141. 535 179 180; 690 98 110; 691 109 95; 692 97 116; 693 115 96; 694 102 180
142. 695 176 161; 696 104 179; 697 175 163; 698 153 171; 699 172 160; 700 154 165
143. 701 166 159; 702 3 20; 703 20 22; 704 22 28; 705 28 30; 706 30 36; 707 36 38
144. 708 38 8; 709 7 40; 710 40 34; 711 34 32; 712 32 26; 713 26 24; 714 24 18
145. 715 18 4; 716 1 18; 717 3 17; 718 17 22; 719 18 21; 720 21 26; 721 22 25
146. 722 25 30; 723 26 29; 724 29 34; 725 30 33; 726 33 38; 727 34 37; 728 37 7
147. 729 38 5; 730 2 17; 731 1 19; 732 19 21; 733 17 23; 734 23 25; 735 21 27
148. 736 27 29; 737 25 31; 738 31 33; 739 29 35; 740 35 37; 741 33 39; 742 39 5
149. 743 37 6; 744 4 19; 745 2 20; 746 20 23; 747 19 24; 748 24 27; 749 23 28
150. 750 28 31; 751 27 32; 752 31 36; 753 32 35; 754 35 40; 755 36 39; 756 39 8

STAAD TRUSS

-- PAGE NO. 4

151. 757 40 6; 758 9 44; 759 10 41; 760 41 48; 761 44 45; 762 45 52; 763 48 49
 152. 764 49 14; 765 52 13; 766 10 43; 767 11 44; 768 44 47; 769 43 48; 770 48 51
 153. 771 47 52; 772 52 15; 773 51 14; 774 11 42; 775 12 43; 776 43 46; 777 42 47
 154. 778 47 50; 779 46 51; 780 51 16; 781 50 15; 782 9 42; 783 12 41; 784 41 46
 155. 785 42 45; 786 45 50; 787 46 49; 788 50 13; 789 49 16; 790 181 182
 156. 791 183 184; 792 185 186; 793 187 188; 794 117 189; 795 189 190; 796 190 118
 157. 797 118 117; 798 119 191; 799 191 192; 800 192 120; 801 120 119; 802 117 119
 158. 803 118 120; 804 190 192; 805 189 191; 806 119 193; 807 120 194; 808 192 195
 159. 809 191 196; 810 197 198; 811 198 199; 812 199 200; 813 200 197; 814 182 201
 160. 815 184 202; 816 186 203; 817 188 204; 818 201 205; 819 202 206; 820 203 207
 161. 821 204 208; 822 205 209; 823 206 210; 824 207 211; 825 208 212; 826 209 213
 162. 827 210 214; 828 211 215; 829 212 216; 830 213 217; 831 214 218; 832 215 219
 163. 833 216 220; 834 217 117; 835 218 118; 836 219 189; 837 220 190; 838 193 221
 164. 839 194 222; 840 195 223; 841 196 224; 842 221 225; 843 222 226; 844 223 227
 165. 845 224 228; 846 225 197; 847 226 198; 848 227 199; 849 228 200; 850 117 191
 166. 851 189 119; 852 189 192; 853 190 191; 854 118 192; 855 190 120; 856 118 119
 167. 857 117 120; 858 190 117; 859 118 189; 860 119 192; 861 120 191; 862 183 188
 168. 863 188 202; 864 202 208; 865 208 210; 866 210 216; 867 216 218; 868 218 190
 169. 869 118 220; 870 220 214; 871 214 212; 872 212 206; 873 206 204; 874 204 184
 170. 875 184 187; 876 181 184; 877 183 182; 878 182 202; 879 184 201; 880 201 206
 171. 881 202 205; 882 205 210; 883 206 209; 884 209 214; 885 210 213; 886 213 218
 172. 887 214 217; 888 217 118; 889 218 117; 890 185 182; 891 181 186; 892 186 201
 173. 893 182 203; 894 203 205; 895 201 207; 896 207 209; 897 205 211; 898 211 213
 174. 899 209 215; 900 215 217; 901 213 219; 902 219 117; 903 217 189; 904 187 186
 175. 905 185 188; 906 188 203; 907 186 204; 908 204 207; 909 203 208; 910 208 211
 176. 911 207 212; 912 211 216; 913 212 215; 914 215 220; 915 216 219; 916 219 190
 177. 917 220 189; 918 119 196; 919 191 193; 920 193 224; 921 196 221; 922 221 228
 178. 923 224 225; 924 225 200; 925 228 197; 926 191 195; 927 192 196; 928 196 223
 179. 929 195 224; 930 224 227; 931 223 228; 932 228 199; 933 227 200; 934 192 194
 180. 935 120 195; 936 195 222; 937 194 223; 938 223 226; 939 222 227; 940 227 198
 181. 941 226 199; 942 119 194; 943 120 193; 944 193 222; 945 194 221; 946 221 226
 182. 947 222 225; 948 226 197; 949 225 198
 183. DEFINE MATERIAL START
 184. ISOTROPIC STEEL
 185. E 2.05E+08
 186. POISSON 0.3
 187. DENSITY 76.8195
 188. ALPHA 1.2E-05
 189. DAMP 0.03
 190. G 7.88462E+07
 191. TYPE STEEL
 192. STRENGTH RY 1.5 RT 1.2
 193. END DEFINE MATERIAL
 194. MEMBER PROPERTY INDIAN
 195. 1 TO 4 25 TO 28 790 TO 793 814 TO 817 TABLE ST ISA200X200X20
 196. 29 TO 36 818 TO 825 TABLE ST ISA150X150X20
 197. 13 TO 16 37 TO 48 802 TO 805 826 TO 837 TABLE ST ISA150X150X12
 198. 17 TO 20 49 TO 60 806 TO 809 838 TO 849 TABLE ST ISA75X75X5
 199. 5 TO 12 161 TO 180 337 TO 356 794 TO 801 TABLE ST ISA130X130X10
 200. 181 TO 204 209 TO 212 357 TO 380 TABLE ST ISA150X150X12
 201. 21 TO 24 810 TO 813 TABLE ST ISA50X50X5
 202. 702 703 714 TO 719 730 TO 733 744 TO 747 862 863 874 TO 879 890 TO 893 904 -
 203. 905 TO 907 TABLE ST ISA90X90X6
 204. 117 TO 124 706 TO 711 724 TO 729 738 TO 743 752 TO 757 850 TO 857 866 TO 871 -
 205. 884 TO 889 898 TO 903 912 TO 917 TABLE ST ISA100X100X10
 206. 758 TO 789 918 TO 949 TABLE ST ISA50X50X5

STAAD TRUSS

-- PAGE NO. 5

207. 125 TO 128 249 TO 288 421 TO 460 858 TO 861 TABLE ST ISA90X90X6
208. 213 TO 248 299 310 321 332 385 TO 420 471 482 493 504 TO 528 531 533 TO 535 -
209. 690 TO 701 TABLE ST ISA100X100X10
210. 289 TO 298 300 TO 309 311 TO 320 322 TO 331 461 TO 470 472 TO 481 483 TO 492 -
211. 494 TO 503 TABLE ST ISA65X65X5
212. 704 705 712 713 720 TO 723 734 TO 737 748 TO 751 864 865 872 873 880 TO 883 -
213. 894 TO 897 908 TO 911 TABLE ST ISA90X90X6
214. CONSTANTS
215. BETA 45 MEMB 14 803
216. BETA 135 MEMB 15 804
217. BETA 225 MEMB 16 805
218. BETA 315 MEMB 13 802
219. MATERIAL STEEL ALL
220. *****
221. SUPPORTS
222. 1 TO 4 181 183 185 187 PINNED
223. *****
224. LOAD 1 DEAD LOAD + LIVE LOAD
225. SELFWEIGHT Y -1.15
226. JOINT LOAD
227. **WEIGHT OF CONDUCTOR & INSULATOR
228. 111 112 167 168 173 177 FY -5.2104
229. **WEIGHT OF MEN WITH TOOL
230. 9 TO 12 119 120 191 192 FY -0.375
231. MEMBER LOAD
232. **WEIGHT OF SUSPENSION
233. 235 407 518 CON GY -0.65 0.225
234. JOINT LOAD
235. **WEIGHT OF EARTH WIRE
236. 13 TO 16 197 TO 200 FY -0.1134
237. 113 114 169 170 174 178 FY -3.2545
238. *****
239. LOAD 2 LOADTYPE NONE TITLE WIND ALONG X DIRECTION(PARALLEL TO BEAM)
240. JOINT LOAD
241. **WIND LOAD ON TOWER
242. 1 3 181 183 FX 1
243. 17 18 182 184 FX 1.98
244. 21 22 201 202 FX 1.78
245. 25 26 205 206 FX 1.65
246. 29 30 209 210 FX 1.49
247. 33 34 213 214 FX 1.26
248. 37 38 217 218 FX 1.37
249. 5 7 117 TO 120 FX 1.45
250. 9 12 119 120 FX 0.97
251. 41 42 193 194 FX 0.49
252. 45 46 221 222 FX 0.43
253. 49 50 225 226 FX 0.37
254. 13 16 197 198 FX 0.17
255. *****
256. LOAD 3 LOADTYPE NONE TITLE WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)
257. JOINT LOAD
258. **WIND LOAD ON TOWER
259. 1 2 181 185 FZ 1
260. 17 19 182 186 FZ 1.98
261. 21 23 201 203 FZ 1.78
262. 25 27 205 207 FZ 1.65

STAAD TRUSS

-- PAGE NO. 6

263. 29 31 209 211 FZ 1.49
264. 33 35 213 215 FZ 1.26
265. 37 39 217 219 FZ 1.37
266. 5 6 117 189 FZ 1.45
267. 9 10 119 191 FZ 0.97
268. 41 44 193 196 FZ 0.49
269. 45 48 221 224 FZ 0.43
270. 49 52 225 228 FZ 0.37
271. 13 14 197 200 FZ 0.17
272. **WIND LOAD ON BEAM
273. 59 60 63 64 67 68 71 72 79 80 83 84 87 88 91 92 95 96 99 TO 101 103 113 114 -
274. 123 124 127 128 131 132 135 136 139 140 143 144 147 148 151 152 155 156 159 -
275. 160 TO 161 163 169 170 174 178 FZ 0.462
276. *****
277. **BEAM-G2(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
278. **TOWER -4T2
279. *****
280. LOAD 4 NC(0P-0E) +WIND PARALLEL TO BEAM
281. JOINT LOAD
282. **NORMAL TENSION FORCE
283. 111 112 167 168 173 177 FZ 20
284. *WIND LOAD ON CONDUCTOR & INSULATOR
285. 111 TO 114 167 TO 170 173 174 177 178 FX 9
286. MEMBER LOAD
287. **WIND LOAD ON SUSPENSION
288. 235 407 518 CON GX 0.91 0.225
289. JOINT LOAD
290. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
291. 13 TO 16 197 TO 200 FX 0.15 FZ 2.5
292. *****
293. LOAD 5 SC(0P-0E) +WIND PARALLEL TO BEAM
294. JOINT LOAD
295. **SHORT CIRCUIT FORCE
296. 113 114 169 170 174 178 FZ 39.77
297. *WIND LOAD ON CONDUCTOR & INSULATOR
298. 111 TO 114 167 TO 170 173 174 177 178 FX 9
299. MEMBER LOAD
300. **WIND LOAD ON SUSPENSION
301. 235 407 518 CON GX 0.91 0.225
302. JOINT LOAD
303. **WIND LOAD ON EARTH WIRE
304. 13 TO 16 197 TO 200 FX 0.15
305. *****
306. LOAD 6 NC(0P-0E) +WIND PERPENDICULAR TO BEAM
307. JOINT LOAD
308. **NORMAL TENSION FORCE
309. 111 112 167 168 173 177 FZ 20
310. MEMBER LOAD
311. **WIND LOAD ON SUSPENSION
312. 235 407 518 CON GZ 0.91 0.225
313. JOINT LOAD
314. **NORMAL TENSION FORCE
315. 13 TO 16 197 TO 200 FZ 2.5
316. *****
317. LOAD 7 SC(0P-0E) +WIND PERPENDICULAR TO BEAM
318. JOINT LOAD

STAAD TRUSS

-- PAGE NO. 7

```
319. **SHORT CIRCUIT FORCE
320. 113 114 169 170 174 178 FZ 39.77
321. MEMBER LOAD
322. **WIND LOAD ON SUSPENSION
323. 235 407 518 CON GZ 0.91 0.225
324. *****
325. LOAD 8 LOADTYPE NONE TITLE NC(30P-0E) +WIND PARALLEL TO BEAM
326. JOINT LOAD
327. 111 112 167 168 173 177 FZ 34.65
328. MEMBER LOAD
329. 235 407 518 CON GX 0.79 0.225
330. JOINT LOAD
331. 111 112 167 168 173 177 FX 20
332. 111 TO 114 167 TO 170 173 174 177 178 FX 7.8
333. 13 TO 16 197 TO 200 FX 1.375 FZ 1.25
334. *****
335. LOAD 9 LOADTYPE NONE TITLE SC(30P-0E) +WIND PARALLEL TO BEAM
336. JOINT LOAD
337. 111 TO 114 167 TO 170 173 174 177 178 FX 7.8
338. MEMBER LOAD
339. 235 407 518 CON GX 0.79 0.225
340. JOINT LOAD
341. 13 TO 16 197 TO 200 FX 0.125
342. *****
343. LOAD 10 LOADTYPE NONE TITLE NC(30P-0E) +WIND PERPENDICULAR TO BEAM
344. JOINT LOAD
345. 111 112 167 168 173 177 FX 20
346. 111 112 167 168 173 177 FZ 34.65
347. 111 TO 114 167 TO 170 173 174 177 178 FZ 4.505
348. MEMBER LOAD
349. 235 407 518 CON GZ 0.46 0.225
350. JOINT LOAD
351. 13 TO 16 197 TO 200 FX 2.24 FZ 2.17
352. *****
353. LOAD 11 LOADTYPE NONE TITLE SC(30P-0E) +WIND PERPENDICULAR TO BEAM
354. JOINT LOAD
355. 111 TO 114 167 TO 170 173 174 177 178 FZ 4.965
356. 13 TO 16 197 TO 200 FX 0.075
357. MEMBER LOAD
358. 235 407 518 CON GZ 0.46 0.225
359. *****
360. LOAD 12 LOADTYPE NONE TITLE NC(0P-30E) +WIND PARALLEL TO BEAM
361. JOINT LOAD
362. 111 112 167 168 173 177 FZ 34.65
363. 111 112 167 168 173 177 FY -20
364. 111 TO 114 167 TO 170 173 174 177 178 FX 8.55
365. 13 TO 16 197 TO 200 FX 0.125
366. MEMBER LOAD
367. 235 407 518 CON GX 0.46 0.225
368. *****
369. LOAD 13 LOADTYPE NONE TITLE SC(0P-30E) +WIND PARALLEL TO BEAM
370. JOINT LOAD
371. 111 TO 114 167 TO 170 173 174 177 178 FX 8.55
372. MEMBER LOAD
373. 235 407 518 CON GX 0.46 0.225
374. JOINT LOAD
```

STAAD TRUSS

-- PAGE NO. 8

```
375. 13 TO 16 197 TO 200 FX 0.125
376. *****
377. LOAD 14 LOADTYPE NONE TITLE NC(0P-30E) +WIND PERPENDICULAR TO BEAM
378. JOINT LOAD
379. 111 TO 114 167 TO 170 173 174 177 178 FZ 0.46
380. 111 112 167 168 173 177 FZ 34.65
381. 111 112 167 168 173 177 FY -20
382. 13 TO 16 197 TO 200 FX 2.17 FZ 2.17
383. MEMBER LOAD
384. 235 407 518 CON GZ 0.46 0.225
385. *****
386. LOAD 15 LOADTYPE NONE TITLE SC(0P-30E) +WIND PERPENDICULAR TO BEAM
387. JOINT LOAD
388. 111 TO 114 167 TO 170 173 174 177 178 FZ 0.46
389. MEMBER LOAD
390. 235 407 518 CON GZ 0.46 0.225
391. *****
392. LOAD 16 LOADTYPE NONE TITLE NC(30P-30E) +WIND PARALLEL TO BEAM
393. JOINT LOAD
394. 111 TO 114 167 TO 170 173 174 177 178 FX 7.41
395. 111 112 167 168 173 177 FX 17.33
396. 111 112 167 168 173 177 FY -20
397. 111 112 167 168 173 177 FZ 30
398. 13 TO 16 197 TO 200 FX 1.19 FZ 1.08
399. 13 TO 16 197 TO 200 FY -1.25
400. MEMBER LOAD
401. 235 407 518 CON GX 0.4 0.225
402. *****
403. LOAD 17 LOADTYPE NONE TITLE SC(30P-30E) +WIND PARALLEL TO BEAM
404. JOINT LOAD
405. 111 TO 114 167 TO 170 173 174 177 178 FX 7.41
406. 13 TO 16 197 TO 200 FX 0.113
407. MEMBER LOAD
408. 235 407 518 CON GX 0.4 0.225
409. *****
410. LOAD 18 LOADTYPE NONE TITLE NC(30P-30E) +WIND PERPENDICULAR TO BEAM
411. JOINT LOAD
412. 111 TO 114 167 TO 170 173 174 177 178 FZ 4.27
413. 111 112 167 168 173 177 FX 17.33
414. 111 112 167 168 173 177 FY -20
415. 111 112 167 168 173 177 FZ 30
416. 13 TO 16 197 TO 200 FX 1.94 FZ 1.87
417. MEMBER LOAD
418. 235 407 518 CON GZ 0.23 0.225
419. *****
420. LOAD 19 LOADTYPE NONE TITLE SC(30P-30E) +WIND PERPENDICULAR TO BEAM
421. JOINT LOAD
422. 13 TO 16 197 TO 200 FX 0.0625
423. 111 TO 114 167 TO 170 173 174 177 178 FZ 4.275
424. 111 112 167 168 173 177 FX 17.33
425. MEMBER LOAD
426. 235 407 518 CON GZ 0.23 0.225
427. *****
428. *LOAD COMBINATIONS FOR MEMBER DESIGN (FACTORED)
429. *****
430. *****
```

STAAD TRUSS

-- PAGE NO. 9

431. LOAD COMB 101 2(DL + NC + WIND PARALLEL TO BEAM)
432. 1 2.0 2 2.0 4 2.0
433. *****
434. LOAD COMB 201 1.5(DL +SC + WIND PARALLEL TO BEAM)
435. 1 1.5 2 1.5 5 1.5
436. *****
437. LOAD COMB 102 2(DL +NC + WIND PERPENDICULAR TO BEAM)
438. 1 2.0 3 2.0 6 2.0
439. *****
440. LOAD COMB 202 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
441. 1 1.5 3 1.5 7 1.5
442. *****
443. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVAT
444. *****
445. LOAD COMB 103 2(DL +NC + WIND PARALLEL TO BEAM)
446. 1 2.0 2 2.0 8 2.0
447. *****
448. LOAD COMB 203 1.5(DL +SC + WIND PARALLEL TO BEAM)
449. 1 1.5 2 1.5 9 1.5
450. *****
451. LOAD COMB 104 2(DL +NC + WIND PERPENDICULAR TO BEAM)
452. 1 2.0 3 2.0 10 2.0
453. *****
454. LOAD COMB 204 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
455. 1 1.5 3 1.5 11 1.5
456. *****
457. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVAT
458. *****
459. LOAD COMB 105 2(DL +NC + WIND PARALLEL TO BEAM)
460. 1 2.0 2 2.0 12 2.0
461. *****
462. LOAD COMB 205 1.5(DL +SC + WIND PARALLEL TO BEAM)
463. 1 1.5 2 1.5 13 1.5
464. *****
465. LOAD COMB 106 2(DL +NC + WIND PERPENDICULAR TO BEAM)
466. 1 2.0 3 2.0 14 2.0
467. *****
468. LOAD COMB 206 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
469. 1 1.5 3 1.5 15 1.5
470. *****
471. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVAT
472. *****
473. LOAD COMB 107 2(DL +NC + WIND PARALLEL TO BEAM)
474. 1 2.0 2 2.0 16 2.0
475. *****
476. LOAD COMB 207 1.5(DL +SC + WIND PARALLEL TO BEAM)
477. 1 1.5 2 1.5 17 1.5
478. *****
479. LOAD COMB 108 2(DL +NC + WIND PERPENDICULAR TO BEAM)
480. 1 2.0 3 2.0 18 2.0
481. *****
482. LOAD COMB 208 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
483. 1 1.5 3 1.5 19 1.5
484. *****
485. *LOAD COMBINATIONS FOR FOUNDATION & BASE PLATE DESIGN (UNFACTORED)
486. *****

STAAD TRUSS

-- PAGE NO. 10

```
487. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATI
488. *****
489. LOAD COMB 301 DL + NC + WIND PARALLEL TO BEAM
490. 1 1.0 2 1.0 4 1.0
491. *****
492. LOAD COMB 401 DL +SC + WIND PARALLEL TO BEAM
493. 1 1.0 2 1.0 5 1.0
494. *****
495. LOAD COMB 302 DL +NC + WIND PERPENDICULAR TO BEAM
496. 1 1.0 3 1.0 6 1.0
497. *****
498. LOAD COMB 402 DL +SC + WIND PERPENDICULAR TO BEAM
499. 1 1.0 3 1.0 7 1.0
500. *****
501. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVAT
502. *****
503. LOAD COMB 303 DL +NC + WIND PARALLEL TO BEAM
504. 1 1.0 2 1.0 8 1.0
505. *****
506. LOAD COMB 403 DL +SC + WIND PARALLEL TO BEAM
507. 1 1.0 2 1.0 9 1.0
508. *****
509. LOAD COMB 304 DL +NC + WIND PERPENDICULAR TO BEAM
510. 1 1.0 3 1.0 10 1.0
511. *****
512. LOAD COMB 404 DL +SC + WIND PERPENDICULAR TO BEAM
513. 1 1.0 3 1.0 11 1.0
514. *****
515. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVAT
516. *****
517. LOAD COMB 305 DL +NC + WIND PARALLEL TO BEAM
518. 1 1.0 2 1.0 12 1.0
519. *****
520. LOAD COMB 405 DL +SC + WIND PARALLEL TO BEAM
521. 1 1.0 2 1.0 13 1.0
522. *****
523. LOAD COMB 306 DL +NC + WIND PERPENDICULAR TO BEAM
524. 1 1.0 3 1.0 14 1.0
525. *****
526. LOAD COMB 406 DL +SC + WIND PERPENDICULAR TO BEAM
527. 1 1.0 3 1.0 15 1.0
528. *****
529. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVA
530. *****
531. LOAD COMB 307 DL +NC + WIND PARALLEL TO BEAM
532. 1 1.0 2 1.0 16 1.0
533. *****
534. LOAD COMB 407 DL +SC + WIND PARALLEL TO BEAM
535. 1 1.0 2 1.0 17 1.0
536. *****
537. LOAD COMB 308 DL +NC + WIND PERPENDICULAR TO BEAM
538. 1 1.0 3 1.0 18 1.0
539. *****
540. LOAD COMB 408 DL +SC + WIND PERPENDICULAR TO BEAM
541. 1 1.0 3 1.0 19 1.0
542. PERFORM ANALYSIS
```

STAAD TRUSS

-- PAGE NO. 11

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	216	NUMBER OF MEMBERS	692
NUMBER OF PLATES	0	NUMBER OF SOLIDS	0
NUMBER OF SURFACES	0	NUMBER OF SUPPORTS	8

Using 64-bit analysis engine.

SOLVER USED IS THE IN-CORE ADVANCED MATH SOLVER

TOTAL PRIMARY LOAD CASES = 19, TOTAL DEGREES OF FREEDOM = 624
TOTAL LOAD COMBINATION CASES = 32 SO FAR.

543. *****
544. PARAMETER 1
545. CODE AISC UNIFIED 2016
546. STEEL TAKE OFF LIST 1 TO 60 117 TO 128 702 TO 789

STAAD TRUSS

-- PAGE NO. 12

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA200X200X20	28.03	16.451
ST ISA130X130X10	17.60	3.394
ST ISA150X150X12	36.43	9.739
ST ISA75X75X5	24.31	1.358
ST ISA50X50X5	63.96	2.353
ST ISA150X150X20	24.03	10.373
ST ISA100X100X10	105.15	15.428
ST ISA90X90X6	155.34	12.529

	TOTAL =	71.624

***** END OF DATA FROM INTERNAL STORAGE *****

547. PARAMETER 2

548. CODE AISC UNIFIED 2016

549. STEEL TAKE OFF LIST 161 TO 204 209 TO 332 337 TO 380 385 TO 528 531 -

550. 533 TO 535 690 TO 701

STAAD TRUSS

-- PAGE NO. 13

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA130X130X10	41.40	7.983
ST ISA150X150X12	57.80	15.452
ST ISA100X100X10	150.46	22.076
ST ISA90X90X6	194.50	15.689
ST ISA65X65X5	204.84	9.835

	TOTAL =	71.034

***** END OF DATA FROM INTERNAL STORAGE *****

551. FINISH

***** END OF THE STAAD.Pro RUN *****

*** DATE= AUG 24,2024 TIME= 16:59:34 ***

STAAD TRUSS

-- PAGE NO. 14

```
*****
*   For technical assistance on STAAD.Pro, please visit   *
*   http://www.bentley.com/en/support/                   *
*                                                         *
*   Details about additional assistance from               *
*   Bentley and Partners can be found at program menu    *
*   Help->Technical Support                               *
*                                                         *
*               Copyright (c) Bentley Systems, Inc.      *
*               http://www.bentley.com                   *
*****
```


MEMBER & CONNECTION BOLT DESIGN FOR
TOWER-4T1

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MAINBUS MKD."4T1"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

A DESIGN OF MAIN-LEG FOR PART - PA,PB

- a) Angle Section tried & adopted = 200 x 200 x 20
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 141190.63 kg
Maximum Tension in main leg for Panel = 124865.25 kg
- c) Effective Length of Angle, L1 & L2 = 3504.00 & 3504.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1752.00 / 39.30 = 44.58 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1752.00 / 61.40 = 28.53 < 120$ hence o.k.
- e) Gross Area of Cross Section, Ag = 76.4000 sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 69.40$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 69.40 = 176914.4$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 44.58
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2388.79$ Kg/sqcm.
k) Permissible Compressive Load = $2388.79 \times 76.4000 = 182503.4$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 20$ mm = 20230.45 Kgs
No. of 16mm bolts required, = $176914.45 / 12711.17 = 13.92$ nos. Say **14.00 no.**
- p) Ultimate Maximum Compression per Leg = $141190.63 \times 1.00 = 141190.63$ Kg.
- q) Ultimate Maximum Tension per Leg = $124865.25 \times 1.00 = 124865.25$ Kg.
- r) Factor of Safety
In Compression = $182503.4 / 141190.63 = 1.29 > 1.0000$ It is Safe
In Tension = $176914.4 / 124865.25 = 1.42 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

B DESIGN OF MAIN-LEG FOR PART - PC, PD

- a) Angle Section tried & adopted = 150 x 150 x 20
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 101601.31 kg
Maximum Tension in main leg for Panel = 91731.602 kg
- c) Effective Length of Angle, L1 & L2 = 3003.00 & 3003.00 mm respily.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1501.50 / 29.30 = 51.25 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1501.50 / 45.30 = 33.15 < 120$ hence o.k.
- e) Gross Area of Cross Section, Ag = 56.20 sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 49.20$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 49.20 = 125420.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 51.25
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 7.50 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2337.23$ Kg/sqcm.
k) Permissible Compressive Load = $2337.23 \times 56.2000 = 131352.4$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415 / 4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 20 mm = 20230.45 Kgs
No. of 16mm bolts required, = $125420.62 / 12711.17 = 9.87$ nos. Say **10.00 no.**
- p) Ultimate Maximum Compression per Leg = $101601.31 \times 1.00 = 101601.31$ Kg.
- q) Ultimate Maximum Tension per Leg = $91731.60 \times 1.00 = 91731.60$ Kg.
- r) Factor of Safety
In Compression = $131352.4 / 101601.31 = 1.29 > 1.0000$ It is Safe
In Tension = $125420.6 / 91731.60 = 1.37 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

C DESIGN OF MAIN-LEG FOR PART - PE, PF, PG,PH

- a) Angle Section tried & adopted = 150 x 150 x 12
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 69030.39 kg
Maximum Tension in main leg for Panel = 56485.469 kg
- c) Effective Length of Angle, L1 & L2 = 2302.00 & 2302.00 mm resply.
- d) Slenderness ratio L1/rvv = 2302.00 / 29.70 = 77.51 < 120 hence o.k.
L2/rxx = 2302.00 / 46.30 = 49.72 < 120 hence o.k.
- e) Gross Area of Cross Section, Ag = 34.80 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 30.60 sqcm.
- g) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 30.60 = 78005.5 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 77.51
Limiting b/t ratio = $210 / (F_y)^{0.5}$ = 13.28
Actual b/t ratio = 12.50 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of C_e = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$ = 125.66
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$ = 2064.30 Kg/sqcm.
- k) Permissible Compressive Load = 2064.30 x 34.8000 = 71837.6 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161)$ = 12711.17 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 12 \text{ mm}$ = 12138.27 Kgs
No. of 16mm bolts required, = 71837.64 / 12138.27 = 5.92 nos. Say **6.00 no.**
- p) Ultimate Maximum Compression per Leg = 69030.39 x 1.00 = 69030.39 Kg.
- q) Ultimate Maximum Tension per Leg = 56485.47 x 1.00 = 56485.47 Kg.
- r) Factor of Safety
In Compression = 71837.6 / 69030.39 = **1.04 > 1.0000 It is Safe**
In Tension = 78005.5 / 56485.47 = **1.38 > 1.0000 It is Safe**

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

C DESIGN OF MAIN-LEG FOR PART - PI, PJ,PK,PL

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 5640.28 kg
Maximum Tension in main leg for Panel = 5224.563 kg
- c) Effective Length of Angle, L1 & L2 = 1576.00 & 1576.00 mm respily.
- d) Slenderness ratio $L1/r_{vv} = 1576.00 / 14.60 = 107.95 < 120$ hence o.k.
 $L2/r_{xx} = 1576.00 / 23.10 = 68.23 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 7.27$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 5.52$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 5.52 = 14071.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 107.95
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1467.78$ Kg/sqcm.
k) Permissible Compressive Load = $1467.78 \times 7.2700 = 10670.8$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t) = 5057.61$ Kgs
 $t = 5$ mm
No. of 16mm bolts required, = $10670.79 / 5057.61 = 2.11$ nos. Say **3.00 no.**
- p) Ultimate Maximum Compression per Leg = $5640.28 \times 1.00 = 5640.28$ Kg.
- q) Ultimate Maximum Tension per Leg = $5224.56 \times 1.00 = 5224.56$ Kg.
- r) Factor of Safety
In Compression = $10670.8 / 5640.28 = 1.89 > 1.0000$ It is Safe
In Tension = $14071.6 / 5224.56 = 2.69 > 1.0000$ It is Safe

* DESIGN OF BRACINGS FOR TOWER MKD. "4T1"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - GA, JA

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, L2	=	4871.00				
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1217.75	/	17.50		
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2435.50	/	27.70		
d)	Gross Area of Cross Section, Ag	=	10.5000 sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts						
	$v =$	4.1700	+	5.2200	x	0.7056	= 7.8531 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy	=		250 Mpa		
g)	Permissible Tensile Stress	=		2549.20 Kg/sqcm.			
h)	Permissible Tensile Load	=		2549.20	x	7.8531	
		=		20019.2 Kgs			
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=		87.92			
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$	=		13.28			
	Actual b/t ratio	=		15.00	>	13.28	
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)	=		2325.91 Kg/sqcm.			
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=		125.66			
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=		1756.58 Kg/sqcm.			
j)	Permissible Compressive Load	=		1756.58	x	10.5000	
		=		18444.1 Kgs			
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$	=		6355.58 Kgs			
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$	t =	6 mm	=		6069.13 Kgs	
	No. of 16mm bolts required,	=		18444.12	/	6069.13	
		=		3.04 nos. Say			
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=		13688.092 kg			
	Maximum Tension in Bracing	=		13755.735 kg			
m)	In Compression	=	18444.1	/	13688.09	=	1.35 > 1.0 safe
	In Tension	=	20019.2	/	13755.74	=	1.46 > 1.0 safe

4.00 no.

B DESIGN OF BRACINGS - GB, JB

- a) Angle Section tried & adopted = 90 x 90 x 6
- b) Length of Angle, L2 = 4204.00 mm
- c) Slenderness $0.25 \cdot L2 / r_{vv}$ = 1051.00 / 17.50 = 60.06 < 200 hence o.k.
 Slenderness $0.5 \cdot L2 / r_{xx}$ = 2102.00 / 27.70 = 75.88 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 10.5000 sqcm.
- e) Net Area of Cross Section Ae = A1 + A2.k
 assuming 1 No.s 16mm Dia. Bolts
 $v = 4.1700 + 5.2200 \times 0.7056 = 7.8531$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 7.8531 = 20019.2 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 75.88
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 15.00 > 13.28
 Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1901.83$ Kg/sqcm.
 j) Permissible Compressive Load = 1901.83 x 10.5000 = 19969.2 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 6$ mm = 6069.13 Kgs
 No. of 16mm bolts required, = $19969.17 / 6069.13 = 3.29$ nos. Say **4.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 14893.349 kg
 Maximum Tension in Bracing = 15240.810 kg
- m) In Compression = 19969.2 / 14893.35 = **1.34 > 1.0 safe**
 In Tension = 20019.2 / 15240.81 = **1.31 > 1.0 safe**

C DESIGN OF BRACINGS - GC, JC

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L2 = 3453.00 mm
- c) Slenderness $0.5 \times L2 / r_{vv}$ = 1726.50 / 19.40 = 88.99 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 3453.00 / 30.50 = 113.21 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2$.k
assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 113.21
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1514.66$ Kg/sqcm.
j) Permissible Compressive Load = 1514.66 x 19.0000 = 28778.5 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161) = 6355.58$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 10 mm = 10115.22 Kgs
No. of 16mm bolts required, = 28778.52 / 6355.58 = 4.53 nos. Say **5.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 22718.059 kg
Maximum Tension in Bracing = 21639.828 kg
- m) In Compression = 28778.5 / 22718.06 = **1.27 > 1.0 safe**
In Tension = 36948.8 / 21639.83 = **1.71 > 1.0 safe**

D DESIGN OF BRACINGS - GD, JD

- a) Angle Section tried & adopted = 50 x 50 x 5
- b) Length of Angle, L2 = 2286.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1143.00 / 9.70 = 117.84 < 200 hence o.k.
 Slenderness $L2 / r_{xx}$ = 2286.00 / 23.10 = 98.96 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 4.7900 sqcm.
- e) Net Area of Cross Section $A_e = A1 + A2.k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 1.5000 + 2.3750 \times 0.6545 = 3.0545$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.0545 = 7786.6 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 117.84
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 10.00 < 13.28
 Value of $F_y = 2549.20$ Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1428.46$ Kg/sqcm.
 j) Permissible Compressive Load = 1428.46 x 4.7900 = 6842.3 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161) = 6355.58$ Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
 No. of 16mm bolts required, = $6842.34 / 5057.61 = 1.35$ nos. Say
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 1653.574 kg
 Maximum Tension in Bracing = 1613.331 kg
- m) In Compression = 6842.3 / 1653.57 = 4.14 > 1.0 safe
 In Tension = 7786.6 / 1613.33 = 4.83 > 1.0 safe

2.00 no.

MEMBER & CONNECTION BOLT DESIGN FOR
BEAM-G1

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MAINBUS BEAM MKD."4T1"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

A DESIGN OF MAIN-LEG FOR PART - MA

- a) Angle Section tried & adopted = 130 x 130 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 43885.04 kg
Maximum Tension in main leg for Panel = 47189.72 kg
- c) Effective Length of Angle, L1 & L2 = 1035.00 & 1035.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1035.00 / 25.70 = 40.27 < 120$ hence o.k.
 $L2/r_{xx} = 1035.00 / 40.20 = 25.75 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 25.1000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 21.60$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 21.60 = 55062.7$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 40.27
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 13.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2418.29$ Kg/sqcm.
- k) Permissible Compressive Load = $2418.29 \times 25.1000 = 60699.1$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t) = 10115.22$ Kgs
No. of 16mm bolts required, $t = 10$ mm = $55062.71 / 10115.22 = 5.44$ nos. Say **6.00 no.**
- p) Ultimate Maximum Compression per Leg = $43885.04 \times 1.00 = 43885.04$ Kg.
- q) Ultimate Maximum Tension per Leg = $47189.72 \times 1.00 = 47189.72$ Kg.
- r) Factor of Safety
In Compression = $60699.1 / 43885.04 = 1.38 > 1.0000$ It is Safe
In Tension = $55062.7 / 47189.72 = 1.17 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

B DESIGN OF MAIN-LEG FOR PART - MB

- a) Angle Section tried & adopted = 150 x 150 x 12
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 72668.35 kg
Maximum Tension in main leg for Panel = 68912.906 kg
- c) Effective Length of Angle, L1 & L2 = 1310.00 & 1310.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1310.00 / 29.70 = 44.11 < 120$ hence o.k.
 $L2/r_{xx} = 1310.00 / 46.30 = 28.29 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 34.8000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 30.60$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 30.60 = 78005.5$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 44.11
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 12.50 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2392.17$ Kg/sqcm.
- k) Permissible Compressive Load = $2392.17 \times 34.8000 = 83247.5$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t) = 12138.27$ Kgs
 $t = 12$ mm
No. of 16mm bolts required, = $78005.51 / 12138.27 = 6.43$ nos. Say **7.00 no.**
- p) Ultimate Maximum Compression per Leg = $72668.35 \times 1.00 = 72668.35$ Kg.
- q) Ultimate Maximum Tension per Leg = $68912.91 \times 1.00 = 68912.91$ Kg.
- r) Factor of Safety
In Compression = $83247.5 / 72668.35 = 1.15 > 1.0000$ It is Safe
In Tension = $78005.5 / 68912.91 = 1.13 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1) & BEAM (G1)

C DESIGN OF MAIN-LEG FOR PART - AA, AB

- a) Angle Section tried & adopted = 130 x 130 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 18429.34 kg
Maximum Tension in main leg for Panel = 15123.655 kg
- c) Effective Length of Angle, L1 & L2 = 2200.00 & 2200.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 2200.00 / 25.70 = 85.60 < 120$ hence o.k.
 $L2/r_{xx} = 2200.00 / 40.20 = 54.73 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 25.1000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 21.60$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 21.60 = 55062.7$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 85.60
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 13.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1957.73$ Kg/sqcm.
- k) Permissible Compressive Load = $1957.73 \times 25.1000 = 49139.0$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t) \quad t = 10 \text{ mm} = 10115.22$ Kgs
No. of 16mm bolts required, $49138.99 / 10115.22 = 4.86$ nos. Say **5.00 no.**
- p) Ultimate Maximum Compression per Leg = $18429.34 \times 1.00 = 18429.34$ Kg.
- q) Ultimate Maximum Tension per Leg = $15123.66 \times 1.00 = 15123.66$ Kg.
- r) Factor of Safety
In Compression = $49139.0 / 18429.34 = 2.67 > 1.0000$ It is Safe
In Tension = $55062.7 / 15123.66 = 3.64 > 1.0000$ It is Safe

* DESIGN OF BRACINGS FOR BEAM MKD. "G1"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - SA & UA

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, $L2$	=	2431.00				
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1215.50	/	17.50		
	Slenderness $L2 / r_{xx}$	=	2431.00	/	27.70		
d)	Gross Area of Cross Section, A_g	=	10.5000 sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts						
	$v =$	=	4.1700	+	5.2200	x	0.7056
f)	Minimum guaranteed yield Stress of Material	=	250 Mpa				
g)	Permissible Tensile Stress	=	2549.20 Kg/sqcm.				
h)	Permissible Tensile Load	=	2549.20	x	7.8531		
		=	20019.2 Kgs				
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	87.76				
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	15.00 > 13.28				
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)	=	2325.91 Kg/sqcm.				
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=	1758.68 Kg/sqcm.				
j)	Permissible Compressive Load	=	1758.68	x	10.5000		
		=	18466.2 Kgs				
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$	=	6355.58 Kgs				
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$	=	6069.13	Kgs			
	No. of 16mm bolts required,	=	18466.19	/	6069.13		
		=	3.04 nos. Say				
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	11382.659 kg				
	Maximum Tension in Bracing	=	11229.269 kg				
m)	In Compression	=	18466.2	/	11382.66	=	1.62 > 1.0 safe
	In Tension	=	20019.2	/	11229.27	=	1.78 > 1.0 safe

4.00 no.

B DESIGN OF BRACINGS - SB & UB

- a) Angle Section tried & adopted = 65 x 65 x 5
- b) Length of Angle, L_2 = 2560.00 mm
- c) Slenderness $0.5 \cdot L_2 / r_{vv}$ = 1280.00 / 12.60 = 101.59 < 200 hence o.k.
 Slenderness L_2 / r_{xx} = 2560.00 / 19.90 = 128.64 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 6.2500 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 2.2500 + 3.1250 \times 0.6835 = 4.3861$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 4.3861 = 11181.0 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 128.64
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 13.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [3.1415^2 \times E / \{ KL/r \}^2] = 1216.24$ Kg/sqcm.
- j) Permissible Compressive Load = 1216.24 x 6.2500 = 7601.5 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
 No. of 16mm bolts required, = 7601.51 / 5057.61 = 1.50 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 5628.085 kg
 Maximum Tension in Bracing = 5790.790 kg
- m) In Compression = 7601.5 / 5628.09 = **1.35 > 1.0 safe**
 In Tension = 11181.0 / 5790.79 = **1.93 > 1.0 safe**

C DESIGN OF BRACINGS - DA, DB

- a) Angle Section tried & adopted = 90 x 90 x 6
- b) Length of Angle, L_2 = 2125.00 mm
- c) Slenderness $0.5 \cdot L_2 / r_{vv}$ = 1062.50 / 17.50 = 60.71 < 200 hence o.k.
Slenderness L_2 / r_{xx} = 2125.00 / 27.70 = 76.71 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 10.5000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 4.1700 + 5.2200 \times 0.7056 = 7.8531$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 7.8531 = 20019.2 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 76.71
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1892.49$ Kg/sqcm.
- j) Permissible Compressive Load = 1892.49 x 10.5000 = 19871.2 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 6$ mm = 6069.13 Kgs
No. of 16mm bolts required, = $19871.19 / 6069.13 = 3.27$ nos. Say **4.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 3444.662 kg
Maximum Tension in Bracing = 5174.634 kg
- m) In Compression = 19871.2 / 3444.66 = **5.77 > 1.0 safe**
In Tension = 20019.2 / 5174.63 = **3.87 > 1.0 safe**

D DESIGN OF BRACINGS - YH, YC, YD, SV

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L2 = 2200.00 mm
- c) Slenderness $0.5 \times L2/r_{vv}$ = 1100.00 / 19.40 = 56.70 < 200 hence o.k.
 Slenderness $L2/r_{xx}$ = 2200.00 / 30.50 = 72.13 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2.k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 72.13
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 10.00 < 13.28
 Value of $F_y = 2549.20$ Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2129.25$ Kg/sqcm.
- j) Permissible Compressive Load = 2129.25 x 19.0000 = 40455.7 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 10 mm = 10115.22 Kgs
 No. of 16mm bolts required, = 36948.80 / 9930.60 = 3.72 nos. Say **4.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 20988.827 kg
 Maximum Tension in Bracing = 17463.633 kg
- m) In Compression = 40455.7 / 20988.83 = **1.93 > 1.0 safe**
 In Tension = 36948.8 / 17463.63 = **2.12 > 1.0 safe**

BASE PLATE & ANCHOR BOLT DESIGN

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T1" (NORMAL CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	72746.26
B) MAXIMUM TENSION PER LEG	66288.31	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	4503.50	2034.28
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	3862.15	6695.69
E) RESULTANT SHEAR	5932.77	6997.89
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 72746.258 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 66288.313 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 72746.258 Kgs (Working)
- b) Maximum Tensile Load per Leg = 66288.313 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 92.67 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm ($A_1 = B \times D$)
- f) Main leg angle = L200x200x20
- g) Base Plate Size adopted b x l = 550.00 x 550.00 x 36.00 mm ($A_2 = b \times l$)
- h) Net Area of Base Plate provided = 550.000 x 550.000 = 3025.000 sqcm
- i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $72746.258 / 3025.000 + 0.000 / 27729.167$
= 24.048 Kg/sqcm.
< $92.670 \text{ Kg/sqcm. 'hence o.k.}$
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 217.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $24.0483 \times 55.000 \times 21.790^2 / 2.000$
= 314002.014 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
- b) Edge distance of Bolts = 100.00 mm
- c) Nominal Diameter of Bolts = 56.00 mm
- d) Diameter of Bolt Hole = 60.000 mm
- e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $217.900 - 100.000$
= 117.900 mm
- f) C/C of outer line of bolts, 'a' = $550.000 - 100.000 - 100.000$
= 350.000 mm
- g) Tension per bolt, $t = P/4 + M_x/n.a + M_y/n.a$ = $66288.313 / 4.000 + 0.000 / 70.000$
= 16572.078 Kgs
- h) Bending moment @ face of Stiffener = $2.000 \times 16572.0783 \times 11.790$
= 390769.605 Kg-cm
- Maximum bending moment = 390769.605 Kg-cm
- Minimum section modulus Z_{min} = 750.956 cm^3
- i) Maximum bending stress = $520.3630 \text{ Kg / sq. cm}$
< $1850.000 \text{ Kg / sq. cm}$

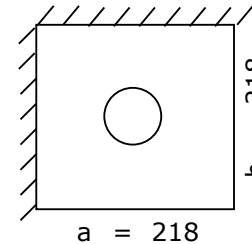
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

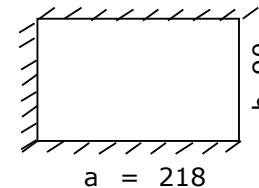
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 218 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 24.0483 \\ s_b &= 1.769 \times 24 \times 21.79^2 / 3.60^2 = 1558.56 \\ \text{Allowable bending stress } (1.00 \times 1850) &< 1850 \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 218 \text{ mm} \quad b = 90 \text{ mm} \\ a / b &= 2.416 \quad \beta = 0.798 \quad q = 24.0483 \\ s_b &= 0.798 \times 24 \times 9.02^2 / 3.60^2 = 120.47 \\ \text{Allowable bending stress } (1.00 \times 1850) &< 1850 \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(Stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	66288.31 Kgs.
c) Thus force / cm of weld length	=	207.15 Kgs.
d) Resistance /cm ² of weld	=	1100.00 Kgs.
e) Throat Size of weld required	=	0.19 cms
f) Thus fillet thickness required	=	2.66 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)

H Design of Anchor Bolts

Diameter of Bolt	=	56 mm
Nos. of Bolts per Leg	=	4
Root area of M56 bolts, Ae=0.785*Ag	=	1933 mm ²
Gross area of M56 bolts, Ag	=	2463 mm ²

Check for Normal Condition :-

Axial Tension in Each Bolt Pt	=	16572.1 Kgs.

Tensile stress,ft = Pt/Ae	=	$\frac{16572.1}{19.33}$	
	=	857.12 Kg/cm ²	< 1200.0 Kg/cm ²
Permissible tensile stress,Ft	=	1200 x 1.00	Hence Safe

Shear Force In Each Bolt , Ps	=	5932.77 / 4	= 1483.19 kg
Shear stress, fs = Ps/Ag	=	$\frac{1483.19}{24.63}$	
	=	60.22 Kg/cm ²	< 800.0 Kg/cm ²
Permissible Shear stress,Fs	=	800.00 x 1.00	Hence Safe

Combined stress check for Normal Condition :-

$$fs/Fs + ft/Ft < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{857.12}{1200} + \frac{60.22}{800} = 0.79 \quad \text{Hence Safe.}$$

Anchor length For Normal Condition :-

Anchor Length, Le	=	Pull per bolt / ($\pi \times d \times \tau_{bd}$)	
	=	$\frac{16572.08}{17.59 \times 8.00}$	($\tau_{bd} = 8 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000)
Thus length of embedment 'L'	=	117.75 cms.	

PROVIDE 4 NOS. 56 MM DIA. ANCHORE BOLT WITH MIN. 1200MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T1" (SHORT CIRCUIT CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

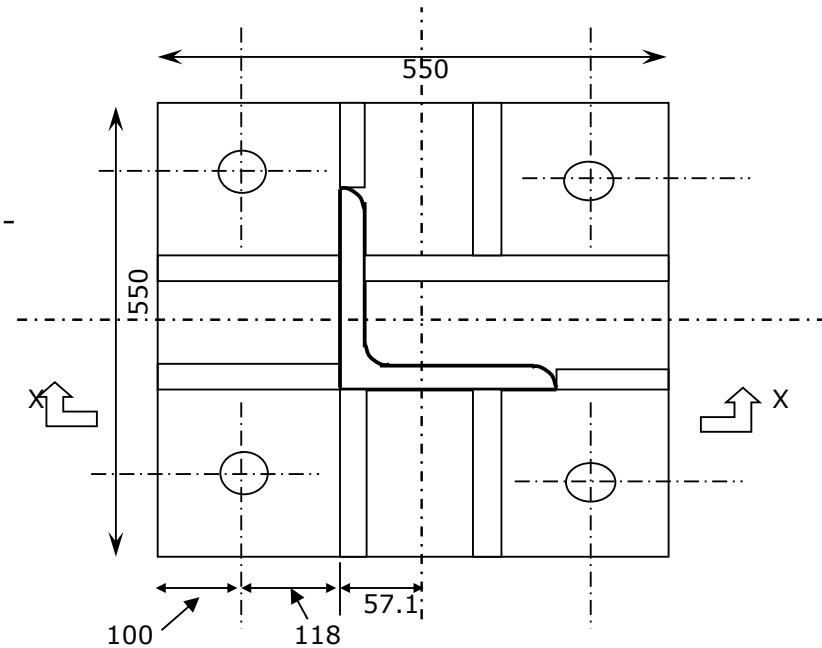
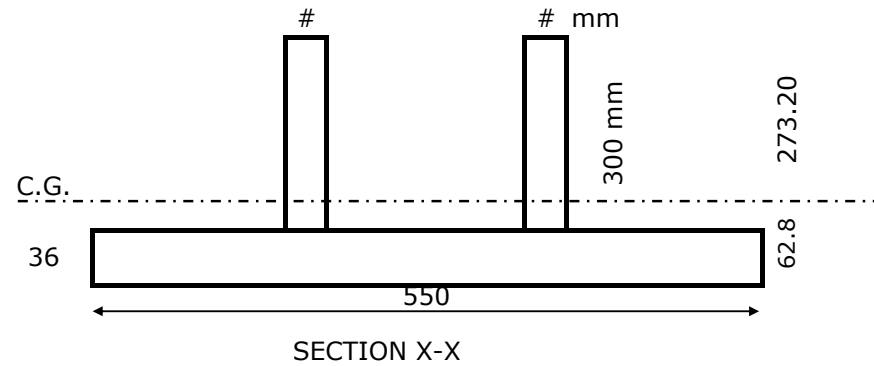
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	56643.33
B) MAXIMUM TENSION PER LEG	50106.02	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	4109.87	2019.63
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	2403.47	4887.40
E) RESULTANT SHEAR	4761.06	5288.25
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 56643.331 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 50106.016 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 56643.331 Kgs (Working)
- b) Maximum Tensile Load per Leg = 50106.016 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 92.67 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress **σ_{bs}** in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm ($A_1 = B \times D$)
- f) Main leg angle = L200x200x20
- g) Base Plate Size adopted b x l = 550.00 x 550.00 x 36.00 mm ($A_2 = b \times l$)
- h) Net Area of Base Plate provided = 550.000 x 550.000 = 3025.000 sqcm
- i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)



C Section modulus

Moment of Inertia @ C G axis Ixx	=	205161120.00 mm ⁴
Section Modulus Zxx(top)	=	750955.78 mm ³
Section Modulus Zxx(bottom)	=	3266896.82 mm ³
Minimum Section Modulus Zxx(top)	=	750.956 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $56643.331 / 3025.000 + 0.000 / 27729.167$
= 18.7251 Kg/sqcm.
< 92.670 Kg/sqcm. 'hence o.k.
b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 217.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $18.7251 \times 55.000 \times 21.790^2 / 2.000$
= 244495.325 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
b) Edge distance of Bolts = 100.00 mm
c) Nominal Diameter of Bolts = 56.00 mm
d) Diameter of Bolt Hole = 60.000 mm
e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $217.900 - 100.000$
= 117.900 mm
f) C/C of outer line of bolts, 'a' = $550.000 - 100.000 - 100.000$
= 350.000 mm
g) Tension per bolt, $t = P/4 + M_x/n.a + M_y/n.a$ = $50106.016 / 4.000 + 0.000 / 70.000$
= 12526.504 Kgs
h) Bending moment @ face of Stiffener = $2.000 \times 12526.504 \times 11.790$
= 295374.964 Kg-cm
Maximum bending moment = 295374.964 Kg-cm
Minimum section modulus Z_{min} = 750.956 cm^3
i) Maximum bending stress = $393.3320 \text{ Kg / sq. cm}$
< $1850.000 \text{ Kg / sq. cm}$

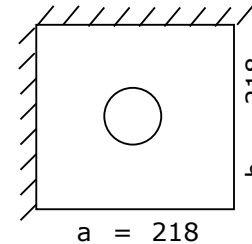
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

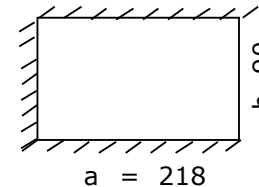
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 218 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 18.7251 \\ s_b &= 1.769 \times 19 \times 21.79^2 / 3.60^2 = 1213.56 \\ \text{Allowable bending stress } (1.25 \times 1850) &< 2312.5 \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 218 \text{ mm} \quad b = 90 \text{ mm} \\ a / b &= 2.416 \quad \beta = 0.798 \quad q = 18.7251 \\ s_b &= 0.798 \times 19 \times 9.02^2 / 3.60^2 = 93.81 \\ \text{Allowable bending stress } (1.25 \times 1850) &< 2312.5 \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	50106.02 Kgs.
c) Thus force / cm of weld length	=	156.58 Kgs.
d) Resistance /cm ² of weld	=	1375.00 Kgs.
e) Throat Size of weld required	=	0.11 cms
f) Thus fillet thickness required	=	1.61 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T1)

H Design of Anchor Bolts

Diameter of Bolt	=	56 mm
Nos. of Bolts per Leg	=	4
Root area of M56 bolts, Ae=0.785*Ag	=	1933 mm ²
Gross area of M56 bolts, Ag	=	2463 mm ²

Check for Short Circuit Condition :-

Axial Tension in Each Bolt Pt	=	12526.5 Kgs.

Tensile stress,ft = Pt/Ae	=	$\frac{12526.5}{19.33}$	
	=	647.88 Kg/cm ²	< 1500.0 Kg/cm ²
Permissible tensile stress,Ft	=	1200 x 1.25	Hence Safe

Shear Force In Each Bolt , Ps	=	4761.06 / 4	= 1190.27 kg
Shear stress, fs = Ps/Ag	=	$\frac{1190.27}{24.63}$	
	=	48.33 Kg/cm ²	< 1000.0 Kg/cm ²
Permissible Shear stress,Fs	=	800.00 x 1.25	Hence Safe

Combined stress check for Short Circuit Condition :-

$$fs/Fs + ft/Ft < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{647.88}{1500} + \frac{48.33}{1000} = 0.48 \quad \textbf{Hence Safe.}$$

Anchor length For Short Circuit Condition :-

Anchor Length, Le	=	Pull per bolt / ($\pi \times d \times \tau_{bd}$)	
	=	$\frac{12526.50}{17.59 \times 10.64}$	($\tau_{bd} = 8 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000) (33% INCREASE)
Thus length of embedment 'L'	=	66.92 cms.	

PROVIDE 4 NOS. 56 MM DIA. ANCHORE BOLT WITH MIN. 700MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

400kV AIS

	OWNER MAHAN ENERGEN LIMITED (MEL) 2x800 MW ULTRA SUPER CRITICAL THERMAL POWER PROJECT, MAHAN (PHASE-II), SINGRAULI, M.P.
	OWNER'S ENGINEER TATA CONSULTING ENGINEERS LIMITED
 Godrej & Boyce Mfg. Co. Ltd.	EPC Contractor GODREJ AND BOYCE MFG. CO. LTD

DOCUMENT TITLE	4T2 TOWER & BEAM G2 TYPE STRUCTURE-DESIGN & LINE DIAGRAM
OWNER DOC. NO.	552H-E-EPC-SYD-DC-U-V-0002
CONTRACTOR / SUPPLIER DOC. NO.	GNB-MEL-CE-013
PACKAGE DISCIPLINE	CIVIL
PREPARED BY	JMP
REVIEWED BY	NT
APPROVED BY	NMP

Sr. No.	Revision No.	Date	Reasons for Change
1	0	08.07.2024	First issue
2	1	26.07.2024	Revised submission

**CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER
PROJECT AT SINGRAULI ,MP**

DESIGN FOR **400KV** GANTRY TOWER (**4T2**) & BEAM (**G2**)

INDEX

Sr.No.	Description	Page no.
1	GEOMETRY	3
2	LOAD EVALUATION	6,16
3	PICTORIAL VIEW OF STAAD MODEL	33
4	STAAD ANALYSIS & DESIGN	39
5	MEMBER & CONNECTION BOLT DESIGN	48,54
6	BASE PLATE & ANCHOR BOLT DESIGN	67

GEOMETRY

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL
4T2	ANGLE SIZE	L150x150x16	L150x150x16	L130x130x12	L130x130x12	L130x130x10	L130x130x10	L130x130x10	L130x130x10	L75x75x5	L75x75x5	L75x75x5	L75x75x5
	NO. OF BOLTS	10	10	06	06	06	06	06	06	04	04	04	04

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	GA,JA	GB,JB	GC,JC	GD,JD	GE,JE	AA,AB	DA,DB
4T2	ANGLE SIZE	L75x75x5	L75x75x5	L100x100x10	L50x50x5	L45x45x5	L100x100x10	L60x60x5
	NO. OF BOLTS	03	03	05	02	01	04	02

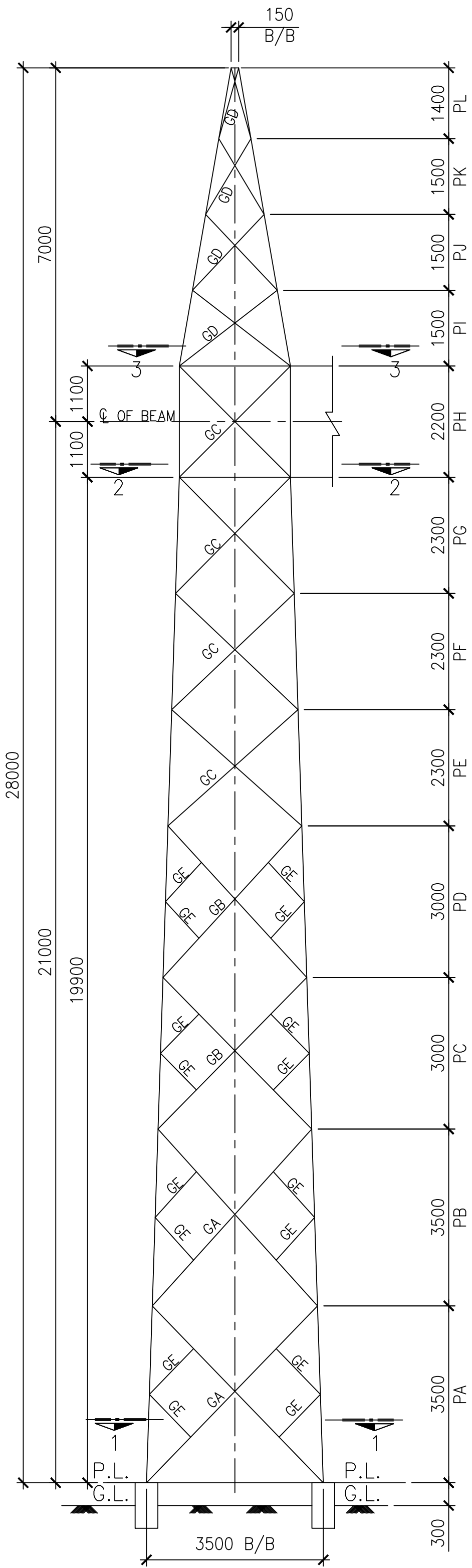
B

C

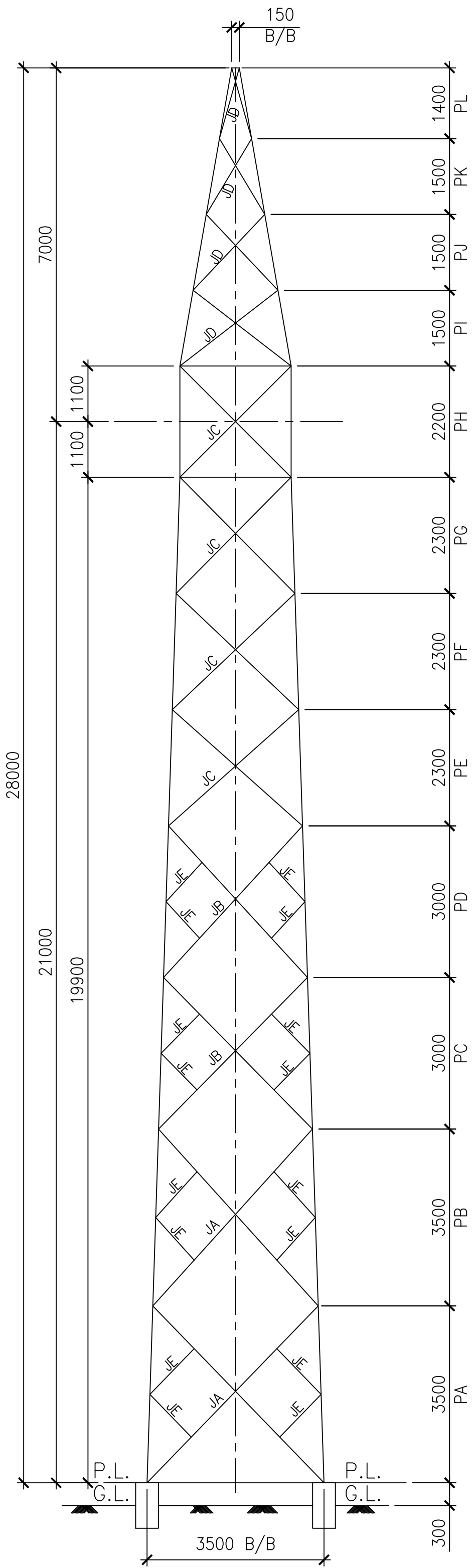
D

E

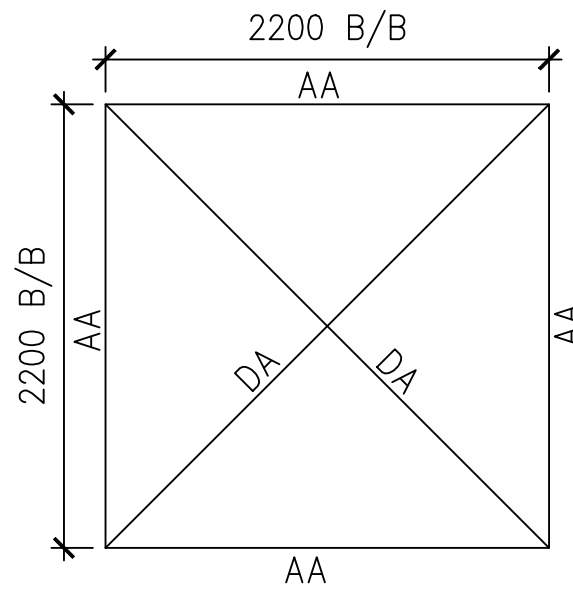
F



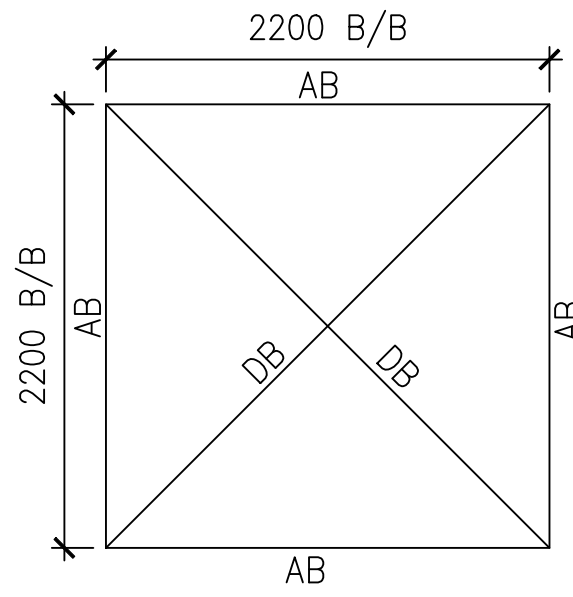
TRANSVERSE FACE



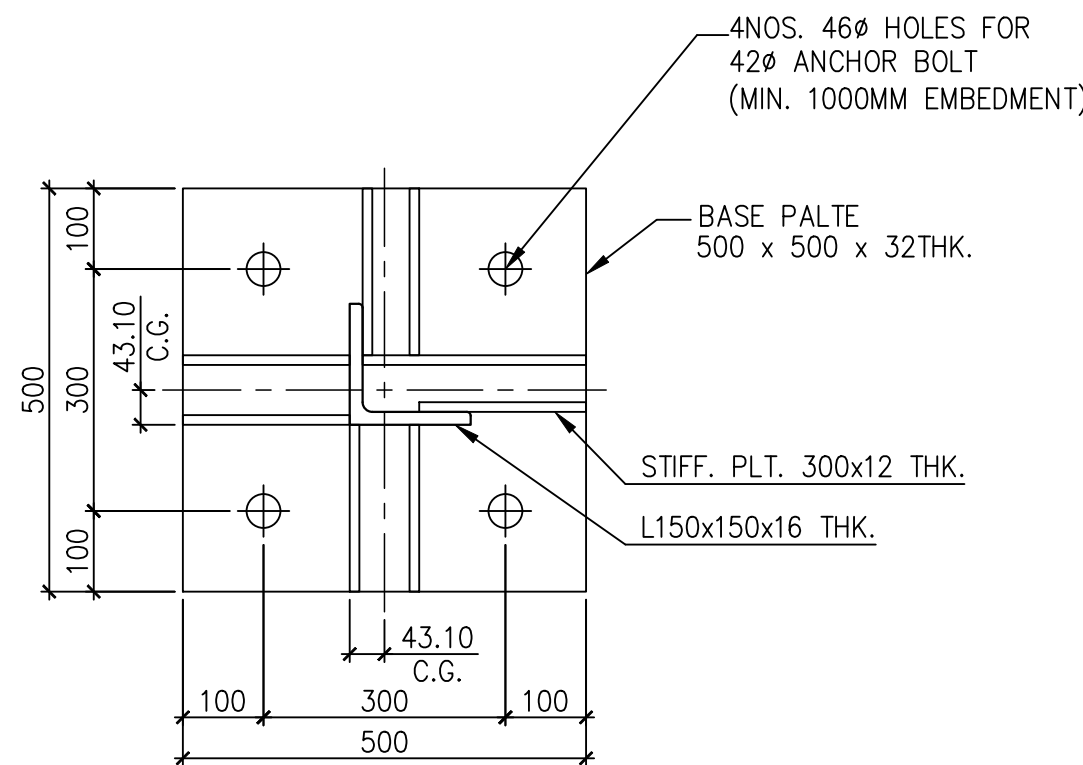
LONGITUDINAL FACE



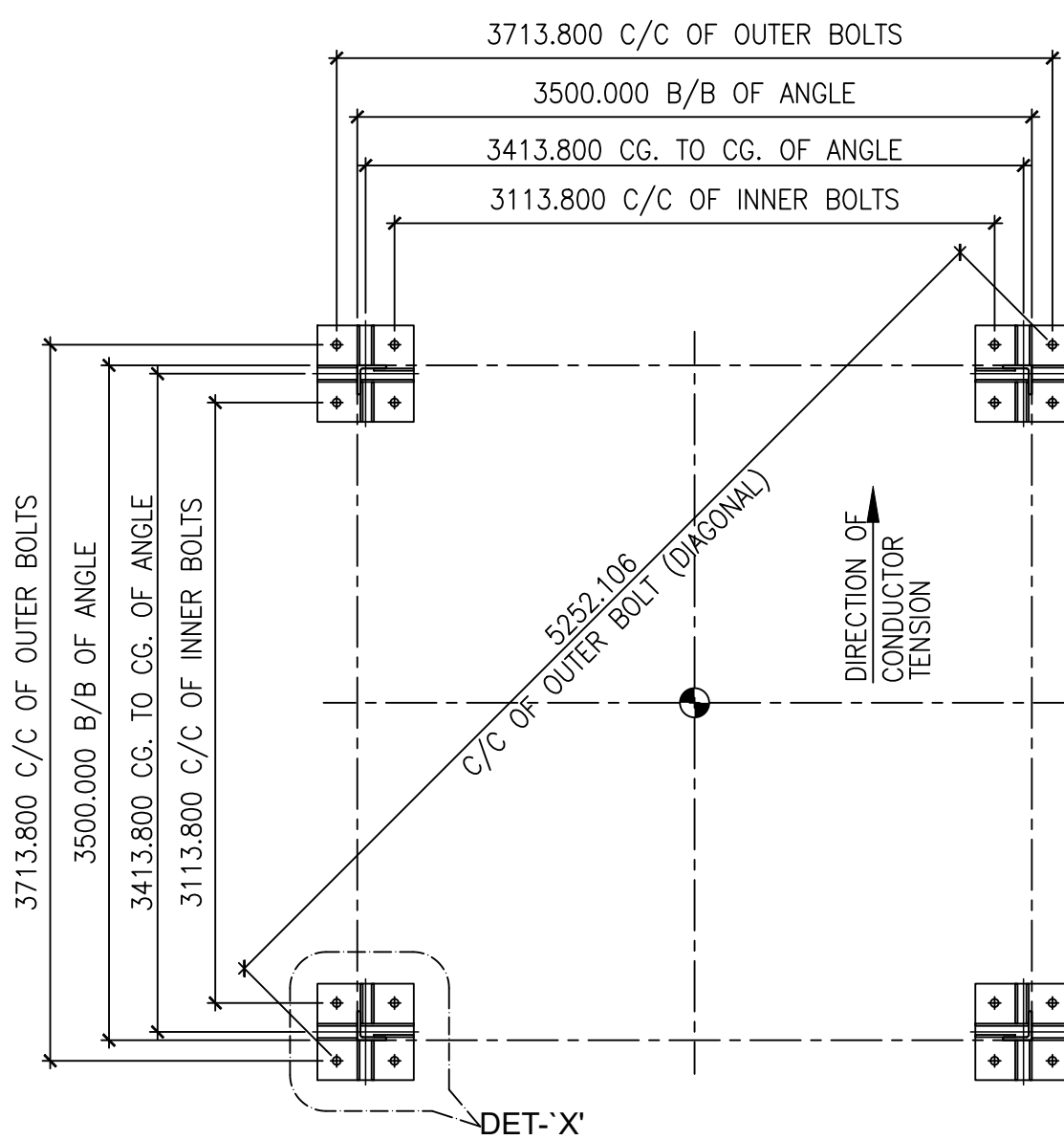
SECTION '2-2'



SECTION '3-3'



DETAIL AT 'X'



SECTION '1-1'
ANCHOR BOLT SETTING PLAN

REFERENCE DWG NO.: –
552H-E-EPC-SYD-DE-L-V-0003

LEGEND: –

TOWER MARKED '4T2 TOWER' IS A END TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF INTERMEDIATE GANTRY WITH CONDUCTOR TENSION OF 2.780T UNDER NORMAL CONDITION & 7.954T UNDER SHORT CIRCUIT CONDITION WITHOUT DEVIATION.

HIGHLIGHT: –

SPAN OF GIRDER	27.00 M.
HEIGHT OF GIRDER	21.00 M.
HEIGHT OF TOWER	28.00 M.
CONDUCTOR TENSION	2.780T (NC)
	7.954T (SC)
CONDUCTOR DEVIATION	0 DEGREE

NOTES: –

- ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS 16mm DIA BOLT

400kV TOWER MKD. 4T2

BEAM MKD.	ANGLE SIZE AND NO. OF BOLTS	MA	MB	SA	SB	UA	UB	SV	YH	YD	YC
G2	ANGLE SIZE	L100x100x10	L130x130x12	L60x60x5	L50x50x5	L60x60x5	L50x50x5	L60x60x5	L60x60x5	L60x60x5	L60x60x5
	NO. OF BOLTS	04	06	02	02	02	02	02	02	02	02

LEGEND: –

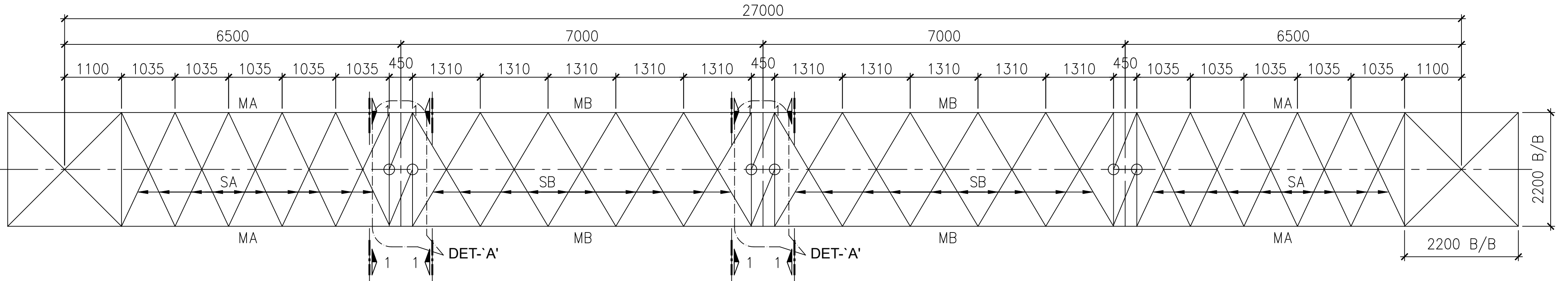
TOWER MARKED ‘4T2 TOWER’ IS A END TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF INTERMEDIATE GANTRY WITH CONDUCTOR TENSION OF 2.780T UNDER NORMAL CONDITION & 7.954T UNDER SHORT CIRCUIT CONDITION WITHOUT DEVIATION.

HIGHLIGHT: –

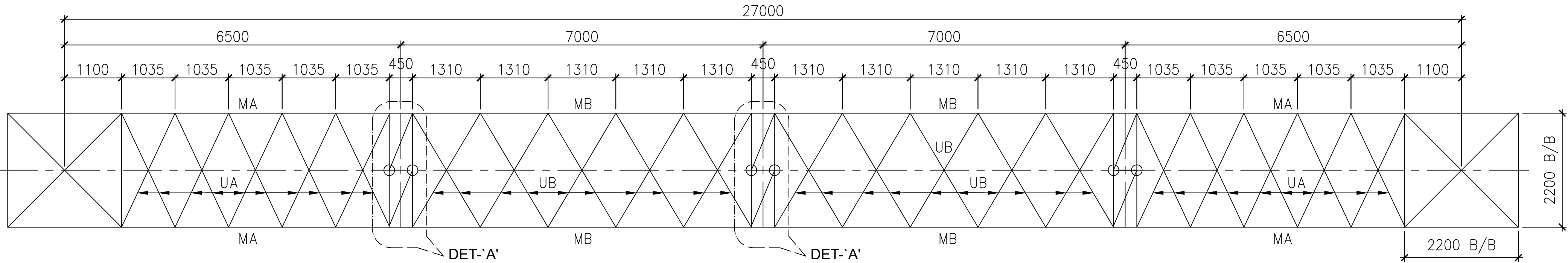
SPAN OF GIRDER 27.00 M.
HEIGHT OF GIRDER 21.00 M.
HEIGHT OF TOWER 28.00 M.
CONDUCTOR TENSION 2.780T (NC)
7.954T (SC)
CONDUCTOR DEVIATION 0 DEGREE

NOTES: –

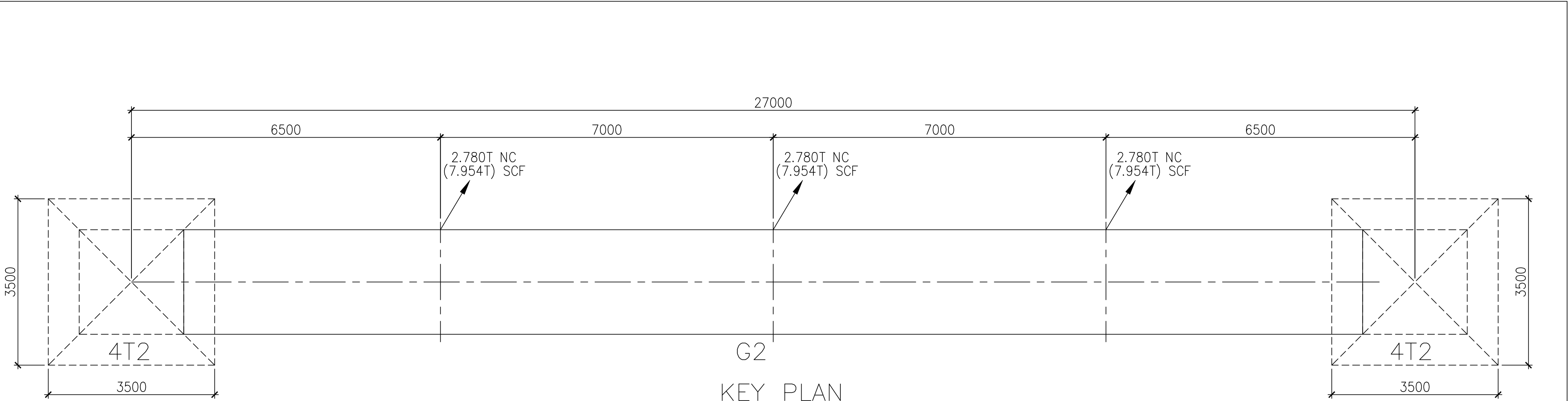
1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS
16mm DIA BOLT
6 DETAILS FOR TENSION AND SUSPENSION WILL BE PROVIDED IN FABRICATION DRAWING.



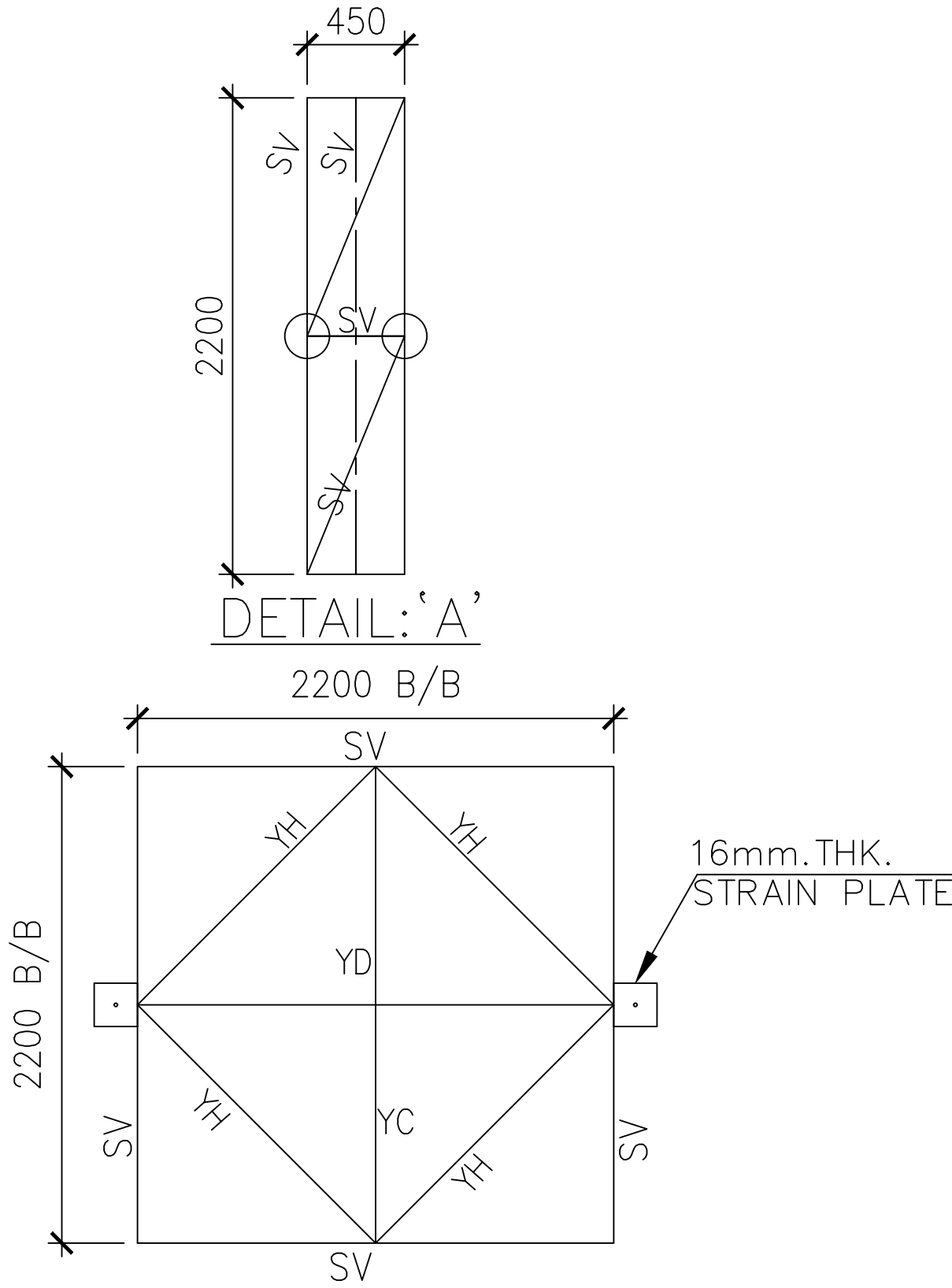
TOP PLAN



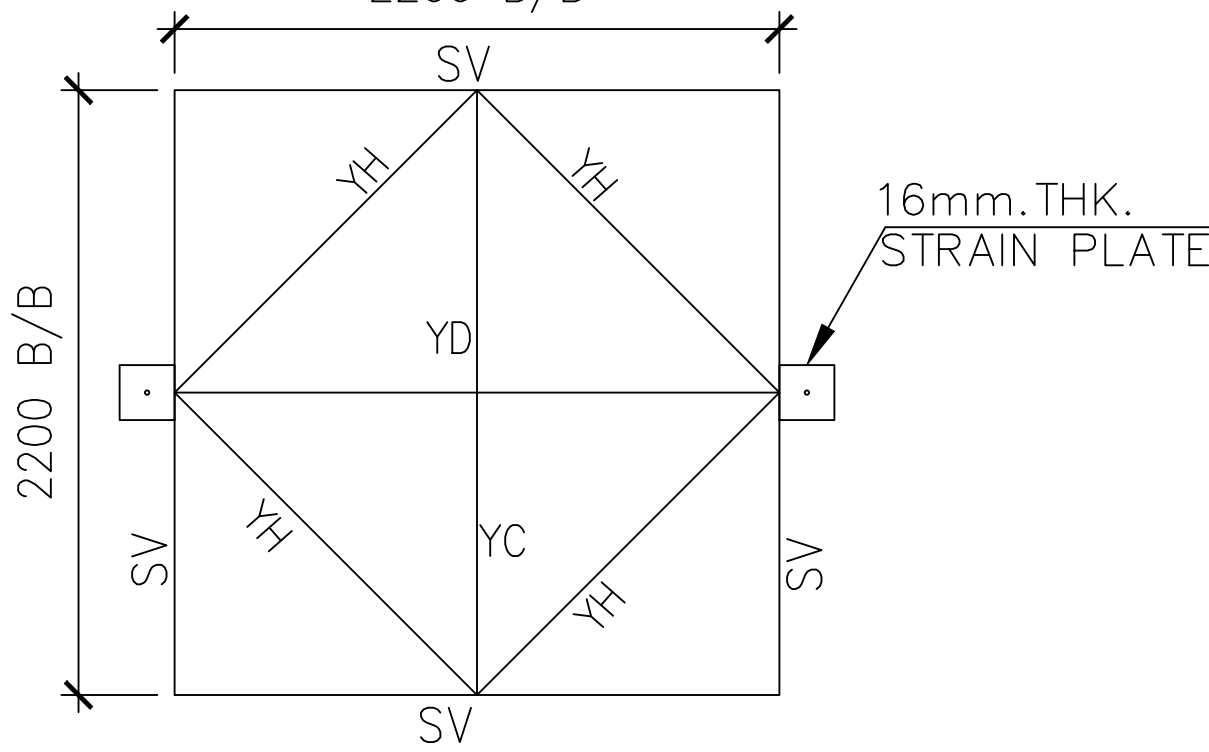
ELEVATION



KEY PLAN



DETAIL: 'A'



SECTION '1-1'

400kV TOWER MKD. G2

LOAD EVALUATION FOR BEAM-G2

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN OF "G2" BEAM
* LOAD EVALUATION FOR 400 kV BEAM MKD. "G2" (WITH ZERO DEVIATION IN PLAN & ELEVATION)	

SUMMARY OF CONDUCTOR AND INSULATOR FORCES				
		CONDUCTOR & INSULATOR FORCES		
		TRANSVERSE LOAD (kg)	VERTICAL LOAD (kg)	LONGITUDINAL LOAD (kg)
(1) NO DEVIATION	WIND PARALLEL TO BEAM (NC)	810.00	0.00	1390.00
	WIND PARALLEL TO BEAM (SC)	810.00	0.00	3977.00
	WIND PERPENDICULAR TO BEAM (NC)	0.00	0.00	1548.20
	WIND PERPENDICULAR TO BEAM (SC)	0.00	0.00	4135.20
	SELF WEIGHT OF INSULATOR & COND. (LEFT)	0.00	393.90	0.00
	SELF WEIGHT OF INSULATOR & COND. (RIGHT)	0	393.90	0
	EARTH WIRE LOAD			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)				
* LOAD EVALUATION FOR 400kV BEAM MKD. "G2" (WITHOUT DEVIATION IN PLAN & ELEVATION)					
# <u>GENERAL NOTES & WIND PRESSURE EVAULATION : -</u>					
* LOADS					
a)	All Dead & Live Loads shall be as per	=	I.S. 802		
b)	All Wind Loads shall be as per	=	I.S. 802		
* FACTOR OF SAFETY					
a)	IN NORMAL CONDITION	=	2.0		
b)	IN SHORT-CIRCUIT CONDITION	=	1.50		
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015					
a)	Basic Wind Speed	Vb	=	39	m/s (As Per Technical Specifications)
b)	Reliabilty level		=	1.00	(As Per Technical Specifications)
c)	Terrain Category		=	1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s (As Per Cl. 8.3 of IS802 (P1/S1)-2015)
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm (As Per Cl. 8.4 of IS802 (P1/S1)-2015)

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)									
*	CONDUCTOR DETAILS									
a)	Description	=	ACSR MOOSE							
b)	Dia. of conductor	=	31.770	mm	(As per Electrical Input)					
c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)					
d)	Tension per phase	=	2780	Kg/phase	(Normal Condition)					
		=	7954	Kg/phase	(Short-Circuit Condition)					
f)	No. of Sub conductor per phase	=	4	(As per Electrical Input)						
g)	No. of tension insulator / phase	=	2	(As per Electrical Input)						
h)	No. of suspension insulator / phase	=	1	(As per Electrical Input)						
i)	Length of wire on left side, L1 =	=	51.20	m	(As per T.S. 2.26, Cl 7.9,) / (As Per site conditions)					
j)	Length of wire on right side, L2 =	=	52.50	m						
k)	Conductor span	=	81.85	m						
	Left side Span (50%) = (52.50)			x	0.50	=	26.25	m		
	Right side Span (50%) = (51.20)			x	0.50	=	25.60	m		
	Add 30 m for Jumpers/ droppers(ASSUMED)					=	30.00	m		
l)	Angle of Deviation									
	In plan	=	0	deg.						
	In Elevation	=	0	deg.						
*	INSULATOR DETAILS									
a)	Weight of suspension insulator string with hardware	=	65.40	Kg						
b)	Weight of tension insulator string with hardware	=	65.40	Kg						
c)	Length of tension insulator	=	4.975	m						
d)	Length of suspension insulator	=	4.975	m						
e)	Diameter of tension insulator	=	135.00	mm						
d)	Diameter of suspension insulator	=	135.00	mm						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*

GIRDER DETAILS

- a) C/C of girder = 27.00 m
- b) Length of parts being on either side being = 5.400 & 7.000 m
- c) Hamper width of tower = 2.20 m
- d) Clear span of girder = 24.80 m
- e) Width of girder = 2.20 m
- f) Depth of girder = 2.20 m
- g) Height of Girder from Plinth Level = 20.25 m

	Vertical	Longitudial	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	2780.00	0.00
Load Due to Short Circuit Tension Due to Deviations in kg	0.00	7954.00	0.00

#

GEOMETRY FOR GIRDER :-

Part		Section		No. of pieces	Length in m
Main Leg					
Chord Central	MC	L	130x130x12	4	14.000
Chord Left	MA	L	100x100x10	4	5.400
Chord Right	MA	L	100x100x10	4	5.400
Plan					
Horizontal Belt	SV	L	60x60x5	6	2.200
Lattice Left	SA	L	60x60x5	20	2.431
Lattice Central	SB	L	50x50x5	40	2.560
Lattice Right	SA	L	60x60x5	20	2.431
Elevation					
Vertical Belt	SV	L	60x60x5	6	2.200
Lattice Left	UA	L	60x60x5	20	2.431
Lattice Central	UC	L	50x50x5	40	2.560
Lattice Right	UA	L	60x60x5	20	2.431
Connector Vertical	YD	L	60x60x5	6	2.200
Connector Horizontal	YC	L	60x60x5	6	2.200
Diamong Bracing	YH	L	60x60x5	24	1.556

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)									
# <u>LOAD CALCULATIONS :-</u>										
* VERTICAL LOADS :										
- Weight of Conductor										
a)	Length of conductor	=	26.25	+	25.60	+	30.00			
		=	81.85	m						
b)	Weight of conductor	=	81.85	x	2.004	x	4.00			
		=	656.11	Kgs		Say	=	657.00	Kgs	
- Weight of Insulator										
a)	Weight of tension insulators string with hardware	=	65.40	Kgs per phase						
b)	Weight of suspension Insulator string with hardware	=	65.40	Kgs per phase						
- Weight of line man with tools										
	at middle phase	=	150	Kgs						
- Loads due to Conductor Tension										
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						
* LONGITUDINAL LOADS :										
- Wind Load on Girder										
a)	Net Surface area	Ae	=	17.55	sqm (Refer the break up below)					
b)	Gross Surface Area	Ag	=	54.56	sqm					
c)	Solidity Ratio	Ae/Ag	=	0.3216						
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)					
f)	Wind Load Ws = Pz x Cdt x Gt x Ae	=	3356.44	Kgs		Say	=	3360.00	Kgs	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00 mm							
b)	Length of insulator, Li	=	0.00 m							
c)	Net area Exposed, Ai = 50% of Li.di	=	0.00 sqm							
d)	Ratio of Li / di		0.00							
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)						
f)	Gust Response Factor	Gi =	1.700	(As Per Table-6 of IS802 (P1/S1)-2015)						
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	0.00 Kgs	Say	=	0.00 Kgs				
h)	Wind Load on Tension insulator in Longitudinal Direction	=	0.00 Kg							
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00 mm							
b)	Length of insulator, Li	=	4.98 m							
c)	Net area Exposed, Ai = Li.di	=	0.67 sqm							
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)						
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)						
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69 Kgs	Say	=	91.00 Kgs				
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	91.00 Kg							
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77 mm							
b)	Length of conductor, Lc	=	0.00 m							
c)	Net area Exposed, Lc.dc	=	0.00 sqm							
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)						
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)						
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	0.00 Kg	Say	=	0.00 Kgs				
g)	Wind Load on Conductor in Longitudinal Direction	=	0.00 Kg							
-	Loads due to Conductor Tension									
a)	Normal Condition	=	2780.00 Kgs							
b)	Short Circuit Tension	=	7954.00 Kgs							

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)									
*	TRANSVERSE LOADS:									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction			=	91.00	Kg				
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction			=	91.00	Kg				
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	81.85	m						
c)	Net area Exposed, Lc.dc	=	2.60	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	627.01	Kg		Say	=	628.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction			=	628.00	Kg				
-	Loads due to Conductor Tension									
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP												
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)												
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>													
Dead load		Self Wt.		Self Wt.									
		Cond.		T-Insu.									
TOTAL FY / PHASE	=	657.00	+	65.40		=	722.40	Kgs					
FY / NODE	=	328.50	+	65.40		=	393.90	Kgs					
Dead load		Self Wt.		Self Wt.									
		Cond.		T-Insu.									
TOTAL FY / PHASE	=	0.00	+	0.00		=	0.00	Kgs					
FY / NODE	=	0.00	+	0.00		=	0.00	Kgs					
- JOINT LOAD ON NODE NO. : 4.00													
		Lineman											
		With Tool											
TOTAL FY	=	150.00				=	150.00	Kgs					
FY / NODE	=	37.50				=	37.50	Kgs					
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>													
- JOINT LOAD ON NODE NO. : 0.00													
Wind load		Wind on		Wind on		Wind on							
		Cond.		T-Insu.		sus.							
TOTAL FX / PHASE	=	628.00	+	91.00	+	91.00		=	810.00	Kgs			
FX / NODE	=	628.00	+	91.00	+	91.00		=	810.00	Kgs			
Cond. Tension				Conductor		Cond. Tension		Conductor		Cond. Tension			
				Tension				Tension					
TOTAL FX / PHASE	=			0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	2780.00	Kgs
FX / NODE	=			0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	1390.00	Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>													
- JOINT LOAD ON NODE NO. : 0.00													
Wind load		Wind on		Wind on		Wind on							
		Cond.		T-Insu.		S-Insu.							
TOTAL FX / PHASE	=	628.00	+	91.00	+	91.00		810.00	Kgs				
FX / NODE	=	628.00	+	91.00	+	91.00		810.00	Kgs				
Cond. Tension				Cond. Tension		Cond. Tension		Conductor		Cond. Tension			
								Tension					
TOTAL FX / PHASE	=			0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	7954.00	Kgs
FX / NODE	=			0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	3977.00	Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)										
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 1077 TO 1100											
Wind load	Wind on Cond.	Wind on T-Insu.	Wind on S-Insu.								
TOTAL FZ / PHASE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs		
FZ / NODE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs		
Cond. Tension	Cond. Tension			Cond. Tension	Conductor Tension	Cond. Tension	Conductor Tension				
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	= 2780.00 Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	= 1390.00 Kgs
- WIND LOAD ON JOINT : 0.00											
	Wind load on Str.										
TOTAL FZ	=	3360.00				=	3360.00	Kgs			
FZ / NODE	=	3360.00	/	50		=	67.20	Kgs			
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.	Wind on T-Insu.	Wind on T-Insu.								
TOTAL FZ / PHASE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs		
FZ / NODE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs		
Cond. Tension	Cond Tension			Cond. Tension	Conductor Tension	Cond. Tension	Conductor Tension				
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	= 7954.00 Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	= 3977.00 Kgs
- WIND LOAD ON JOINT :											
	Wind load on Str.										
TOTAL FZ	=	3360.00				=	3360.00	Kgs			
FZ / NODE	=	3360.00	/	50		=	67.20	Kgs			

LOAD EVALUATION FOR TOWER-4T2

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)		
* <u>GEOMETRY FOR MAINBUS MKD."4T2"</u>			
TRANSVERSE FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES
LONGITUDINAL FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES

TABLE 1.1 - DATA FOR THE DESIGN OF THE SIDEWALK								
SR. NO.	LEVEL m	SEGMENT m	T. WIDTH m	L. WIDTH m	WIDTH' T m	WIDTH' L m	ANGLE T - FACE	ANGLE L - FACE
PL	28.0000	0.0000	0.1500	0.1500	0.15	0.15	0.000	0.000
PK	26.6000	1.4000	0.6364	0.6364	0.39	0.39	74.311	74.311
PJ	25.1000	1.5000	1.1576	1.1576	0.90	0.90	59.120	59.120
PI	23.6000	1.5000	1.6788	1.6788	1.42	1.42	46.605	46.605
PH	22.1000	1.5000	2.2000	2.2000	1.94	1.94	37.720	37.720
PG	19.9000	2.2000	2.2000	2.2000	2.20	2.20	45.000	45.000
PF	17.6000	2.3000	2.3503	2.3503	2.28	2.28	45.312	45.312
PE	15.3000	2.3000	2.5005	2.5005	2.43	2.43	43.480	43.480
PD	13.0000	2.3000	2.6508	2.6508	2.58	2.58	41.764	41.764
PC	10.0000	3.0000	2.8467	2.8467	2.75	2.75	47.503	47.503
PB	7.0000	3.0000	3.0427	3.0427	2.94	2.94	45.533	45.533
PA	3.5000	3.5000	3.2714	3.2714	3.16	3.16	47.949	47.949
	0.0000	3.5000	3.5000	3.5000	3.39	3.39	45.951	45.951

WIDTH' = PLAN WIDTH AT THE GIVEN LEVEL - SEGMENT HEIGHT x TAN θ

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** SOLIDITY RATIO FOR LONGITUDINAL FACE FOR TOWER MKD."4T2"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	130x130x10	2.200	100x100x10	3.111	-	0.000	100x100x10	2.200	1.485	4.840	0.307	1.700
PG	130x130x10	2.300	100x100x10	3.235	-	0.000	100x100x10	2.200	1.538	5.233	0.294	1.706
PF	130x130x10	2.300	100x100x10	3.343	-	0.000	-	0.000	1.330	5.578	0.238	1.762
PE	130x130x10	2.300	100x100x10	3.453	-	0.000	-	0.000	1.353	5.924	0.228	1.772
PD	130x130x12	3.000	75X75X5	4.069	45x45x5	3.534	-	0.000	1.794	8.246	0.218	1.782
PC	130x130x12	3.000	75X75X5	4.204	45x45x5	3.602	-	0.000	1.821	8.834	0.206	1.794
PB	150x150x16	3.500	75X75X5	4.713	45x45x5	4.107	-	0.000	2.233	11.050	0.202	1.798
PA	150x150x16	3.500	75X75X5	4.870	45x45x5	4.185	-	0.000	2.265	11.850	0.191	1.809

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.150 \times 3.5 \times 2 + 0.075 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.265
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.265 / 11.849$	=	0.191
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	$= \text{Main leg} \times \text{length} \times 2 + \text{Bracing} \times \text{Length} \times 2 + \text{Secondary Bracing} \times \text{Length} \times 2 + \text{Horizontal} \times \text{Length}$		
	$= (0.13 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.330
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.329 / 5.578$	=	0.238

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** WIND LOAD ON LONGITUDINAL FACE FOR TOWER MKD."4T2"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliabilty level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd²
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T2" - TABLE 1

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.36	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.36	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.36	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.36	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.36	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.36	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.36	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.36	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.36	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.36	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.36	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.36	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T2" - TABLE 2

A Segment No. from Top	B Segment Top Levels (metres)	C Design Speed Vz (metres/sec)	D Design Pressure Pz (kg/metre2)	E Gross Area of Parts Ag (metres ²)	F Solidity Ratio (Actual)	G Force co-efficient Cdt	H Gust Coefficient Gt	I Wind Load Pz x Cdt x Gt x Ae (kg)
PL	28.0000	30.6327	57.4098	0.5505	0.6779	1.6000	1.9600	67.1878
PK	26.6000	30.6327	57.4098	1.3456	0.3120	1.7000	1.9600	80.2967
PJ	25.1000	30.6327	57.4098	2.1273	0.2129	1.7871	1.9600	91.0921
PI	23.6000	30.6327	57.4098	2.9091	0.1697	1.8303	1.9600	101.6756
PH	22.1000	30.6327	57.4098	4.8400	0.3068	1.7000	1.9600	284.0587
PG	19.9000	30.6327	57.4098	5.2328	0.2940	1.7060	1.9600	295.3011
PF	17.6000	30.6327	57.4098	5.5784	0.2384	1.7616	1.8500	248.8077
PE	15.3000	30.6327	57.4098	5.9239	0.2284	1.7716	1.8500	254.5873
PD	13.0000	30.6327	57.4098	8.2462	0.2175	1.7825	1.8500	339.5977
PC	10.0000	30.6327	57.4098	8.8342	0.2062	1.7938	1.7000	318.8850
PB	7.0000	30.6327	57.4098	11.0496	0.2021	1.7979	1.7000	391.8189
PA	3.5000	30.6327	57.4098	11.8499	0.1911	1.8089	1.7000	399.8478
	0.0000							0.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T2" - TABLE 3

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	284.0587	192.8671	22.1000	4262.3640	97.0000	97.0000
PG	2.3000	19.9000	295.3011	289.6799	19.9000	5764.6299	145.0000	145.0000
PF	2.3000	17.6000	248.8077	272.0544	17.6000	4788.1571	137.0000	137.0000
PE	2.3000	15.3000	254.5873	251.6975	15.3000	3850.9715	126.0000	126.0000
PD	3.0000	13.0000	339.5977	297.0925	13.0000	3862.2024	149.0000	149.0000
PC	3.0000	10.0000	318.8850	329.2413	10.0000	3292.4133	165.0000	165.0000
PB	3.5000	7.0000	391.8189	355.3519	7.0000	2487.4636	178.0000	178.0000
PA	3.5000	3.5000	399.8478	395.8334	3.5000	1385.4168	198.0000	198.0000
	0.0000	0.0000	0.0000	199.9239	0.0000	0.0000	100.0000	100.0000
			2873.1563	2873.1563		37021.3792	1441.0000	1441.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** SOLIDITY RATIO FOR TRANSVERSE FACE FOR TOWER MKD."4T2"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	130x130x10	2.200	100x100x10	3.111	-	0.000	100x100x10	2.200	1.485	4.840	0.307	1.700
PG	130x130x10	2.300	100x100x10	3.235	-	0.000	100x100x10	2.200	1.538	5.233	0.294	1.706
PF	130x130x10	2.300	100x100x10	3.343	-	0.000	-	0.000	1.330	5.578	0.238	1.762
PE	130x130x10	2.300	100x100x10	3.453	-	0.000	-	0.000	1.353	5.924	0.228	1.772
PD	130x130x12	3.000	75X75X5	4.069	45x45x5	3.534	-	0.000	1.794	8.246	0.218	1.782
PC	130x130x12	3.000	75X75X5	4.204	45x45x5	3.602	-	0.000	1.821	8.834	0.206	1.794
PB	150x150x16	3.500	75X75X5	4.713	45x45x5	4.107	-	0.000	2.233	11.050	0.202	1.798
PA	150x150x16	3.500	75X75X5	4.870	45x45x5	4.185	-	0.000	2.265	11.850	0.191	1.809

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.150 \times 3.5 \times 2 + 0.075 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.265
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.265 / 11.849$	=	0.191
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.13 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.330
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.329 / 5.578$	=	0.238

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** WIND LOAD ON TRANSVERSE FACE FOR TOWER MKD."4T2"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliabilty level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)
- f) Design Wind Speed, Vd = VR x K1 x K2
- g) Gust Co-efficient
- | | | | |
|----------------------------------|-----------|---|-------------|
| Value of Gt for height upto 10 m | Gt | = | 1.70 |
| Value of Gt at height of 20 m | Gt | = | 1.85 |
| Value of Gt at height of 30 m | Gt | = | 1.96 |
| Value of Gt at height of 40 m | Gt | = | 2.07 |
| Value of Gt at height of 50 m | Gt | = | 2.13 |
- h) Design Wind Pressure , Pd = 0.6 x Vd^2
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T2" - TABLE 1

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.3636	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.3636	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.3636	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.3636	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.3636	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.3636	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.3636	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.3636	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.3636	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.3636	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.3636	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.3636	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T2" - TABLE 3

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	284.0587	192.8671	22.1000	4262.3640	97.0000	97.0000
PG	2.3000	19.9000	295.3011	289.6799	19.9000	5764.6299	145.0000	145.0000
PF	2.3000	17.6000	248.8077	272.0544	17.6000	4788.1571	137.0000	137.0000
PE	2.3000	15.3000	254.5873	251.6975	15.3000	3850.9715	126.0000	126.0000
PD	3.0000	13.0000	339.5977	297.0925	13.0000	3862.2024	149.0000	149.0000
PC	3.0000	10.0000	318.8850	329.2413	10.0000	3292.4133	165.0000	165.0000
PB	3.5000	7.0000	391.8189	355.3519	7.0000	2487.4636	178.0000	178.0000
PA	3.5000	3.5000	399.8478	395.8334	3.5000	1385.4168	198.0000	198.0000
	0.0000	0.0000	0.0000	199.9239	0.0000	0.0000	100.0000	100.0000
			2873.1563	2873.1563		37021.3792	1441.0000	1441.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** EARTH WIRE LOAD EVALUATION FOR TOWER MKD."4T2"**

(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)

*** WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

*** EARTH WIRE LOADING :-**

a)	Length of wire on left side, L1 =	=	51.20	m
b)	Length of wire on right side, L2 =	=	52.50	m
c)	Earthwire Span (L1 + L2) (Full Span on both side for worst condition)	=	103.70	m
d)	Diameter of Earth Wire	=	10.980	mm
e)	Weight of Earth Wire	=	0.600	Kg/m
f)	Total Weight of Earth Wire per Tower	=	62.220	Kg
g)	Earth Wire Tension	=	1000.00	Kg
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table 27 of IS875-1987, part III)
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x 1.20 x 1.1386	
		=	78.44	Kg
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg
	Wind Load on Earth-Wire in Transverse Dirn.	=	80.00	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

k) Angle of Deviation

In Plan = 0.00 °

In Elevation = 0.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	1000.00	0.00

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn. = 80 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Vertical Loads :-

Weight of Earth-wire = 62 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Say = 62 Kg

Longitudinal Loads :-

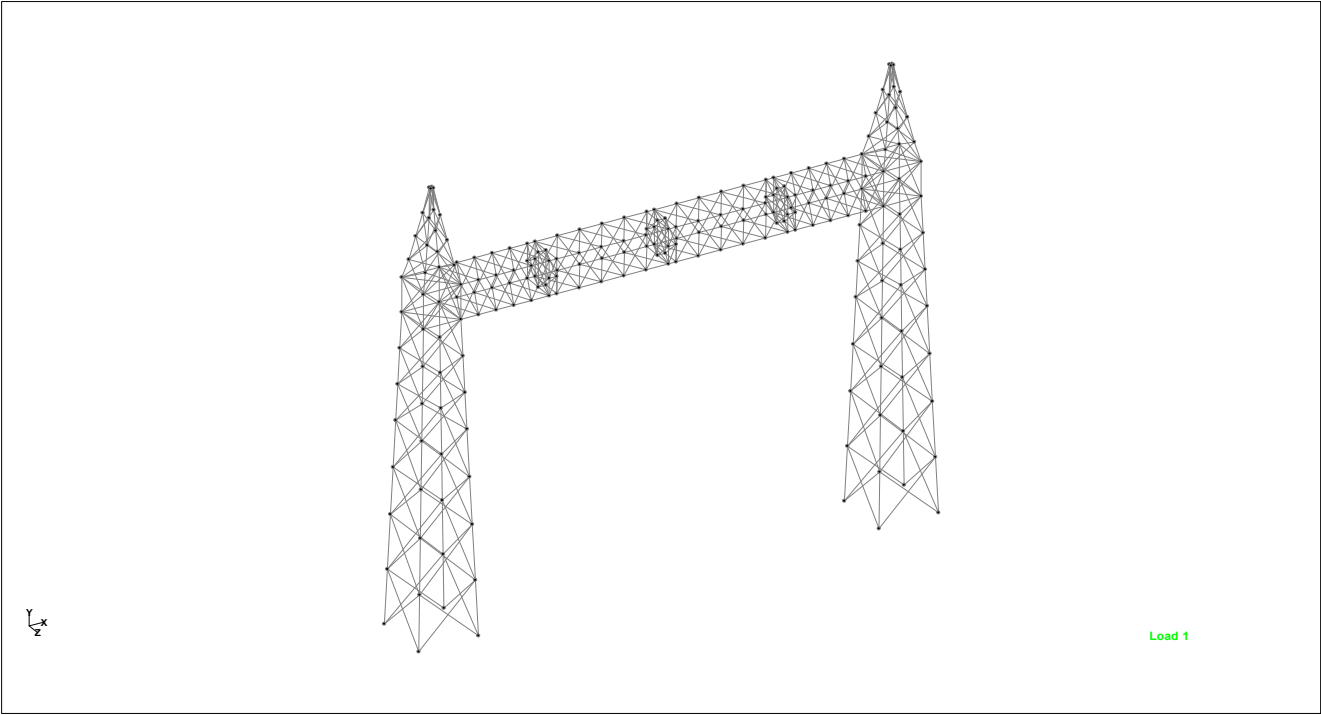
Wind Load on Earth-Wire in Longitudinal Dirn. = 0 Kg

Load Due to Normal Tension Due to Deviation = 1000 Kg

Say = 1000 Kg

PICTORIAL VIEW OF STAAD MODEL

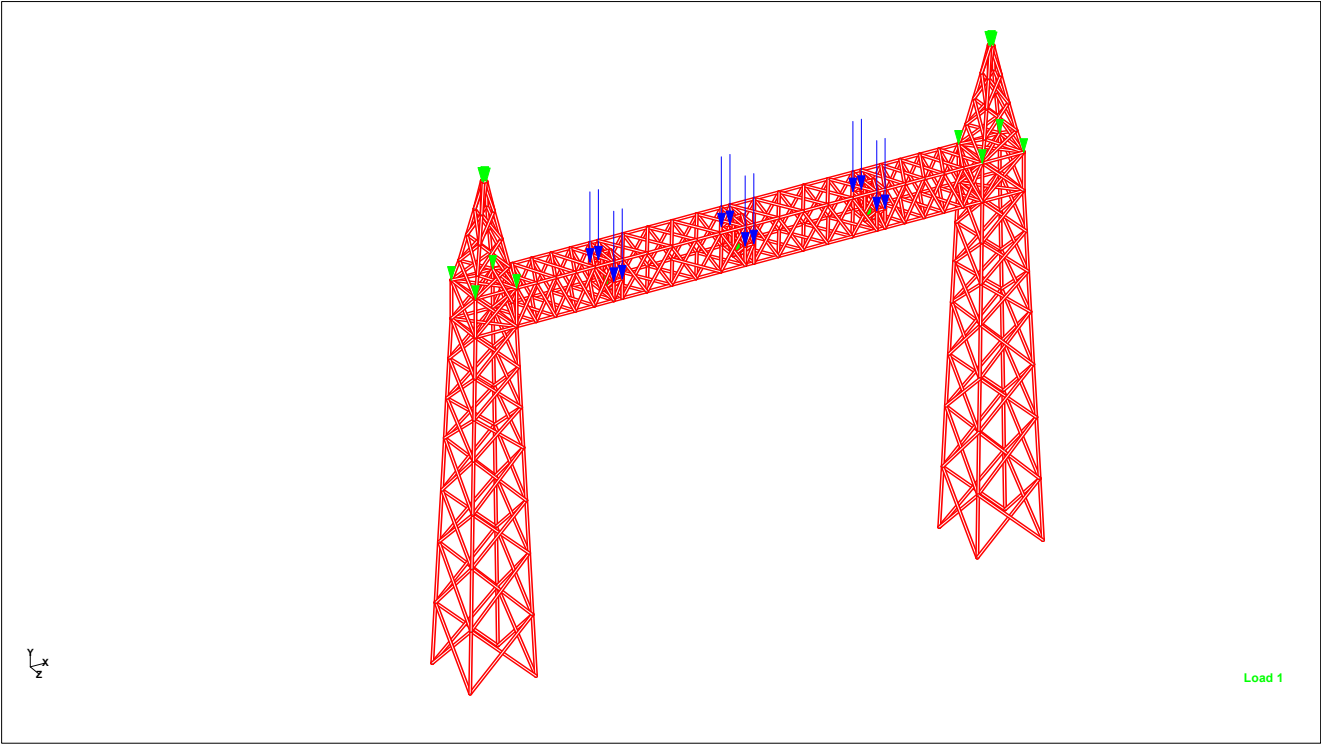
Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		1	
Job Title	Part	Ref	
Client	By	Date	Chd
		02-JULY-24	
File TOWER 4T2 & BEAM G2.STD	Date Time 05-Jul-2024 19:19		



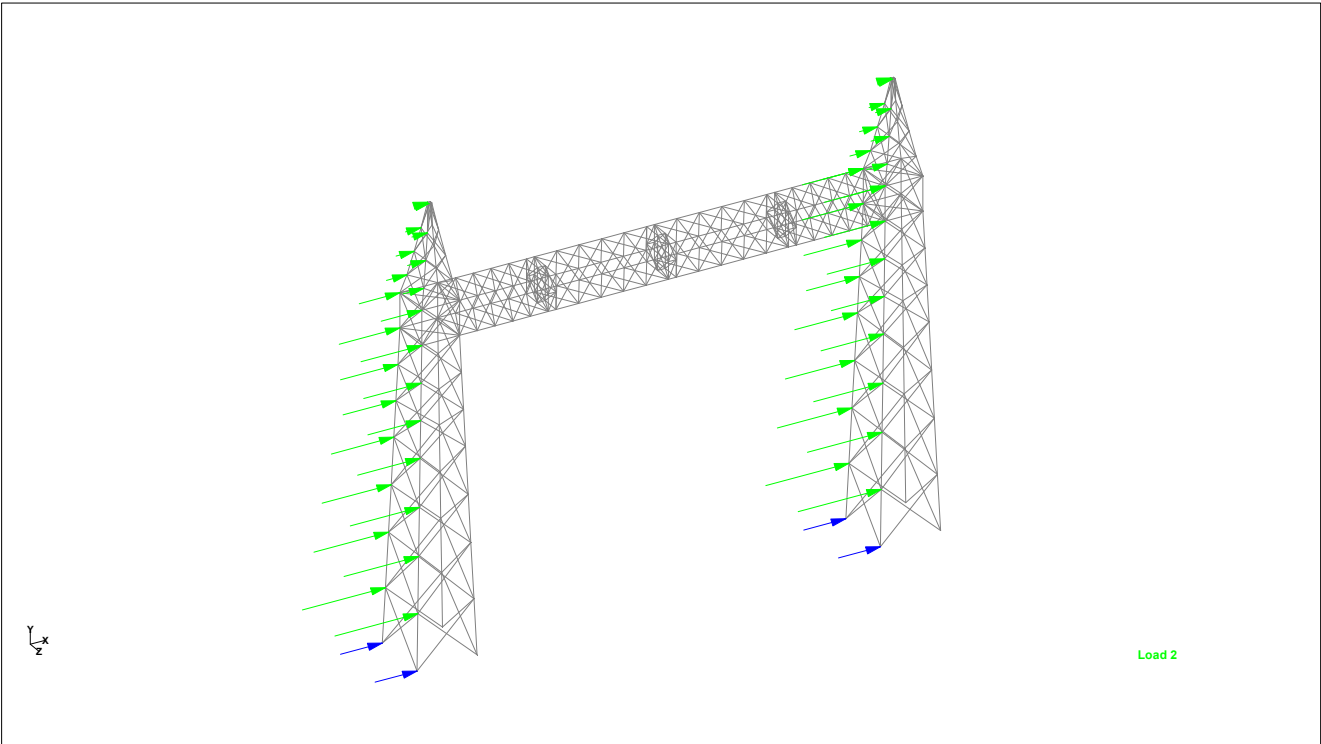
Whole Structure

3D Rendered View

Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		2	
Job Title	Part	Ref	
Client	By	Date	Chd
File	Date Time		
TOWER 4T2 & BEAM G2.STD	05-Jul-2024 19:19		

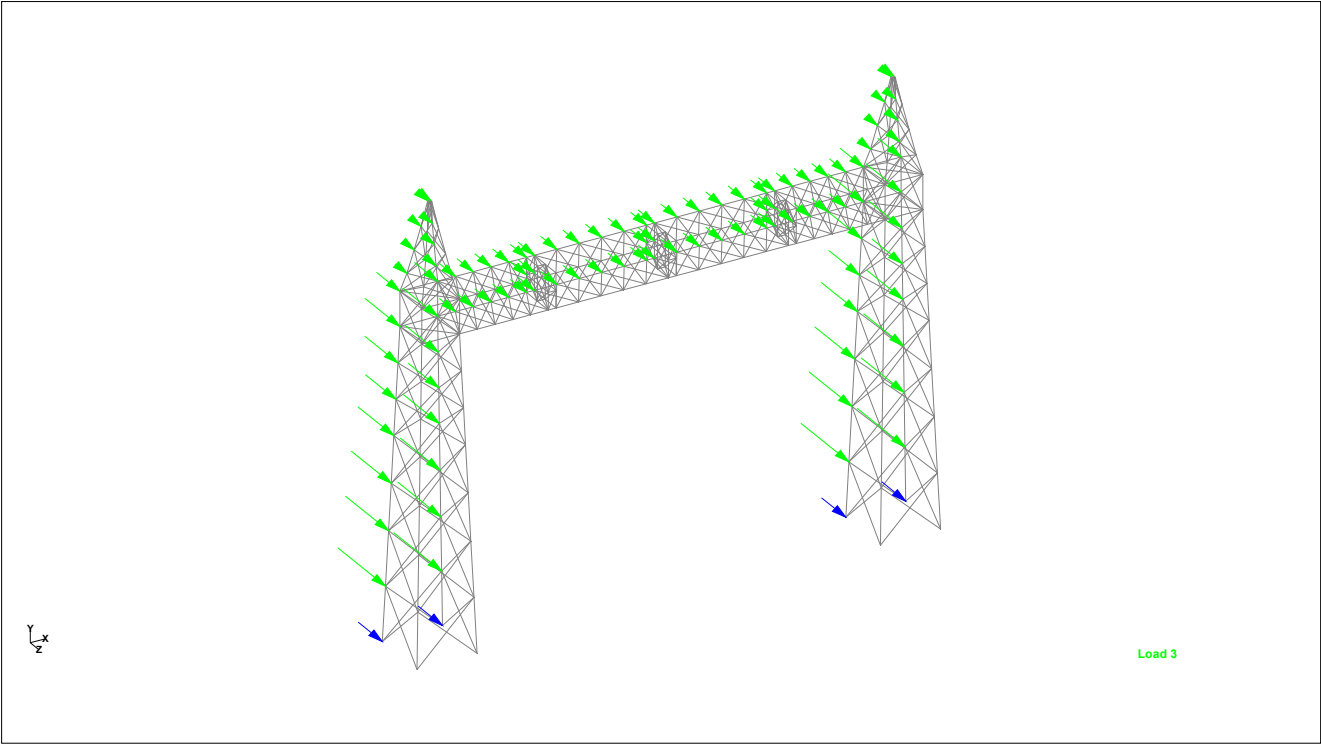


DEAD LOAD&LIVE LOAD

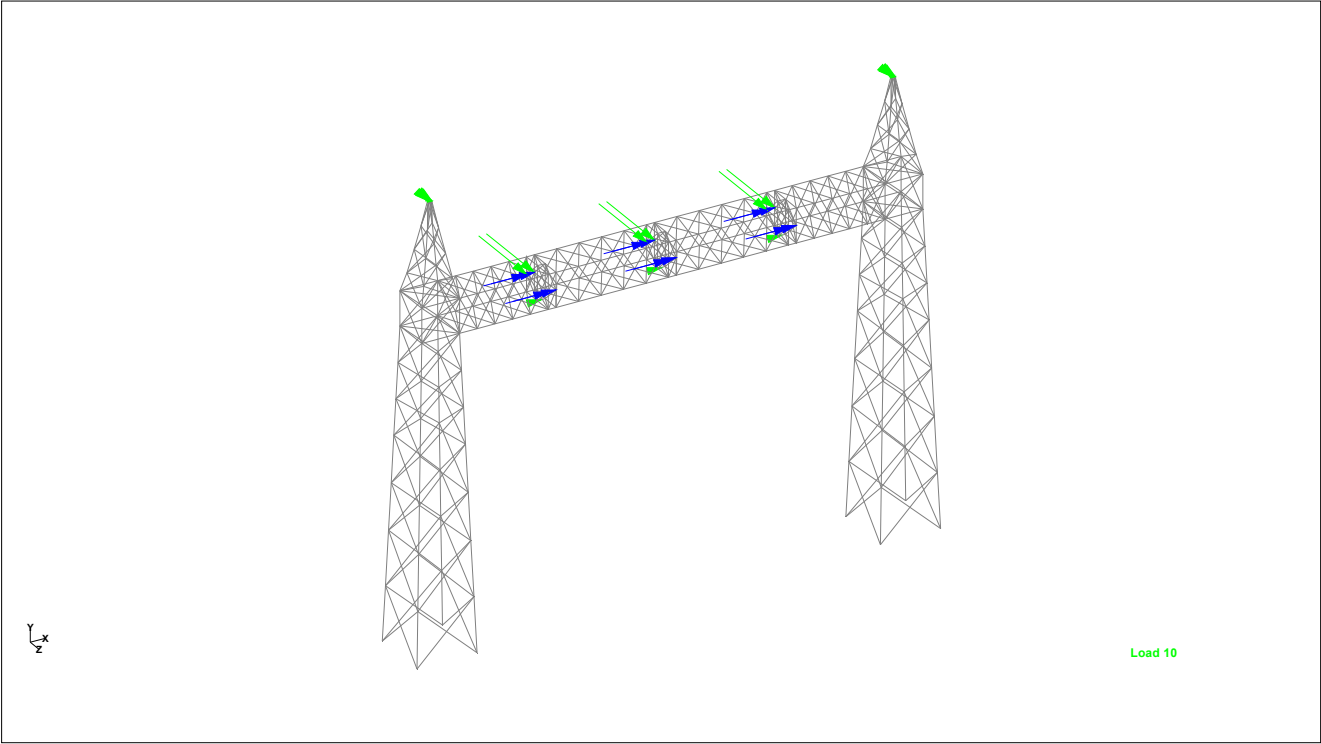


WIND IN X-DIRECTION

Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		3	
Job Title	Part		Ref
Client	By	Date 02-JULY-24	Chd
File TOWER 4T2 & BEAM G2.STD	Date Time 05-Jul-2024 19:19		

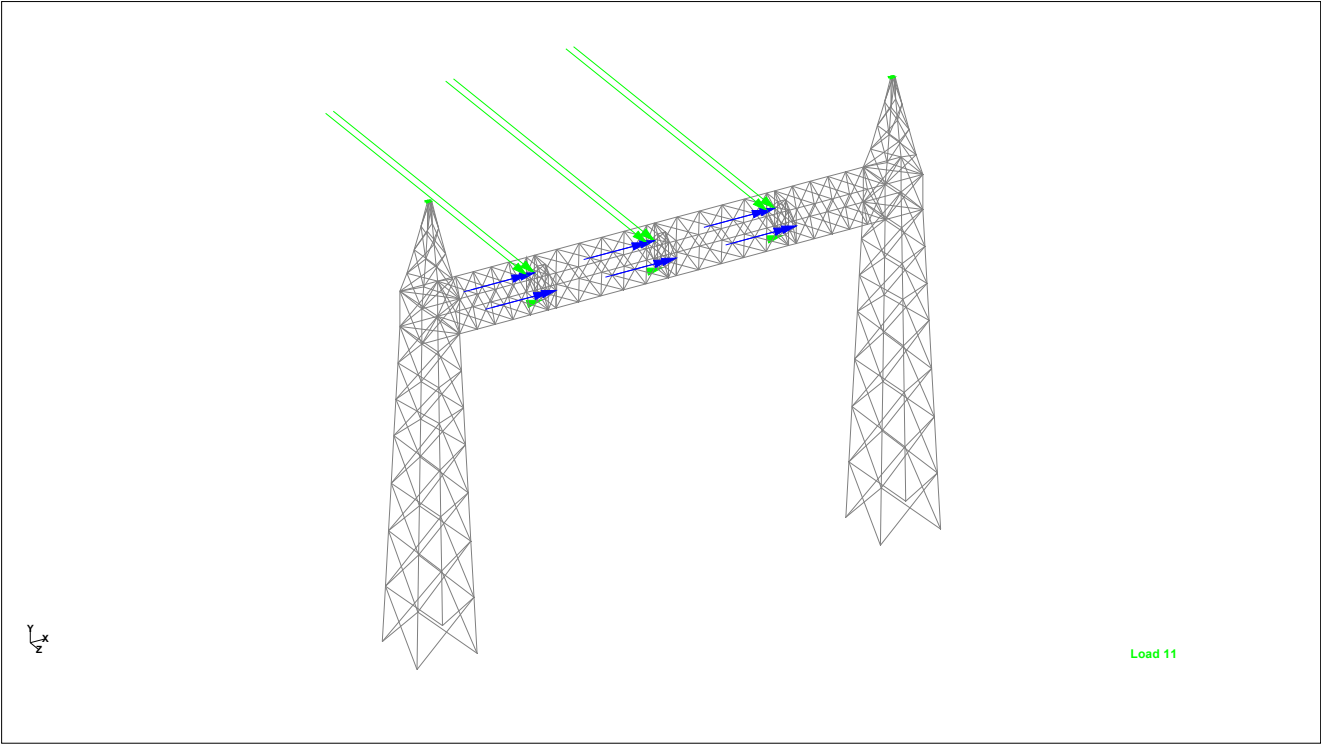


WIND IN Z- DIRECTION

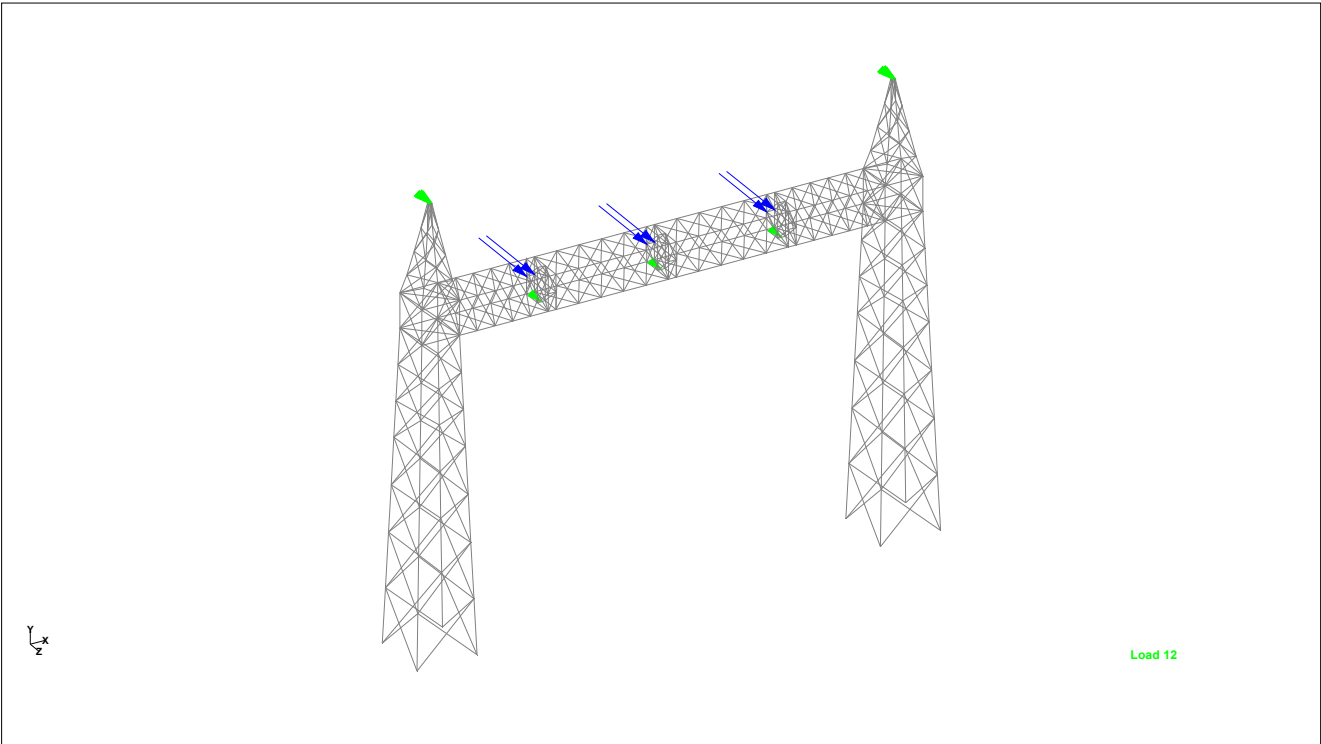


NC(OP-0E) +WIND PARALLEL TO BEAM

Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		4	
Job Title	Part		Re f
Client	By	Date 02-JULY-24	Chd
File TOWER 4T2 & BEAM G2.STD	Date Time 05-Jul-2024 19:19		

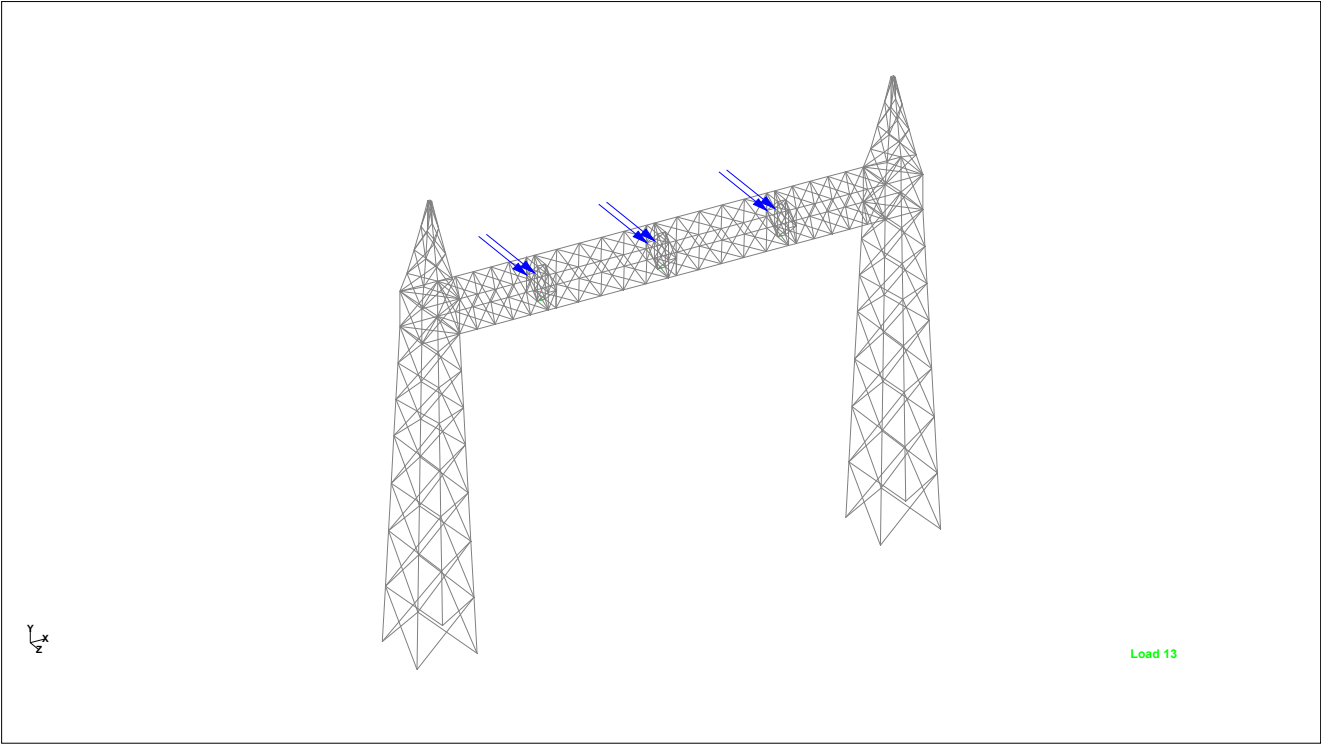


SC(0P-0E) +WIND PARALLEL TO BEAM



NC(0P-0E) +WIND PERPENDICULAR TO BEAM

Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		5	
Job Title	Part		Ref
Client	By	Date	Chd
		02-JULY-24	
File TOWER 4T2 & BEAM G2.STD	Date Time 05-Jul-2024 19:19		



SC(0P-0E) +WIND PERPENDICULAR TO BEAM

STAAD ANALYSIS & DESIGN

```

*****
*
*          STAAD.Pro 2023
*          Version  23.00.03.25
*          Proprietary Program of
*          Bentley Systems, Inc.
*          Date=    JUL  6, 2024
*          Time=    10:56:55
*
* Licensed to: Anhera Enterprise
*****

```

1. STAAD TRUSS

INPUT FILE: Z:\Data\PROJECTS\2024\24P041-MAHAN-GODREJ\DESIGN\400 KV TOW.. .STD

2. START JOB INFORMATION

3. ENGINEER DATE 02-JULY-24

4. END JOB INFORMATION

5. INPUT WIDTH 79

6. UNIT METER KN

7. JOINT COORDINATES

```

8. 1 0 0 0; 2 3.5 0 0; 3 0 0 3.5; 4 3.5 0 3.5; 5 0.65 19.9 0.65; 6 2.85 19.9 0.65
9. 7 0.65 19.9 2.85; 8 2.85 19.9 2.85; 9 0.65 22.1 0.65; 10 2.85 22.1 0.65
10. 11 2.85 22.1 2.85; 12 0.65 22.1 2.85; 13 1.675 28 1.675; 14 1.825 28 1.675
11. 15 1.825 28 1.825; 16 1.675 28 1.825; 17 0.114 3.5 0.114; 18 0.114 3.5 3.386
12. 19 3.386 3.5 0.114; 20 3.386 3.5 3.386; 21 0.227 7 0.227; 22 0.227 7 3.271
13. 23 3.271 7 0.227; 24 3.271 7 3.271; 25 0.327 10 0.327; 26 0.327 10 3.173
14. 27 3.173 10 0.327; 28 3.173 10 3.173; 29 0.425 13 0.425; 30 0.425 13 3.075
15. 31 3.075 13 0.425; 32 3.075 13 3.075; 33 0.5 15.3 0.5; 34 0.5 15.3 3
16. 35 3 15.3 0.5; 36 3 15.3 3; 37 0.575 17.6 0.575; 38 0.575 17.6 2.925
17. 39 2.925 17.6 0.575; 40 2.925 17.6 2.925; 41 0.911 23.282 0.911
18. 42 0.911 23.282 2.6; 43 2.6 23.282 2.6; 44 2.6 23.282 0.911
19. 45 1.171 24.815 1.171; 46 1.171 24.815 2.34; 47 2.34 24.815 2.34
20. 48 2.34 24.815 1.171; 49 1.432 26.347 1.432; 50 1.432 26.347 2.078
21. 51 2.078 26.347 2.078; 52 2.078 26.347 1.432; 53 3.885 19.9 2.85
22. 54 3.885 22.1 2.85; 55 3.885 22.1 0.65; 56 3.885 19.9 0.65; 57 4.92 19.9 2.85
23. 58 4.92 22.1 2.85; 59 4.92 22.1 0.65; 60 4.92 19.9 0.65; 61 5.955 19.9 2.85
24. 62 5.955 22.1 2.85; 63 5.955 22.1 0.65; 64 5.955 19.9 0.65; 65 6.99 19.9 2.85
25. 66 6.99 22.1 2.85; 67 6.99 22.1 0.65; 68 6.99 19.9 0.65; 69 7.785 19.9 2.85
26. 70 7.785 22.1 2.85; 71 7.785 22.1 0.65; 72 7.785 19.9 0.65; 73 8.475 19.9 0.65
27. 74 8.475 22.1 2.85; 75 8.475 22.1 0.65; 76 8.475 19.9 0.65
28. 77 8.475 22.1 0.65; 78 8.475 19.9 2.85; 79 8.475 22.1 2.85; 80 8.475 22.1 0.65
29. 81 8.475 19.9 2.85; 82 8.475 22.1 2.85; 83 8.475 19.9 0.65; 84 8.475 22.1 2.85
30. 85 8.475 19.9 0.65; 86 8.475 22.1 0.65; 87 8.475 19.9 2.85; 88 8.475 22.1 2.85
31. 89 8.475 19.9 0.65; 90 8.475 22.1 2.85; 91 8.475 22.1 0.65; 92 8.475 19.9 0.65
32. 93 8.475 19.9 2.85; 94 8.475 22.1 2.85; 95 8.475 22.1 0.65; 96 8.475 19.9 0.65
33. 97 8.025 19.9 2.85; 98 8.025 22.1 2.85; 99 8.025 22.1 0.65
34. 100 8.025 19.9 0.65; 101 15.025 19.9 0.65; 102 15.025 19.9 2.85
35. 103 15.025 22.1 0.65; 104 15.025 22.1 2.85; 105 8.025 22.1 1.75
36. 106 8.475 22.1 1.75; 107 8.025 21 2.85; 108 8.475 21 2.85; 109 8.025 21 0.65
37. 110 8.475 21 0.65; 111 8.025 19.9 1.75; 112 8.475 19.9 1.75
38. 113 27.65 19.9 0.65; 114 27.65 19.9 2.85; 115 27.65 22.1 0.65
39. 116 27.65 22.1 2.85; 117 26.615 19.9 2.85; 118 26.615 22.1 2.85

```

39. 123 26.615 22.1 0.65; 124 26.615 19.9 0.65; 125 25.58 19.9 2.85
40. 126 25.58 22.1 2.85; 127 25.58 22.1 0.65; 128 25.58 19.9 0.65
41. 129 24.545 19.9 2.85; 130 24.545 22.1 2.85; 131 24.545 22.1 0.65
42. 132 24.545 19.9 0.65; 133 23.51 19.9 2.85; 134 23.51 22.1 2.85
43. 135 23.51 22.1 0.65; 136 23.51 19.9 0.65; 137 20.715 19.9 2.85
44. 138 20.715 22.1 2.85; 139 20.715 22.1 0.65; 140 20.715 19.9 0.65
45. 141 19.405 19.9 2.85; 142 19.405 22.1 2.85; 143 19.405 22.1 0.65
46. 144 19.405 19.9 0.65; 145 18.095 19.9 2.85; 146 18.095 22.1 2.85
47. 147 18.095 22.1 0.65; 148 18.095 19.9 0.65; 149 16.785 19.9 2.85
48. 150 16.785 22.1 2.85; 151 16.785 22.1 0.65; 152 16.785 19.9 0.65
49. 153 22.025 19.9 2.85; 154 22.025 22.1 2.85; 155 22.025 22.1 0.65
50. 156 22.025 19.9 0.65; 157 22.475 19.9 2.85; 158 22.475 22.1 2.85
51. 159 22.475 22.1 0.65; 160 22.475 19.9 0.65; 161 15.475 19.9 0.65
52. 162 15.475 19.9 2.85; 163 15.475 22.1 0.65; 164 15.475 22.1 2.85
53. 165 22.475 22.1 1.75; 166 22.025 22.1 1.75; 167 22.475 21 2.85
54. 168 22.025 21 2.85; 169 22.475 21 0.65; 170 22.025 21 0.65
55. 171 22.475 19.9 1.75; 172 22.025 19.9 1.75; 173 15.025 21 2.85
56. 174 15.025 21 0.65; 175 15.025 22.1 1.75; 176 15.025 19.9 1.75
57. 177 15.475 21 2.85; 178 15.475 21 0.65; 179 15.475 22.1 1.75
58. 180 15.475 19.9 1.75; 181 27 0 0; 182 27.114 3.5 0.114; 183 27 0 3.5
59. 184 27.114 3.5 3.386; 185 30.5 0 0; 186 30.386 3.5 0.114; 187 30.5 0 3.5
60. 188 30.386 3.5 3.386; 189 29.85 19.9 0.65; 190 29.85 19.9 2.85
61. 191 29.85 22.1 0.65; 192 29.85 22.1 2.85; 193 27.911 23.282 0.911
62. 194 27.911 23.282 2.6; 195 29.6 23.282 2.6; 196 29.6 23.282 0.911
63. 197 28.675 28 1.675; 198 28.675 28 1.825; 199 28.825 28 1.825
64. 200 28.825 28 1.675; 201 27.227 7 0.227; 202 27.227 7 3.271
65. 203 30.271 7 0.227; 204 30.271 7 3.271; 205 27.327 10 0.327
66. 206 27.327 10 3.173; 207 30.173 10 0.327; 208 30.173 10 3.173
67. 209 27.425 13 0.425; 210 27.425 13 3.075; 211 30.075 13 0.425
68. 212 30.075 13 3.075; 213 27.5 15.3 0.5; 214 27.5 15.3 3; 215 30 15.3 0.5
69. 216 30 15.3 3; 217 27.575 17.6 0.575; 218 27.575 17.6 2.925
70. 219 29.925 17.6 0.575; 220 29.925 17.6 2.925; 221 28.171 24.815 1.171
71. 222 28.171 24.815 2.34; 223 29.34 24.815 2.34; 224 29.34 24.815 1.171
72. 225 28.432 26.347 1.432; 226 28.432 26.347 2.078; 227 29.078 26.347 2.078
73. 228 29.078 26.347 1.432
74. MEMBER INCIDENCES
75. 1 1 17; 2 3 18; 3 2 19; 4 4 20; 5 5 6; 6 6 8; 7 8 7; 8 7 5; 9 9 10; 10 10 11
76. 11 11 12; 12 12 9; 13 5 9; 14 7 12; 15 8 11; 16 6 10; 17 9 41; 18 12 42
77. 19 11 43; 20 10 44; 21 13 16; 22 16 15; 23 15 14; 24 14 13; 25 17 21; 26 18 22
78. 27 19 23; 28 20 24; 29 21 25; 30 22 26; 31 23 27; 32 24 28; 33 25 29; 34 26 30
79. 35 27 31; 36 28 32; 37 29 33; 38 30 34; 39 31 35; 40 32 36; 41 33 37; 42 34 38
80. 43 35 39; 44 36 40; 45 37 5; 46 38 7; 47 39 6; 48 40 8; 49 41 45; 50 42 46
81. 51 43 47; 52 44 48; 53 45 49; 54 46 50; 55 47 51; 56 48 52; 57 49 13; 58 50 16
82. 59 51 15; 60 52 14; 117 5 10; 118 6 9; 119 6 11; 120 8 10; 121 7 11; 122 8 12
83. 123 7 9; 124 5 12; 125 8 5; 126 7 6; 127 9 11; 128 12 10; 161 8 57; 162 11 58
84. 163 10 59; 164 6 60; 165 57 61; 166 58 62; 167 59 63; 168 60 64; 169 61 65
85. 170 62 66; 171 63 67; 172 64 68; 173 65 69; 174 66 70; 175 67 71; 176 68 72
86. 177 69 97; 178 70 98; 179 71 99; 180 72 100; 181 93 97; 182 94 98; 183 95 99
87. 184 96 100; 185 77 81; 186 78 82; 187 79 83; 188 80 84; 189 81 85; 190 82 86
88. 191 83 87; 192 84 88; 193 85 89; 194 86 90; 195 87 91; 196 88 92; 197 89 102
89. 198 90 104; 199 91 103; 200 92 101; 201 93 77; 202 94 78; 203 95 79; 204 96 80
90. 209 101 161; 210 102 162; 211 103 163; 212 104 164; 213 99 109; 214 95 110
91. 215 98 111; 216 94 112; 217 99 113; 218 95 114; 219 100 115; 220 96 116
92. 221 109 98; 222 110 94; 223 111 97; 224 112 93; 225 113 100; 226 114 96
93. 227 115 97; 228 116 93; 229 113 109; 230 109 111; 231 111 115; 232 115 113
94. 233 109 110; 234 111 112; 235 115 116; 236 113 114; 237 110 114; 238 110 112

95. 239 112 116; 240 116 114; 241 110 116; 242 112 114; 243 109 115; 244 111 113
96. 245 97 112; 246 111 94; 247 100 114; 248 113 95; 249 8 58; 250 57 11
97. 251 57 62; 252 61 58; 253 61 66; 254 65 62; 255 65 70; 256 69 66; 257 69 98
98. 258 97 70; 259 6 59; 260 60 10; 261 60 63; 262 64 59; 263 64 67; 264 68 63
99. 265 68 71; 266 72 67; 267 72 99; 268 100 71; 269 11 59; 270 58 10; 271 58 63
100. 272 62 59; 273 62 67; 274 66 63; 275 66 71; 276 70 67; 277 70 99; 278 71 98
101. 279 8 60; 280 57 6; 281 57 64; 282 61 60; 283 61 68; 284 65 64; 285 65 72
102. 286 69 68; 287 69 100; 288 72 97; 289 94 77; 290 93 78; 291 77 82; 292 81 78
103. 293 82 85; 294 81 86; 295 86 89; 296 85 90; 297 90 102; 298 89 104
104. 299 104 173; 300 95 80; 301 96 79; 302 80 83; 303 84 79; 304 83 88; 305 84 87
105. 306 87 92; 307 88 91; 308 91 101; 309 92 103; 310 103 174; 311 94 79
106. 312 78 95; 313 78 83; 314 79 82; 315 82 87; 316 83 86; 317 87 90; 318 86 91
107. 319 91 104; 320 90 103; 321 104 175; 322 93 80; 323 77 96; 324 77 84
108. 325 80 81; 326 81 88; 327 84 85; 328 88 89; 329 85 92; 330 92 102; 331 89 101
109. 332 102 176; 337 118 121; 338 120 122; 339 119 123; 340 117 124; 341 121 125
110. 342 122 126; 343 123 127; 344 124 128; 345 125 129; 346 126 130; 347 127 131
111. 348 128 132; 349 129 133; 350 130 134; 351 131 135; 352 132 136; 353 133 157
112. 354 134 158; 355 135 159; 356 136 160; 357 153 157; 358 154 158; 359 155 159
113. 360 156 160; 361 137 141; 362 138 142; 363 139 143; 364 140 144; 365 141 145
114. 366 142 146; 367 143 147; 368 144 148; 369 145 149; 370 146 150; 371 147 151
115. 372 148 152; 373 149 162; 374 150 164; 375 151 163; 376 152 161; 377 153 137
116. 378 154 138; 379 155 139; 380 156 140; 385 159 165; 386 155 166; 387 158 167
117. 388 154 168; 389 159 169; 390 155 170; 391 160 171; 392 156 172; 393 165 158
118. 394 166 154; 395 167 157; 396 168 153; 397 169 160; 398 170 156; 399 171 157
119. 400 172 153; 401 169 165; 402 165 167; 403 167 171; 404 171 169; 405 165 166
120. 406 167 168; 407 171 172; 408 169 170; 409 166 170; 410 166 168; 411 168 172
121. 412 172 170; 413 166 172; 414 168 170; 415 165 171; 416 167 169; 417 157 168
122. 418 167 154; 419 160 170; 420 169 155; 421 118 122; 422 121 120; 423 121 126
123. 424 125 122; 425 125 130; 426 129 126; 427 129 134; 428 133 130; 429 133 158
124. 430 157 134; 431 117 123; 432 124 119; 433 124 127; 434 128 123; 435 128 131
125. 436 132 127; 437 132 135; 438 136 131; 439 136 159; 440 160 135; 441 120 123
126. 442 122 119; 443 122 127; 444 126 131; 445 126 131; 446 130 127; 447 130 135
127. 448 134 131; 449 134 159; 450 135 158; 451 118 124; 452 121 117; 453 121 128
128. 454 125 124; 455 125 132; 456 129 128; 457 129 136; 458 133 132; 459 133 160
129. 460 136 157; 461 154 137; 462 153 138; 463 137 142; 464 141 138; 465 142 145
130. 466 141 146; 467 146 149; 468 145 150; 469 150 162; 470 149 164; 471 164 177
131. 472 155 140; 473 156 139; 474 140 143; 475 144 139; 476 143 148; 477 144 147
132. 478 147 152; 479 148 151; 480 151 161; 481 152 163; 482 163 178; 483 154 139
133. 484 138 155; 485 138 143; 486 139 142; 487 142 147; 488 143 146; 489 147 150
134. 490 146 151; 491 151 164; 492 150 163; 493 164 179; 494 153 140; 495 137 156
135. 496 137 144; 497 140 141; 498 141 148; 499 144 145; 500 148 149; 501 145 152
136. 502 152 162; 503 149 161; 504 162 180; 505 173 102; 506 174 101; 507 175 103
137. 508 176 101; 509 177 162; 510 178 161; 511 179 163; 512 180 161; 513 174 175
138. 514 175 173; 515 173 176; 516 176 174; 517 173 177; 518 176 180; 519 174 178
139. 520 175 179; 521 179 177; 522 177 180; 523 178 179; 524 178 180; 525 102 177
140. 526 173 164; 527 174 163; 528 101 178; 531 175 176; 533 178 177; 534 174 173
141. 535 179 180; 690 98 110; 691 109 95; 692 97 116; 693 115 96; 694 102 180
142. 695 176 161; 696 104 179; 697 175 163; 698 153 171; 699 172 160; 700 154 165
143. 701 166 159; 702 3 20; 703 20 22; 704 22 28; 705 28 30; 706 30 36; 707 36 38
144. 708 38 8; 709 7 40; 710 40 34; 711 34 32; 712 32 26; 713 26 24; 714 24 18
145. 715 18 4; 716 1 18; 717 3 17; 718 17 22; 719 18 21; 720 21 26; 721 22 25
146. 722 25 30; 723 26 29; 724 29 34; 725 30 33; 726 33 38; 727 34 37; 728 37 7
147. 729 38 5; 730 2 17; 731 1 19; 732 19 21; 733 17 23; 734 23 25; 735 21 27
148. 736 27 29; 737 25 31; 738 31 33; 739 29 35; 740 35 37; 741 33 39; 742 39 5
149. 743 37 6; 744 4 19; 745 2 20; 746 20 23; 747 19 24; 748 24 27; 749 23 28
150. 750 28 31; 751 27 32; 752 31 36; 753 32 35; 754 35 40; 755 36 39; 756 39 8

151. 757 40 6; 758 9 44; 759 10 41; 760 41 48; 761 44 45; 762 45 52; 763 48 49
152. 764 49 14; 765 52 13; 766 10 43; 767 11 44; 768 44 47; 769 43 48; 770 48 51
153. 771 47 52; 772 52 15; 773 51 14; 774 11 42; 775 12 43; 776 43 46; 777 42 47
154. 778 47 50; 779 46 51; 780 51 16; 781 50 15; 782 9 42; 783 12 41; 784 41 46
155. 785 42 45; 786 45 50; 787 46 49; 788 50 13; 789 49 16; 790 181 182
156. 791 183 184; 792 185 186; 793 187 188; 794 117 189; 795 189 190; 796 190 118
157. 797 118 117; 798 119 191; 799 191 192; 800 192 120; 801 120 119; 802 117 119
158. 803 118 120; 804 190 192; 805 189 191; 806 119 193; 807 120 194; 808 192 195
159. 809 191 196; 810 197 198; 811 198 199; 812 199 200; 813 200 197; 814 182 201
160. 815 184 202; 816 186 203; 817 188 204; 818 201 205; 819 202 206; 820 203 207
161. 821 204 208; 822 205 209; 823 206 210; 824 207 211; 825 208 212; 826 209 213
162. 827 210 214; 828 211 215; 829 212 216; 830 213 217; 831 214 218; 832 215 219
163. 833 216 220; 834 217 117; 835 218 118; 836 219 189; 837 220 190; 838 193 221
164. 839 194 222; 840 195 223; 841 196 224; 842 221 225; 843 222 226; 844 223 227
165. 845 224 228; 846 225 197; 847 226 198; 848 227 199; 849 228 200; 850 117 191
166. 851 189 119; 852 189 192; 853 190 191; 854 118 192; 855 190 120; 856 118 119
167. 857 117 120; 858 190 117; 859 118 189; 860 119 192; 861 120 191; 862 183 188
168. 863 188 202; 864 202 208; 865 208 210; 866 210 216; 867 216 218; 868 218 190
169. 869 118 220; 870 220 214; 871 214 212; 872 212 206; 873 206 204; 874 204 184
170. 875 184 187; 876 181 184; 877 183 182; 878 182 202; 879 184 201; 880 201 206
171. 881 202 205; 882 205 210; 883 206 209; 884 209 214; 885 210 213; 886 213 218
172. 887 214 217; 888 217 118; 889 218 117; 890 185 182; 891 181 186; 892 186 201
173. 893 182 203; 894 203 205; 895 201 207; 896 207 209; 897 205 211; 898 211 213
174. 899 209 215; 900 215 217; 901 213 219; 902 219 117; 903 217 189; 904 187 186
175. 905 185 188; 906 188 203; 907 186 204; 908 204 207; 909 203 208; 910 208 211
176. 911 207 212; 912 211 216; 913 212 215; 914 215 220; 915 216 219; 916 219 190
177. 917 220 189; 918 119 196; 919 191 193; 920 193 224; 921 196 221; 922 221 228
178. 923 224 225; 924 225 200; 925 228 197; 926 191 195; 927 192 196; 928 196 223
179. 929 195 224; 930 224 227; 931 223 228; 932 228 199; 933 227 200; 934 192 194
180. 935 120 195; 936 195 222; 937 194 223; 938 223 226; 939 222 227; 940 227 198
181. 941 226 199; 942 119 194; 943 120 193; 944 193 222; 945 194 221; 946 221 226
182. 947 222 225; 948 226 197; 949 225 198
183. DEFINE MATERIAL START
184. ISOTROPIC STEEL
185. E 2.05E+08
186. POISSON 0.3
187. DENSITY 76.8195
188. ALPHA 1.2E-05
189. DAMP 0.03
190. G 7.88462E+07
191. TYPE STEEL
192. STRENGTH RY 1.5 RT 1.2
193. END DEFINE MATERIAL
194. MEMBER PROPERTY INDIAN
195. 1 TO 4 25 TO 28 790 TO 793 814 TO 817 TABLE ST ISA150X150X16
196. 29 TO 36 818 TO 825 TABLE ST ISA130X130X12
197. 13 TO 16 37 TO 48 802 TO 805 826 TO 837 TABLE ST ISA130X130X10
198. MEMBER PROPERTY 'INDIA (IS 2023).DB3'
199. 17 TO 20 49 TO 60 806 TO 809 838 TO 849 TABLE 'ANGLE EQUAL' ST 'ISA 75X75X5'
200. 702 TO 705 712 TO 723 730 TO 737 744 TO 751 862 TO 865 872 TO 883 890 TO 897 -
201. 904 TO 911 TABLE 'ANGLE EQUAL' ST 'ISA 75X75X5'
202. 117 TO 124 706 TO 711 724 TO 729 738 TO 743 752 TO 757 850 TO 857 866 TO 871 -
203. 884 TO 889 898 TO 903 912 TO 917 TABLE 'ANGLE EQUAL' ST 'ISA 100X100X10'
204. 758 TO 789 918 TO 949 TABLE 'ANGLE EQUAL' ST 'ISA 50X50X5'
205. 5 TO 12 161 TO 180 337 TO 356 794 TO 800 -
206. 801 TABLE 'ANGLE EQUAL' ST 'ISA 100X100X10'

207. 181 TO 204 209 TO 212 357 TO 380 TABLE 'ANGLE EQUAL' ST 'ISA 130X130X12'
208. 125 TO 128 249 TO 288 421 TO 460 858 TO 860 -
209. 861 TABLE 'ANGLE EQUAL' ST 'ISA 60X60X5'
210. 289 TO 298 300 TO 309 311 TO 320 322 TO 331 461 TO 470 472 TO 481 483 TO 492 -
211. 494 TO 503 TABLE 'ANGLE EQUAL' ST 'ISA 50X50X5'
212. 213 TO 248 299 310 321 332 385 TO 420 471 482 493 504 TO 528 531 533 TO 535 -
213. 690 TO 701 TABLE 'ANGLE EQUAL' ST 'ISA 60X60X5'
214. 21 TO 24 810 TO 813 TABLE 'ANGLE EQUAL' ST 'ISA 50X50X5'
215. CONSTANTS
216. MATERIAL STEEL ALL
217. *****
218. SUPPORTS
219. 1 TO 4 181 183 185 187 PINNED
220. *****
221. LOAD 1 DEAD LOAD + LIVE LOAD
222. SELFWEIGHT Y -1.15
223. JOINT LOAD
224. **WEIGHT OF CONDUCTOR & INSULATOR
225. 111 TO 114 167 TO 170 173 174 177 178 FY -3.939
226. **WEIGHT OF MEN WITH TOOL
227. 9 TO 12 119 120 191 192 FY -0.375
228. MEMBER LOAD
229. **WEIGHT OF SUSPENSION
230. 235 407 518 CON GY -0.65 0.225
231. JOINT LOAD
232. **WEIGHT OF EARTH WIRE
233. 13 TO 16 197 TO 200 FY -0.155
234. *****
235. LOAD 2 LOADTYPE NONE TITLE WIND ALONG X DIRECTION(PARALLEL TO BEAM)
236. JOINT LOAD
237. **WIND LOAD ON TOWER
238. 1 3 181 183 FX 1
239. 17 18 182 184 FX 1.98
240. 21 22 201 202 FX 1.78
241. 25 26 205 206 FX 1.65
242. 29 30 209 210 FX 1.49
243. 33 34 213 214 FX 1.26
244. 37 38 217 218 FX 1.37
245. 5 7 117 TO 120 FX 1.45
246. 9 12 119 120 FX 0.97
247. 41 42 193 194 FX 0.49
248. 45 46 221 222 FX 0.43
249. 49 50 225 226 FX 0.37
250. 13 16 197 198 FX 0.17
251. *****
252. LOAD 3 LOADTYPE NONE TITLE WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)
253. JOINT LOAD
254. **WIND LOAD ON TOWER
255. 1 2 181 185 FZ 1
256. 17 19 182 186 FZ 1.98
257. 21 23 201 203 FZ 1.78
258. 25 27 205 207 FZ 1.65
259. 29 31 209 211 FZ 1.49
260. 33 35 213 215 FZ 1.26
261. 37 39 217 219 FZ 1.37
262. 5 6 117 189 FZ 1.45

263. 9 10 119 191 FZ 0.97
264. 41 44 193 196 FZ 0.49
265. 45 48 221 224 FZ 0.43
266. 49 52 225 228 FZ 0.37
267. 13 14 197 200 FZ 0.17
268. **WIND LOAD ON BEAM
269. 59 60 63 64 67 68 71 72 79 80 83 84 87 88 91 92 95 96 99 TO 101 103 113 114 -
270. 123 124 127 128 131 132 135 136 139 140 143 144 147 148 151 152 155 156 159 -
271. 160 TO 161 163 169 170 174 178 FZ 0.672
272. *****
273. **BEAM-G2(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
274. **TOWER -4T2
275. *****
276. LOAD 10 NC(0P-0E) +WIND PARALLEL TO BEAM
277. JOINT LOAD
278. **NORMAL TENSION FORCE
279. 113 114 169 170 174 178 FZ 13.9
280. *WIND LOAD ON CONDUCTOR & INSULATOR
281. 111 TO 114 167 TO 170 173 174 177 178 FX 7.2
282. MEMBER LOAD
283. **WIND LOAD ON SUSPENSION
284. 235 407 518 CON GX 0.91 0.225
285. JOINT LOAD
286. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
287. 13 TO 16 197 TO 200 FX 0.2 FZ 2.5
288. *****
289. LOAD 11 SC(0P-0E) +WIND PARALLEL TO BEAM
290. JOINT LOAD
291. **SHORT CIRCUIT FORCE
292. 113 114 169 170 174 178 FZ 39.77
293. *WIND LOAD ON CONDUCTOR & INSULATOR
294. 111 TO 114 167 TO 170 173 174 177 178 FX 7.2
295. MEMBER LOAD
296. **WIND LOAD ON SUSPENSION
297. 235 407 518 CON GX 0.91 0.225
298. JOINT LOAD
299. **WIND LOAD ON EARTH WIRE
300. 13 TO 16 197 TO 200 FX 0.2
301. *****
302. LOAD 12 NC(0P-0E) +WIND PERPENDICULAR TO BEAM
303. JOINT LOAD
304. **NORMAL TENSION FORCE
305. 113 114 169 170 174 178 FZ 13.9
306. MEMBER LOAD
307. **WIND LOAD ON SUSPENSION
308. 235 407 518 CON GZ 0.91 0.225
309. JOINT LOAD
310. **NORMAL TENSION FORCE
311. 13 TO 16 197 TO 200 FZ 2.5
312. *****
313. LOAD 13 SC(0P-0E) +WIND PERPENDICULAR TO BEAM
314. JOINT LOAD
315. **SHORT CIRCUIT FORCE
316. 113 114 169 170 174 178 FZ 39.77
317. MEMBER LOAD
318. **WIND LOAD ON SUSPENSION

```

319. 235 407 518 CON GZ 0.91 0.225
320. *****
321. ***LOAD COMBINATIONS FOR MEMBER DESIGN (FACTORED)
322. *****
323. *(BEAM WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
324. *****
325. LOAD COMB 101 2.0(DL + NC + WIND PARALLEL TO BEAM)
326. 1 2.0 2 2.0 10 2.0
327. *****
328. LOAD COMB 201 1.5(DL + SC + WIND PARALLEL TO BEAM)
329. 1 1.5 2 1.5 11 1.5
330. *****
331. LOAD COMB 102 2.0(DL + NC + WIND PERPENDICULAR TO BEAM)
332. 1 2.0 3 2.0 12 2.0
333. *****
334. LOAD COMB 202 1.5(DL + SC + WIND PERPENDICULAR TO BEAM)
335. 1 1.5 3 1.5 13 1.5
336. *****
337. *LOAD COMBINATIONS FOR FOUNDATION & BASE PLATE DESIGN (UNFACTORED)
338. *****
339. *(BEAM WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
340. *****
341. LOAD COMB 301 1.0(DL + NC + WIND PARALLEL TO BEAM)
342. 1 1.0 2 1.0 10 1.0
343. *****
344. LOAD COMB 401 1.0(DL + SC + WIND PARALLEL TO BEAM)
345. 1 1.0 2 1.0 11 1.0
346. *****
347. LOAD COMB 302 1.0(DL + NC + WIND PERPENDICULAR TO BEAM)
348. 1 1.0 3 1.0 12 1.0
349. *****
350. LOAD COMB 402 1.0(DL + SC + WIND PERPENDICULAR TO BEAM)
351. 1 1.0 3 1.0 13 1.0
352. *****
353. PERFORM ANALYSIS

```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	216	NUMBER OF MEMBERS	692
NUMBER OF PLATES	0	NUMBER OF SOLIDS	0
NUMBER OF SURFACES	0	NUMBER OF SUPPORTS	8

Using 64-bit analysis engine.

SOLVER USED IS THE IN-CORE ADVANCED MATH SOLVER

TOTAL	PRIMARY LOAD CASES =	7,	TOTAL DEGREES OF FREEDOM =	624
TOTAL	LOAD COMBINATION CASES =	8	SO FAR.	

354. LOAD LIST 101 102 201 202

355. *****

356. FINISH

***** END OF THE STAAD.Pro RUN *****

**** DATE= JUL 6,2024 TIME= 10:57: 0 ****

* For technical assistance on STAAD.Pro, please visit *
* <http://www.bentley.com/en/support/> *

* *
* Details about additional assistance from *
* Bentley and Partners can be found at program menu *
* Help->Technical Support *

* *
* Copyright (c) Bentley Systems, Inc. *
* <http://www.bentley.com> *

MEMBER & CONNECTION BOLT DESIGN FOR
TOWER-4T2

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MAINBUS MKD."4T2"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

A DESIGN OF MAIN-LEG FOR PART - PA,PB

- a) Angle Section tried & adopted = 150 x 150 x 16
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 79567.81 kg
Maximum Tension in main leg for Panel = 70174.17 kg
- c) Effective Length of Angle, L1 & L2 = 3504.00 & 3504.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1752.00 / 29.40 = 59.59 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1752.00 / 45.80 = 38.25 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 45.60$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 40.00$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 40.00 = 101968.0$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 59.59
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 9.38 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2262.57$ Kg/sqcm.
- k) Permissible Compressive Load = $2262.57 \times 45.6000 = 103173.0$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 16$ mm = 16184.36 Kgs
No. of 16mm bolts required, = $101967.98 / 12711.17 = 8.02$ nos. Say **9.00 no.**
- p) Ultimate Maximum Compression per Leg = $79567.81 \times 1.00 = 79567.81$ Kg.
- q) Ultimate Maximum Tension per Leg = $70174.17 \times 1.00 = 70174.17$ Kg.
- r) Factor of Safety
In Compression = $103173.0 / 79567.81 = 1.30 > 1.0000$ It is Safe
In Tension = $101968.0 / 70174.17 = 1.45 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

B DESIGN OF MAIN-LEG FOR PART - PC, PD

- a) Angle Section tried & adopted = 130 x 130 x 12
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 54635.98 kg
Maximum Tension in main leg for Panel = 48236.800 kg
- c) Effective Length of Angle, L1 & L2 = 3003.00 & 3003.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1501.50 / 25.60 = 58.65 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1501.50 / 39.90 = 37.63 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 29.90$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 25.7000$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 25.70 = 65514.4$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 58.65
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.83 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2271.53$ Kg/sqcm.
- k) Permissible Compressive Load = $2271.53 \times 29.9000 = 67918.8$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 12$ mm = 12138.27 Kgs
No. of 16mm bolts required, = $65514.43 / 12138.27 = 5.40$ nos. Say **6.00 no.**
- p) Ultimate Maximum Compression per Leg = $54635.98 \times 1.00 = 54635.98$ Kg.
- q) Ultimate Maximum Tension per Leg = $48236.80 \times 1.00 = 48236.80$ Kg.
- r) Factor of Safety
In Compression = $67918.8 / 54635.98 = 1.24 > 1.0000$ It is Safe
In Tension = $65514.4 / 48236.80 = 1.36 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

C DESIGN OF MAIN-LEG FOR PART - PE, PF, PG,PH

- a) Angle Section tried & adopted = 130 x 130 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 35651.61 kg
Maximum Tension in main leg for Panel = 29468.765 kg
- c) Effective Length of Angle, L1 & L2 = 2302.00 & 2302.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 2302.00 / 25.70 = 89.57 < 120$ hence o.k.
 $L2/r_{xx} = 2302.00 / 40.20 = 57.26 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 25.10$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 21.6000$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 21.60 = 55062.7$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 89.57
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 13.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1901.61$ Kg/sqcm.
- k) Permissible Compressive Load = $1901.61 \times 25.1000 = 47730.5$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
No. of 16mm bolts required, = $47730.46 / 10115.22 = 4.72$ nos. Say **5.00 no.**
- p) Ultimate Maximum Compression per Leg = $35651.61 \times 1.00 = 35651.61$ Kg.
- q) Ultimate Maximum Tension per Leg = $29468.77 \times 1.00 = 29468.77$ Kg.
- r) Factor of Safety
In Compression = $47730.5 / 35651.61 = 1.34 > 1.0000$ It is Safe
In Tension = $55062.7 / 29468.77 = 1.87 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

C DESIGN OF MAIN-LEG FOR PART - PI, PJ,PK,PL

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 3678.77 kg
Maximum Tension in main leg for Panel = 3243.844 kg
- c) Effective Length of Angle, L1 & L2 = 1576.00 & 1576.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1576.00 / 14.60 = 107.95 < 120$ hence o.k.
 $L2/r_{xx} = 1576.00 / 23.10 = 68.23 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 7.27$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 5.5200$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 5.52 = 14071.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 107.95
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1467.78$ Kg/sqcm.
- k) Permissible Compressive Load = $1467.78 \times 7.2700 = 10670.8$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
No. of 16mm bolts required, = $10670.79 / 5057.61 = 2.11$ nos. Say **3.00 no.**
- p) Ultimate Maximum Compression per Leg = $3678.77 \times 1.00 = 3678.77$ Kg.
- q) Ultimate Maximum Tension per Leg = $3243.84 \times 1.00 = 3243.84$ Kg.
- r) Factor of Safety
In Compression = $10670.8 / 3678.77 = 2.90 > 1.0000$ It is Safe
In Tension = $14071.6 / 3243.84 = 4.34 > 1.0000$ It is Safe

* DESIGN OF BRACINGS FOR TOWER MKD. "4T2"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - GA, JA

a)	Angle Section tried & adopted	=	75	x	75	x	5
b)	Length of Angle, L2	=	4871.00				mm
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1217.75	/	14.60	=	83.41 < 200 hence o.k.
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2435.50	/	23.10	=	105.43 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	7.2700 sqcm.				
e)	Net Area of Cross Section Ae = A1 + A2.k assuming 1 No.s 16mm Dia. Bolts						
	$v =$	=	2.7500	+	3.6250	x	0.6947 = 5.2684 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy	= 250 Mpa				
g)	Permissible Tensile Stress	= 2549.20 Kg/sqcm.					
h)	Permissible Tensile Load	= 2549.20 x 5.2684 = 13430.3 Kgs					
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	105.43				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	15.00 > 13.28				
	Value of Fy = Fcr (as per cl. 5.2.2.2.)	=	2325.91 Kg/sqcm.				
	Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$	=	1507.26 Kg/sqcm.				
j)	Permissible Compressive Load	=	1507.26 x 7.2700 = 10957.8 Kgs				
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58 Kgs				
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	5 mm	=	5057.61 Kgs		
	No. of 16mm bolts required,	=	10957.80	/	5057.61		
		=	2.17 nos. Say				
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	9530.391 kg				
	Maximum Tension in Bracing	=	9377.308 kg				
m)	In Compression	=	10957.8	/	9530.39	=	1.15 > 1.0 safe
	In Tension	=	13430.3	/	9377.31	=	1.43 > 1.0 safe

3.00 no.

B DESIGN OF BRACINGS - GB, JB

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Length of Angle, L2 = 4204.00 mm
- c) Slenderness $0.25 \cdot L2 / r_{vv}$ = 1051.00 / 14.60 = 71.99 < 200 hence o.k.
 Slenderness $0.5 \cdot L2 / r_{xx}$ = 2102.00 / 23.10 = 91.00 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 7.2700 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 2.7500 + 3.6250 \times 0.6947 = 5.2684$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 5.2684 = 13430.3 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 91.00
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 15.00 > 13.28
 Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ (KL/r / C_e)^2 \}] \times F_y = 1716.11$ Kg/sqcm.
 j) Permissible Compressive Load = 1716.11 x 7.2700 = 12476.1 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
 No. of 16mm bolts required, = 12476.13 / 5057.61 = 2.47 nos. Say **3.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 10317.894 kg
 Maximum Tension in Bracing = 10359.592 kg
- m) In Compression = 12476.1 / 10317.89 = **1.21 > 1.0 safe**
 In Tension = 13430.3 / 10359.59 = **1.30 > 1.0 safe**

C DESIGN OF BRACINGS - GC, JC

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L_2 = 3453.00 mm
- c) Slenderness $0.5 \cdot L_2 / r_{vv}$ = 1726.50 / 19.40 = 88.99 < 200 hence o.k.
Slenderness L_2 / r_{xx} = 3453.00 / 30.50 = 113.21 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 113.21
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ (KL/r / C_e)^2 \}] \times F_y = 1514.66$ Kg/sqcm.
- j) Permissible Compressive Load = 1514.66 x 19.0000 = 28778.5 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
No. of 16mm bolts required, = 28778.52 / 6355.58 = 4.53 nos. Say **5.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 11742.961 kg
Maximum Tension in Bracing = 11286.248 kg
- m) In Compression = 28778.5 / 11742.96 = **2.45 > 1.0 safe**
In Tension = 36948.8 / 11286.25 = **3.27 > 1.0 safe**

D DESIGN OF BRACINGS - GD, JD

- a) Angle Section tried & adopted = 50 x 50 x 5
- b) Length of Angle, L2 = 2286.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1143.00 / 9.70 = 117.84 < 200 hence o.k.
 Slenderness $L2 / r_{xx}$ = 2286.00 / 23.10 = 98.96 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 4.7900 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 1.5000 + 2.3750 \times 0.6545 = 3.0545$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.0545 = 7786.6 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 117.84
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 10.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ (KL/r / C_e)^2 \}] \times F_y = 1428.46$ Kg/sqcm.
- j) Permissible Compressive Load = 1428.46 x 4.7900 = 6842.3 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
 No. of 16mm bolts required, = 6842.34 / 5057.61 = 1.35 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 1429.614 kg
 Maximum Tension in Bracing = 1404.565 kg
- m) In Compression = 6842.3 / 1429.61 = **4.79 > 1.0 safe**
 In Tension = 7786.6 / 1404.57 = **5.54 > 1.0 safe**

MEMBER & CONNECTION BOLT DESIGN FOR
BEAM-G2

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MAINBUS BEAM MKD."4T2"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

A DESIGN OF MAIN-LEG FOR PART - MA

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 26191.63 kg
Maximum Tension in main leg for Panel = 28704.53 kg
- c) Effective Length of Angle, L1 & L2 = 1035.00 & 1035.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1035.00 / 19.40 = 53.35 < 120$ hence o.k.
 $L2/r_{xx} = 1035.00 / 30.50 = 33.93 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 19.00$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 15.50$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 15.50 = 39512.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 53.35
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2319.46$ Kg/sqcm.
k) Permissible Compressive Load = $2319.46 \times 19.0000 = 44069.8$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
No. of 16mm bolts required, = $39512.59 / 10115.22 = 3.91$ nos. Say **4.00 no.**
- p) Ultimate Maximum Compression per Leg = $26191.63 \times 1.00 = 26191.63$ Kg.
- q) Ultimate Maximum Tension per Leg = $28704.53 \times 1.00 = 28704.53$ Kg.
- r) Factor of Safety
In Compression = $44069.8 / 26191.63 = 1.68 > 1.0000$ It is Safe
In Tension = $39512.6 / 28704.53 = 1.38 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

B DESIGN OF MAIN-LEG FOR PART - MC

- a) Angle Section tried & adopted = 130 x 130 x 12
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 43570.62 kg
Maximum Tension in main leg for Panel = 42630.010 kg
- c) Effective Length of Angle, L1 & L2 = 1310.00 & 1310.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1310.00 / 25.60 = 51.17 < 120$ hence o.k.
 $L2/r_{xx} = 1310.00 / 39.90 = 32.83 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 29.90$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 25.7000$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 25.70 = 65514.4$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 51.17
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.83 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2337.84$ Kg/sqcm.
k) Permissible Compressive Load = $2337.84 \times 29.9000 = 69901.5$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 12$ mm = 12138.27 Kgs
No. of 16mm bolts required, = $65514.43 / 12138.27 = 5.40$ nos. Say **6.00 no.**
- p) Ultimate Maximum Compression per Leg = $43570.62 \times 1.00 = 43570.62$ Kg.
- q) Ultimate Maximum Tension per Leg = $42630.01 \times 1.00 = 42630.01$ Kg.
- r) Factor of Safety
In Compression = $69901.5 / 43570.62 = 1.60 > 1.0000$ It is Safe
In Tension = $65514.4 / 42630.01 = 1.54 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

C DESIGN OF MAIN-LEG FOR PART - AA, AB

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 9104.25 kg
Maximum Tension in main leg for Panel = 8579.904 kg
- c) Effective Length of Angle, L1 & L2 = 2200.00 & 2200.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 2200.00 / 19.40 = 113.40 < 120$ hence o.k.
 $L2/r_{xx} = 2200.00 / 30.50 = 72.13 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 19.00$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 15.5000$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 15.50 = 39512.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 113.40
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1511.20$ Kg/sqcm.
k) Permissible Compressive Load = $1511.20 \times 19.0000 = 28712.9$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
No. of 16mm bolts required, = $28712.85 / 10115.22 = 2.84$ nos. Say **3.00 no.**
- p) Ulitmate Maximum Compression per Leg = $9104.25 \times 1.00 = 9104.25$ Kg.
- q) Ultimate Maximum Tension per Leg = $8579.90 \times 1.00 = 8579.90$ Kg.
- r) Factor of Safety
In Compression = $28712.9 / 9104.25 = 3.15 > 1.0000$ It is Safe
In Tension = $39512.6 / 8579.90 = 4.61 > 1.0000$ It is Safe

* DESIGN OF BRACINGS FOR BEAM MKD. "G2"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - SA & UA

a)	Angle Section tried & adopted	=	60	x	60	x	5
b)	Length of Angle, L2	=	2431.00				mm
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1215.50	/	11.60	=	104.78 < 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2431.00	/	18.20	=	133.57 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	5.7500 sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts						
	$v =$	2.0000 +	2.8750	x	0.6761	=	3.9437 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy	= 250 Mpa				
g)	Permissible Tensile Stress	= 2549.20 Kg/sqcm.					
h)	Permissible Tensile Load	= 2549.20 x 3.9437					=
		10053.2 Kgs					
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	133.57				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	12.00 < 13.28				
	Value of Fy	=	2549.20 Kg/sqcm.				
	Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	Fa = $[3.1415^2 \times E / \{ KL/r \}^2]$	=	1128.15 Kg/sqcm.				
j)	Permissible Compressive Load	=	1128.15 x 5.7500				
		=	6486.9 Kgs				
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58 Kgs				
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	5 mm	=	5057.61 Kgs		
	No. of 16mm bolts required,	=	6486.86 / 5057.61				
		=	1.28 nos. Say				
			2.00 no.				
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	6124.492 kg				
	Maximum Tension in Bracing	=	6095.353 kg				
m)	In Compression	=	6486.9	/	6124.49	=	1.06 > 1.0 safe
	In Tension	=	10053.2	/	6095.35	=	1.65 > 1.0 safe

B DESIGN OF BRACINGS - SB & UB

- a) Angle Section tried & adopted = 50 x 50 x 5
- b) Length of Angle, L2 = 2560.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1280.00 / 9.70 = 131.96 < 200 hence o.k.
 Slenderness $L2 / r_{xx}$ = 2560.00 / 15.20 = 168.42 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 4.7900 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 1.5000 + 2.3750 \times 0.6545 = 3.0545$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.0545 = 7786.6 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 168.42
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 10.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [3.1415^2 \times E / \{ K L / r \}^2] = 709.58$ Kg/sqcm.
- j) Permissible Compressive Load = 709.58 x 4.7900 = 3398.9 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161) = 9930.60$ Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
 No. of 16mm bolts required, = 3398.88 / 5057.61 = 0.67 nos. Say **1.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 2492.037 kg
 Maximum Tension in Bracing = 2543.566 kg
- m) In Compression = 3398.9 / 2492.04 = **1.36 > 1.0 safe**
 In Tension = 7786.6 / 2543.57 = **3.06 > 1.0 safe**

C DESIGN OF BRACINGS - DA, DB

a)	Angle Section tried & adopted	=	60	x	60	x	5	
b)	Length of Angle, L2	=	2125.00	mm				
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1062.50	/	11.60	=	91.59	< 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2125.00	/	18.20	=	116.76	< 200 hence o.k.
d)	Gross Area of Cross Section, A_g	=	5.7500	sqcm.				
e)	Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$ assuming 1 No.s 16mm Dia. Bolts							
	$v = 2.0000 + 2.8750 \times 0.6761$	=	3.9437	sqcm.				
f)	Minimum guaranteed yield Stress of Material F_y	=	250	Mpa				
g)	Permissible Tensile Stress	=	2549.20	Kg/sqcm.				
h)	Permissible Tensile Load	=	2549.20	x	3.9437	=	10053.2	Kgs
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.							
	Governing Slenderness ratio	=	116.76					
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$	=	13.28					
	Actual b/t ratio	=	12.00	<	13.28			
	Value of F_y	=	2549.20	Kg/sqcm.				
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66					
	$F_a = [1 - 0.5 \{ (KL/r / C_e)^2 \}] \times F_y$	=	1448.85	Kg/sqcm.				
j)	Permissible Compressive Load	=	1448.85	x	5.7500	=	8330.9	Kgs
k)	No. of 16mm bolts required, Permissible Shear Stress for 5.6 class bolts $= 310$ Mpa	=	3161	Kg/sqcm.				
	Permissible Bearing Stress for 5.6 class bolts $= 620$ Mpa	=	6322	Kg/sqcm.				
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$	=	9930.60	Kgs				
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$	$t = 5$ mm	=	5057.61	Kgs			
	No. of 16mm bolts required,	=	8330.91	/	5057.61	=	1.65	nos. Say
								2.00 no.
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing Maximum Compression in Bracing	=	1995.275	kg				
	Maximum Tension in Bracing	=	2431.334	kg				
m)	In Compression	=	8330.9	/	1995.28	=	4.18	> 1.0 safe
	In Tension	=	10053.2	/	2431.33	=	4.13	> 1.0 safe

D DESIGN OF BRACINGS - YH, YC, YD, SV

- a) Angle Section tried & adopted = 60 x 60 x 5
- b) Length of Angle, L_2 = 2200.00 mm
- c) Slenderness $0.5 \times L_2/r_{vv}$ = 1100.00 / 11.60 = 94.83 < 200 hence o.k.
Slenderness L_2/r_{xx} = 2200.00 / 18.20 = 120.88 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 5.7500 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2.k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 2.0000 + 2.8750 \times 0.6761 = 3.9437$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.9437 = 10053.2 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 120.88
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 12.00 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1369.81$ Kg/sqcm.
- j) Permissible Compressive Load = 1369.81 x 5.7500 = 7876.4 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
No. of 16mm bolts required, = 7876.42 / 5057.61 = 1.56 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 6727.471 kg
Maximum Tension in Bracing = 5062.566 kg
- m) In Compression = 7876.4 / 6727.47 = **1.17 > 1.0 safe**
In Tension = 10053.2 / 5062.57 = **1.99 > 1.0 safe**

BASE PLATE & ANCHOR BOLT DESIGN

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T2" (NORMAL CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

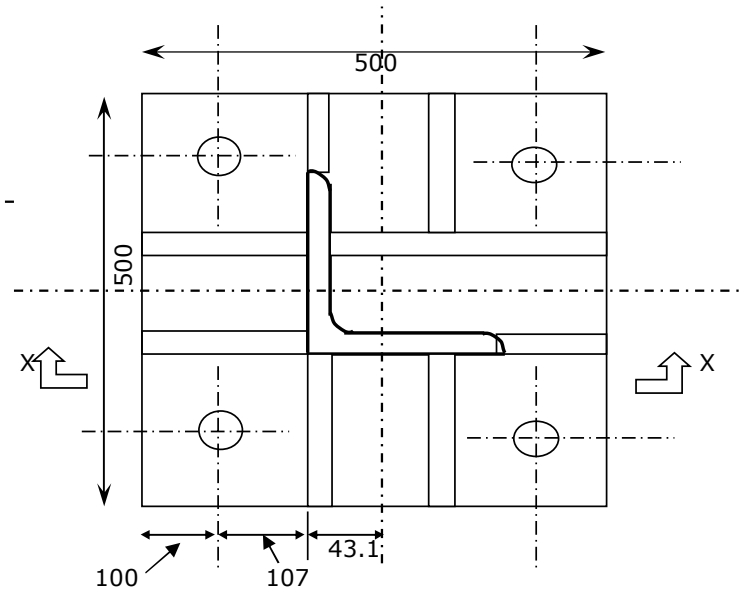
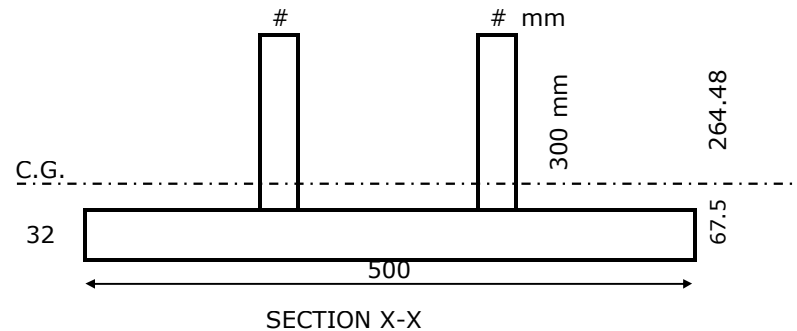
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	37401.34
B) MAXIMUM TENSION PER LEG	30687.27	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	2340.97	3434.49
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	2156.02	1622.25
E) RESULTANT SHEAR	3182.53	3798.35
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 37401.338 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 30687.268 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 37401.338 Kgs (Working)
b) Maximum Tensile Load per Leg = 30687.268 Kgs (Working)
c) Perm. bearing Stress - M25 concrete = 101.94 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm (A1 = BxD)
f) Main leg angle = L150x150x16
g) Base Plate Size adopted b x l = 500.00 x 500.00 x 32.00 mm (A2 = b x l)
h) Net Area of Base Plate provided = 500.000 x 500.000
= 2500.000 sqcm
i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)



C Section modulus

Moment of Inertia @ C G axis Ixx	= 192195126.44 mm ⁴
Section Modulus Zxx(top)	= 726683.01 mm ³
Section Modulus Zxx(bottom)	= 2846608.10 mm ³
Minimum Section Modulus Zxx(top)	= 726.683 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $37401.338 / 2500.000 + 0.000 / 20833.333$
= 14.961 Kg/sqcm.
< 101.937 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 206.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $14.9605 \times 50.000 \times 20.690^2 / 2.000$
= 160106.189 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
- b) Edge distance of Bolts = 100.00 mm
- c) Nominal Diameter of Bolts = 42.00 mm
- d) Diameter of Bolt Hole = 46.000 mm
- e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $206.900 - 100.000$
= 106.900 mm
- f) C/C of outer line of bolts, 'a' = $500.000 - 100.000 - 100.000$
= 300.000 mm
- g) Tension per bolt, $t = P/4 + Mx/n.a + My/n.a$ = $30687.268 / 4.000 + 0.000 / 60.000$
= 7671.817 Kgs
- h) Bending moment @ face of Stiffener = $2.000 \times 7671.8170 \times 10.690$
= 164023.447 Kg-cm
- Maximum bending moment = 164023.447 Kg-cm
- Minimum section modulus Z_{min} = 726.683 cm^3
- i) Maximum bending stress = $225.7153 \text{ Kg / sq. cm}$
< 1850.000 Kg / sq. cm

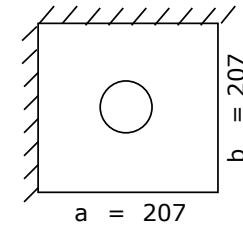
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

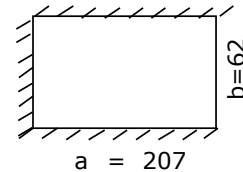
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 207 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 14.9605 \\ s_b &= 1.769 \times 15 \times 20.69^2 / 3.20^2 = \mathbf{1106.36} \\ \text{Allowable bending stress } (1.00 \times 1850) &< \mathbf{1850} \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 207 \text{ mm} \quad b = 62 \text{ mm} \\ a / b &= 3.326 \quad \beta = 0.798 \quad q = 14.9605 \\ s_b &= 0.798 \times 15 \times 6.22^2 / 3.20^2 = \mathbf{45.11} \\ \text{Allowable bending stress } (1.00 \times 1850) &< \mathbf{1850} \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(Stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	30687.27 Kgs.
c) Thus force / cm of weld length	=	95.90 Kgs.
d) Resistance /cm ² of weld	=	1100.00 Kgs.
e) Throat Size of weld required	=	0.09 cms
f) Thus fillet thickness required	=	1.23 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

H Design of Anchor Bolts

Diameter of Bolt	=	42 mm
Nos. of Bolts per Leg	=	4
Root area of M42 bolts, $A_e=0.785 \cdot A_g$	=	1088 mm ²
Gross area of M42 bolts, A_g	=	1385 mm ²

Check for Normal Condition :-

Axial Tension in Each Bolt P_t	=	7671.8 Kgs.

Tensile stress, $f_t = P_t/A_e$	=	$\frac{7671.8}{10.88}$

	=	705.41 Kg/cm ²	<	1200.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.00		Hence Safe

Shear Force In Each Bolt , P_s	=	3182.53 / 4	=	795.63 kg

Shear stress, $f_s = P_s/A_g$	=	$\frac{795.63}{13.85}$

	=	57.43 Kg/cm ²	<	800.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.00		Hence Safe

Combined stress check for Normal Condition :-

$f_s/F_s + f_t/F_t$	<	1.40	(ref. cl.8.9.4.5 IS:800-1984)

$\frac{705.41}{1200} + \frac{57.43}{800}$	=	0.66	Hence Safe.

Anchor length For Normal Condition :-

Anchor Length, L_e	=	$\frac{\text{Pull per bolt}}{(\pi \times d \times \tau_{bd})}$

	=	$\frac{7671.82}{13.19 \times 8.00}$	($\tau_{bd} = 8 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000)

Thus length of embedment 'L'	=	72.68 cms.

PROVIDE 4 NOS. 42 MM DIA. ANCHORE BOLT WITH MIN. 750MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T2" (SHORT CIRCUIT CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

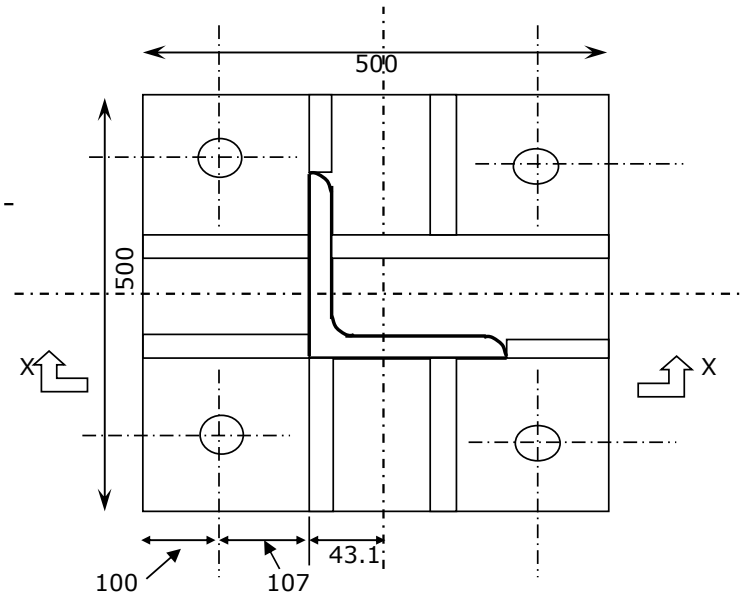
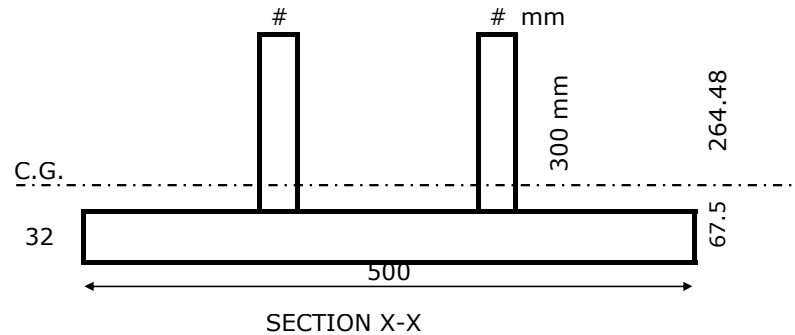
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	57061.06
B) MAXIMUM TENSION PER LEG	50355.69	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	2349.77	4851.83
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	4590.29	2635.29
E) RESULTANT SHEAR	5156.76	5521.33
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 57061.058 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 50355.686 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 57061.058 Kgs (Working)
b) Maximum Tensile Load per Leg = 50355.686 Kgs (Working)
c) Perm. bearing Stress - M25 concrete = 101.94 Kg/sqcm. ($\sqrt{A1/A2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm (A1 = BxD)
f) Main leg angle = L150x150x16
g) Base Plate Size adopted b x l = 500.00 x 500.00 x 32.00 mm (A2 = b x l)
h) Net Area of Base Plate provided = 500.000 x 500.000 = 2500.000 sqcm
i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)



C Section modulus

Moment of Inertia @ C G axis Ixx	= 192195126.44 mm ⁴
Section Modulus Zxx(top)	= 726683.01 mm ³
Section Modulus Zxx(bottom)	= 2846608.10 mm ³
Minimum Section Modulus Zxx(top)	= 726.683 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $57061.058 / 2500.000 + 0.000 / 20833.333$
= 22.8244 Kg/sqcm.
< 101.937 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 206.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions:

- c) Bending moment @ face of Stiffener = $22.8244 \times 50.000 \times 20.690^2 / 2.000$
= 244264.752 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
b) Edge distance of Bolts = 100.00 mm
c) Nominal Diameter of Bolts = 42.00 mm
d) Diameter of Bolt Hole = 46.000 mm
e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $206.900 - 100.000$
= 106.900 mm
f) C/C of outer line of bolts, 'a' = $500.000 - 100.000 - 100.000$
= 300.000 mm
g) Tension per bolt, $t = P/4 + Mx/n.a + My/n.a$ = $50355.686 / 4.000 + 0.000 / 60.000$
= 12588.922 Kgs
h) Bending moment @ face of Stiffener = $2.000 \times 12588.9215 \times 10.690$
= 269151.142 Kg-cm
- Maximum bending moment = 269151.142 Kg-cm
Minimum section modulus Z_{min} = 726.683 cm^3
i) Maximum bending stress = $370.3832 \text{ Kg / sq. cm}$
< 1850.000 Kg / sq. cm

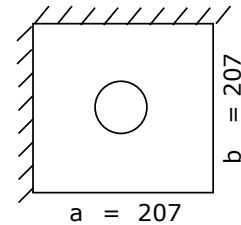
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

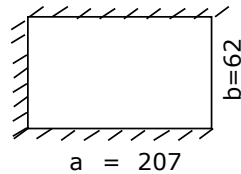
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 207 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 22.8244 \\ s_b &= 1.769 \times 23 \times 20.69^2 / 3.20^2 = \mathbf{1687.91} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 207 \text{ mm} \quad b = 62 \text{ mm} \\ a / b &= 3.326 \quad \beta = 0.798 \quad q = 22.8244 \\ s_b &= 0.798 \times 23 \times 6.22^2 / 3.20^2 = \mathbf{68.82} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	50355.69 Kgs.
c) Thus force / cm of weld length	=	157.36 Kgs.
d) Resistance /cm ² of weld	=	1375.00 Kgs.
e) Throat Size of weld required	=	0.11 cms
f) Thus fillet thickness required	=	1.62 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2) & BEAM (G2)

H Design of Anchor Bolts

Diameter of Bolt	=	42 mm
Nos. of Bolts per Leg	=	4
Root area of M42 bolts, $A_e=0.785 \cdot A_g$	=	1088 mm ²
Gross area of M42 bolts, A_g	=	1385 mm ²

Check for Short Circuit Condition :-

Axial Tension in Each Bolt P_t = 12588.9 Kgs.

Tensile stress, $f_t = P_t / A_e$ = $\frac{12588.9}{10.88}$

Permissible tensile stress, F_t = $\frac{1157.53 \text{ Kg/cm}^2}{1200 \times 1.25}$ < 1500.0 Kg/cm²
Hence Safe

Shear Force In Each Bolt , P_s = $\frac{5156.76}{4}$ = 1289.19 kg

Shear stress, $f_s = P_s / A_g$ = $\frac{1289.19}{13.85}$

Permissible Shear stress, F_s = $\frac{93.05 \text{ Kg/cm}^2}{800.00 \times 1.25}$ < 1000.0 Kg/cm²
Hence Safe

Combined stress check for Short Circuit Condition :-

$f_s / F_s + f_t / F_t < 1.40$ (ref. cl.8.9.4.5 IS:800-1984)

$\frac{1157.53}{1500} + \frac{93.05}{1000} = 0.86$ **Hence Safe.**

Anchor length For Short Circuit Condition :-

Anchor Length, L_e = Pull per bolt / $(\pi \times d \times \tau_{bd})$

= $\frac{12588.92}{13.19 \times 10.64}$ ($\tau_{bd} = 8 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000) (33% INCREASE)

Thus length of embedment 'L' = 89.67 cms.

PROVIDE 4 NOS. 42 MM DIA. ANCHORE BOLT WITH MIN. 900MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

400kV AIS

	OWNER MAHAN ENERGEN LIMITED (MEL) 2x800 MW ULTRA SUPER CRITICAL THERMAL POWER PROJECT, MAHAN (PHASE-II), SINGRAULI, M.P.
	OWNER'S ENGINEER TATA CONSULTING ENGINEERS LIMITED
 Godrej & Boyce Mfg. Co. Ltd.	EPC Contractor GODREJ AND BOYCE MFG. CO. LTD

DOCUMENT TITLE	4T3-4T4 TOWER & BEAM G3 TYPE STRUCTURE -DESIGN & LINE DIAGRAM
OWNER DOC. NO.	552H-E-EPC-SYD-DC-U-V-0003
CONTRACTOR / SUPPLIER DOC. NO.	GNB-MEL-CE-014
PACKAGE DISCIPLINE	CIVIL
PREPARED BY	JMP
REVIEWED BY	NT
APPROVED BY	NMP

Sr. No.	Revision No.	Date	Reasons for Change
1	01	13.09.2024	First issue

**CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER
PROJECT AT SINGRAULI ,MP**

DESIGN FOR **400KV** GANTRY TOWER (**4T3 & 4T4**) & BEAM (**G3**)

INDEX

Sr.No.	Description	Page no.
1	GEOMETRY	3
2	LOAD EVALUATION	7,17,34
3	PICTORIAL VIEW OF STAAD MODEL	50
4	STAAD ANALYSIS & DESIGN	57
5	MEMBER & CONNECTION BOLT DESIGN	70,79,89
6	BASE PLATE & ANCHOR BOLT DESIGN	99,110

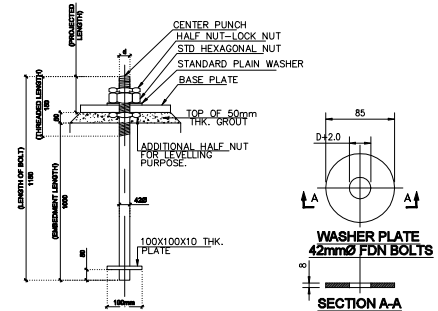
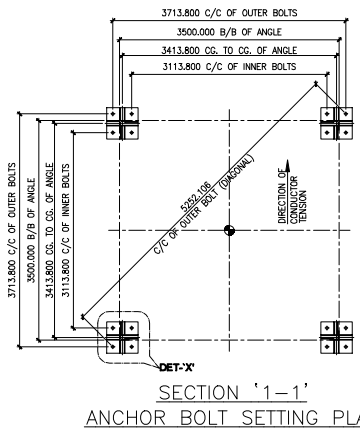
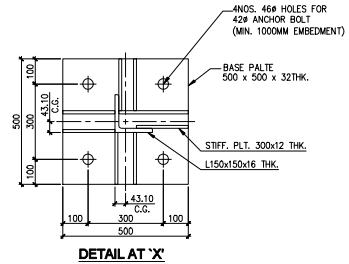
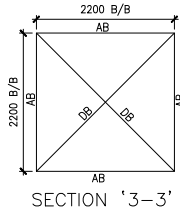
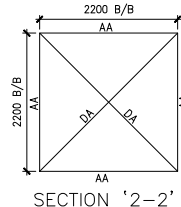
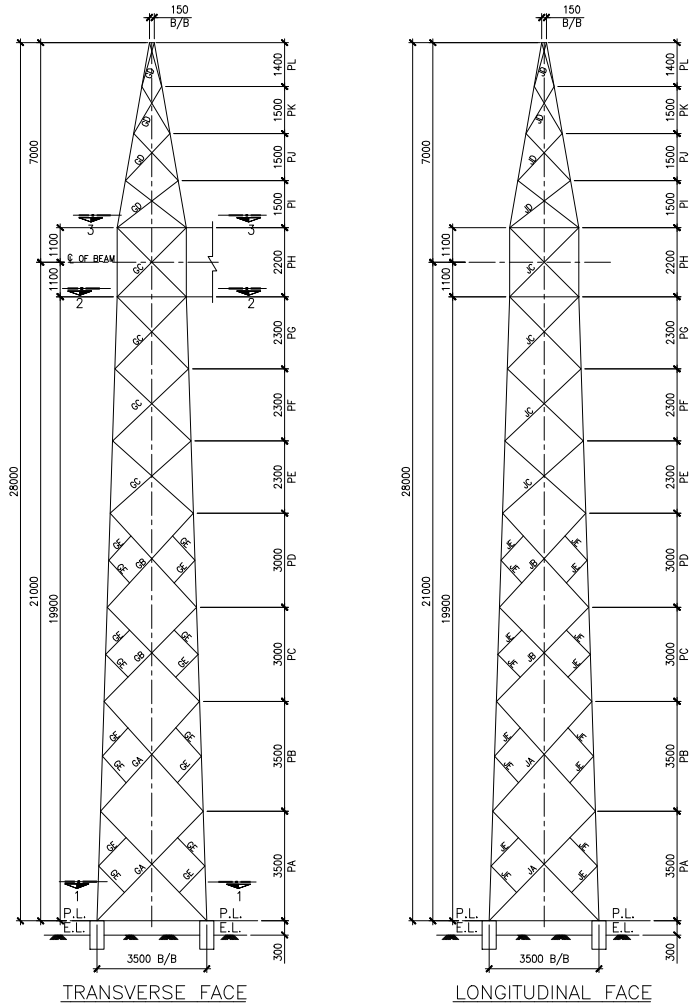
GEOMETRY

EL 0.00 LEVEL CORRESPONDS TO RL 338.000.

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL
4T3	ANGLE SIZE	L150x150x16	L150x150x16	L130x130x10	L130x130x10	L130x130x10	L130x130x10	L130x130x10	L130x130x10	L75x75x5	L75x75x5	L75x75x5	L75x75x5
	NO. OF BOLTS	10	10	06	06	06	06	06	06	04	04	04	04

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	GA,JA	GB,JB	GC,JC	GD,JD	GE,JE	AA,AB	DA,DB
4T3	ANGLE SIZE	L75x75x5	L75x75x5	L90x90x6	L50x50x5	L45x45x5	L100x100x10	L65x65x5
	NO. OF BOLTS	03	03	03	02	01	04	03

REFERENCE DRAWINGS:-	
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-L-V-0002	STRUCTURAL LAYOUT PLAN & SECTION
CONTRACTOR DRAWING NO: GNB-MEL-CE-003	STRUCTURAL LAYOUT PLAN & SECTION
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-F-V-0001	FOUNDATION BOLTS DRAWING FOR TOWERS
CONTRACTOR DRAWING NO: GNB-MEL-CE-005	FOUNDATION BOLTS DRAWING FOR TOWERS
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-O-V-0003	4T3 - FABRICATION DRAWING
CONTRACTOR DRAWING NO: GNB-MEL-CE-017	4T3 - FABRICATION DRAWING



LEGEND:-

TOWER MARKED '4T3 TOWER' IS A TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF GANTRY WITH CONDUCTOR TENSION OF 2.04T UNDER NORMAL CONDITION & 7.011T UNDER SHORT CIRCUIT CONDITION WITHOUT DEVIATION.

HIGHLIGHT:-

SPAN OF GIRDER	27.00 M.
HEIGHT OF GIRDER	21.00 M.
HEIGHT OF TOWER	28.00 M.
CONDUCTOR TENSION	2.040T (NC)
CONDUCTOR DEVIATION	7.011T (SC)
	0 DEGREE

NOTES:-

- 1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- 3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- 4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- 5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS 16mm DIA BOLT

400kV TOWER MKD. 4T3

BEAM MKD.	ANGLE SIZE AND NO. OF BOLTS	MA	MB	SA	SB	UA	UB	SV	YH	YD	YC
G3	ANGLE SIZE	L90x90x8	L100x100x10	L65x65x5	L60x60x5	L65x65x5	L60x60x5	L60x60x5	L60x60x5	L60x60x5	L60x60x5
	NO. OF BOLTS	04	04	02	02	02	02	02	02	02	02

LEGEND: -

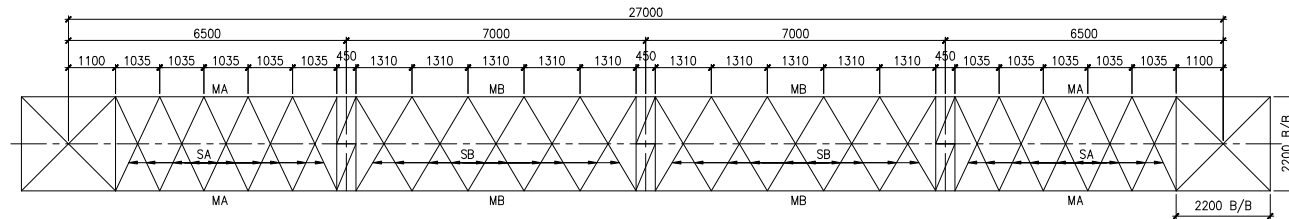
TOWER MARKED '4T3 & 4T4 TOWER' IS A TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF GANTRY WITH CONDUCTOR TENSION OF 2.040T UNDER NORMAL CONDITION & 7.011T UNDER SHORT CIRCUIT CONDITION WITHOUT DEVIATION.

HIGHLIGHT: -

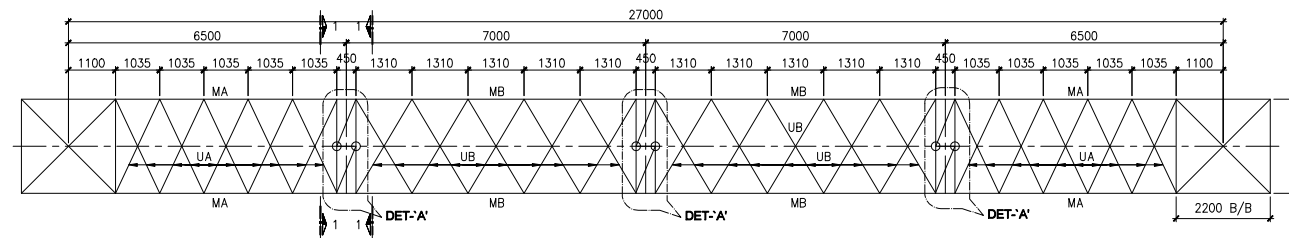
SPAN OF GIRDER	27.00 M.
HEIGHT OF GIRDER	21.00 M.
HEIGHT OF TOWER	28.00 M.
CONDUCTOR TENSION	2.040T (NC) 7.011T (SC)
CONDUCTOR DEVIATION	0 DEGREE

NOTES: -

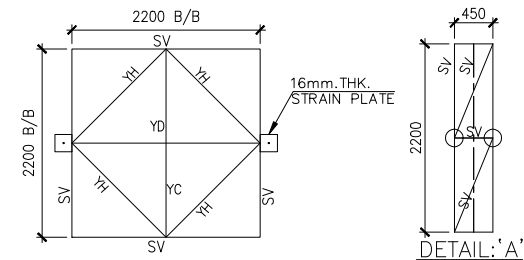
- 1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- 3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- 4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- 5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS
16mm DIA BOLT



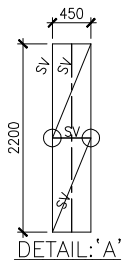
TOP & BOTTOM PLAN



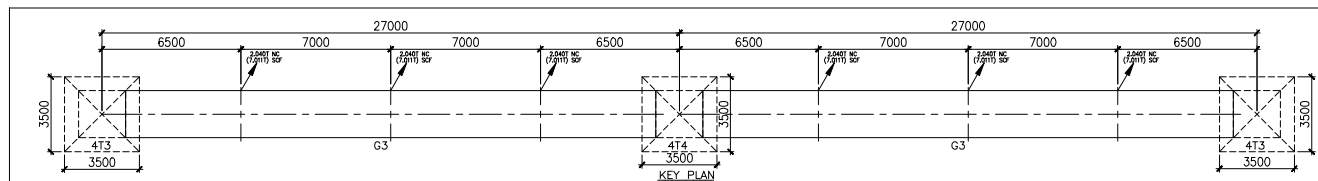
ELEVATION



SECTION '1-1'



DETAIL: 'A'



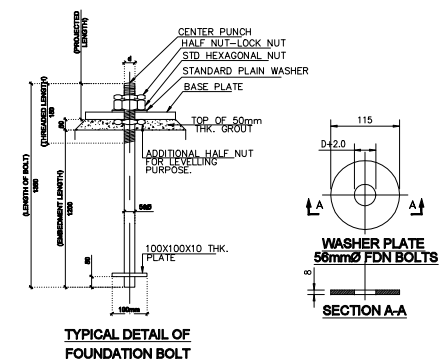
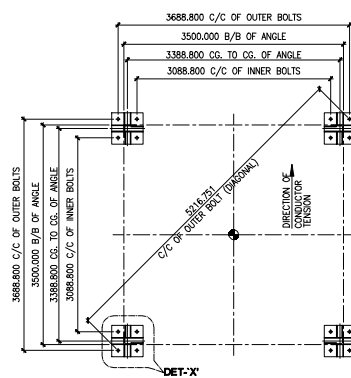
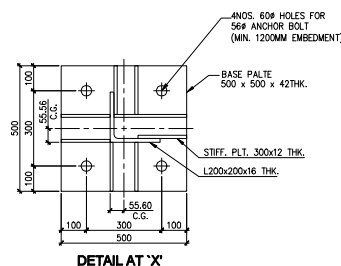
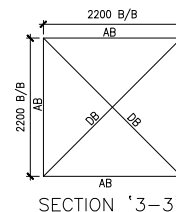
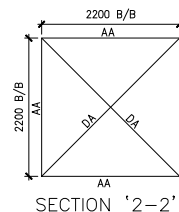
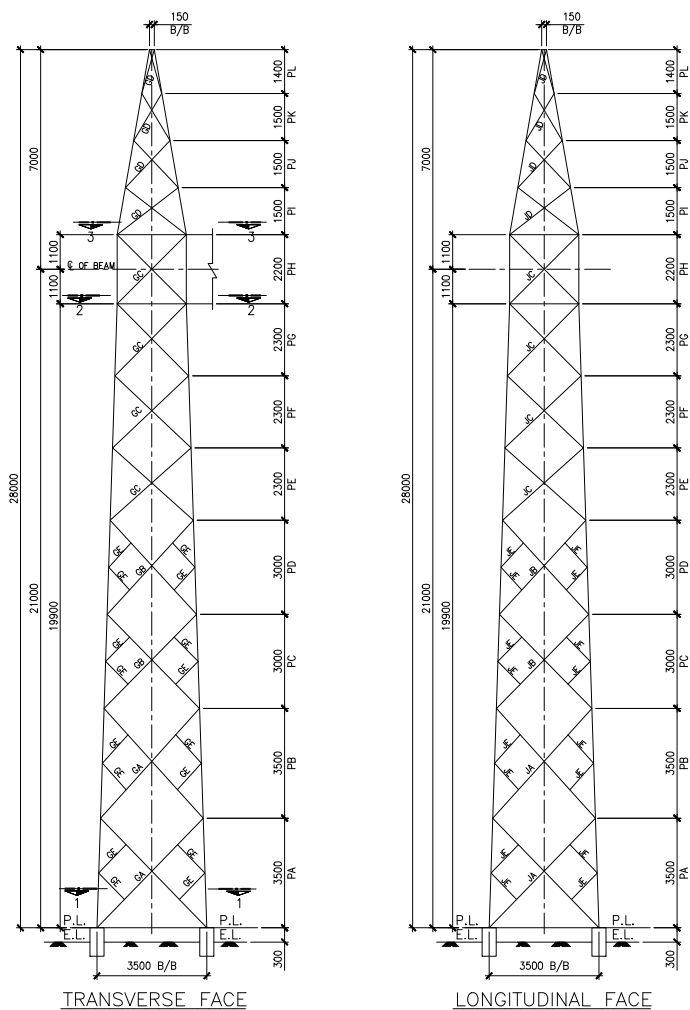
KEY PLAN

400kV TOWER MKD. G3

EL 0.00 LEVEL CORRESPONDS TO RL 338.000.

REFERENCE DRAWINGS:-	
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-L-V-0002	STRUCTURAL LAYOUT PLAN & SECTION
CONTRACTOR DRAWING NO: GNB-MEL-CE-003	STRUCTURAL LAYOUT PLAN & SECTION
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-F-V-0001	FOUNDATION BOLTS DRAWING FOR TOWERS
CONTRACTOR DRAWING NO: GNB-MEL-CE-005	FOUNDATION BOLTS DRAWING FOR TOWERS
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-O-V-0012	414 - FABRICATION DRAWING
CONTRACTOR DRAWING NO: GNB-MEL-CE-111	414 - FABRICATION DRAWING

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	GA,JA	GB,JB	GC,JC	GD,JD	GE,JE	AA,AB	DA,DB
4T4	ANGLE SIZE	L90x90x6	L90x90x6	L100x100x10	L50x50x5	L45x45x5	L100x100x10	L65x65x5
	NO. OF BOLTS	04	04	05	02	01	04	03



LEGEND: —

TOWER MARKED '4T4 TOWER' IS A TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF GANTRY WITH CONDUCTOR TENSION OF 2.040T UNDER NORMAL CONDITION & 7.011T UNDER SHORT CIRCUIT CONDITION WITHOUT DEVIATION.

HIGHLIGHT: -

SPAN OF GIRDER	27.00 M.
HEIGHT OF GIRDER	21.00 M.
HEIGHT OF TOWER	28.00 M.
CONDUCTOR TENSION	2.040T (NC)
	7.011T (SC)
CONDUCTOR DEVIATION	0 DEGREE

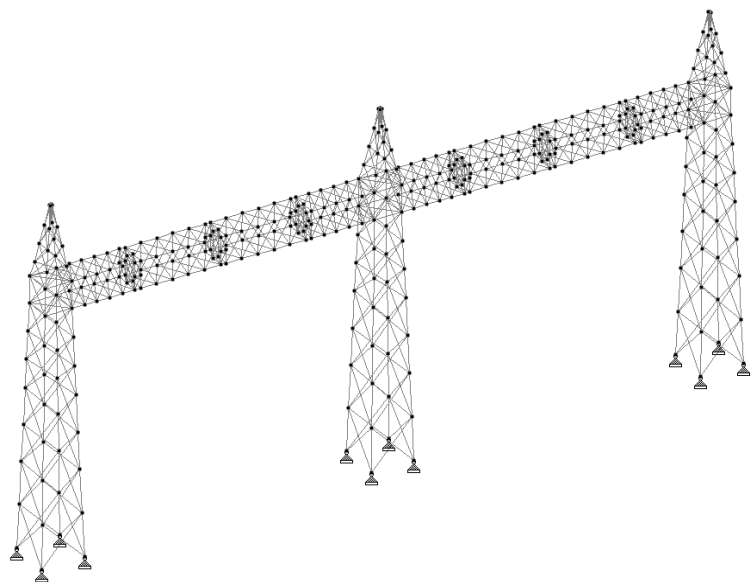
NOTES: –

- 1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- 3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- 4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- 5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS 16mm DIA BOLT

400kV TOWER MKD. 4T4

LOAD EVALUATION FOR BEAM-G3

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN OF "G3" BEAM
* LOAD EVALUATION FOR 400 kV BEAM MKD. "G3" (WITH ZERO DEVIATION IN PLAN & ELEVATION)	



SUMMARY OF CONDUCTOR AND INSULATOR FORCES				
		CONDUCTOR & INSULATOR FORCES		
		TRANSVERSE LOAD (kg)	VERTICAL LOAD (kg)	LONGITUDINAL LOAD (kg)
(1) NO DEVIATION	WIND PARALLEL TO BEAM (NC)	496.00	0.00	1020.00
	WIND PARALLEL TO BEAM (SC)	496.00	0.00	3505.50
	WIND PERPENDICULAR TO BEAM (NC)	0.00	0.00	1179.90
	WIND PERPENDICULAR TO BEAM (SC)	0.00	0.00	3665.40
	SELF WEIGHT OF INSULATOR & COND. (LEFT)	0.00	214.40	0.00
	SELF WEIGHT OF INSULATOR & COND. (RIGHT)	0	214.40	0
	EARTH WIRE LOAD			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3,4T4) & BEAM (G3)				
* LOAD EVALUATION FOR 400 kV BEAM MKD. "G3" (WITH ZERO DEVIATION IN PLAN & ELEVATION)					
# GENERAL NOTES & WIND PRESSURE EVALUATION : -					
* LOADS					
a)	All Dead & Live Loads shall be as per	=	I.S. 802		
b)	All Wind Loads shall be as per	=	I.S. 802		
* FACTOR OF SAFETY					
a)	IN NORMAL CONDITION	=	2.0		
b)	IN SHORT-CIRCUIT CONDITION	=	1.50		
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015					
a)	Basic Wind Speed	Vb	=	39	m/s (As Per Technical Specifications)
b)	Reliability level		=	1.00	(As Per Technical Specifications)
c)	Terrain Category		=	1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s (As Per Cl. 8.3 of IS802 (P1/S1)-2015)
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm (As Per Cl. 8.4 of IS802 (P1/S1)-2015)

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3,4T4) & BEAM (G3)									
*	CONDUCTOR DETAILS									
a)	Description	=	ACSR MOOSE							
b)	Dia. of conductor	=	31.770	mm	(As per Electrical Input)					
c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)					
d)	Tension per phase	=	2040	Kg/phase	(Normal Condition)					
		=	7011	Kg/phase	(Short-Circuit Condition)					
f)	No. of Sub conductor per phase	=	2	(As per Electrical Input)						
g)	No. of tension insulator / phase	=	2	(As per Electrical Input)						
h)	No. of suspension insulator / phase	=	1	(As per Electrical Input)						
i)	Length of wire on left side, L1 =	=	51.20	m	(As per T.S. 2.26, Cl 7.9,) / (As Per site conditions)					
j)	Length of wire on right side, L2 =	=	52.50	m						
k)	Conductor span	=	81.85	m						
	Left side Span (50%) = (52.50)			x	0.50	=	26.25	m		
	Right side Span (50%) = (51.20)			x	0.50	=	25.60	m		
	Add 30 m for Jumpers/ droppers(ASSUMED)					=	30.00	m		
l)	Angle of Deviation									
	In plan	=	0	deg.						
	In Elevation	=	0	deg.						
*	INSULATOR DETAILS									
a)	Weight of suspension insulator string with hardware	=	49.90	Kg						
b)	Weight of tension insulator string with hardware	=	49.90	Kg						
c)	Length of tension insulator	=	4.975	m						
d)	Length of suspension insulator	=	4.975	m						
e)	Diameter of tension insulator	=	135.00	mm						
d)	Diameter of suspension insulator	=	135.00	mm						

Project :-

CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP

Title :-

DESIGN FOR 400KV GANTRY TOWER (4T3,4T4) & BEAM (G3)

*

GIRDER DETAILS

a) C/C of girder

=

27.00

m

b) Length of parts being on either side being

=

5.400

&

7.000

m

c) Hamper width of tower

=

2.20

m

d) Clear span of girder

=

24.80

m

e) Width of girder

=

2.20

m

f) Depth of girder

=

2.20

m

g) Height of Girder from Plinth Level

=

20.25

m

	Vertical	Longitudial	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	2040.00	0.00
Load Due to Short Circuit Tension Due to Deviations in kg	0.00	7011.00	0.00

#

GEOMETRY FOR GIRDER :-

Part	Section		No. of pieces	Length in m
Main Leg				
Chord Central	MC	L 100x100x10	4	14.000
Chord Left	MA	L 90x90x8	4	5.400
Chord Right	MA	L 90x90x8	4	5.400
Plan				
Horizontal Belt	SV	L 60x60x5	6	2.200
Lattice Left	SA	L 65x65x5	20	2.431
Lattice Central	SB	L 60x60x5	40	2.560
Lattice Right	SA	L 65x65x5	20	2.431
Elevation				
Vertical Belt	SV	L 60x60x5	6	2.200
Lattice Left	UA	L 65x65x5	20	2.431
Lattice Central	UB	L 60x60x5	40	2.560
Lattice Right	UA	L 65x65x5	20	2.431
Connector Vertical	YD	L 60x60x5	6	2.200
Connector Horizontal	YC	L 60x60x5	6	2.200
Diamong Bracing	YH	L 60x60x5	24	1.556

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP																																																																																						
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3,4T4) & BEAM (G3)																																																																																						
# LOAD CALCULATIONS :-																																																																																							
* VERTICAL LOADS :																																																																																							
- Weight of Conductor																																																																																							
a)	Length of conductor	=	26.25	+	25.60	+	30.00																																																																																
		=	81.85	m																																																																																			
b)	Weight of conductor	=	81.85	x	2.004	x	2.00																																																																																
		=	328.05	Kgs			Say	=	329.00	Kgs																																																																													
- Weight of Insulator																																																																																							
a)	Weight of tension insulators string with hardware	=	99.80	Kgs per phase																																																																																			
b)	Weight of suspension Insulator string with hardware	=	49.90	Kgs per phase																																																																																			
- Weight of line man with tools																																																																																							
	at middle phase	=	150	Kgs																																																																																			
- Loads due to Conductor Tension																																																																																							
a)	Normal Condition	=	0.00	Kgs																																																																																			
b)	Short Circuit Tension	=	0.00	Kgs																																																																																			
* LONGITUDINAL LOADS :																																																																																							
- Wind Load on Girder																																																																																							
a)	Net Surface area	Ae	=	18.00	sqm (Refer the break up below)																																																																																		
b)	Gross Surface Area	Ag	=	54.56	sqm																																																																																		
c)	Solidity Ratio	Ae/Ag	=	0.3299																																																																																			
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)																																																																																		
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)																																																																																		
f)	Wind Load Ws = Pz x Cdt x Gt x Ae	=	3443.33	Kgs		Say	=	3445.00	Kgs																																																																														
<table><tr><th colspan="2">Part</th><th colspan="2">Section</th><th>No. of pieces</th><th>Length in m</th><th>Solid Area in sqm</th></tr><tr><td colspan="7">Main Leg</td></tr><tr><td>Chord Central</td><td>MC</td><td>L</td><td>100x100x10</td><td>2</td><td>14.000</td><td>2.80</td></tr><tr><td>Chord Left</td><td>MA</td><td>L</td><td>90x90x8</td><td>2</td><td>5.400</td><td>0.97</td></tr><tr><td>Chord Right</td><td>MA</td><td>L</td><td>90x90x8</td><td>2</td><td>5.400</td><td>0.97</td></tr><tr><td colspan="7">Elevation</td></tr><tr><td>Vertical Belt</td><td>SV</td><td>L</td><td>60x60x5</td><td>6</td><td>2.200</td><td>0.79</td></tr><tr><td>Lattice Left</td><td>UA</td><td>L</td><td>65x65x5</td><td>20</td><td>2.431</td><td>3.16</td></tr><tr><td>Lattice Central</td><td>UB</td><td>L</td><td>60x60x5</td><td>40</td><td>2.560</td><td>6.14</td></tr><tr><td>Lattice Right</td><td>UA</td><td>L</td><td>65x65x5</td><td>20</td><td>2.431</td><td>3.16</td></tr><tr><td colspan="5">Total Area</td><td>18.00</td><td>sqm</td></tr></table>											Part		Section		No. of pieces	Length in m	Solid Area in sqm	Main Leg							Chord Central	MC	L	100x100x10	2	14.000	2.80	Chord Left	MA	L	90x90x8	2	5.400	0.97	Chord Right	MA	L	90x90x8	2	5.400	0.97	Elevation							Vertical Belt	SV	L	60x60x5	6	2.200	0.79	Lattice Left	UA	L	65x65x5	20	2.431	3.16	Lattice Central	UB	L	60x60x5	40	2.560	6.14	Lattice Right	UA	L	65x65x5	20	2.431	3.16	Total Area					18.00	sqm
Part		Section		No. of pieces	Length in m	Solid Area in sqm																																																																																	
Main Leg																																																																																							
Chord Central	MC	L	100x100x10	2	14.000	2.80																																																																																	
Chord Left	MA	L	90x90x8	2	5.400	0.97																																																																																	
Chord Right	MA	L	90x90x8	2	5.400	0.97																																																																																	
Elevation																																																																																							
Vertical Belt	SV	L	60x60x5	6	2.200	0.79																																																																																	
Lattice Left	UA	L	65x65x5	20	2.431	3.16																																																																																	
Lattice Central	UB	L	60x60x5	40	2.560	6.14																																																																																	
Lattice Right	UA	L	65x65x5	20	2.431	3.16																																																																																	
Total Area					18.00	sqm																																																																																	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3,4T4) & BEAM (G3)				
-	Wind Load on Tension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	0.00 m		
c)	Net area Exposed, Ai = 50% of Li.di	=	0.00 sqm		
d)	Ratio of Li / di		0.00		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.700	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	0.00 Kgs	Say	= 0.00 Kgs
h)	Wind Load on Tension insulator in Longitudinal Direction	=	0.00 Kg		
-	Wind Load on Suspension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	4.98 m		
c)	Net area Exposed, Ai = Li.di	=	0.67 sqm		
d)	Ratio of Li / di		36.85		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69 Kgs	Say	= 91.00 Kgs
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	91.00 Kg		
-	Wind Load on Conductor				
a)	Diameter of conductor, dc	=	31.77 mm		
b)	Length of conductor, Lc	=	0.00 m		
c)	Net area Exposed, Lc.dc	=	0.00 sqm		
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)	
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)	
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	0.00 Kg	Say	= 0.00 Kgs
g)	Wind Load on Conductor in Longitudinal Direction	=	0.00 Kg		
-	Loads due to Conductor Tension				
a)	Normal Condition	=	2040.00 Kgs		
b)	Short Circuit Tension	=	7011.00 Kgs		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3,4T4) & BEAM (G3)									
*	TRANSVERSE LOADS:									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction			=	91.00	Kg				
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction			=	91.00	Kg				
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	81.85	m						
c)	Net area Exposed, Lc.dc	=	2.60	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	313.50	Kg		Say	=	314.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction			=	314.00	Kg				
-	Loads due to Conductor Tension									
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3,4T4) & BEAM (G3)										
# SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-											
Dead load	Self Wt.		Self Wt.								
	Cond.		T-Insu.								
TOTAL FY / PHASE	=	329.00	+	99.80		=	428.80	Kgs			
FY / NODE	=	164.50	+	49.90		=	214.40	Kgs			
Dead load	Self Wt.		Self Wt.								
	Cond.		T-Insu.								
TOTAL FY / PHASE	=	0.00	+	0.00		=	0.00	Kgs			
FY / NODE	=	0.00	+	0.00		=	0.00	Kgs			
- JOINT LOAD ON NODE NO. : 4.00											
	Lineman										
	With Tool										
TOTAL FY	=	150.00				=	150.00	Kgs			
FY / NODE	=	37.50				=	37.50	Kgs			
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on		Wind on		Wind on						
	Cond.		T-Insu.		sus.						
TOTAL FX / PHASE	=	314.00	+	91.00	+	91.00		=	496.00	Kgs	
FX / NODE	=	314.00	+	91.00	+	91.00		=	496.00	Kgs	
Cond. Tension			Conductor		Cond. Tension		Conductor		Cond. Tension		Conductor
			Tension				Tension				Tension
TOTAL FX / PHASE	=		0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	2040.00 Kgs
FX / NODE	=		0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	1020.00 Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on		Wind on		Wind on						
	Cond.		T-Insu.		S-Insu.						
TOTAL FX / PHASE	=	314.00	+	91.00	+	91.00		496.00	Kgs		
FX / NODE	=	314.00	+	91.00	+	91.00		496.00	Kgs		
Cond. Tension			Cond.		Cond. Tension		Conductor		Cond. Tension		Tension
			Tension				Tension				
TOTAL FX / PHASE	=		0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	7011.00 Kgs
FX / NODE	=		0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	3505.50 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3,4T4) & BEAM (G3)										
* LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)											
- JOINT LOAD ON NODE NO. : 1077 TO 1100											
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.						
TOTAL FZ / PHASE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs		
FZ / NODE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs		
Cond. Tension	Cond. Tension				Cond. Tension	Conductor Tension		Cond. Tension	Conductor Tension		
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	= 2040.00 Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	= 1020.00 Kgs
- WIND LOAD ON JOINT : 0.00											
	Wind load on Str.										
TOTAL FZ	=	3445.00					=	3445.00	Kgs		
FZ / NODE	=	3445.00	/	50			=	68.90	Kgs		
* LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on T-Insu.						
TOTAL FZ / PHASE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs		
FZ / NODE	=	0.00	+	0.00	+	91.00	=	91.00	Kgs		
Cond. Tension	Cond Tension				Cond. Tension	Conductor Tension		Cond. Tension	Conductor Tension		
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	= 7011.00 Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	= 3505.50 Kgs
- WIND LOAD ON JOINT :											
	Wind load on Str.										
TOTAL FZ	=	3445.00					=	3445.00	Kgs		
FZ / NODE	=	3445.00	/	50			=	68.90	Kgs		

LOAD EVALUATION FOR TOWER-4T3

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)		
<u>* GEOMETRY FOR MAINBUS MKD."4T3"</u>			
TRANSVERSE FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES
LONGITUDINAL FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES

SR. NO.	LEVEL m	SEGMENT m	T. WIDTH m	L. WIDTH m	WIDTH' T m	WIDTH' L m	ANGLE T - FACE	ANGLE L - FACE
PL	28.0000	0.0000	0.1500	0.1500	0.15	0.15	0.000	0.000
PK	26.6000	1.4000	0.6364	0.6364	0.39	0.39	74.311	74.311
PJ	25.1000	1.5000	1.1576	1.1576	0.90	0.90	59.120	59.120
PI	23.6000	1.5000	1.6788	1.6788	1.42	1.42	46.605	46.605
PH	22.1000	1.5000	2.2000	2.2000	1.94	1.94	37.720	37.720
PG	19.9000	2.2000	2.2000	2.2000	2.20	2.20	45.000	45.000
PF	17.6000	2.3000	2.3503	2.3503	2.28	2.28	45.312	45.312
PE	15.3000	2.3000	2.5005	2.5005	2.43	2.43	43.480	43.480
PD	13.0000	2.3000	2.6508	2.6508	2.58	2.58	41.764	41.764
PC	10.0000	3.0000	2.8467	2.8467	2.75	2.75	47.503	47.503
PB	7.0000	3.0000	3.0427	3.0427	2.94	2.94	45.533	45.533
PA	3.5000	3.5000	3.2714	3.2714	3.16	3.16	47.949	47.949
	0.0000	3.5000	3.5000	3.5000	3.39	3.39	45.951	45.951

WIDTH' = PLAN WIDTH AT THE GIVEN LEVEL - SEGMENT HEIGHT x TAN θ

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** SOLIDITY RATIO FOR LONGITUDINAL FACE FOR TOWER MKD."4T3"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	130x130x10	2.200	90x90x6	3.111	-	0.000	100x100x10	2.200	1.420	4.840	0.293	1.707
PG	130x130x10	2.300	90x90x6	3.235	-	0.000	100x100x10	2.200	1.470	5.233	0.281	1.719
PF	130x130x10	2.300	90x90x6	3.343	-	0.000	-	0.000	1.260	5.578	0.226	1.774
PE	130x130x10	2.300	90x90x6	3.453	-	0.000	-	0.000	1.281	5.924	0.216	1.784
PD	130x130x10	3.000	75X75X5	4.069	45x45x5	3.534	-	0.000	1.794	8.246	0.218	1.782
PC	130x130x10	3.000	75X75X5	4.204	45x45x5	3.602	-	0.000	1.821	8.834	0.206	1.794
PB	150x150x16	3.500	75X75X5	4.713	45x45x5	4.107	-	0.000	2.233	11.050	0.202	1.798
PA	150x150x16	3.500	75X75X5	4.870	45x45x5	4.185	-	0.000	2.265	11.850	0.191	1.809

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.150 \times 3.5 \times 2 + 0.075 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.265
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.265 / 11.849$	=	0.191
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.13 \times 2.3 \times 2 + 0.9 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.260
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.259 / 5.578$	=	0.226

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** WIND LOAD ON LONGITUDINAL FACE FOR TOWER MKD."4T3"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliability level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/ (As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd^2
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T3" - TABLE 1

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.36	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.36	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.36	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.36	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.36	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.36	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.36	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.36	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.36	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.36	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.36	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.36	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T3" - TABLE 2

A Segment No. from Top	B Segment Top Levels (metres)	C Design Speed Vz (metres/sec)	D Design Pressure Pz (kg/metre2)	E Gross Area of Parts Ag (metres ²)	F Solidity Ratio (Actual)	G Force co-efficient Cdt	H Gust Coefficient Gt	I Wind Load Pz x Cdt x Gt x Ae (kg)
PL	28.0000	30.6327	57.4098	0.5505	0.6779	1.6000	1.9600	67.1878
PK	26.6000	30.6327	57.4098	1.3456	0.3120	1.7000	1.9600	80.2967
PJ	25.1000	30.6327	57.4098	2.1273	0.2129	1.7871	1.9600	91.0921
PI	23.6000	30.6327	57.4098	2.9091	0.1697	1.8303	1.9600	101.6756
PH	22.1000	30.6327	57.4098	4.8400	0.2933	1.7067	1.9600	272.6288
PG	19.9000	30.6327	57.4098	5.2328	0.2810	1.7190	1.9600	284.4072
PF	17.6000	30.6327	57.4098	5.5784	0.2258	1.7742	1.8500	237.3582
PE	15.3000	30.6327	57.4098	5.9239	0.2162	1.7838	1.8500	242.6078
PD	13.0000	30.6327	57.4098	8.2462	0.2175	1.7825	1.8500	339.5977
PC	10.0000	30.6327	57.4098	8.8342	0.2062	1.7938	1.7000	318.8850
PB	7.0000	30.6327	57.4098	11.0496	0.2021	1.7979	1.7000	391.8189
PA	3.5000	30.6327	57.4098	11.8499	0.1911	1.8089	1.7000	399.8478
	0.0000							0.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T3" - TABLE 3

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	272.6288	187.1522	22.1000	4136.0639	94.0000	94.0000
PG	2.3000	19.9000	284.4072	278.5180	19.9000	5542.5081	140.0000	140.0000
PF	2.3000	17.6000	237.3582	260.8827	17.6000	4591.5348	131.0000	131.0000
PE	2.3000	15.3000	242.6078	239.9830	15.3000	3671.7399	120.0000	120.0000
PD	3.0000	13.0000	339.5977	291.1028	13.0000	3784.3359	146.0000	146.0000
PC	3.0000	10.0000	318.8850	329.2413	10.0000	3292.4133	165.0000	165.0000
PB	3.5000	7.0000	391.8189	355.3519	7.0000	2487.4636	178.0000	178.0000
PA	3.5000	3.5000	399.8478	395.8334	3.5000	1385.4168	198.0000	198.0000
	0.0000	0.0000	0.0000	199.9239	0.0000	0.0000	100.0000	100.0000
			2827.4036	2827.4036		36219.2369	1418.0000	1418.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** SOLIDITY RATIO FOR TRANSVERSE FACE FOR TOWER MKD."4T3"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	130x130x10	2.200	90x90x6	3.111	-	0.000	100x100x10	2.200	1.420	4.840	0.293	1.707
PG	130x130x10	2.300	90x90x6	3.235	-	0.000	100x100x10	2.200	1.470	5.233	0.281	1.719
PF	130x130x10	2.300	90x90x6	3.343	-	0.000	-	0.000	1.260	5.578	0.226	1.774
PE	130x130x10	2.300	90x90x6	3.453	-	0.000	-	0.000	1.281	5.924	0.216	1.784
PD	130x130x10	3.000	75X75X5	4.069	45x45x5	3.534	-	0.000	1.794	8.246	0.218	1.782
PC	130x130x10	3.000	75X75X5	4.204	45x45x5	3.602	-	0.000	1.821	8.834	0.206	1.794
PB	150x150x16	3.500	75X75X5	4.713	45x45x5	4.107	-	0.000	2.233	11.050	0.202	1.798
PA	150x150x16	3.500	75X75X5	4.870	45x45x5	4.185	-	0.000	2.265	11.850	0.191	1.809

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.150 \times 3.5 \times 2 + 0.075 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.265
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.265 / 11.849$	=	0.191
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.13 \times 2.3 \times 2 + 0.09 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.260
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.259 / 5.578$	=	0.226

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** WIND LOAD ON TRANSVERSE FACE FOR TOWER MKD."4T3"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliability level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd²
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caclulated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T3" - TABLE 1

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.3636	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.3636	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.3636	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.3636	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.3636	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.3636	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.3636	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.3636	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.3636	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.3636	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.3636	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.3636	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T3" - TABLE 3

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	272.6288	187.1522	22.1000	4136.0639	94.0000	94.0000
PG	2.3000	19.9000	284.4072	278.5180	19.9000	5542.5081	140.0000	140.0000
PF	2.3000	17.6000	237.3582	260.8827	17.6000	4591.5348	131.0000	131.0000
PE	2.3000	15.3000	242.6078	239.9830	15.3000	3671.7399	120.0000	120.0000
PD	3.0000	13.0000	339.5977	291.1028	13.0000	3784.3359	146.0000	146.0000
PC	3.0000	10.0000	318.8850	329.2413	10.0000	3292.4133	165.0000	165.0000
PB	3.5000	7.0000	391.8189	355.3519	7.0000	2487.4636	178.0000	178.0000
PA	3.5000	3.5000	399.8478	395.8334	3.5000	1385.4168	198.0000	198.0000
	0.0000	0.0000	0.0000	199.9239	0.0000	0.0000	100.0000	100.0000
			2827.4036	2827.4036		36219.2369	1418.0000	1418.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** EARTH WIRE LOAD EVALUATION FOR TOWER MKD."4T3"**
(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)

*** WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

*** EARTH WIRE LOADING :-**

a)	Length of wire on left side, L1 =	=	51.20	m
b)	Length of wire on right side, L2 =	=	52.50	m
c)	Earthwire Span (L1 + L2) (Full Span on both side for worst condition)	=	103.70	m
d)	Diameter of Earth Wire	=	10.980	mm
e)	Weight of Earth Wire	=	0.600	Kg/m
f)	Total Weight of Earth Wire per Tower	=	62.220	Kg
g)	Earth Wire Tension	=	1000.00	Kg
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table 27 of IS875-1987, part III)
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x 1.20 x 1.1386	
		=	78.44	Kg
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg
	Wind Load on Earth-Wire in Transverse Dirn.	=	80.00	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

k) Angle of Deviation

In Plan = 0.00 °

In Elevation = 0.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	1000.00	0.00

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn. = 80 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Vertical Loads :-

Weight of Earth-wire = 62 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Say = 62 Kg

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn. = 0 Kg

Load Due to Normal Tension Due to Deviation = 1000 Kg

Say = 1000 Kg

LOAD EVALUATION FOR TOWER-4T4

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)		
* <u>GEOMETRY FOR MAINBUS MKD."4T4"</u>			
TRANSVERSE FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES
LONGITUDINAL FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES

SR. NO.	LEVEL m	SEGMENT m	T. WIDTH m	L. WIDTH m	WIDTH' T m	WIDTH' L m	ANGLE T - FACE	ANGLE L - FACE
PL	28.0000	0.0000	0.1500	0.1500	0.15	0.15	0.000	0.000
PK	26.6000	1.4000	0.6364	0.6364	0.39	0.39	74.311	74.311
PJ	25.1000	1.5000	1.1576	1.1576	0.90	0.90	59.120	59.120
PI	23.6000	1.5000	1.6788	1.6788	1.42	1.42	46.605	46.605
PH	22.1000	1.5000	2.2000	2.2000	1.94	1.94	37.720	37.720
PG	19.9000	2.2000	2.2000	2.2000	2.20	2.20	45.000	45.000
PF	17.6000	2.3000	2.3503	2.3503	2.28	2.28	45.312	45.312
PE	15.3000	2.3000	2.5005	2.5005	2.43	2.43	43.480	43.480
PD	13.0000	2.3000	2.6508	2.6508	2.58	2.58	41.764	41.764
PC	10.0000	3.0000	2.8467	2.8467	2.75	2.75	47.503	47.503
PB	7.0000	3.0000	3.0427	3.0427	2.94	2.94	45.533	45.533
PA	3.5000	3.5000	3.2714	3.2714	3.16	3.16	47.949	47.949
	0.0000	3.5000	3.5000	3.5000	3.39	3.39	45.951	45.951

WIDTH' = PLAN WIDTH AT THE GIVEN LEVEL - SEGMENT HEIGHT x TAN θ

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** SOLIDITY RATIO FOR LONGITUDINAL FACE FOR TOWER MKD."4T4"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	150x150x12	2.200	100x100x10	3.111	-	0.000	100x100x10	2.200	1.577	4.840	0.326	1.700
PG	150x150x12	2.300	100x100x10	3.235	-	0.000	100x100x10	2.200	1.635	5.233	0.312	1.700
PF	150x150x12	2.300	100x100x10	3.343	-	0.000	-	0.000	1.426	5.578	0.256	1.744
PE	150x150x12	2.300	100x100x10	3.453	-	0.000	-	0.000	1.450	5.924	0.245	1.755
PD	150x150x16	3.000	90x90x6	4.069	45x45x5	3.534	-	0.000	2.048	8.246	0.248	1.752
PC	150x150x16	3.000	90x90x6	4.204	45x45x5	3.602	-	0.000	2.080	8.834	0.235	1.765
PB	200x200x16	3.500	90x90x6	4.713	45x45x5	4.107	-	0.000	2.749	11.050	0.249	1.751
PA	200x200x16	3.500	90x90x6	4.870	45x45x5	4.185	-	0.000	2.786	11.850	0.235	1.765

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.20 \times 3.5 \times 2 + 0.09 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.786
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.785 / 11.849$	=	0.235
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.15 \times 2.3 \times 2 + 0.09 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.356
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.356 / 5.578$	=	0.243

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** WIND LOAD ON LONGITUDINAL FACE FOR TOWER MKD."4T4"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliability level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/ (As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd^2
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T4" - TABLE 1

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.36	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.36	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.36	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.36	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.36	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.36	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.36	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.36	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.36	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.36	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.36	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.36	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T4" - TABLE 2

A Segment No. from Top	B Segment Top Levels (metres)	C Design Speed Vz (metres/sec)	D Design Pressure Pz (kg/metre2)	E Gross Area of Parts Ag (metres ²)	F Solidity Ratio (Actual)	G Force co-efficient Cdt	H Gust Coefficient Gt	I Wind Load Pz x Cdt x Gt x Ae (kg)
PL	28.0000	30.6327	57.4098	0.5505	0.6779	1.6000	1.9600	67.1878
PK	26.6000	30.6327	57.4098	1.3456	0.3120	1.7000	1.9600	80.2967
PJ	25.1000	30.6327	57.4098	2.1273	0.2129	1.7871	1.9600	91.0921
PI	23.6000	30.6327	57.4098	2.9091	0.1697	1.8303	1.9600	101.6756
PH	22.1000	30.6327	57.4098	4.8400	0.3259	1.7000	1.9600	301.7339
PG	19.9000	30.6327	57.4098	5.2328	0.3124	1.7000	1.9600	312.7359
PF	17.6000	30.6327	57.4098	5.5784	0.2557	1.7443	1.8500	264.2578
PE	15.3000	30.6327	57.4098	5.9239	0.2447	1.7553	1.8500	270.2527
PD	13.0000	30.6327	57.4098	8.2462	0.2484	1.7516	1.8500	381.0106
PC	10.0000	30.6327	57.4098	8.8342	0.2354	1.7646	1.7000	358.1884
PB	7.0000	30.6327	57.4098	11.0496	0.2488	1.7512	1.7000	469.8294
PA	3.5000	30.6327	57.4098	11.8499	0.2351	1.7649	1.7000	479.8543
	0.0000							0.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T4" - TABLE 3

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	301.7339	201.7047	22.1000	4457.6745	101.0000	101.0000
PG	2.3000	19.9000	312.7359	307.2349	19.9000	6113.9738	154.0000	154.0000
PF	2.3000	17.6000	264.2578	288.4968	17.6000	5077.5442	145.0000	145.0000
PE	2.3000	15.3000	270.2527	267.2553	15.3000	4089.0054	134.0000	134.0000
PD	3.0000	13.0000	381.0106	325.6317	13.0000	4233.2118	163.0000	163.0000
PC	3.0000	10.0000	358.1884	369.5995	10.0000	3695.9954	185.0000	185.0000
PB	3.5000	7.0000	469.8294	414.0089	7.0000	2898.0623	208.0000	208.0000
PA	3.5000	3.5000	479.8543	474.8418	3.5000	1661.9464	238.0000	238.0000
	0.0000	0.0000	0.0000	239.9271	0.0000	0.0000	120.0000	120.0000
			3178.1151	3178.1151		39555.1744	1594.0000	1594.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** SOLIDITY RATIO FOR TRANSVERSE FACE FOR TOWER MKD."4T4"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	150x150x12	2.200	100x100x10	3.111	-	0.000	100x100x10	2.200	1.577	4.840	0.326	1.700
PG	150x150x12	2.300	100x100x10	3.235	-	0.000	100x100x10	2.200	1.635	5.233	0.312	1.700
PF	150x150x12	2.300	100x100x10	3.343	-	0.000	-	0.000	1.426	5.578	0.256	1.744
PE	150x150x12	2.300	100x100x10	3.453	-	0.000	-	0.000	1.450	5.924	0.245	1.755
PD	150x150x16	3.000	90x90x6	4.069	45x45x5	3.534	-	0.000	2.048	8.246	0.248	1.752
PC	150x150x16	3.000	90x90x6	4.204	45x45x5	3.602	-	0.000	2.080	8.834	0.235	1.765
PB	200x200x16	3.500	90x90x6	4.713	45x45x5	4.107	-	0.000	2.749	11.050	0.249	1.751
PA	200x200x16	3.500	90x90x6	4.870	45x45x5	4.185	-	0.000	2.786	11.850	0.235	1.765

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.20 \times 3.5 \times 2 + 0.09 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.786
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.785 / 11.849$	=	0.235
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.15 \times 2.3 \times 2 + 0.09 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.356
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.356 / 5.578$	=	0.243

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** WIND LOAD ON TRANSVERSE FACE FOR TOWER MKD."4T4"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliability level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd²
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caclulated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T4" - TABLE 1

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.3636	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.3636	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.3636	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.3636	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.3636	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.3636	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.3636	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.3636	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.3636	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.3636	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.3636	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.3636	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T4" - TABLE 3

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	301.7339	201.7047	22.1000	4457.6745	101.0000	101.0000
PG	2.3000	19.9000	312.7359	307.2349	19.9000	6113.9738	154.0000	154.0000
PF	2.3000	17.6000	264.2578	288.4968	17.6000	5077.5442	145.0000	145.0000
PE	2.3000	15.3000	270.2527	267.2553	15.3000	4089.0054	134.0000	134.0000
PD	3.0000	13.0000	381.0106	325.6317	13.0000	4233.2118	163.0000	163.0000
PC	3.0000	10.0000	358.1884	369.5995	10.0000	3695.9954	185.0000	185.0000
PB	3.5000	7.0000	469.8294	414.0089	7.0000	2898.0623	208.0000	208.0000
PA	3.5000	3.5000	479.8543	474.8418	3.5000	1661.9464	238.0000	238.0000
	0.0000	0.0000	0.0000	239.9271	0.0000	0.0000	120.0000	120.0000
			3178.1151	3178.1151		39555.1744	1594.0000	1594.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

*** EARTH WIRE LOAD EVALUATION FOR TOWER MKD."4T4"**
(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)

*** WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

*** EARTH WIRE LOADING :-**

a)	Length of wire on left side, L1 =	=	51.20	m
b)	Length of wire on right side, L2 =	=	52.50	m
c)	Earthwire Span (L1 + L2)	(Full Span on both side for worst condition) =	103.70	m
d)	Diameter of Earth Wire	=	10.980	mm
e)	Weight of Earth Wire	=	0.600	Kg/m
f)	Total Weight of Earth Wire per Tower	=	62.220	Kg
g)	Earth Wire Tension	=	1000.00	Kg
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table 27 of IS875-1987, part III)
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x 1.20 x 1.1386	
		=	78.44	Kg
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg
	Wind Load on Earth-Wire in Transverse Dirn.	=	80.00	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4, 4T3) & BEAM (G3)

k) Angle of Deviation

In Plan = 0.00 °

In Elevation = 0.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	1000.00	0.00

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn. = 80 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Vertical Loads :-

Weight of Earth-wire = 62 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Say = 62 Kg

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn. = 0 Kg

Load Due to Normal Tension Due to Deviation = 1000 Kg

Say = 1000 Kg

PICTORIAL VIEW OF STAAD MODEL

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 1	Rev
Job Title	Part		Ref
Client	By	Date02-JULY-24	Chd
FileTOWER 4T3 , 4T4 & BEAM G3.STD		Date Time08-Jul-2024 14:03	

Job Information

	Engineer	Checked	Approved
Name:			
Date:	02-JULY-24		
Comments:			
Structure Type:	TRUSS		

Geometry

Entity Type	Count	Highest
Nodes	380	396
Analytical Members	1224	1481

Load Cases

Load Case Type	Count
Primary	7
Combination	8

Included in this printout are data for:

All	The Whole Structure

Load Case Table

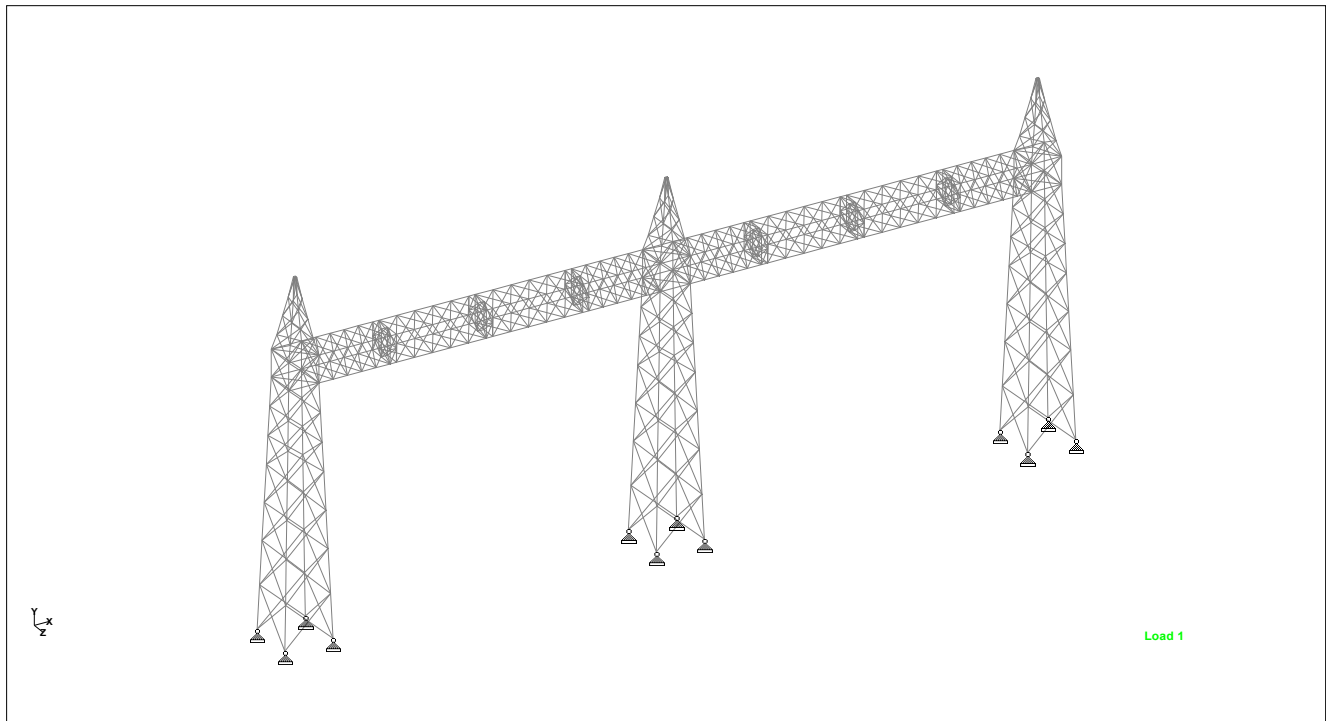
Included in this printout are results for load cases:

L/C	Type	Name
1	Primary	DEAD LOAD + LIVE LOAD
2	Primary	WIND ALONG X DIRECTION(PARALLEL TO BEAM)
3	Primary	WIND ALONG Z DIRECTION (PERPENDICULAR TO BEAM)
10	Primary	NC(OP-0E) +WIND PARALLEL TO BEAM
11	Primary	SC(OP-0E) +WIND PARALLEL TO BEAM
12	Primary	NC(OP-0E) +WIND PERPENDICULAR TO BEAM
13	Primary	SC(OP-0E) +WIND PERPENDICULAR TO BEAM
101	Combination	2.0(DL + NC + WIND PARALLEL TO BEAM)
201	Combination	1.5(DL + SC + WIND PARALLEL TO BEAM)
102	Combination	2.0(DL + NC + WIND PERPENDICULAR TO BEAM)
202	Combination	1.5(DL + SC + WIND PERPENDICULAR TO BEAM)

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 2	Rev
Job Title	Part		Ref
Client	By	Date 02-JULY-24	Chd
File TOWER 4T3 , 4T4 & BEAM G3.STD	Date Time 08-Jul-2024 14:03		

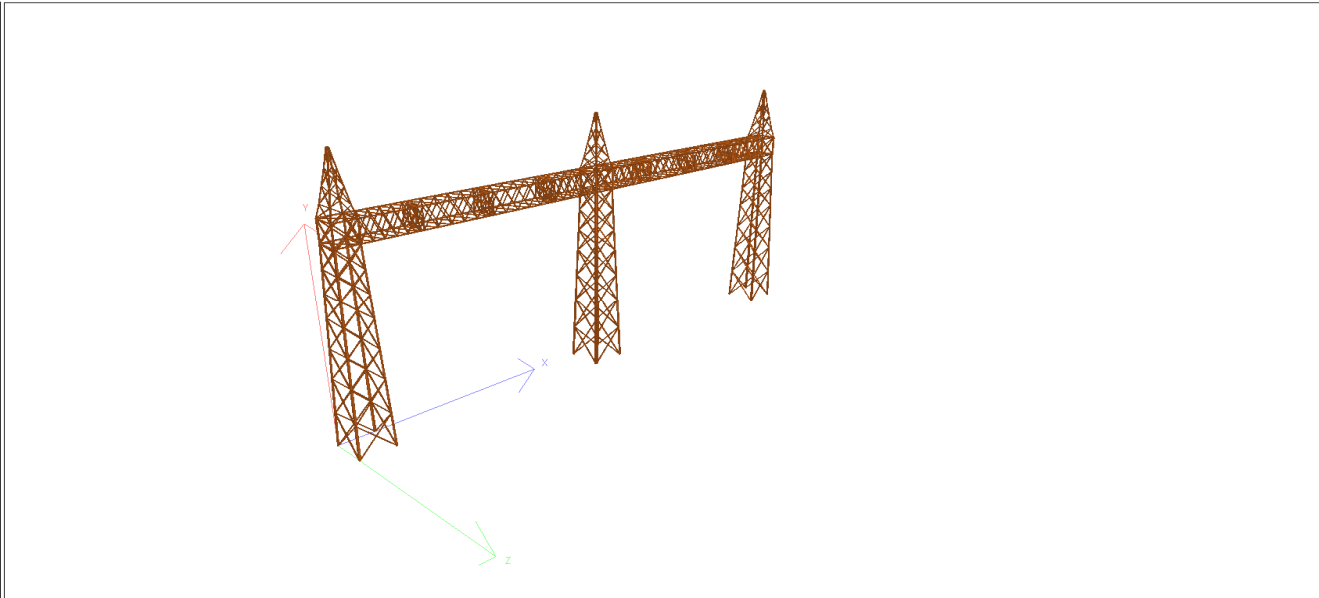
Load Case Table Cont...

L/C	Type	Name
301	Combination	1.0(DL + NC + WIND PARALLEL TO BEAM)
401	Combination	1.0(DL + SC + WIND PARALLEL TO BEAM)
302	Combination	1.0(DL + NC + WIND PERPENDICULAR TO BEAM)
402	Combination	1.0(DL + SC + WIND PERPENDICULAR TO BEAM)

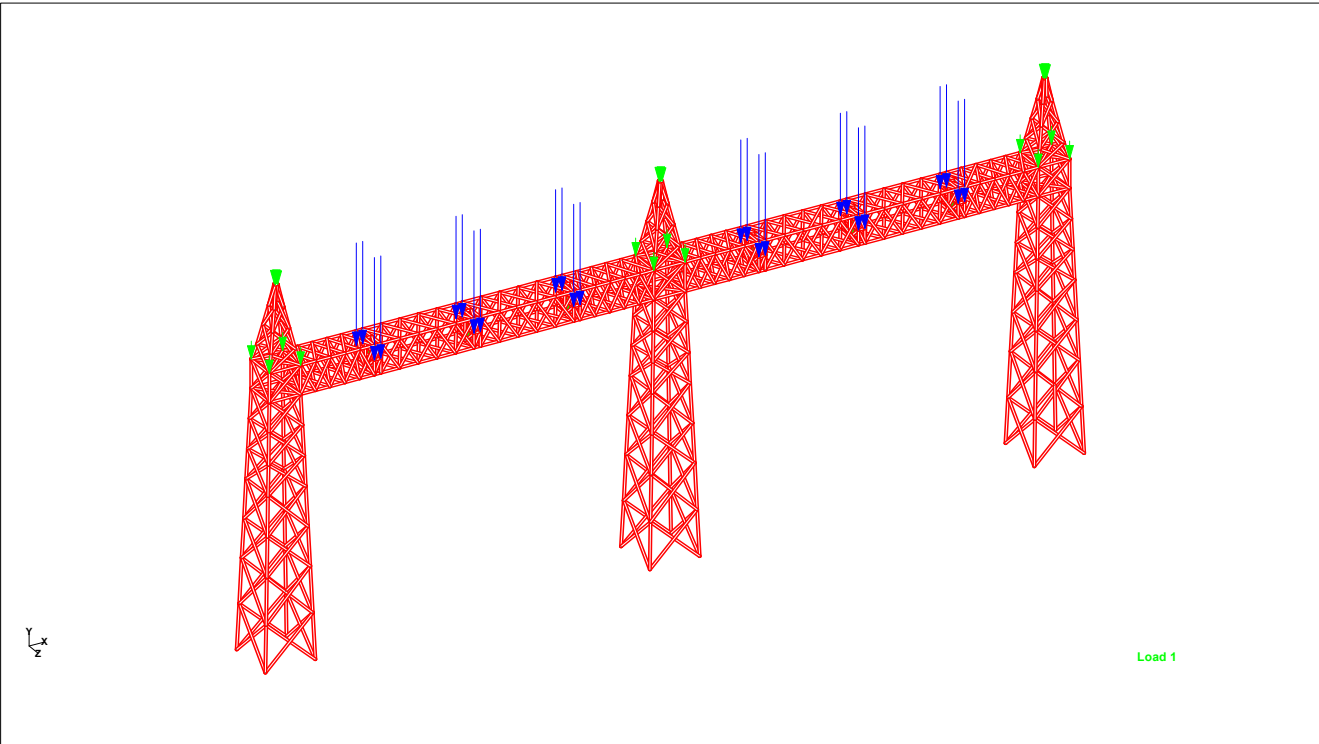


Whole Structure

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 3	Rev
	Part		Ref
Job Title	Client	By y	Date 02-JULY-24 Chd
File TOWER 4T3 , 4T4 & BEAM G3.STD		Date Time 08-Jul-2024 14:03	

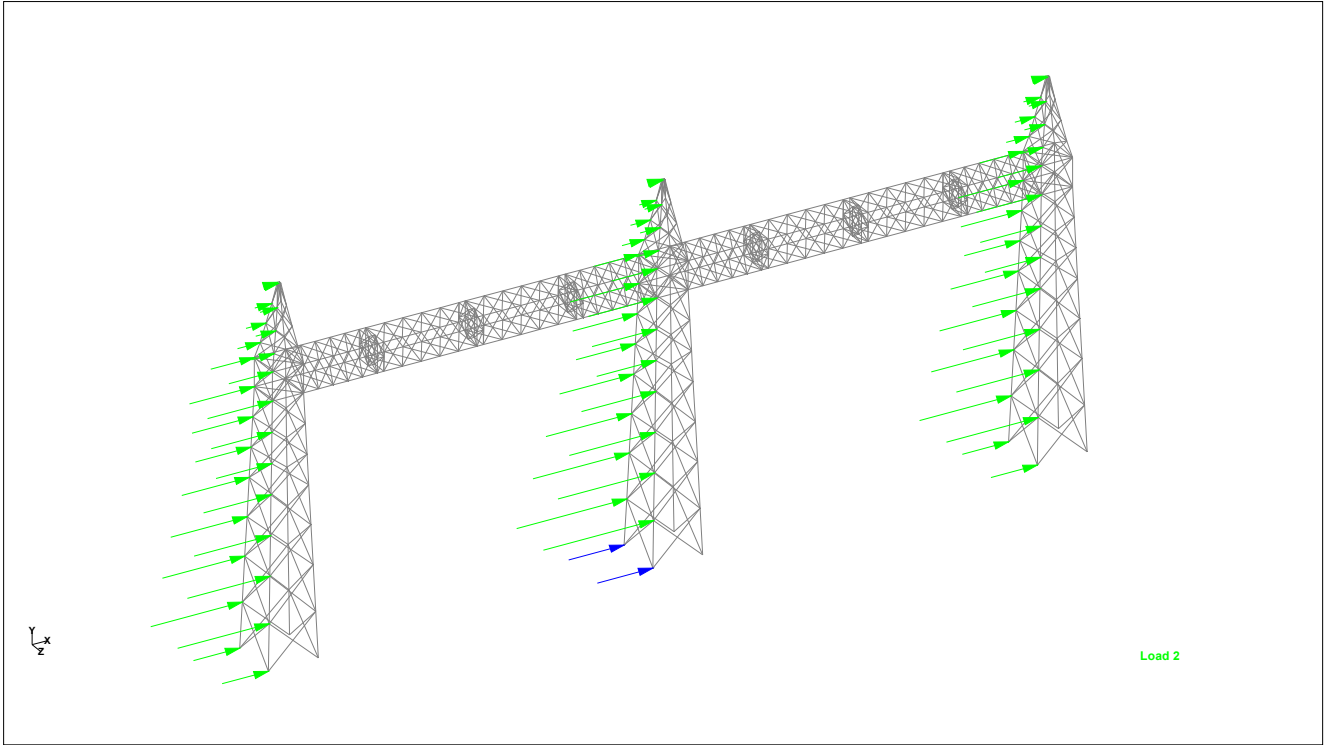


3D Rendered View

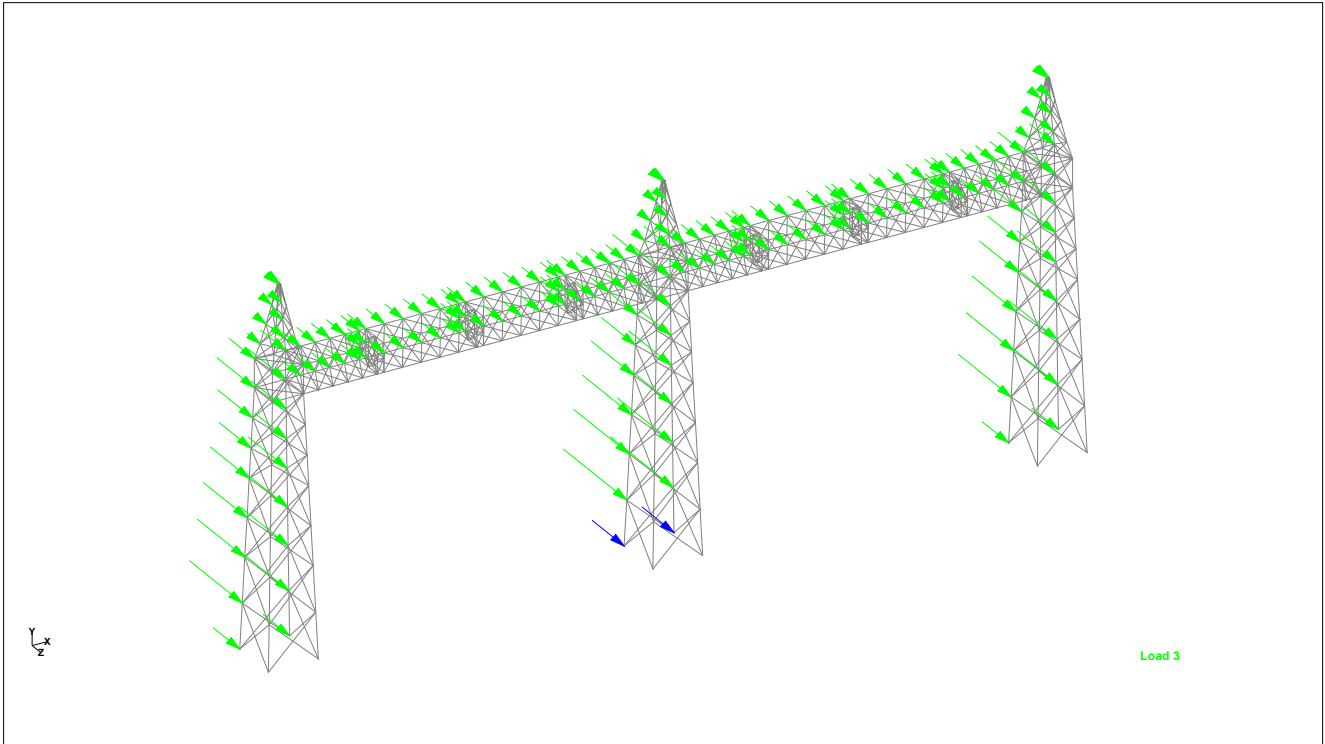


DEAD LOAD + LIVE LOAD

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		4	
Job Title	Part		Ref
Client	By	Date	Chd
File TOWER 4T3 , 4T4 & BEAM G3.STD		02-JULY-24	
	Date Time 08-Jul-2024 14:03		

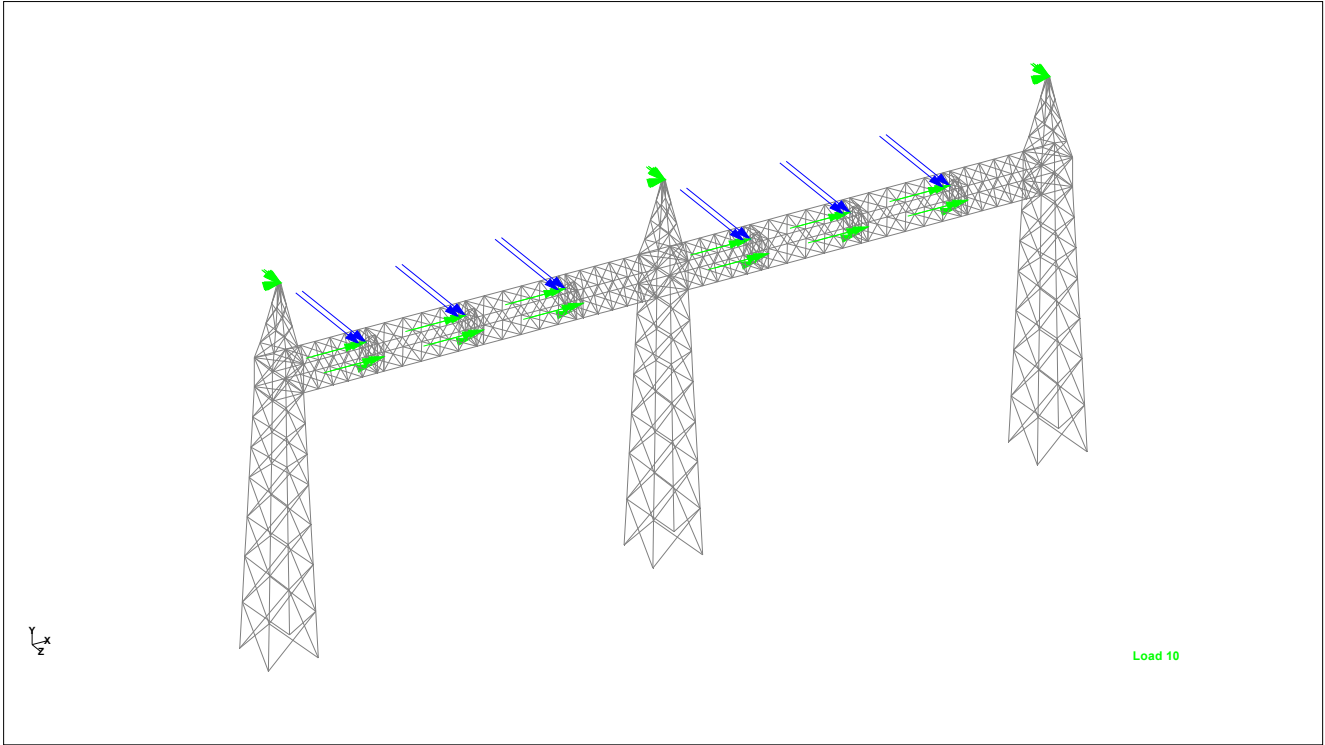


WIND ALONG X DIRECTION(PARALLEL TO BEAM)

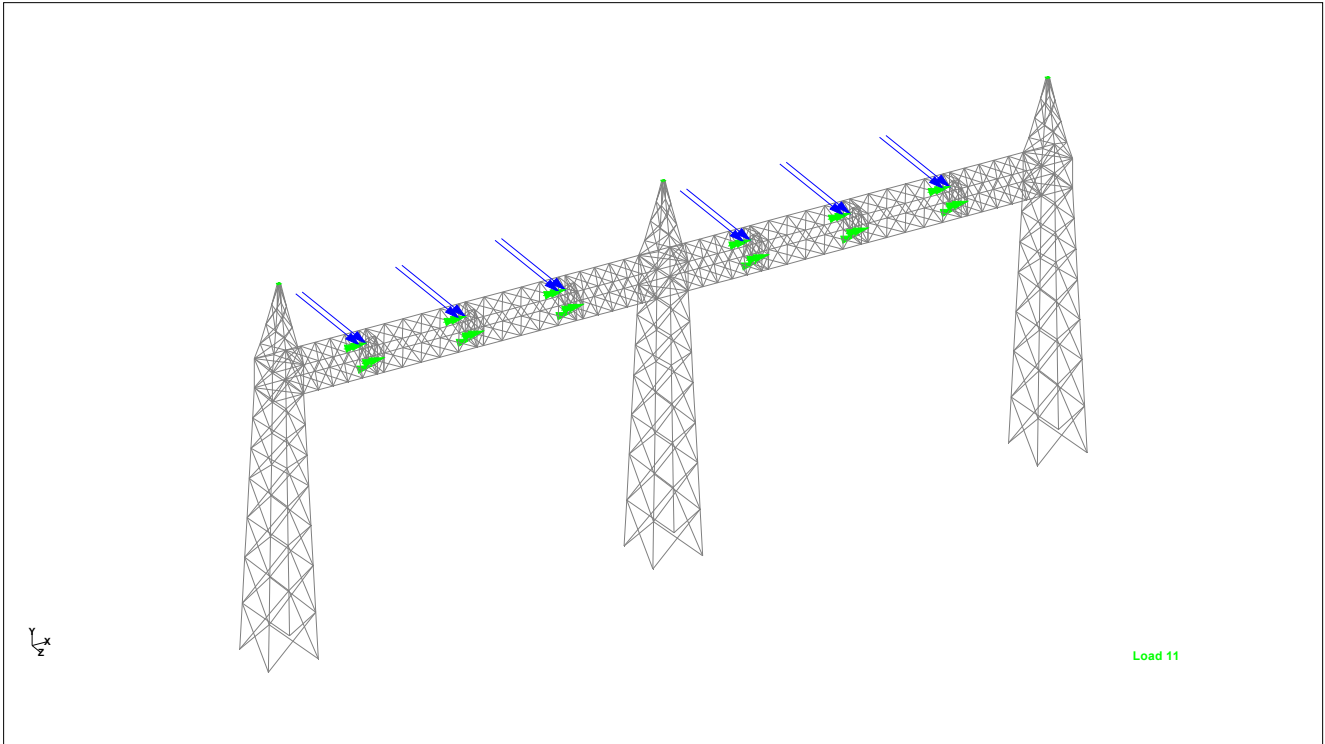


WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 5	Rev
	Part		Ref
Job Title	By	Date 02-JULY-24	Chd
Client	Date Time 08-Jul-2024 14:03		
File TOWER 4T3 , 4T4 & BEAM G3.STD			

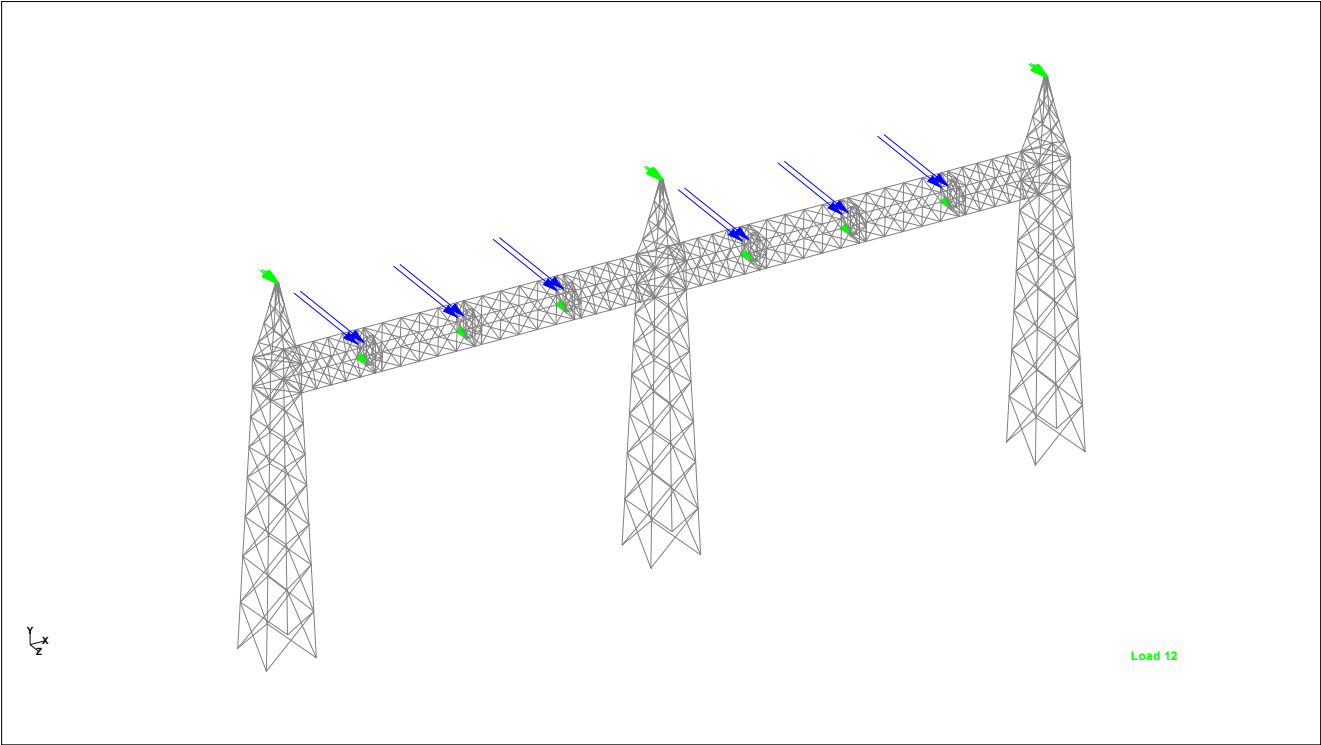


NC(0P-0E) +WIND PARALLEL TO BEAM

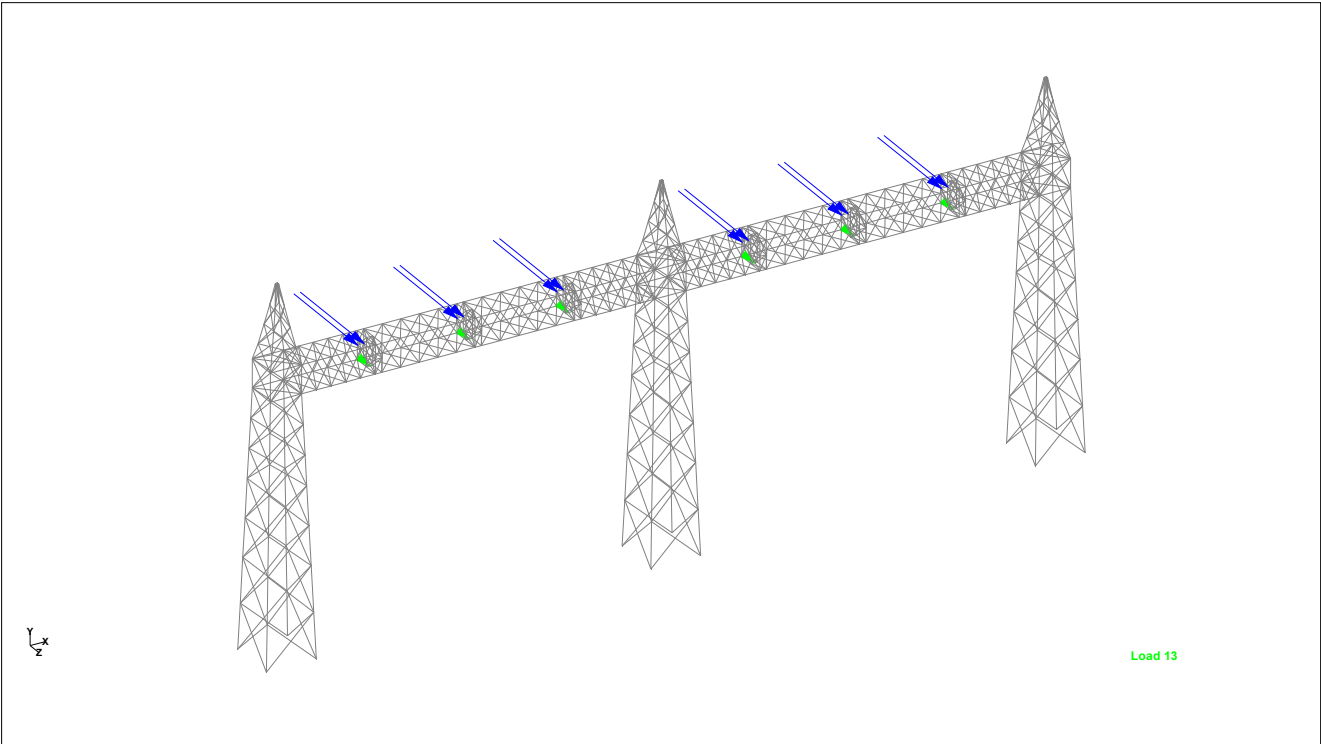


SC(0P-0E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel		Job No.	Sheet No. 6	Rev
Job Title		Part		Ref
Client		By	Date 02-JULY-24	Chd
File TOWER 4T3 , 4T4 & BEAM G3.STD		Date Time 08-Jul-2024 14:03		



NC(0P-0E) +WIND PERPENDICULAR TO BEAM



SC(0P-0E) +WIND PERPENDICULAR TO BEAM

STAAD ANALYSIS & DESIGN

```

*****
*
*          STAAD.Pro 2023
*          Version  23.00.03.25
*          Proprietary Program of
*          Bentley Systems, Inc.
*          Date=    AUG 23, 2024
*          Time=    14:55:55
*
* Licensed to: Anhera Enterprise
*****

```

```

1. STAAD TRUSS
INPUT FILE: Z:\Data\PROJECTS\2024\24P041-MAHAN-GODREJ\DESIGN\400 KV TOW.. .STD
2. START JOB INFORMATION
3. ENGINEER DATE 02-JULY-24
4. END JOB INFORMATION
5. INPUT WIDTH 79
6. UNIT METER KN
7. JOINT COORDINATES
8. 1 0 0 0; 2 3.5 0 0; 3 0 0 3.5; 4 3.5 0 3.5; 5 0.65 19.9 0.65; 6 2.85 19.9 0.65
9. 7 0.65 19.9 2.85; 8 2.85 19.9 2.85; 9 0.65 22.1 0.65; 10 2.85 22.1 0.65
10. 11 2.85 22.1 2.85; 12 0.65 22.1 2.85; 13 1.675 28 1.675; 14 1.825 28 1.675
11. 15 1.825 28 1.825; 16 1.675 28 1.825; 17 0.114 3.5 0.114; 18 0.114 3.5 3.386
12. 19 3.386 3.5 0.114; 20 3.386 3.5 3.386; 21 0.227 7 0.227; 22 0.227 7 3.271
13. 23 3.271 7 0.227; 24 3.271 7 3.271; 25 0.327 10 0.327; 26 0.327 10 3.173
14. 27 3.173 10 0.327; 28 3.173 10 3.173; 29 0.425 13 0.425; 30 0.425 13 3.075
15. 31 3.075 13 0.425; 32 3.075 13 3.075; 33 0.5 15.3 0.5; 34 0.5 15.3 3
16. 35 3 15.3 0.5; 36 3 15.3 3; 37 0.575 17.6 0.575; 38 0.575 17.6 2.925
17. 39 2.925 17.6 0.575; 40 2.925 17.6 2.925; 41 0.911 23.282 0.911
18. 42 0.911 23.282 2.6; 43 2.6 23.282 2.6; 44 2.6 23.282 0.911
19. 45 1.171 24.815 1.171; 46 1.171 24.815 2.34; 47 2.34 24.815 2.34
20. 48 2.34 24.815 1.171; 49 1.432 26.347 1.432; 50 1.432 26.347 2.078
21. 51 2.078 26.347 2.078; 52 2.078 26.347 1.432; 57 3.885 19.9 2.85
22. 58 3.885 22.1 2.85; 59 3.885 22.1 0.65; 60 3.885 19.9 0.65; 61 4.92 19.9 2.85
23. 62 4.92 22.1 2.85; 63 4.92 22.1 0.65; 64 4.92 19.9 0.65; 65 5.955 19.9 2.85
24. 66 5.955 22.1 2.85; 67 5.955 22.1 0.65; 68 5.955 19.9 0.65; 69 6.99 19.9 2.85
25. 70 6.99 22.1 2.85; 71 6.99 22.1 0.65; 72 6.99 19.9 0.65; 77 9.785 19.9 2.85
26. 78 9.785 22.1 2.85; 79 9.785 22.1 0.65; 80 9.785 19.9 0.65
27. 81 11.095 19.9 2.85; 82 11.095 22.1 2.85; 83 11.095 22.1 0.65
28. 84 11.095 19.9 0.65; 85 12.405 19.9 2.85; 86 12.405 22.1 2.85
29. 87 12.405 22.1 0.65; 88 12.405 19.9 0.65; 89 13.715 19.9 2.85
30. 90 13.715 22.1 2.85; 91 13.715 22.1 0.65; 92 13.715 19.9 0.65
31. 93 8.475 19.9 2.85; 94 8.475 22.1 2.85; 95 8.475 22.1 0.65; 96 8.475 19.9 0.65
32. 97 8.025 19.9 2.85; 98 8.025 22.1 2.85; 99 8.025 22.1 0.65
33. 100 8.025 19.9 0.65; 101 15.025 19.9 0.65; 102 15.025 19.9 2.85
34. 103 15.025 22.1 0.65; 104 15.025 22.1 2.85; 109 8.025 22.1 1.75
35. 110 8.475 22.1 1.75; 111 8.025 21 2.85; 112 8.475 21 2.85; 113 8.025 21 0.65
36. 114 8.475 21 0.65; 115 8.025 19.9 1.75; 116 8.475 19.9 1.75
37. 117 27.65 19.9 0.65; 118 27.65 19.9 2.85; 119 27.65 22.1 0.65
38. 120 27.65 22.1 2.85; 121 26.615 19.9 2.85; 122 26.615 22.1 2.85

```

STAAD TRUSS

-- PAGE NO. 2

39. 123 26.615 22.1 0.65; 124 26.615 19.9 0.65; 125 25.58 19.9 2.85
40. 126 25.58 22.1 2.85; 127 25.58 22.1 0.65; 128 25.58 19.9 0.65
41. 129 24.545 19.9 2.85; 130 24.545 22.1 2.85; 131 24.545 22.1 0.65
42. 132 24.545 19.9 0.65; 133 23.51 19.9 2.85; 134 23.51 22.1 2.85
43. 135 23.51 22.1 0.65; 136 23.51 19.9 0.65; 137 20.715 19.9 2.85
44. 138 20.715 22.1 2.85; 139 20.715 22.1 0.65; 140 20.715 19.9 0.65
45. 141 19.405 19.9 2.85; 142 19.405 22.1 2.85; 143 19.405 22.1 0.65
46. 144 19.405 19.9 0.65; 145 18.095 19.9 2.85; 146 18.095 22.1 2.85
47. 147 18.095 22.1 0.65; 148 18.095 19.9 0.65; 149 16.785 19.9 2.85
48. 150 16.785 22.1 2.85; 151 16.785 22.1 0.65; 152 16.785 19.9 0.65
49. 153 22.025 19.9 2.85; 154 22.025 22.1 2.85; 155 22.025 22.1 0.65
50. 156 22.025 19.9 0.65; 157 22.475 19.9 2.85; 158 22.475 22.1 2.85
51. 159 22.475 22.1 0.65; 160 22.475 19.9 0.65; 161 15.475 19.9 0.65
52. 162 15.475 19.9 2.85; 163 15.475 22.1 0.65; 164 15.475 22.1 2.85
53. 165 22.475 22.1 1.75; 166 22.025 22.1 1.75; 167 22.475 21 2.85
54. 168 22.025 21 2.85; 169 22.475 21 0.65; 170 22.025 21 0.65
55. 171 22.475 19.9 1.75; 172 22.025 19.9 1.75; 173 15.025 21 2.85
56. 174 15.025 21 0.65; 175 15.025 22.1 1.75; 176 15.025 19.9 1.75
57. 177 15.475 21 2.85; 178 15.475 21 0.65; 179 15.475 22.1 1.75
58. 180 15.475 19.9 1.75; 181 27 0 0; 182 27.114 3.5 0.114; 183 27 0 3.5
59. 184 27.114 3.5 3.386; 185 30.5 0 0; 186 30.386 3.5 0.114; 187 30.5 0 3.5
60. 188 30.386 3.5 3.386; 189 29.85 19.9 0.65; 190 29.85 19.9 2.85
61. 191 29.85 22.1 0.65; 192 29.85 22.1 2.85; 193 27.911 23.282 0.911
62. 194 27.911 23.282 2.6; 195 29.6 23.282 2.6; 196 29.6 23.282 0.911
63. 197 28.675 28 1.675; 198 28.675 28 1.825; 199 28.825 28 1.825
64. 200 28.825 28 1.675; 201 27.227 7 0.227; 202 27.227 7 3.271
65. 203 30.271 7 0.227; 204 30.271 7 3.271; 205 27.327 10 0.327
66. 206 27.327 10 3.173; 207 30.173 10 0.327; 208 30.173 10 3.173
67. 209 27.425 13 0.425; 210 27.425 13 3.075; 211 30.075 13 0.425
68. 212 30.075 13 3.075; 213 27.5 15.3 0.5; 214 27.5 15.3 3; 215 30 15.3 0.5
69. 216 30 15.3 3; 217 27.575 17.6 0.575; 218 27.575 17.6 2.925
70. 219 29.925 17.6 0.575; 220 29.925 17.6 2.925; 221 28.171 24.815 1.171
71. 222 28.171 24.815 2.34; 223 29.34 24.815 2.34; 224 29.34 24.815 1.171
72. 225 28.432 26.347 1.432; 226 28.432 26.347 2.078; 227 29.078 26.347 2.078
73. 228 29.078 26.347 1.432; 229 57.5 0 0; 230 54 0 0; 231 57.5 0 3.5
74. 232 54 0 3.5; 233 56.85 19.9 0.65; 234 54.65 19.9 0.65; 235 56.85 19.9 2.85
75. 236 54.65 19.9 2.85; 237 56.85 22.1 0.65; 238 54.65 22.1 0.65
76. 239 54.65 22.1 2.85; 240 56.85 22.1 2.85; 241 55.825 28 1.675
77. 242 55.675 28 1.675; 243 55.675 28 1.825; 244 55.825 28 1.825
78. 245 57.386 3.5 0.114; 246 57.386 3.5 3.386; 247 54.114 3.5 0.114
79. 248 54.114 3.5 3.386; 249 57.273 7 0.227; 250 57.273 7 3.271
80. 251 54.229 7 0.227; 252 54.229 7 3.271; 253 57.173 10 0.327
81. 254 57.173 10 3.173; 255 54.327 10 0.327; 256 54.327 10 3.173
82. 257 57.075 13 0.425; 258 57.075 13 3.075; 259 54.425 13 0.425
83. 260 54.425 13 3.075; 261 57 15.3 0.5; 262 57 15.3 3; 263 54.5 15.3 0.5
84. 264 54.5 15.3 3; 265 56.925 17.6 0.575; 266 56.925 17.6 2.925
85. 267 54.575 17.6 0.575; 268 54.575 17.6 2.925; 269 56.589 23.282 0.911
86. 270 56.589 23.282 2.6; 271 54.9 23.282 2.6; 272 54.9 23.282 0.911
87. 273 56.329 24.815 1.171; 274 56.329 24.815 2.34; 275 55.16 24.815 2.34
88. 276 55.16 24.815 1.171; 277 56.068 26.347 1.432; 278 56.068 26.347 2.078
89. 279 55.422 26.347 2.078; 280 55.422 26.347 1.432; 281 53.615 19.9 2.85
90. 282 53.615 22.1 2.85; 283 53.615 22.1 0.65; 284 53.615 19.9 0.65
91. 285 52.58 19.9 2.85; 286 52.58 22.1 2.85; 287 52.58 22.1 0.65
92. 288 52.58 19.9 0.65; 289 51.545 19.9 2.85; 290 51.545 22.1 2.85
93. 291 51.545 22.1 0.65; 292 51.545 19.9 0.65; 293 50.51 19.9 2.85
94. 294 50.51 22.1 2.85; 295 50.51 22.1 0.65; 296 50.51 19.9 0.65

STAAD TRUSS

-- PAGE NO. 3

95. 297 47.715 19.9 2.85; 298 47.715 22.1 2.85; 299 47.715 22.1 0.65
96. 300 47.715 19.9 0.65; 301 46.405 19.9 2.85; 302 46.405 22.1 2.85
97. 303 46.405 22.1 0.65; 304 46.405 19.9 0.65; 305 45.095 19.9 2.85
98. 306 45.095 22.1 2.85; 307 45.095 22.1 0.65; 308 45.095 19.9 0.65
99. 309 43.785 19.9 2.85; 310 43.785 22.1 2.85; 311 43.785 22.1 0.65
100. 312 43.785 19.9 0.65; 313 49.025 19.9 2.85; 314 49.025 22.1 2.85
101. 315 49.025 22.1 0.65; 316 49.025 19.9 0.65; 317 49.475 19.9 2.85
102. 318 49.475 22.1 2.85; 319 49.475 22.1 0.65; 320 49.475 19.9 0.65
103. 321 42.475 19.9 0.65; 322 42.475 19.9 2.85; 323 42.475 22.1 0.65
104. 324 42.475 22.1 2.85; 325 49.475 22.1 1.75; 326 49.025 22.1 1.75
105. 327 49.475 21 2.85; 328 49.025 21 2.85; 329 49.475 21 0.65; 330 49.025 21 0.65
106. 331 49.475 19.9 1.75; 332 49.025 19.9 1.75; 337 30.885 19.9 2.85
107. 338 30.885 22.1 2.85; 339 30.885 22.1 0.65; 340 30.885 19.9 0.65
108. 341 31.92 19.9 2.85; 342 31.92 22.1 2.85; 343 31.92 22.1 0.65
109. 344 31.92 19.9 0.65; 345 32.955 19.9 2.85; 346 32.955 22.1 2.85
110. 347 32.955 22.1 0.65; 348 32.955 19.9 0.65; 349 33.99 19.9 2.85
111. 350 33.99 22.1 2.85; 351 33.99 22.1 0.65; 352 33.99 19.9 0.65
112. 353 36.785 19.9 2.85; 354 36.785 22.1 2.85; 355 36.785 22.1 0.65
113. 356 36.785 19.9 0.65; 357 38.095 19.9 2.85; 358 38.095 22.1 2.85
114. 359 38.095 22.1 0.65; 360 38.095 19.9 0.65; 361 39.405 19.9 2.85
115. 362 39.405 22.1 2.85; 363 39.405 22.1 0.65; 364 39.405 19.9 0.65
116. 365 40.715 19.9 2.85; 366 40.715 22.1 2.85; 367 40.715 22.1 0.65
117. 368 40.715 19.9 0.65; 369 35.475 19.9 2.85; 370 35.475 22.1 2.85
118. 371 35.475 22.1 0.65; 372 35.475 19.9 0.65; 373 35.025 19.9 2.85
119. 374 35.025 22.1 2.85; 375 35.025 22.1 0.65; 376 35.025 19.9 0.65
120. 377 42.025 19.9 0.65; 378 42.025 19.9 2.85; 379 42.025 22.1 0.65
121. 380 42.025 22.1 2.85; 381 35.025 22.1 1.75; 382 35.475 22.1 1.75
122. 383 35.025 21 2.85; 384 35.475 21 2.85; 385 35.025 21 0.65; 386 35.475 21 0.65
123. 387 35.025 19.9 1.75; 388 35.475 19.9 1.75; 389 42.475 21 2.85
124. 390 42.475 21 0.65; 391 42.475 22.1 1.75; 392 42.475 19.9 1.75
125. 393 42.025 21 2.85; 394 42.025 21 0.65; 395 42.025 22.1 1.75
126. 396 42.025 19.9 1.75
127. MEMBER INCIDENCES
128. 1 1 17; 2 3 18; 3 2 19; 4 4 20; 5 5 6; 6 6 8; 7 8 7; 8 7 5; 9 9 10; 10 10 11
129. 11 11 12; 12 12 9; 13 5 9; 14 7 12; 15 8 11; 16 6 10; 17 9 41; 18 12 42
130. 19 11 43; 20 10 44; 21 13 16; 22 16 15; 23 15 14; 24 14 13; 25 17 21; 26 18 22
131. 27 19 23; 28 20 24; 29 21 25; 30 22 26; 31 23 27; 32 24 28; 33 25 29; 34 26 30
132. 35 27 31; 36 28 32; 37 29 33; 38 30 34; 39 31 35; 40 32 36; 41 33 37; 42 34 38
133. 43 35 39; 44 36 40; 45 37 5; 46 38 7; 47 39 6; 48 40 8; 49 41 45; 50 42 46
134. 51 43 47; 52 44 48; 53 45 49; 54 46 50; 55 47 51; 56 48 52; 57 49 13; 58 50 16
135. 59 51 15; 60 52 14; 117 5 10; 118 6 9; 119 6 11; 120 8 10; 121 7 11; 122 8 12
136. 123 7 9; 124 5 12; 125 8 5; 126 7 6; 127 9 11; 128 12 10; 161 8 57; 162 11 58
137. 163 10 59; 164 6 60; 165 57 61; 166 58 62; 167 59 63; 168 60 64; 169 61 65
138. 170 62 66; 171 63 67; 172 64 68; 173 65 69; 174 66 70; 175 67 71; 176 68 72
139. 177 69 97; 178 70 98; 179 71 99; 180 72 100; 181 93 97; 182 94 98; 183 95 99
140. 184 96 100; 185 77 81; 186 78 82; 187 79 83; 188 80 84; 189 81 85; 190 82 86
141. 191 83 87; 192 84 88; 193 85 89; 194 86 90; 195 87 91; 196 88 92; 197 89 102
142. 198 90 104; 199 91 103; 200 92 101; 201 93 77; 202 94 78; 203 95 79; 204 96 80
143. 209 101 161; 210 102 162; 211 103 163; 212 104 164; 213 99 109; 214 95 110
144. 215 98 111; 216 94 112; 217 99 113; 218 95 114; 219 100 115; 220 96 116
145. 221 109 98; 222 110 94; 223 111 97; 224 112 93; 225 113 100; 226 114 96
146. 227 115 97; 228 116 93; 229 113 109; 230 109 111; 231 111 115; 232 115 113
147. 233 109 110; 234 111 112; 235 115 116; 236 113 114; 237 110 114; 238 110 112
148. 239 112 116; 240 116 114; 241 110 116; 242 112 114; 243 109 115; 244 111 113
149. 245 97 112; 246 111 94; 247 100 114; 248 113 95; 249 8 58; 250 57 11
150. 251 57 62; 252 61 58; 253 61 66; 254 65 62; 255 65 70; 256 69 66; 257 69 98

STAAD TRUSS

-- PAGE NO. 4

151. 258 97 70; 259 6 59; 260 60 10; 261 60 63; 262 64 59; 263 64 67; 264 68 63
152. 265 68 71; 266 72 67; 267 72 99; 268 100 71; 269 11 59; 270 58 10; 271 58 63
153. 272 62 59; 273 62 67; 274 66 63; 275 66 71; 276 70 67; 277 70 99; 278 71 98
154. 279 8 60; 280 57 6; 281 57 64; 282 61 60; 283 61 68; 284 65 64; 285 65 72
155. 286 69 68; 287 69 100; 288 72 97; 289 94 77; 290 93 78; 291 77 82; 292 81 78
156. 293 82 85; 294 81 86; 295 86 89; 296 85 90; 297 90 102; 298 89 104
157. 299 104 173; 300 95 80; 301 96 79; 302 80 83; 303 84 79; 304 83 88; 305 84 87
158. 306 87 92; 307 88 91; 308 91 101; 309 92 103; 310 103 174; 311 94 79
159. 312 78 95; 313 78 83; 314 79 82; 315 82 87; 316 83 86; 317 87 90; 318 86 91
160. 319 91 104; 320 90 103; 321 104 175; 322 93 80; 323 77 96; 324 77 84
161. 325 80 81; 326 81 88; 327 84 85; 328 88 89; 329 85 92; 330 92 102; 331 89 101
162. 332 102 176; 337 118 121; 338 120 122; 339 119 123; 340 117 124; 341 121 125
163. 342 122 126; 343 123 127; 344 124 128; 345 125 129; 346 126 130; 347 127 131
164. 348 128 132; 349 129 133; 350 130 134; 351 131 135; 352 132 136; 353 133 157
165. 354 134 158; 355 135 159; 356 136 160; 357 153 157; 358 154 158; 359 155 159
166. 360 156 160; 361 137 141; 362 138 142; 363 139 143; 364 140 144; 365 141 145
167. 366 142 146; 367 143 147; 368 144 148; 369 145 149; 370 146 150; 371 147 151
168. 372 148 152; 373 149 162; 374 150 164; 375 151 163; 376 152 161; 377 153 137
169. 378 154 138; 379 155 139; 380 156 140; 385 159 165; 386 155 166; 387 158 167
170. 388 154 168; 389 159 169; 390 155 170; 391 160 171; 392 156 172; 393 165 158
171. 394 166 154; 395 167 157; 396 168 153; 397 169 160; 398 170 156; 399 171 157
172. 400 172 153; 401 169 165; 402 165 167; 403 167 171; 404 171 169; 405 165 166
173. 406 167 168; 407 171 172; 408 169 170; 409 166 170; 410 166 168; 411 168 172
174. 412 172 170; 413 166 172; 414 168 170; 415 165 171; 416 167 169; 417 157 168
175. 418 167 154; 419 160 170; 420 169 155; 421 118 122; 422 121 120; 423 121 126
176. 424 125 122; 425 125 130; 426 129 126; 427 129 134; 428 133 130; 429 133 158
177. 430 157 134; 431 117 123; 432 124 119; 433 124 127; 434 128 123; 435 128 131
178. 436 132 127; 437 132 135; 438 136 131; 439 136 159; 440 160 135; 441 120 123
179. 442 122 119; 443 122 127; 444 126 123; 445 126 131; 446 130 127; 447 130 135
180. 448 134 131; 449 134 159; 450 135 158; 451 118 124; 452 121 117; 453 121 128
181. 454 125 124; 455 125 132; 456 129 128; 457 129 136; 458 133 132; 459 133 160
182. 460 136 157; 461 154 137; 462 153 138; 463 137 142; 464 141 138; 465 142 145
183. 466 141 146; 467 146 149; 468 145 150; 469 150 162; 470 149 164; 471 164 177
184. 472 155 140; 473 156 139; 474 140 143; 475 144 139; 476 143 148; 477 144 147
185. 478 147 152; 479 148 151; 480 151 161; 481 152 163; 482 163 178; 483 154 139
186. 484 138 155; 485 138 143; 486 139 142; 487 142 147; 488 143 146; 489 147 150
187. 490 146 151; 491 151 164; 492 150 163; 493 164 179; 494 153 140; 495 137 156
188. 496 137 144; 497 140 141; 498 141 148; 499 144 145; 500 148 149; 501 145 152
189. 502 152 162; 503 149 161; 504 162 180; 505 173 102; 506 174 101; 507 175 103
190. 508 176 101; 509 177 162; 510 178 161; 511 179 163; 512 180 161; 513 174 175
191. 514 175 173; 515 173 176; 516 176 174; 517 173 177; 518 176 180; 519 174 178
192. 520 175 179; 521 179 177; 522 177 180; 523 178 179; 524 178 180; 525 102 177
193. 526 173 164; 527 174 163; 528 101 178; 531 175 176; 533 178 177; 534 174 173
194. 535 179 180; 690 98 110; 691 109 95; 692 97 116; 693 115 96; 694 102 180
195. 695 176 161; 696 104 179; 697 175 163; 698 153 171; 699 172 160; 700 154 165
196. 701 166 159; 702 3 20; 703 20 22; 704 22 28; 705 28 30; 706 30 36; 707 36 38
197. 708 38 8; 709 7 40; 710 40 34; 711 34 32; 712 32 26; 713 26 24; 714 24 18
198. 715 18 4; 716 1 18; 717 3 17; 718 17 22; 719 18 21; 720 21 26; 721 22 25
199. 722 25 30; 723 26 29; 724 29 34; 725 30 33; 726 33 38; 727 34 37; 728 37 7
200. 729 38 5; 730 2 17; 731 1 19; 732 19 21; 733 17 23; 734 23 25; 735 21 27
201. 736 27 29; 737 25 31; 738 31 33; 739 29 35; 740 35 37; 741 33 39; 742 39 5
202. 743 37 6; 744 4 19; 745 2 20; 746 20 23; 747 19 24; 748 24 27; 749 23 28
203. 750 28 31; 751 27 32; 752 31 36; 753 32 35; 754 35 40; 755 36 39; 756 39 8
204. 757 40 6; 758 9 44; 759 10 41; 760 41 48; 761 44 45; 762 45 52; 763 48 49
205. 764 49 14; 765 52 13; 766 10 43; 767 11 44; 768 44 47; 769 43 48; 770 48 51
206. 771 47 52; 772 52 15; 773 51 14; 774 11 42; 775 12 43; 776 43 46; 777 42 47

STAAD TRUSS

-- PAGE NO. 5

207. 778 47 50; 779 46 51; 780 51 16; 781 50 15; 782 9 42; 783 12 41; 784 41 46
208. 785 42 45; 786 45 50; 787 46 49; 788 50 13; 789 49 16; 790 181 182
209. 791 183 184; 792 185 186; 793 187 188; 794 117 189; 795 189 190; 796 190 118
210. 797 118 117; 798 119 191; 799 191 192; 800 192 120; 801 120 119; 802 117 119
211. 803 118 120; 804 190 192; 805 189 191; 806 119 193; 807 120 194; 808 192 195
212. 809 191 196; 810 197 198; 811 198 199; 812 199 200; 813 200 197; 814 182 201
213. 815 184 202; 816 186 203; 817 188 204; 818 201 205; 819 202 206; 820 203 207
214. 821 204 208; 822 205 209; 823 206 210; 824 207 211; 825 208 212; 826 209 213
215. 827 210 214; 828 211 215; 829 212 216; 830 213 217; 831 214 218; 832 215 219
216. 833 216 220; 834 217 117; 835 218 118; 836 219 189; 837 220 190; 838 193 221
217. 839 194 222; 840 195 223; 841 196 224; 842 221 225; 843 222 226; 844 223 227
218. 845 224 228; 846 225 197; 847 226 198; 848 227 199; 849 228 200; 850 117 191
219. 851 189 119; 852 189 192; 853 190 191; 854 118 192; 855 190 120; 856 118 119
220. 857 117 120; 858 190 117; 859 118 189; 860 119 192; 861 120 191; 862 183 188
221. 863 188 202; 864 202 208; 865 208 210; 866 210 216; 867 216 218; 868 218 190
222. 869 118 220; 870 220 214; 871 214 212; 872 212 206; 873 206 204; 874 204 184
223. 875 184 187; 876 181 184; 877 183 182; 878 182 202; 879 184 201; 880 201 206
224. 881 202 205; 882 205 210; 883 206 209; 884 209 214; 885 210 213; 886 213 218
225. 887 214 217; 888 217 118; 889 218 117; 890 185 182; 891 181 186; 892 186 201
226. 893 182 203; 894 203 205; 895 201 207; 896 207 209; 897 205 211; 898 211 213
227. 899 209 215; 900 215 217; 901 213 219; 902 219 117; 903 217 189; 904 187 186
228. 905 185 188; 906 188 203; 907 186 204; 908 204 207; 909 203 208; 910 208 211
229. 911 207 212; 912 211 216; 913 212 215; 914 215 220; 915 216 219; 916 219 190
230. 917 220 189; 918 119 196; 919 191 193; 920 193 224; 921 196 221; 922 221 228
231. 923 224 225; 924 225 200; 925 228 197; 926 191 195; 927 192 196; 928 196 223
232. 929 195 224; 930 224 227; 931 223 228; 932 228 199; 933 227 200; 934 192 194
233. 935 120 195; 936 195 222; 937 194 223; 938 223 226; 939 222 227; 940 227 198
234. 941 226 199; 942 119 194; 943 120 193; 944 193 222; 945 194 221; 946 221 226
235. 947 222 225; 948 226 197; 949 225 198; 950 229 245; 951 231 246; 952 230 247
236. 953 232 248; 954 233 234; 955 234 236; 956 236 235; 957 235 233; 958 237 238
237. 959 238 239; 960 239 240; 961 240 237; 962 233 237; 963 235 240; 964 236 239
238. 965 234 238; 966 237 269; 967 240 270; 968 239 271; 969 238 272; 970 241 244
239. 971 244 243; 972 243 242; 973 242 241; 974 245 249; 975 246 250; 976 247 251
240. 977 248 252; 978 249 253; 979 250 254; 980 251 255; 981 252 256; 982 253 257
241. 983 254 258; 984 255 259; 985 256 260; 986 257 261; 987 258 262; 988 259 263
242. 989 260 264; 990 261 265; 991 262 266; 992 263 267; 993 264 268; 994 265 233
243. 995 266 235; 996 267 234; 997 268 236; 998 269 273; 999 270 274; 1000 271 275
244. 1001 272 276; 1002 273 277; 1003 274 278; 1004 275 279; 1005 276 280
245. 1006 277 241; 1007 278 244; 1008 279 243; 1009 280 242; 1010 233 238
246. 1011 234 237; 1012 234 239; 1013 236 238; 1014 235 239; 1015 236 240
247. 1016 235 237; 1017 233 240; 1018 236 233; 1019 235 234; 1020 237 239
248. 1021 240 238; 1022 236 281; 1023 239 282; 1024 238 283; 1025 234 284
249. 1026 281 285; 1027 282 286; 1028 283 287; 1029 284 288; 1030 285 289
250. 1031 286 290; 1032 287 291; 1033 288 292; 1034 289 293; 1035 290 294
251. 1036 291 295; 1037 292 296; 1038 293 317; 1039 294 318; 1040 295 319
252. 1041 296 320; 1042 313 317; 1043 314 318; 1044 315 319; 1045 316 320
253. 1046 297 301; 1047 298 302; 1048 299 303; 1049 300 304; 1050 301 305
254. 1051 302 306; 1052 303 307; 1053 304 308; 1054 305 309; 1055 306 310
255. 1056 307 311; 1057 308 312; 1058 309 322; 1059 310 324; 1060 311 323
256. 1061 312 321; 1062 313 297; 1063 314 298; 1064 315 299; 1065 316 300
257. 1066 321 377; 1067 322 378; 1068 323 379; 1069 324 380; 1070 319 325
258. 1071 315 326; 1072 318 327; 1073 314 328; 1074 319 329; 1075 315 330
259. 1076 320 331; 1077 316 332; 1078 325 318; 1079 326 314; 1080 327 317
260. 1081 328 313; 1082 329 320; 1083 330 316; 1084 331 317; 1085 332 313
261. 1086 329 325; 1087 325 327; 1088 327 331; 1089 331 329; 1090 325 326
262. 1091 327 328; 1092 331 332; 1093 329 330; 1094 326 330; 1095 326 328

STAAD TRUSS

-- PAGE NO. 6

263. 1096 328 332; 1097 332 330; 1098 326 332; 1099 328 330; 1100 325 331
 264. 1101 327 329; 1102 317 328; 1103 327 314; 1104 320 330; 1105 329 315
 265. 1106 236 282; 1107 281 239; 1108 281 286; 1109 285 282; 1110 285 290
 266. 1111 289 286; 1112 289 294; 1113 293 290; 1114 293 318; 1115 317 294
 267. 1116 234 283; 1117 284 238; 1118 284 287; 1119 288 283; 1120 288 291
 268. 1121 292 287; 1122 292 295; 1123 296 291; 1124 296 319; 1125 320 295
 269. 1126 239 283; 1127 282 238; 1128 282 287; 1129 286 283; 1130 286 291
 270. 1131 290 287; 1132 290 295; 1133 294 291; 1134 294 319; 1135 295 318
 271. 1136 236 284; 1137 281 234; 1138 281 288; 1139 285 284; 1140 285 292
 272. 1141 289 288; 1142 289 296; 1143 293 292; 1144 293 320; 1145 296 317
 273. 1146 314 297; 1147 313 298; 1148 297 302; 1149 301 298; 1150 302 305
 274. 1151 301 306; 1152 306 309; 1153 305 310; 1154 310 322; 1155 309 324
 275. 1156 324 389; 1157 315 300; 1158 316 299; 1159 300 303; 1160 304 299
 276. 1161 303 308; 1162 304 307; 1163 307 312; 1164 308 311; 1165 311 321
 277. 1166 312 323; 1167 323 390; 1168 314 299; 1169 298 315; 1170 298 303
 278. 1171 299 302; 1172 302 307; 1173 303 306; 1174 307 310; 1175 306 311
 279. 1176 311 324; 1177 310 323; 1178 324 391; 1179 313 300; 1180 297 316
 280. 1181 297 304; 1182 300 301; 1183 301 308; 1184 304 305; 1185 308 309
 281. 1186 305 312; 1187 312 322; 1188 309 321; 1189 322 392; 1190 190 337
 282. 1191 192 338; 1192 191 339; 1193 189 340; 1194 337 341; 1195 338 342
 283. 1196 339 343; 1197 340 344; 1198 341 345; 1199 342 346; 1200 343 347
 284. 1201 344 348; 1202 345 349; 1203 346 350; 1204 347 351; 1205 348 352
 285. 1206 349 373; 1207 350 374; 1208 351 375; 1209 352 376; 1210 369 373
 286. 1211 370 374; 1212 371 375; 1213 372 376; 1214 353 357; 1215 354 358
 287. 1216 355 359; 1217 356 360; 1218 357 361; 1219 358 362; 1220 359 363
 288. 1221 360 364; 1222 361 365; 1223 362 366; 1224 363 367; 1225 364 368
 289. 1226 365 378; 1227 366 380; 1228 367 379; 1229 368 377; 1230 369 353
 290. 1231 370 354; 1232 371 355; 1233 372 356; 1234 375 381; 1235 371 382
 291. 1236 374 383; 1237 370 384; 1238 375 385; 1239 371 386; 1240 376 387
 292. 1241 372 388; 1242 381 374; 1243 382 370; 1244 383 373; 1245 384 369
 293. 1246 385 376; 1247 386 372; 1248 387 373; 1249 388 369; 1250 385 381
 294. 1251 381 383; 1252 383 387; 1253 387 385; 1254 381 382; 1255 383 384
 295. 1256 387 388; 1257 385 386; 1258 382 386; 1259 382 384; 1260 384 388
 296. 1261 388 386; 1262 382 388; 1263 384 386; 1264 381 387; 1265 383 385
 297. 1266 373 384; 1267 383 370; 1268 376 386; 1269 385 371; 1270 190 338
 298. 1271 337 192; 1272 337 342; 1273 341 338; 1274 341 346; 1275 345 342
 299. 1276 345 350; 1277 349 346; 1278 349 374; 1279 373 350; 1280 189 339
 300. 1281 340 191; 1282 340 343; 1283 344 339; 1284 344 347; 1285 348 343
 301. 1286 348 351; 1287 352 347; 1288 352 375; 1289 376 351; 1290 192 339
 302. 1291 338 191; 1292 338 343; 1293 342 339; 1294 342 347; 1295 346 343
 303. 1296 346 351; 1297 350 347; 1298 350 375; 1299 351 374; 1300 190 340
 304. 1301 337 189; 1302 337 344; 1303 341 340; 1304 341 348; 1305 345 344
 305. 1306 345 352; 1307 349 348; 1308 349 376; 1309 352 373; 1310 370 353
 306. 1311 369 354; 1312 353 358; 1313 357 354; 1314 358 361; 1315 357 362
 307. 1316 362 365; 1317 361 366; 1318 366 378; 1319 365 380; 1320 380 393
 308. 1321 371 356; 1322 372 355; 1323 356 359; 1324 360 355; 1325 359 364
 309. 1326 360 363; 1327 363 368; 1328 364 367; 1329 367 377; 1330 368 379
 310. 1331 379 394; 1332 370 355; 1333 354 371; 1334 354 359; 1335 355 358
 311. 1336 358 363; 1337 359 362; 1338 363 366; 1339 362 367; 1340 367 380
 312. 1341 366 379; 1342 380 395; 1343 369 356; 1344 353 372; 1345 353 360
 313. 1346 356 357; 1347 357 364; 1348 360 361; 1349 364 365; 1350 361 368
 314. 1351 368 378; 1352 365 377; 1353 378 396; 1354 389 322; 1355 390 321
 315. 1356 391 323; 1357 392 321; 1358 393 378; 1359 394 377; 1360 395 379
 316. 1361 396 377; 1362 390 391; 1363 391 389; 1364 389 392; 1365 392 390
 317. 1366 389 393; 1367 392 396; 1368 390 394; 1369 391 395; 1370 395 393
 318. 1371 393 396; 1372 394 395; 1373 394 396; 1374 322 393; 1375 389 380

STAAD TRUSS

-- PAGE NO. 7

319. 1376 390 379; 1377 321 394; 1378 391 392; 1379 394 393; 1380 390 389
320. 1381 395 396; 1382 318 326; 1383 325 315; 1384 317 332; 1385 331 316
321. 1386 322 396; 1387 392 377; 1388 324 395; 1389 391 379; 1390 369 387
322. 1391 388 376; 1392 370 381; 1393 382 375; 1394 231 248; 1395 248 250
323. 1396 250 256; 1397 256 258; 1398 258 264; 1399 264 266; 1400 266 236
324. 1401 235 268; 1402 268 262; 1403 262 260; 1404 260 254; 1405 254 252
325. 1406 252 246; 1407 246 232; 1408 229 246; 1409 231 245; 1410 245 250
326. 1411 246 249; 1412 249 254; 1413 250 253; 1414 253 258; 1415 254 257
327. 1416 257 262; 1417 258 261; 1418 261 266; 1419 262 265; 1420 265 235
328. 1421 266 233; 1422 230 245; 1423 229 247; 1424 247 249; 1425 245 251
329. 1426 251 253; 1427 249 255; 1428 255 257; 1429 253 259; 1430 259 261
330. 1431 257 263; 1432 263 265; 1433 261 267; 1434 267 233; 1435 265 234
331. 1436 232 247; 1437 230 248; 1438 248 251; 1439 247 252; 1440 252 255
332. 1441 251 256; 1442 256 259; 1443 255 260; 1444 259 264; 1445 260 263
333. 1446 263 268; 1447 264 267; 1448 267 236; 1449 268 234; 1450 237 272
334. 1451 238 269; 1452 269 276; 1453 272 273; 1454 273 280; 1455 276 277
335. 1456 277 242; 1457 280 241; 1458 238 271; 1459 239 272; 1460 272 275
336. 1461 271 276; 1462 276 279; 1463 275 280; 1464 280 243; 1465 279 242
337. 1466 239 270; 1467 240 271; 1468 271 274; 1469 270 275; 1470 275 278
338. 1471 274 279; 1472 279 244; 1473 278 243; 1474 237 270; 1475 240 269
339. 1476 269 274; 1477 270 273; 1478 273 278; 1479 274 277; 1480 278 241
340. 1481 277 244
341. DEFINE MATERIAL START
342. ISOTROPIC STEEL
343. E 2.05E+008
344. POISSON 0.3
345. DENSITY 76.8195
346. ALPHA 1.2E-005
347. DAMP 0.03
348. G 7.88462E+007
349. TYPE STEEL
350. STRENGTH RY 1.5 RT 1.2
351. END DEFINE MATERIAL
352. MEMBER PROPERTY INDIAN
353. 1 TO 4 25 TO 28 950 TO 953 974 TO 977 TABLE ST ISA150X150X16
354. 29 TO 36 978 TO 985 TABLE ST ISA130X130X10
355. 13 TO 16 37 TO 48 962 TO 965 986 TO 997 TABLE ST ISA130X130X10
356. 17 TO 20 49 TO 60 966 TO 969 998 TO 1009 TABLE ST ISA75X75X5
357. 702 TO 705 712 TO 723 730 TO 737 744 TO 751 1394 TO 1397 1404 TO 1415 1422 -
358. 1423 TO 1429 1436 TO 1443 TABLE ST ISA75X75X5
359. 117 TO 124 706 TO 711 724 TO 729 738 TO 743 752 TO 757 1010 TO 1017 -
360. 1398 TO 1403 1416 TO 1421 1430 TO 1435 1444 TO 1449 TABLE ST ISA90X90X6
361. 758 TO 789 1450 TO 1481 TABLE ST ISA50X50X5
362. 161 TO 180 337 TO 356 1022 TO 1041 1190 TO 1209 TABLE ST ISA90X90X8
363. 181 TO 204 209 TO 212 357 TO 380 1042 TO 1069 1210 TO 1232 -
364. 1233 TABLE ST ISA100X100X10
365. 125 TO 128 249 TO 288 421 TO 460 858 TO 861 1018 TO 1021 1106 TO 1145 1270 -
366. 1271 TO 1309 TABLE ST ISA65X65X5
367. 289 TO 298 300 TO 309 311 TO 320 322 TO 331 461 TO 470 472 TO 481 483 TO 492 -
368. 494 TO 503 1146 TO 1155 1157 TO 1166 1168 TO 1177 1179 TO 1188 1310 TO 1319 -
369. 1321 TO 1330 1332 TO 1341 1343 TO 1352 TABLE ST ISA60X60X5
370. 213 TO 248 299 310 321 332 385 TO 420 471 482 493 504 TO 528 531 533 TO 535 -
371. 690 TO 701 1070 TO 1105 1156 1167 1178 1189 1234 TO 1269 1320 1331 1342 1353 -
372. 1354 TO 1393 TABLE ST ISA60X60X5
373. 21 TO 24 810 TO 813 970 TO 973 TABLE ST ISA50X50X5
374. 790 TO 793 814 TO 817 TABLE ST ISA200X200X16

STAAD TRUSS

-- PAGE NO. 8

375. 818 TO 825 TABLE ST ISA150X150X16
376. 802 TO 805 826 TO 837 TABLE ST ISA150X150X12
377. 806 TO 809 838 TO 849 TABLE ST ISA75X75X5
378. 862 TO 865 872 TO 883 890 TO 897 904 TO 911 TABLE ST ISA90X90X6
379. 850 TO 857 866 TO 871 884 TO 889 898 TO 903 912 TO 917 TABLE ST ISA100X100X10
380. 918 TO 949 TABLE ST ISA50X50X5
381. 5 TO 12 794 TO 801 954 TO 961 TABLE ST ISA100X100X10
382. CONSTANTS
383. BETA 45 MEMB 14 803 964
384. BETA 135 MEMB 15 804 963
385. BETA 225 MEMB 16 805 962
386. BETA 315 MEMB 13 802 965
387. MATERIAL STEEL ALL
388. *****
389. SUPPORTS
390. 1 TO 4 181 183 185 187 229 TO 232 PINNED
391. *****
392. LOAD 1 DEAD LOAD + LIVE LOAD
393. SELFWEIGHT Y -1.15
394. JOINT LOAD
395. **WEIGHT OF CONDUCTOR & INSULATOR
396. 111 TO 114 167 TO 170 173 174 177 178 327 TO 330 383 TO 386 389 390 393 -
397. 394 FY -2.14
398. **WEIGHT OF MEN WITH TOOL
399. 9 TO 12 119 120 191 192 237 TO 240 FY -0.375
400. MEMBER LOAD
401. **WEIGHT OF SUSPENSION
402. 235 407 518 1092 1256 1367 CON GY -0.5 0.225
403. JOINT LOAD
404. **WEIGHT OF EARTH WIRE
405. 13 TO 16 197 TO 200 241 TO 244 FY -0.155
406. *****
407. LOAD 2 LOADTYPE NONE TITLE WIND ALONG X DIRECTION(PARALLEL TO BEAM)
408. JOINT LOAD
409. **WIND LOAD ON TOWER 4T3
410. 181 183 FX 1.2
411. 182 184 FX 2.38
412. 201 202 FX 2.08
413. 205 206 FX 1.85
414. 209 210 FX 1.63
415. 213 214 FX 1.34
416. 217 218 FX 1.45
417. 117 118 FX 1.54
418. 119 120 FX 1.01
419. 193 194 FX 0.49
420. 221 222 FX 0.43
421. 225 226 FX 0.37
422. 197 198 FX 0.17
423. **WIND LOAD ON TOWER 4T4
424. 1 3 230 232 FX 1
425. 17 18 247 248 FX 1.98
426. 21 22 251 252 FX 1.78
427. 25 26 255 256 FX 1.65
428. 29 30 259 260 FX 1.46
429. 33 34 263 264 FX 1.2
430. 37 38 267 268 FX 1.31

STAAD TRUSS

-- PAGE NO. 9

```
431. 5 7 234 236 FX 1.4
432. 9 12 238 239 FX 0.94
433. 41 42 271 272 FX 0.49
434. 45 46 275 276 FX 0.43
435. 49 50 279 280 FX 0.37
436. 13 16 242 243 FX 0.17
437. *****
438. LOAD 3 LOADTYPE NONE TITLE WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)
439. JOINT LOAD
440. **WIND LOAD ON TOWER 4T3
441. 181 185 FZ 1.2
442. 182 186 FZ 2.38
443. 201 203 FZ 2.08
444. 205 207 FZ 1.85
445. 209 211 FZ 1.6
446. 213 215 FZ 1.28
447. 217 219 FZ 1.39
448. 117 189 FZ 1.48
449. 119 191 FZ 0.98
450. 193 196 FZ 0.49
451. 221 224 FZ 0.43
452. 225 228 FZ 0.37
453. 197 200 FZ 0.17
454. **WIND LOAD ON TOWER 4T4
455. 1 2 229 230 FZ 1
456. 17 19 245 247 FZ 1.98
457. 21 23 249 251 FZ 1.78
458. 25 27 253 255 FZ 1.65
459. 29 31 257 259 FZ 1.46
460. 33 35 261 263 FZ 1.2
461. 37 39 265 267 FZ 1.31
462. 5 6 233 234 FZ 1.4
463. 9 10 237 238 FZ 0.94
464. 41 44 269 272 FZ 0.49
465. 45 48 273 276 FZ 0.43
466. 49 52 277 280 FZ 0.37
467. 13 14 241 242 FZ 0.17
468. **WIND LOAD ON BEAM
469. 59 60 63 64 67 68 71 72 79 80 83 84 87 88 91 92 95 96 99 TO 101 103 113 114 -
470. 123 124 127 128 131 132 135 136 139 140 143 144 147 148 151 152 155 156 159 -
471. 160 TO 161 163 169 170 174 178 283 284 287 288 291 292 295 296 299 300 303 -
472. 304 307 308 311 312 315 316 319 TO 321 323 329 330 339 340 343 344 347 348 -
473. 351 352 355 356 359 360 363 364 367 368 371 372 375 TO 377 379 385 386 390 -
474. 394 FZ 0.69
475. *****
476. **BEAM-G3(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
477. **TOWER -4T3 & 4T4
478. *****
479. LOAD 10 NC(0P-0E) +WIND PARALLEL TO BEAM
480. JOINT LOAD
481. **NORMAL TENSION FORCE
482. 113 114 169 170 174 178 329 330 385 386 390 394 FZ 10.2
483. *WIND LOAD ON CONDUCTOR & INSULATOR
484. 111 TO 114 167 TO 170 173 174 177 178 327 TO 330 383 TO 386 389 390 393 -
485. 394 FX 4.96
486. MEMBER LOAD
```

STAAD TRUSS

-- PAGE NO. 10

```
487. **WIND LOAD ON SUSPENSION
488. 235 407 518 1092 1256 1367 CON GX 0.91 0.225
489. JOINT LOAD
490. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
491. 13 TO 16 197 TO 200 241 TO 244 FX 0.2 FZ 2.5
492. *****
493. LOAD 11 SC(0P-0E) +WIND PARALLEL TO BEAM
494. JOINT LOAD
495. **SHORT CIRCUIT FORCE
496. 113 114 169 170 174 178 329 330 385 386 390 394 FZ 35.05
497. *WIND LOAD ON CONDUCTOR & INSULATOR
498. 111 TO 114 167 TO 170 173 174 177 178 327 TO 330 383 TO 386 389 390 393 -
499. 394 FX 4.96
500. MEMBER LOAD
501. **WIND LOAD ON SUSPENSION
502. 235 407 518 1092 1256 1367 CON GX 0.91 0.225
503. JOINT LOAD
504. **WIND LOAD ON EARTH WIRE
505. 13 TO 16 197 TO 200 241 TO 244 FX 0.2
506. *****
507. LOAD 12 NC(0P-0E) +WIND PERPENDICULAR TO BEAM
508. JOINT LOAD
509. **NORMAL TENSION FORCE
510. 113 114 169 170 174 178 329 330 385 386 390 394 FZ 10.2
511. MEMBER LOAD
512. **WIND LOAD ON SUSPENSION
513. 235 407 518 1092 1256 1367 CON GZ 0.91 0.225
514. JOINT LOAD
515. **NORMAL TENSION FORCE
516. 13 TO 16 197 TO 200 241 TO 244 FZ 2.5
517. *****
518. LOAD 13 SC(0P-0E) +WIND PERPENDICULAR TO BEAM
519. JOINT LOAD
520. **SHORT CIRCUIT FORCE
521. 113 114 169 170 174 178 329 330 385 386 390 394 FZ 35.05
522. MEMBER LOAD
523. **WIND LOAD ON SUSPENSION
524. 235 407 518 1092 1256 1367 CON GZ 0.91 0.225
525. *****
526. ***LOAD COMBINATIONS FOR MEMBER DESIGN (FACTORED)
527. *****
528. *(BEAM WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
529. *****
530. LOAD COMB 101 2.0(DL + NC + WIND PARALLEL TO BEAM)
531. 1 2.0 2 2.0 10 2.0
532. *****
533. LOAD COMB 201 1.5(DL + SC + WIND PARALLEL TO BEAM)
534. 1 1.5 2 1.5 11 1.5
535. *****
536. LOAD COMB 102 2.0(DL + NC + WIND PERPENDICULAR TO BEAM)
537. 1 2.0 3 2.0 12 2.0
538. *****
539. LOAD COMB 202 1.5(DL + SC + WIND PERPENDICULAR TO BEAM)
540. 1 1.5 3 1.5 13 1.5
541. *****
542. *LOAD COMBINATIONS FOR FOUNDATION & BASE PLATE DESIGN (UNFACTORED)
```

STAAD TRUSS

-- PAGE NO. 11

```

543. *****
544. *(BEAM WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
545. *****
546. LOAD COMB 301 1.0(DL + NC + WIND PARALLEL TO BEAM)
547. 1 1.0 2 1.0 10 1.0
548. *****
549. LOAD COMB 401 1.0(DL + SC + WIND PARALLEL TO BEAM)
550. 1 1.0 2 1.0 11 1.0
551. *****
552. LOAD COMB 302 1.0(DL + NC + WIND PERPENDICULAR TO BEAM)
553. 1 1.0 3 1.0 12 1.0
554. *****
555. LOAD COMB 402 1.0(DL + SC + WIND PERPENDICULAR TO BEAM)
556. 1 1.0 3 1.0 13 1.0
557. *****
558. PERFORM ANALYSIS

```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	380	NUMBER OF MEMBERS	1224
NUMBER OF PLATES	0	NUMBER OF SOLIDS	0
NUMBER OF SURFACES	0	NUMBER OF SUPPORTS	12

Using 64-bit analysis engine.

SOLVER USED IS THE IN-CORE ADVANCED MATH SOLVER

```

TOTAL      PRIMARY LOAD CASES =      7, TOTAL DEGREES OF FREEDOM =    1104
TOTAL LOAD COMBINATION CASES =      8 SO FAR.

```

```

559. LOAD LIST 101 102 201 202
560. *****
561. PARAMETER 1
562. CODE AISC UNIFIED 2010
563. STEEL TAKE OFF LIST 1 TO 60 117 TO 128 702 TO 789

```


STAAD TRUSS

-- PAGE NO. 12

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA150X150X16	28.03	9.840
ST ISA100X100X10	17.60	2.582
ST ISA130X130X10	60.46	11.657
ST ISA75X75X5	167.20	9.338
ST ISA50X50X5	63.96	2.353
ST ISA90X90X6	105.15	8.481
ST ISA65X65X5	12.45	0.598
TOTAL =		44.850

***** END OF DATA FROM INTERNAL STORAGE *****

564. PARAMETER 2

565. CODE AISC UNIFIED 2010

566. STEEL TAKE OFF LIST 790 TO 949

STAAD TRUSS

-- PAGE NO. 13

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA200X200X16	28.03	13.307
ST ISA100X100X10	122.75	18.011
ST ISA150X150X12	36.43	9.739
ST ISA75X75X5	24.31	1.358
ST ISA50X50X5	63.96	2.353
ST ISA150X150X16	24.03	8.435
ST ISA65X65X5	12.45	0.598
ST ISA90X90X6	142.89	11.526

	TOTAL =	65.325

***** END OF DATA FROM INTERNAL STORAGE *****

567. PARAMETER 3

568. CODE AISC UNIFIED 2010

569. STEEL TAKE OFF LIST 161 TO 204 209 TO 332 337 TO 380 385 TO 528 531 -

570. 533 TO 535 690 TO 701

STAAD TRUSS

-- PAGE NO. 14

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA90X90X8	41.40	4.389
ST ISA100X100X10	57.80	8.481
ST ISA60X60X5	355.30	15.694
ST ISA65X65X5	194.50	9.339
TOTAL =		37.902

***** END OF DATA FROM INTERNAL STORAGE *****

571. FINISH

***** END OF THE STAAD.Pro RUN *****

**** DATE= AUG 23,2024 TIME= 14:55:57 ****

STAAD TRUSS

-- PAGE NO. 15

```
*****
*   For technical assistance on STAAD.Pro, please visit   *
*   http://www.bentley.com/en/support/                   *
*                                                         *
*   Details about additional assistance from               *
*   Bentley and Partners can be found at program menu    *
*   Help->Technical Support                               *
*                                                         *
*               Copyright (c) Bentley Systems, Inc.      *
*               http://www.bentley.com                   *
*****
```

MEMBER & CONNECTION BOLT DESIGN FOR
TOWER-4T3

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3) & BEAM (G3)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MKD."4T3"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3) & BEAM (G3)

A DESIGN OF MAIN-LEG FOR PART - PA,PB

- a) Angle Section tried & adopted = 150 x 150 x 16
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 62348.15 kg
Maximum Tension in main leg for Panel = 54672.55 kg
- c) Effective Length of Angle, L1 & L2 = 3504.00 & 3504.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1752.00 / 29.40 = 59.59 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1752.00 / 45.80 = 38.25 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 45.6000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 40.00$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 40.00 = 101968.0$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 59.59
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 9.38 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2262.57$ Kg/sqcm.
k) Permissible Compressive Load = $2262.57 \times 45.6000 = 103173.0$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 16 mm = 16184.36 Kgs
No. of 16mm bolts required, = $101967.98 / 12711.17 = 8.02$ nos. Say **9.00 no.**
- p) Ultimate Maximum Compression per Leg = $62348.15 \times 1.00 = 62348.15$ Kg.
- q) Ultimate Maximum Tension per Leg = $54672.55 \times 1.00 = 54672.55$ Kg.
- r) Factor of Safety
In Compression = $103173.0 / 62348.15 = 1.65 > 1.0000$ It is Safe
In Tension = $101968.0 / 54672.55 = 1.87 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3) & BEAM (G3)

B DESIGN OF MAIN-LEG FOR PART - PC, PD

- a) Angle Section tried & adopted = 130 x 130 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 42986.62 kg
Maximum Tension in main leg for Panel = 38238.291 kg
- c) Effective Length of Angle, L1 & L2 = 3003.00 & 3003.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1501.50 / 25.70 = 58.42 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1501.50 / 40.20 = 37.35 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 25.10$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 21.60$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 21.60 = 55062.7$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 58.42
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 13.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2273.69$ Kg/sqcm.
- k) Permissible Compressive Load = $2273.69 \times 25.1000 = 57069.6$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 10 mm = 10115.22 Kgs
No. of 16mm bolts required, = $55062.71 / 10115.22 = 5.44$ nos. Say **6.00 no.**
- p) Ulitmate Maximum Compression per Leg = $42986.62 \times 1.00 = 42986.62$ Kg.
- q) Ultimate Maximum Tension per Leg = $38238.29 \times 1.00 = 38238.29$ Kg.
- r) Factor of Safety
In Compression = $57069.6 / 42986.62 = 1.33 > 1.0000$ It is Safe
In Tension = $55062.7 / 38238.29 = 1.44 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3) & BEAM (G3)

C DESIGN OF MAIN-LEG FOR PART - PE, PF, PG,PH

- a) Angle Section tried & adopted = 130 x 130 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 28930.81 kg
Maximum Tension in main leg for Panel = 23968.960 kg
- c) Effective Length of Angle, L1 & L2 = 2302.00 & 2302.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 2302.00 / 25.70 = 89.57 < 120$ hence o.k.
 $L2/r_{xx} = 2302.00 / 40.20 = 57.26 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 25.10$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 21.60$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 21.60 = 55062.7$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 89.57
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 13.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1901.61$ Kg/sqcm.
- k) Permissible Compressive Load = $1901.61 \times 25.1000 = 47730.5$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 10 mm = 10115.22 Kgs
No. of 16mm bolts required, = $47730.46 / 10115.22 = 4.72$ nos. Say **5.00 no.**
- p) Ulitmate Maximum Compression per Leg = $28930.81 \times 1.00 = 28930.81$ Kg.
- q) Ultimate Maximum Tension per Leg = $23968.96 \times 1.00 = 23968.96$ Kg.
- r) Factor of Safety
In Compression = $47730.5 / 28930.81 = 1.65 > 1.0000$ It is Safe
In Tension = $55062.7 / 23968.96 = 2.30 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3) & BEAM (G3)

C DESIGN OF MAIN-LEG FOR PART - PI, PJ,PK,PL

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 3678.55 kg
Maximum Tension in main leg for Panel = 3291.053 kg
- c) Effective Length of Angle, L1 & L2 = 1576.00 & 1576.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1576.00 / 14.60 = 107.95 < 120$ hence o.k.
 $L2/r_{xx} = 1576.00 / 23.10 = 68.23 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 7.27$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 5.52$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 5.52 = 14071.6 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 107.95
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1467.78$ Kg/sqcm.
k) Permissible Compressive Load = 1467.78 x 7.2700 = 10670.8 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
No. of 16mm bolts required, = 10670.79 / 5057.61 = 2.11 nos. Say **3.00 no.**
- p) Ulitmate Maximum Compression per Leg = 3678.55 x 1.00 = 3678.55 Kg.
- q) Ultimate Maximum Tension per Leg = 3291.05 x 1.00 = 3291.05 Kg.
- r) Factor of Safety
In Compression = 10670.8 / 3678.55 = **2.90 > 1.0000 It is Safe**
In Tension = 14071.6 / 3291.05 = **4.28 > 1.0000 It is Safe**

*** DESIGN OF BRACINGS FOR TOWER MKD. "4T3"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - GA, JA

a)	Angle Section tried & adopted	=	75	x	75	x	5
b)	Length of Angle, L2	=	4871.00				
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1217.75	/	14.60		
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2435.50	/	23.10		
d)	Gross Area of Cross Section, Ag	=	7.2700 sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts						
	$v =$	2.7500	+	3.6250	x	0.6947	= 5.2684 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy	=		250 Mpa		
g)	Permissible Tensile Stress	=		2549.20 Kg/sqcm.			
h)	Permissible Tensile Load	=		2549.20	x	5.2684	
		=		13430.3 Kgs			
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=		105.43			
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$	=		13.28			
	Actual b/t ratio	=		15.00 > 13.28			
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)	=		2325.91 Kg/sqcm.			
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=		125.66			
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=		1507.26 Kg/sqcm.			
j)	Permissible Compressive Load	=		1507.26	x	7.2700	
		=		10957.8 Kgs			
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$	=		6355.58 Kgs			
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$	t =	5 mm	=		5057.61 Kgs	
	No. of 16mm bolts required,	=		10957.80	/	5057.61	
		=		2.17 nos. Say			
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=		8702.576	kg		
	Maximum Tension in Bracing	=		8503.678	kg		
m)	In Compression	=	10957.8	/	8702.58	= 1.26 > 1.0 safe	
	In Tension	=	13430.3	/	8503.68	= 1.58 > 1.0 safe	

3.00 no.

B DESIGN OF BRACINGS - GB, JB

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Length of Angle, L2 = 4204.00 mm
- c) Slenderness $0.25 \cdot L2 / r_{vv}$ = 1051.00 / 14.60 = 71.99 < 200 hence o.k.
 Slenderness $0.5 \cdot L2 / r_{xx}$ = 2102.00 / 23.10 = 91.00 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 7.2700 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 2.7500 + 3.6250 \times 0.6947 = 5.2684$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 5.2684 = 13430.3 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 91.00
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 15.00 > 13.28
 Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1716.11$ Kg/sqcm.
 j) Permissible Compressive Load = 1716.11 x 7.2700 = 12476.1 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
 No. of 16mm bolts required, = 12476.13 / 5057.61 = 2.47 nos. Say **3.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 9390.758 kg
 Maximum Tension in Bracing = 9352.979 kg
- m) In Compression = 12476.1 / 9390.76 = **1.33 > 1.0 safe**
 In Tension = 13430.3 / 9352.98 = **1.44 > 1.0 safe**

C DESIGN OF BRACINGS - GC, JC

- a) Angle Section tried & adopted = 90 x 90 x 6
- b) Length of Angle, L2 = 3453.00 mm
- c) Slenderness $0.5 \times L2 / r_{vv}$ = 1726.50 / 17.50 = 98.66 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 3453.00 / 27.70 = 124.66 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 10.5000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2$.k
assuming 1 No.s 16mm Dia. Bolts
 $v = 4.1700 + 5.2200 \times 0.7056 = 7.8531$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 7.8531 = 20019.2 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 124.66
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1181.51$ Kg/sqcm.
j) Permissible Compressive Load = 1181.51 x 10.5000 = 12405.9 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 6$ mm = 6069.13 Kgs
No. of 16mm bolts required, = 12405.86 / 6069.13 = 2.04 nos. Say **3.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 10579.072 kg
Maximum Tension in Bracing = 10224.855 kg
- m) In Compression = 12405.9 / 10579.07 = **1.17 > 1.0 safe**
In Tension = 20019.2 / 10224.86 = **1.96 > 1.0 safe**

D DESIGN OF BRACINGS - GD, JD

a)	Angle Section tried & adopted	=	50	x	50	x	5	
b)	Length of Angle, L2	=	2286.00	mm				
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1143.00	/	9.70	=	117.84	< 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2286.00	/	23.10	=	98.96	< 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	4.7900	sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts							
	$v = 1.5000 + 2.3750 \times 0.6545$	=	3.0545	sqcm.				
f)	Minimum guaranteed yield Stress of Material F_y	=	250	Mpa				
g)	Permissible Tensile Stress	=	2549.20	Kg/sqcm.				
h)	Permissible Tensile Load	=	2549.20	x	3.0545	=	7786.6	Kgs
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.							
	Governing Slenderness ratio	=	117.84					
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$	=	13.28					
	Actual b/t ratio	=	10.00	<	13.28			
	Value of F_y	=	2549.20	Kg/sqcm.				
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66					
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=	1428.46	Kg/sqcm.				
j)	Permissible Compressive Load	=	1428.46	x	4.7900	=	6842.3	Kgs
k)	No. of 16mm bolts required, Permissible Shear Stress for 5.6 class bolts	=	310	Mpa	=	3161	Kg/sqcm.	
	Permissible Bearing Stress for 5.6 class bolts	=	620	Mpa	=	6322	Kg/sqcm.	
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$	=	6355.58	Kgs				
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$	$t = 5 \text{ mm}$	=	5057.61	Kgs			
	No. of 16mm bolts required,	=	6842.34	/	5057.61	=	1.35	nos. Say
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing Maximum Compression in Bracing	=	1428.794	kg				
	Maximum Tension in Bracing	=	1405.411	kg				
m)	In Compression	=	6842.3	/	1428.79	=	4.79	> 1.0 safe
	In Tension	=	7786.6	/	1405.41	=	5.54	> 1.0 safe

2.00 no.

MEMBER & CONNECTION BOLT DESIGN FOR
TOWER-4T4

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4) & BEAM (G3)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MKD."4T4"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4) & BEAM (G3)

A DESIGN OF MAIN-LEG FOR PART - PA,PB

- a) Angle Section tried & adopted = 200 x 200 x 16
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 133156.23 kg
Maximum Tension in main leg for Panel = 122277.49 kg
- c) Effective Length of Angle, L1 & L2 = 3504.00 & 3504.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1752.00 / 39.60 = 44.24 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1752.00 / 61.90 = 28.30 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 61.8000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 56.20$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 56.20 = 143265.0$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 44.24
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 12.50 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2391.21$ Kg/sqcm.
- k) Permissible Compressive Load = $2391.21 \times 61.8000 = 147776.7$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 16 mm = 16184.36 Kgs
No. of 16mm bolts required, = $143265.01 / 12711.17 = 11.27$ nos. Say **12.00 no.**
- p) Ultimate Maximum Compression per Leg = $133156.23 \times 1.00 = 133156.23$ Kg.
- q) Ultimate Maximum Tension per Leg = $122277.49 \times 1.00 = 122277.49$ Kg.
- r) Factor of Safety
In Compression = $147776.7 / 133156.23 = 1.11 > 1.0000$ It is Safe
In Tension = $143265.0 / 122277.49 = 1.17 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4) & BEAM (G3)

B DESIGN OF MAIN-LEG FOR PART - PC, PD

- a) Angle Section tried & adopted = 150 x 150 x 16
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 97270.60 kg
Maximum Tension in main leg for Panel = 88217.464 kg
- c) Effective Length of Angle, L1 & L2 = 3003.00 & 3003.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1501.50 / 29.40 = 51.07 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1501.50 / 45.80 = 32.78 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 45.60$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 40.00$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 40.00 = 101968.0$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 51.07
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 9.38 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2338.67$ Kg/sqcm.
- k) Permissible Compressive Load = $2338.67 \times 45.6000 = 106643.4$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 16 mm = 16184.36 Kgs
No. of 16mm bolts required, = $101967.98 / 12711.17 = 8.02$ nos. Say **9.00 no.**
- p) Ulitmate Maximum Compression per Leg = $97270.60 \times 1.00 = 97270.60$ Kg.
- q) Ultimate Maximum Tension per Leg = $88217.46 \times 1.00 = 88217.46$ Kg.
- r) Factor of Safety
In Compression = $106643.4 / 97270.60 = 1.10 > 1.0000$ It is Safe
In Tension = $101968.0 / 88217.46 = 1.16 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4) & BEAM (G3)

C DESIGN OF MAIN-LEG FOR PART - PE, PF, PG,PH

- a) Angle Section tried & adopted = 150 x 150 x 12
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 60149.20 kg
Maximum Tension in main leg for Panel = 52339.866 kg
- c) Effective Length of Angle, L1 & L2 = 2302.00 & 2302.00 mm resply.
- d) Slenderness ratio L1/rvv = 2302.00 / 29.70 = 77.51 < 120 hence o.k.
L2/rxx = 2302.00 / 46.30 = 49.72 < 120 hence o.k.
- e) Gross Area of Cross Section, Ag = 34.80 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 30.60 sqcm.
- g) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 30.60 = 78005.5 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 77.51
Limiting b/t ratio = $210 / (F_y)^{0.5}$ = 13.28
Actual b/t ratio = 12.50 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$ = 125.66
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$ = 2064.30 Kg/sqcm.
- k) Permissible Compressive Load = 2064.30 x 34.8000 = 71837.6 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161)$ = 12711.17 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 12 mm = 12138.27 Kgs
No. of 16mm bolts required, = 71837.64 / 12138.27 = 5.92 nos. Say **6.00 no.**
- p) Ulitmate Maximum Compression per Leg = 60149.20 x 1.00 = 60149.20 Kg.
- q) Ultimate Maximum Tension per Leg = 52339.87 x 1.00 = 52339.87 Kg.
- r) Factor of Safety
In Compression = 71837.6 / 60149.20 = **1.19 > 1.0000 It is Safe**
In Tension = 78005.5 / 52339.87 = **1.49 > 1.0000 It is Safe**

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4) & BEAM (G3)

C DESIGN OF MAIN-LEG FOR PART - PI, PJ,PK,PL

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 3678.54 kg
Maximum Tension in main leg for Panel = 3244.284 kg
- c) Effective Length of Angle, L1 & L2 = 1576.00 & 1576.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1576.00 / 14.60 = 107.95 < 120$ hence o.k.
 $L2/r_{xx} = 1576.00 / 23.10 = 68.23 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 7.27$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 5.52$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 5.52 = 14071.6 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 107.95
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1467.78$ Kg/sqcm.
k) Permissible Compressive Load = 1467.78 x 7.2700 = 10670.8 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
No. of 16mm bolts required, = 10670.79 / 5057.61 = 2.11 nos. Say **3.00 no.**
- p) Ultimate Maximum Compression per Leg = 3678.54 x 1.00 = 3678.54 Kg.
- q) Ultimate Maximum Tension per Leg = 3244.28 x 1.00 = 3244.28 Kg.
- r) Factor of Safety
In Compression = 10670.8 / 3678.54 = **2.90 > 1.0000 It is Safe**
In Tension = 14071.6 / 3244.28 = **4.34 > 1.0000 It is Safe**

* DESIGN OF BRACINGS FOR TOWER MKD. "4T4"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - GA, JA

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, L2	=	4871.00				
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1217.75	/	17.50		
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2435.50	/	27.70		
d)	Gross Area of Cross Section, Ag	=	10.5000 sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts						
	$v =$	4.1700	+	5.2200	x	0.7056	= 7.8531 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy	=		250 Mpa		
g)	Permissible Tensile Stress	=		2549.20 Kg/sqcm.			
h)	Permissible Tensile Load	=		2549.20	x	7.8531	
		=		20019.2 Kgs			
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=		87.92			
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$	=		13.28			
	Actual b/t ratio	=		15.00	>	13.28	
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)	=		2325.91 Kg/sqcm.			
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=		125.66			
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=		1756.58 Kg/sqcm.			
j)	Permissible Compressive Load	=		1756.58	x	10.5000	
		=		18444.1 Kgs			
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$	=		6355.58 Kgs			
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$	t =	6 mm	=		6069.13 Kgs	
	No. of 16mm bolts required,	=		18444.12	/	6069.13	
		=		3.04 nos. Say			
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=		12254.973	kg		
	Maximum Tension in Bracing	=		11864.453	kg		
m)	In Compression	=	18444.1	/	12254.97	= 1.51 > 1.0 safe	
	In Tension	=	20019.2	/	11864.45	= 1.69 > 1.0 safe	

4.00 no.

B DESIGN OF BRACINGS - GB, JB

- a) Angle Section tried & adopted = 90 x 90 x 6
- b) Length of Angle, L2 = 4204.00 mm
- c) Slenderness $0.25 \cdot L2 / r_{vv}$ = 1051.00 / 17.50 = 60.06 < 200 hence o.k.
 Slenderness $0.5 \cdot L2 / r_{xx}$ = 2102.00 / 27.70 = 75.88 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 10.5000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 4.1700 + 5.2200 \times 0.7056 = 7.8531$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 7.8531 = 20019.2 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 75.88
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 15.00 > 13.28
 Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ (KL/r / C_e)^2 \}] \times F_y = 1901.83$ Kg/sqcm.
 j) Permissible Compressive Load = 1901.83 x 10.5000 = 19969.2 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 6$ mm = 6069.13 Kgs
 No. of 16mm bolts required, = $19969.17 / 6069.13 = 3.29$ nos. Say **4.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 13261.833 kg
 Maximum Tension in Bracing = 13200.332 kg
- m) In Compression = 19969.2 / 13261.83 = **1.51 > 1.0 safe**
 In Tension = 20019.2 / 13200.33 = **1.52 > 1.0 safe**

C DESIGN OF BRACINGS - GC, JC

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L2 = 3453.00 mm
- c) Slenderness $0.5 \times L2 / r_{vv}$ = 1726.50 / 19.40 = 88.99 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 3453.00 / 30.50 = 113.21 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2$.k
assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 113.21
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1514.66$ Kg/sqcm.
j) Permissible Compressive Load = 1514.66 x 19.0000 = 28778.5 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161) = 6355.58$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 10 mm = 10115.22 Kgs
No. of 16mm bolts required, = 28778.52 / 6355.58 = 4.53 nos. Say **5.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 15015.877 kg
Maximum Tension in Bracing = 14644.853 kg
- m) In Compression = 28778.5 / 15015.88 = **1.92 > 1.0 safe**
In Tension = 36948.8 / 14644.85 = **2.52 > 1.0 safe**

D DESIGN OF BRACINGS - GD, JD

a)	Angle Section tried & adopted	=	50	x	50	x	5	
b)	Length of Angle, L2	=	2286.00	mm				
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1143.00	/	9.70	=	117.84	< 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2286.00	/	23.10	=	98.96	< 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	4.7900	sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts							
	$v = 1.5000 + 2.3750 \times 0.6545$	=	3.0545	sqcm.				
f)	Minimum guaranteed yield Stress of Material F_y	=	250	Mpa				
g)	Permissible Tensile Stress	=	2549.20	Kg/sqcm.				
h)	Permissible Tensile Load	=	2549.20	x	3.0545	=	7786.6	Kgs
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.							
	Governing Slenderness ratio	=	117.84					
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$	=	13.28					
	Actual b/t ratio	=	10.00	<	13.28			
	Value of F_y	=	2549.20	Kg/sqcm.				
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66					
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=	1428.46	Kg/sqcm.				
j)	Permissible Compressive Load	=	1428.46	x	4.7900	=	6842.3	Kgs
k)	No. of 16mm bolts required, Permissible Shear Stress for 5.6 class bolts	=	310	Mpa	=	3161	Kg/sqcm.	
	Permissible Bearing Stress for 5.6 class bolts	=	620	Mpa	=	6322	Kg/sqcm.	
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$	=	6355.58	Kgs				
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$	$t = 5$ mm	=	5057.61	Kgs			
	No. of 16mm bolts required,	=	6842.34	/	5057.61	=	1.35	nos. Say
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing Maximum Compression in Bracing	=	1421.238	kg				
	Maximum Tension in Bracing	=	1405.984	kg				
m)	In Compression	=	6842.3	/	1421.24	=	4.81	> 1.0 safe
	In Tension	=	7786.6	/	1405.98	=	5.54	> 1.0 safe

2.00 no.

MEMBER & CONNECTION BOLT DESIGN FOR
BEAM-G3

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3 & 4T4) & BEAM (G3)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV BEAM MKD."G3"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802 (part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3 & 4T4) & BEAM (G3)

A DESIGN OF MAIN-LEG FOR PART - MA

- a) Angle Section tried & adopted = 90 x 90 x 8
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 24273.20 kg
Maximum Tension in main leg for Panel = 20624.73 kg
- c) Effective Length of Angle, L1 & L2 = 1035.00 & 1035.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1035.00 / 17.50 = 59.14 < 120$ hence o.k.
 $L2/r_{xx} = 1035.00 / 27.50 = 37.64 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 13.8000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 11.00$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 11.00 = 28041.2$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 59.14
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 11.25 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2266.87$ Kg/sqcm.
k) Permissible Compressive Load = $2266.87 \times 13.8000 = 31282.8$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 8$ mm = 8092.18 Kgs
No. of 16mm bolts required, $28041.20 / 8092.18 = 3.47$ nos. Say **4.00 no.**
- p) Ultimate Maximum Compression per Leg = $24273.20 \times 1.00 = 24273.20$ Kg.
- q) Ultimate Maximum Tension per Leg = $20624.73 \times 1.00 = 20624.73$ Kg.
- r) Factor of Safety
In Compression = $31282.8 / 24273.20 = 1.29 > 1.0000$ It is Safe
In Tension = $28041.2 / 20624.73 = 1.36 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3 & 4T4) & BEAM (G3)

B DESIGN OF MAIN-LEG FOR PART - MB

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 27090.42 kg
Maximum Tension in main leg for Panel = 26100.637 kg
- c) Effective Length of Angle, L1 & L2 = 1310.00 & 1310.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1310.00 / 19.40 = 67.53 < 120$ hence o.k.
 $L2/r_{xx} = 1310.00 / 30.50 = 42.95 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 19.0000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 15.50$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 15.50 = 39512.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 67.53
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2181.16$ Kg/sqcm.
k) Permissible Compressive Load = $2181.16 \times 19.0000 = 41442.1$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
No. of 16mm bolts required, = $39512.59 / 10115.22 = 3.91$ nos. Say **4.00 no.**
- p) Ultimate Maximum Compression per Leg = $27090.42 \times 1.00 = 27090.42$ Kg.
- q) Ultimate Maximum Tension per Leg = $26100.64 \times 1.00 = 26100.64$ Kg.
- r) Factor of Safety
In Compression = $41442.1 / 27090.42 = 1.53 > 1.0000$ It is Safe
In Tension = $39512.6 / 26100.64 = 1.51 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3 & 4T4) & BEAM (G3)

C DESIGN OF MAIN-LEG FOR PART - AA, AB

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 18449.04 kg
Maximum Tension in main leg for Panel = 17872.188 kg
- c) Effective Length of Angle, L1 & L2 = 2200.00 & 2200.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 2200.00 / 19.40 = 113.40 < 120$ hence o.k.
 $L2/r_{xx} = 2200.00 / 30.50 = 72.13 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 19.0000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 15.50$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 15.50 = 39512.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 113.40
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1511.20$ Kg/sqcm.
k) Permissible Compressive Load = $1511.20 \times 19.0000 = 28712.9$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
No. of 16mm bolts required, = $28712.85 / 10115.22 = 2.84$ nos. Say **3.00 no.**
- p) Ultimate Maximum Compression per Leg = $18449.04 \times 1.00 = 18449.04$ Kg.
- q) Ultimate Maximum Tension per Leg = $17872.19 \times 1.00 = 17872.19$ Kg.
- r) Factor of Safety
In Compression = $28712.9 / 18449.04 = 1.56 > 1.0000$ It is Safe
In Tension = $39512.6 / 17872.19 = 2.21 > 1.0000$ It is Safe

* DESIGN OF BRACINGS FOR BEAM MKD. "G3"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802 (part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - SA & UA

a)	Angle Section tried & adopted	=	65	x	65	x	5
b)	Length of Angle, L2	=	2431.00				mm
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1215.50	/	12.60	=	96.47 < 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2431.00	/	19.90	=	122.16 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	6.2500 sqcm.				
e)	Net Area of Cross Section $A_e = A1 + A2.k$ assuming 1 No.s 16mm Dia. Bolts						
	$v =$	2.2500	+	3.1250	x	0.6835	= 4.3861 sqcm.
f)	Minimum guaranteed yield Stress of Material				Fy	=	250 Mpa
g)	Permissible Tensile Stress					=	2549.20 Kg/sqcm.
h)	Permissible Tensile Load					=	2549.20 x 4.3861
						=	11181.0 Kgs
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio					=	122.16
	Limiting b/t ratio $= 210 / (F_y)^{0.5}$					=	13.28
	Actual b/t ratio					=	13.00 < 13.28
	Value of Fy					=	2549.20 Kg/sqcm.
	Value of Ce $= 3.1415 \times \text{sq. root of } (2 \times E / F_y)$					=	125.66
	$F_a = [1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$					=	1344.67 Kg/sqcm.
j)	Permissible Compressive Load					=	1344.67 x 6.2500
						=	8404.2 Kgs
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=		=	3161 Kg/sqcm.
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=		=	6322 Kg/sqcm.
	Capacity for 5.6 class in single shear $= (3.1415/4 \times d \times d \times 3161)$					=	6355.58 Kgs
	Capacity for 5.6 class in bearing $= (6322 \times d \times t)$				t =	5 mm	= 5057.61 Kgs
	No. of 16mm bolts required,					=	8404.18 / 5057.61
						=	1.66 nos. Say
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing					=	6991.401 kg
	Maximum Tension in Bracing					=	6874.762 kg
m)	In Compression	=	8404.2	/	6991.40	=	1.20 > 1.0 safe
	In Tension	=	11181.0	/	6874.76	=	1.63 > 1.0 safe

2.00 no.

B DESIGN OF BRACINGS - SB & UB

- a) Angle Section tried & adopted = 60 x 60 x 5
- b) Length of Angle, L2 = 2560.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1280.00 / 11.60 = 110.34 < 200 hence o.k.
 Slenderness $L2 / r_{xx}$ = 2560.00 / 18.20 = 140.66 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 5.7500 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 2.0000 + 2.8750 \times 0.6761 = 3.9437$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.9437 = 10053.2 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 140.66
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 12.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [3.1415^2 \times E / \{ (K L / r)^2 \}] = 1017.32$ Kg/sqcm.
- j) Permissible Compressive Load = 1017.32 x 5.7500 = 5849.6 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
 No. of 16mm bolts required, = 5849.57 / 5057.61 = 1.16 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 3560.170 kg
 Maximum Tension in Bracing = 3437.336 kg
- m) In Compression = 5849.6 / 3560.17 = **1.64 > 1.0 safe**
 In Tension = 10053.2 / 3437.34 = **2.92 > 1.0 safe**

C DESIGN OF BRACINGS - DA, DB

- a) Angle Section tried & adopted = 65 x 65 x 5
- b) Length of Angle, L2 = 2125.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1062.50 / 12.60 = 84.33 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 2125.00 / 19.90 = 106.78 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 6.2500 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2$
assuming 1 No.s 16mm Dia. Bolts
 $v = 2.2500 + 3.1250 \times 0.6835 = 4.3861$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 4.3861 = 11181.0 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 106.78
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 13.00 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1628.82$ Kg/sqcm.
- j) Permissible Compressive Load = 1628.82 x 6.2500 = 10180.1 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
No. of 16mm bolts required, = 10180.14 / 5057.61 = 2.01 nos. Say **3.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 1153.994 kg
Maximum Tension in Bracing = 1555.313 kg
- m) In Compression = 10180.1 / 1153.99 = **8.82 > 1.0 safe**
In Tension = 11181.0 / 1555.31 = **7.19 > 1.0 safe**

D DESIGN OF BRACINGS - YH, YC, YD, SV

- a) Angle Section tried & adopted = 60 x 60 x 5
- b) Length of Angle, L2 = 2200.00 mm
- c) Slenderness $0.5 \times L2/r_{vv}$ = 1100.00 / 11.60 = 94.83 < 200 hence o.k.
 Slenderness $L2/r_{xx}$ = 2200.00 / 18.20 = 120.88 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 5.7500 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2.k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 2.0000 + 2.8750 \times 0.6761 = 3.9437$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.9437 = 10053.2 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 120.88
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 12.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1369.81$ Kg/sqcm.
 j) Permissible Compressive Load = 1369.81 x 5.7500 = 7876.4 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
 No. of 16mm bolts required, = 7876.42 / 5057.61 = 1.56 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 5711.466 kg
 Maximum Tension in Bracing = 4717.659 kg
- m) In Compression = 7876.4 / 5711.47 = **1.38 > 1.0 safe**
 In Tension = 10053.2 / 4717.66 = **2.13 > 1.0 safe**

BASE PLATE & ANCHOR BOLT DESIGN
OF 4T3

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T3" (NORMAL CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

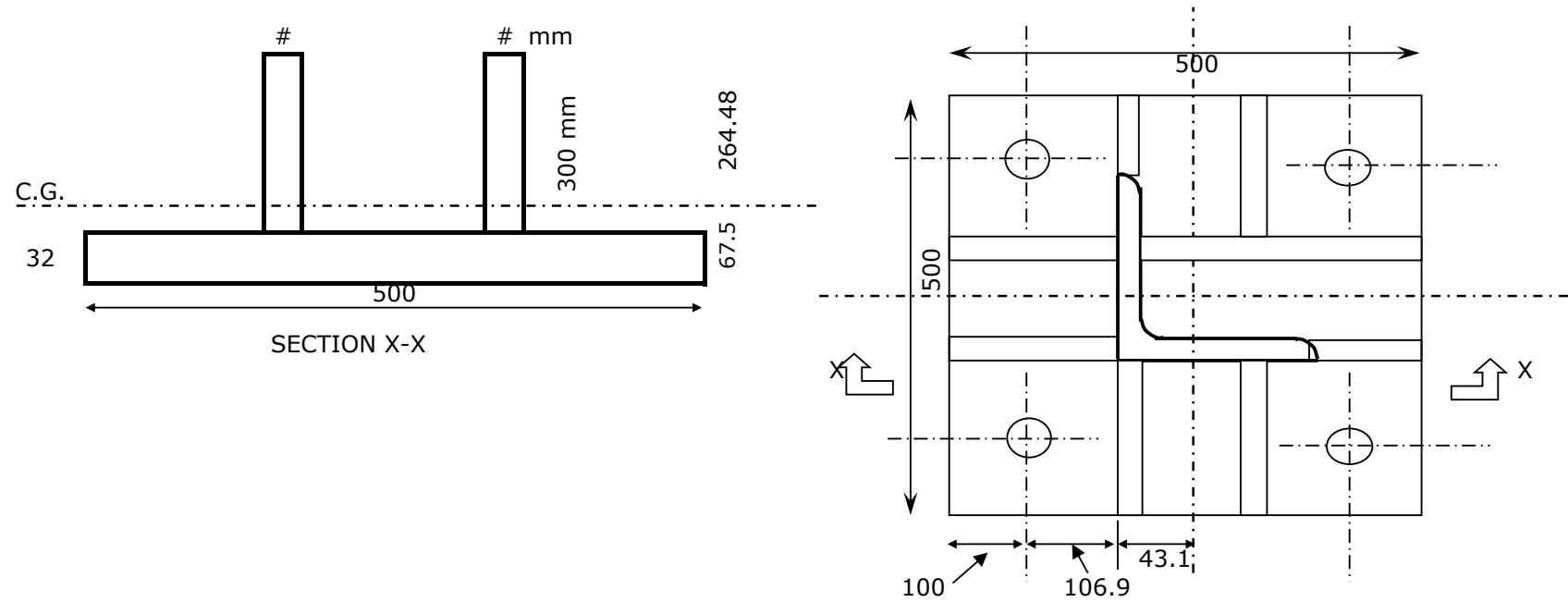
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	28321.69
B) MAXIMUM TENSION PER LEG	22999.88	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	1763.99	2711.40
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	1618.26	1131.09
E) RESULTANT SHEAR	2393.83	2937.87
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 28321.690 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 22999.877 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 28321.690 Kgs (Working)
- b) Maximum Tensile Load per Leg = 22999.877 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 101.94 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress **σ_{bs}** in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm ($A_1 = B \times D$)
- f) Main leg angle = L150x150x16
- g) Base Plate Size adopted b x l = 500.00 x 500.00 x 32.00 mm ($A_2 = b \times l$)
- h) Net Area of Base Plate provided = 500.000 x 500.000 = 2500.000 sqcm
- i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)



C Section modulus

Moment of Inertia @ C G axis Ixx	=	192195126.44 mm ⁴
Section Modulus Zxx(top)	=	726683.01 mm ³
Section Modulus Zxx(bottom)	=	2846608.10 mm ³
Minimum Section Modulus Zxx(top)	=	726.683 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $28321.690 / 2500.000 + 0.000 / 20833.333$
= 11.329 Kg/sqcm.
< $101.937 \text{ Kg/sqcm. 'hence o.k.}$
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 206.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $11.3287 \times 50.000 \times 20.690^2 / 2.000$
= 121238.386 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
- b) Edge distance of Bolts = 100.00 mm
- c) Nominal Diameter of Bolts = 42.00 mm
- d) Diameter of Bolt Hole = 46.000 mm
- e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $206.900 - 100.000$
= 106.900 mm
- f) C/C of outer line of bolts, 'a' = $500.000 - 100.000 - 100.000$
= 300.000 mm
- g) Tension per bolt, $t = P/4 + M_x/n.a + M_y/n.a$ = $22999.877 / 4.000 + 0.000 / 60.000$
= 5749.969 Kgs
- h) Bending moment @ face of Stiffener = $2.000 \times 5749.9693 \times 10.690$
= 122934.343 Kg-cm
- Maximum bending moment = 122934.343 Kg-cm
- Minimum section modulus Z_{min} = 726.683 cm^3
- i) Maximum bending stress = $169.1719 \text{ Kg / sq. cm}$
< $1850.000 \text{ Kg / sq. cm}$

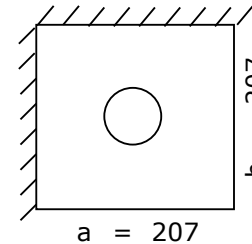
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

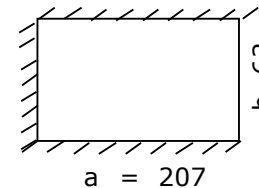
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 207 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 11.3287 \\ s_b &= 1.769 \times 11 \times 20.69^2 / 3.20^2 = \mathbf{837.78} \\ \text{Allowable bending stress } (1.00 \times 1850) &< \mathbf{1850} \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 207 \text{ mm} \quad b = 62 \text{ mm} \\ a / b &= 3.326 \quad \beta = 0.798 \quad q = 11.3287 \\ s_b &= 0.798 \times 11 \times 6.22^2 / 3.20^2 = \mathbf{34.16} \\ \text{Allowable bending stress } (1.00 \times 1850) &< \mathbf{1850} \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(Stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	22999.88 Kgs.
c) Thus force / cm of weld length	=	71.87 Kgs.
d) Resistance /cm ² of weld	=	1100.00 Kgs.
e) Throat Size of weld required	=	0.07 cms
f) Thus fillet thickness required	=	0.92 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)

H Design of Anchor Bolts

Diameter of Bolt	=	42 mm
Nos. of Bolts per Leg	=	4
Root area of M42 bolts, Ae=0.785*Ag	=	1088 mm ²
Gross area of M42 bolts, Ag	=	1385 mm ²

Check for Normal Condition :-

Axial Tension in Each Bolt Pt	=	5750.0 Kgs.

Tensile stress,ft = Pt/Ae	=	$\frac{5750.0}{10.88}$	
	=	528.70 Kg/cm ²	< 1200.0 Kg/cm ²
Permissible tensile stress,Ft	=	1200 x 1.00	Hence Safe

Shear Force In Each Bolt , Ps	=	2393.83 / 4	= 598.46 kg
Shear stress, fs = Ps/Ag	=	$\frac{598.46}{13.85}$	
	=	43.20 Kg/cm ²	< 800.0 Kg/cm ²
Permissible Shear stress,Fs	=	800.00 x 1.00	Hence Safe

Combined stress check for Normal Condition :-

$$fs/Fs + ft/Ft < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{528.70}{1200} + \frac{43.20}{800} = 0.49 \quad \textbf{Hence Safe.}$$

Anchor length For Normal Condition :-

Anchor Length, Le	=	Pull per bolt / ($\pi \times d \times \tau_{bd}$)	
	=	$\frac{5749.97}{13.19 \times 8.00}$	($\tau_{bd} = 8 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000)
Thus length of embedment 'L'	=	54.47 cms.	

PROVIDE 4 NOS. 42 MM DIA. ANCHORE BOLT WITH MIN. 550MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T3" (SHORT CIRCUIT CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

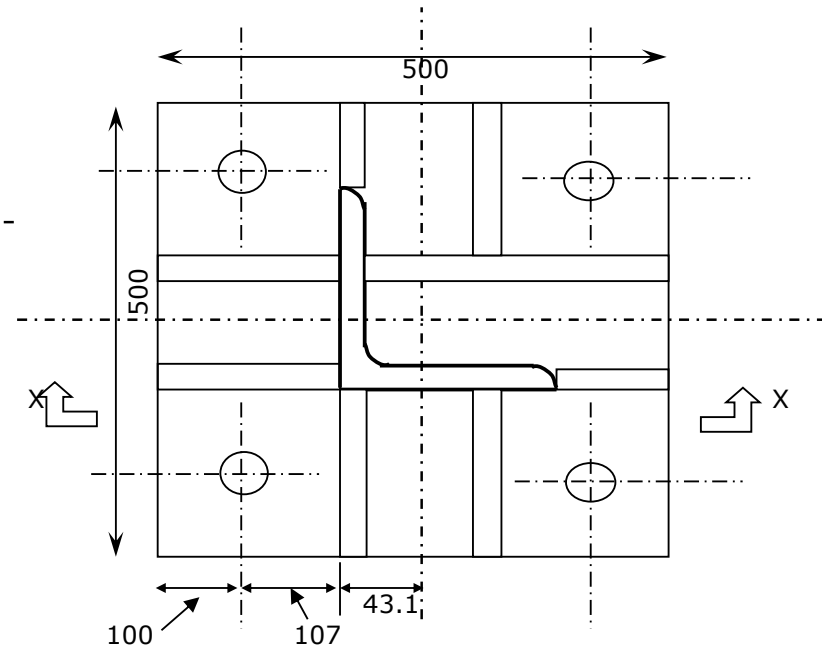
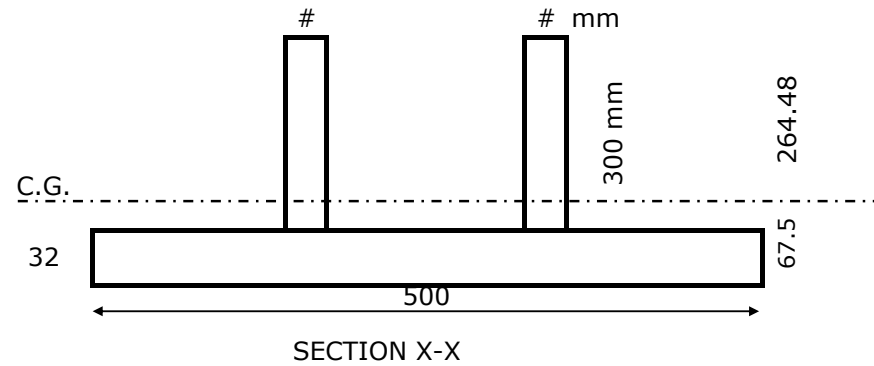
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	44721.25
B) MAXIMUM TENSION PER LEG	39126.08	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	1439.76	4222.40
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	3921.62	1645.55
E) RESULTANT SHEAR	4177.56	4531.72
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 44721.253 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 39126.077 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 44721.253 Kgs (Working)
- b) Maximum Tensile Load per Leg = 39126.077 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 101.94 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress **σ_{bs}** in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm ($A_1 = B \times D$)
- f) Main leg angle = L150x150x16
- g) Base Plate Size adopted b x l = 500.00 x 500.00 x 32.00 mm ($A_2 = b \times l$)
- h) Net Area of Base Plate provided = 500.000 x 500.000 = 2500.000 sqcm
- i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)



C Section modulus

Moment of Inertia @ C G axis Ixx	=	192195126.44 mm ⁴
Section Modulus Zxx(top)	=	726683.01 mm ³
Section Modulus Zxx(bottom)	=	2846608.10 mm ³
Minimum Section Modulus Zxx(top)	=	726.683 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $44721.253 / 2500.000 + 0.000 / 20833.333$
= 17.8885 Kg/sqcm.
< $101.937 \text{ Kg/sqcm. 'hence o.k.}$
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 206.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $17.8885 \times 50.000 \times 20.690^2 / 2.000$
= 191440.996 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
- b) Edge distance of Bolts = 100.00 mm
- c) Nominal Diameter of Bolts = 42.00 mm
- d) Diameter of Bolt Hole = 46.000 mm
- e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $206.900 - 100.000$
= 106.900 mm
- f) C/C of outer line of bolts, 'a' = $500.000 - 100.000 - 100.000$
= 300.000 mm
- g) Tension per bolt, $t = P/4 + M_x/n.a + M_y/n.a$ = $39126.077 / 4.000 + 0.000 / 60.000$
= 9781.519 Kgs
- h) Bending moment @ face of Stiffener = $2.000 \times 9781.5193 \times 10.690$
= 209128.882 Kg-cm
- Maximum bending moment = 209128.882 Kg-cm
- Minimum section modulus Z_{min} = 726.683 cm^3
- i) Maximum bending stress = $287.7856 \text{ Kg / sq. cm}$
< $1850.000 \text{ Kg / sq. cm}$

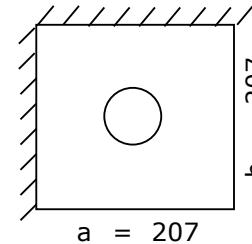
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

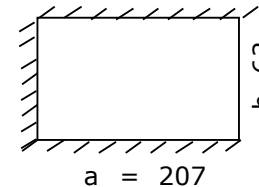
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 207 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 17.8885 \\ s_b &= 1.769 \times 18 \times 20.69^2 / 3.20^2 = \mathbf{1322.89} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 207 \text{ mm} \quad b = 62 \text{ mm} \\ a / b &= 3.326 \quad \beta = 0.798 \quad q = 17.8885 \\ s_b &= 0.798 \times 18 \times 6.22^2 / 3.20^2 = \mathbf{53.93} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	39126.08 Kgs.
c) Thus force / cm of weld length	=	122.27 Kgs.
d) Resistance /cm ² of weld	=	1375.00 Kgs.
e) Throat Size of weld required	=	0.09 cms
f) Thus fillet thickness required	=	1.26 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T3)

H Design of Anchor Bolts

Diameter of Bolt	=	42 mm
Nos. of Bolts per Leg	=	4
Root area of M42 bolts, $A_e=0.785 \times A_g$	=	1088 mm ²
Gross area of M42 bolts, A_g	=	1385 mm ²

Check for Short Circuit Condition :-

Axial Tension in Each Bolt Pt	=	9781.5 Kgs.

Tensile stress, $f_t = P_t/A_e$	=	$\frac{9781.5}{10.88}$	
	=	899.39 Kg/cm ²	< 1500.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.25	Hence Safe

Shear Force In Each Bolt , Ps	=	4177.56 / 4	= 1044.39 kg
Shear stress, $f_s = P_s/A_g$	=	$\frac{1044.39}{13.85}$	
	=	75.38 Kg/cm ²	< 1000.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.25	Hence Safe

Combined stress check for Short Circuit Condition :-

$$f_s/F_s + f_t/F_t < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{899.39}{1500} + \frac{75.38}{1000} = 0.67 \quad \text{Hence Safe.}$$

Anchor length For Short Circuit Condition :-

Anchor Length, L_e	=	Pull per bolt / $(\pi \times d \times \tau_{bd})$	
	=	$\frac{9781.52}{13.19 \times 10.64}$	($\tau_{bd} = 8 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000) (33% INCREASE)
Thus length of embedment 'L'	=	69.67 cms.	

PROVIDE 4 NOS. 42 MM DIA. ANCHORE BOLT WITH MIN. 700MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

BASE PLATE & ANCHOR BOLT DESIGN
OF 4T4

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T4" (NORMAL CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

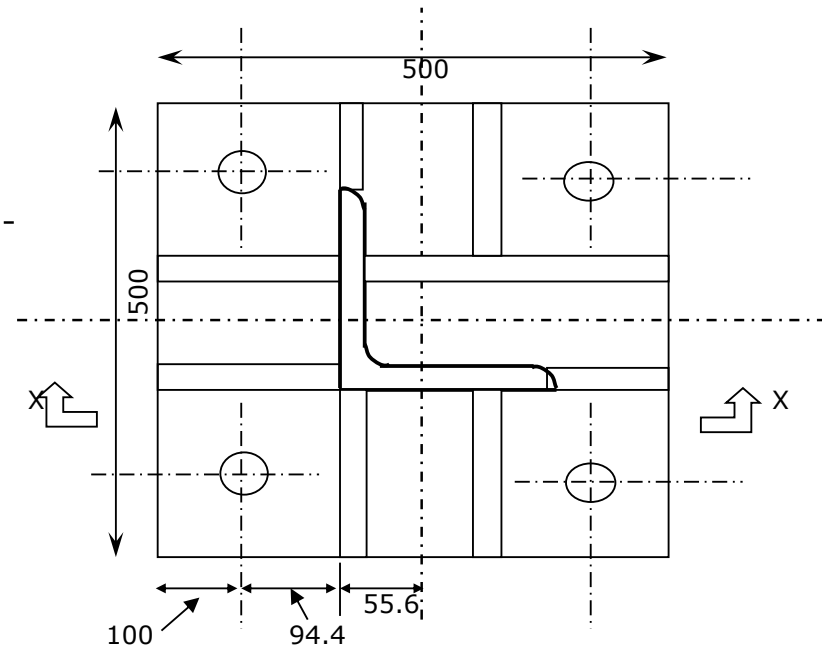
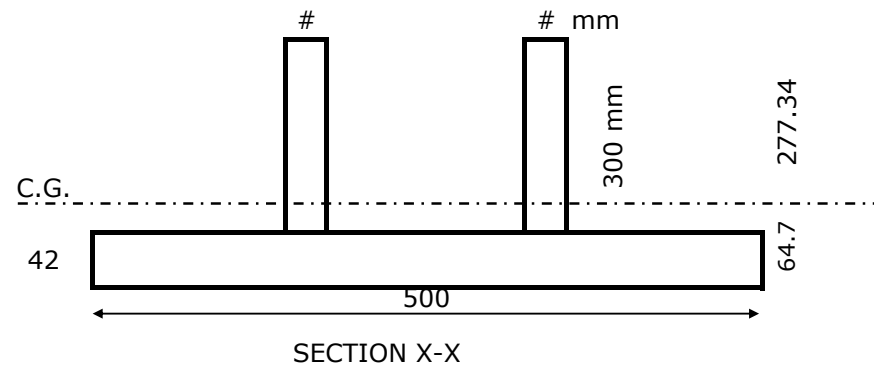
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	48600.76
B) MAXIMUM TENSION PER LEG	40807.76	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	3140.96	3507.85
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	2581.85	2836.54
E) RESULTANT SHEAR	4065.91	4511.20
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 48600.755 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 40807.759 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 48600.755 Kgs (Working)
- b) Maximum Tensile Load per Leg = 40807.759 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 101.94 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress **σ_{bs}** in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm (A1 = BxD)
- f) Main leg angle = L200x200x16
- g) Base Plate Size adopted b x l = 500.00 x 500.00 x 42.00 mm (A2 = b x l)
- h) Net Area of Base Plate provided = 500.000 x 500.000 = 2500.000 sqcm
- i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)



C Section modulus

Moment of Inertia @ C G axis Ixx	=	213868531.91 mm ⁴
Section Modulus Zxx(top)	=	771140.85 mm ³
Section Modulus Zxx(bottom)	=	3307608.09 mm ³
Minimum Section Modulus Zxx(top)	=	771.141 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $48600.755 / 2500.000 + 0.000 / 20833.333$
= 19.440 Kg/sqcm.
< 101.937 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 194.40 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $19.4403 \times 50.000 \times 19.440^2 / 2.000$
= 183668.863 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
- b) Edge distance of Bolts = 100.00 mm
- c) Nominal Diameter of Bolts = 56.00 mm
- d) Diameter of Bolt Hole = 60.000 mm
- e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $194.400 - 100.000$
= 94.400 mm
- f) C/C of outer line of bolts, 'a' = $500.000 - 100.000 - 100.000$
= 300.000 mm
- g) Tension per bolt, $t = P/4 + M_x/n.a + M_y/n.a$ = $40807.759 / 4.000 + 0.000 / 60.000$
= 10201.940 Kgs
- h) Bending moment @ face of Stiffener = $2.000 \times 10201.9398 \times 9.440$
= 192612.622 Kg-cm
- Maximum bending moment = 192612.622 Kg-cm
- Minimum section modulus Z_{min} = 771.141 cm^3
- i) Maximum bending stress = $249.7762 \text{ Kg / sq. cm}$
< 1850.000 Kg / sq. cm

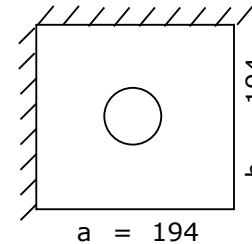
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

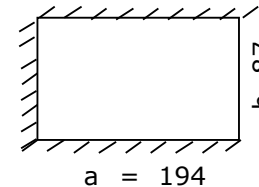
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 194 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 19.4403 \\ s_b &= 1.769 \times 19 \times 19.44^2 / 4.20^2 = \mathbf{736.76} \\ \text{Allowable bending stress } (1.00 \times 1850) &< \mathbf{1850} \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 194 \text{ mm} \quad b = 87 \text{ mm} \\ a / b &= 2.229 \quad \beta = 0.798 \quad q = 19.4403 \\ s_b &= 0.798 \times 19 \times 8.72^2 / 4.20^2 = \mathbf{66.87} \\ \text{Allowable bending stress } (1.00 \times 1850) &< \mathbf{1850} \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(Stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	40807.76 Kgs.
c) Thus force / cm of weld length	=	127.52 Kgs.
d) Resistance /cm ² of weld	=	1100.00 Kgs.
e) Throat Size of weld required	=	0.12 cms
f) Thus fillet thickness required	=	1.64 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)

H Design of Anchor Bolts

Diameter of Bolt	=	56 mm
Nos. of Bolts per Leg	=	4
Root area of M56 bolts, Ae=0.785*Ag	=	1933 mm ²
Gross area of M56 bolts, Ag	=	2463 mm ²

Check for Normal Condition :-

Axial Tension in Each Bolt Pt	=	10201.9 Kgs.

Tensile stress,ft = Pt/Ae	=	$\frac{10201.9}{19.33}$	
	=	527.65 Kg/cm ²	< 1200.0 Kg/cm ²
Permissible tensile stress,Ft	=	1200 x 1.00	Hence Safe

Shear Force In Each Bolt , Ps	=	4065.91 / 4	= 1016.48 kg
Shear stress, fs = Ps/Ag	=	$\frac{1016.48}{24.63}$	
	=	41.27 Kg/cm ²	< 800.0 Kg/cm ²
Permissible Shear stress,Fs	=	800.00 x 1.00	Hence Safe

Combined stress check for Normal Condition :-

$$fs/Fs + ft/Ft < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{527.65}{1200} + \frac{41.27}{800} = 0.49 \quad \text{Hence Safe.}$$

Anchor length For Normal Condition :-

Anchor Length, Le	=	Pull per bolt / ($\pi \times d \times \tau_{bd}$)	
	=	$\frac{10201.94}{17.59 \times 8.00}$	($\tau_{bd} = 8 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000)
Thus length of embedment 'L'	=	72.49 cms.	

PROVIDE 4 NOS. 56 MM DIA. ANCHORE BOLT WITH MIN. 750MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T4" (SHORT CIRCUIT CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

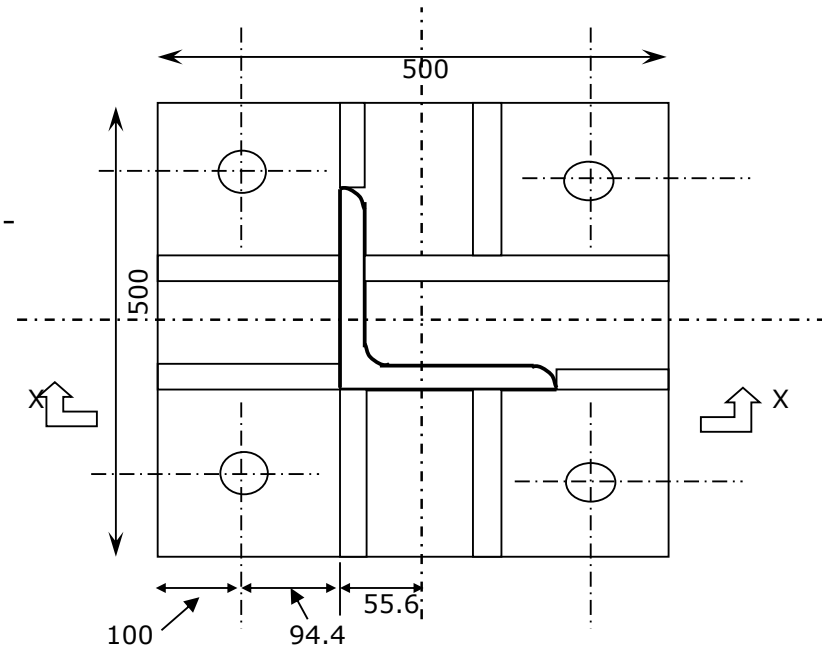
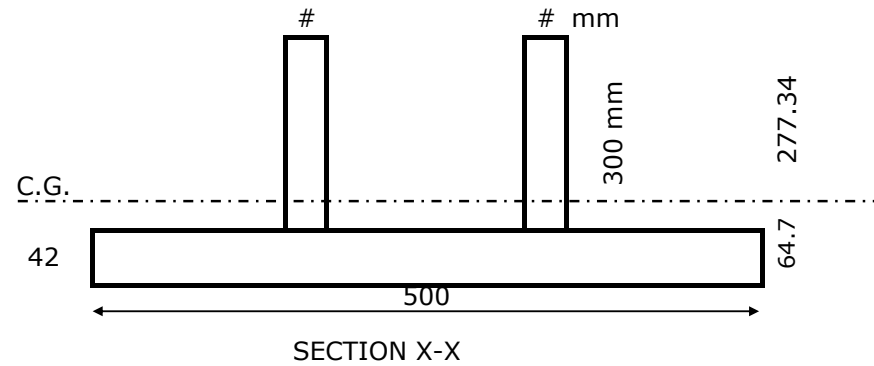
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	95050.08
B) MAXIMUM TENSION PER LEG	87275.58	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	4889.73	5256.72
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	6629.97	6826.10
E) RESULTANT SHEAR	8238.08	8615.61
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 95050.080 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 87275.578 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 95050.080 Kgs (Working)
- b) Maximum Tensile Load per Leg = 87275.578 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 101.94 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress **σ_{bs}** in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm ($A_1 = B \times D$)
- f) Main leg angle = L200x200x16
- g) Base Plate Size adopted b x l = 500.00 x 500.00 x 42.00 mm ($A_2 = b \times l$)
- h) Net Area of Base Plate provided = 500.000 x 500.000 = 2500.000 sqcm
- i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)



C Section modulus

Moment of Inertia @ C G axis Ixx	=	213868531.91 mm ⁴
Section Modulus Zxx(top)	=	771140.85 mm ³
Section Modulus Zxx(bottom)	=	3307608.09 mm ³
Minimum Section Modulus Zxx(top)	=	771.141 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $95050.080 / 2500.000 + 0.000 / 20833.333$
= 38.0200 Kg/sqcm.
< 101.937 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 194.40 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $38.0200 \times 50.000 \times 19.440^2 / 2.000$
= 359207.179 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
- b) Edge distance of Bolts = 100.00 mm
- c) Nominal Diameter of Bolts = 56.00 mm
- d) Diameter of Bolt Hole = 60.000 mm
- e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $194.400 - 100.000$
= 94.400 mm
- f) C/C of outer line of bolts, 'a' = $500.000 - 100.000 - 100.000$
= 300.000 mm
- g) Tension per bolt, $t = P/4 + M_x/n.a + M_y/n.a$ = $87275.578 / 4.000 + 0.000 / 60.000$
= 21818.895 Kgs
- h) Bending moment @ face of Stiffener = $2.000 \times 21818.8945 \times 9.440$
= 411940.728 Kg-cm
- Maximum bending moment = 411940.728 Kg-cm
- Minimum section modulus Z_{min} = 771.141 cm³
- i) Maximum bending stress = $534.1965 \text{ Kg / sq. cm}$
< 1850.000 Kg / sq. cm

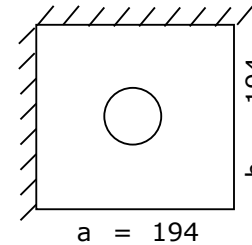
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

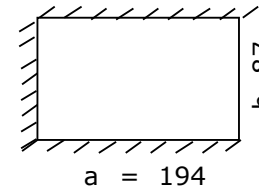
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a &= b = 194 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 38.0200 \\ s_b &= 1.769 \times 38 \times 19.44^2 / 4.20^2 = \mathbf{1440.90} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 194 \text{ mm} \quad b = 87 \text{ mm} \\ a / b &= 2.229 \quad \beta = 0.798 \quad q = 38.0200 \\ s_b &= 0.798 \times 38 \times 8.72^2 / 4.20^2 = \mathbf{130.78} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	87275.58 Kgs.
c) Thus force / cm of weld length	=	272.74 Kgs.
d) Resistance /cm ² of weld	=	1375.00 Kgs.
e) Throat Size of weld required	=	0.20 cms
f) Thus fillet thickness required	=	2.81 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T4)

H Design of Anchor Bolts

Diameter of Bolt	=	56 mm
Nos. of Bolts per Leg	=	4
Root area of M56 bolts, $A_e=0.785 \times A_g$	=	1933 mm ²
Gross area of M56 bolts, A_g	=	2463 mm ²

Check for Short Circuit Condition :-

Axial Tension in Each Bolt Pt	=	21818.9 Kgs.

Tensile stress, $f_t = P_t / A_e$	=	$\frac{21818.9}{19.33}$	
	=	1128.49 Kg/cm ²	< 1500.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.25	Hence Safe

Shear Force In Each Bolt , P_s	=	8238.08 / 4	= 2059.52 kg
Shear stress, $f_s = P_s / A_g$	=	$\frac{2059.52}{24.63}$	
	=	83.62 Kg/cm ²	< 1000.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.25	Hence Safe

Combined stress check for Short Circuit Condition :-

$$f_s / F_s + f_t / F_t < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{1128.49}{1500} + \frac{83.62}{1000} = 0.84 \quad \text{Hence Safe.}$$

Anchor length For Short Circuit Condition :-

Anchor Length, L_e	=	Pull per bolt / $(\pi \times d \times \tau_{bd})$	
	=	$\frac{21818.89}{17.59 \times 10.64}$	$(\tau_{bd} = 8 \text{ kg/cm}^2, \text{Refer Table-21, IS:456,2000) (33\% INCREASE)}$
Thus length of embedment 'L'	=	116.56 cms.	

PROVIDE 4 NOS. 56 MM DIA. ANCHORE BOLT WITH MIN. 1200MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

400kV AIS

	OWNER MAHAN ENERGEN LIMITED (MEL) 2x800 MW ULTRA SUPER CRITICAL THERMAL POWER PROJECT, MAHAN (PHASE-II), SINGRAULI, M.P.
	OWNER'S ENGINEER TATA CONSULTING ENGINEERS LIMITED
 Godrej & Boyce Mfg. Co. Ltd.	EPC Contractor GODREJ AND BOYCE MFG. CO. LTD

DOCUMENT TITLE	4T5-4T6-4T2 TOWER & BEAM G4& G2 Structure design & Staad
OWNER DOC. NO.	552H-E-EPC-SYD-DC-U-V-0015
CONTRACTOR / SUPPLIER DOC. NO.	GNB-MEL-CE-099
PACKAGE DISCIPLINE	CIVIL
PREPARED BY	JMP
REVIEWED BY	NVT
APPROVED BY	NMP

Sr. No.	Revision No.	Date	Reasons for Change
1	0	05.08.2024	First issue
2	1	13.09.2024	Revised submission

**CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER
PROJECT AT SINGRAULI ,MP**

DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

INDEX

Sr.No.	Description	Page no.
1	GEOMETRY	3
2	LOAD EVALUATION	7
3	PICTORIAL VIEW OF STAAD MODEL	85
4	STAAD ANALYSIS & DESIGN	99
5	MEMBER & CONNECTION BOLT DESIGN	123
6	BASE PLATE & ANCHOR BOLT DESIGN	140

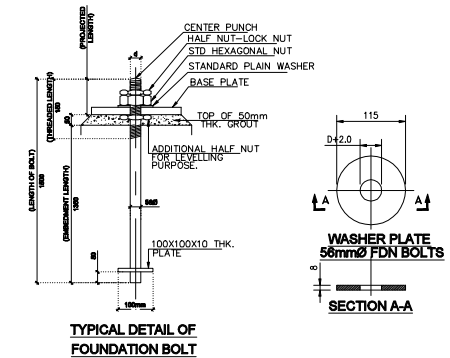
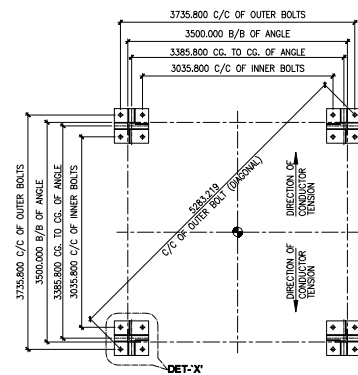
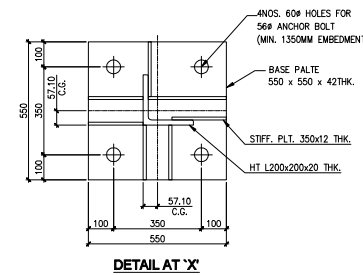
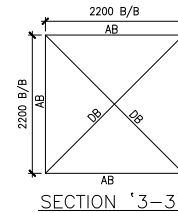
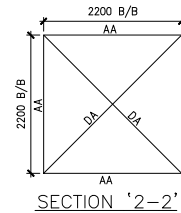
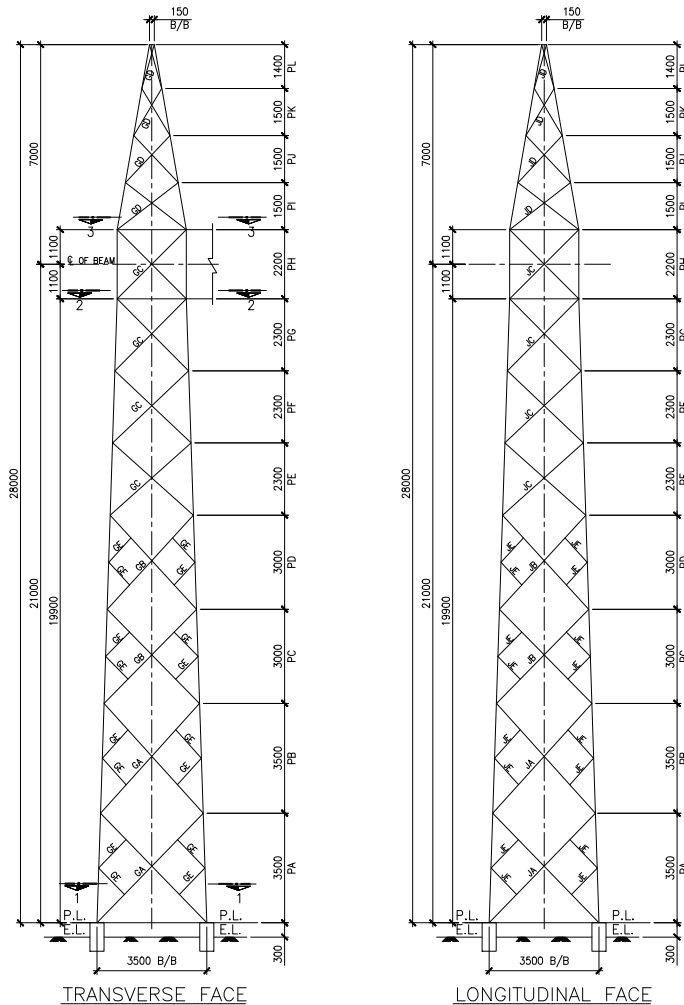
GEOMETRY

EL 0.00 LEVEL CORRESPONDS TO RL 338.000.

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL
4T5	ANGLE SIZE	L200x200x20	L200x200x20	L150x150x20	L150x150x20	L150x150x16	L150x150x16	L150x150x16	L150x150x16	L75x75x5	L75x75x5	L75x75x5	L75x75x5
	NO. OF BOLTS	14	14	10	10	08	08	08	08	04	04	04	04

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	GA,JA	GB,JB	GC,JC	GD,JD	GE,JE	AA,AB	DA,DB
4T5	ANGLE SIZE	L90x90x6	L90x90x6	L100x100x10	L50x50x5	L45x45x5	L130x130x12	L90x90x6
	NO. OF BOLTS	04	04	05	02	01	05	04

REFERENCE DRAWINGS:-	
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-L-V-0002	STRUCTURAL LAYOUT PLAN & SECTION
CONTRACTOR DRAWING NO: GNB-MEL-CE-003	STRUCTURAL LAYOUT PLAN & SECTION
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-F-V-0001	FOUNDATION BOLTS DRAWING FOR TOWERS
CONTRACTOR DRAWING NO: GNB-MEL-CE-005	FOUNDATION BOLTS DRAWING FOR TOWERS
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-O-V-0013	4T5 - FABRICATION DRAWING
CONTRACTOR DRAWING NO: GNB-MEL-CE-112	4T5 - FABRICATION DRAWING



LEGEND:-

TOWER MARKED '4T5 TOWER' IS A TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF GANTRY WITH CONDUCTOR TENSION OF 2.860T UNDER NORMAL CONDITION & 8.848T UNDER SHORT CIRCUIT CONDITION WITH DEVIATION.

HIGHLIGHT:-

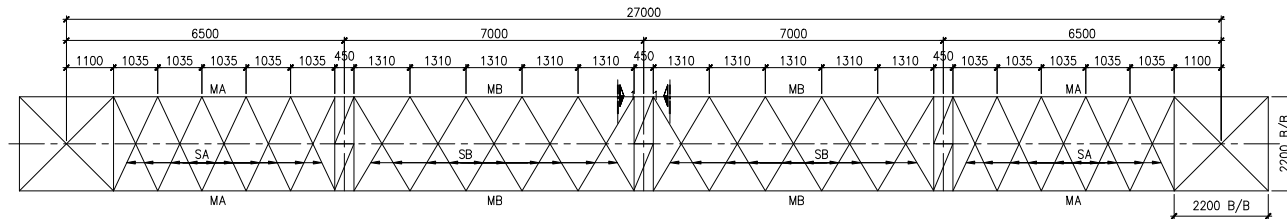
SPAN OF GIRDER	27.00 M.
HEIGHT OF GIRDER	21.00 M.
HEIGHT OF TOWER	28.00 M.
CONDUCTOR TENSION	2.860T (NC)
CONDUCTOR DEVIATION	8.848T (SC)
	±30 DEGREE

NOTES:-

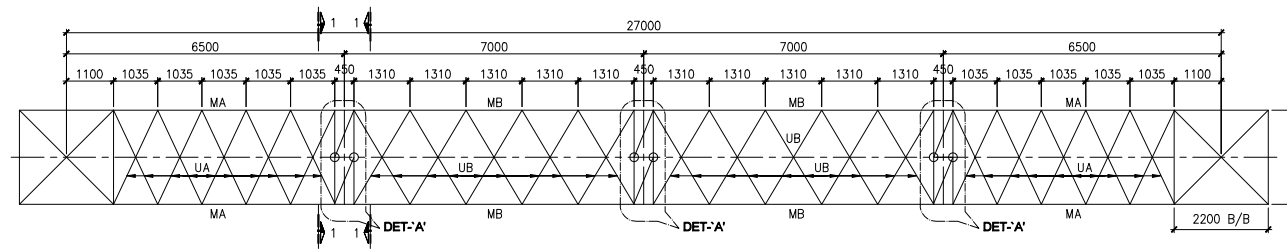
- 1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- 3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- 4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- 5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS 16mm DIA BOLT

400kV TOWER MKD. 4T5

BEAM MKD.	ANGLE SIZE AND NO. OF BOLTS	MA	MB	SA	SB	UA	UB	SV	YH	YD	YC
G4	ANGLE SIZE	L130x130x12	L150x150x16	L90x90x6	L65x65x5	L90x90x6	L65x65x5	L100x100x10	L100x100x10	L100x100x10	L100x100x10
	NO. OF BOLTS	06	09	04	02	04	02	04	04	04	04



TOP & BOTTOM PLAN



ELEVATION

LEGEND: -

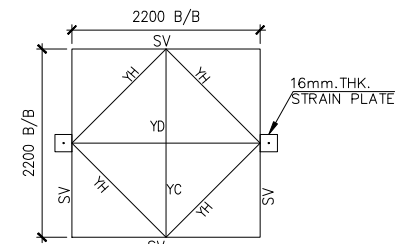
TOWER MARKED '4T5 & 4T6 TOWER' IS A TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF GANTRY WITH CONDUCTOR TENSION OF 2.680T UNDER NORMAL CONDITION & 8.848T UNDER SHORT CIRCUIT CONDITION WITH DEVIATION.

HIGHLIGHT: -

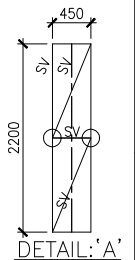
SPAN OF GIRDER	27.00 M.
HEIGHT OF GIRDER	21.00 M.
HEIGHT OF TOWER	28.00 M.
CONDUCTOR TENSION	2.680T (NC)
	8.848T (SC)
CONDUCTOR DEVIATION	±30 DEGREE

NOTES: -

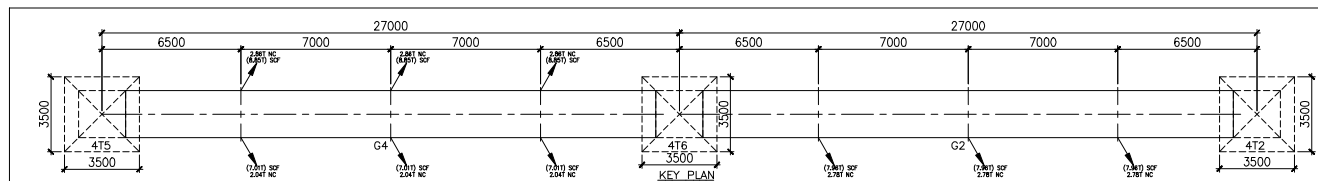
- 1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- 3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- 4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- 5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS
16mm DIA BOLT



SECTION '1-1'



DETAIL: 'A'



KEY PLAN

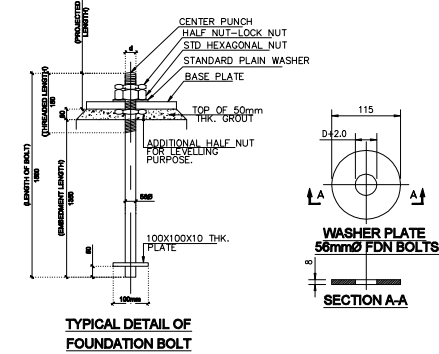
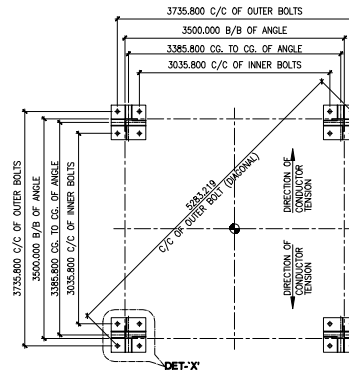
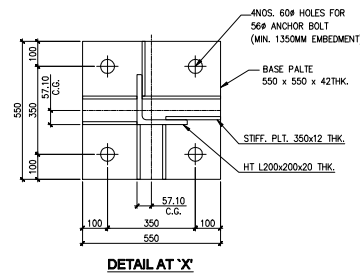
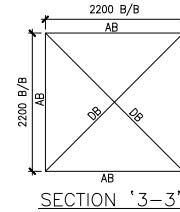
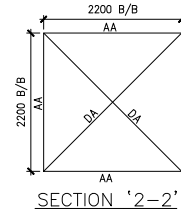
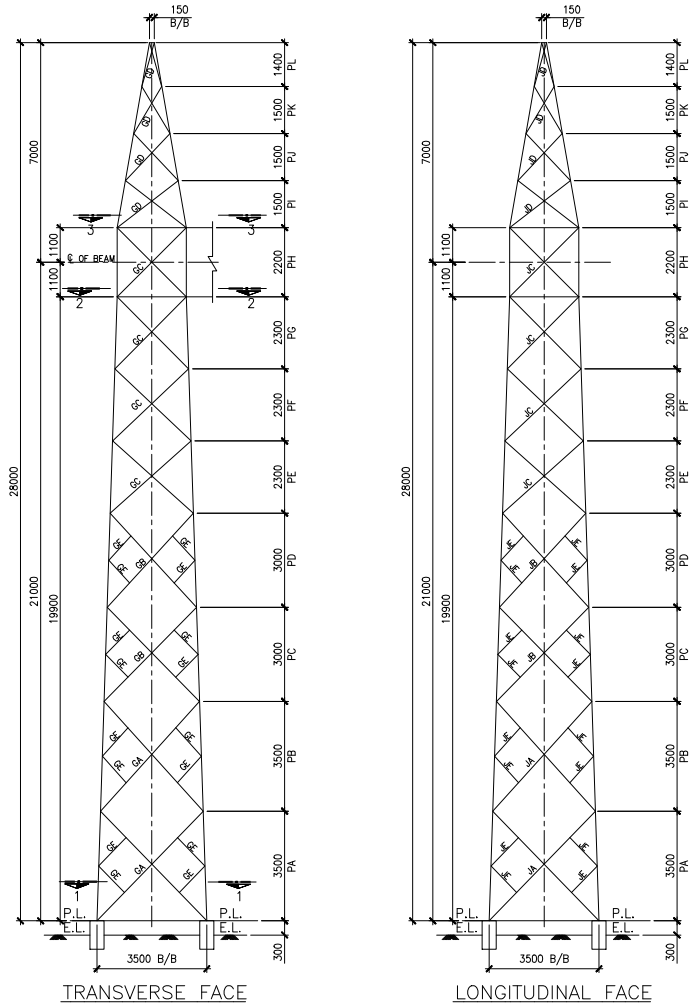
400kV TOWER MKD. G4

EL 0.00 LEVEL CORRESPONDS TO RL 338.000.

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL
4T6	ANGLE SIZE	L200x200x20	L200x200x20	L150x150x20	L150x150x20	L150x150x16	L150x150x16	L150x150x16	L150x150x16	L75x75x5	L75x75x5	L75x75x5	L75x75x5
	NO. OF BOLTS	14	14	10	10	08	08	08	08	04	04	04	04

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	GA,JA	GB,JB	GC,JC	GD,JD	GE,JE	AA,AB	DA,DB
4T6	ANGLE SIZE	L90x90x6	L90x90x6	L100x100x10	L50x50x5	L45x45x5	L130x130x12	L90x90x6
	NO. OF BOLTS	04	04	05	02	01	05	04

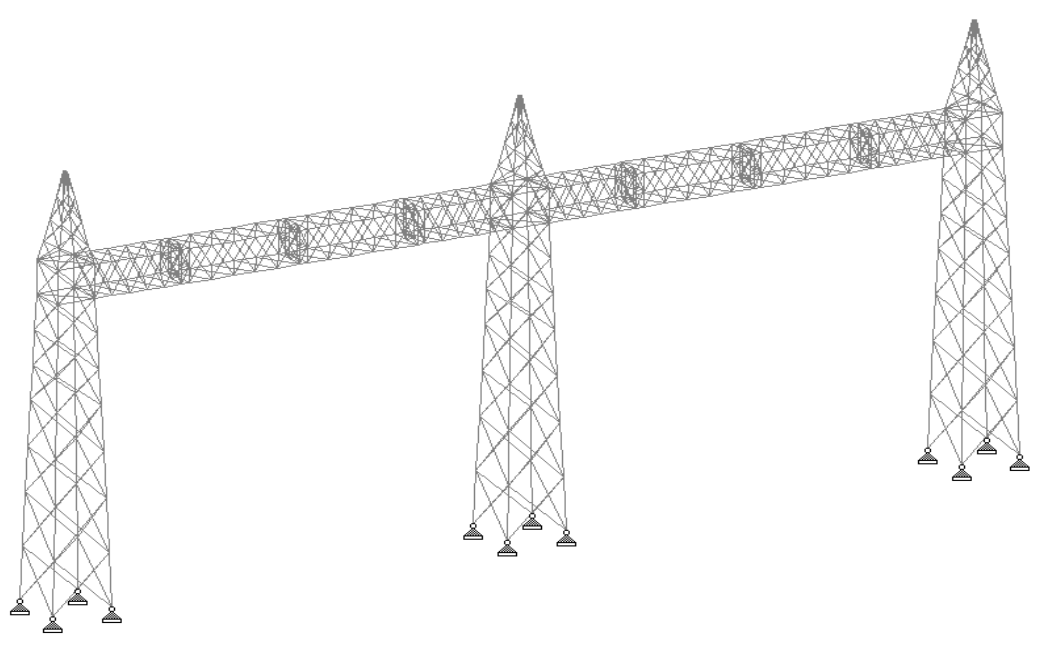
REFERENCE DRAWINGS:-	
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-L-V-0002	STRUCTURAL LAYOUT PLAN & SECTION
CONTRACTOR DRAWING NO: GNB-MEL-CE-003	STRUCTURAL LAYOUT PLAN & SECTION
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-F-V-0001	FOUNDATION BOLTS DRAWING FOR TOWERS
CONTRACTOR DRAWING NO: GNB-MEL-CE-005	FOUNDATION BOLTS DRAWING FOR TOWERS
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-O-V-0014	4T6 - FABRICATION DRAWING
CONTRACTOR DRAWING NO: GNB-MEL-CE-113	4T6 - FABRICATION DRAWING



LEGEND:-	
TOWER MARKED '4T6 TOWER' IS A TOWER WITH PEAK SUPPORTING ONE GIRDER OF SPAN 27.00M. OF GANTRY WITH CONDUCTOR TENSION OF 2.680T UNDER NORMAL CONDITION & 8.848T UNDER SHORT CIRCUIT CONDITION WITH DEVIATION.	
HIGHLIGHT:-	
SPAN OF GIRDER	27.00 M.
HEIGHT OF GIRDER	21.00 M.
HEIGHT OF TOWER	28.00 M.
CONDUCTOR TENSION	2.680T (NC)
CONDUCTOR DEVIATION	8.848T (SC)
	±30 DEGREE
NOTES:-	
1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.	
2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5	
3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.	
4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE	
5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS 16mm DIA BOLT	

400kV TOWER MKD. 4T6

LOAD EVALUATION FOR BEAM-G4

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP			
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)			
* LOAD EVALUATION FOR 400 kV BEAM MKD. "G4"				
				
SUMMARY OF CONDUCTOR AND INSULATOR FORCES				
		CONDUCTOR & INSULATOR FORCES		
		TRANSVERSE LOAD (kg)	VERTICAL LOAD (kg)	LONGITUDINAL LOAD (kg)
(1) NO DEVIATION	WIND PARALLEL TO BEAM (NC)	481.50	0.00	1430.00
	WIND PARALLEL TO BEAM (SC)	481.50	0.00	4424.00
	WIND PERPENDICULAR TO BEAM (NC)	0.00	0.00	1491.40
	WIND PERPENDICULAR TO BEAM (SC)	0.00	0.00	4485.40
	SELF WEIGHT OF INSULATOR & COND. (LEFT)	0.00	254.40	0.00
	SELF WEIGHT OF INSULATOR & COND. (RIGHT)	0	254.40	0
	EARTH WIRE LOAD			

(2) 30' PLAN DEVIATION	WIND PARALLEL TO BEAM (NC)	1847.50	0.00	2477.00
	WIND PARALLEL TO BEAM (SC)	4841.50	0.00	7663.00
	WIND PERPENDICULAR TO BEAM (NC)	1430.00	0.00	2779.40
	WIND PERPENDICULAR TO BEAM (SC)	0.00	0.00	7965.40
	SELF WEIGHT OF INSULATOR	0.00	254.40	0.00
	SELF WEIGHT OF CONDUCTOR	0	254.40	0
	EARTH WIRE LOAD			
(3) 30' ELEVATION DEVIATION	WIND PARALLEL TO BEAM (NC)	378.00	-1430.00	2477.00
	WIND PARALLEL TO BEAM (SC)	378.00	-4425.00	7663.00
	WIND PERPENDICULAR TO BEAM (NC)	0.00	-1430.00	2773.40
	WIND PERPENDICULAR TO BEAM (SC)	0.00	-4425.00	7959.40
	SELF WEIGHT OF INSULATOR	0.00	254.40	0.00
	SELF WEIGHT OF CONDUCTOR	0.00	254.40	0.00
	EARTH WIRE LOAD			
(4) 30' PLAN + 30' ELEV. DEVIATION	WIND PARALLEL TO BEAM (NC)	1617.00	-1430.00	2145.00
	WIND PARALLEL TO BEAM (SC)	4210.00	-4425.00	6636.00
	WIND PERPENDICULAR TO BEAM (NC)	1239.00	-1430.00	2424.90
	WIND PERPENDICULAR TO BEAM (SC)	0.00	-4425.00	6915.90
	SELF WEIGHT OF INSULATOR	0.00	254.40	0.00
	SELF WEIGHT OF CONDUCTOR	0.00	254.40	0.00
	EARTH WIRE LOAD			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)				
* <u>LOAD EVALUATION FOR 400kV BEAM MKD. "G4" (WITHOUT DEVIATION IN PLAN & ELEVATION)</u>					
# <u>GENERAL NOTES & WIND PRESSURE EVALUATION :-</u>					
* LOADS					
a)	All Dead & Live Loads shall be as per	=	I.S.	802	
b)	All Wind Loads shall be as per	=	I.S.	802	
* FACTOR OF SAFETY					
a)	IN NORMAL CONDITION	=	2.0		
b)	IN SHORT-CIRCUIT CONDITION	=	1.50		
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015					
a)	Basic Wind Speed	Vb	=	39	m/s (As Per Technical Specifications)
b)	Reliability level		=	1.00	(As Per Technical Specifications)
c)	Terrain Category		=	1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s (As Per Cl. 8.3 of IS802 (P1/S1)-2015)
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm (As Per Cl. 8.4 of IS802 (P1/S1)-2015)

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
*CONDUCTOR DETAILS a)Description =ACSR MOOSE b)Dia. of conductor =31.770 mm (As per Electrical Input) c)Weight of conductor =2.004 Kg/m (As per Electrical Input) d)Tension per phase =2860 Kg/phase (Normal Condition) =8848 Kg/phase (Short-Circuit Condition) f)No. of Sub conductor per phase =2 (As per Electrical Input) g)No. of tension insulator / phase =2 (As per Electrical Input) h)No. of suspension insulator / phase =1 (As per Electrical Input) i)Length of wire on left side, L1 = =52.50 m (As per T.S. 2.26, Cl 7.9,) /(As Per site conditions) j)Length of wire on right side, L2 = =91.30 m k)Conductor span =101.90 m Left side Span (50%) =(91.30) x0.50 =45.65 m Right side Span (50%) =(52.50) x0.50 =26.25 m Add 30 m for Jumpers/ droppers(ASSUMED) =30.00 m l)Angle of Deviation In plan =0 deg. In Elevation =0 deg. *INSULATOR DETAILS a)Weight of suspension insulator string with hardware =49.90 Kg b)Weight of tension insulator string with hardware =49.90 Kg c)Length of tension insulator =4.975 m d)Length of suspension insulator =4.975 m e)Diameter of tension insulator =135.00 mm d)Diameter of suspension insulator =135.00 mm										

Project :-

CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP

Title :-

DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)

*

GIRDER DETAILS

a) C/C of girder

= 27.00 m

b) Length of parts being on either side being

= 5.400 & 7.000 m

c) Hamper width of tower

= 2.20 m

d) Clear span of girder

= 24.80 m

e) Width of girder

= 2.20 m

f) Depth of girder

= 2.20 m

g) Height of Girder from Plinth Level

= 19.90 m

	Vertical	Longitudial	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	2860.00	0.00
Load Due to Short Circuit Tension Due to Deviations in kg	0.00	8848.00	0.00

#

GEOMETRY FOR GIRDER :-

Part			Section	No. of pieces	Length in m
Main Leg					
Chord Central	MC	L	150x150x16	4	14.000
Chord Left	MA	L	130x130x12	4	5.400
Chord Right	MA	L	130x130x12	4	5.400
Plan					
Horizontal Belt	SV	L	100x100x10	12	2.200
Lattice Left	SA	L	90x90x6	20	2.431
Lattice Central	SB	L	65x65x5	40	2.560
Lattice Right	SA	L	90x90x6	20	2.431
Elevation					
Vertical Belt	SV	L	100x100x10	12	2.200
Lattice Left	UA	L	90x90x6	20	2.431
Lattice Central	UB	L	65x65x5	40	2.560
Lattice Right	UA	L	90x90x6	20	2.431
Connector Vertical	YD	L	100x100x10	6	2.200
Connector Horizontal	YC	L	100x100x10	6	2.200
Diamong Bracing	YH	L	100x100x10	24	1.556

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
# LOAD CALCULATIONS :-										
* VERTICAL LOADS :										
- Weight of Conductor										
a)	Length of conductor	=	45.65	+	26.25	+	30.00			
		=	101.90	m						
b)	Weight of conductor	=	101.90	x	2.004	x	2.00			
		=	408.42	Kgs		Say	=	409.00	Kgs	
- Weight of Insulator										
a)	Weight of tension insulators string with hardware	=	49.90	Kgs per phase						
b)	Weight of suspension Insulator string with hardware	=	49.90	Kgs per phase						
- Weight of line man with tools										
	at middle phase	=	150	Kgs						
- Loads due to Conductor Tension										
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						
* LONGITUDINAL LOADS :										
- Wind Load on Girder										
a)	Net Surface area	Ae	=	16.03	sqm (Refer the break up below)					
b)	Gross Surface Area	Ag	=	54.56	sqm					
c)	Solidity Ratio	Ae/Ag	=	0.2938						
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)					
f)	Wind Load Ws = Pz x Cdt x Gt x Ae	=	3066.72	Kgs		Say	=	3070.00	Kgs	
Part		Section		No. of pieces	Length in m	Solid Area in sqm				
Main Leg										
Chord Central	MC	L	150x150x16	2	14.000	4.20				
Chord Left	MA	L	130x130x12	2	5.400	1.40				
Chord Right	MA	L	130x130x12	2	5.400	1.40				
Elevation										
Vertical Belt	SV	L	100x100x10	6	2.200	1.32				
Lattice Left	UA	L	90x90x6	10	2.431	2.19				
Lattice Central	UB	L	65x65x5	20	2.560	3.33				
Lattice Right	UA	L	90x90x6	10	2.431	2.19				
					Total Area	16.03		sqm		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)				
-	Wind Load on Tension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	0.00 m		
c)	Net area Exposed, Ai = Li.di	=	0.00 sqm		
d)	Ratio of Li / di	=	0.00		
e)	Drag Co-efficient for insulators	Cdi =	0.000	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	0.00 Kgs	Say	= 0.00 Kgs
h)	Wind Load on Tension insulator in Longitudinal Direction	=	0.00 Kg		
-	Wind Load on Suspension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	4.98 m		
c)	Net area Exposed, Ai = Li.di	=	0.67 sqm		
d)	Ratio of Li / di	=	36.85		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	90.69 Kgs	Say	= 91.00 Kgs
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	91.00 Kg		
-	Wind Load on Conductor				
a)	Diameter of conductor, dc	=	31.77 mm		
b)	Length of conductor, Lc	=	0.00 m		
c)	Net area Exposed, Lc.dc	=	0.00 sqm		
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)	
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)	
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	0.00 Kg	Say	= 0.00 Kgs
g)	Wind Load on Conductor in Longitudinal Direction	=	0.00 Kg		
-	Loads due to Conductor Tension				
a)	Normal Condition	=	2860.00 Kgs		
b)	Short Circuit Tension	=	8848.00 Kgs		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)					
*	TRANSVERSE LOADS:					
-	Wind Load on Tension Insulator					
a)	Diameter of insulator, di	=	135.00	mm		
b)	Length of insulator, Li	=	4.98	m		
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm		
d)	Ratio of Li / di		36.85			
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)		
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)		
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	181.38	Kgs	Say =	182.00 Kgs
h)	Wind Load on Tension insulator in Transverse Direction			=	182.00	Kg
-	Wind Load on Suspension Insulator					
a)	Diameter of insulator, di	=	135.00	mm		
b)	Length of insulator, Li	=	4.98	m		
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm		
d)	Ratio of Li / di		36.85			
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)		
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)		
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	90.69	Kgs	Say =	91.00 Kgs
h)	Wind Load on Suspension insulator in Transverse Direction			=	91.00	Kg
-	Wind Load on Conductor					
a)	Diameter of conductor, dc	=	31.77	mm		
b)	Length of conductor, Lc	=	101.90	m		
c)	Net area Exposed, Lc.dc	=	3.24	sqm		
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)		
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)		
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	780.60	Kg	Say =	781.00 Kgs
g)	Wind Load on Conductor in Transverse Direction			=	781.00	Kg
-	Loads due to Conductor Tension					
a)	Normal Condition	=	0.00	Kgs		
b)	Short Circuit Tension	=	0.00	Kgs		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)										
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>											
Dead load	Self Wt.		Self Wt.								
	Cond.		T-Insu.								
TOTAL FY / PHASE	=	409.00	+	99.80	=	508.80	Kgs				
FY / NODE	=	204.50	+	49.90	=	254.40	Kgs				
Dead load	Self Wt.		Self Wt.								
	Cond.		S-Insu.								
TOTAL FY / PHASE	=	0.00	+	49.90	=	49.90	Kgs				
FY / NODE	=	0.00	+	49.90	=	49.90	Kgs				
- JOINT LOAD ON NODE NO. : 4.00											
	Lineman										
	With Tool										
TOTAL FY	=	150.00			=	150.00	Kgs				
FY / NODE	=	37.50			=	37.50	Kgs				
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on		Wind on			Wind on					
	Cond.		T-Insu.			sus.					
TOTAL FX / PHASE	=	781.00	+	182.00	=	963.00	Kgs	91.00	Kgs		
FX / NODE	=	390.50	+	91.00	=	481.50	Kgs	91.00	Kgs		
Cond. Tension			Conductor		Cond. Tension	Conductor		Cond. Tension	Conductor		
			Tension			Tension			Tension		
TOTAL FX / PHASE	=		0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	2860.00 Kgs
FX / NODE	=		0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	1430.00 Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on		Wind on			Wind on					
	Cond.		T-Insu.			S-Insu.					
TOTAL FX / PHASE	=	781.00	+	182.00	=	963.00	Kgs	91.00	Kgs		
FX / NODE	=	390.50	+	91.00	=	481.50	Kgs	91.00	Kgs		
Cond. Tension			Conductor		Cond. Tension	Conductor		Cond. Tension	Tension		
			Tension			Tension					
TOTAL FX / PHASE	=		0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	8848.00 Kgs
FX / NODE	=		0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	4424.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>										
- JOINT LOAD ON NODE NO. : 0.00										
Wind load		Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.				
TOTAL FZ / PHASE		=	0.00	+	0.00	=	0.00 Kgs	91.00 Kgs		
FZ / NODE		=	0.00	+	0.00	=	0.00 Kgs	91.00 Kgs		
Cond. Tension		Cond. Tension		Cond. Tension		Conductor Tension		Cond. Tension		Conductor Tension
TOTAL FX / PHASE		=	0.00	=	0.00 Kgs	TOTAL FY / PHASE		=	0.00 Kgs	TOTAL FZ / PHASE = 2860.00 Kgs
FX / NODE		=	0.00	=	0.00 Kgs	FY / NODE		=	0.00 Kgs	FZ / NODE = 1430.00 Kgs
- WIND LOAD ON JOINT : 0.00										
		Wind load on Str.								
TOTAL FZ		=	3070.00			=	3070.00 Kgs			
FZ / NODE		=	3070.00	/	50	=	61.40 Kgs			
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>										
- JOINT LOAD ON NODE NO. : 0.00										
Wind load		Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.				
TOTAL FZ / PHASE		=	0.00	+	0.00	=	0.00 Kgs	91.00 Kgs		
FZ / NODE		=	0.00	+	0.00	=	0.00 Kgs	91.00 Kgs		
Cond. Tension		Cond. Tension		Cond. Tension		Conductor Tension		Cond. Tension		Conductor Tension
TOTAL FX / PHASE		=	0.00	=	0.00 Kgs	TOTAL FY / PHASE		=	0.00 Kgs	TOTAL FZ / PHASE = 8848.00 Kgs
FX / NODE		=	0.00	=	0.00 Kgs	FY / NODE		=	0.00 Kgs	FZ / NODE = 4424.00 Kgs
- WIND LOAD ON JOINT :										
		Wind load on Str.								
TOTAL FZ		=	3070.00			=	3070.00 Kgs			
FZ / NODE		=	3070.00	/	50	=	61.40 Kgs			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
* LOAD EVALUATION FOR 400KV BEAM MKD. "G4" (WITH DEVIATION IN PLAN)										
# GENERAL NOTES & WIND PRESSURE EVAULATION : -										
* LOADS										
a)	All Dead & Live Loads shall be as per	=	I.S. 802							
b)	All Wind Loads shall be as per	=	I.S. 802							
* FACTOR OF SAFETY										
a)	IN NORMAL / BROKEN WIRE CONDITION	=	2.0							
b)	IN SHORT-CIRCUIT CONDITION	=	1.50							
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015										
a)	Basic Wind Speed	Vb	=	39	m/s	(As Per Technical Specifications)				
b)	Reliabilty level		=	1.00	(As Per Technical Specifications)					
c)	Terrain Category		=	1.00	(As Per Technical Specifications)					
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)					
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s	(As Per Cl. 8.2 of IS802 (P1/S1)-2015)				
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)					
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)					
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s	(As Per Cl. 8.3 of IS802 (P1/S1)-2015)				
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm	(As Per Cl. 8.4 of IS802 (P1/S1)-2015)				
* CONDUCTOR DETAILS										
a)	Description	=	ACSR MOOSE							
b)	Dia. of conductor	=	31.77	mm	(As per Electrical Input)					
c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)					
d)	Tension per phase	=	2860	Kg/phase	(Normal Condition)					
		=	8848	Kg/phase	(Short-Circuit Condition)					
f)	No. of Sub conductor per phase	=	2	(As per Electrical Input)						
g)	No. of tension insulator / phase	=	2	(As per Electrical Input)						
h)	No. of suspension insulator / phase	=	1	(As per Electrical Input)						
i)	Length of wire on left side, L1 =	=	52.5	m	(As per T.S. 2.26, Cl 7.9,)					
j)	Length of wire on right side, L2 =	=	91.30	m	/(As Per site conditions)					
k)	Conductor span	=	101.90	m						
	Left side Span (50%)	= (	91.30	)	x	0.50	=	45.65	m	
	Right side Span (50%)	= (	52.50	)	x	0.50	=	26.25	m	
	Add 30 m for Jumpers/ droppers						=	30.00	m	
l)	Angle of Deviation									
	In plan	=	30	deg.						
	In Elevation	=	0	deg.						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)					
*	INSULATOR DETAILS					
	a)	Weight of suspension insulator string with hardware		=	49.00	Kg
	a)	Weight of tension insulator string with hardware		=	49.90	Kg (As per Electrical Input)
	b)	Length of tension insulator		=	4.98	m (As per Electrical Input)
	d)	Length of suspension insulator		=	4.98	m (Assumed with Hardware)
	c)	Diameter of tension insulator		=	135.00	mm (As per Electrical Input)
	d)	Diameter of suspension insulator		=	135.00	mm (Asssued)
	GIRDER DETAILS					
	a)	C/C of girder		=	27.00	m
	c)	Hamper width of tower		=	2.20	m
d)	Clear span of girder		=	24.80	m	
e)	Width of girder		=	2.20	m	
f)	Depth of girder		=	2.20	m	
g)	Height of Girder from Plinth Level		=	19.90	m	
#			Vertical	Longitudial	Transverse	
	Load Due to Normal Tension Due to Deviations in kg		0.00	2477.00	1430.00	
	Load Due to Short Circuit Tension Due to Deviations in kg		0.00	7663.00	4424.00	
	<u>GEOMETRY FOR GIRDER :-</u>					
	Part		Section	No. of pieces	Length in m	
	Main Leg					
	Chord Central	MC L	150x150x16	4	14.000	
	Chord Left	MA L	130x130x12	4	5.400	
	Chord Right	MA L	130x130x12	4	5.400	
	Plan					
Horizontal Belt	SV L	100x100x10	12	2.200		
Lattice Left	SA L	90x90x6	20	2.431		
Lattice Central	SB L	65x65x5	40	2.560		
Lattice Right	SA L	90x90x6	20	2.431		
Elevation						
Vertical Belt	SV L	100x100x10	12	2.200		
Lattice Left	UA L	90x90x6	20	2.431		
Lattice Central	UC L	65x65x5	40	2.560		
Lattice Right	UA L	90x90x6	20	2.431		
Connector Vertical	YD L	100x100x10	6	2.200		
Connector Horizontal	YC L	100x100x10	6	2.200		
Diamong Bracing	YH L	100x100x10	24	1.556		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
# LOAD CALCULATIONS :-										
* VERTICAL LOADS :										
- Weight of Conductor										
a)	Length of conductor	=	45.65	+	26.25	+	30.00			
		=	101.90	m						
b)	Weight of conductor	=	101.90	x	2.004	x	2.00			
		=	408.42	Kgs		Say	=	409.00	Kgs	
- Weight of Insulator										
a)	Weight of tension insulators string with hardware	=	49.90	Kgs per phase						
- Weight of line man with tools										
	at middle phase	=	150	Kgs						
- Loads due to Conductor Tension										
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						
* LONGITUDINAL LOADS :										
- Wind Load on Girder										
a)	Net Surface area	Ae	=	16.03	sqm (Refer the break up below)					
b)	Gross Surface Area	Ag	=	54.56	sqm					
c)	Solidity Ratio	Ae/Ag	=	0.2938						
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)					
f)	Wind Load Ws = Pz x Cdt x Gt x Ae	=	3066.72	Kgs		Say	=	3070.00	Kgs	
Part		Section		No. of pieces	Length in m	Solid Area in sqm				
Main Leg										
Chord Central	MC	L	150x150x16	2	14.000	4.20				
Chord Left	MA	L	130x130x12	2	5.400	1.40				
Chord Right	MA	L	130x130x12	2	5.400	1.40				
Elevation										
Vertical Belt	SV	L	100x100x10	6	2.200	1.32				
Lattice Left	UA	L	90x90x6	10	2.431	2.19				
Lattice Central	UC	L	65x65x5	20	2.560	3.33				
Lattice Right	UA	L	90x90x6	10	2.431	2.19				
Total Area						16.03	sqm			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)				
-	Wind Load on Tension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	2.49 m		
c)	Net area Exposed, Ai = Li.di	=	0.34 sqm		
d)	Ratio of Li / di		18.43		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	90.69 Kgs	Say	= 91.00 Kgs
h)	Wind Load on Tension insulator in Longitudinal Direction	=	91.00 Kg		
-	Wind Load on Suspension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	2.49 m		
c)	Net area Exposed, Ai = Li.di	=	0.34 sqm		
d)	Ratio of Li / di		18.43		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	45.34 Kgs	Say	= 46.00 Kgs
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	46.00 Kg		
-	Wind Load on Conductor				
a)	Diameter of conductor, dc	=	31.77 mm		
b)	Length of conductor, Lc	=	50.95 m		
c)	Net area Exposed, Lc.dc	=	1.62 sqm		
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)	
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)	
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	390.30 Kg	Say	= 391.00 Kgs
g)	Wind Load on Conductor in Longitudinal Direction	=	391.00 Kg		
-	Loads due to Conductor Tension				
a)	Normal Condition	=	2477.00 Kgs		
b)	Short Circuit Tension	=	7663.00 Kgs		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)				
* TRANSVERSE LOADS:					
- Wind Load on Tension Insulator					
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	4.31 m		
c)	Net area Exposed, Ai = of Li.di	=	0.58 sqm		
d)	Ratio of Li / di		31.91		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	157.08 Kgs	Say	= 158.00 Kgs
h)	Wind Load on Tension insulator in Transverse Direction		= 158.00 Kg		
- Wind Load on Suspension Insulator					
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	4.31 m		
c)	Net area Exposed, Ai = Li.di	=	0.58 sqm		
d)	Ratio of Li / di		31.91		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	78.54 Kgs	Say	= 79.00 Kgs
h)	Wind Load on Suspension insulator in Transverse Direction		= 79.00 Kg		
- Wind Load on Conductor					
a)	Diameter of conductor, dc	=	31.77 mm		
b)	Length of conductor, Lc	=	88.25 m		
c)	Net area Exposed, Lc.dc	=	2.80 sqm		
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)	
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)	
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	676.02 Kg	Say	= 677.00 Kgs
g)	Wind Load on Conductor in Transverse Direction		= 677.00 Kg		
- Loads due to Conductor Tension					
a)	Normal Condition	=	1430.00 Kgs		
b)	Short Circuit Tension	=	4424.00 Kgs		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>										
Dead load			Self Wt.		Self Wt.					
			Cond.		T-Insu.					
TOTAL FY / PHASE	=	409.00	+	99.80	=	508.80	Kgs			
FY / NODE	=	204.50	+	49.90	=	254.40	Kgs			
Dead load			Self Wt.		Self Wt.					
			Cond.		T-Insu.					
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs			
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs			
- JOINT LOAD ON NODE NO. : 4.00										
			Lineman							
			With Tool							
TOTAL FY	=	150.00			=	150.00	Kgs			
FY / NODE	=	37.50			=	37.50	Kgs			
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>										
- JOINT LOAD ON NODE NO. : 0.00										
Wind load			Wind on		Wind on		Wind on			
			Cond.		T-Insu.		T-Insu.			
TOTAL FX / PHASE	=	677.00	+	158.00	=	835.00	Kgs		79.00	
FX / NODE	=	338.50	+	79.00	=	417.50	Kgs		79.00	
Cond. Tension				Conductor	Cond. Tension		Conductor	Cond. Tension	Conductor	
				Tension			Tension		Tension	
TOTAL FX / PHASE		=		1430.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE = 2477.00 Kgs
FX / NODE		=		1430.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE = 2477.00 Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>										
- JOINT LOAD ON NODE NO. : 0.00										
Wind load			Wind on		Wind on		Wind on			
			Cond.		T-Insu.		S-Insu.			
TOTAL FX / PHASE	=	677.00	+	158.00	=	835.00	Kgs		79.00	
FX / NODE	=	338.50	+	79.00	=	417.50	Kgs		79.00	
Cond. Tension				Cond. Tension		Conductor	Cond. Tension		Tension	
						Tension				
TOTAL FX / PHASE		=		4424.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE = 7663.00 Kgs
FX / NODE		=		4424.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE = 7663.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)										
* LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)											
- JOINT LOAD ON NODE NO.		:	0.00								
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.						
TOTAL FZ / PHASE	=	391.00	+	91.00	=	482.00 Kgs		46.00			
FZ / NODE	=	195.50	+	45.50	=	241.00 Kgs		46.00			
Cond. Tension	Cond. Tension		Cond. Tension		Conductor Tension		Cond. Tension	Conductor Tension			
TOTAL FX / PHASE	=	1430.00	=	1430.00 Kgs	TOTAL FY / PHASE	=	0.00 Kgs	TOTAL FZ / PHASE	=	2477.00 Kgs	
FX / NODE	=	1430.00	=	1430.00 Kgs	FY / NODE	=	0.00 Kgs	FZ / NODE	=	2477.00 Kgs	
- WIND LOAD ON JOINT		:	0.00								
	Wind load on Str.										
TOTAL FZ	=	3070.00			=	3070.00 Kgs					
FZ / NODE	=	3070.00	/	50	=	61.40 Kgs					
* LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)											
- JOINT LOAD ON NODE NO.		:	0.00								
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on T-Insu.						
TOTAL FZ / PHASE	=	391.00	+	91.00	=	482.00 Kgs		46.00			
FZ / NODE	=	195.50	+	45.50	=	241.00 Kgs		46.00			
Cond. Tension	Cond. Tension		Cond. Tension		Conductor Tension		Cond. Tension	Conductor Tension			
TOTAL FX / PHASE	=	4424.00 Kgs			TOTAL FY / PHASE	=	0.00 Kgs	TOTAL FZ / PHASE	=	7663.00 Kgs	
FX / NODE	=	4424.00 Kgs			FY / NODE	=	0.00 Kgs	FZ / NODE	=	7663.00 Kgs	
- WIND LOAD ON JOINT		:									
	Wind load on Str.										
TOTAL FZ	=	3070.00			=	3070.00 Kgs					
FZ / NODE	=	3070.00	/	50	=	61.40 Kgs					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
* LOAD EVALUATION FOR 400kV BEAM MKD. "G4" (WITH DEVIATION IN ELEVATION)										
# GENERAL NOTES & WIND PRESSURE EVALUATION :-										
* LOADS										
a)	All Dead & Live Loads shall be as per	=	I.S. 802							
b)	All Wind Loads shall be as per	=	I.S. 802							
* FACTOR OF SAFETY										
a)	IN NORMAL / BROKEN WIRE CONDITION	=	2.0							
b)	IN SHORT-CIRCUIT CONDITION	=	1.50							
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015										
a)	Basic Wind Speed	Vb	=	39	m/s	(As Per Technical Specifications)				
b)	Reliabilty level		=	1.00		(As Per Technical Specifications)				
c)	Terrain Category		=	1.00		(As Per Technical Specifications)				
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375		(As Per IS802 (P1/S1)-2015)				
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s	(As Per Cl. 8.2 of IS802 (P1/S1)-2015)				
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00		(As Per Table-2 of IS802 (P1/S1)-2015)				
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08		(As Per Table-3 of IS802 (P1/S1)-2015)				
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s	(As Per Cl. 8.3 of IS802 (P1/S1)-2015)				
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm	(As Per Cl. 8.4 of IS802 (P1/S1)-2015)				
* CONDUCTOR DETAILS										
a)	Description	=	ACSR MOOSE							
b)	Dia. of conductor	=	31.77	mm	(As per Electrical Input)					
c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)					
d)	Tension per phase	=	2860	Kg/phase	(Normal Condition)					
		=	8848	Kg/phase	(Short-Circuit Condition)					
f)	No. of Sub conductor per phase	=	2		(As per Electrical Input)					
g)	No. of tension insulator / phase	=	2		(As per Electrical Input)					
h)	No. of suspension insulator / phase	=	1		(As per Electrical Input)					
i)	Length of wire on left side, L1 =	=	52.50	m	(As per T.S. 2.26, Cl 7.9,)	/(As Per site conditions)				
j)	Length of wire on right side, L2 =	=	91.30	m						
k)	Conductor span	=	101.90	m						
	Left side Span (50%)	= (	91.30	)	x	0.50	=	45.65	m	
	Right side Span (50%)	= (	52.50	)	x	0.50	=	26.25	m	
	Add 10 m for Jumpers/ droppers						=	30.00	m	
l)	Angle of Deviation									
	In plan	=	0	deg.						
	In Elevation	=	30	deg.						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)				
* INSULATOR DETAILS					
a)	Weight of suspension insulator string with hardware	=	49.00	Kg	
a)	Weight of tension insulator string with hardware	=	49.90	Kg	(As per Electrical Input)
b)	Length of tension insulator	=	4.98	m	(As per Electrical Input)
d)	Length of suspension insulator	=	4.98	m	(Assumed with Hardware)
c)	Diameter of tension insulator	=	135.00	mm	(As per Electrical Input)
d)	Diameter of suspension insulator	=	135.00	mm	(Assumed)
* GIRDER DETAILS					
a)	C/C of girder	=	27.00	m	
c)	Hamper width of tower	=	2.20	m	
d)	Clear span of girder	=	24.80	m	
e)	Width of girder	=	2.20	m	
f)	Depth of girder	=	2.20	m	
g)	Height of Girder from Plinth Level	=	19.90	m	
		Vertical	Longitudial	Transverse	
Load Due to Normal Tension Due to Deviations in kg		-1430.00	2477.00	0.00	
Load Due to Short Circuit Tension Due to Deviations in kg		-4425.00	7663.00	0.00	
# GEOMETRY FOR GIRDER :-					
Part		Section		No. of pieces	Length in m
Main Leg					
Chord Central	MC	L	150x150x16	4	14.000
Chord Left	MA	L	130x130x12	4	5.400
Chord Right	MA	L	130x130x12	4	5.400
Plan					
Horizontal Belt	SV	L	100x100x10	12	2.200
Lattice Left	SA	L	90x90x6	20	2.431
Lattice Central	SB	L	65x65x5	40	2.560
Lattice Right	SA	L	90x90x6	20	2.431
Elevation					
Vertical Belt	SV	L	100x100x10	12	2.200
Lattice Left	UA	L	90x90x6	20	2.431
Lattice Central	UC	L	65x65x5	40	2.560
Lattice Right	UA	L	90x90x6	20	2.431
Connector Vertical	YD	L	100x100x10	6	2.200
Connector Horizontal	YC	L	100x100x10	6	2.200
Diamong Bracing	YH	L	100x100x10	24	1.556

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
# LOAD CALCULATIONS :-										
* VERTICAL LOADS :										
- Weight of Conductor										
a)	Length of conductor	=	45.65	+	26.25	+	30.00			
		=	101.90	m						
b)	Weight of conductor	=	101.90	x	2.004	x	2.00			
		=	408.42	Kgs		Say	=	409.00	Kgs	
- Weight of Insulator										
a)	Weight of tension insulators string with hardware	=	49.90	Kgs per phase						
- Weight of line man with tools										
	at middle phase	=	150	Kgs						
- Loads due to Conductor Tension										
a)	Normal Condition	=	-1430.00	Kgs						
b)	Short Circuit Tension	=	-4425.00	Kgs						
* LONGITUDINAL LOADS :										
- Wind Load on Girder										
a)	Net Surface area	Ae	=	16.03	sqm (Refer the break up below)					
b)	Gross Surface Area	Ag	=	54.56	sqm					
c)	Solidity Ratio	Ae/Ag	=	0.2938						
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)					
f)	Wind Load Ws = Pz x Cdt x Gt x Ae	=	3066.72	Kgs		Say	=	3070.00	Kgs	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.29	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	78.54	Kgs	Say	=	79.00	Kgs		
h)	Wind Load on Tension insulator in Longitudinal Direction	=	79.00	Kg						
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.29	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	39.27	Kgs	Say	=	40.00	Kgs		
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	40.00	Kg						
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	50.95	m						
c)	Net area Exposed, Lc.dc	=	1.62	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	390.30	Kg	Say	=	391.00	Kgs		
g)	Wind Load on Conductor in Longitudinal Direction	=	391.00	Kg						
-	Loads due to Conductor Tension									
a)	Normal Condition	=	2477.00	Kgs						
b)	Short Circuit Tension	=	7663.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
*	TRANSVERSE LOADS:									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.29	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	78.54	Kgs		Say	=	79.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction			=	79.00	Kg				
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.29	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	39.27	Kgs		Say	=	40.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction			=	40.00	Kg				
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	88.25	m						
c)	Net area Exposed, Lc.dc	=	2.80	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	676.02	Kg		Say	=	677.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction			=	677.00	Kg				
-	Loads due to Conductor Tension									
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP												
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)												
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>													
Dead load		Self Wt.		Self Wt.									
		Cond.		T-Insu.									
TOTAL FY / PHASE	=	409.00	+	99.80	=	508.80	Kgs						
FY / NODE	=	204.50	+	49.90	=	254.40	Kgs						
Dead load		Self Wt.		Self Wt.									
		Cond.		T-Insu.									
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs						
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs						
- JOINT LOAD ON NODE NO. : 0.00													
		Lineman											
		With Tool											
TOTAL FY	=	150.00			=	150.00	Kgs						
FY / NODE	=	37.50			=	37.50	Kgs						
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>													
- JOINT LOAD ON NODE NO. : 0.00													
Wind load		Wind on		Wind on									
		Cond.		T-Insu.									
TOTAL FX / PHASE	=	677.00	+	79.00	=	756.00	Kgs						
FX / NODE	=	338.50	+	39.50	=	378.00	Kgs						
Cond. Tension				Conductor	Cond. Tension								
				Tension		Conductor		Cond. Tension		Conductor			
						Tension				Tension			
TOTAL FX / PHASE			=	0.00	Kgs	TOTAL FY / PHASE	=	-1430.00	Kgs	TOTAL FZ / PHASE	=	2477.00	Kgs
FX / NODE			=	0.00	Kgs	FY / NODE	=	-1430.00	Kgs	FZ / NODE	=	2477.00	Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>													
- JOINT LOAD ON NODE NO. : 0.00													
Wind load		Wind on		Wind on									
		Cond.		T-Insu.									
TOTAL FX / PHASE	=	677.00	+	79.00	=	756.00	Kgs						
FX / NODE	=	338.50	+	39.50	=	378.00	Kgs						
Cond. Tension				Conductor	Cond. Tension								
				Tension		Conductor		Cond. Tension		Tension			
						Tension							
TOTAL FX / PHASE			=	0.00	Kgs	TOTAL FY / PHASE	=	-4425.00	Kgs	TOTAL FZ / PHASE	=	7663.00	Kgs
FX / NODE			=	0.00	Kgs	FY / NODE	=	-4425.00	Kgs	FZ / NODE	=	7663.00	Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>										
- JOINT LOAD ON NODE NO. : 0.00										
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.					
TOTAL FZ / PHASE	=	391.00	+	79.00	=	470.00	Kgs	40.00		
FZ / NODE	=	195.50	+	39.50	=	235.00	Kgs	40.00		
Cond. Tension	Cond. Tension			Cond. Tension	Conductor Tension			Cond. Tension	Conductor Tension	
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	-1430.00	Kgs	TOTAL FZ / PHASE = 2477.00 Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	-1430.00	Kgs	FZ / NODE = 2477.00 Kgs
- WIND LOAD ON JOINT : 0.00										
	Wind load on Str.									
TOTAL FZ	=	3070.00			=	3070.00	Kgs			
FZ / NODE	=	3070.00	/	50	=	61.40	Kgs			
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>										
- JOINT LOAD ON NODE NO. : 0.00										
Wind load	Wind on Cond.		Wind on T-Insu.		Wind on S-Insu.					
TOTAL FZ / PHASE	=	391.00	+	79.00	=	470.00	Kgs	40.00		
FZ / NODE	=	195.50	+	39.50	=	235.00	Kgs	20.00		
Cond. Tension	Cond. Tension			Cond. Tension	Conductor Tension			Cond. Tension	Conductor Tension	
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	-4425.00	Kgs	TOTAL FZ / PHASE = 7663.00 Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	-4425.00	Kgs	FZ / NODE = 7663.00 Kgs
- WIND LOAD ON JOINT :										
	Wind load on Str.									
TOTAL FZ	=	3070.00			=	3070.00	Kgs			
FZ / NODE	=	3070.00	/	50	=	61.40	Kgs			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
* LOAD EVALUATION FOR 400kV BEAM MKD. "G4" (WITH DEVIATION IN PLAN & ELEVATION)										
# GENERAL NOTES & WIND PRESSURE EVAULATION : -										
* LOADS										
a)	All Dead & Live Loads shall be as per	=	I.S.	802						
b)	All Wind Loads shall be as per	=	I.S.	802						
* FACTOR OF SAFETY										
a)	IN NORMAL / BROKEN WIRE CONDITION	=	2.0							
b)	IN SHORT-CIRCUIT CONDITION	=	1.50							
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015										
a)	Basic Wind Speed	Vb	=	39	m/s	(As Per Technical Specifications)				
b)	Reliabilty level		=	1.00	(As Per Technical Specifications)					
c)	Terrain Category		=	1.00	(As Per Technical Specifications)					
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)					
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s	(As Per Cl. 8.2 of IS802 (P1/S1)-2015)				
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)					
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)					
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s	(As Per Cl. 8.3 of IS802 (P1/S1)-2015)				
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm (As Per Cl. 8.4 of IS802 (P1/S1)-2015)					
* CONDUCTOR DETAILS										
a)	Description	=	ACSR MOOSE							
b)	Dia. of conductor	=	31.77	mm	(As per Electrical Input)					
c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)					
d)	Tension per phase	=	2860	Kg/phase (Normal Condition)						
		=	8848	Kg/phase (Short-Circuit Condition)						
f)	No. of Sub conductor per phase	=	2	(As per Electrical Input)						
g)	No. of tension insulator / phase	=	2	(As per Electrical Input)						
h)	No. of suspension insulator / phase	=	1	(As per Electrical Input)						
i)	Length of wire on left side, L1 =	=	52.50	m	(As per T.S. 2.26, Cl 7.9,) /(As Per site conditions)					
j)	Length of wire on right side, L2 =	=	91.30	m						
k)	Conductor span	=	101.90	m						
	Left side Span (50%)	= (	91.30	)	x	0.50	=	45.65	m	
	Right side Span (50%)	= (	52.50	)	x	0.50	=	26.25	m	
	Add 10 m for Jumpers/ droppers						=	30.00	m	
l)	Angle of Deviation									
	In plan	=	30	deg.						
	In Elevation	=	30	deg.						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)

- * **INSULATOR DETAILS**
- a) Weight of tension insulator string with hardware = **49.90** Kg (As per Electrical Input)
- b) Length of tension insulator = **4.98** m (As per Electrical Input)
- c) Diameter of tension insulator = **135.00** mm (As per Electrical Input)

- * **GIRDER DETAILS**
- a) C/C of girder = **27.00** m
- c) Hamper width of tower = **2.20** m
- d) Clear span of girder = **24.80** m
- e) Width of girder = **2.20** m
- f) Depth of girder = **2.20** m
- g) Height of Girder from Plinth Level = **19.90** m

	Vertical	Longitudial	Transverse
Load Due to Normal Tension Due to Deviations in kg	-1430.00	2145.00	1239.00
Load Due to Short Circuit Tension Due to Deviations in kg	-4425.00	6636.00	3832.00

GEOMETRY FOR GIRDER :-

Part	Section	No. of pieces	Length in m
Main Leg			
Chord Central MC L	150x150x16	4	14.000
Chord Left MA L	130x130x12	4	5.400
Chord Right MA L	130x130x12	4	5.400
Plan			
Horizontal Belt SV L	100x100x10	12	2.200
Lattice Left SA L	90x90x6	20	2.431
Lattice Central SB L	65x65x5	40	2.560
Lattice Right SA L	90x90x6	20	2.431
Elevation			
Vertical Belt SV L	100x100x10	12	2.200
Lattice Left UA L	90x90x6	20	2.431
Lattice Central UB L	65x65x5	40	2.560
Lattice Right UA L	90x90x6	20	2.431
Connector Vertical YD L	100x100x10	6	2.200
Connector Horizontal YC L	100x100x10	6	2.200
Diamong Bracing YH L	100x100x10	24	1.556

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
# LOAD CALCULATIONS :-										
* VERTICAL LOADS :										
- Weight of Conductor										
a)	Length of conductor	=	45.65	+	26.25	+	30.00			
		=	101.90	m						
b)	Weight of conductor	=	101.90	x	2.004	x	2.00			
		=	408.42	Kgs		Say	=	409.00	Kgs	
- Weight of Insulator										
a)	Weight of tension insulators string with hardware	=	49.90	Kgs per phase						
- Weight of line man with tools										
	at middle phase	=	150	Kgs						
- Loads due to Conductor Tension										
a)	Normal Condition	=	-1430.00	Kgs						
b)	Short Circuit Tension	=	-4425.00	Kgs						
* LONGITUDINAL LOADS :										
- Wind Load on Girder										
a)	Net Surface area	Ae	=	16.03	sqm (Refer the break up below)					
b)	Gross Surface Area	Ag	=	54.56	sqm					
c)	Solidity Ratio	Ae/Ag	=	0.2938						
d)	Drag Co-efficient for Towers	Cdt	=	1.700	(As Per Table-5 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gt	=	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)					
f)	Wind Load Ws = Pz x Cdt x Gt x Ae	=	3066.72	Kgs		Say	=	3070.00	Kgs	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	2.49	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.17	sqm						
d)	Ratio of Li / di		18.43							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	45.34	Kgs		Say	=	46.00	Kgs	
h)	Wind Load on Tension insulator in Longitudinal Direction	=	46.00	Kg						
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	2.49	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.17	sqm						
d)	Ratio of Li / di		18.43							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	22.67	Kgs		Say	=	23.00	Kgs	
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	23.00	Kg						
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	50.95	m						
c)	Net area Exposed, Lc.dc	=	1.62	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	390.30	Kg		Say	=	391.00	Kgs	
g)	Wind Load on Conductor in Longitudinal Direction	=	391.00	Kg						
-	Loads due to Conductor Tension									
a)	Normal Condition	=	2145.00	Kgs						
b)	Short Circuit Tension	=	6636.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)									
*	TRANSVERSE LOADS:									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.29	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	78.54	Kgs		Say	=	79.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction				=	79.00		Kg		
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.29	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Ai x Cdi x Gi	=	39.27	Kgs		Say	=	40.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction				=	40.00		Kg		
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	88.25	m						
c)	Net area Exposed, Lc.dc	=	2.80	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	676.02	Kg		Say	=	677.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction				=	677.00		Kg		
-	Loads due to Conductor Tension									
a)	Normal Condition	=	1239.00	Kgs						
b)	Short Circuit Tension	=	3832.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP													
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)													
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>														
Dead load		Self Wt.		Self Wt.										
		Cond.		T-Insu.										
TOTAL FY / PHASE	=	409.00	+	99.80	=	508.80	Kgs							
FY / NODE	=	204.50	+	49.90	=	254.40	Kgs							
Dead load		Self Wt.		Self Wt.										
		Cond.		T-Insu.										
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs							
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs							
- JOINT LOAD ON NODE NO. : 0.00														
		Lineman												
		With Tool												
TOTAL FY	=	150.00			=	150.00	Kgs							
FY / NODE	=	37.50			=	37.50	Kgs							
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>														
- JOINT LOAD ON NODE NO. : 0.00														
Wind load		Wind on		Wind on				Wind on						
		Cond.		T-Insu.				S-Insu.						
TOTAL FX / PHASE	=	677.00	+	79.00	=	756.00	Kgs	40.00						
FX / NODE	=	338.50	+	39.50	=	378.00	Kgs	40.00						
Cond. Tension			Conductor		Cond. Tension		Conductor	Cond. Tension			Conductor			
			Tension				Tension				Tension			
TOTAL FX / PHASE		=	1239.00	Kgs	TOTAL FY / PHASE		=	-1430.00	Kgs	TOTAL FZ / PHASE		=	2145.00	Kgs
FX / NODE		=	1239.00	Kgs	FY / NODE		=	-1430.00	Kgs	FZ / NODE		=	2145.00	Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>														
- JOINT LOAD ON NODE NO. : 0.00														
Wind load		Wind on		Wind on				Wind on						
		Cond.		T-Insu.				T-Insu.						
TOTAL FX / PHASE	=	677.00	+	79.00	=	756.00	Kgs	40.00						
FX / NODE	=	338.50	+	39.50	=	378.00	Kgs	40.00						
Cond. Tension			Cond. Tension		Cond. Tension		Conductor	Cond. Tension			Tension			
							Tension							
TOTAL FX / PHASE		=	3832.00	Kgs	TOTAL FY / PHASE		=	-4425.00	Kgs	TOTAL FZ / PHASE		=	6636.00	Kgs
FX / NODE		=	3832.00	Kgs	FY / NODE		=	-4425.00	Kgs	FZ / NODE		=	6636.00	Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)										
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.			Wind on S-Insu.					
TOTAL FZ / PHASE	=	391.00	+	46.00	=	437.00 Kgs		23.00			
FZ / NODE	=	195.50	+	23.00	=	218.50 Kgs		23.00			
Cond. Tension	Cond. Tension			Cond. Tension	Conductor Tension	Cond. Tension		Conductor Tension			
TOTAL FX / PHASE	=	1239.00	=	1239.00 Kgs	TOTAL FY / PHASE	=	-1430.00 Kgs	TOTAL FZ / PHASE	=	2145.00 Kgs	
FX / NODE	=	619.50	=	1239.00 Kgs	FY / NODE	=	-1430.00 Kgs	FZ / NODE	=	2145.00 Kgs	
- WIND LOAD ON JOINT : 0.00											
	Wind load on Str.										
TOTAL FZ	=	3070.00			=	3070.00 Kgs					
FZ / NODE	=	3070.00	/	50	=	61.40 Kgs					
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.			Wind on S-Insu.					
TOTAL FZ / PHASE	=	391.00	+	46.00	=	437.00 Kgs		23.00			
FZ / NODE	=	195.50	+	23.00	=	218.50 Kgs		23.00			
Cond. Tension	Cond. Tension			Cond. Tension	Conductor Tension	Cond. Tension		Conductor Tension			
TOTAL FX / PHASE	=	3832.00 Kgs			TOTAL FY / PHASE	=	-4425.00 Kgs	TOTAL FZ / PHASE	=	6636.00 Kgs	
FX / NODE	=	3832.00 Kgs			FY / NODE	=	-4425.00 Kgs	FZ / NODE	=	6636.00 Kgs	
- WIND LOAD ON JOINT :											
	Wind load on Str.										
TOTAL FZ	=	3070.00			=	3070.00 Kgs					
FZ / NODE	=	3070.00	/	50	=	61.40 Kgs					

LOAD EVALUATION FOR TOWER-4T6

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)		
* <u>GEOMETRY FOR MAINBUS MKD."4T6"</u>			
TRANSVERSE FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES
LONGITUDINAL FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES

SR. NO.	LEVEL m	SEGMENT m	T. WIDTH m	L. WIDTH m	WIDTH' T m	WIDTH' L m	ANGLE T - FACE	ANGLE L - FACE
PL	28.0000	0.0000	0.1500	0.1500	0.15	0.15	0.000	0.000
PK	26.6000	1.4000	0.6364	0.6364	0.39	0.39	74.311	74.311
PJ	25.1000	1.5000	1.1576	1.1576	0.90	0.90	59.120	59.120
PI	23.6000	1.5000	1.6788	1.6788	1.42	1.42	46.605	46.605
PH	22.1000	1.5000	2.2000	2.2000	1.94	1.94	37.720	37.720
PG	19.9000	2.2000	2.2000	2.2000	2.20	2.20	45.000	45.000
PF	17.6000	2.3000	2.3503	2.3503	2.28	2.28	45.312	45.312
PE	15.3000	2.3000	2.5005	2.5005	2.43	2.43	43.480	43.480
PD	13.0000	2.3000	2.6508	2.6508	2.58	2.58	41.764	41.764
PC	10.0000	3.0000	2.8467	2.8467	2.75	2.75	47.503	47.503
PB	7.0000	3.0000	3.0427	3.0427	2.94	2.94	45.533	45.533
PA	3.5000	3.5000	3.2714	3.2714	3.16	3.16	47.949	47.949
	0.0000	3.5000	3.5000	3.5000	3.39	3.39	45.951	45.951

WIDTH' = PLAN WIDTH AT THE GIVEN LEVEL - SEGMENT HEIGHT x TAN θ

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

*** SOLIDITY RATIO FOR LONGITUDINAL FACE FOR TOWER MKD."4T6"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	150x150x16	2.200	100x100x10	3.111	-	0.000	130x130x12	2.200	1.647	4.840	0.340	1.700
PG	150x150x16	2.300	100x100x10	3.235	-	0.000	130x130x12	2.200	1.704	5.233	0.326	1.700
PF	150x150x16	2.300	100x100x10	3.343	-	0.000	-	0.000	1.426	5.578	0.256	1.744
PE	150x150x16	2.300	100x100x10	3.453	-	0.000	-	0.000	1.450	5.924	0.245	1.755
PD	150x150x20	3.000	90x90x6	4.069	45x45x5	3.534	-	0.000	2.048	8.246	0.248	1.752
PC	150x150x20	3.000	90x90x6	4.204	45x45x5	3.602	-	0.000	2.080	8.834	0.235	1.765
PB	200x200x20	3.500	90x90x6	4.713	45x45x5	4.107	-	0.000	2.749	11.050	0.249	1.751
PA	200x200x20	3.500	90x90x6	4.870	45x45x5	4.185	-	0.000	2.786	11.850	0.235	1.765

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.20 \times 3.5 \times 2 + 0.09 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.786
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.785 / 11.849$	=	0.235
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	$= \text{Main leg} \times \text{length} \times 2 + \text{Bracing} \times \text{Length} \times 2 + \text{Secondary Bracing} \times \text{Length} \times 2 + \text{Horizontal} \times \text{Length}$		
	$= (0.15 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.427
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.426 / 5.578$	=	0.256

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

*** WIND LOAD ON LONGITUDINAL FACE FOR TOWER MKD."4T6"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliabilty level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd^2
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T6" - TABLE 1								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.36	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.36	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.36	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.36	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.36	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.36	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.36	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.36	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.36	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.36	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.36	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.36	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T6" - TABLE 2								
A Segment No. from Top	B Segment Top Levels (metres)	C Design Speed Vz (metres/sec)	D Design Pressure Pz (kg/metre2)	E Gross Area of Parts Ag (metres ²)	F Solidity Ratio (Actual)	G Force co-efficient Cdt	H Gust Coefficient Gt	I Wind Load Pz x Cdt x Gt x Ae (kg)
PL	28.0000	30.6327	57.4098	0.5505	0.6779	1.6000	1.9600	67.1878
PK	26.6000	30.6327	57.4098	1.3456	0.3120	1.7000	1.9600	80.2967
PJ	25.1000	30.6327	57.4098	2.1273	0.2129	1.7871	1.9600	91.0921
PI	23.6000	30.6327	57.4098	2.9091	0.1697	1.8303	1.9600	101.6756
PH	22.1000	30.6327	57.4098	4.8400	0.3402	1.7000	1.9600	314.9902
PG	19.9000	30.6327	57.4098	5.2328	0.3257	1.7000	1.9600	325.9922
PF	17.6000	30.6327	57.4098	5.5784	0.2557	1.7443	1.8500	264.2578
PE	15.3000	30.6327	57.4098	5.9239	0.2447	1.7553	1.8500	270.2527
PD	13.0000	30.6327	57.4098	8.2462	0.2484	1.7516	1.8500	381.0106
PC	10.0000	30.6327	57.4098	8.8342	0.2354	1.7646	1.7000	358.1884
PB	7.0000	30.6327	57.4098	11.0496	0.2488	1.7512	1.7000	469.8294
PA	3.5000	30.6327	57.4098	11.8499	0.2351	1.7649	1.7000	479.8543
	0.0000							0.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T6" - TABLE 3								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	314.9902	208.3329	22.1000	4604.1574	105.0000	105.0000
PG	2.3000	19.9000	325.9922	320.4912	19.9000	6377.7756	161.0000	161.0000
PF	2.3000	17.6000	264.2578	295.1250	17.6000	5194.2003	148.0000	148.0000
PE	2.3000	15.3000	270.2527	267.2553	15.3000	4089.0054	134.0000	134.0000
PD	3.0000	13.0000	381.0106	325.6317	13.0000	4233.2118	163.0000	163.0000
PC	3.0000	10.0000	358.1884	369.5995	10.0000	3695.9954	185.0000	185.0000
PB	3.5000	7.0000	469.8294	414.0089	7.0000	2898.0623	208.0000	208.0000
PA	3.5000	3.5000	479.8543	474.8418	3.5000	1661.9464	238.0000	238.0000
	0.0000	0.0000	0.0000	239.9271	0.0000	0.0000	120.0000	120.0000
			3204.6279	3204.6279		40082.1152	1608.0000	1608.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

*** SOLIDITY RATIO FOR TRANSVERSE FACE FOR TOWER MKD."4T6"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	150x150x16	2.200	100x100x10	3.111	-	0.000	130x130x12	2.200	1.647	4.840	0.340	1.700
PG	150x150x16	2.300	100x100x10	3.235	-	0.000	130x130x12	2.200	1.704	5.233	0.326	1.700
PF	150x150x16	2.300	100x100x10	3.343	-	0.000	-	0.000	1.426	5.578	0.256	1.744
PE	150x150x16	2.300	100x100x10	3.453	-	0.000	-	0.000	1.450	5.924	0.245	1.755
PD	150x150x20	3.000	90x90x6	4.069	45x45x5	3.534	-	0.000	2.048	8.246	0.248	1.752
PC	150x150x20	3.000	90x90x6	4.204	45x45x5	3.602	-	0.000	2.080	8.834	0.235	1.765
PB	200x200x20	3.500	90x90x6	4.713	45x45x5	4.107	-	0.000	2.749	11.050	0.249	1.751
PA	200x200x20	3.500	90x90x6	4.870	45x45x5	4.185	-	0.000	2.786	11.850	0.235	1.765

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.20 \times 3.5 \times 2 + 0.09 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\%$ for connections	=	2.786
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.785 / 11.849$	=	0.235
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	$= \text{Main leg} \times \text{length} \times 2 + \text{Bracing} \times \text{Length} \times 2 + \text{Secondary Bracing} \times \text{Length} \times 2 + \text{Horizontal} \times \text{Length}$		
	$= (0.15 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\%$ for connections	=	1.427
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.426 / 5.578$	=	0.256

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

*** WIND LOAD ON TRANSVERSE FACE FOR TOWER MKD."4T6"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliabilty level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g) Gust Co-efficient

Value of Gt for height upto 10 m	Gt	=	1.70
Value of Gt at height of 20 m	Gt	=	1.85
Value of Gt at height of 30 m	Gt	=	1.96
Value of Gt at height of 40 m	Gt	=	2.07
Value of Gt at height of 50 m	Gt	=	2.13

h) Design Wind Pressure , Pd = 0.6 x Vd^2

- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
- Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
- Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
- Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
- Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
- In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
- In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
- In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T6" - TABLE 1								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.3636	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.3636	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.3636	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.3636	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.3636	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.3636	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.3636	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.3636	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.3636	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.3636	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.3636	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.3636	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T6" - TABLE 3								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	314.9902	208.3329	22.1000	4604.1574	105.0000	105.0000
PG	2.3000	19.9000	325.9922	320.4912	19.9000	6377.7756	161.0000	161.0000
PF	2.3000	17.6000	264.2578	295.1250	17.6000	5194.2003	148.0000	148.0000
PE	2.3000	15.3000	270.2527	267.2553	15.3000	4089.0054	134.0000	134.0000
PD	3.0000	13.0000	381.0106	325.6317	13.0000	4233.2118	163.0000	163.0000
PC	3.0000	10.0000	358.1884	369.5995	10.0000	3695.9954	185.0000	185.0000
PB	3.5000	7.0000	469.8294	414.0089	7.0000	2898.0623	208.0000	208.0000
PA	3.5000	3.5000	479.8543	474.8418	3.5000	1661.9464	238.0000	238.0000
	0.0000	0.0000	0.0000	239.9271	0.0000	0.0000	120.0000	120.0000
			3204.6279	3204.6279		40082.1152	1608.0000	1608.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

*** EARTH WIRE LOAD EVALUATION FOR TOWER MKD."4T6"**

(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)

*** WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

*** EARTH WIRE LOADING :-**

a)	Length of wire on left side, L1 =	=	91.30	m
b)	Length of wire on right side, L2 =	=	52.50	m
c)	Earthwire Span (L1 + L2)/2	=	71.90	m
d)	Diameter of Earth Wire	=	10.980	mm
e)	Weight of Earth Wire	=	0.600	Kg/m
f)	Total Weight of Earth Wire per Tower	=	43.140	Kg
g)	Earth Wire Tension	=	1000.00	Kg
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table 27 of IS875-1987, part III)
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x 1.20 x 0.7895	
		=	54.39	Kg
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg
	Wind Load on Earth-Wire in Transverse Dirn.	=	55.00	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)

k) Angle of Deviation

In Plan

= 0.00 °

In Elevation

= 0.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	1000.00	0.00

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn.

= 55 Kg

Load Due to Normal Tension Due to Deviation

= 0 Kg

Say = 55 **Kg**

Vertical Loads :-

Weight of Earth-wire

= 43 Kg

Load Due to Normal Tension Due to Deviation

= 0 Kg

Say = 43 **Kg**

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn.

= 0 Kg

Load Due to Normal Tension Due to Deviation

= 1000 Kg

Say = 1000 **Kg**

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)					
* <u>WIND LOAD EVALUATION</u>						
Design Wind Pressure, Pz		=	57.41	Kg/m ²		
* <u>EARTH WIRE LOADING :-</u>						
a)	Length of wire on left side, L1 =	=	91.30	m		
b)	Length of wire on right side, L2 =	=	52.50	m		
c)	Earthwire Span (L1 + L2)/2	=	71.90	m		
d)	Diameter of Earth Wire	=	10.980	mm		
e)	Weight of Earth Wire	=	0.600	Kg/m		
f)	Total Weight of Earth Wire per Tower	=	43.140	Kg		
g)	Earth Wire Tension	=	1000.00	Kg		
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table30 of IS875-2015, part III)		
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x	1.20	x	0.7895
		=	54.39	Kg		
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	30.00	Kg		
	Wind Load on Earth-Wire in Transverse Dirn.	=	50.00	Kg		
k)	Angle of Deviation					
	In Plan	=	30.00	°		
	In Elevation	=	0.00	°		
			Vertical	Long.	Transverse	
	Load Due to Normal Tension Due to Deviations in kg		0.00	866.03	500.00	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)		
<u>Transverse Loads :-</u>			
Wind Load on Earth-Wire in Transverse Dirn.	=	50	Kg
Load Due to Normal Tension Due to Deviation	=	500	Kg
Say	=	<u>550</u>	Kg
<u>Vertical Loads :-</u>			
Weight of Earth-wire	=	43	Kg
Load Due to Normal Tension Due to Deviation	=	0	Kg
Say	=	<u>43</u>	Kg
<u>Longitudinal Loads :-</u>			
Wind Load on Earth-Wire in Longitudinal Dirn.	=	30	Kg
Load Due to Normal Tension Due to Deviation	=	866	Kg
Say	=	<u>896</u>	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)					
*	<u>WIND LOAD EVALUATION</u>					
	Design Wind Pressure, Pz	=	57.41	Kg/m ²		
*	<u>EARTH WIRE LOADING :-</u>					
a)	Length of wire on left side, L1 =	=	91.30	m		
b)	Length of wire on right side, L2 =	=	52.50	m		
c)	Earthwire Span (L1 + L2)/2	=	71.90	m		
d)	Diameter of Earth Wire	=	10.980	mm		
e)	Weight of Earth Wire	=	0.600	Kg/m		
f)	Total Weight of Earth Wire per Tower	=	43.140	Kg		
g)	Earth Wire Tension	=	1000.00	Kg		
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table30 of IS875-2015, part III)		
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x	1.20	x	0.7895
		=	54.39	Kg		
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg		
	Wind Load on Earth-Wire in Transverse Dirn.	=	50.00	Kg		
k)	Angle of Deviation					
	In Plan	=	0.00	°		
	In Elevation	=	30.00	°		
			Vertical	Long.	Transverse	
Load Due to Normal Tension Due to Deviations in kg			-500.00	866.03	0.00	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)				
<u>Transverse Loads :-</u>					
Wind Load on Earth-Wire in Transverse Dirn.		=	50		Kg
Load Due to Normal Tension Due to Deviation		=	0		Kg
	Say	=	50		Kg
<u>Vertical Loads :-</u>					
Weight of Earth-wire		=	43		Kg
Load Due to Normal Tension Due to Deviation		=	-500		Kg
	Say	=	-457		Kg
<u>Longitudinal Loads :-</u>					
Wind Load on Earth-Wire in Longitudinal Dirn.		=	0		Kg
Load Due to Normal Tension Due to Deviation		=	866		Kg
	Say	=	866		Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)					
*	<u>WIND LOAD EVALUATION</u>					
	Design Wind Pressure, Pz	=	57.41	Kg/m ²		
*	<u>EARTH WIRE LOADING :-</u>					
a)	Length of wire on left side, L1 =	=	91.30	m		
b)	Length of wire on right side, L2 =	=	52.50	m		
c)	Earthwire Span (L1 + L2)/2	=	71.90	m		
d)	Diameter of Earth Wire	=	10.980	mm		
e)	Weight of Earth Wire	=	0.600	Kg/m		
f)	Total Weight of Earth Wire per Tower	=	43.140	Kg		
g)	Earth Wire Tension	=	1000.00	Kg		
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table30 of IS875-2015, part III)		
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x	1.20	x	0.7895
		=	54.39	Kg		
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	25.00	Kg		
	Wind Load on Earth-Wire in Transverse Dirn.	=	45.00	Kg		
k)	Angle of Deviation					
	In Plan	=	30.00	°		
	In Elevation	=	30.00	°		
			Vertical	Long.	Transverse	
Load Due to Normal Tension Due to Deviations in kg			-500.00	750.00	433.01	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T6) & BEAM (G4,G2)				
<u>Transverse Loads :-</u>					
Wind Load on Earth-Wire in Transverse Dirn.		=	45		Kg
Load Due to Normal Tension Due to Deviation		=	433		Kg
	Say	=	<u>478</u>		Kg
<u>Vertical Loads :-</u>					
Weight of Earth-wire		=	43		Kg
Load Due to Normal Tension Due to Deviation		=	-500		Kg
	Say	=	<u>-457</u>		Kg
<u>Longitudinal Loads :-</u>					
Wind Load on Earth-Wire in Longitudinal Dirn.		=	25		Kg
Load Due to Normal Tension Due to Deviation		=	750		Kg
	Say	=	<u>775</u>		Kg

LOAD EVALUATION FOR TOWER-4T5

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)		
* GEOMETRY FOR MAINBUS MKD."4T5"			
TRANSVERSE FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES
LONGITUDINAL FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES

TABLE 1.1 - DATA FOR THE DESIGN OF THE RAMP								
SR. NO.	LEVEL m	SEGMENT m	T. WIDTH m	L. WIDTH m	WIDTH' T m	WIDTH' L m	ANGLE T - FACE	ANGLE L - FACE
PL	28.0000	0.0000	0.1500	0.1500	0.15	0.15	0.000	0.000
PK	26.6000	1.4000	0.6364	0.6364	0.39	0.39	74.311	74.311
PJ	25.1000	1.5000	1.1576	1.1576	0.90	0.90	59.120	59.120
PI	23.6000	1.5000	1.6788	1.6788	1.42	1.42	46.605	46.605
PH	22.1000	1.5000	2.2000	2.2000	1.94	1.94	37.720	37.720
PG	19.9000	2.2000	2.2000	2.2000	2.20	2.20	45.000	45.000
PF	17.6000	2.3000	2.3503	2.3503	2.28	2.28	45.312	45.312
PE	15.3000	2.3000	2.5005	2.5005	2.43	2.43	43.480	43.480
PD	13.0000	2.3000	2.6508	2.6508	2.58	2.58	41.764	41.764
PC	10.0000	3.0000	2.8467	2.8467	2.75	2.75	47.503	47.503
PB	7.0000	3.0000	3.0427	3.0427	2.94	2.94	45.533	45.533
PA	3.5000	3.5000	3.2714	3.2714	3.16	3.16	47.949	47.949
	0.0000	3.5000	3.5000	3.5000	3.39	3.39	45.951	45.951

WIDTH' = PLAN WIDTH AT THE GIVEN LEVEL - SEGMENT HEIGHT x TAN θ

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

* SOLIDITY RATIO FOR LONGITUDINAL FACE FOR TOWER MKD."4T5"												
Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	150x150x16	2.200	100x100x10	3.111	-	0.000	130x130x12	2.200	1.647	4.840	0.340	1.700
PG	150x150x16	2.300	100x100x10	3.235	-	0.000	130x130x12	2.200	1.704	5.233	0.326	1.700
PF	150x150x16	2.300	100x100x10	3.343	-	0.000	-	0.000	1.426	5.578	0.256	1.744
PE	150x150x16	2.300	100x100x10	3.453	-	0.000	-	0.000	1.450	5.924	0.245	1.755
PD	150x150x20	3.000	90x90x6	4.069	45x45x5	3.534	-	0.000	2.048	8.246	0.248	1.752
PC	150x150x20	3.000	90x90x6	4.204	45x45x5	3.602	-	0.000	2.080	8.834	0.235	1.765
PB	200x200x20	3.500	90x90x6	4.713	45x45x5	4.107	-	0.000	2.749	11.050	0.249	1.751
PA	200x200x20	3.500	90x90x6	4.870	45x45x5	4.185	-	0.000	2.786	11.850	0.235	1.765

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.20 \times 3.5 \times 2 + 0.09 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.786
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.785 / 11.849$	=	0.235
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.15 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.427
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.426 / 5.578$	=	0.256

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

*** WIND LOAD ON LONGITUDINAL FACE FOR TOWER MKD."4T5"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliabilty level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g) Gust Co-efficient

Value of Gt for height upto 10 m	Gt	=	1.70
Value of Gt at height of 20 m	Gt	=	1.85
Value of Gt at height of 30 m	Gt	=	1.96
Value of Gt at height of 40 m	Gt	=	2.07
Value of Gt at height of 50 m	Gt	=	2.13

h) Design Wind Pressure , Pd = 0.6 x Vd^2

- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
- Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
- Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
- Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
- Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
- In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
- In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
- In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T5" - TABLE 1								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.36	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.36	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.36	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.36	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.36	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.36	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.36	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.36	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.36	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.36	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.36	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.36	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T5" - TABLE 2								
A Segment No. from Top	B Segment Top Levels (metres)	C Design Speed Vz (metres/sec)	D Design Pressure Pz (kg/metre2)	E Gross Area of Parts Ag (metres ²)	F Solidity Ratio (Actual)	G Force co-efficient Cdt	H Gust Coefficient Gt	I Wind Load Pz x Cdt x Gt x Ae (kg)
PL	28.0000	30.6327	57.4098	0.5505	0.6779	1.6000	1.9600	67.1878
PK	26.6000	30.6327	57.4098	1.3456	0.3120	1.7000	1.9600	80.2967
PJ	25.1000	30.6327	57.4098	2.1273	0.2129	1.7871	1.9600	91.0921
PI	23.6000	30.6327	57.4098	2.9091	0.1697	1.8303	1.9600	101.6756
PH	22.1000	30.6327	57.4098	4.8400	0.3402	1.7000	1.9600	314.9902
PG	19.9000	30.6327	57.4098	5.2328	0.3257	1.7000	1.9600	325.9922
PF	17.6000	30.6327	57.4098	5.5784	0.2557	1.7443	1.8500	264.2578
PE	15.3000	30.6327	57.4098	5.9239	0.2447	1.7553	1.8500	270.2527
PD	13.0000	30.6327	57.4098	8.2462	0.2484	1.7516	1.8500	381.0106
PC	10.0000	30.6327	57.4098	8.8342	0.2354	1.7646	1.7000	358.1884
PB	7.0000	30.6327	57.4098	11.0496	0.2488	1.7512	1.7000	469.8294
PA	3.5000	30.6327	57.4098	11.8499	0.2351	1.7649	1.7000	479.8543
	0.0000							0.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T5" - TABLE 3								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	314.9902	208.3329	22.1000	4604.1574	105.0000	105.0000
PG	2.3000	19.9000	325.9922	320.4912	19.9000	6377.7756	161.0000	161.0000
PF	2.3000	17.6000	264.2578	295.1250	17.6000	5194.2003	148.0000	148.0000
PE	2.3000	15.3000	270.2527	267.2553	15.3000	4089.0054	134.0000	134.0000
PD	3.0000	13.0000	381.0106	325.6317	13.0000	4233.2118	163.0000	163.0000
PC	3.0000	10.0000	358.1884	369.5995	10.0000	3695.9954	185.0000	185.0000
PB	3.5000	7.0000	469.8294	414.0089	7.0000	2898.0623	208.0000	208.0000
PA	3.5000	3.5000	479.8543	474.8418	3.5000	1661.9464	238.0000	238.0000
	0.0000	0.0000	0.0000	239.9271	0.0000	0.0000	120.0000	120.0000
			3204.6279	3204.6279		40082.1152	1608.0000	1608.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

* SOLIDITY RATIO FOR TRANSVERSE FACE FOR TOWER MKD."4T5"												
Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	150x150x16	2.200	100x100x10	3.111	-	0.000	130x130x12	2.200	1.647	4.840	0.340	1.700
PG	150x150x16	2.300	100x100x10	3.235	-	0.000	130x130x12	2.200	1.704	5.233	0.326	1.700
PF	150x150x16	2.300	100x100x10	3.343	-	0.000	-	0.000	1.426	5.578	0.256	1.744
PE	150x150x16	2.300	100x100x10	3.453	-	0.000	-	0.000	1.450	5.924	0.245	1.755
PD	150x150x20	3.000	90x90x6	4.069	45x45x5	3.534	-	0.000	2.048	8.246	0.248	1.752
PC	150x150x20	3.000	90x90x6	4.204	45x45x5	3.602	-	0.000	2.080	8.834	0.235	1.765
PB	200x200x20	3.500	90x90x6	4.713	45x45x5	4.107	-	0.000	2.749	11.050	0.249	1.751
PA	200x200x20	3.500	90x90x6	4.870	45x45x5	4.185	-	0.000	2.786	11.850	0.235	1.765

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.20 \times 3.5 \times 2 + 0.09 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.786
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.785 / 11.849$	=	0.235
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	$= \text{Main leg} \times \text{length} \times 2 + \text{Bracing} \times \text{Length} \times 2 + \text{Secondary Bracing} \times \text{Length} \times 2 + \text{Horizontal} \times \text{Length}$		
	$= (0.15 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.427
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.426 / 5.578$	=	0.256

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

*** WIND LOAD ON TRANSVERSE FACE FOR TOWER MKD."4T5"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliability level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd^2
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assumed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T5" - TABLE 1								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.3636	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.3636	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.3636	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.3636	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.3636	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.3636	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.3636	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.3636	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.3636	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.3636	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.3636	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.3636	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T5" - TABLE 3								
A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	314.9902	208.3329	22.1000	4604.1574	105.0000	105.0000
PG	2.3000	19.9000	325.9922	320.4912	19.9000	6377.7756	161.0000	161.0000
PF	2.3000	17.6000	264.2578	295.1250	17.6000	5194.2003	148.0000	148.0000
PE	2.3000	15.3000	270.2527	267.2553	15.3000	4089.0054	134.0000	134.0000
PD	3.0000	13.0000	381.0106	325.6317	13.0000	4233.2118	163.0000	163.0000
PC	3.0000	10.0000	358.1884	369.5995	10.0000	3695.9954	185.0000	185.0000
PB	3.5000	7.0000	469.8294	414.0089	7.0000	2898.0623	208.0000	208.0000
PA	3.5000	3.5000	479.8543	474.8418	3.5000	1661.9464	238.0000	238.0000
	0.0000	0.0000	0.0000	239.9271	0.0000	0.0000	120.0000	120.0000
			3204.6279	3204.6279		40082.1152	1608.0000	1608.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

*** EARTH WIRE LOAD EVALUATION FOR TOWER MKD."4T5"**

(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)

*** WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

*** EARTH WIRE LOADING :-**

a)	Length of wire on left side, L1 =	=	91.30	m
b)	Length of wire on right side, L2 =	=	52.50	m
c)	Earthwire Span (L1 + L2)/2	=	71.90	m
d)	Diameter of Earth Wire	=	10.980	mm
e)	Weight of Earth Wire	=	0.600	Kg/m
f)	Total Weight of Earth Wire per Tower	=	43.140	Kg
g)	Earth Wire Tension	=	1000.00	Kg
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table 27 of IS875-1987, part III)
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x 1.20 x 0.7895	
		=	54.39	Kg
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg
	Wind Load on Earth-Wire in Transverse Dirn.	=	55.00	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)

k) Angle of Deviation

In Plan = 0.00 °

In Elevation = 0.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	1000.00	0.00

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn. = 55 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Say = 55 **Kg**

Vertical Loads :-

Weight of Earth-wire = 43 Kg

Load Due to Normal Tension Due to Deviation = 0 Kg

Say = 43 **Kg**

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn. = 0 Kg

Load Due to Normal Tension Due to Deviation = 1000 Kg

Say = 1000 **Kg**

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP													
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)													
* <u>WIND LOAD EVALUATION</u> Design Wind Pressure, Pz = 57.41 Kg/m² * <u>EARTH WIRE LOADING :-</u> a) Length of wire on left side, L1 = 91.30 m b) Length of wire on right side, L2 = 52.50 m c) Earthwire Span (L1 + L2)/2 = 71.90 m d) Diameter of Earth Wire = 10.980 mm e) Weight of Earth Wire = 0.600 Kg/m f) Total Weight of Earth Wire per Tower = 43.140 Kg g) Earth Wire Tension = 1000.00 Kg h) Wind Force Co-efficient for Wires & Cables, Cf = 1.20 (refer table30 of IS875-2015, part III) i) Wind on Earth-Wire, Pz x Cf x Area = 57.41 x 1.20 x 0.7895 = 54.39 Kg Wind Load on Earth-Wire in Longitudinal Dirn. = 30.00 Kg Wind Load on Earth-Wire in Transverse Dirn. = 50.00 Kg k) Angle of Deviation In Plan = 30.00 ° In Elevation = 0.00 ° <table><thead><tr><th></th><th>Vertical</th><th>Long.</th><th>Transverse</th></tr></thead><tbody><tr><td>Load Due to Normal Tension Due to Deviations in kg</td><td>0.00</td><td>866.03</td><td>500.00</td></tr></tbody></table>								Vertical	Long.	Transverse	Load Due to Normal Tension Due to Deviations in kg	0.00	866.03	500.00
	Vertical	Long.	Transverse											
Load Due to Normal Tension Due to Deviations in kg	0.00	866.03	500.00											

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)		
<u>Transverse Loads :-</u>			
Wind Load on Earth-Wire in Transverse Dirn.	=	50	Kg
Load Due to Normal Tension Due to Deviation	=	500	Kg
Say	=	<u>550</u>	Kg
<u>Vertical Loads :-</u>			
Weight of Earth-wire	=	43	Kg
Load Due to Normal Tension Due to Deviation	=	0	Kg
Say	=	<u>43</u>	Kg
<u>Longitudinal Loads :-</u>			
Wind Load on Earth-Wire in Longitudinal Dirn.	=	30	Kg
Load Due to Normal Tension Due to Deviation	=	866	Kg
Say	=	<u>896</u>	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)					
*	<u>WIND LOAD EVALUATION</u>					
	Design Wind Pressure, Pz	=	57.41	Kg/m ²		
*	<u>EARTH WIRE LOADING :-</u>					
a)	Length of wire on left side, L1 =	=	91.30	m		
b)	Length of wire on right side, L2 =	=	52.50	m		
c)	Earthwire Span (L1 + L2)/2	=	71.90	m		
d)	Diameter of Earth Wire	=	10.980	mm		
e)	Weight of Earth Wire	=	0.600	Kg/m		
f)	Total Weight of Earth Wire per Tower	=	43.140	Kg		
g)	Earth Wire Tension	=	1000.00	Kg		
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table30 of IS875-2015, part III)		
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x	1.20	x	0.7895
		=	54.39	Kg		
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg		
	Wind Load on Earth-Wire in Transverse Dirn.	=	50.00	Kg		
k)	Angle of Deviation					
	In Plan	=	0.00	°		
	In Elevation	=	30.00	°		
			Vertical	Long.	Transverse	
Load Due to Normal Tension Due to Deviations in kg			-500.00	866.03	0.00	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)				
<u>Transverse Loads :-</u>					
Wind Load on Earth-Wire in Transverse Dirn.		=	50		Kg
Load Due to Normal Tension Due to Deviation		=	0		Kg
	Say	=	50		Kg
<u>Vertical Loads :-</u>					
Weight of Earth-wire		=	43		Kg
Load Due to Normal Tension Due to Deviation		=	-500		Kg
	Say	=	-457		Kg
<u>Longitudinal Loads :-</u>					
Wind Load on Earth-Wire in Longitudinal Dirn.		=	0		Kg
Load Due to Normal Tension Due to Deviation		=	866		Kg
	Say	=	866		Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP													
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)													
* <u>WIND LOAD EVALUATION</u> Design Wind Pressure, Pz = 57.41 Kg/m² * <u>EARTH WIRE LOADING :-</u> a) Length of wire on left side, L1 = 91.30 m b) Length of wire on right side, L2 = 52.50 m c) Earthwire Span (L1 + L2)/2 = 71.90 m d) Diameter of Earth Wire = 10.980 mm e) Weight of Earth Wire = 0.600 Kg/m f) Total Weight of Earth Wire per Tower = 43.140 Kg g) Earth Wire Tension = 1000.00 Kg h) Wind Force Co-efficient for Wires & Cables, Cf = 1.20 (refer table30 of IS875-2015, part III) i) Wind on Earth-Wire, Pz x Cf x Area = 57.41 x 1.20 x 0.7895 = 54.39 Kg Wind Load on Earth-Wire in Longitudinal Dirn. = 25.00 Kg Wind Load on Earth-Wire in Transverse Dirn. = 45.00 Kg k) Angle of Deviation In Plan = 30.00 ° In Elevation = 30.00 ° <table><thead><tr><th></th><th>Vertical</th><th>Long.</th><th>Transverse</th></tr></thead><tbody><tr><td>Load Due to Normal Tension Due to Deviations in kg</td><td>-500.00</td><td>750.00</td><td>433.01</td></tr></tbody></table>								Vertical	Long.	Transverse	Load Due to Normal Tension Due to Deviations in kg	-500.00	750.00	433.01
	Vertical	Long.	Transverse											
Load Due to Normal Tension Due to Deviations in kg	-500.00	750.00	433.01											

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5) & BEAM (G4,G2)				
<u>Transverse Loads :-</u>					
Wind Load on Earth-Wire in Transverse Dirn.		=	45		Kg
Load Due to Normal Tension Due to Deviation		=	433		Kg
	Say	=	<u>478</u>		Kg
<u>Vertical Loads :-</u>					
Weight of Earth-wire		=	43		Kg
Load Due to Normal Tension Due to Deviation		=	-500		Kg
	Say	=	<u>-457</u>		Kg
<u>Longitudinal Loads :-</u>					
Wind Load on Earth-Wire in Longitudinal Dirn.		=	25		Kg
Load Due to Normal Tension Due to Deviation		=	750		Kg
	Say	=	<u>775</u>		Kg

PICTORIAL VIEW OF STAAD MODEL

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 1	Rev
Job Title	Part		Re f
Client	B y	Date 02-JULY-24	Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD		Date Time 01-Aug-2024 12:27	

Job Information

	Engineer	Checked	Approved
Name:			
Date:	02-JULY-24		
Comments:			
Structure Type:	TRUSS		

Geometry

Entity Type	Count	Highest
Nodes	380	392
Analytical Members	1224	1481

Load Cases

Load Case Type	Count
Primary	19
Combination	32

Included in this printout are data for:

All	The Whole Structure

Load Case Table

Included in this printout are results for load cases:

L/C	Type	Name
1	Primary	DEAD LOAD + LIVE LOAD
2	Primary	WIND ALONG X DIRECTION(PARALLEL TO BEAM)
3	Primary	WIND ALONG Z DIRECTION (PERPENDICULAR TO BEAM)
4	Primary	NC(0P-0E) +WIND PARALLEL TO BEAM
5	Primary	SC(0P-0E) +WIND PARALLEL TO BEAM
6	Primary	NC(0P-0E) +WIND PERPENDICULAR TO BEAM
7	Primary	SC(0P-0E) +WIND PERPENDICULAR TO BEAM
8	Primary	NC(30P-0E) +WIND PARALLEL TO BEAM
9	Primary	SC(30P-0E) +WIND PARALLEL TO BEAM
10	Primary	NC(30P-0E) +WIND PERPENDICULAR TO BEAM
11	Primary	SC(30P-0E) +WIND PERPENDICULAR TO BEAM

		Job No.	Sheet No. 2	Rev
Software licensed to Anhera Enterprise Connected User: Madhusudan Patel				
Job Title		Part	Ref	
Client		By	Date 02-JULY-24	Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD		Date Time 01-Aug-2024 12:27		

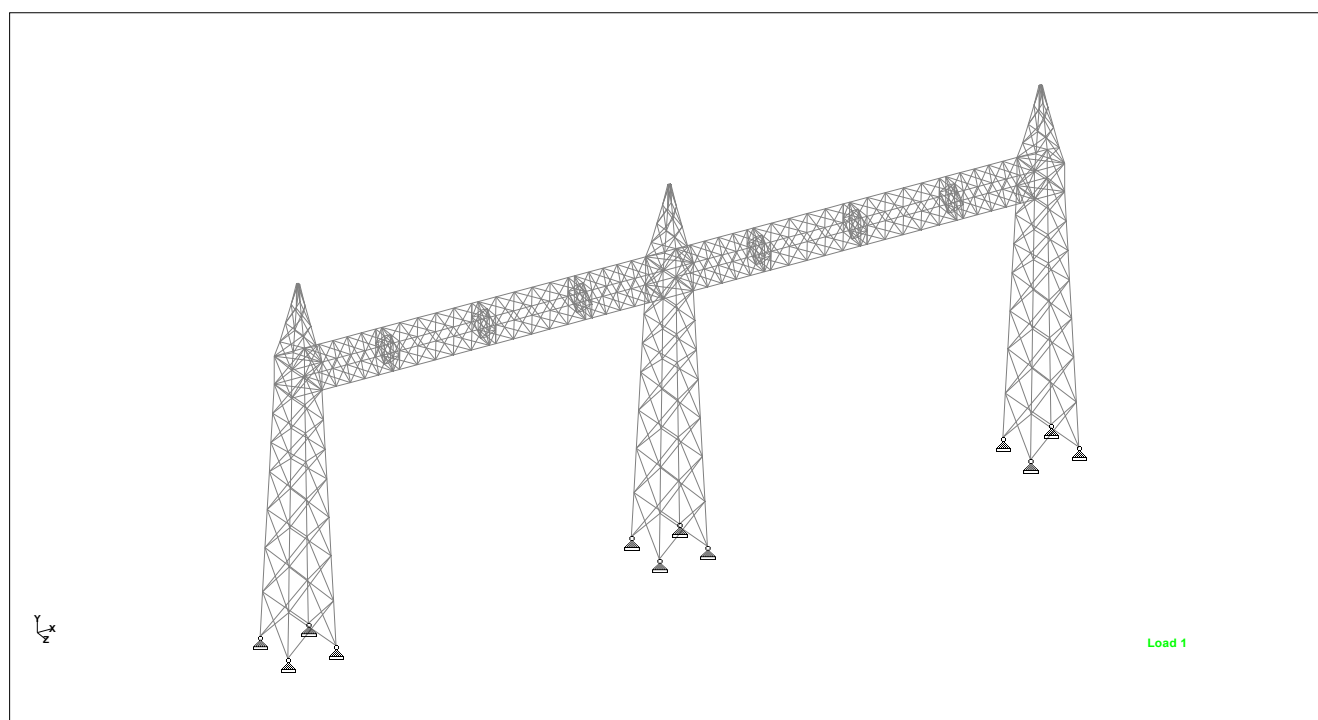
Load Case Table Cont...

L/C	Type	Name
12	Primary	NC(0P-30E) +WIND PARALLEL TO BEAM
13	Primary	SC(0P-30E) +WIND PARALLEL TO BEAM
14	Primary	NC(0P-30E) +WIND PERPENDICULAR TO BEAM
15	Primary	SC(0P-30E) +WIND PERPENDICULAR TO BEAM
16	Primary	NC(30P-30E) +WIND PARALLEL TO BEAM
17	Primary	SC(30P-30E) +WIND PARALLEL TO BEAM
18	Primary	NC(30P-30E) +WIND PERPENDICULAR TO BEAM
19	Primary	SC(30P-30E) +WIND PERPENDICULAR TO BEAM
101	Combination	2(DL + NC + WIND PARALLEL TO BEAM)
201	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
102	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
202	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
103	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
203	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
104	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
204	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
105	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
205	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
106	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
206	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
107	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
207	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
108	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
208	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
301	Combination	DL + NC + WIND PARALLEL TO BEAM
401	Combination	DL +SC + WIND PARALLEL TO BEAM
302	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
402	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
303	Combination	DL +NC + WIND PARALLEL TO BEAM
403	Combination	DL +SC + WIND PARALLEL TO BEAM

Job No.	Sheet No. 3	Rev
Job Title	Part	Ref
Client	By	Date 02-JULY-24 Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD	Date Time 01-Aug-2024 12:27	

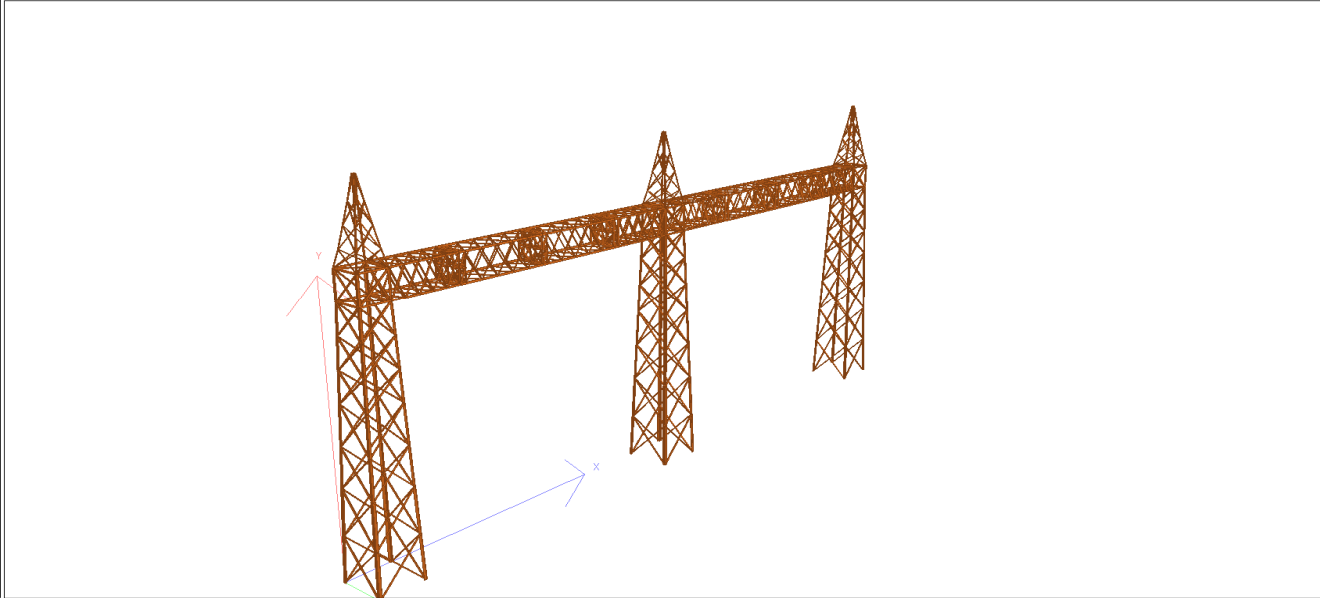
Load Case Table Cont...

L/C	Type	Name
304	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
404	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
305	Combination	DL +NC + WIND PARALLEL TO BEAM
405	Combination	DL +SC + WIND PARALLEL TO BEAM
306	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
406	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
307	Combination	DL +NC + WIND PARALLEL TO BEAM
407	Combination	DL +SC + WIND PARALLEL TO BEAM
308	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
408	Combination	DL +SC + WIND PERPENDICULAR TO BEAM

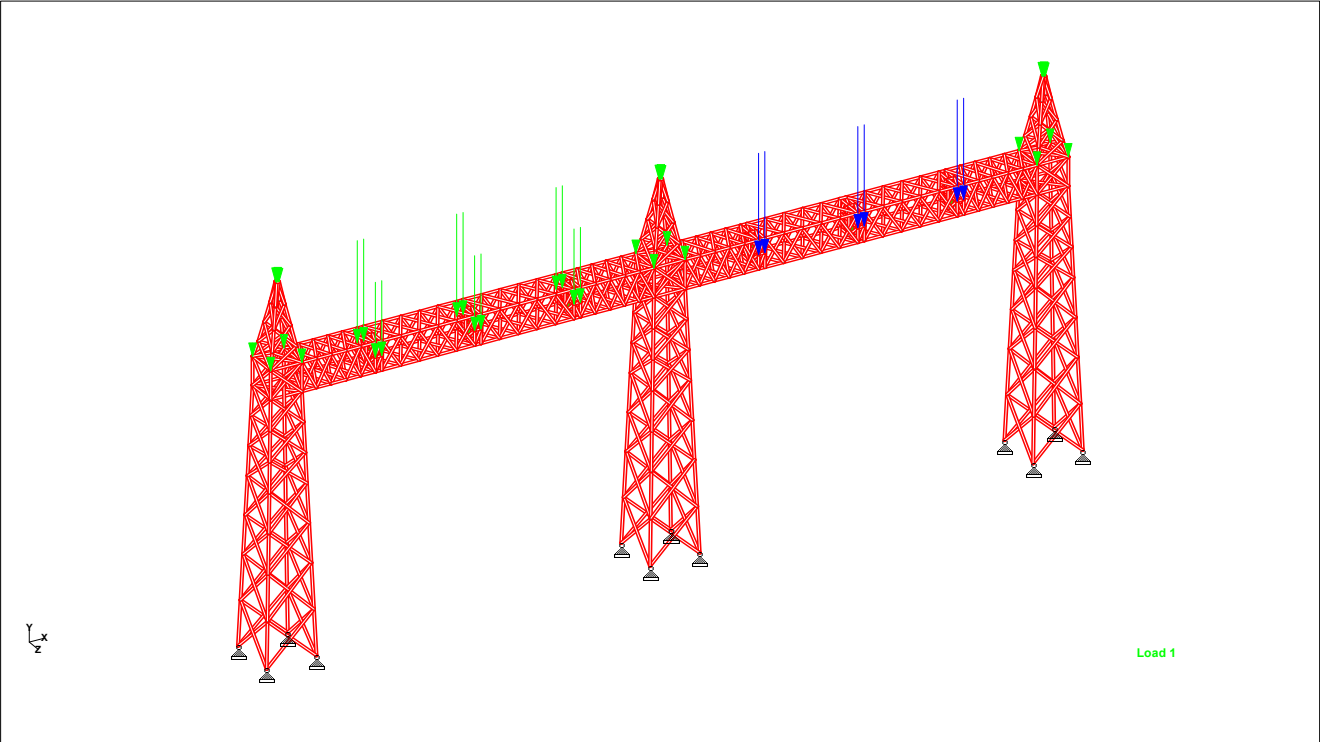


Whole Structure

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 4	Rev
Job Title	Part	Ref	
Client	By	Date 02-JULY-24	Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD	Date Time 01-Aug-2024 12:27		

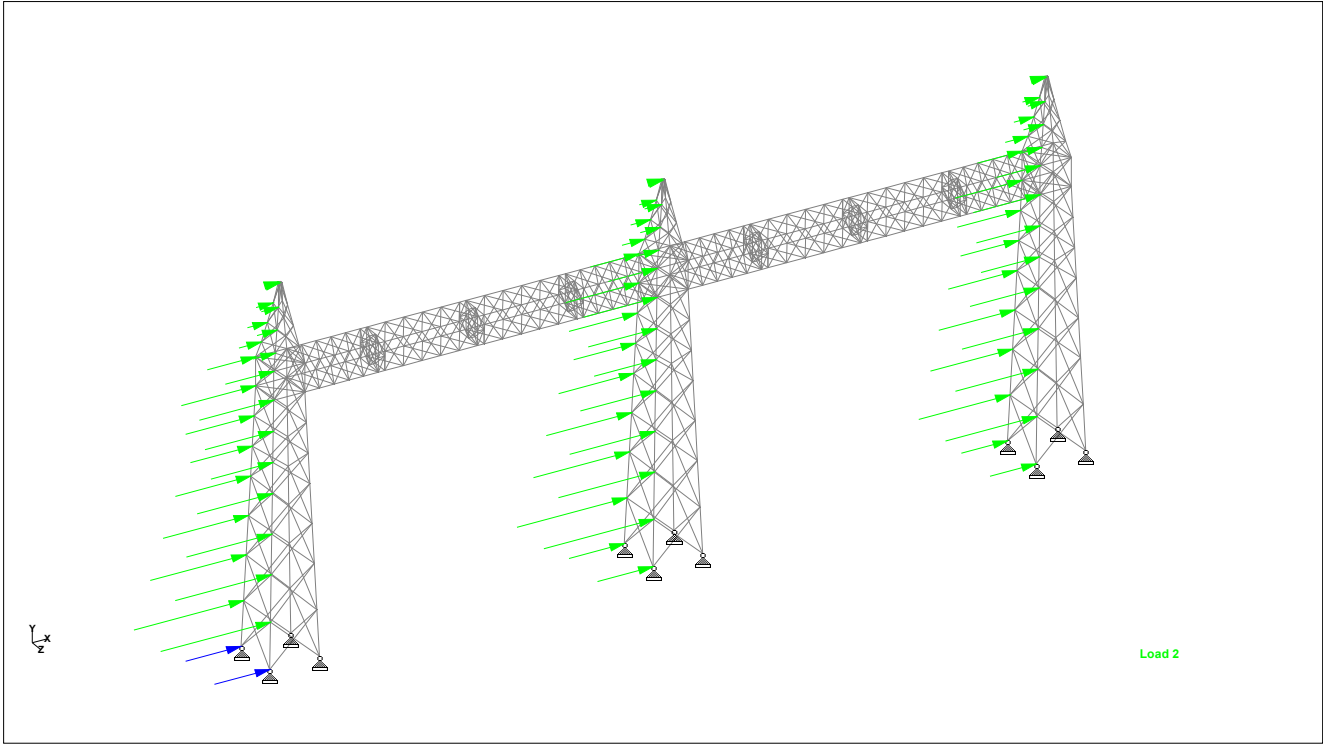


3D Rendered View

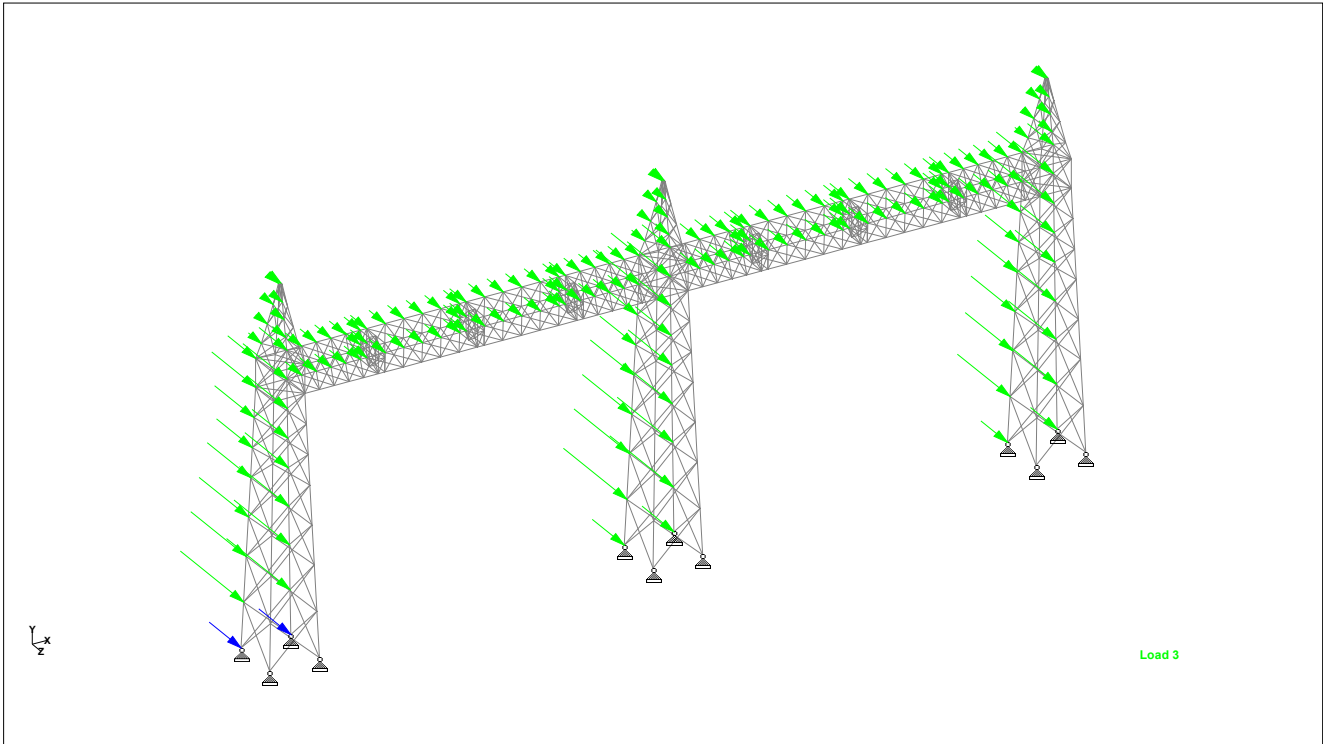


DEAD LOAD

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 5	Rev
Job Title	Part	Ref	
Client	By	Date 02-JULY-24	Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD	Date Time 01-Aug-2024 12:27		

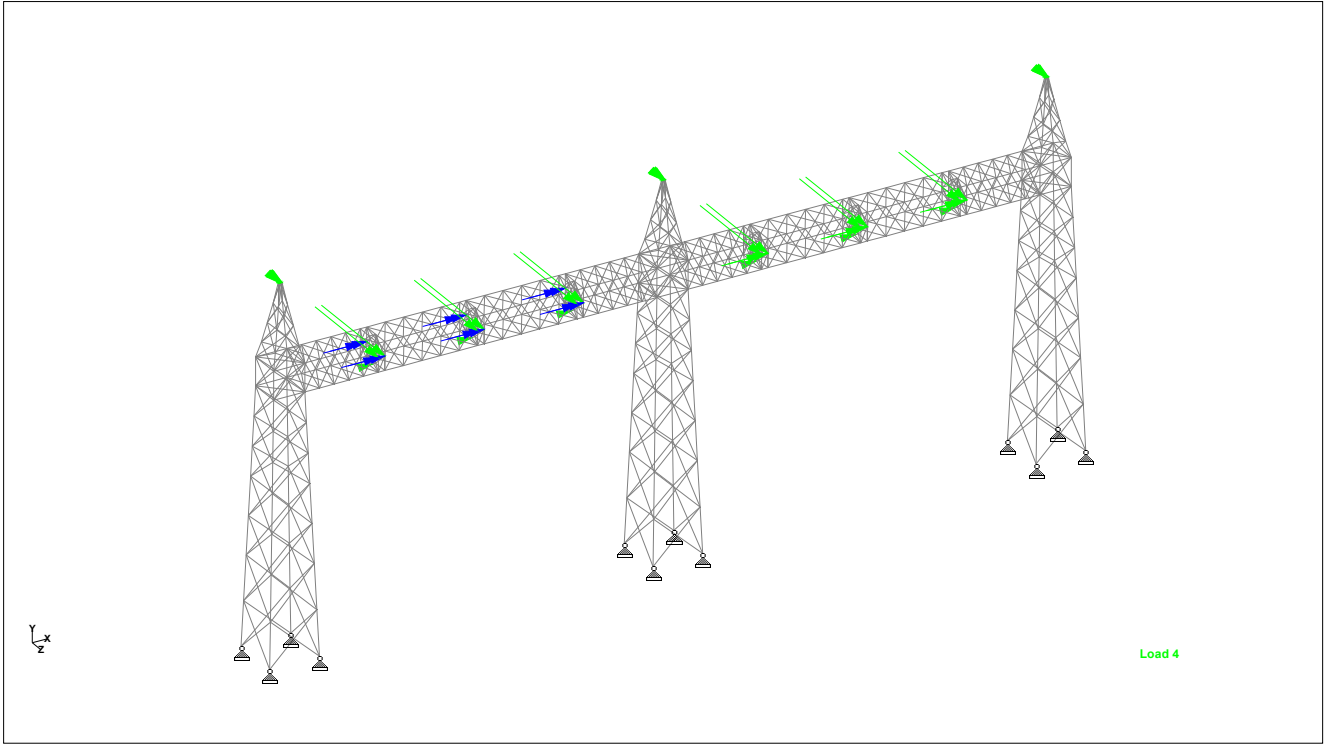


WIND ALONG X DIRECTION(PARALLEL TO BEAM)

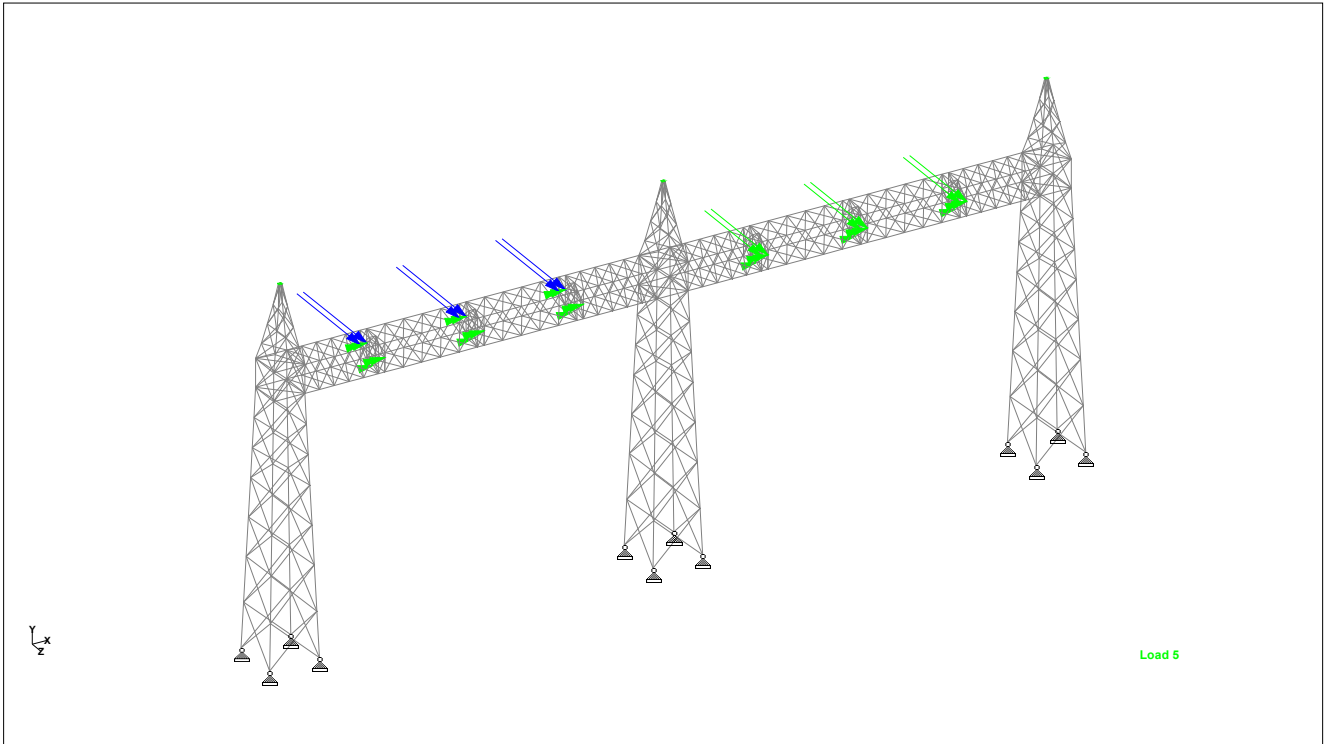


WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 6	Rev
	Part		Re f
Job Title	Client	By	Date 02-JULY-24
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD		Date Time 01-Aug-2024 12:27	

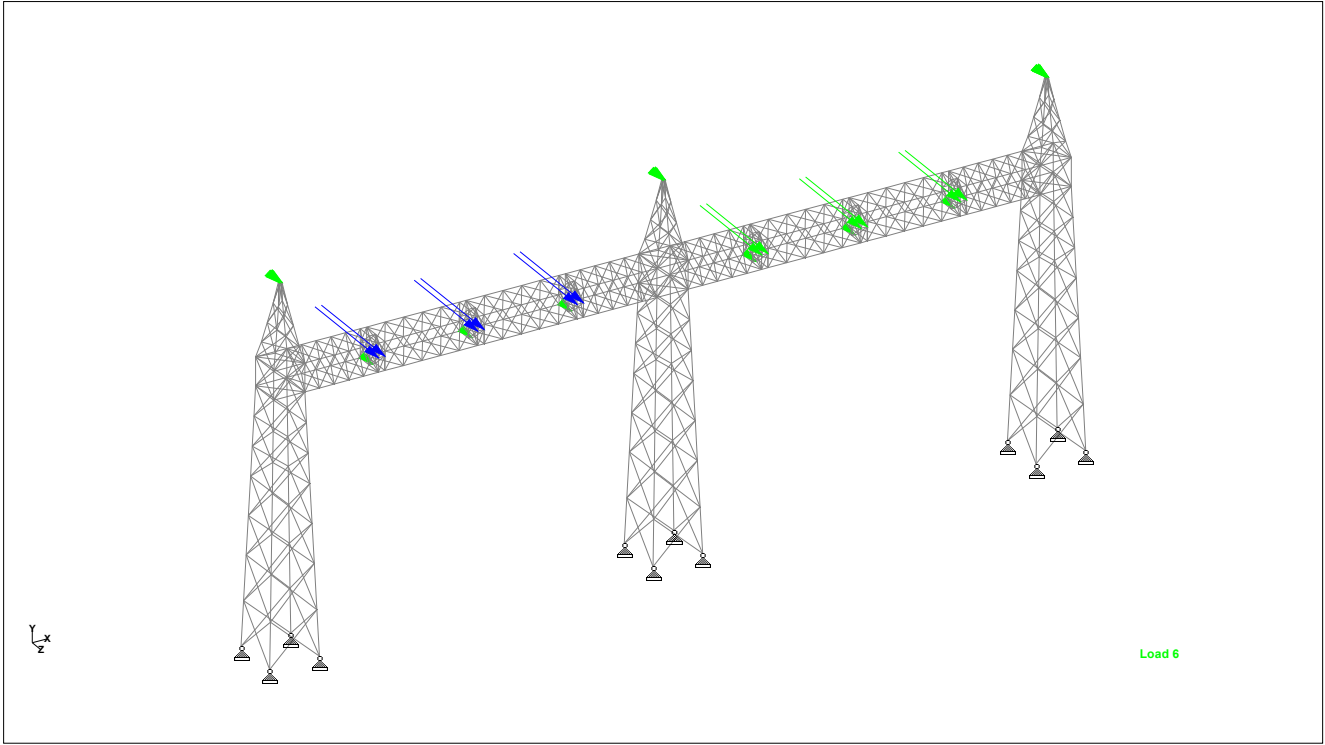


NC(0P-0E) +WIND PARALLEL TO BEAM

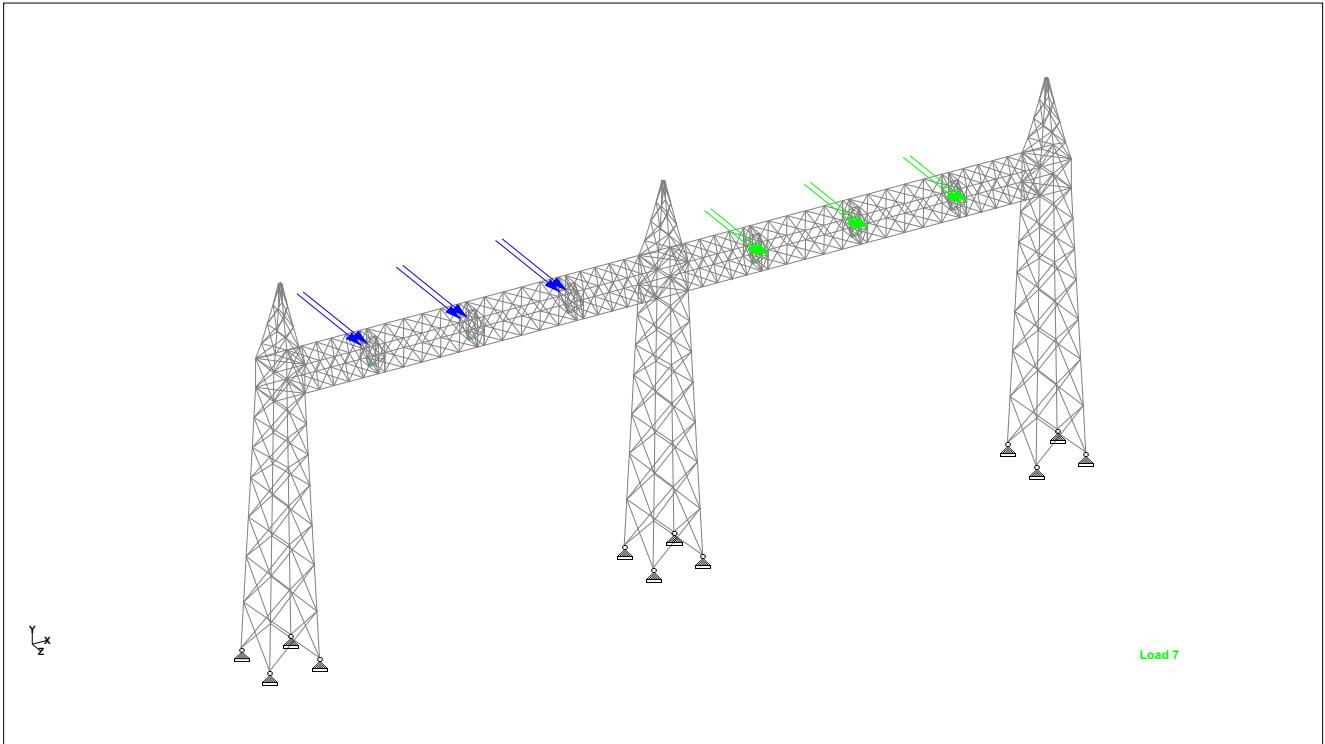


SC(0P-0E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 7	Rev	
	Part		Ref	
Job Title	Client	By y	Date 02-JULY-24	Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD		Date Time 01-Aug-2024 12:27		

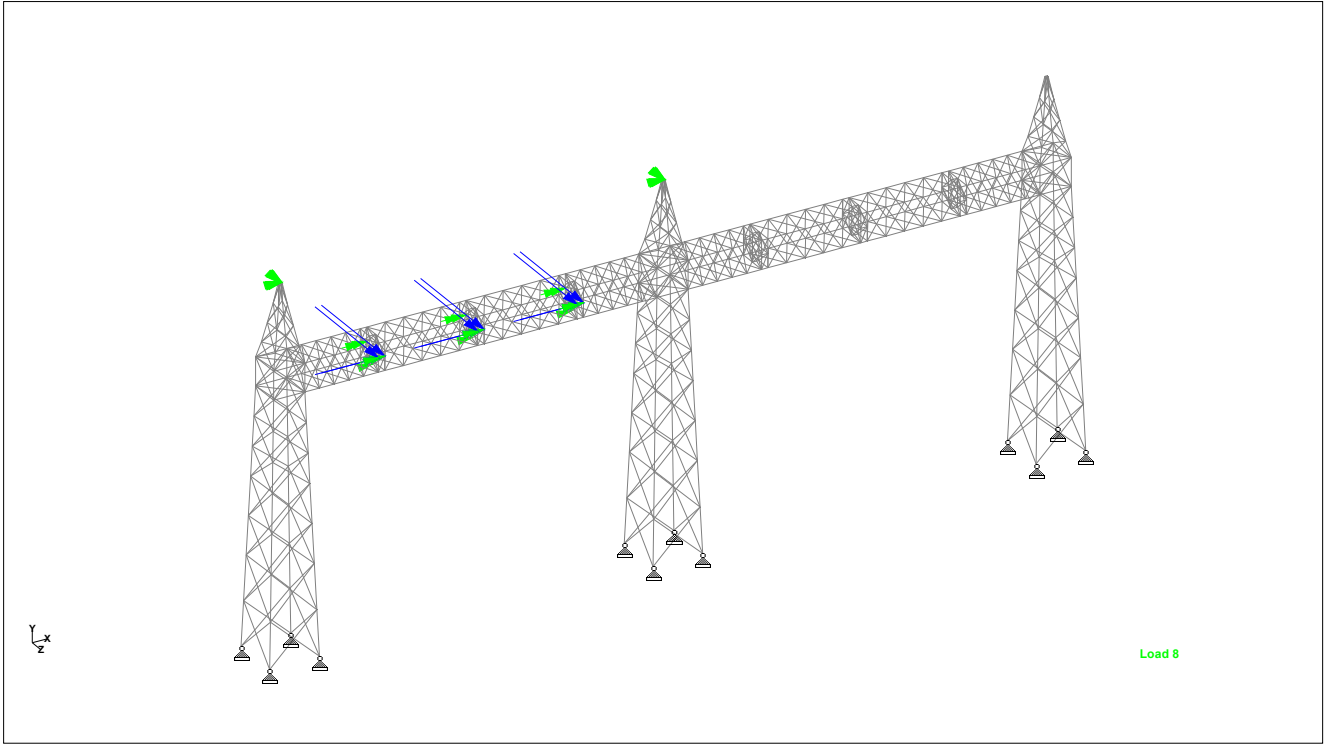


NC(0P-0E) +WIND PERPENDICULAR TO BEAM

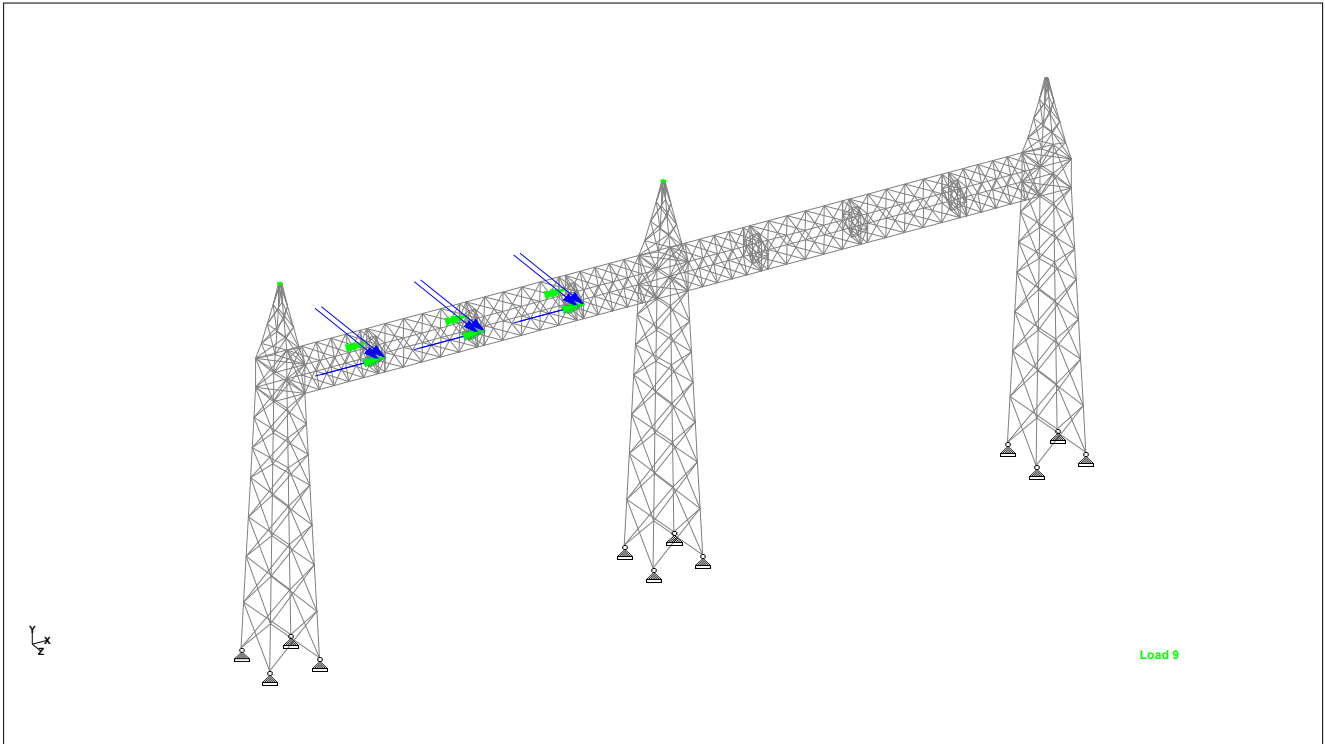


SC(0P-0E) +WIND PERPENDICULAR TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 8	Rev
	Part		Ref
Job Title	Client	By y	Date 02-JULY-24 Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD		Date Time 01-Aug-2024 12:27	

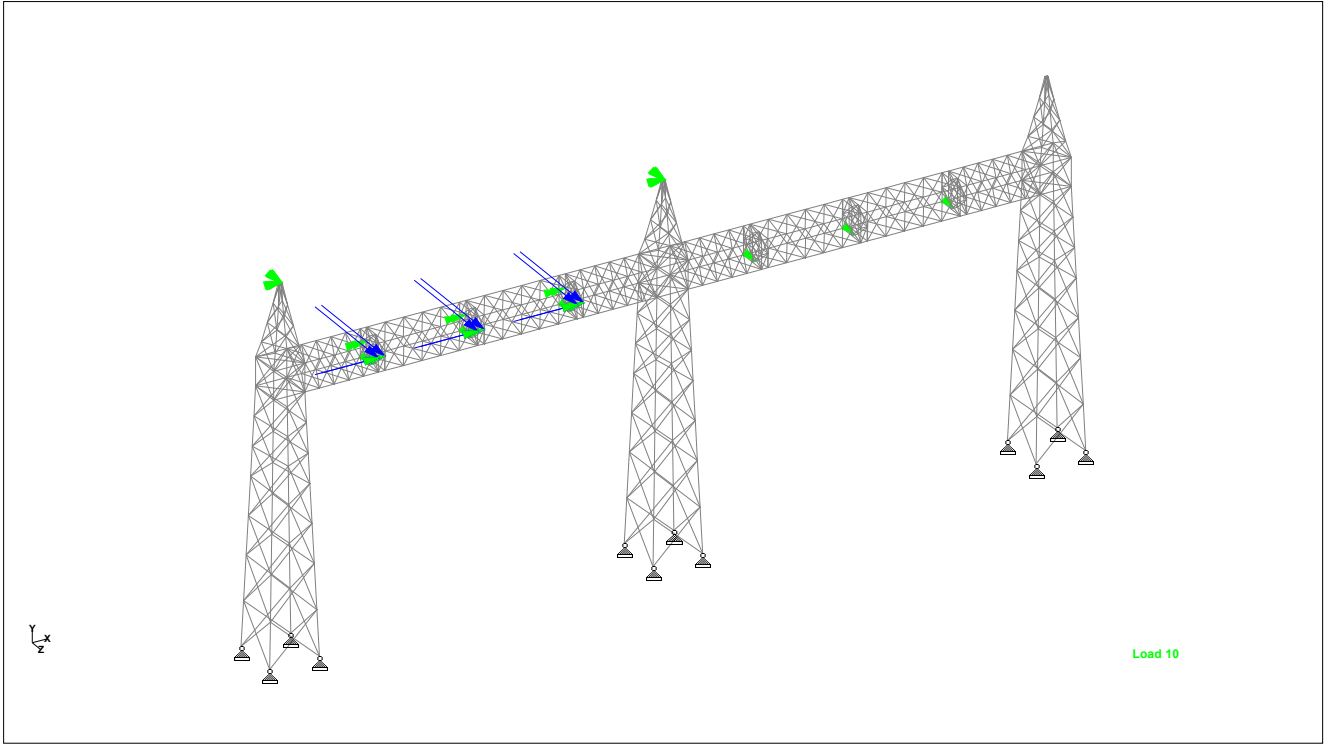


NC(30P-0E) +WIND PARALLEL TO BEAM

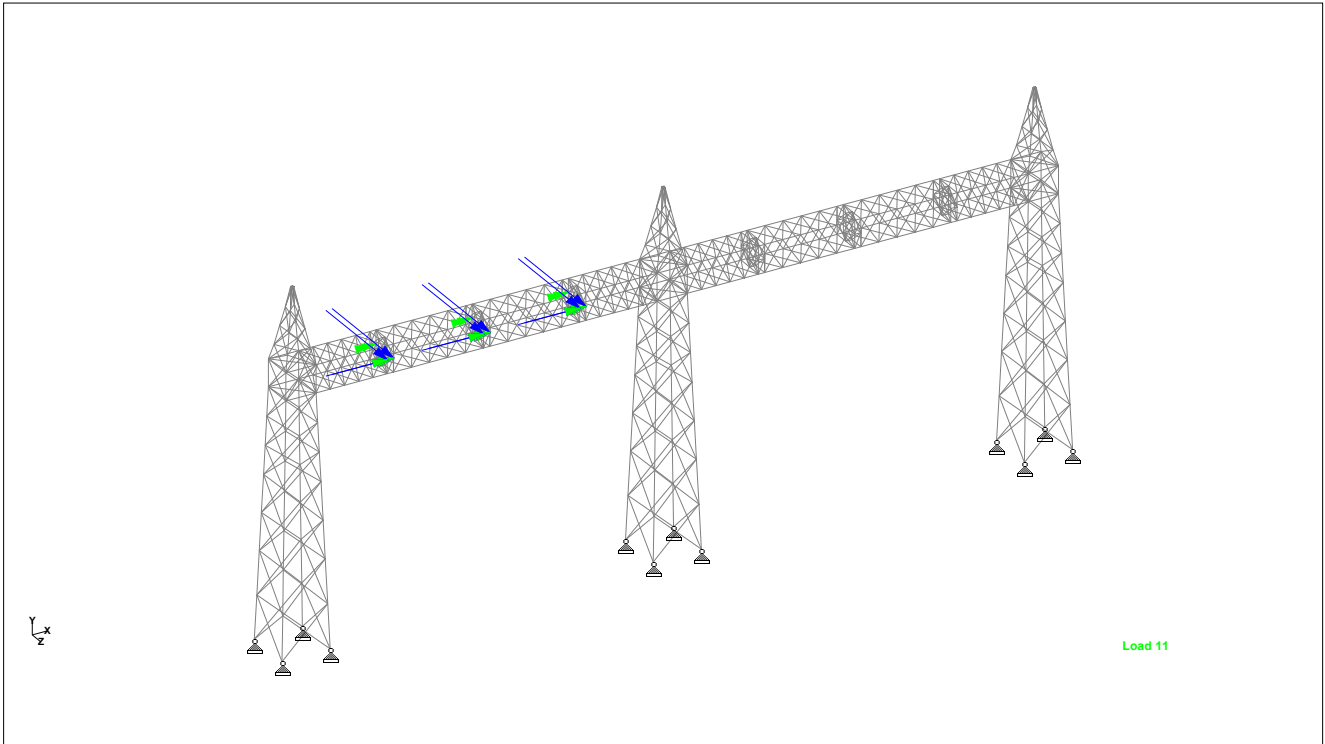


SC(30P-0E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		9	
Job Title	Part		Re f
Client	B y	Date 02-JULY-24	Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD	Date Time 01-Aug-2024 12:27		

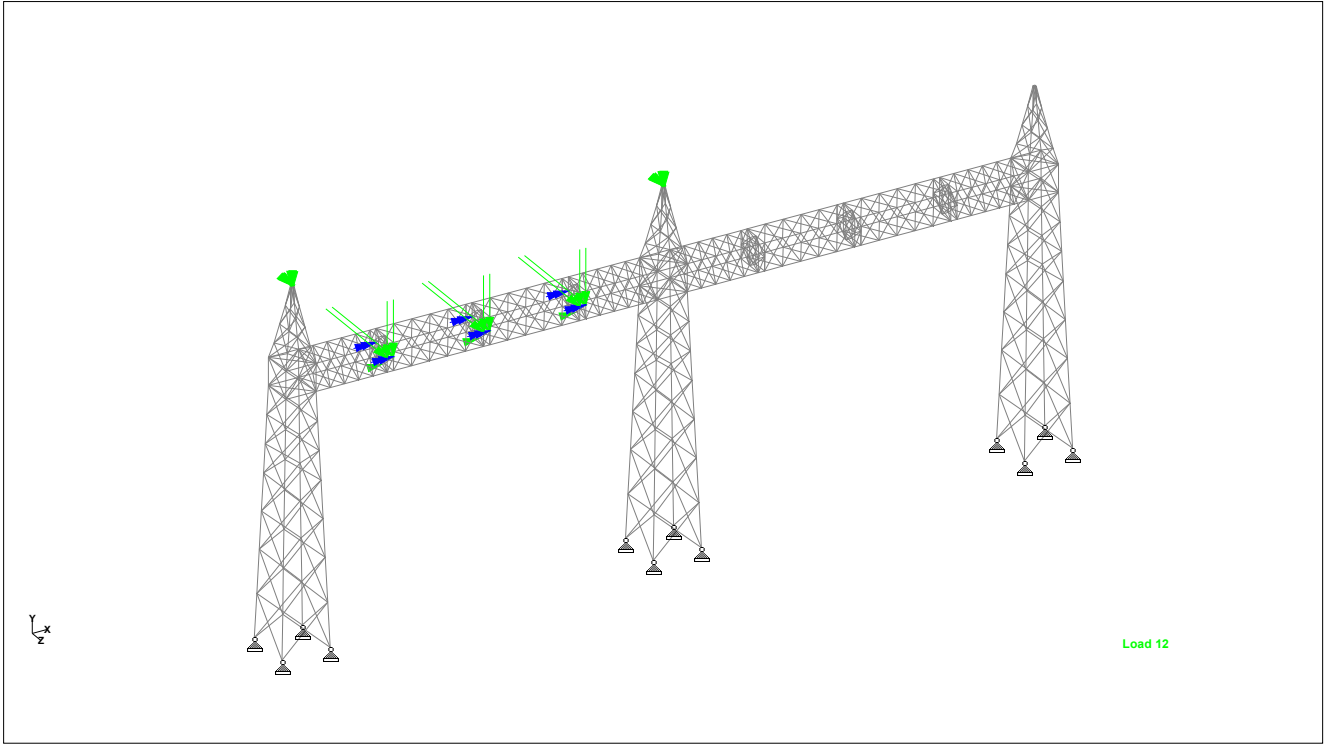


NC(30P-0E) +WIND PERPENDICULAR TO BEAM

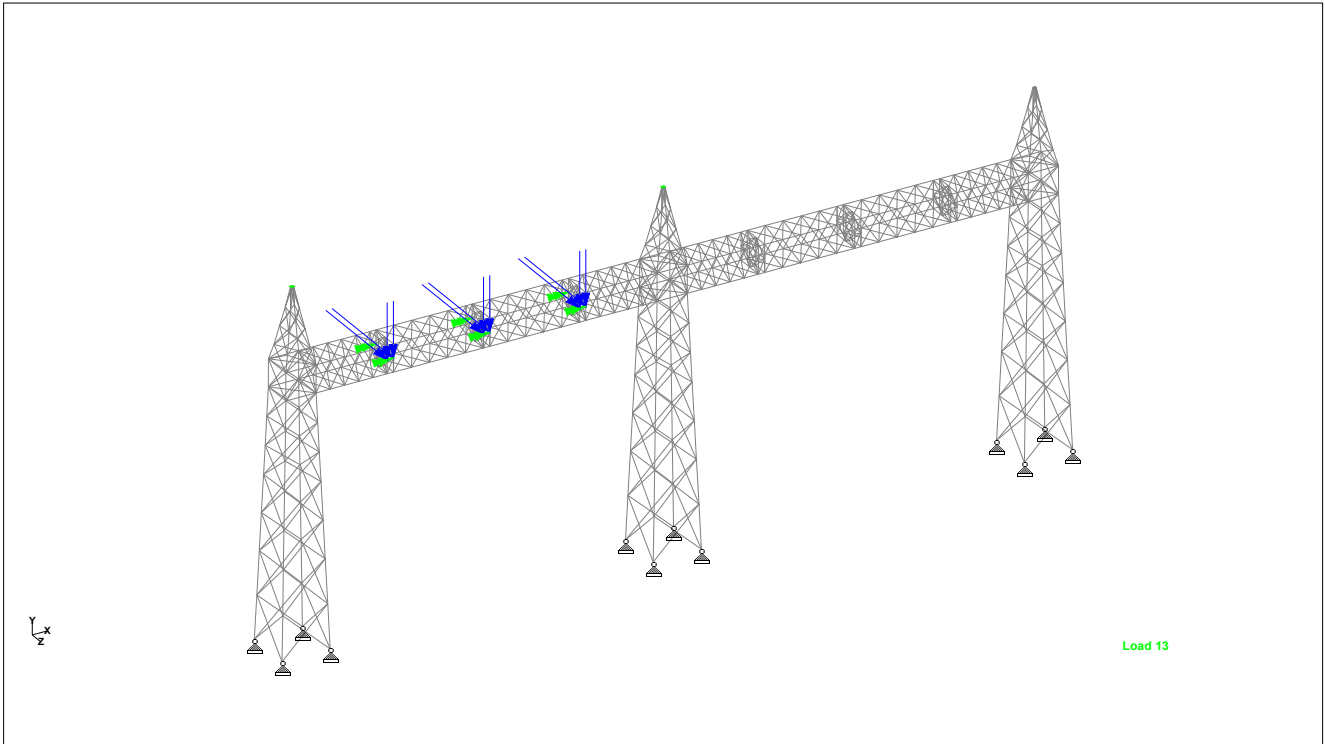


SC(30P-0E) +WIND PERPENDICULAR TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		10	
Job Title	Part	Ref	
Client	By	Date	Chd
File	Date Time		
TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD	01-Aug-2024 12:27		

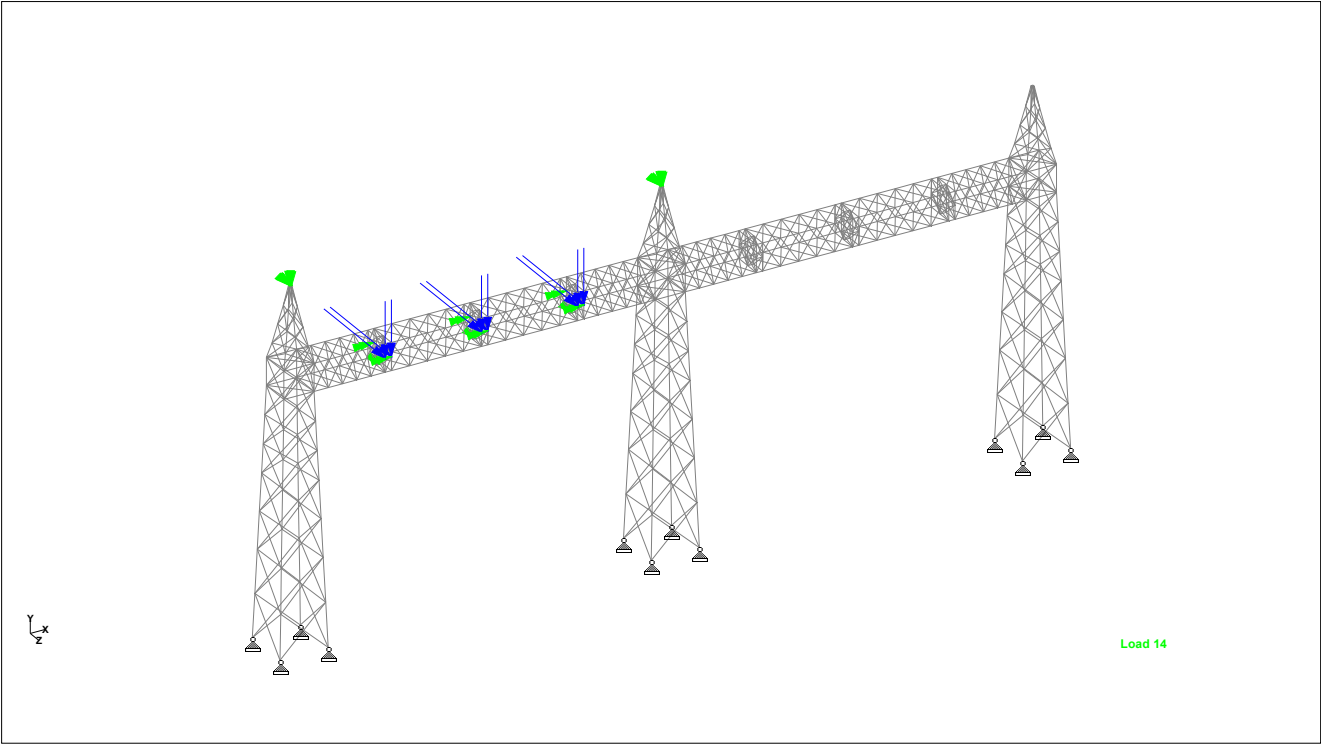


NC(0P-30E) +WIND PARALLEL TO BEAM

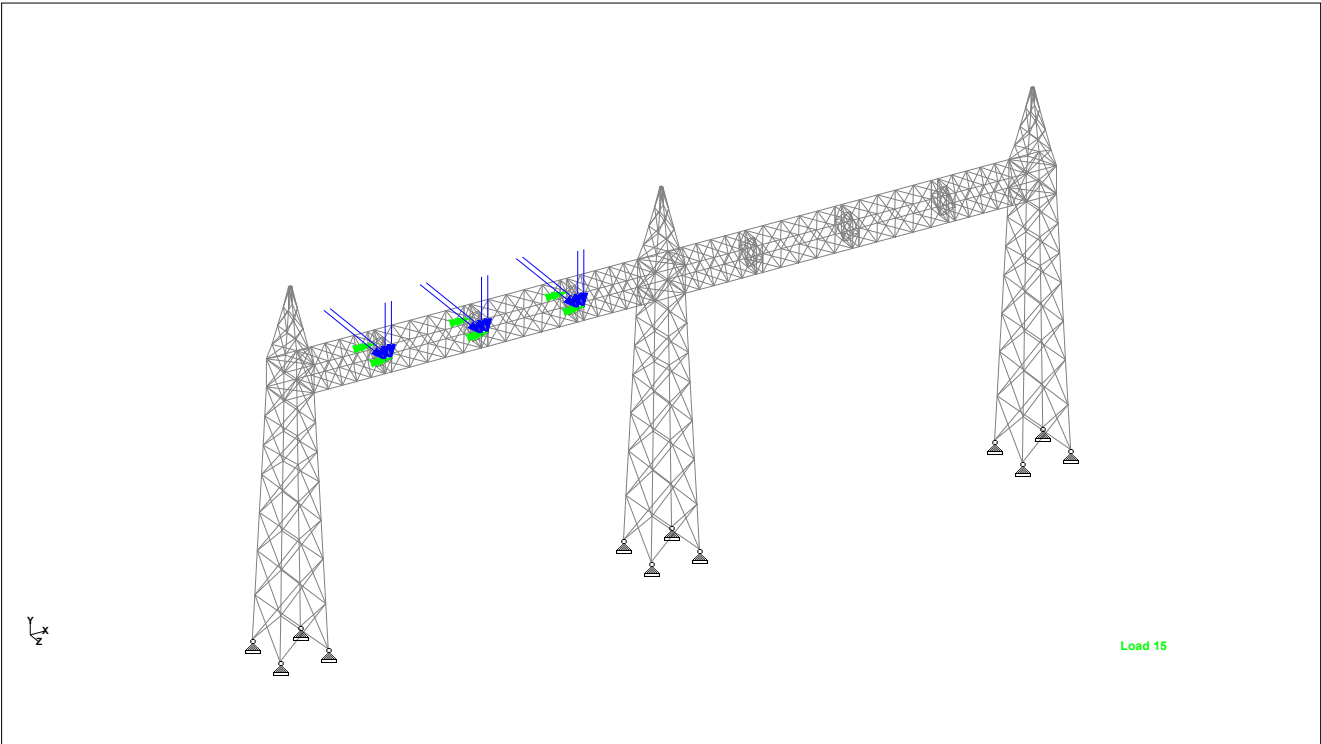


SC(0P-30E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No.	Rev
		11	
Job Title	Part	Ref	
Client	By	Date	Chd
File	Date Time		
TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD	01-Aug-2024 12:27		

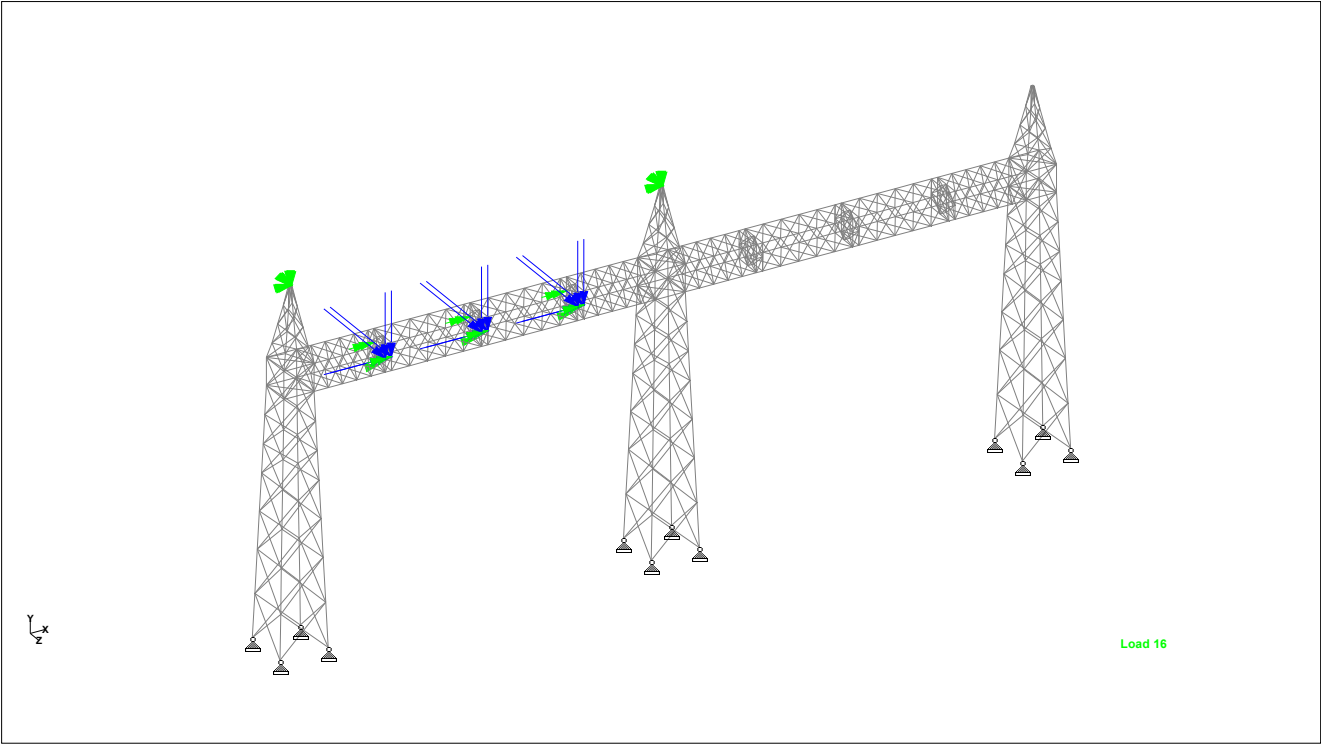


NC(0P-30E) +WIND PERPENDICULAR TO BEAM

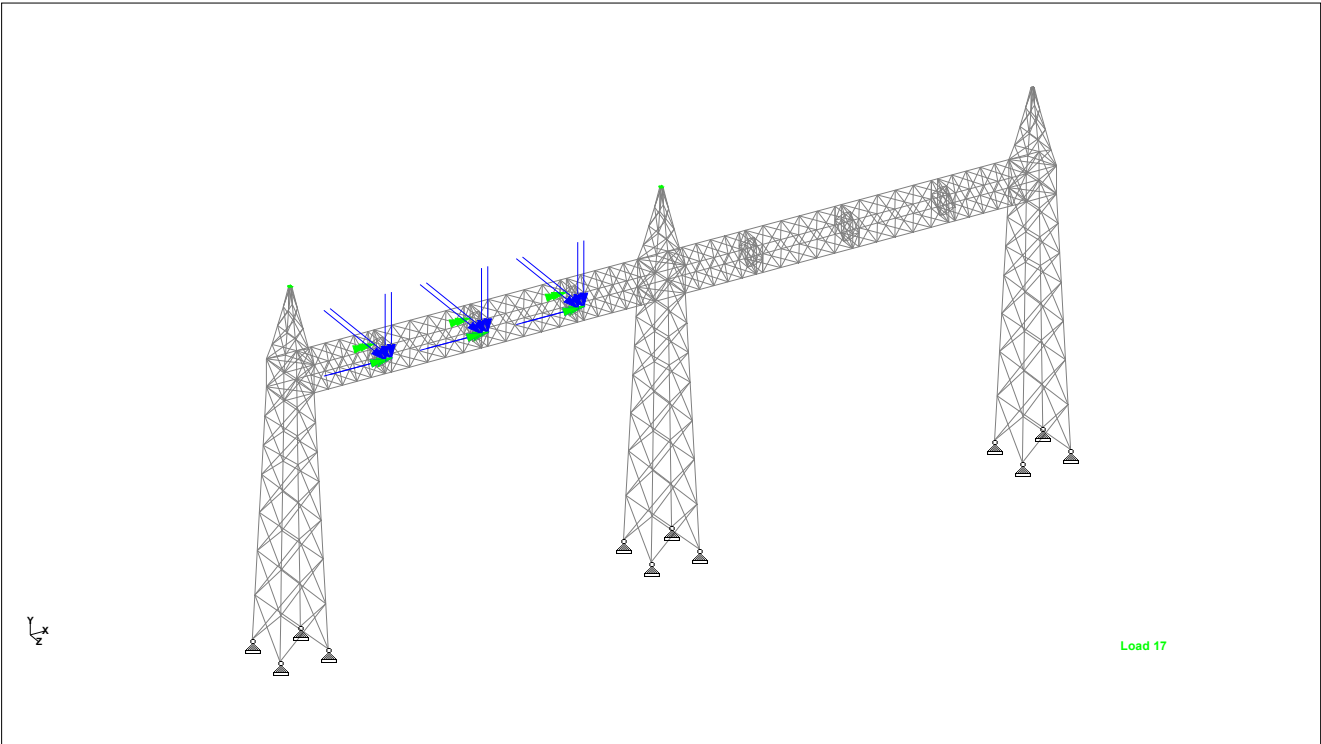


SC(0P-30E) +WIND PERPENDICULAR TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 12	Rev
	Part		Re f
Job Title	Client	By	Date 02-JULY-24
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD		Date Time 01-Aug-2024 12:27	

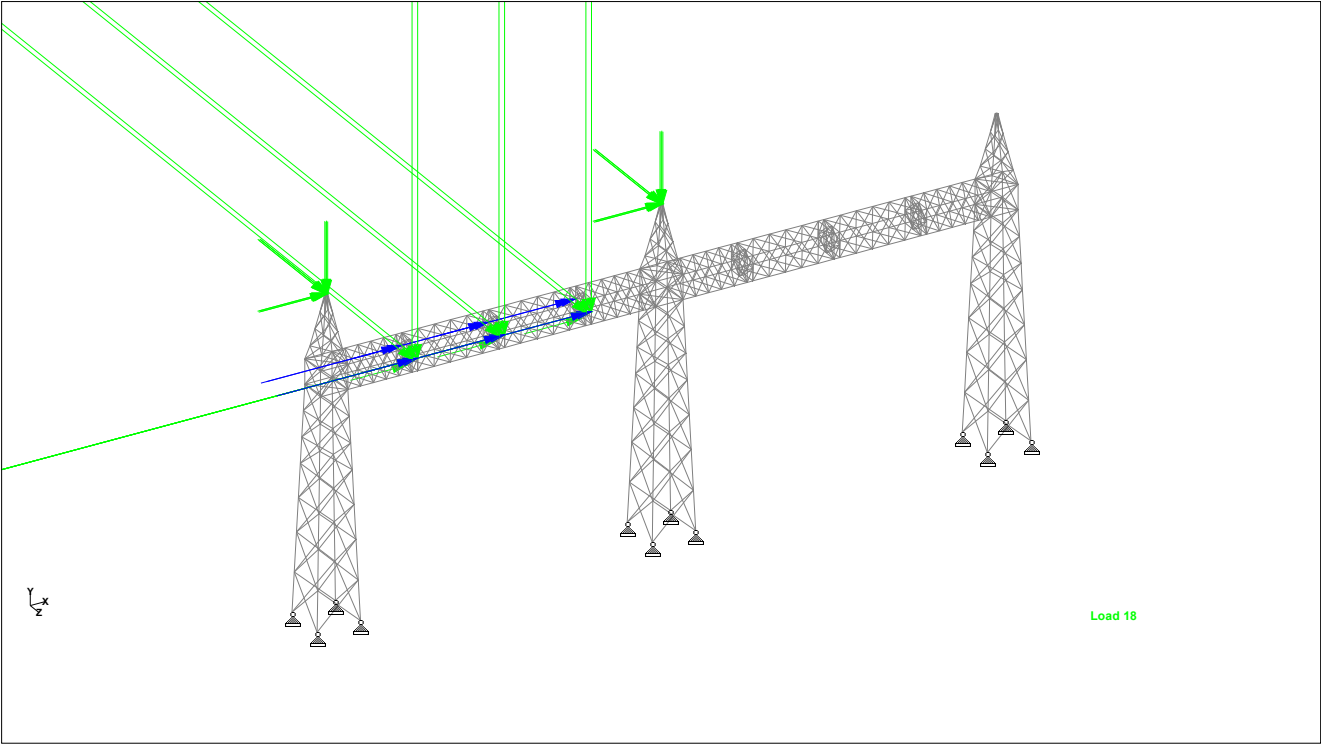


NC(30P-30E) +WIND PARALLEL TO BEAM

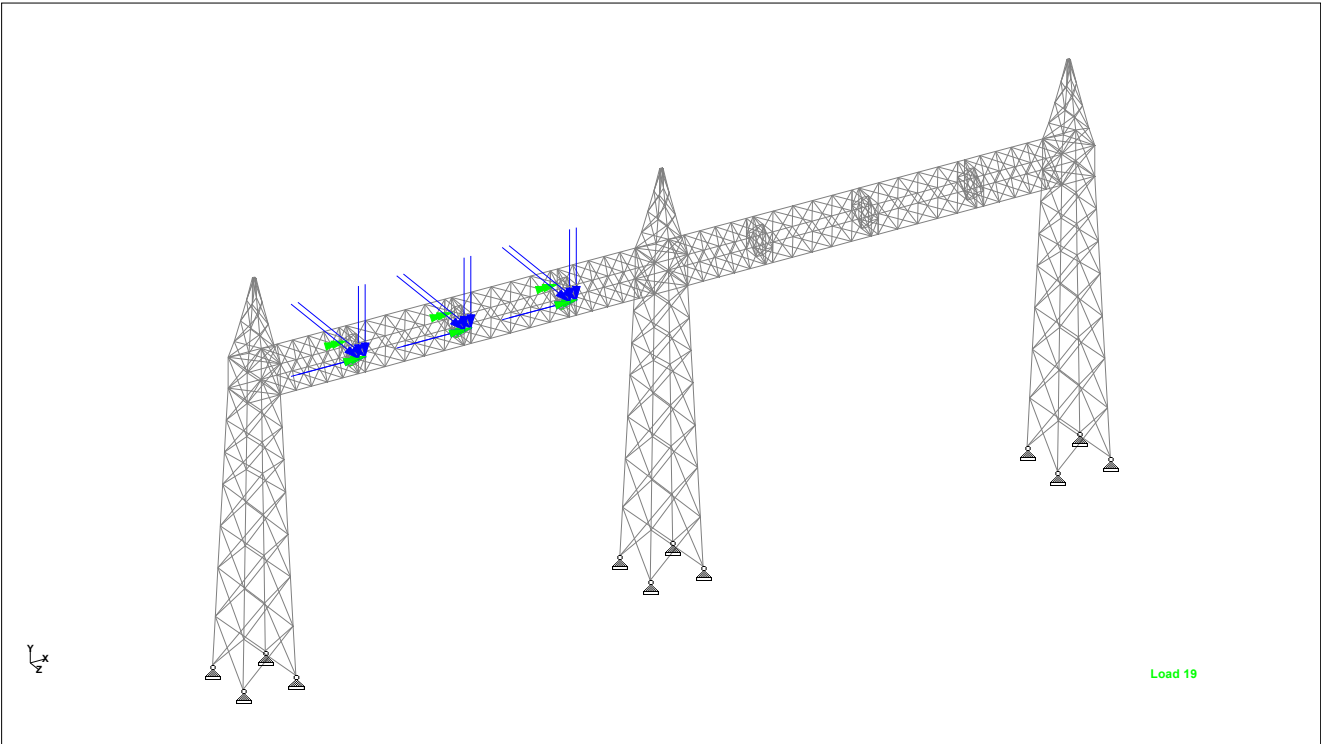


SC(30P-30E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel		Job No.	Sheet No. 13	Rev
Job Title		Part		Ref
Client		By	Date 02-JULY-24	Chd
File TOWER 4T5,4T6,4T2 & BEAM G4,G2.STD		Date Time 01-Aug-2024 12:27		



NC(30P-30E) +WIND PERPENDICULAR TO BEAM



SC(30P-30E) +WIND PERPENDICULAR TO BEAM

STAAD ANALYSIS & DESIGN

```

*****
*
*          STAAD.Pro 2023
*          Version  23.00.03.25
*          Proprietary Program of
*          Bentley Systems, Inc.
*          Date=    AUG 23, 2024
*          Time=    14:59: 4
*
* Licensed to: Anhera Enterprise
*****

```

```

1. STAAD TRUSS
INPUT FILE: Z:\Data\PROJECTS\2024\24P041-MAHAN-GODREJ\DESIGN\400 KV TOW.. .STD
2. START JOB INFORMATION
3. ENGINEER DATE 02-JULY-24
4. END JOB INFORMATION
5. INPUT WIDTH 79
6. UNIT METER KN
7. JOINT COORDINATES
8. 1 0 0 0; 2 3.5 0 0; 3 0 0 3.5; 4 3.5 0 3.5; 5 0.65 19.9 0.65; 6 2.85 19.9 0.65
9. 7 0.65 19.9 2.85; 8 2.85 19.9 2.85; 9 0.65 22.1 0.65; 10 2.85 22.1 0.65
10. 11 2.85 22.1 2.85; 12 0.65 22.1 2.85; 13 1.675 28 1.675; 14 1.825 28 1.675
11. 15 1.825 28 1.825; 16 1.675 28 1.825; 17 0.114 3.5 0.114; 18 0.114 3.5 3.386
12. 19 3.386 3.5 0.114; 20 3.386 3.5 3.386; 21 0.227 7 0.227; 22 0.227 7 3.271
13. 23 3.271 7 0.227; 24 3.271 7 3.271; 25 0.327 10 0.327; 26 0.327 10 3.173
14. 27 3.173 10 0.327; 28 3.173 10 3.173; 29 0.425 13 0.425; 30 0.425 13 3.075
15. 31 3.075 13 0.425; 32 3.075 13 3.075; 33 0.5 15.3 0.5; 34 0.5 15.3 3
16. 35 3 15.3 0.5; 36 3 15.3 3; 37 0.575 17.6 0.575; 38 0.575 17.6 2.925
17. 39 2.925 17.6 0.575; 40 2.925 17.6 2.925; 41 0.911 23.282 0.911
18. 42 0.911 23.282 2.6; 43 2.6 23.282 2.6; 44 2.6 23.282 0.911
19. 45 1.171 24.815 1.171; 46 1.171 24.815 2.34; 47 2.34 24.815 2.34
20. 48 2.34 24.815 1.171; 49 1.432 26.347 1.432; 50 1.432 26.347 2.078
21. 51 2.078 26.347 2.078; 52 2.078 26.347 1.432; 57 3.885 19.9 2.85
22. 58 3.885 22.1 2.85; 59 3.885 22.1 0.65; 60 3.885 19.9 0.65; 61 4.92 19.9 2.85
23. 62 4.92 22.1 2.85; 63 4.92 22.1 0.65; 64 4.92 19.9 0.65; 65 5.955 19.9 2.85
24. 66 5.955 22.1 2.85; 67 5.955 22.1 0.65; 68 5.955 19.9 0.65; 69 6.99 19.9 2.85
25. 70 6.99 22.1 2.85; 71 6.99 22.1 0.65; 72 6.99 19.9 0.65; 77 9.785 19.9 2.85
26. 78 9.785 22.1 2.85; 79 9.785 22.1 0.65; 80 9.785 19.9 0.65
27. 81 11.095 19.9 2.85; 82 11.095 22.1 2.85; 83 11.095 22.1 0.65
28. 84 11.095 19.9 0.65; 85 12.405 19.9 2.85; 86 12.405 22.1 2.85
29. 87 12.405 22.1 0.65; 88 12.405 19.9 0.65; 89 13.715 19.9 2.85
30. 90 13.715 22.1 2.85; 91 13.715 22.1 0.65; 92 13.715 19.9 0.65
31. 93 8.475 19.9 2.85; 94 8.475 22.1 2.85; 95 8.475 22.1 0.65; 96 8.475 19.9 0.65
32. 97 8.025 19.9 2.85; 98 8.025 22.1 2.85; 99 8.025 22.1 0.65
33. 100 8.025 19.9 0.65; 101 15.025 19.9 0.65; 102 15.025 19.9 2.85
34. 103 15.025 22.1 0.65; 104 15.025 22.1 2.85; 109 8.025 22.1 1.75
35. 110 8.475 22.1 1.75; 111 8.025 21 2.85; 112 8.475 21 2.85; 113 8.025 21 0.65
36. 114 8.475 21 0.65; 115 8.025 19.9 1.75; 116 8.475 19.9 1.75
37. 117 27.65 19.9 0.65; 118 27.65 19.9 2.85; 119 27.65 22.1 0.65
38. 120 27.65 22.1 2.85; 121 26.615 19.9 2.85; 122 26.615 22.1 2.85

```

STAAD TRUSS

-- PAGE NO. 2

39. 123 26.615 22.1 0.65; 124 26.615 19.9 0.65; 125 25.58 19.9 2.85
40. 126 25.58 22.1 2.85; 127 25.58 22.1 0.65; 128 25.58 19.9 0.65
41. 129 24.545 19.9 2.85; 130 24.545 22.1 2.85; 131 24.545 22.1 0.65
42. 132 24.545 19.9 0.65; 133 23.51 19.9 2.85; 134 23.51 22.1 2.85
43. 135 23.51 22.1 0.65; 136 23.51 19.9 0.65; 137 20.715 19.9 2.85
44. 138 20.715 22.1 2.85; 139 20.715 22.1 0.65; 140 20.715 19.9 0.65
45. 141 19.405 19.9 2.85; 142 19.405 22.1 2.85; 143 19.405 22.1 0.65
46. 144 19.405 19.9 0.65; 145 18.095 19.9 2.85; 146 18.095 22.1 2.85
47. 147 18.095 22.1 0.65; 148 18.095 19.9 0.65; 149 16.785 19.9 2.85
48. 150 16.785 22.1 2.85; 151 16.785 22.1 0.65; 152 16.785 19.9 0.65
49. 153 22.025 19.9 2.85; 154 22.025 22.1 2.85; 155 22.025 22.1 0.65
50. 156 22.025 19.9 0.65; 157 22.475 19.9 2.85; 158 22.475 22.1 2.85
51. 159 22.475 22.1 0.65; 160 22.475 19.9 0.65; 161 15.475 19.9 0.65
52. 162 15.475 19.9 2.85; 163 15.475 22.1 0.65; 164 15.475 22.1 2.85
53. 165 22.475 22.1 1.75; 166 22.025 22.1 1.75; 167 22.475 21 2.85
54. 168 22.025 21 2.85; 169 22.475 21 0.65; 170 22.025 21 0.65
55. 171 22.475 19.9 1.75; 172 22.025 19.9 1.75; 173 15.025 21 2.85
56. 174 15.025 21 0.65; 175 15.025 22.1 1.75; 176 15.025 19.9 1.75
57. 177 15.475 21 2.85; 178 15.475 21 0.65; 179 15.475 22.1 1.75
58. 180 15.475 19.9 1.75; 181 27 0 0; 182 27.114 3.5 0.114; 183 27 0 3.5
59. 184 27.114 3.5 3.386; 185 30.5 0 0; 186 30.386 3.5 0.114; 187 30.5 0 3.5
60. 188 30.386 3.5 3.386; 189 29.85 19.9 0.65; 190 29.85 19.9 2.85
61. 191 29.85 22.1 0.65; 192 29.85 22.1 2.85; 193 27.911 23.282 0.911
62. 194 27.911 23.282 2.6; 195 29.6 23.282 2.6; 196 29.6 23.282 0.911
63. 197 28.675 28 1.675; 198 28.675 28 1.825; 199 28.825 28 1.825
64. 200 28.825 28 1.675; 201 27.227 7 0.227; 202 27.227 7 3.271
65. 203 30.271 7 0.227; 204 30.271 7 3.271; 205 27.327 10 0.327
66. 206 27.327 10 3.173; 207 30.173 10 0.327; 208 30.173 10 3.173
67. 209 27.425 13 0.425; 210 27.425 13 3.075; 211 30.075 13 0.425
68. 212 30.075 13 3.075; 213 27.5 15.3 0.5; 214 27.5 15.3 3; 215 30 15.3 0.5
69. 216 30 15.3 3; 217 27.575 17.6 0.575; 218 27.575 17.6 2.925
70. 219 29.925 17.6 0.575; 220 29.925 17.6 2.925; 221 28.171 24.815 1.171
71. 222 28.171 24.815 2.34; 223 29.34 24.815 2.34; 224 29.34 24.815 1.171
72. 225 28.432 26.347 1.432; 226 28.432 26.347 2.078; 227 29.078 26.347 2.078
73. 228 29.078 26.347 1.432; 229 30.885 19.9 2.85; 230 30.885 22.1 2.85
74. 231 30.885 22.1 0.65; 232 30.885 19.9 0.65; 233 31.92 19.9 2.85
75. 234 31.92 22.1 2.85; 235 31.92 22.1 0.65; 236 31.92 19.9 0.65
76. 237 32.955 19.9 2.85; 238 32.955 22.1 2.85; 239 32.955 22.1 0.65
77. 240 32.955 19.9 0.65; 241 33.99 19.9 2.85; 242 33.99 22.1 2.85
78. 243 33.99 22.1 0.65; 244 33.99 19.9 0.65; 245 35.025 19.9 2.85
79. 246 35.025 22.1 2.85; 247 35.025 22.1 0.65; 248 35.025 19.9 0.65
80. 249 35.475 19.9 2.85; 250 35.475 22.1 2.85; 251 35.475 22.1 0.65
81. 252 35.475 19.9 0.65; 253 36.785 19.9 2.85; 254 38.095 19.9 2.85
82. 255 36.785 22.1 2.85; 256 38.095 22.1 2.85; 257 36.785 22.1 0.65
83. 258 38.095 22.1 0.65; 259 36.785 19.9 0.65; 260 38.095 19.9 0.65
84. 261 39.405 19.9 2.85; 262 39.405 22.1 2.85; 263 39.405 22.1 0.65
85. 264 39.405 19.9 0.65; 265 40.715 19.9 2.85; 266 40.715 22.1 2.85
86. 267 40.715 22.1 0.65; 268 40.715 19.9 0.65; 269 42.025 19.9 2.85
87. 270 42.025 22.1 2.85; 271 42.025 22.1 0.65; 272 42.025 19.9 0.65
88. 273 42.475 19.9 0.65; 274 42.475 19.9 2.85; 275 42.475 22.1 0.65
89. 276 42.475 22.1 2.85; 277 35.025 22.1 1.75; 278 35.475 22.1 1.75
90. 279 35.025 21 2.85; 280 35.475 21 2.85; 281 35.025 21 0.65; 282 35.475 21 0.65
91. 283 35.025 19.9 1.75; 284 35.475 19.9 1.75; 285 42.025 21 2.85
92. 286 42.025 21 0.65; 287 42.025 22.1 1.75; 288 42.025 19.9 1.75
93. 289 54.65 19.9 2.85; 290 53.615 19.9 2.85; 291 54.65 22.1 2.85
94. 292 53.615 22.1 2.85; 293 54.65 22.1 0.65; 294 53.615 22.1 0.65

STAAD TRUSS

-- PAGE NO. 3

95. 295 54.65 19.9 0.65; 296 53.615 19.9 0.65; 297 52.58 19.9 2.85
 96. 298 52.58 22.1 2.85; 299 52.58 22.1 0.65; 300 52.58 19.9 0.65
 97. 301 51.545 19.9 2.85; 302 51.545 22.1 2.85; 303 51.545 22.1 0.65
 98. 304 51.545 19.9 0.65; 305 50.51 19.9 2.85; 306 50.51 22.1 2.85
 99. 307 50.51 22.1 0.65; 308 50.51 19.9 0.65; 309 49.475 19.9 2.85
 100. 310 49.475 22.1 2.85; 311 49.475 22.1 0.65; 312 49.475 19.9 0.65
 101. 313 49.025 19.9 2.85; 314 49.025 22.1 2.85; 315 49.025 22.1 0.65
 102. 316 49.025 19.9 0.65; 317 47.715 19.9 2.85; 318 46.405 19.9 2.85
 103. 319 47.715 22.1 2.85; 320 46.405 22.1 2.85; 321 47.715 22.1 0.65
 104. 322 46.405 22.1 0.65; 323 47.715 19.9 0.65; 324 46.405 19.9 0.65
 105. 325 45.095 19.9 2.85; 326 45.095 22.1 2.85; 327 45.095 22.1 0.65
 106. 328 45.095 19.9 0.65; 329 43.785 19.9 2.85; 330 43.785 22.1 2.85
 107. 331 43.785 22.1 0.65; 332 43.785 19.9 0.65; 333 49.475 22.1 1.75
 108. 334 49.025 22.1 1.75; 335 49.475 21 2.85; 336 49.025 21 2.85
 109. 337 49.475 21 0.65; 338 49.025 21 0.65; 339 49.475 19.9 1.75
 110. 340 49.025 19.9 1.75; 341 42.475 21 2.85; 342 42.475 21 0.65
 111. 343 42.475 22.1 1.75; 344 42.475 19.9 1.75; 345 54 0 0; 346 54.114 3.5 0.114
 112. 347 54 0 3.5; 348 54.114 3.5 3.386; 349 57.5 0 0; 350 57.386 3.5 0.114
 113. 351 57.5 0 3.5; 352 57.386 3.5 3.386; 353 56.85 19.9 0.65; 354 56.85 19.9 2.85
 114. 355 56.85 22.1 0.65; 356 56.85 22.1 2.85; 357 54.911 23.282 0.911
 115. 358 54.911 23.282 2.6; 359 56.6 23.282 2.6; 360 56.6 23.282 0.911
 116. 361 55.675 28 1.675; 362 55.675 28 1.825; 363 55.825 28 1.825
 117. 364 55.825 28 1.675; 365 54.227 7 0.227; 366 54.227 7 3.271
 118. 367 57.271 7 0.227; 368 57.271 7 3.271; 369 54.327 10 0.327
 119. 370 54.327 10 3.173; 371 57.173 10 0.327; 372 57.173 10 3.173
 120. 373 54.425 13 0.425; 374 54.425 13 3.075; 375 57.075 13 0.425
 121. 376 57.075 13 3.075; 377 54.5 15.3 0.5; 378 54.5 15.3 3; 379 57 15.3 0.5
 122. 380 57 15.3 3; 381 54.575 17.6 0.575; 382 54.575 17.6 2.925
 123. 383 56.925 17.6 0.575; 384 56.925 17.6 2.925; 385 55.171 24.815 1.171
 124. 386 55.171 24.815 2.34; 387 56.34 24.815 2.34; 388 56.34 24.815 1.171
 125. 389 55.432 26.347 1.432; 390 55.432 26.347 2.078; 391 56.078 26.347 2.078
 126. 392 56.078 26.347 1.432
 127. MEMBER INCIDENCES
 128. 1 1 17; 2 3 18; 3 2 19; 4 4 20; 5 5 6; 6 6 8; 7 8 7; 8 7 5; 9 9 10; 10 10 11
 129. 11 11 12; 12 12 9; 13 5 9; 14 7 12; 15 8 11; 16 6 10; 17 9 41; 18 12 42
 130. 19 11 43; 20 10 44; 21 13 16; 22 16 15; 23 15 14; 24 14 13; 25 17 21; 26 18 22
 131. 27 19 23; 28 20 24; 29 21 25; 30 22 26; 31 23 27; 32 24 28; 33 25 29; 34 26 30
 132. 35 27 31; 36 28 32; 37 29 33; 38 30 34; 39 31 35; 40 32 36; 41 33 37; 42 34 38
 133. 43 35 39; 44 36 40; 45 37 5; 46 38 7; 47 39 6; 48 40 8; 49 41 45; 50 42 46
 134. 51 43 47; 52 44 48; 53 45 49; 54 46 50; 55 47 51; 56 48 52; 57 49 13; 58 50 16
 135. 59 51 15; 60 52 14; 117 5 10; 118 6 9; 119 6 11; 120 8 10; 121 7 11; 122 8 12
 136. 123 7 9; 124 5 12; 125 8 5; 126 7 6; 127 9 11; 128 12 10; 161 8 57; 162 11 58
 137. 163 10 59; 164 6 60; 165 57 61; 166 58 62; 167 59 63; 168 60 64; 169 61 65
 138. 170 62 66; 171 63 67; 172 64 68; 173 65 69; 174 66 70; 175 67 71; 176 68 72
 139. 177 69 97; 178 70 98; 179 71 99; 180 72 100; 181 93 97; 182 94 98; 183 95 99
 140. 184 96 100; 185 77 81; 186 78 82; 187 79 83; 188 80 84; 189 81 85; 190 82 86
 141. 191 83 87; 192 84 88; 193 85 89; 194 86 90; 195 87 91; 196 88 92; 197 89 102
 142. 198 90 104; 199 91 103; 200 92 101; 201 93 77; 202 94 78; 203 95 79; 204 96 80
 143. 209 101 161; 210 102 162; 211 103 163; 212 104 164; 213 99 109; 214 95 110
 144. 215 98 111; 216 94 112; 217 99 113; 218 95 114; 219 100 115; 220 96 116
 145. 221 109 98; 222 110 94; 223 111 97; 224 112 93; 225 113 100; 226 114 96
 146. 227 115 97; 228 116 93; 229 113 109; 230 109 111; 231 111 115; 232 115 113
 147. 233 109 110; 234 111 112; 235 115 116; 236 113 114; 237 110 114; 238 110 112
 148. 239 112 116; 240 116 114; 241 110 116; 242 112 114; 243 109 115; 244 111 113
 149. 245 97 112; 246 111 94; 247 100 114; 248 113 95; 249 8 58; 250 57 11
 150. 251 57 62; 252 61 58; 253 61 66; 254 65 62; 255 65 70; 256 69 66; 257 69 98

STAAD TRUSS

-- PAGE NO. 4

151. 258 97 70; 259 6 59; 260 60 10; 261 60 63; 262 64 59; 263 64 67; 264 68 63
152. 265 68 71; 266 72 67; 267 72 99; 268 100 71; 269 11 59; 270 58 10; 271 58 63
153. 272 62 59; 273 62 67; 274 66 63; 275 66 71; 276 70 67; 277 70 99; 278 71 98
154. 279 8 60; 280 57 6; 281 57 64; 282 61 60; 283 61 68; 284 65 64; 285 65 72
155. 286 69 68; 287 69 100; 288 72 97; 289 94 77; 290 93 78; 291 77 82; 292 81 78
156. 293 82 85; 294 81 86; 295 86 89; 296 85 90; 297 90 102; 298 89 104
157. 299 104 173; 300 95 80; 301 96 79; 302 80 83; 303 84 79; 304 83 88; 305 84 87
158. 306 87 92; 307 88 91; 308 91 101; 309 92 103; 310 103 174; 311 94 79
159. 312 78 95; 313 78 83; 314 79 82; 315 82 87; 316 83 86; 317 87 90; 318 86 91
160. 319 91 104; 320 90 103; 321 104 175; 322 93 80; 323 77 96; 324 77 84
161. 325 80 81; 326 81 88; 327 84 85; 328 88 89; 329 85 92; 330 92 102; 331 89 101
162. 332 102 176; 337 118 121; 338 120 122; 339 119 123; 340 117 124; 341 121 125
163. 342 122 126; 343 123 127; 344 124 128; 345 125 129; 346 126 130; 347 127 131
164. 348 128 132; 349 129 133; 350 130 134; 351 131 135; 352 132 136; 353 133 157
165. 354 134 158; 355 135 159; 356 136 160; 357 153 157; 358 154 158; 359 155 159
166. 360 156 160; 361 137 141; 362 138 142; 363 139 143; 364 140 144; 365 141 145
167. 366 142 146; 367 143 147; 368 144 148; 369 145 149; 370 146 150; 371 147 151
168. 372 148 152; 373 149 162; 374 150 164; 375 151 163; 376 152 161; 377 153 137
169. 378 154 138; 379 155 139; 380 156 140; 385 159 165; 386 155 166; 387 158 167
170. 388 154 168; 389 159 169; 390 155 170; 391 160 171; 392 156 172; 393 165 158
171. 394 166 154; 395 167 157; 396 168 153; 397 169 160; 398 170 156; 399 171 157
172. 400 172 153; 401 169 165; 402 165 167; 403 167 171; 404 171 169; 405 165 166
173. 406 167 168; 407 171 172; 408 169 170; 409 166 170; 410 166 168; 411 168 172
174. 412 172 170; 413 166 172; 414 168 170; 415 165 171; 416 167 169; 417 157 168
175. 418 167 154; 419 160 170; 420 169 155; 421 118 122; 422 121 120; 423 121 126
176. 424 125 122; 425 125 130; 426 129 126; 427 129 134; 428 133 130; 429 133 158
177. 430 157 134; 431 117 123; 432 124 119; 433 124 127; 434 128 123; 435 128 131
178. 436 132 127; 437 132 135; 438 136 131; 439 136 159; 440 160 135; 441 120 123
179. 442 122 119; 443 122 127; 444 126 123; 445 126 131; 446 130 127; 447 130 135
180. 448 134 131; 449 134 159; 450 135 158; 451 118 124; 452 121 117; 453 121 128
181. 454 125 124; 455 125 132; 456 129 128; 457 129 136; 458 133 132; 459 133 160
182. 460 136 157; 461 154 137; 462 153 138; 463 137 142; 464 141 138; 465 142 145
183. 466 141 146; 467 146 149; 468 145 150; 469 150 162; 470 149 164; 471 164 177
184. 472 155 140; 473 156 139; 474 140 143; 475 144 139; 476 143 148; 477 144 147
185. 478 147 152; 479 148 151; 480 151 161; 481 152 163; 482 163 178; 483 154 139
186. 484 138 155; 485 138 143; 486 139 142; 487 142 147; 488 143 146; 489 147 150
187. 490 146 151; 491 151 164; 492 150 163; 493 164 179; 494 153 140; 495 137 156
188. 496 137 144; 497 140 141; 498 141 148; 499 144 145; 500 148 149; 501 145 152
189. 502 152 162; 503 149 161; 504 162 180; 505 173 102; 506 174 101; 507 175 103
190. 508 176 101; 509 177 162; 510 178 161; 511 179 163; 512 180 161; 513 174 175
191. 514 175 173; 515 173 176; 516 176 174; 517 173 177; 518 176 180; 519 174 178
192. 520 175 179; 521 179 177; 522 177 180; 523 178 179; 524 178 180; 525 102 177
193. 526 173 164; 527 174 163; 528 101 178; 531 175 176; 533 178 177; 534 174 173
194. 535 179 180; 690 98 110; 691 109 95; 692 97 116; 693 115 96; 694 102 180
195. 695 176 161; 696 104 179; 697 175 163; 698 153 171; 699 172 160; 700 154 165
196. 701 166 159; 702 3 20; 703 20 22; 704 22 28; 705 28 30; 706 30 36; 707 36 38
197. 708 38 8; 709 7 40; 710 40 34; 711 34 32; 712 32 26; 713 26 24; 714 24 18
198. 715 18 4; 716 1 18; 717 3 17; 718 17 22; 719 18 21; 720 21 26; 721 22 25
199. 722 25 30; 723 26 29; 724 29 34; 725 30 33; 726 33 38; 727 34 37; 728 37 7
200. 729 38 5; 730 2 17; 731 1 19; 732 19 21; 733 17 23; 734 23 25; 735 21 27
201. 736 27 29; 737 25 31; 738 31 33; 739 29 35; 740 35 37; 741 33 39; 742 39 5
202. 743 37 6; 744 4 19; 745 2 20; 746 20 23; 747 19 24; 748 24 27; 749 23 28
203. 750 28 31; 751 27 32; 752 31 36; 753 32 35; 754 35 40; 755 36 39; 756 39 8
204. 757 40 6; 758 9 44; 759 10 41; 760 41 48; 761 44 45; 762 45 52; 763 48 49
205. 764 49 14; 765 52 13; 766 10 43; 767 11 44; 768 44 47; 769 43 48; 770 48 51
206. 771 47 52; 772 52 15; 773 51 14; 774 11 42; 775 12 43; 776 43 46; 777 42 47

STAAD TRUSS

-- PAGE NO. 5

207. 778 47 50; 779 46 51; 780 51 16; 781 50 15; 782 9 42; 783 12 41; 784 41 46
208. 785 42 45; 786 45 50; 787 46 49; 788 50 13; 789 49 16; 790 181 182
209. 791 183 184; 792 185 186; 793 187 188; 794 117 189; 795 189 190; 796 190 118
210. 797 118 117; 798 119 191; 799 191 192; 800 192 120; 801 120 119; 802 117 119
211. 803 118 120; 804 190 192; 805 189 191; 806 119 193; 807 120 194; 808 192 195
212. 809 191 196; 810 197 198; 811 198 199; 812 199 200; 813 200 197; 814 182 201
213. 815 184 202; 816 186 203; 817 188 204; 818 201 205; 819 202 206; 820 203 207
214. 821 204 208; 822 205 209; 823 206 210; 824 207 211; 825 208 212; 826 209 213
215. 827 210 214; 828 211 215; 829 212 216; 830 213 217; 831 214 218; 832 215 219
216. 833 216 220; 834 217 117; 835 218 118; 836 219 189; 837 220 190; 838 193 221
217. 839 194 222; 840 195 223; 841 196 224; 842 221 225; 843 222 226; 844 223 227
218. 845 224 228; 846 225 197; 847 226 198; 848 227 199; 849 228 200; 850 117 191
219. 851 189 119; 852 189 192; 853 190 191; 854 118 192; 855 190 120; 856 118 119
220. 857 117 120; 858 190 117; 859 118 189; 860 119 192; 861 120 191; 862 183 188
221. 863 188 202; 864 202 208; 865 208 210; 866 210 216; 867 216 218; 868 218 190
222. 869 118 220; 870 220 214; 871 214 212; 872 212 206; 873 206 204; 874 204 184
223. 875 184 187; 876 181 184; 877 183 182; 878 182 202; 879 184 201; 880 201 206
224. 881 202 205; 882 205 210; 883 206 209; 884 209 214; 885 210 213; 886 213 218
225. 887 214 217; 888 217 118; 889 218 117; 890 185 182; 891 181 186; 892 186 201
226. 893 182 203; 894 203 205; 895 201 207; 896 207 209; 897 205 211; 898 211 213
227. 899 209 215; 900 215 217; 901 213 219; 902 219 117; 903 217 189; 904 187 186
228. 905 185 188; 906 188 203; 907 186 204; 908 204 207; 909 203 208; 910 208 211
229. 911 207 212; 912 211 216; 913 212 215; 914 215 220; 915 216 219; 916 219 190
230. 917 220 189; 918 119 196; 919 191 193; 920 193 224; 921 196 221; 922 221 228
231. 923 224 225; 924 225 200; 925 228 197; 926 191 195; 927 192 196; 928 196 223
232. 929 195 224; 930 224 227; 931 223 228; 932 228 199; 933 227 200; 934 192 194
233. 935 120 195; 936 195 222; 937 194 223; 938 223 226; 939 222 227; 940 227 198
234. 941 226 199; 942 119 194; 943 120 193; 944 193 222; 945 194 221; 946 221 226
235. 947 222 225; 948 226 197; 949 225 198; 950 190 229; 951 192 230; 952 191 231
236. 953 189 232; 954 229 233; 955 230 234; 956 231 235; 957 232 236; 958 233 237
237. 959 234 238; 960 235 239; 961 236 240; 962 237 241; 963 238 242; 964 239 243
238. 965 240 244; 966 241 245; 967 242 246; 968 243 247; 969 244 248; 970 249 245
239. 971 250 246; 972 251 247; 973 252 248; 974 253 254; 975 255 256; 976 257 258
240. 977 259 260; 978 254 261; 979 256 262; 980 258 263; 981 260 264; 982 261 265
241. 983 262 266; 984 263 267; 985 264 268; 986 265 269; 987 266 270; 988 267 271
242. 989 268 272; 990 249 253; 991 250 255; 992 251 257; 993 252 259; 994 272 273
243. 995 269 274; 996 271 275; 997 270 276; 998 247 277; 999 251 278; 1000 246 279
244. 1001 250 280; 1002 247 281; 1003 251 282; 1004 248 283; 1005 252 284
245. 1006 277 246; 1007 278 250; 1008 279 245; 1009 280 249; 1010 281 248
246. 1011 282 252; 1012 283 245; 1013 284 249; 1014 281 277; 1015 277 279
247. 1016 279 283; 1017 283 281; 1018 277 278; 1019 279 280; 1020 283 284
248. 1021 281 282; 1022 278 282; 1023 278 280; 1024 280 284; 1025 284 282
249. 1026 278 284; 1027 280 282; 1028 277 283; 1029 279 281; 1030 245 280
250. 1031 279 250; 1032 248 282; 1033 281 251; 1034 190 230; 1035 229 192
251. 1036 229 234; 1037 233 230; 1038 233 238; 1039 237 234; 1040 237 242
252. 1041 241 238; 1042 241 246; 1043 245 242; 1044 189 231; 1045 232 191
253. 1046 232 235; 1047 236 231; 1048 236 239; 1049 240 235; 1050 240 243
254. 1051 244 239; 1052 244 247; 1053 248 243; 1054 192 231; 1055 230 191
255. 1056 230 235; 1057 234 231; 1058 234 239; 1059 238 235; 1060 238 243
256. 1061 242 239; 1062 242 247; 1063 243 246; 1064 190 232; 1065 229 189
257. 1066 229 236; 1067 233 232; 1068 233 240; 1069 237 236; 1070 237 244
258. 1071 241 240; 1072 241 248; 1073 244 245; 1074 250 253; 1075 249 255
259. 1076 253 256; 1077 254 255; 1078 256 261; 1079 254 262; 1080 262 265
260. 1081 261 266; 1082 266 269; 1083 265 270; 1084 270 285; 1085 251 259
261. 1086 252 257; 1087 259 258; 1088 260 257; 1089 258 264; 1090 260 263
262. 1091 263 268; 1092 264 267; 1093 267 272; 1094 268 271; 1095 271 286

STAAD TRUSS

-- PAGE NO. 6

263. 1096 250 257; 1097 255 251; 1098 255 258; 1099 257 256; 1100 256 263
 264. 1101 258 262; 1102 263 266; 1103 262 267; 1104 267 270; 1105 266 271
 265. 1106 270 287; 1107 249 259; 1108 253 252; 1109 253 260; 1110 259 254
 266. 1111 254 264; 1112 260 261; 1113 264 265; 1114 261 268; 1115 268 269
 267. 1116 265 272; 1117 269 288; 1118 289 290; 1119 291 292; 1120 293 294
 268. 1121 295 296; 1122 290 297; 1123 292 298; 1124 294 299; 1125 296 300
 269. 1126 297 301; 1127 298 302; 1128 299 303; 1129 300 304; 1130 301 305
 270. 1131 302 306; 1132 303 307; 1133 304 308; 1134 305 309; 1135 306 310
 271. 1136 307 311; 1137 308 312; 1138 313 309; 1139 314 310; 1140 315 311
 272. 1141 316 312; 1142 317 318; 1143 319 320; 1144 321 322; 1145 323 324
 273. 1146 318 325; 1147 320 326; 1148 322 327; 1149 324 328; 1150 325 329
 274. 1151 326 330; 1152 327 331; 1153 328 332; 1154 329 274; 1155 330 276
 275. 1156 331 275; 1157 332 273; 1158 313 317; 1159 314 319; 1160 315 321
 276. 1161 316 323; 1162 311 333; 1163 315 334; 1164 310 335; 1165 314 336
 277. 1166 311 337; 1167 315 338; 1168 312 339; 1169 316 340; 1170 333 310
 278. 1171 334 314; 1172 335 309; 1173 336 313; 1174 337 312; 1175 338 316
 279. 1176 339 309; 1177 340 313; 1178 337 333; 1179 333 335; 1180 335 339
 280. 1181 339 337; 1182 333 334; 1183 335 336; 1184 339 340; 1185 337 338
 281. 1186 334 338; 1187 334 336; 1188 336 340; 1189 340 338; 1190 334 340
 282. 1191 336 338; 1192 333 339; 1193 335 337; 1194 309 336; 1195 335 314
 283. 1196 312 338; 1197 337 315; 1198 289 292; 1199 290 291; 1200 290 298
 284. 1201 297 292; 1202 297 302; 1203 301 298; 1204 301 306; 1205 305 302
 285. 1206 305 310; 1207 309 306; 1208 295 294; 1209 296 293; 1210 296 299
 286. 1211 300 294; 1212 300 303; 1213 304 299; 1214 304 307; 1215 308 303
 287. 1216 308 311; 1217 312 307; 1218 291 294; 1219 292 293; 1220 292 299
 288. 1221 298 294; 1222 298 303; 1223 302 299; 1224 302 307; 1225 306 303
 289. 1226 306 311; 1227 307 310; 1228 289 296; 1229 290 295; 1230 290 300
 290. 1231 297 296; 1232 297 304; 1233 301 300; 1234 301 308; 1235 305 304
 291. 1236 305 312; 1237 308 309; 1238 314 317; 1239 313 319; 1240 317 320
 292. 1241 318 319; 1242 320 325; 1243 318 326; 1244 326 329; 1245 325 330
 293. 1246 330 274; 1247 329 276; 1248 276 341; 1249 315 323; 1250 316 321
 294. 1251 323 322; 1252 324 321; 1253 322 328; 1254 324 327; 1255 327 332
 295. 1256 328 331; 1257 331 273; 1258 332 275; 1259 275 342; 1260 314 321
 296. 1261 319 315; 1262 319 322; 1263 321 320; 1264 320 327; 1265 322 326
 297. 1266 327 330; 1267 326 331; 1268 331 276; 1269 330 275; 1270 276 343
 298. 1271 313 323; 1272 317 316; 1273 317 324; 1274 323 318; 1275 318 328
 299. 1276 324 325; 1277 328 329; 1278 325 332; 1279 332 274; 1280 329 273
 300. 1281 274 344; 1282 285 269; 1283 286 272; 1284 287 271; 1285 288 272
 301. 1286 341 274; 1287 342 273; 1288 343 275; 1289 344 273; 1290 286 287
 302. 1291 287 285; 1292 285 288; 1293 288 286; 1294 285 341; 1295 288 344
 303. 1296 286 342; 1297 287 343; 1298 343 341; 1299 341 344; 1300 342 343
 304. 1301 342 344; 1302 269 341; 1303 285 276; 1304 286 275; 1305 272 342
 305. 1306 287 288; 1307 342 341; 1308 286 285; 1309 343 344; 1310 246 278
 306. 1311 277 251; 1312 245 284; 1313 283 252; 1314 269 344; 1315 288 273
 307. 1316 270 343; 1317 287 275; 1318 313 339; 1319 340 312; 1320 314 333
 308. 1321 334 311; 1322 345 346; 1323 347 348; 1324 349 350; 1325 351 352
 309. 1326 295 353; 1327 353 354; 1328 354 289; 1329 289 295; 1330 293 355
 310. 1331 355 356; 1332 356 291; 1333 291 293; 1334 295 293; 1335 289 291
 311. 1336 354 356; 1337 353 355; 1338 293 357; 1339 291 358; 1340 356 359
 312. 1341 355 360; 1342 361 362; 1343 362 363; 1344 363 364; 1345 364 361
 313. 1346 346 365; 1347 348 366; 1348 350 367; 1349 352 368; 1350 365 369
 314. 1351 366 370; 1352 367 371; 1353 368 372; 1354 369 373; 1355 370 374
 315. 1356 371 375; 1357 372 376; 1358 373 377; 1359 374 378; 1360 375 379
 316. 1361 376 380; 1362 377 381; 1363 378 382; 1364 379 383; 1365 380 384
 317. 1366 381 295; 1367 382 289; 1368 383 353; 1369 384 354; 1370 357 385
 318. 1371 358 386; 1372 359 387; 1373 360 388; 1374 385 389; 1375 386 390

STAAD TRUSS

-- PAGE NO. 7

319. 1376 387 391; 1377 388 392; 1378 389 361; 1379 390 362; 1380 391 363
320. 1381 392 364; 1382 295 355; 1383 353 293; 1384 353 356; 1385 354 355
321. 1386 289 356; 1387 354 291; 1388 289 293; 1389 295 291; 1390 354 295
322. 1391 289 353; 1392 293 356; 1393 291 355; 1394 347 352; 1395 352 366
323. 1396 366 372; 1397 372 374; 1398 374 380; 1399 380 382; 1400 382 354
324. 1401 289 384; 1402 384 378; 1403 378 376; 1404 376 370; 1405 370 368
325. 1406 368 348; 1407 348 351; 1408 345 348; 1409 347 346; 1410 346 366
326. 1411 348 365; 1412 365 370; 1413 366 369; 1414 369 374; 1415 370 373
327. 1416 373 378; 1417 374 377; 1418 377 382; 1419 378 381; 1420 381 289
328. 1421 382 295; 1422 349 346; 1423 345 350; 1424 350 365; 1425 346 367
329. 1426 367 369; 1427 365 371; 1428 371 373; 1429 369 375; 1430 375 377
330. 1431 373 379; 1432 379 381; 1433 377 383; 1434 383 295; 1435 381 353
331. 1436 351 350; 1437 349 352; 1438 352 367; 1439 350 368; 1440 368 371
332. 1441 367 372; 1442 372 375; 1443 371 376; 1444 375 380; 1445 376 379
333. 1446 379 384; 1447 380 383; 1448 383 354; 1449 384 353; 1450 293 360
334. 1451 355 357; 1452 357 388; 1453 360 385; 1454 385 392; 1455 388 389
335. 1456 389 364; 1457 392 361; 1458 355 359; 1459 356 360; 1460 360 387
336. 1461 359 388; 1462 388 391; 1463 387 392; 1464 392 363; 1465 391 364
337. 1466 356 358; 1467 291 359; 1468 359 386; 1469 358 387; 1470 387 390
338. 1471 386 391; 1472 391 362; 1473 390 363; 1474 293 358; 1475 291 357
339. 1476 357 386; 1477 358 385; 1478 385 390; 1479 386 389; 1480 390 361
340. 1481 389 362
341. DEFINE MATERIAL START
342. ISOTROPIC STEEL
343. E 2.05E+008
344. POISSON 0.3
345. DENSITY 76.8195
346. ALPHA 1.2E-005
347. DAMP 0.03
348. G 7.88462E+007
349. TYPE STEEL
350. STRENGTH RY 1.5 RT 1.2
351. END DEFINE MATERIAL
352. MEMBER PROPERTY INDIAN
353. 1 TO 4 25 TO 28 TABLE ST ISA200X200X20
354. 29 TO 36 TABLE ST ISA150X150X20
355. 13 TO 16 37 TO 48 TABLE ST ISA150X150X16
356. 17 TO 20 49 TO 60 TABLE ST ISA75X75X5
357. 5 TO 12 161 TO 180 337 TO 356 794 TO 801 TABLE ST ISA130X130X12
358. 181 TO 204 209 TO 212 357 TO 380 TABLE ST ISA150X150X16
359. 21 TO 24 810 TO 813 1342 TO 1345 TABLE ST ISA50X50X5
360. 702 TO 705 712 TO 723 730 TO 737 744 TO 751 TABLE ST ISA90X90X6
361. 117 TO 124 706 TO 711 724 TO 729 738 TO 743 752 TO 757 TABLE ST ISA100X100X10
362. 758 TO 789 TABLE ST ISA50X50X5
363. 125 TO 128 249 TO 288 421 TO 460 858 TO 861 TABLE ST ISA90X90X6
364. 213 TO 248 299 310 321 332 385 TO 420 471 482 493 504 TO 528 531 533 TO 535 -
365. 690 TO 701 TABLE ST ISA100X100X10
366. 289 TO 298 300 TO 309 311 TO 320 322 TO 331 461 TO 470 472 TO 481 483 TO 492 -
367. 494 TO 503 TABLE ST ISA65X65X5
368. 790 TO 793 814 TO 817 TABLE ST ISA200X200X20
369. 818 TO 825 TABLE ST ISA150X150X20
370. 802 TO 805 826 TO 837 TABLE ST ISA150X150X16
371. 806 TO 809 838 TO 849 TABLE ST ISA75X75X5
372. 1322 TO 1325 1346 TO 1349 TABLE ST ISA150X150X16
373. 1350 TO 1357 TABLE ST ISA130X130X12
374. 1334 TO 1337 1358 TO 1369 TABLE ST ISA130X130X10

STAAD TRUSS

-- PAGE NO. 8

375. 1338 TO 1341 1370 TO 1381 TABLE ST ISA75X75X5
376. 862 TO 865 872 TO 883 890 TO 897 904 TO 911 TABLE ST ISA90X90X6
377. 850 TO 857 866 TO 871 884 TO 889 898 TO 903 912 TO 917 TABLE ST ISA100X100X10
378. 918 TO 949 TABLE ST ISA50X50X5
379. 1394 TO 1397 1404 TO 1415 1422 TO 1429 1436 TO 1443 TABLE ST ISA75X75X5
380. 1382 TO 1389 1398 TO 1403 1416 TO 1421 1430 TO 1435 1444 TO 1448 -
381. 1449 TABLE ST ISA100X100X10
382. 1450 TO 1481 TABLE ST ISA50X50X5
383. 970 TO 997 1138 TO 1161 TABLE ST ISA130X130X12
384. 950 TO 969 1118 TO 1137 1326 TO 1333 TABLE ST ISA100X100X10
385. 1034 TO 1073 1198 TO 1237 1390 TO 1393 TABLE ST ISA60X60X5
386. 1074 TO 1083 1085 TO 1094 1096 TO 1105 1107 TO 1116 1238 TO 1247 1249 TO 1258 -
387. 1260 TO 1269 1271 TO 1280 TABLE ST ISA60X60X5
388. 998 TO 1033 1084 1095 1106 1117 1162 TO 1197 1248 1259 1270 1281 TO 1320 -
389. 1321 TABLE ST ISA60X60X5
390. CONSTANTS
391. BETA 45 MEMB 14 803 1335
392. BETA 135 MEMB 15 804 1336
393. BETA 225 MEMB 16 805 1337
394. BETA 315 MEMB 13 802 1334
395. MATERIAL STEEL ALL
396. *****
397. SUPPORTS
398. 1 TO 4 181 183 185 187 345 347 349 351 PINNED
399. *****
400. LOAD 1 DEAD LOAD + LIVE LOAD
401. *****SELFWEIGHT OF BEAM G2 AND G4*****
402. SELFWEIGHT Y -1.15
403. *****BEAM G4*****
404. JOINT LOAD
405. **WEIGHT OF CONDUCTOR & INSULATOR OF G4
406. 111 112 167 168 173 177 FY -2.1523
407. JOINT LOAD
408. 113 114 169 170 174 178 FY -2.9299
409. JOINT LOAD
410. **WEIGHT OF EARTH WIRE OF G4
411. 13 TO 16 197 TO 200 FY -0.1079
412. MEMBER LOAD
413. **WEIGHT OF SUSPENSION OF G4
414. 235 407 518 CON GY -0.49 0.225
415. *****BEAM G2*****
416. **WEIGHT OF CONDUCTOR & INSULATOR OF G2
417. JOINT LOAD
418. 279 280 285 335 336 341 FY -2.909
419. **WEIGHT OF EARTH WIRE OF G2
420. JOINT LOAD
421. 361 TO 364 FY -0.1079
422. **WEIGHT OF SUSPENSION OF G2
423. MEMBER LOAD
424. 1020 1184 1295 CON GY -0.65 0.225
425. *****FOR BOTH G2 AND G4*****
426. **WEIGHT OF MEN WITH TOOL OF G2 AND G4
427. JOINT LOAD
428. 9 TO 12 119 120 191 192 291 293 355 356 FY -0.375
429. *****
430. LOAD 2 LOADTYPE NONE TITLE WIND ALONG X DIRECTION(PARALLEL TO BEAM)

STAAD TRUSS

-- PAGE NO. 9

```
431. JOINT LOAD
432. **WIND LOAD ON TOWER
433. *****WIND LOAD ON TOWER 4T2*****
434. 1 3 FX 1.2
435. 17 18 FX 2.38
436. 21 22 FX 2.08
437. 25 26 FX 1.85
438. 29 30 FX 1.63
439. 33 34 FX 1.34
440. 37 38 FX 1.48
441. 5 7 FX 1.61
442. 9 12 FX 1.05
443. 41 42 FX 0.49
444. 45 46 FX 0.43
445. 49 50 FX 0.37
446. 13 16 FX 0.17
447. *****WIND LOAD ON TOWER 4T5*****
448. 181 183 FX 1.2
449. 182 184 FX 2.38
450. 201 202 FX 2.08
451. 205 206 FX 1.85
452. 209 210 FX 1.63
453. 213 214 FX 1.34
454. 217 218 FX 1.48
455. 117 118 FX 1.61
456. 119 120 FX 1.05
457. 193 194 FX 0.49
458. 221 222 FX 0.43
459. 225 226 FX 0.37
460. 197 198 FX 0.17
461. *****WIND LOAD ON TOWER 4T6*****
462. 345 347 FX 1
463. 346 348 FX 1.98
464. 365 366 FX 1.78
465. 369 370 FX 1.65
466. 373 374 FX 1.49
467. 377 378 FX 1.26
468. 381 382 FX 1.37
469. 289 295 FX 1.45
470. 291 293 FX 0.97
471. 357 358 FX 0.49
472. 385 386 FX 0.43
473. 389 390 FX 0.37
474. 361 362 FX 0.17
475. *****
476. LOAD 3 LOADTYPE NONE TITLE WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)
477. JOINT LOAD
478. **WIND LOAD ON BEAM
479. *****FOR BEAM G4*****
480. 59 60 63 64 67 68 71 72 79 80 83 84 87 88 91 92 95 96 99 TO 101 103 113 114 -
481. 123 124 127 128 131 132 135 136 139 140 143 144 147 148 151 152 155 156 159 -
482. 160 TO 161 163 169 170 174 178 FZ 0.614
483. *****FOR BEAM G2*****
484. 235 236 239 240 243 244 247 248 251 252 257 TO 260 263 264 267 268 -
485. 271 TO 273 275 281 282 286 294 296 299 300 303 304 307 308 311 312 315 316 -
486. 321 TO 324 327 328 331 332 337 338 342 FZ 0.73
```

STAAD TRUSS

-- PAGE NO. 10

```
487. JOINT LOAD
488. **WIND LOAD ON TOWER
489. *****WIND LOAD ON TOWER 4T2*****
490. 1 2 FZ 1.2
491. 17 19 FZ 2.38
492. 21 23 FZ 2.08
493. 25 27 FZ 1.85
494. 29 31 FZ 1.63
495. 33 35 FZ 1.34
496. 37 39 FZ 1.48
497. 5 6 FZ 1.65
498. 9 10 FZ 1.05
499. 41 44 FZ 0.49
500. 45 48 FZ 0.43
501. 49 52 FZ 0.37
502. 13 14 FZ 0.17
503. *****WIND LOAD ON TOWER 4T5*****
504. 181 185 FZ 1.2
505. 182 186 FZ 2.38
506. 201 203 FZ 2.08
507. 205 207 FZ 1.85
508. 209 211 FZ 1.63
509. 213 215 FZ 1.34
510. 217 219 FZ 1.48
511. 117 189 FZ 1.61
512. 119 191 FZ 1.05
513. 193 196 FZ 0.49
514. 221 224 FZ 0.43
515. 225 228 FZ 0.37
516. 197 200 FZ 0.17
517. *****WIND LOAD ON TOWER 4T6*****
518. 345 349 FZ 1
519. 346 350 FZ 1.98
520. 365 367 FZ 1.78
521. 369 371 FZ 1.65
522. 373 375 FZ 1.49
523. 377 379 FZ 1.26
524. 381 383 FZ 1.37
525. 295 353 FZ 1.45
526. 293 355 FZ 0.97
527. 357 360 FZ 0.49
528. 385 388 FZ 0.43
529. 389 392 FZ 0.37
530. 361 364 FZ 0.17
531. *****
532. **BEAM-G2(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
533. **TOWER -4T2
534. *****
535. LOAD 4 NC(0P-0E) +WIND PARALLEL TO BEAM
536. *****FOR BEAM G4*****
537. JOINT LOAD
538. **NORMAL TENSION FORCE
539. 111 112 167 168 173 177 FZ 14.3
540. *WIND LOAD ON CONDUCTOR & INSULATOR
541. 111 TO 114 167 TO 170 173 174 177 178 FX 4.815
542. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
```

STAAD TRUSS

-- PAGE NO. 11

543. 13 TO 16 197 TO 200 FX 0.1375 FZ 2.5
544. MEMBER LOAD
545. **WIND LOAD ON SUSPENSION
546. 235 407 518 CON GX 0.91 0.225
547. *****FOR BEAM G2*****
548. JOINT LOAD
549. **NORMAL TENSION FORCE
550. 279 280 285 335 336 341 FZ 13.9
551. *WIND LOAD ON CONDUCTOR & INSULATOR
552. 279 280 285 335 336 341 FX 5.22
553. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
554. 361 TO 364 FX 0.1375 FZ 2.5
555. **WIND LOAD ON SUSPENSION
556. MEMBER LOAD
557. 1020 1184 1295 CON GX 0.91 0.225
558. *****
559. LOAD 5 SC(OP-0E) +WIND PARALLEL TO BEAM
560. *****FOR BEAM G4*****
561. JOINT LOAD
562. **SHORT CIRCUIT FORCE
563. 113 114 169 170 174 178 FZ 44.24
564. *WIND LOAD ON CONDUCTOR & INSULATOR
565. 111 TO 114 167 TO 170 173 174 177 178 FX 4.815
566. **WIND LOAD ON EARTH WIRE
567. 13 TO 16 197 TO 200 FX 0.1375
568. **WIND LOAD ON SUSPENSION
569. MEMBER LOAD
570. 235 407 518 CON GX 0.91 0.225
571. *****FOR BEAM G2*****
572. JOINT LOAD
573. **SHORT CIRCUIT FORCE
574. 279 280 285 335 336 341 FZ 39.77
575. *WIND LOAD ON CONDUCTOR & INSULATOR
576. 279 280 285 335 336 341 FX 5.22
577. **WIND LOAD ON EARTH WIRE
578. 361 TO 364 FX 0.1375
579. **WIND LOAD ON SUSPENSION
580. MEMBER LOAD
581. 1020 1184 1295 CON GX 0.91 0.225
582. *****
583. LOAD 6 NC(OP-0E) +WIND PERPENDICULAR TO BEAM
584. *****FOR BEAM G4*****
585. JOINT LOAD
586. **NORMAL TENSION FORCE
587. 111 112 167 168 173 177 FZ 14.3
588. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
589. 13 TO 16 197 TO 200 361 TO 364 FZ 2.5
590. MEMBER LOAD
591. **WIND LOAD ON SUSPENSION
592. 235 407 518 CON GZ 0.91 0.225
593. *****FOR BEAM G2*****
594. JOINT LOAD
595. **NORMAL TENSION FORCE
596. 279 280 285 335 336 341 FZ 13.9
597. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
598. 361 TO 364 FZ 2.5

STAAD TRUSS

-- PAGE NO. 12

```
599. **WIND LOAD ON SUSPENSION
600. MEMBER LOAD
601. 1020 1184 1295 CON GZ 0.91 0.225
602. *****
603. LOAD 7 SC(0P-0E) +WIND PERPENDICULAR TO BEAM
604. *****FOR BEAM G4*****
605. JOINT LOAD
606. **SHORT CIRCUIT FORCE
607. 113 114 169 170 174 178 FZ 44.24
608. MEMBER LOAD
609. **WIND LOAD ON SUSPENSION
610. 235 407 518 CON GZ 0.91 0.225
611. *****FOR BEAM G2*****
612. JOINT LOAD
613. 279 280 285 335 336 341 FZ 39.77
614. **WIND LOAD ON SUSPENSION
615. MEMBER LOAD
616. 1020 1184 1295 CON GZ 0.91 0.225
617. *****
618. LOAD 8 LOADTYPE NONE TITLE NC(30P-0E) +WIND PARALLEL TO BEAM
619. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
620. **NORMAL TENSION FORCE
621. JOINT LOAD
622. 111 112 167 168 173 177 FX 14.3 FZ 24.77
623. *WIND LOAD ON CONDUCTOR & INSULATOR
624. JOINT LOAD
625. 111 TO 114 167 TO 170 173 174 177 178 FX 4.175
626. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
627. JOINT LOAD
628. 13 TO 16 197 TO 200 FX 1.375 FZ 2.24
629. **WIND LOAD ON SUSPENSION
630. MEMBER LOAD
631. 235 407 518 CON GX 0.91 0.225
632. *****
633. LOAD 9 LOADTYPE NONE TITLE SC(30P-0E) +WIND PARALLEL TO BEAM
634. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
635. **SHORT CIRCUIT FORCE
636. JOINT LOAD
637. 111 112 167 168 173 177 FX 44.24 FZ 76.63
638. *WIND LOAD ON CONDUCTOR & INSULATOR
639. JOINT LOAD
640. 111 TO 114 167 TO 170 173 174 177 178 FX 4.175
641. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
642. JOINT LOAD
643. 13 TO 16 197 TO 200 FX 0.125 FZ 0.075
644. **WIND LOAD ON SUSPENSION
645. MEMBER LOAD
646. 235 407 518 CON GX 0.91 0.225
647. *****
648. LOAD 10 LOADTYPE NONE TITLE NC(30P-0E) +WIND PERPENDICULAR TO BEAM
649. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
650. **NORMAL TENSION FORCE
651. JOINT LOAD
652. 111 112 167 168 173 177 FX 14.3 FZ 24.77
653. *WIND LOAD ON CONDUCTOR & INSULATOR
654. JOINT LOAD
```

STAAD TRUSS

-- PAGE NO. 13

655. 111 TO 114 167 TO 170 173 174 177 178 FX 2.41
656. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
657. JOINT LOAD
658. 13 TO 16 197 TO 200 FX 1.25 FZ 2.17
659. **WIND LOAD ON SUSPENSION
660. MEMBER LOAD
661. 235 407 518 1020 1184 1295 CON GZ 0.91 0.225
662. *****
663. LOAD 11 LOADTYPE NONE TITLE SC(30P-0E) +WIND PERPENDICULAR TO BEAM
664. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
665. **SHORT CIRCUIT FORCE
666. JOINT LOAD
667. 111 112 167 168 173 177 FX 44.24 FZ 76.63
668. *WIND LOAD ON CONDUCTOR & INSULATOR
669. JOINT LOAD
670. 111 TO 114 167 TO 170 173 174 177 178 FX 2.41
671. **WIND LOAD ON SUSPENSION
672. MEMBER LOAD
673. 235 407 518 CON GZ 0.91 0.225
674. *****
675. LOAD 12 LOADTYPE NONE TITLE NC(0P-30E) +WIND PARALLEL TO BEAM
676. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
677. **NORMAL TENSION FORCE
678. JOINT LOAD
679. 111 112 167 168 173 177 FY -14.3 FZ 24.77
680. *WIND LOAD ON CONDUCTOR & INSULATOR
681. 111 TO 114 167 TO 170 173 174 177 178 FX 3.78
682. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
683. 13 TO 16 197 TO 200 FX 0.125 FY -1.25 FZ 2.17
684. **WIND LOAD ON SUSPENSION
685. MEMBER LOAD
686. 235 407 518 CON GX 0.91 0.225
687. *****
688. LOAD 13 LOADTYPE NONE TITLE SC(0P-30E) +WIND PARALLEL TO BEAM
689. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
690. **SHORT CIRCUIT FORCE
691. JOINT LOAD
692. 111 112 167 168 173 177 FY -44.25 FZ 76.63
693. *WIND LOAD ON CONDUCTOR & INSULATOR
694. JOINT LOAD
695. 111 TO 114 167 TO 170 173 174 177 178 FX 3.78
696. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
697. JOINT LOAD
698. 13 TO 16 197 TO 200 FX 0.125
699. **WIND LOAD ON SUSPENSION
700. MEMBER LOAD
701. 235 407 518 CON GX 0.91 0.225
702. *****
703. LOAD 14 LOADTYPE NONE TITLE NC(0P-30E) +WIND PERPENDICULAR TO BEAM
704. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
705. **NORMAL TENSION FORCE
706. JOINT LOAD
707. 111 112 167 168 173 177 FY -14.3 FZ 24.77
708. *WIND LOAD ON CONDUCTOR & INSULATOR
709. JOINT LOAD
710. 111 TO 114 167 TO 170 173 174 177 178 FX 2.35

STAAD TRUSS

-- PAGE NO. 14

711. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
712. JOINT LOAD
713. 13 TO 16 197 TO 200 FY -1.25 FZ 2.165
714. **WIND LOAD ON SUSPENSION
715. MEMBER LOAD
716. 235 407 518 CON GZ 0.91 0.225
717. *****
718. LOAD 15 LOADTYPE NONE TITLE SC(0P-30E) +WIND PERPENDICULAR TO BEAM
719. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
720. **SHORT CIRCUIT FORCE
721. JOINT LOAD
722. 111 112 167 168 173 177 FY -44.25 FZ 76.63
723. *WIND LOAD ON CONDUCTOR & INSULATOR
724. JOINT LOAD
725. 111 TO 114 167 TO 170 173 174 177 178 FX 2.35
726. **WIND LOAD ON SUSPENSION
727. MEMBER LOAD
728. 235 407 518 CON GZ 0.91 0.225
729. *****
730. LOAD 16 LOADTYPE NONE TITLE NC(30P-30E) +WIND PARALLEL TO BEAM
731. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
732. **NORMAL TENSION FORCE
733. JOINT LOAD
734. 111 112 167 168 173 177 FX 12.39 FY -14.3 FZ 21.45
735. *WIND LOAD ON CONDUCTOR & INSULATOR
736. JOINT LOAD
737. 111 TO 114 167 TO 170 173 174 177 178 FX 3.78
738. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
739. JOINT LOAD
740. 13 TO 16 197 TO 200 FX 1.195 FY -1.25 FZ 1.94
741. **WIND LOAD ON SUSPENSION
742. MEMBER LOAD
743. 235 407 518 CON GX 0.91 0.225
744. *****
745. LOAD 17 LOADTYPE NONE TITLE SC(30P-30E) +WIND PARALLEL TO BEAM
746. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
747. **SHORT CIRCUIT FORCE
748. JOINT LOAD
749. 111 112 167 168 173 177 FX 38.32 FY -44.25 FZ 66.36
750. *WIND LOAD ON CONDUCTOR & INSULATOR
751. JOINT LOAD
752. 111 TO 114 167 TO 170 173 174 177 178 FX 3.78
753. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
754. JOINT LOAD
755. 13 TO 16 197 TO 200 FX 0.1125 FZ 0.0625
756. **WIND LOAD ON SUSPENSION
757. MEMBER LOAD
758. 235 407 518 CON GX 0.91 0.225
759. *****
760. LOAD 18 LOADTYPE NONE TITLE NC(30P-30E) +WIND PERPENDICULAR TO BEAM
761. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
762. **NORMAL TENSION FORCE
763. JOINT LOAD
764. 111 112 167 168 173 177 FX 12.39 FY -14.3 FZ 21.45
765. *WIND LOAD ON CONDUCTOR & INSULATOR
766. JOINT LOAD

STAAD TRUSS

-- PAGE NO. 15

767. 111 TO 114 167 TO 170 173 174 177 178 FX 2.18
768. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
769. JOINT LOAD
770. 13 TO 16 197 TO 200 FX 1.0825 FY -1.25 FZ 1.87
771. **WIND LOAD ON SUSPENSION
772. MEMBER LOAD
773. 235 407 518 CON GX 0.91 0.225
774. *****
775. LOAD 19 LOADTYPE NONE TITLE SC(30P-30E) +WIND PERPENDICULAR TO BEAM
776. *****DEVIATION IS ONLY IN BEAM G4,THEREFORE FOR BEAM G4*****
777. **SHORT CIRCUIT FORCE
778. JOINT LOAD
779. 111 112 167 168 173 177 FX 38.32 FY -44.25 FZ 66.36
780. *WIND LOAD ON CONDUCTOR & INSULATOR
781. JOINT LOAD
782. 111 TO 114 167 TO 170 173 174 177 178 FX 2.18
783. **WIND LOAD ON SUSPENSION
784. MEMBER LOAD
785. 235 407 518 CON GX 0.91 0.225
786. *****
787. *LOAD COMBINATIONS FOR MEMBER DESIGN (FACTORED)
788. *****
789. *****
790. LOAD COMB 101 2(DL + NC + WIND PARALLEL TO BEAM)
791. 1 2.0 2 2.0 4 2.0
792. *****
793. LOAD COMB 201 1.5(DL +SC + WIND PARALLEL TO BEAM)
794. 1 1.5 2 1.5 5 1.5
795. *****
796. LOAD COMB 102 2(DL +NC + WIND PERPENDICULAR TO BEAM)
797. 1 2.0 3 2.0 6 2.0
798. *****
799. LOAD COMB 202 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
800. 1 1.5 3 1.5 7 1.5
801. *****
802. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVAT
803. *****
804. LOAD COMB 103 2(DL +NC + WIND PARALLEL TO BEAM)
805. 1 2.0 2 2.0 8 2.0
806. *****
807. LOAD COMB 203 1.5(DL +SC + WIND PARALLEL TO BEAM)
808. 1 1.5 2 1.5 9 1.5
809. *****
810. LOAD COMB 104 2(DL +NC + WIND PERPENDICULAR TO BEAM)
811. 1 2.0 3 2.0 10 2.0
812. *****
813. LOAD COMB 204 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
814. 1 1.5 3 1.5 11 1.5
815. *****
816. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVAT
817. *****
818. LOAD COMB 105 2(DL +NC + WIND PARALLEL TO BEAM)
819. 1 2.0 2 2.0 12 2.0
820. *****
821. LOAD COMB 205 1.5(DL +SC + WIND PARALLEL TO BEAM)
822. 1 1.5 2 1.5 13 1.5

STAAD TRUSS

-- PAGE NO. 16

823. *****
824. LOAD COMB 106 2(DL +NC + WIND PERPENDICULAR TO BEAM)
825. 1 2.0 3 2.0 14 2.0
826. *****
827. LOAD COMB 206 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
828. 1 1.5 3 1.5 15 1.5
829. *****
830. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVA
831. *****
832. LOAD COMB 107 2(DL +NC + WIND PARALLEL TO BEAM)
833. 1 2.0 2 2.0 16 2.0
834. *****
835. LOAD COMB 207 1.5(DL +SC + WIND PARALLEL TO BEAM)
836. 1 1.5 2 1.5 17 1.5
837. *****
838. LOAD COMB 108 2(DL +NC + WIND PERPENDICULAR TO BEAM)
839. 1 2.0 3 2.0 18 2.0
840. *****
841. LOAD COMB 208 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
842. 1 1.5 3 1.5 19 1.5
843. *****
844. *LOAD COMBINATIONS FOR FOUNDATION & BASE PLATE DESIGN (UNFACTORED)
845. *****
846. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATI
847. *****
848. LOAD COMB 301 DL + NC + WIND PARALLEL TO BEAM
849. 1 1.0 2 1.0 4 1.0
850. *****
851. LOAD COMB 401 DL +SC + WIND PARALLEL TO BEAM
852. 1 1.0 2 1.0 5 1.0
853. *****
854. LOAD COMB 302 DL +NC + WIND PERPENDICULAR TO BEAM
855. 1 1.0 3 1.0 6 1.0
856. *****
857. LOAD COMB 402 DL +SC + WIND PERPENDICULAR TO BEAM
858. 1 1.0 3 1.0 7 1.0
859. *****
860. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVAT
861. *****
862. LOAD COMB 303 DL +NC + WIND PARALLEL TO BEAM
863. 1 1.0 2 1.0 8 1.0
864. *****
865. LOAD COMB 403 DL +SC + WIND PARALLEL TO BEAM
866. 1 1.0 2 1.0 9 1.0
867. *****
868. LOAD COMB 304 DL +NC + WIND PERPENDICULAR TO BEAM
869. 1 1.0 3 1.0 10 1.0
870. *****
871. LOAD COMB 404 DL +SC + WIND PERPENDICULAR TO BEAM
872. 1 1.0 3 1.0 11 1.0
873. *****
874. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVAT
875. *****
876. LOAD COMB 305 DL +NC + WIND PARALLEL TO BEAM
877. 1 1.0 2 1.0 12 1.0
878. *****

STAAD TRUSS

-- PAGE NO. 17

```

879. LOAD COMB 405 DL +SC + WIND PARALLEL TO BEAM
880. 1 1.0 2 1.0 13 1.0
881. *****
882. LOAD COMB 306 DL +NC + WIND PERPENDICULAR TO BEAM
883. 1 1.0 3 1.0 14 1.0
884. *****
885. LOAD COMB 406 DL +SC + WIND PERPENDICULAR TO BEAM
886. 1 1.0 3 1.0 15 1.0
887. *****
888. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVA
889. *****
890. LOAD COMB 307 DL +NC + WIND PARALLEL TO BEAM
891. 1 1.0 2 1.0 16 1.0
892. *****
893. LOAD COMB 407 DL +SC + WIND PARALLEL TO BEAM
894. 1 1.0 2 1.0 17 1.0
895. *****
896. LOAD COMB 308 DL +NC + WIND PERPENDICULAR TO BEAM
897. 1 1.0 3 1.0 18 1.0
898. *****
899. LOAD COMB 408 DL +SC + WIND PERPENDICULAR TO BEAM
900. 1 1.0 3 1.0 19 1.0
901. PERFORM ANALYSIS

```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	380	NUMBER OF MEMBERS	1224
NUMBER OF PLATES	0	NUMBER OF SOLIDS	0
NUMBER OF SURFACES	0	NUMBER OF SUPPORTS	12

Using 64-bit analysis engine.

SOLVER USED IS THE IN-CORE ADVANCED MATH SOLVER

```

TOTAL      PRIMARY LOAD CASES =    19, TOTAL DEGREES OF FREEDOM =    1104
TOTAL LOAD COMBINATION CASES =    32 SO FAR.

```

```

902. *****
903. PARAMETER 1
904. CODE IS800 LSD
905. STEEL TAKE OFF LIST 1 TO 60 117 TO 128 702 TO 789

```

STAAD TRUSS

-- PAGE NO. 18

STEEL TAKE OFF

STEEL TAKE-OFF

	PROFILE	LENGTH(METE)	WEIGHT(KN)
ST	ISA200X200X20	28.03	16.451
ST	ISA130X130X12	17.60	4.043
ST	ISA150X150X16	36.43	12.789
ST	ISA75X75X5	24.31	1.358
ST	ISA50X50X5	63.96	2.353
ST	ISA150X150X20	24.03	10.373
ST	ISA100X100X10	105.15	15.428
ST	ISA90X90X6	155.34	12.529

		TOTAL =	75.324

***** END OF DATA FROM INTERNAL STORAGE *****

906. PARAMETER 2

907. CODE IS800 LSD

908. STEEL TAKE OFF LIST 790 TO 949

STAAD TRUSS

-- PAGE NO. 19

STEEL TAKE OFF

STEEL TAKE-OFF

	PROFILE	LENGTH(METE)	WEIGHT(KN)
ST	ISA200X200X20	28.03	16.451
ST	ISA130X130X12	17.60	4.043
ST	ISA150X150X16	36.43	12.789
ST	ISA75X75X5	24.31	1.358
ST	ISA50X50X5	63.96	2.353
ST	ISA150X150X20	24.03	10.373
ST	ISA100X100X10	105.15	15.428
ST	ISA90X90X6	155.34	12.529

		TOTAL =	75.324

***** END OF DATA FROM INTERNAL STORAGE *****

909. PARAMETER 3

910. CODE IS800 LSD

911. STEEL TAKE OFF LIST 1322 TO 1481

STAAD TRUSS

-- PAGE NO. 20

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA150X150X16	28.03	9.840
ST ISA100X100X10	122.75	18.011
ST ISA130X130X10	36.43	7.024
ST ISA75X75X5	167.20	9.338
ST ISA50X50X5	63.96	2.353
ST ISA130X130X12	24.03	5.519
ST ISA60X60X5	12.45	0.550
TOTAL =		52.635

***** END OF DATA FROM INTERNAL STORAGE *****

912. PARAMETER 4

913. CODE IS800 LSD

914. STEEL TAKE OFF LIST 161 TO 204 209 TO 332 337 TO 380 385 TO 528 531 -

915. 533 TO 535 690 TO 701

STAAD TRUSS

-- PAGE NO. 21

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA130X130X12	41.40	9.509
ST ISA150X150X16	57.80	20.292
ST ISA100X100X10	150.46	22.076
ST ISA90X90X6	194.50	15.689
ST ISA65X65X5	204.84	9.835

	TOTAL =	77.400

***** END OF DATA FROM INTERNAL STORAGE *****

916. PARAMETER 5

917. CODE IS800 LSD

918. STEEL TAKE OFF LIST 950 TO 1321

STAAD TRUSS

-- PAGE NO. 22

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA100X100X10	41.40	6.074
ST ISA130X130X12	57.80	13.276
ST ISA60X60X5	549.80	24.285

	TOTAL =	43.636

***** END OF DATA FROM INTERNAL STORAGE *****

919. FINISH

***** END OF THE STAAD.Pro RUN *****

**** DATE= AUG 23,2024 TIME= 14:59:11 ****

STAAD TRUSS

-- PAGE NO. 23

```
*****
*   For technical assistance on STAAD.Pro, please visit   *
*   http://www.bentley.com/en/support/                   *
*                                                         *
*   Details about additional assistance from               *
*   Bentley and Partners can be found at program menu    *
*   Help->Technical Support                               *
*                                                         *
*               Copyright (c) Bentley Systems, Inc.       *
*               http://www.bentley.com                     *
*****
```

MEMBER & CONNECTION BOLT DESIGN FOR
TOWER-4T6

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MAINBUS MKD."4T6"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802 (part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)

A DESIGN OF MAIN-LEG FOR PART - PA,PB

- a) Angle Section tried & adopted = 200 x 200 x 20
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 169267.51 kg
Maximum Tension in main leg for Panel = 154691.93 kg
- c) Effective Length of Angle, L1 & L2 = 3504.00 & 3504.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1752.00 / 39.30 = 44.58 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1752.00 / 61.40 = 28.53 < 120$ hence o.k.
- e) Gross Area of Cross Section, Ag = 76.4000 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 69.40 sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 69.40 = 176914.4$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 44.58
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2388.79$ Kg/sqcm.
k) Permissible Compressive Load = $2388.79 \times 76.4000 = 182503.4$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t) \quad t = 20 \text{ mm} = 20230.45$ Kgs
No. of 16mm bolts required, = $176914.45 / 12711.17 = 13.92$ nos. Say **14.00 no.**
- p) Ultimate Maximum Compression per Leg = $169267.51 \times 1.00 = 169267.51$ Kg.
- q) Ultimate Maximum Tension per Leg = $154691.93 \times 1.00 = 154691.93$ Kg.
- r) Factor of Safety
In Compression = $182503.4 / 169267.51 = 1.08 > 1.0000$ It is Safe
In Tension = $176914.4 / 154691.93 = 1.14 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)

B DESIGN OF MAIN-LEG FOR PART - PC, PD

- a) Angle Section tried & adopted = 150 x 150 x 20
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 118688.16 kg
Maximum Tension in main leg for Panel = 106650.940 kg
- c) Effective Length of Angle, L1 & L2 = 3003.00 & 3003.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1501.50 / 29.30 = 51.25 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1501.50 / 45.30 = 33.15 < 120$ hence o.k.
- e) Gross Area of Cross Section, Ag = 56.20 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 49.20 sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 49.20 = 125420.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 51.25
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 7.50 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2337.23$ Kg/sqcm.
k) Permissible Compressive Load = $2337.23 \times 56.2000 = 131352.4$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 20 mm = 20230.45 Kgs
No. of 16mm bolts required, = $125420.62 / 12711.17 = 9.87$ nos. Say **10.00 no.**
- p) Ulitmate Maximum Compression per Leg = $118688.16 \times 1.00 = 118688.16$ Kg.
- q) Ultimate Maximum Tension per Leg = $106650.94 \times 1.00 = 106650.94$ Kg.
- r) Factor of Safety
In Compression = $131352.4 / 118688.16 = 1.11 > 1.0000$ It is Safe
In Tension = $125420.6 / 106650.94 = 1.18 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)

C DESIGN OF MAIN-LEG FOR PART - PE, PF, PG,PH

- a) Angle Section tried & adopted = 150 x 150 x 16
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 77687.16 kg
Maximum Tension in main leg for Panel = 59243.956 kg
- c) Effective Length of Angle, L1 & L2 = 2302.00 & 2302.00 mm resply.
- d) Slenderness ratio L1/rvv = 2302.00 / 29.40 = 78.30 < 120 hence o.k.
L2/rxx = 2302.00 / 45.80 = 50.26 < 120 hence o.k.
- e) Gross Area of Cross Section, Ag = 45.60 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 40.00 sqcm.
- g) Minimum guaranteed yield Stress of Material Fy = 250 Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 40.00 = 101968.0 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 78.30
Limiting b/t ratio = $210 / (F_y)^{0.5}$ = 13.28
Actual b/t ratio = 9.38 < 13.28
Value of Fy = 2549.20 Kg/sqcm.
Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$ = 125.66
Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$ = 2054.35 Kg/sqcm.
k) Permissible Compressive Load = 2054.35 x 45.6000 = 93678.5 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161)$ = 12711.17 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 16 mm = 16184.36 Kgs
No. of 16mm bolts required, = $93678.52 / 12711.17$ = 7.37 nos. Say **8.00 no.**
- p) Ulitmate Maximum Compression per Leg = 77687.16 x 1.00 = 77687.16 Kg.
- q) Ultimate Maximum Tension per Leg = 59243.96 x 1.00 = 59243.96 Kg.
- r) Factor of Safety
In Compression = $93678.5 / 77687.16$ = **1.21 > 1.0000 It is Safe**
In Tension = $101968.0 / 59243.96$ = **1.72 > 1.0000 It is Safe**

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T5,4T6,4T2) & BEAM (G4 & G2)

C DESIGN OF MAIN-LEG FOR PART - PI, PJ,PK,PL

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 4723.24 kg
Maximum Tension in main leg for Panel = 4308.970 kg
- c) Effective Length of Angle, L1 & L2 = 1576.00 & 1576.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1576.00 / 14.60 = 107.95 < 120$ hence o.k.
 $L2/r_{xx} = 1576.00 / 23.10 = 68.23 < 120$ hence o.k.
- e) Gross Area of Cross Section, Ag = 7.27 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 5.52 sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 5.52 = 14071.6 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 107.95
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1467.78 \text{ Kg/sqcm.}$
k) Permissible Compressive Load = 1467.78 x 7.2700 = 10670.8 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17 \text{ Kgs}$
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
No. of 16mm bolts required, = 10670.79 / 5057.61 = 2.11 nos. Say **3.00 no.**
- p) Ultimate Maximum Compression per Leg = 4723.24 x 1.00 = 4723.24 Kg.
- q) Ultimate Maximum Tension per Leg = 4308.97 x 1.00 = 4308.97 Kg.
- r) Factor of Safety
In Compression = 10670.8 / 4723.24 = **2.26 > 1.0000 It is Safe**
In Tension = 14071.6 / 4308.97 = **3.27 > 1.0000 It is Safe**

* DESIGN OF BRACINGS FOR TOWER MKD. "4T6"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - GA, JA

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, L2	=	4871.00				
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1217.75	/	17.50	=	69.59 < 200 hence o.k.
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2435.50	/	27.70	=	87.92 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	10.5000 sqcm.				
e)	Net Area of Cross Section Ae = A1 + A2.k assuming 1 No.s 16mm Dia. Bolts						
	$v =$	=	4.1700 +	x	5.2200	x	0.7056 = 7.8531 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy =	250 Mpa				
g)	Permissible Tensile Stress	=	2549.20 Kg/sqcm.				
h)	Permissible Tensile Load	=	2549.20	x	7.8531		
		=	20019.2 Kgs				
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	87.92				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	15.00	>	13.28		
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)	=	2325.91 Kg/sqcm.				
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=	1756.58 Kg/sqcm.				
j)	Permissible Compressive Load	=	1756.58	x	10.5000		
		=	18444.1 Kgs				
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58 Kgs				
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	6 mm	=	6069.13 Kgs		
	No. of 16mm bolts required,	=	18444.12	/	6069.13		
		=	3.04 nos. Say				
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	15709.384 kg				
	Maximum Tension in Bracing	=	15367.272 kg				
m)	In Compression	=	18444.1	/	15709.38	=	1.17 > 1.0 safe
	In Tension	=	20019.2	/	15367.27	=	1.30 > 1.0 safe

4.00 no.

B DESIGN OF BRACINGS - GB, JB

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, L2	=	4204.00	mm			
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1051.00	/	17.50	=	60.06 < 200 hence o.k.
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2102.00	/	27.70	=	75.88 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	10.5000	sqcm.			
e)	Net Area of Cross Section Ae = A1 + A2.k assuming 1 No.s 16mm Dia. Bolts						
	$v = 4.1700 + 5.2200 \times 0.7056$	=	7.8531	sqcm.			
f)	Minimum guaranteed yield Stress of Material	Fy	=	250	Mpa		
g)	Permissible Tensile Stress		=	2549.20	Kg/sqcm.		
h)	Permissible Tensile Load		=	2549.20	x	7.8531	
			=	20019.2	Kgs		
i)	Permissible Compressive Stress						
	Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	75.88				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	15.00	>	13.28		
	Value of Fy = Fcr (as per cl. 5.2.2.2.)	=	2325.91	Kg/sqcm.			
	Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$	=	1901.83	Kg/sqcm.			
j)	Permissible Compressive Load	=	1901.83	x	10.5000		
		=	19969.2	Kgs			
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310	Mpa	=	3161	Kg/sqcm.
	Permissible Bearing Stress for 5.6 class bolts	=	620	Mpa	=	6322	Kg/sqcm.
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58	Kgs			
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	6 mm	=	6069.13	Kgs	
	No. of 16mm bolts required,	=	19969.17	/	6069.13		
		=	3.29	nos. Say			4.00 no.
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	17162.461	kg			
	Maximum Tension in Bracing	=	17193.435	kg			
m)	In Compression	=	19969.2	/	17162.46	=	1.16 > 1.0 safe
	In Tension	=	20019.2	/	17193.44	=	1.16 > 1.0 safe

C DESIGN OF BRACINGS - GC, JC

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L_2 = 3453.00 mm
- c) Slenderness $0.5 \cdot L_2 / r_{vv}$ = 1726.50 / 19.40 = 88.99 < 200 hence o.k.
Slenderness L_2 / r_{xx} = 3453.00 / 30.50 = 113.21 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 113.21
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1514.66$ Kg/sqcm.
- j) Permissible Compressive Load = 1514.66 x 19.0000 = 28778.5 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
No. of 16mm bolts required, = 28778.52 / 6355.58 = 4.53 nos. Say **5.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 21145.528 kg
Maximum Tension in Bracing = 21325.951 kg
- m) In Compression = 28778.5 / 21145.53 = **1.36 > 1.0 safe**
In Tension = 36948.8 / 21325.95 = **1.73 > 1.0 safe**

D DESIGN OF BRACINGS - GD, JD

- a) Angle Section tried & adopted = 50 x 50 x 5
- b) Length of Angle, L2 = 2286.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1143.00 / 9.70 = 117.84 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 2286.00 / 23.10 = 98.96 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 4.7900 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 1.5000 + 2.3750 \times 0.6545 = 3.0545$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.0545 = 7786.6 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 117.84
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1428.46$ Kg/sqcm.
- j) Permissible Compressive Load = 1428.46 x 4.7900 = 6842.3 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
No. of 16mm bolts required, = 6842.34 / 5057.61 = 1.35 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 1483.788 kg
Maximum Tension in Bracing = 1471.767 kg
- m) In Compression = 6842.3 / 1483.79 = **4.61 > 1.0 safe**
In Tension = 7786.6 / 1471.77 = **5.29 > 1.0 safe**

MEMBER & CONNECTION BOLT DESIGN FOR
TOWER-4T5

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MAINBUS MKD."4T5"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

A DESIGN OF MAIN-LEG FOR PART - PA,PB

- a) Angle Section tried & adopted = 200 x 200 x 20
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 155246.07 kg
Maximum Tension in main leg for Panel = 147340.32 kg
- c) Effective Length of Angle, L1 & L2 = 3504.00 & 3504.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1752.00 / 39.30 = 44.58 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1752.00 / 61.40 = 28.53 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 76.4000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 69.40$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 69.40 = 176914.4$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 44.58
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2388.79$ Kg/sqcm.
k) Permissible Compressive Load = $2388.79 \times 76.4000 = 182503.4$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 20 mm = 20230.45 Kgs
No. of 16mm bolts required, = $176914.45 / 12711.17 = 13.92$ nos. Say **14.00 no.**
- p) Ultimate Maximum Compression per Leg = 155246.07 x 1.00 = 155246.07 Kg.
- q) Ultimate Maximum Tension per Leg = 147340.32 x 1.00 = 147340.32 Kg.
- r) Factor of Safety
In Compression = $182503.4 / 155246.07 = 1.18 > 1.0000$ It is Safe
In Tension = $176914.4 / 147340.32 = 1.20 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

B DESIGN OF MAIN-LEG FOR PART - PC, PD

- a) Angle Section tried & adopted = 150 x 150 x 20
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 112277.63 kg
Maximum Tension in main leg for Panel = 105990.940 kg
- c) Effective Length of Angle, L1 & L2 = 3003.00 & 3003.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1501.50 / 29.30 = 51.25 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1501.50 / 45.30 = 33.15 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 56.20$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 49.20$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 49.20 = 125420.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 51.25
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 7.50 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2337.23$ Kg/sqcm.
k) Permissible Compressive Load = $2337.23 \times 56.2000 = 131352.4$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 20 mm = 20230.45 Kgs
No. of 16mm bolts required, = $125420.62 / 12711.17 = 9.87$ nos. Say **10.00 no.**
- p) Ultimate Maximum Compression per Leg = $112277.63 \times 1.00 = 112277.63$ Kg.
- q) Ultimate Maximum Tension per Leg = $105990.94 \times 1.00 = 105990.94$ Kg.
- r) Factor of Safety
In Compression = $131352.4 / 112277.63 = 1.17 > 1.0000$ It is Safe
In Tension = $125420.6 / 105990.94 = 1.18 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

C DESIGN OF MAIN-LEG FOR PART - PE, PF, PG,PH

- a) Angle Section tried & adopted = 150 x 150 x 16
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 76309.36 kg
Maximum Tension in main leg for Panel = 61635.621 kg
- c) Effective Length of Angle, L1 & L2 = 2302.00 & 2302.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 2302.00 / 29.40 = 78.30 < 120$ hence o.k.
 $L2/r_{xx} = 2302.00 / 45.80 = 50.26 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 45.60$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 40.00$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 40.00 = 101968.0$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 78.30
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 9.38 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2054.35$ Kg/sqcm.
k) Permissible Compressive Load = $2054.35 \times 45.6000 = 93678.5$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 16$ mm = 16184.36 Kgs
No. of 16mm bolts required, = $93678.52 / 12711.17 = 7.37$ nos. Say **8.00 no.**
- p) Ultimate Maximum Compression per Leg = $76309.36 \times 1.00 = 76309.36$ Kg.
- q) Ultimate Maximum Tension per Leg = $61635.62 \times 1.00 = 61635.62$ Kg.
- r) Factor of Safety
In Compression = $93678.5 / 76309.36 = 1.23 > 1.0000$ It is Safe
In Tension = $101968.0 / 61635.62 = 1.65 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

D DESIGN OF MAIN-LEG FOR PART - PI, PJ,PK,PL

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 4723.15 kg
Maximum Tension in main leg for Panel = 4308.302 kg
- c) Effective Length of Angle, L1 & L2 = 1576.00 & 1576.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1576.00 / 14.60 = 107.95 < 120$ hence o.k.
 $L2/r_{xx} = 1576.00 / 23.10 = 68.23 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 7.27$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 5.52$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 5.52 = 14071.6$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 107.95
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1467.78$ Kg/sqcm.
k) Permissible Compressive Load = $1467.78 \times 7.2700 = 10670.8$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
No. of 16mm bolts required, = $10670.79 / 5057.61 = 2.11$ nos. Say **3.00 no.**
- p) Ultimate Maximum Compression per Leg = $4723.15 \times 1.00 = 4723.15$ Kg.
- q) Ultimate Maximum Tension per Leg = $4308.30 \times 1.00 = 4308.30$ Kg.
- r) Factor of Safety
In Compression = $10670.8 / 4723.15 = 2.26 > 1.0000$ It is Safe
In Tension = $14071.6 / 4308.30 = 3.27 > 1.0000$ It is Safe

* DESIGN OF BRACINGS FOR TOWER MKD. "4T5"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - GA, JA

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, L2	=	4871.00	mm			
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1217.75	/	17.50	=	69.59 < 200 hence o.k.
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2435.50	/	27.70	=	87.92 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	10.5000 sqcm.				
e)	Net Area of Cross Section Ae = A1 + A2.k assuming 1 No.s 16mm Dia. Bolts						
	$v = 4.1700 + 5.2200 \times 0.7056$	=	7.8531 sqcm.				
f)	Minimum guaranteed yield Stress of Material	Fy =	250 Mpa				
g)	Permissible Tensile Stress	=	2549.20 Kg/sqcm.				
h)	Permissible Tensile Load	=	2549.20 x		7.8531		
		=	20019.2 Kgs				
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	87.92				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	15.00		> 13.28		
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)	=	2325.91 Kg/sqcm.				
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=	1756.58 Kg/sqcm.				
j)	Permissible Compressive Load	=	1756.58 x		10.5000		
		=	18444.1 Kgs				
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa		=	3161 Kg/sqcm.	
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa		=	6322 Kg/sqcm.	
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58 Kgs				
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	6 mm		=	6069.13 Kgs	
	No. of 16mm bolts required,	=	18444.12 /		6069.13		
		=	3.04 nos. Say				
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	15242.159 kg				
	Maximum Tension in Bracing	=	15130.497 kg				
m)	In Compression	=	18444.1	/	15242.16	=	1.21 > 1.0 safe
	In Tension	=	20019.2	/	15130.50	=	1.32 > 1.0 safe

4.00 no.

B DESIGN OF BRACINGS - GB, JB

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, L2	=	4204.00	mm			
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1051.00	/	17.50	=	60.06 < 200 hence o.k.
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2102.00	/	27.70	=	75.88 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	10.5000	sqcm.			
e)	Net Area of Cross Section Ae = A1 + A2.k assuming 1 No.s 16mm Dia. Bolts						
	$v = 4.1700 + 5.2200 \times 0.7056$	=	7.8531	sqcm.			
f)	Minimum guaranteed yield Stress of Material	Fy	=	250	Mpa		
g)	Permissible Tensile Stress		=	2549.20	Kg/sqcm.		
h)	Permissible Tensile Load		=	2549.20	x	7.8531	
			=	20019.2	Kgs		
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	75.88				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	15.00	>	13.28		
	Value of Fy = Fcr (as per cl. 5.2.2.2.)	=	2325.91	Kg/sqcm.			
	Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$	=	1901.83	Kg/sqcm.			
j)	Permissible Compressive Load	=	1901.83	x	10.5000		
		=	19969.2	Kgs			
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310	Mpa	=	3161	Kg/sqcm.
	Permissible Bearing Stress for 5.6 class bolts	=	620	Mpa	=	6322	Kg/sqcm.
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58	Kgs			
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	6 mm	=	6069.13	Kgs	
	No. of 16mm bolts required,	=	19969.17	/	6069.13		
		=	3.29	nos. Say			4.00 no.
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	16726.763	kg			
	Maximum Tension in Bracing	=	16903.495	kg			
m)	In Compression	=	19969.2	/	16726.76	=	1.19 > 1.0 safe
	In Tension	=	20019.2	/	16903.50	=	1.18 > 1.0 safe

C DESIGN OF BRACINGS - GC, JC

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L2 = 3453.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1726.50 / 19.40 = 88.99 < 200 hence o.k.
 Slenderness $L2 / r_{xx}$ = 3453.00 / 30.50 = 113.21 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 113.21
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 10.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1514.66$ Kg/sqcm.
- j) Permissible Compressive Load = 1514.66 x 19.0000 = 28778.5 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
 No. of 16mm bolts required, = 28778.52 / 6355.58 = 4.53 nos. Say **5.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 19309.401 kg
 Maximum Tension in Bracing = 18643.395 kg
- m) In Compression = 28778.5 / 19309.40 = **1.49 > 1.0 safe**
 In Tension = 36948.8 / 18643.40 = **1.98 > 1.0 safe**

D DESIGN OF BRACINGS - GD, JD

- a) Angle Section tried & adopted = 50 x 50 x 5
- b) Length of Angle, L2 = 2286.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1143.00 / 9.70 = 117.84 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 2286.00 / 23.10 = 98.96 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 4.7900 sqcm.
- e) Net Area of Cross Section Ae = A1 + A2.k
assuming 1 No.s 16mm Dia. Bolts
 $v = 1.5000 + 2.3750 \times 0.6545 = 3.0545$ sqcm.
- f) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.0545 = 7786.6 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 117.84
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1428.46$ Kg/sqcm.
- j) Permissible Compressive Load = 1428.46 x 4.7900 = 6842.3 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
No. of 16mm bolts required, = 6842.34 / 5057.61 = 1.35 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 1493.681 kg
Maximum Tension in Bracing = 1464.492 kg
- m) In Compression = 6842.3 / 1493.68 = **4.58 > 1.0 safe**
In Tension = 7786.6 / 1464.49 = **5.32 > 1.0 safe**

MEMBER & CONNECTION BOLT DESIGN FOR
BEAM-G4

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MAINBUS BEAM MKD."G4"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

A DESIGN OF MAIN-LEG FOR PART - MA

- a) Angle Section tried & adopted = 130 x 130 x 12
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 54795.24 kg
Maximum Tension in main leg for Panel = 60246.82 kg
- c) Effective Length of Angle, L1 & L2 = 1035.00 & 1035.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1035.00 / 25.60 = 40.43 < 120$ hence o.k.
 $L2/r_{xx} = 1035.00 / 39.90 = 25.94 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 29.9000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 25.70$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 25.70 = 65514.4$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 40.43
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.83 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2417.27$ Kg/sqcm.
k) Permissible Compressive Load = $2417.27 \times 29.9000 = 72276.3$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 12$ mm = 12138.27 Kgs
No. of 16mm bolts required, = $65514.43 / 12138.27 = 5.40$ nos. Say **6.00 no.**
- p) Ultimate Maximum Compression per Leg = $54795.24 \times 1.00 = 54795.24$ Kg.
- q) Ultimate Maximum Tension per Leg = $60246.82 \times 1.00 = 60246.82$ Kg.
- r) Factor of Safety
In Compression = $72276.3 / 54795.24 = 1.32 > 1.0000$ It is Safe
In Tension = $65514.4 / 60246.82 = 1.09 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

B DESIGN OF MAIN-LEG FOR PART - MB

- a) Angle Section tried & adopted = 150 x 150 x 16
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 94656.10 kg
Maximum Tension in main leg for Panel = 91097.242 kg
- c) Effective Length of Angle, L1 & L2 = 1310.00 & 1310.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 1310.00 / 29.40 = 44.56 < 120$ hence o.k.
 $L2/r_{xx} = 1310.00 / 45.80 = 28.60 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 45.6000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 40.00$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 40.00 = 101968.0$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 44.56
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 9.38 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2388.95$ Kg/sqcm.
k) Permissible Compressive Load = $2388.95 \times 45.6000 = 108936.0$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 16$ mm = 16184.36 Kgs
No. of 16mm bolts required, = $101967.98 / 12711.17 = 8.02$ nos. Say **9.00 no.**
- p) Ultimate Maximum Compression per Leg = $94656.10 \times 1.00 = 94656.10$ Kg.
- q) Ultimate Maximum Tension per Leg = $91097.24 \times 1.00 = 91097.24$ Kg.
- r) Factor of Safety
In Compression = $108936.0 / 94656.10 = 1.15 > 1.0000$ It is Safe
In Tension = $101968.0 / 91097.24 = 1.12 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2, 4T5, 4T6) & BEAM (G4 & G2)

C DESIGN OF MAIN-LEG FOR PART - AA, AB

- a) Angle Section tried & adopted = 130 x 130 x 12
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 25355.06 kg
Maximum Tension in main leg for Panel = 17965.926 kg
- c) Effective Length of Angle, L1 & L2 = 2200.00 & 2200.00 mm resply.
- d) Slenderness ratio $L1/r_{vv} = 2200.00 / 25.60 = 85.94 < 120$ hence o.k.
 $L2/r_{xx} = 2200.00 / 39.90 = 55.14 < 120$ hence o.k.
- e) Gross Area of Cross Section, Ag = 29.9000 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 25.70 sqcm.
- g) Minimum guaranteed yield Stress of Material Fy = 250 Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 25.70 = 65514.4 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 85.94
Limiting b/t ratio = $210 / (Fy)^{0.5} = 13.28$
Actual b/t ratio = 10.83 < 13.28
Value of Fy = 2549.20 Kg/sqcm.
Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / Fy) = 125.66$
Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times Fy = 1953.10 \text{ Kg/sqcm.}$
k) Permissible Compressive Load = 1953.10 x 29.9000 = 58397.7 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17 \text{ Kgs}$
Capacity for 5.6 class in bearing = $(6322 \times d \times t) \quad t = 12 \text{ mm} = 12138.27 \text{ Kgs}$
No. of 16mm bolts required, = $58397.66 / 12138.27 = 4.81 \text{ nos. Say } \mathbf{5.00 \text{ no.}}$
- p) Ultimate Maximum Compression per Leg = 25355.06 x 1.00 = 25355.06 Kg.
- q) Ultimate Maximum Tension per Leg = 17965.93 x 1.00 = 17965.93 Kg.
- r) Factor of Safety
In Compression = $58397.7 / 25355.06 = \mathbf{2.30 > 1.0000 \text{ It is Safe}}$
In Tension = $65514.4 / 17965.93 = \mathbf{3.65 > 1.0000 \text{ It is Safe}}$

* DESIGN OF BRACINGS FOR BEAM MKD. "G4"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - SA & UA

a)	Angle Section tried & adopted	=	90	x	90	x	6
b)	Length of Angle, L2	=	2431.00				mm
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1215.50	/	17.50	=	69.46 < 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2431.00	/	27.70	=	87.76 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	10.5000 sqcm.				
e)	Net Area of Cross Section Ae = A1 + A2.k assuming 1 No.s 16mm Dia. Bolts						
	$v =$	4.1700 +	5.2200	x	0.7056	=	7.8531 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy	= 250 Mpa				
g)	Permissible Tensile Stress	= 2549.20 Kg/sqcm.					
h)	Permissible Tensile Load	= 2549.20 x 7.8531					=
		20019.2 Kgs					
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	87.76				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	15.00 > 13.28				
	Value of Fy = Fcr (as per cl. 5.2.2.2.)	=	2325.91 Kg/sqcm.				
	Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$	=	1758.68 Kg/sqcm.				
j)	Permissible Compressive Load	=	1758.68 x 10.5000				
		=	18466.2 Kgs				
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58 Kgs				
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	6 mm	=	6069.13 Kgs		
	No. of 16mm bolts required,	=	18466.19 / 6069.13				
		=	3.04 nos. Say				
			4.00 no.				
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	13117.379 kg				
	Maximum Tension in Bracing	=	13122.180 kg				
m)	In Compression	=	18466.2	/	13117.38	=	1.41 > 1.0 safe
	In Tension	=	20019.2	/	13122.18	=	1.53 > 1.0 safe

B DESIGN OF BRACINGS - SB & UB

- a) Angle Section tried & adopted = 65 x 65 x 5
- b) Length of Angle, L_2 = 2560.00 mm
- c) Slenderness $0.5 \cdot L_2 / r_{vv}$ = 1280.00 / 12.60 = 101.59 < 200 hence o.k.
 Slenderness L_2 / r_{xx} = 2560.00 / 19.90 = 128.64 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 6.2500 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 2.2500 + 3.1250 \times 0.6835 = 4.3861$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 4.3861 = 11181.0 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 128.64
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 13.00 < 13.28
 Value of F_y = 2549.20 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [3.1415^2 \times E / \{ K L / r \}^2] = 1216.24$ Kg/sqcm.
- j) Permissible Compressive Load = 1216.24 x 6.2500 = 7601.5 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
 No. of 16mm bolts required, = 7601.51 / 5057.61 = 1.50 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 6135.257 kg
 Maximum Tension in Bracing = 6257.286 kg
- m) In Compression = 7601.5 / 6135.26 = **1.24 > 1.0 safe**
 In Tension = 11181.0 / 6257.29 = **1.79 > 1.0 safe**

C DESIGN OF BRACINGS - DA, DB

a)	Angle Section tried & adopted	=	90	x	90	x	6	
b)	Length of Angle, L2	=	2125.00	mm				
c)	Slenderness $0.5 \cdot L2 / r_{vv}$	=	1062.50	/	17.50	=	60.71	< 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2125.00	/	27.70	=	76.71	< 200 hence o.k.
d)	Gross Area of Cross Section, A_g	=	10.5000	sqcm.				
e)	Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$ assuming 1 No.s 16mm Dia. Bolts							
	$v = 4.1700 + 5.2200 \times 0.7056$	=	7.8531	sqcm.				
f)	Minimum guaranteed yield Stress of Material F_y	=	250	Mpa				
g)	Permissible Tensile Stress	=	2549.20	Kg/sqcm.				
h)	Permissible Tensile Load	=	2549.20	x	7.8531	=	20019.2	Kgs
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.							
	Governing Slenderness ratio	=	76.71					
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28					
	Actual b/t ratio	=	15.00	>	13.28			
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)	=	2325.91	Kg/sqcm.				
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66					
	$F_a = [1 - 0.5 \{ (KL/r / C_e)^2 \}] \times F_y$	=	1892.49	Kg/sqcm.				
j)	Permissible Compressive Load	=	1892.49	x	10.5000	=	19871.2	Kgs
k)	No. of 16mm bolts required, Permissible Shear Stress for 5.6 class bolts = 310 Mpa	=	3161	Kg/sqcm.				
	Permissible Bearing Stress for 5.6 class bolts = 620 Mpa	=	6322	Kg/sqcm.				
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	9930.60	Kgs				
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	=	6069.13	Kgs				
	No. of 16mm bolts required,	=	19871.19	/	6069.13	=	3.27	nos. Say
								4.00 no.
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing Maximum Compression in Bracing	=	4885.409	kg				
	Maximum Tension in Bracing	=	8349.652	kg				
m)	In Compression	=	19871.2	/	4885.41	=	4.07	> 1.0 safe
	In Tension	=	20019.2	/	8349.65	=	2.40	> 1.0 safe

D DESIGN OF BRACINGS - YH, YC, YD, SV

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L2 = 2200.00 mm
- c) Slenderness $0.5 \times L2/r_{vv}$ = 1100.00 / 19.40 = 56.70 < 200 hence o.k.
Slenderness $L2/r_{xx}$ = 2200.00 / 30.50 = 72.13 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2.k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 72.13
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2129.25$ Kg/sqcm.
- j) Permissible Compressive Load = 2129.25 x 19.0000 = 40455.7 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 10$ mm = 10115.22 Kgs
No. of 16mm bolts required, = 36948.80 / 9930.60 = 3.72 nos. Say **4.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 25607.214 kg
Maximum Tension in Bracing = 21460.007 kg
- m) In Compression = 40455.7 / 25607.21 = **1.58 > 1.0 safe**
In Tension = 36948.8 / 21460.01 = **1.72 > 1.0 safe**

BASE PLATE & ANCHOR BOLT DESIGN
OF 4T6 & 4T5

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV MKD."4T5" (NORMAL CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

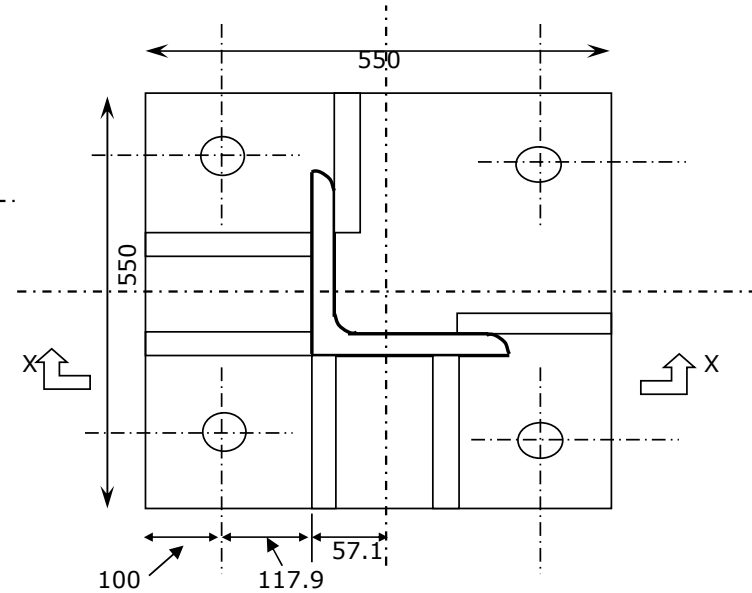
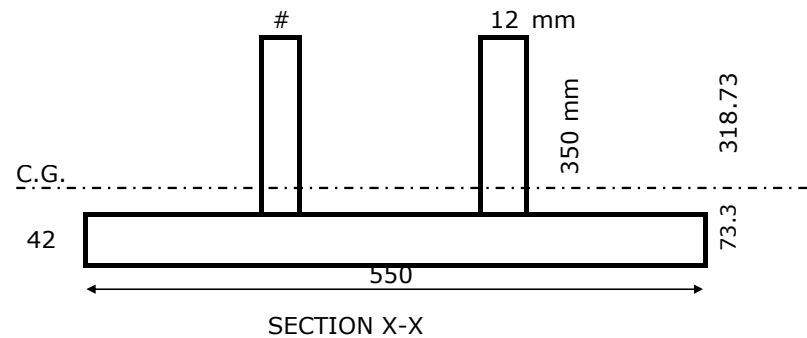
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	50627.00
B) MAXIMUM TENSION PER LEG	44285.01	0.00
C) SHEAR CORRESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	2778.15	1558.74
D) SHEAR CORRESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	2923.65	4517.16
E) RESULTANT SHEAR	4033.10	4778.53
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 50626.999 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 44285.007 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 50626.999 Kgs (Working)
- b) Maximum Tensile Load per Leg = 44285.007 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 92.67 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm (A1 = BxD)
- f) Main leg angle = L200x200x20
- g) Base Plate Size adopted b x l = 550.00 x 550.00 x 42.00 mm (A2 = b x l)
- h) Net Area of Base Plate provided = 550.000 x 550.000 = 3025.000 sqcm
- i) Height & thickness of stiffner = 350 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)



C Section modulus

Moment of Inertia @ C G axis I_{xx}	=	325788260.00 mm ⁴
Section Modulus $Z_{xx}(\text{top})$	=	1022134.26 mm ³
Section Modulus $Z_{xx}(\text{bottom})$	=	4446609.55 mm ³
Minimum Section Modulus $Z_{xx}(\text{top})$	=	1022.134 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $50626.999 / 3025.000 + 0.000 / 27729.167$
= 16.736 Kg/sqcm.
< 92.670 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 217.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $16.7362 \times 55.000 \times 21.790^2 / 2.000$
= 218526.425 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
b) Edge distance of Bolts = 100.00 mm
c) Nominal Diameter of Bolts = 56.00 mm
d) Diameter of Bolt Hole = 60.00 mm
e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $217.900 - 100.000$
= 117.900 mm
f) C/C of outer line of bolts, 'a' = $550.000 - 100.000 - 100.000$
= 350.000 mm
g) Tension per bolt, $t = P/4 + Mx/n.a + My/n.a$ = $44285.007 / 4.000 + 0.000 / 70.000$
= 11071.252 Kgs
h) Bending moment @ face of Stiffener = $2.000 \times 11071.2518 \times 11.790$
= 261060.116 Kg-cm
- Maximum bending moment = 261060.12 Kg-cm
Minimum section modulus Z_{min} = 1022.13 cm^3
i) Maximum bending stress = $255.41 \text{ Kg / sq. cm}$
< 1850.00 Kg / sq. cm

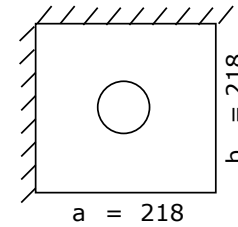
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

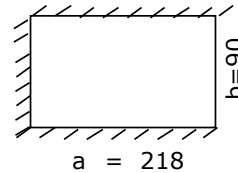
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 218 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 16.74 \\ s_b &= 1.769 \times 17 \times 21.79^2 / 4.20^2 = 796.89 \\ \text{Allowable bending stress } (1.00 \times 1850) &< 1850 \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 218 \text{ mm} \quad b = 90 \text{ mm} \\ a / b &= 2.416 \quad \beta = 0.798 \quad q = 16.7362 \\ s_b &= 0.798 \times 17 \times 9.02^2 / 4.20^2 = 61.60 \\ \text{Allowable bending stress } (1.00 \times 1850) &< 1850 \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(Stiffner)	=	332.00 cms
b) Total vertical force (tensile)	=	44285.01 Kgs.
c) Thus force / cm of weld length	=	133.39 Kgs.
d) Resistance /cm ² of weld	=	1100.00 Kgs.
e) Throat Size of weld required	=	0.12 cms
f) Thus fillet thickness required	=	1.72 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

H Design of Anchor Bolts

Diameter of Bolt	=	56 mm
Nos. of Bolts per Leg	=	4
Root area of M56 bolts, $A_e = 0.785 \cdot A_g$	=	1933 mm ²
Gross area of M56 bolts, A_g	=	2463 mm ²

Check for Normal Condition :-

Axial Tension in Each Bolt P_t	=	11071.3 Kgs.

Tensile stress, $f_t = P_t / A_e$	=	$\frac{11071.3}{19.33}$

	=	572.61 Kg/cm ²	<	1200.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.00		Hence Safe

Shear Force In Each Bolt , P_s	=	4033.10 / 4	=	1008.27 kg

Shear stress, $f_s = P_s / A_g$	=	$\frac{1008.27}{24.63}$

	=	40.94 Kg/cm ²	<	800.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.00		Hence Safe

Combined stress check for Normal Condition :-

$$f_s / F_s + f_t / F_t < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{572.61}{1200} + \frac{40.94}{800} = 0.53 \quad \text{Hence Safe.}$$

Anchor length For Normal Condition :-

$$\text{Anchor Length, } L_e = \frac{\text{Pull per bolt}}{(\pi \times d \times \tau_{bd})}$$

$$= \frac{11071.25}{17.59 \times 9.00} \quad (\tau_{bd} = 9 \text{ kg/cm}^2, \text{Refer Table-21, IS:456,2000})$$

$$\text{Thus length of embedment 'L' } = 69.92 \text{ cms.}$$

PROVIDE 4 NOS. 56 MM DIA. ANCHORE BOLT WITH MIN. 700MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV MKD."4T5" (SHORT CIRCUIT CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

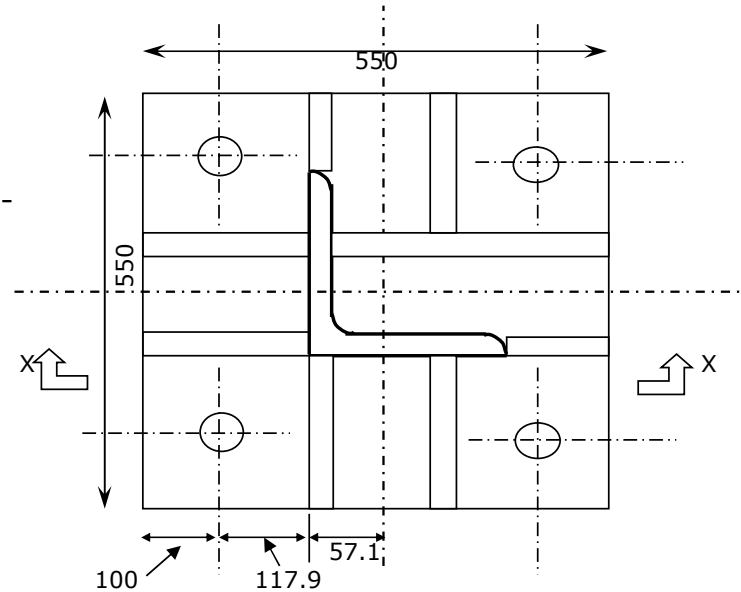
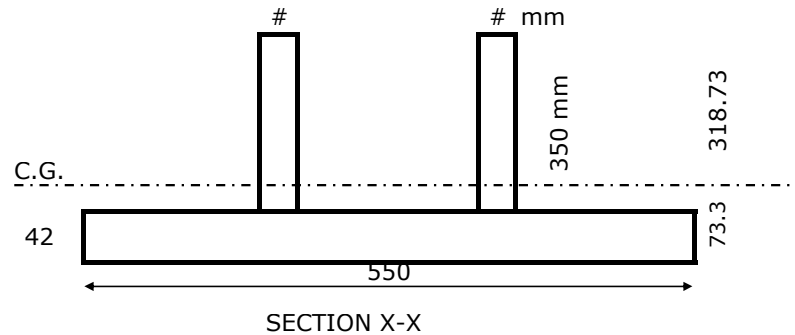
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	110182.96
B) MAXIMUM TENSION PER LEG	104609.22	0.00
C) SHEAR CORRESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	7095.76	3590.33
D) SHEAR CORRESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	6184.12	9885.69
E) RESULTANT SHEAR	9412.39	10517.47
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 110182.960 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 104609.220 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 110182.960 Kgs (Working)
b) Maximum Tensile Load per Leg = 104609.220 Kgs (Working)
c) Perm. bearing Stress - M25 concrete = 92.67 Kg/sqcm. ($\sqrt{A1/A2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm (A1 = BxD)
f) Main leg angle = L200x200x20
g) Base Plate Size adopted b x l = 550.00 x 550.00 x 42.00 mm (A2 = b x l)
h) Net Area of Base Plate provided = 550.000 x 550.000 = 3025.000 sqcm
i) Height & thickness of stiffner = 350 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)



C Section modulus

Moment of Inertia @ C G axis Ixx	= 325788260.00 mm ⁴
Section Modulus Zxx(top)	= 1022134.26 mm ³
Section Modulus Zxx(bottom)	= 4446609.55 mm ³
Minimum Section Modulus Zxx(top)	= 1022.134 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $110182.960 / 3025.000 + 0.000 / 27729.167$
= 36.4241 Kg/sqcm.
< 92.670 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 217.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions:

- c) Bending moment @ face of Stiffener = $36.4241 \times 55.000 \times 21.790^2 / 2.000$
= 475593.829 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
b) Edge distance of Bolts = 100.00 mm
c) Nominal Diameter of Bolts = 56.00 mm
d) Diameter of Bolt Hole = 60.000 mm
e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $217.900 - 100.000$
= 117.900 mm
f) C/C of outer line of bolts, 'a' = $550.000 - 100.000 - 100.000$
= 350.000 mm
g) Tension per bolt, $t = P/4 + M_x/n.a + M_y/n.a$ = $104609.220 / 4.000 + 0.000 / 70.000$
+ $0.000 / 70.000$
= 26152.305 Kgs
h) Bending moment @ face of Stiffener = $2.000 \times 26152.3050 \times 11.790$
= 616671.352 Kg-cm
- Maximum bending moment = 616671.352 Kg-cm
Minimum section modulus $Z_{min} = 1022.134 \text{ cm}^3$
i) Maximum bending stress = $603.3174 \text{ Kg / sq. cm}$
< $1850.000 \text{ Kg / sq. cm}$

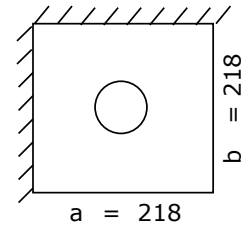
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

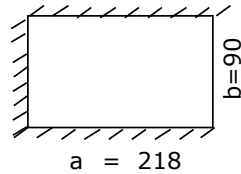
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 218 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 36.4241 \\ s_b &= 1.769 \times 36 \times 21.79^2 / 4.20^2 = \mathbf{1734.33} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 218 \text{ mm} \quad b = 90 \text{ mm} \\ a / b &= 2.416 \quad \beta = 0.798 \quad q = 36.4241 \\ s_b &= 0.798 \times 36 \times 9.02^2 / 4.20^2 = \mathbf{134.06} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(stiffner)	=	332.00 cms
b) Total vertical force (tensile)	=	104609.22 Kgs.
c) Thus force / cm of weld length	=	315.09 Kgs.
d) Resistance /cm ² of weld	=	1375.00 Kgs.
e) Throat Size of weld required	=	0.23 cms
f) Thus fillet thickness required	=	3.24 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

H Design of Anchor Bolts

Diameter of Bolt	=	56 mm
Nos. of Bolts per Leg	=	4
Root area of M56 bolts, $A_e=0.785 \cdot A_g$	=	1933 mm ²
Gross area of M56 bolts, A_g	=	2463 mm ²

Check for Short Circuit Condition :-

Axial Tension in Each Bolt P_t	=	26152.3 Kgs.

Tensile stress, $f_t = P_t / A_e$	=	$\frac{26152.3}{19.33}$

	=	1352.62 Kg/cm ²	<	1500.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.25		Hence Safe

Shear Force In Each Bolt , P_s	=	9412.39 / 4	=	2353.10 kg

Shear stress, $f_s = P_s / A_g$	=	$\frac{2353.10}{24.63}$

	=	95.54 Kg/cm ²	<	1000.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.25		Hence Safe

Combined stress check for Short Circuit Condition :-

$f_s / F_s + f_t / F_t$	<	1.40	(ref. cl.8.9.4.5 IS:800-1984)

$\frac{1352.62}{1500} + \frac{95.54}{1000}$	=	1.00	Hence Safe.

Anchor length For Short Circuit Condition :-

Anchor Length, L_e	=	Pull per bolt / $(\pi \times d \times \tau_{bd})$

	=	$\frac{26152.31}{17.59 \times 11.97}$	($\tau_{bd} = 9 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000) (33% INCREASE)

Thus length of embedment 'L'	=	124.19 cms.

PROVIDE 4 NOS. 56 MM DIA. ANCHORE BOLT WITH MIN. 1250MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV MKD."4T6" (NORMAL CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

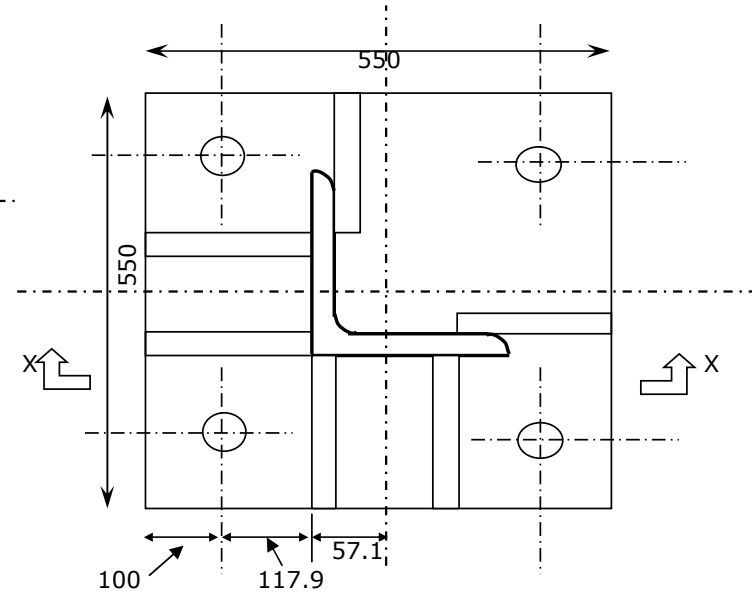
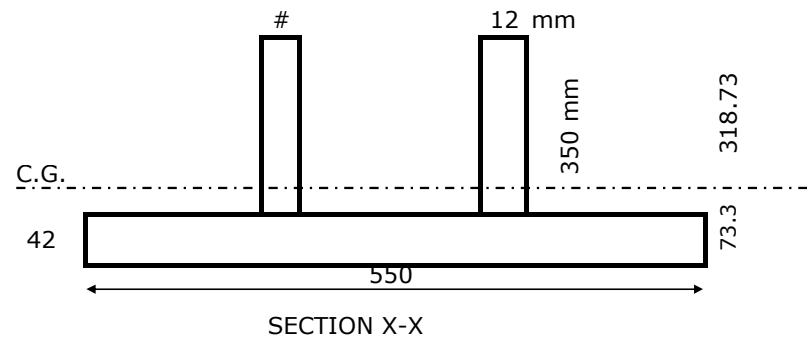
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	60988.96
B) MAXIMUM TENSION PER LEG	51074.73	0.00
C) SHEAR CORRESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	2279.87	3699.74
D) SHEAR CORRESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	4653.48	4006.04
E) RESULTANT SHEAR	5181.96	5453.11
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 60988.963 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 51074.731 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 60988.963 Kgs (Working)
- b) Maximum Tensile Load per Leg = 51074.731 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 92.67 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm (A1 = BxD)
- f) Main leg angle = L200x200x20
- g) Base Plate Size adopted b x l = 550.00 x 550.00 x 42.00 mm (A2 = b x l)
- h) Net Area of Base Plate provided = 550.000 x 550.000 = 3025.000 sqcm
- i) Height & thickness of stiffner = 350 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)



C Section modulus

Moment of Inertia @ C G axis I_{xx}	=	325788260.00 mm ⁴
Section Modulus $Z_{xx}(\text{top})$	=	1022134.26 mm ³
Section Modulus $Z_{xx}(\text{bottom})$	=	4446609.55 mm ³
Minimum Section Modulus $Z_{xx}(\text{top})$	=	1022.134 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $60988.963 / 3025.000 + 0.000 / 27729.167$
= 20.162 Kg/sqcm.
< 92.670 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 217.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $20.1616 \times 55.000 \times 21.790^2 / 2.000$
= 263252.815 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
- b) Edge distance of Bolts = 100.00 mm
- c) Nominal Diameter of Bolts = 56.00 mm
- d) Diameter of Bolt Hole = 60.000 mm
- e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $217.900 - 100.000$
= 117.900 mm
- f) C/C of outer line of bolts, 'a' = $550.000 - 100.000 - 100.000$
= 350.000 mm
- g) Tension per bolt, $t = P/4 + Mx/n.a + My/n.a$ = $51074.731 / 4.000 + 0.000 / 70.000$
+ $0.000 / 70.000$
= 12768.683 Kgs
- h) Bending moment @ face of Stiffener = $2.000 \times 12768.6828 \times 11.790$
= 301085.539 Kg-cm
- Maximum bending moment = 301085.54 Kg-cm
- Minimum section modulus Z_{min} = 1022.13 cm^3
- i) Maximum bending stress = $294.57 \text{ Kg / sq. cm}$
< 1850.00 Kg / sq. cm

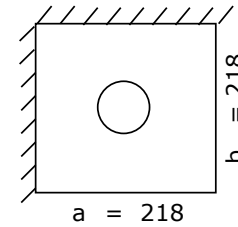
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

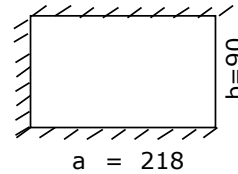
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 218 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 20.16 \\ s_b &= 1.769 \times 20 \times 21.79^2 / 4.20^2 = 960.00 \\ \text{Allowable bending stress } (1.00 \times 1850) &< 1850 \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 218 \text{ mm} \quad b = 90 \text{ mm} \\ a / b &= 2.416 \quad \beta = 0.798 \quad q = 20.1616 \\ s_b &= 0.798 \times 20 \times 9.02^2 / 4.20^2 = 74.21 \\ \text{Allowable bending stress } (1.00 \times 1850) &< 1850 \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(Stiffner)	=	332.00 cms
b) Total vertical force (tensile)	=	51074.73 Kgs.
c) Thus force / cm of weld length	=	153.84 Kgs.
d) Resistance /cm ² of weld	=	1100.00 Kgs.
e) Throat Size of weld required	=	0.14 cms
f) Thus fillet thickness required	=	1.98 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

H Design of Anchor Bolts

Diameter of Bolt	=	56 mm
Nos. of Bolts per Leg	=	4
Root area of M56 bolts, $A_e = 0.785 \cdot A_g$	=	1933 mm ²
Gross area of M56 bolts, A_g	=	2463 mm ²

Check for Normal Condition :-

Axial Tension in Each Bolt P_t	=	12768.7 Kgs.

Tensile stress, $f_t = P_t / A_e$	=	$\frac{12768.7}{19.33}$

	=	660.41 Kg/cm ²	<	1200.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.00		Hence Safe

Shear Force In Each Bolt , P_s	=	5181.96 / 4	=	1295.49 kg
Shear stress, $f_s = P_s / A_g$	=	$\frac{1295.49}{24.63}$		

	=	52.60 Kg/cm ²	<	800.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.00		Hence Safe

Combined stress check for Normal Condition :-

$$f_s / F_s + f_t / F_t < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{660.41}{1200} + \frac{52.60}{800} = 0.62 \quad \text{Hence Safe.}$$

Anchor length For Normal Condition :-

Anchor Length, L_e	=	$\text{Pull per bolt} / (\pi \times d \times \tau_{bd})$		
	=	$\frac{12768.68}{17.59 \times 9.00}$		($\tau_{bd} = 9 \text{ kg/cm}^2$, Refer Table-21, IS:456,2000)
Thus length of embedment 'L'	=	80.64 cms.		

PROVIDE 4 NOS. 56 MM DIA. ANCHORE BOLT WITH MIN. 810MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV MKD."4T6" (SHORT CIRCUIT CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

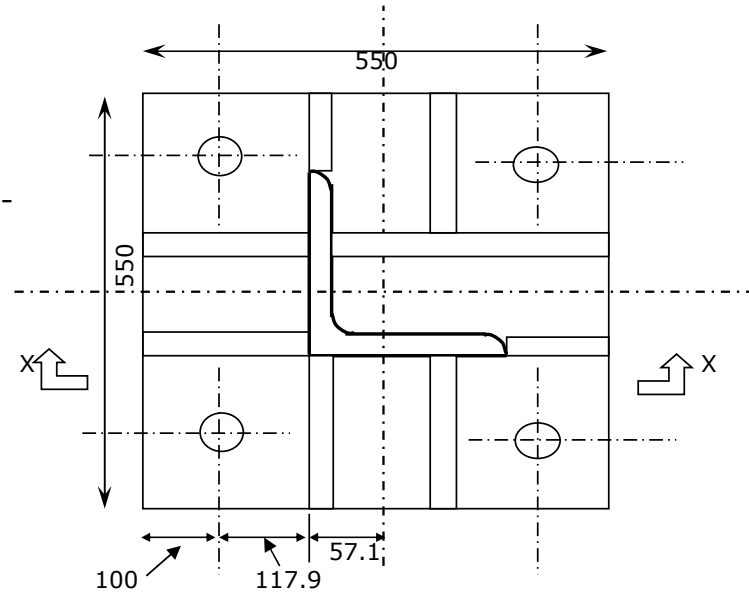
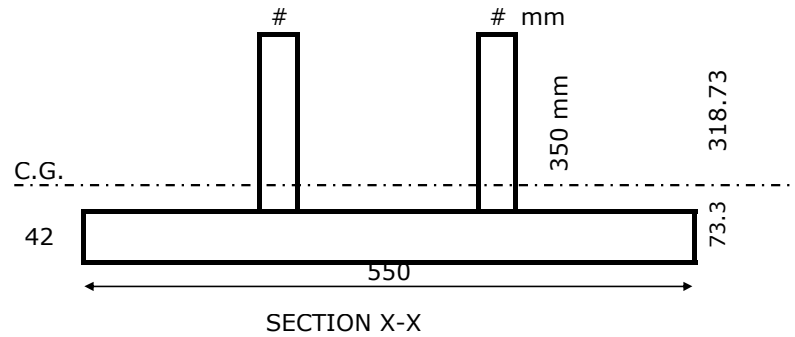
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	120800.46
B) MAXIMUM TENSION PER LEG	110431.98	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	4486.32	8184.78
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	10039.33	7179.27
E) RESULTANT SHEAR	10996.14	10887.26
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 120800.460 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 110431.980 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 120800.460 Kgs (Working)
- b) Maximum Tensile Load per Leg = 110431.980 Kgs (Working)
- c) Perm. bearing Stress - M25 concrete = 92.67 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
- d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
- e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm (A1 = BxD)
- f) Main leg angle = L200x200x20
- g) Base Plate Size adopted b x l = 550.00 x 550.00 x 42.00 mm (A2 = b x l)
- h) Net Area of Base Plate provided = 550.000 x 550.000 = 3025.000 sqcm
- i) Height & thickness of stiffner = 350 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)



C Section modulus

Moment of Inertia @ C G axis Ixx	= 325788260.00 mm ⁴
Section Modulus Zxx(top)	= 1022134.26 mm ³
Section Modulus Zxx(bottom)	= 4446609.55 mm ³
Minimum Section Modulus Zxx(top)	= 1022.134 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $120800.460 / 3025.000 + 0.000 / 27729.167$
= 39.9340 Kg/sqcm.
< 92.670 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 217.90 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions:

- c) Bending moment @ face of Stiffener = $39.9340 \times 55.000 \times 21.790^2 / 2.000$
= 521423.215 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
b) Edge distance of Bolts = 100.00 mm
c) Nominal Diameter of Bolts = 56.00 mm
d) Diameter of Bolt Hole = 60.000 mm
e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $217.900 - 100.000$
= 117.900 mm
f) C/C of outer line of bolts, 'a' = $550.000 - 100.000 - 100.000$
= 350.000 mm
g) Tension per bolt, $t = P/4 + Mx/n.a + My/n.a$ = $110431.980 / 4.000 + 0.000 / 70.000$
+ $0.000 / 70.000$
= 27607.995 Kgs
h) Bending moment @ face of Stiffener = $2.000 \times 27607.9950 \times 11.790$
= 650996.522 Kg-cm
- Maximum bending moment = 650996.522 Kg-cm
Minimum section modulus $Z_{min} = 1022.134 \text{ cm}^3$
i) Maximum bending stress = $636.8992 \text{ Kg / sq. cm}$
< $1850.000 \text{ Kg / sq. cm}$

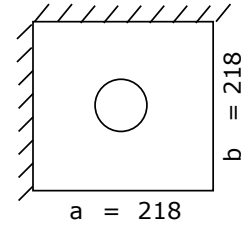
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

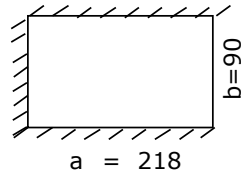
Corner portion

$$\begin{aligned}
 \text{Max. } s_b &= \beta q b^2 / t^2 \\
 a = b &= 218 \text{ mm} \\
 a / b &= 1 \quad \beta = 1.769 \quad q = 39.9340 \\
 s_b &= 1.769 \times 40 \times 21.79^2 / 4.20^2 = \mathbf{1901.46} \\
 \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5}
 \end{aligned}$$



Middle portion

$$\begin{aligned}
 a &= 218 \text{ mm} \quad b = 90 \text{ mm} \\
 a / b &= 2.416 \quad \beta = 0.798 \quad q = 39.9340 \\
 s_b &= 0.798 \times 40 \times 9.02^2 / 4.20^2 = \mathbf{146.98} \\
 \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5}
 \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(stiffner)	=	332.00 cms
b) Total vertical force (tensile)	=	110431.98 Kgs.
c) Thus force / cm of weld length	=	332.63 Kgs.
d) Resistance /cm ² of weld	=	1375.00 Kgs.
e) Throat Size of weld required	=	0.24 cms
f) Thus fillet thickness required	=	3.42 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T2,4T5,4T6) & BEAM (G2 & G4)

H Design of Anchor Bolts

Diameter of Bolt	=	56 mm
Nos. of Bolts per Leg	=	4
Root area of M56 bolts, $A_e=0.785 \cdot A_g$	=	1933 mm ²
Gross area of M56 bolts, A_g	=	2463 mm ²

Check for Short Circuit Condition :-

Axial Tension in Each Bolt P_t	=	27608.0 Kgs.

Tensile stress, $f_t = P_t / A_e$	=	$\frac{27608.0}{19.33}$

	=	1427.90 Kg/cm ²	<	1500.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.25		Hence Safe

Shear Force In Each Bolt , P_s	=	10996.14 / 4	=	2749.04 kg

Shear stress, $f_s = P_s / A_g$	=	$\frac{2749.04}{24.63}$

	=	111.61 Kg/cm ²	<	1000.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.25		Hence Safe

Combined stress check for Short Circuit Condition :-

$f_s / F_s + f_t / F_t$	<	1.40	(ref. cl.8.9.4.5 IS:800-1984)

$\frac{1427.90}{1500} + \frac{111.61}{1000}$	=	1.06	Hence Safe.

Anchor length For Short Circuit Condition :-

Anchor Length, L_e	=	Pull per bolt / $(\pi \times d \times \tau_{bd})$

	=	$\frac{27608.00}{17.59 \times 11.97}$	($\tau_{bd} = 9 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000) (33% INCREASE)

Thus length of embedment 'L'	=	131.10 cms.

PROVIDE 4 NOS. 56 MM DIA. ANCHORE BOLT WITH MIN. 1350MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

400kV AIS

	OWNER MAHAN ENERGEN LIMITED (MEL) 2x800 MW ULTRA SUPER CRITICAL THERMAL POWER PROJECT, MAHAN (PHASE-II), SINGRAULI, M.P.
	OWNER'S ENGINEER TATA CONSULTING ENGINEERS LIMITED
 Godrej & Boyce Mfg. Co. Ltd.	EPC Contractor GODREJ AND BOYCE MFG. CO. LTD

DOCUMENT TITLE	4T7 Tower Structure design calculation
OWNER DOC. NO.	552H-E-EPC-SYD-DC-U-V-0017
CONTRACTOR / SUPPLIER DOC. NO.	GNB-MEL-CE-104
PACKAGE DISCIPLINE	CIVIL
PREPARED BY	JMP
REVIEWED BY	NVT
APPROVED BY	NMP

Sr. No.	Revision No.	Date	Reasons for Change
1	0	07.08.2024	First issue
2	1	18.09.2024	Revised submission

**CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER
PROJECT AT SINGRAULI ,MP**

DESIGN FOR **400KV** GANTRY TOWER (**4T7**)

INDEX

Sr.No.	Description	Page no.
1	GEOMETRY	3
2	LOAD EVALUATION	5
3	PICTORIAL VIEW OF STAAD MODEL	55
4	STAAD ANALYSIS & DESIGN	69
5	MEMBER & CONNECTION BOLT DESIGN	78
6	BASE PLATE & ANCHOR BOLT DESIGN	92

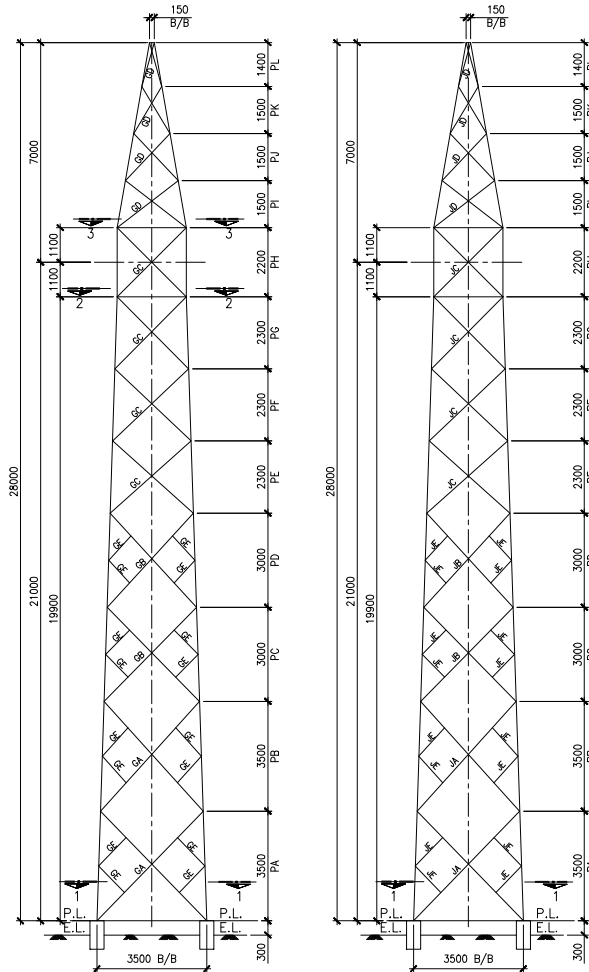
GEOMETRY

EL 0.00 LEVEL CORRESPONDS TO RL 338.000.

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	PA	PB	PC	PD	PE	PF	PG	PH	PI	PJ	PK	PL
477	ANGLE SIZE	L130x130x16	L130x130x16	L130x130x12	L130x130x12	L130x130x10	L130x130x10	L130x130x10	L130x130x10	L75x75x5	L75x75x5	L75x75x5	L75x75x5
	NO. OF BOLTS	08	08	06	06	06	06	06	06	02	02	02	02

TOWER MKD.	ANGLE SIZE AND NO. OF BOLTS	GA,JA	GB,JB	GC,JC	GD,JD	GE,JE	AA,AB	DA,DB	SU	SV	SA
477	ANGLE SIZE	L75x75x5	L75x75x5	L100x100x10	L50x50x5	L45x45x5	L90x90x6	L90x90x6	L100x100x10	L100x100x10	L75x75x5
	NO. OF BOLTS	03	03	05	02	01	03	03	06	04	03

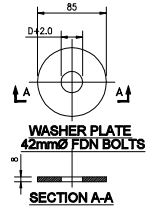
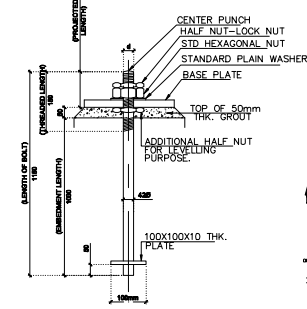
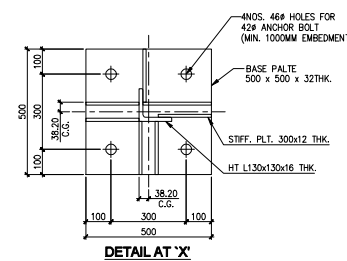
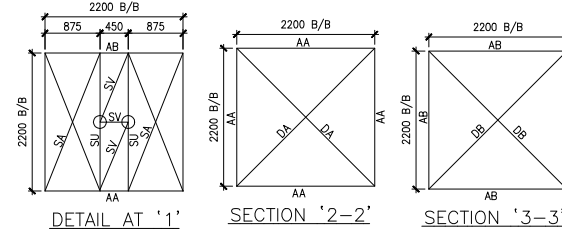
REFERENCE DRAWINGS:-	
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-L-V-0002	STRUCTURAL LAYOUT PLAN & SECTION
CONTRACTOR DRAWING NO: GNB-MEL-CE-003	STRUCTURAL LAYOUT PLAN & SECTION
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-F-V-0001	FOUNDATION BOLTS DRAWING FOR TOWERS
CONTRACTOR DRAWING NO: GNB-MEL-CE-005	FOUNDATION BOLTS DRAWING FOR TOWERS
CLIENT DRAWING NO: 552H-E-EPC-SYD-DC-O-V-0015	477 - FABRICATION DRAWING
CONTRACTOR DRAWING NO: GNB-MEL-CE-114	477 - FABRICATION DRAWING



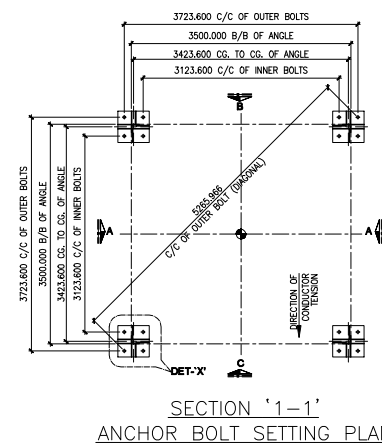
TRANSVERSE FACE VIEW:- 'A'

LONGITUDINAL FACE VIEW:- 'B'

LONGITUDINAL FACE VIEW:- 'C'



TYPICAL DETAIL OF FOUNDATION BOLT



SECTION '1-1' ANCHOR BOLT SETTING PLAN

LEGEND:-

TOWER MARKED '477' TOWER IS A END TOWER WITH PEAK WITH CONDUCTOR TENSION OF 2.860T UNDER NORMAL CONDITION & 8.848T UNDER SHORT CIRCUIT CONDITION WITH DEVIATION.

HIGHLIGHT:-

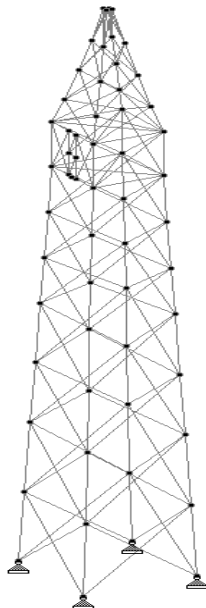
HEIGHT OF TOWER	28.00 M.
CONDUCTOR TENSION	2.860T (NC)
	8.848T (SC)
CONDUCTOR DEVIATION	±30 DEGREE

NOTES:-

- 1 ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
- 2 ALL UN-NOTED MEMBER ARE ISA L45 x 45 x 5
- 3 ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
- 4 ALL DIMENSIONS ARE CENTER LINE DIMENSION UNLESS NOTED OTHERWISE
- 5 ALL CONNECTIONS BOLT SHALL BE 5.6 CLASS 16mm DIA BOLT

400kV TOWER MKD. 477

LOAD EVALUATION FOR
CONNECTION PORTION IN TOWER

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP			
Title :-	DESIGN OF BELT HOLDING CONDUCTOR IN TOWER 4T7			
* LOAD EVALUATION FOR 400 kV TOWER 4T7				
				
SUMMARY OF CONDUCTOR AND INSULATOR FORCES				
		CONDUCTOR & INSULATOR FORCES		
		TRANSVERSE LOAD (kg)	VERTICAL LOAD (kg)	LONGITUDINAL LOAD (kg)
(1) NO DEVIATION	WIND PARALLEL TO BEAM (NC)	278.00	0.00	1430.00
	WIND PARALLEL TO BEAM (SC)	278.00	0.00	4424.00
	WIND PERPENDICULAR TO BEAM (NC)	0.00	0.00	1497.20
	WIND PERPENDICULAR TO BEAM (SC)	0.00	0.00	4491.20
	SELF WEIGHT OF INSULATOR & COND. (LEFT)	0.00	293.40	0.00
	SELF WEIGHT OF INSULATOR & COND. (RIGHT)	0	293.40	0
	EARTH WIRE LOAD			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)				
* LOAD EVALUATION FOR 400kV MKD. TOWER"4T7" (WITHOUT DEVIATION IN PLAN & ELEVATION)					
# GENERAL NOTES & WIND PRESSURE EVALUATION : -					
* LOADS					
a)	All Dead & Live Loads shall be as per	=	I.S.	802	
b)	All Wind Loads shall be as per	=	I.S.	802	
* FACTOR OF SAFETY					
a)	IN NORMAL CONDITION	=	2.0		
b)	IN SHORT-CIRCUIT CONDITION	=	1.50		
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015					
a)	Basic Wind Speed	Vb	=	39	m/s (As Per Technical Specifications)
b)	Reliabilty level		=	1.00	(As Per Technical Specifications)
c)	Terrain Category		=	1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s (As Per Cl. 8.3 of IS802 (P1/S1)-2015)
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm (As Per Cl. 8.4 of IS802 (P1/S1)-2015)

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP	
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)	

*** CONDUCTOR DETAILS**

a) Description	=	ACSR MOOSE			
b) Dia. of conductor	=	31.770	mm	(As per Electrical Input)	
c) Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)	
d) Tension per phase	=	2860	Kg/phase	(Normal Condition)	
	=	8848	Kg/phase	(Short-Circuit Condition)	
f) No. of Sub conductor per phase	=	2		(As per Electrical Input)	
g) No. of tension insulator / phase	=	2		(As per Electrical Input)	
h) No. of suspension insulator / phase	=	1		(As per Electrical Input)	
i) Length of wire on left side, L1 =	=	91.30	m	(As per T.S. 2.26, Cl 7.9,)	/(As Per site conditions)
j) Length of wire on right side, L2 =	=	91.30	m		
k) Conductor span	=	121.30	m		
Left side Span (50%) = (91.30)			x	0.50	= 45.65 m
Right side Span (50%) = (91.30)			x	0.50	= 45.65 m
Add 30 m for Jumpers/ droppers(ASSUMED)					= 30.00 m
l) Angle of Deviation					
In plan	=	0	deg.		
In Elevation	=	0	deg.		

*** INSULATOR DETAILS**

a) Weight of suspension insulator string with hardware	=	49.90	Kg
b) Weight of tension insulator string with hardware	=	49.90	Kg
c) Length of tension insulator	=	4.975	m
d) Length of suspension insulator	=	4.975	m
e) Diameter of tension insulator	=	135.00	mm
d) Diameter of suspension insulator	=	135.00	mm

Project :-

CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP

Title :-

DESIGN FOR 400KV GANTRY TOWER (4T7)

		Vertical	Longitudial	Transverse	
	Load Due to Normal Tension Due to Deviations in kg	0.00	2860.00	0.00	
	Load Due to Short Circuit Tension Due to Deviations in kg	0.00	8848.00	0.00	

LOAD CALCULATIONS :-

*

VERTICAL LOADS :

-

Weight of Conductor

a) Length of conductor

= 45.65 + 45.65 + 30.00

= 121.30 m

b) Weight of conductor

= 121.30 x 2.004 x 2.00

= 486.17 Kgs Say = 487.00 Kgs

-

Weight of Insulator

a) Weight of tension insulators string with hardware

= 49.90 Kgs per phase

b) Weight of suspension Insulator string with hardware

= 49.90 Kgs per phase

-

Weight of line man with tools

at middle phase

= 150 Kgs

-

Loads due to Conductor Tension

a) Normal Condition

= 0.00 Kgs

b) Short Circuit Tension

= 0.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	0.00	m						
c)	Net area Exposed, Ai = 50% of Li.di	=	0.00	sqm						
d)	Ratio of Li / di		0.00							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	0.00	Kgs		Say	=	0.00	Kgs	
h)	Wind Load on Tension insulator in Longitudinal Direction	=	0.00	Kg						
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	91.00	Kg						
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	0.00	m						
c)	Net area Exposed, Lc.dc	=	0.00	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	0.00	Kg		Say	=	0.00	Kgs	
g)	Wind Load on Conductor in Longitudinal Direction	=	0.00	Kg						
-	Loads due to Conductor Tension									
a)	Normal Condition	=	2860.00	Kgs						
b)	Short Circuit Tension	=	8848.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)									
*	TRANSVERSE LOADS:									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction							91.00	Kg	
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai = Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction							91.00	Kg	
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	121.30	m						
c)	Net area Exposed, Lc.dc	=	3.85	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	464.60	Kg		Say	=	465.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction							465.00	Kg	
-	Loads due to Conductor Tension									
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)										
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>											
Dead load	Self Wt.		Self Wt.								
	Cond.		T-Insu.								
TOTAL FY / PHASE	=	487.00	+	99.80	=	586.80	Kgs				
FY / NODE	=	243.50	+	49.90	=	293.40	Kgs				
Dead load	Self Wt.		Self Wt.								
	Cond.		T-Insu.								
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs				
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs				
- JOINT LOAD ON NODE NO. : 4.00											
	Lineman										
	With Tool										
TOTAL FY	=	150.00			=	150.00	Kgs				
FY / NODE	=	37.50			=	37.50	Kgs				
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on		Wind on					Wind on			
	Cond.		T-Insu.					sus.			
TOTAL FX / PHASE	=	465.00	+	91.00	=	556.00	Kgs	91.00			
FX / NODE	=	232.50	+	45.50	=	278.00	Kgs	91.00			
Cond. Tension			Conductor		Cond. Tension	Conductor		Cond. Tension	Conductor		
			Tension			Tension			Tension		
TOTAL FX / PHASE	=		0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	2860.00 Kgs
FX / NODE	=		0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	1430.00 Kgs
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on		Wind on					Wind on			
	Cond.		T-Insu.					S-Insu.			
TOTAL FX / PHASE	=	465.00	+	91.00	=	556.00	Kgs	91.00			
FX / NODE	=	232.50	+	45.50	=	278.00	Kgs	91.00			
Cond. Tension			Conductor		Cond. Tension	Conductor		Cond. Tension	Tension		
			Tension			Tension					
TOTAL FX / PHASE	=		0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	8848.00 Kgs
FX / NODE	=		0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	4424.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)										
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.	Wind on T-Insu.						Wind on S-Insu.			
TOTAL FZ / PHASE	=	0.00	+	0.00	=	0.00	Kgs	91.00			
FZ / NODE	=	0.00	+	0.00	=	0.00	Kgs	91.00			
Cond. Tension	Cond. Tension			Cond. Tension	Conductor Tension			Cond. Tension	Conductor Tension		
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	= 2860.00 Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	= 1430.00 Kgs
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.	Wind on T-Insu.						Wind on T-Insu.			
TOTAL FZ / PHASE	=	0.00	+	0.00	=	0.00	Kgs	91.00			
FZ / NODE	=	0.00	+	0.00	=	0.00	Kgs	91.00			
Cond. Tension	Cond Tension			Cond. Tension	Conductor Tension			Cond. Tension	Conductor Tension		
TOTAL FX / PHASE	=	0.00	=	0.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	= 8848.00 Kgs
FX / NODE	=	0.00	=	0.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	= 4424.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)									
* LOAD EVALUATION FOR 400kV TOWER MKD. "4T7" (WITH DEVIATION IN PLAN)										
#	<u>GENERAL NOTES & WIND PRESSURE EVAULATION : -</u>									
*	LOADS									
	a)	All Dead & Live Loads shall be as per	=	I.S.	802					
	b)	All Wind Loads shall be as per	=	I.S.	802					
*	FACTOR OF SAFETY									
	a)	IN NORMAL / BROKEN WIRE CONDITION	=		2.0					
	b)	IN SHORT-CIRCUIT CONDITION	=		1.50					
*	WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015									
	a)	Basic Wind Speed	Vb	=	39	m/s	(As Per Technical Specifications)			
	b)	Reliabilty level		=	1.00		(As Per Technical Specifications)			
	c)	Terrain Category		=	1.00		(As Per Technical Specifications)			
	d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375		(As Per IS802 (P1/S1)-2015)			
	e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s	(As Per Cl. 8.2 of IS802 (P1/S1)-2015)			
	f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00		(As Per Table-2 of IS802 (P1/S1)-2015)			
	g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08		(As Per Table-3 of IS802 (P1/S1)-2015)			
	h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s	(As Per Cl. 8.3 of IS802 (P1/S1)-2015)			
	i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm	(As Per Cl. 8.4 of IS802 (P1/S1)-2015)			
*	CONDUCTOR DETAILS									
	a)	Description		=	ACSR MOOSE					
	b)	Dia. of conductor		=	31.77	mm	(As per Electrical Input)			
	c)	Weight of conductor		=	2.004	Kg/m	(As per Electrical Input)			
	d)	Tension per phase		=	2860	Kg/phase	(Normal Condition)			
				=	8848	Kg/phase	(Short-Circuit Condition)			
	f)	No. of Sub conductor per phase		=	2		(As per Electrical Input)			
	g)	No. of tension insulator / phase		=	2		(As per Electrical Input)			
	h)	No. of suspension insulator / phase		=	1		(As per Electrical Input)			
	i)	Length of wire on left side, L1 =		=	91.3	m	(As per T.S. 2.26, Cl 7.9,) / (As Per site conditions)			
	j)	Length of wire on right side, L2 =		=	91.3	m				
	k)	Conductor span		=	121.30	m				
		Left side Span (50%) = (91.30)				x 0.50	=	45.65	m	
		Right side Span (50%) = (91.30)				x 0.50	=	45.65	m	
		Add 10 m for Jumpers/ droppers					=	30.00	m	
	l)	Angle of Deviation								
		In plan		=	30	deg.				
		In Elevation		=	0	deg.				

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP																					
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)																					
* INSULATOR DETAILS																						
a)	Weight of suspension insulator string with hardware				=	49.90	Kg (Single String)															
a)	Weight of tension insulator string with hardware				=	49.90	Kg (As per Electrical Input)															
b)	Length of tension insulator				=	4.98	m (As per Electrical Input)															
d)	Length of suspension insulator				=	4.98	m (Assumed with Hardware)															
c)	Diameter of tension insulator				=	135.00	mm (As per Electrical Input)															
d)	Diameter of suspension insulator				=	135.00	mm (Assumed)															
<table><tr><td></td><td>Vertical</td><td>Longitudial</td><td>Transverse</td></tr><tr><td>Load Due to Normal Tension Due to Deviations in kg</td><td>0.00</td><td>2477.00</td><td>1430.00</td></tr><tr><td>Load Due to Short Circuit Tension Due to Deviations in kg</td><td>0.00</td><td>7663.00</td><td>4424.00</td></tr></table>												Vertical	Longitudial	Transverse	Load Due to Normal Tension Due to Deviations in kg	0.00	2477.00	1430.00	Load Due to Short Circuit Tension Due to Deviations in kg	0.00	7663.00	4424.00
	Vertical	Longitudial	Transverse																			
Load Due to Normal Tension Due to Deviations in kg	0.00	2477.00	1430.00																			
Load Due to Short Circuit Tension Due to Deviations in kg	0.00	7663.00	4424.00																			
# <u>LOAD CALCULATIONS :-</u>																						
* VERTICAL LOADS :																						
- Weight of Conductor																						
a)	Length of conductor				=	45.65	+	45.65	+	30.00												
					=	121.30 m																
b)	Weight of conductor				=	121.30	x	2.004	x	2.00												
					=	486.17	Kgs		Say	= 487.00 Kgs												
- Weight of Insulator																						
a)	Weight of tension insulators string with hardware				=	49.90 Kgs per phase																
b)	Weight of suspension Insulator string with hardware				=	49.90 Kgs per phase																
- Weight of line man with tools																						
	at middle phase				=	150 Kgs																
- Loads due to Conductor Tension																						
a)	Normal Condition				=	0.00 Kgs																
b)	Short Circuit Tension				=	0.00 Kgs																

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP				
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)				
-	Wind Load on Tension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	2.49 m		
c)	Net area Exposed, Ai =Li.di	=	0.34 sqm		
d)	Ratio of Li / di		18.43		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	45.34 Kgs	Say	= 46.00 Kgs
h)	Wind Load on Tension insulator in Longitudinal Direction	=	46.00 Kg		
-	Wind Load on Suspension Insulator				
a)	Diameter of insulator, di	=	135.00 mm		
b)	Length of insulator, Li	=	4.98 m		
c)	Net area Exposed, Ai =Li.di	=	0.67 sqm		
d)	Ratio of Li / di		36.85		
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)	
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)	
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69 Kgs	Say	= 91.00 Kgs
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	91.00 Kg		
-	Wind Load on Conductor				
a)	Diameter of conductor, dc	=	31.77 mm		
b)	Length of conductor, Lc	=	60.65 m		
c)	Net area Exposed, Lc.dc	=	1.93 sqm		
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)	
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)	
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	232.30 Kg	Say	= 233.00 Kgs
g)	Wind Load on Conductor in Longitudinal Direction	=	233.00 Kg		
-	Loads due to Conductor Tension				
a)	Normal Condition	=	2477.00 Kgs		
b)	Short Circuit Tension	=	7663.00 Kgs		

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)									
*	TRANSVERSE LOADS:									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.31	m						
c)	Net area Exposed, Ai =Li.di	=	0.58	sqm						
d)	Ratio of Li / di		31.91							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	78.54	Kgs		Say	=	79.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction				=	79.00		Kg		
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai =Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction				=	91.00		Kg		
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	105.05	m						
c)	Net area Exposed, Lc.dc	=	3.34	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	402.36	Kg		Say	=	403.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction				=	403.00		Kg		
-	Loads due to Conductor Tension									
a)	Normal Condition	=	1430.00	Kgs						
b)	Short Circuit Tension	=	4424.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP											
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)											
# SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-												
Dead load	Self Wt.		Self Wt.									
	Cond.		T-Insu.									
TOTAL FY / PHASE	=	487.00	+	99.80	=	586.80	Kgs					
FY / NODE	=	243.50	+	49.90	=	293.40	Kgs					
Dead load	Self Wt.		Self Wt.									
	Cond.		T-Insu.									
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs					
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs					
- JOINT LOAD ON NODE NO. : 0.00												
	Lineman											
	With Tool											
TOTAL FY	=	150.00			=	150.00	Kgs					
FY / NODE	=	37.50			=	37.50	Kgs					
* LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)												
- JOINT LOAD ON NODE NO. : 0.00												
Wind load	Wind on		Wind on					Wind on				
	Cond.		T-Insu.					T-Insu.				
TOTAL FX / PHASE	=	403.00	+	79.00	=	482.00	Kgs	91.00				
FX / NODE	=	201.50	+	79.00	=	280.50	Kgs	91.00				
Cond. Tension			Conductor		Cond. Tension		Conductor	Cond. Tension		Conductor		
			Tension				Tension			Tension		
TOTAL FX / PHASE		=	1430.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	2477.00	Kgs
FX / NODE		=	1430.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	2477.00	Kgs
* LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)												
- JOINT LOAD ON NODE NO. : 0.00												
Wind load	Wind on		Wind on					Wind on				
	Cond.		T-Insu.					S-Insu.				
TOTAL FX / PHASE	=	403.00	+	79.00	=	482.00	Kgs	91.00				
FX / NODE	=	201.50	+	79.00	=	280.50	Kgs	91.00				
Cond. Tension			Cond.		Cond. Tension		Conductor	Cond. Tension		Tension		
			Tension				Tension					
TOTAL FX / PHASE		=	4424.00	Kgs	TOTAL FY / PHASE	=	0.00	Kgs	TOTAL FZ / PHASE	=	7663.00	Kgs
FX / NODE		=	4424.00	Kgs	FY / NODE	=	0.00	Kgs	FZ / NODE	=	7663.00	Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)										
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.			Wind on S-Insu.					
TOTAL FZ / PHASE =	233.00	+	46.00	=	279.00 Kgs	91.00					
FZ / NODE =	116.50	+	46.00	=	162.50 Kgs	91.00					
Cond. Tension	Cond. Tension				Cond. Tension	Conductor Tension		Cond. Tension		Conductor Tension	
TOTAL FX / PHASE =	1430.00	=	1430.00 Kgs		TOTAL FY / PHASE =	0.00 Kgs		TOTAL FZ / PHASE =		2477.00 Kgs	
FX / NODE =	1430.00	=	1430.00 Kgs		FY / NODE =	0.00 Kgs		FZ / NODE =		2477.00 Kgs	
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.		Wind on T-Insu.			Wind on T-Insu.					
TOTAL FZ / PHASE =	233.00	+	46.00	=	279.00 Kgs	91.00					
FZ / NODE =	116.50	+	46.00	=	162.50 Kgs	91.00					
Cond. Tension	Cond. Tension				Cond. Tension	Conductor Tension		Cond. Tension		Conductor Tension	
TOTAL FX / PHASE =	4424.00	=	1430.00 Kgs		TOTAL FY / PHASE =	0.00 Kgs		TOTAL FZ / PHASE =		7663.00 Kgs	
FX / NODE =	4424.00	=	1430.00 Kgs		FY / NODE =	0.00 Kgs		FZ / NODE =		7663.00 Kgs	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)									
* LOAD EVALUATION FOR 400kV TOWER MKD. "4T7" (WITH DEVIATION IN ELEVATION)										
# GENERAL NOTES & WIND PRESSURE EVALUATION : -										
* LOADS										
a)	All Dead & Live Loads shall be as per	=	I.S. 802							
b)	All Wind Loads shall be as per	=	I.S. 802							
* FACTOR OF SAFETY										
a)	IN NORMAL / BROKEN WIRE CONDITION	=	2.0							
b)	IN SHORT-CIRCUIT CONDITION	=	1.50							
* WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015										
a)	Basic Wind Speed	Vb	=	39	m/s	(As Per Technical Specifications)				
b)	Reliabilty level		=	1.00	(As Per Technical Specifications)					
c)	Terrain Category		=	1.00	(As Per Technical Specifications)					
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0	=	1.375	(As Per IS802 (P1/S1)-2015)					
e)	Meteorological Wind Speed, VR = Vb/K0	VR	=	28.36	m/s	(As Per Cl. 8.2 of IS802 (P1/S1)-2015)				
f)	Risk Coefficient for corresponding Reliability level	K1	=	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)					
g)	Terrain Roughness Coefficient for corresponding Terrain Category	K2	=	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)					
h)	Design Wind Speed, Vd = VR x K1 x K2	Vd	=	30.63	m/s	(As Per Cl. 8.3 of IS802 (P1/S1)-2015)				
i)	Design Wind Pressure Pd = 0.6 x Vd x Vd		=	57.41	Kg/sqm (As Per Cl. 8.4 of IS802 (P1/S1)-2015)					
* CONDUCTOR DETAILS										
a)	Description	=	ACSR MOOSE							
b)	Dia. of conductor	=	31.77	mm	(As per Electrical Input)					
c)	Weight of conductor	=	2.004	Kg/m	(As per Electrical Input)					
d)	Tension per phase	=	2860	Kg/phase (Normal Condition)						
		=	8848	Kg/phase (Short-Circuit Condition)						
f)	No. of Sub conductor per phase	=	2	(As per Electrical Input)						
g)	No. of tension insulator / phase	=	2	(As per Electrical Input)						
h)	No. of suspension insulator / phase	=	1	(As per Electrical Input)						
i)	Length of wire on left side, L1 =	=	91.30	m	(As per T.S. 2.26, Cl 7.9,) / (As Per site conditions)					
j)	Length of wire on right side, L2 =	=	91.30	m						
k)	Conductor span	=	121.30	m						
	Left side Span (50%)	= (	91.30	)	x	0.50	=	45.65	m	
	Right side Span (50%)	= (	91.30	)	x	0.50	=	45.65	m	
	Add 10 m for Jumpers/ droppers						=	30.00	m	
l)	Angle of Deviation									
	In plan	=	0	deg.						
	In Elevation	=	30	deg.						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)										
* INSULATOR DETAILS											
a)	Weight of suspension insulator string with hardware				=	49.90		Kg (Single String)			
a)	Weight of tension insulator string with hardware				=	49.90		Kg (As per Electrical Input)			
b)	Length of tension insulator				=	4.98		m (As per Electrical Input)			
d)	Length of suspension insulator				=	4.98		m (Assumed with Hardware)			
c)	Diameter of tension insulator				=	135.00		mm (As per Electrical Input)			
d)	Diameter of suspension insulator				=	135.00		mm (Assumed)			

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)									
-	Wind Load on Tension Insulator									
a)	Diameter of insulator, di	=	135.00 mm							
b)	Length of insulator, Li	=	0.00 m							
c)	Net area Exposed, Ai = 50% of Li.di	=	0.00 sqm							
d)	Ratio of Li / di		0.00							
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)						
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)						
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	0.00 Kgs	Say	=	0.00 Kgs				
h)	Wind Load on Tension insulator in Longitudinal Direction	=	0.00 Kg							
-	Wind Load on Suspension Insulator									
a)	Diameter of insulator, di	=	135.00 mm							
b)	Length of insulator, Li	=	4.98 m							
c)	Net area Exposed, Ai =Li.di	=	0.67 sqm							
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)						
f)	Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)						
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69 Kgs	Say	=	91.00 Kgs				
h)	Wind Load on Suspension insulator in Longitudinal Direction	=	91.00 Kg							
-	Wind Load on Conductor									
a)	Diameter of conductor, dc	=	31.77 mm							
b)	Length of conductor, Lc	=	0.00 m							
c)	Net area Exposed, Lc.dc	=	0.00 sqm							
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)						
e)	Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)						
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	0.00 Kg	Say	=	0.00 Kgs				
g)	Wind Load on Conductor in Longitudinal Direction	=	0.00 Kg							
-	Loads due to Conductor Tension									
a)	Normal Condition	=	2477.00 Kgs							
b)	Short Circuit Tension	=	7663.00 Kgs							

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP									
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)									
* TRANSVERSE LOADS:										
- Wind Load on Tension Insulator										
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai =Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Tension insulator in Transverse Direction			=	91.00	Kg				
- Wind Load on Suspension Insulator										
a)	Diameter of insulator, di	=	135.00	mm						
b)	Length of insulator, Li	=	4.98	m						
c)	Net area Exposed, Ai =Li.di	=	0.67	sqm						
d)	Ratio of Li / di		36.85							
e)	Drag Co-efficient for insulators	Cdi =	1.200		(As Per Cl. 9.3 of IS802 (P1/S1)-2015)					
f)	Gust Response Factor	Gi =	1.960		(As Per Table-6 of IS802 (P1/S1)-2015)					
g)	Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69	Kgs		Say	=	91.00	Kgs	
h)	Wind Load on Suspension insulator in Transverse Direction			=	91.00	Kg				
- Wind Load on Conductor										
a)	Diameter of conductor, dc	=	31.77	mm						
b)	Length of conductor, Lc	=	121.30	m						
c)	Net area Exposed, Lc.dc	=	3.85	sqm						
d)	Drag Co-efficient for wires & Cables	Cdc =	1.0000		(As Per Cl. 9.2 of IS802 (P1/S1)-2015)					
e)	Gust Response Factor	Gc =	2.1000		(As Per Table-7 of IS802 (P1/S1)-2015)					
f)	Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	464.60	Kg		Say	=	465.00	Kgs	
g)	Wind Load on Conductor in Transverse Direction			=	465.00	Kg				
- Loads due to Conductor Tension										
a)	Normal Condition	=	0.00	Kgs						
b)	Short Circuit Tension	=	0.00	Kgs						

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)										
# <u>SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-</u>											
Dead load		Self Wt.		Self Wt.							
		Cond.		T-Insu.							
TOTAL FY / PHASE	=	487.00	+	99.80	=	586.80	Kgs				
FY / NODE	=	243.50	+	49.90	=	293.40	Kgs				
Dead load		Self Wt.		Self Wt.							
		Cond.		T-Insu.							
TOTAL FY / PHASE	=	0.00	+	0.00	=	0.00	Kgs				
FY / NODE	=	0.00	+	0.00	=	0.00	Kgs				
- JOINT LOAD ON NODE NO. : 0.00											
		Lineman									
		With Tool									
TOTAL FY	=	150.00			=	150.00	Kgs				
FY / NODE	=	37.50			=	37.50	Kgs				
* <u>LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load		Wind on		Wind on				Wind on			
		Cond.		T-Insu.				S-Insu.			
TOTAL FX / PHASE	=	465.00	+	91.00	=	556.00	Kgs	91.00			
FX / NODE	=	232.50	+	45.50	=	278.00	Kgs	91.00			
Cond. Tension			Conductor	Cond. Tension		Conductor	Cond. Tension			Conductor	
			Tension			Tension				Tension	
TOTAL FX / PHASE		=	0.00	Kgs	TOTAL FY / PHASE		=	-1430.00	Kgs	TOTAL FZ / PHASE = 2477.00 Kgs	
FX / NODE		=	0.00	Kgs	FY / NODE		=	-1430.00	Kgs	FZ / NODE = 2477.00 Kgs	
* <u>LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load		Wind on		Wind on				Wind on			
		Cond.		T-Insu.				S-Insu.			
TOTAL FX / PHASE	=	465.00	+	91.00	=	556.00	Kgs	91.00			
FX / NODE	=	232.50	+	45.50	=	278.00	Kgs	91.00			
Cond. Tension			Conductor	Cond. Tension		Conductor	Cond. Tension			Tension	
			Tension			Tension					
TOTAL FX / PHASE		=	0.00	Kgs	TOTAL FY / PHASE		=	-4425.00	Kgs	TOTAL FZ / PHASE = 7663.00 Kgs	
FX / NODE		=	0.00	Kgs	FY / NODE		=	-4425.00	Kgs	FZ / NODE = 7663.00 Kgs	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP										
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)										
* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.	Wind on T-Insu.				Wind on S-Insu.					
TOTAL FZ / PHASE	=	0.00	+	0.00	=	0.00 Kgs	91.00				
FZ / NODE	=	0.00	+	0.00	=	0.00 Kgs	91.00				
Cond. Tension	Cond. Tension				Cond. Tension	Conductor Tension	Cond. Tension		Conductor Tension		
TOTAL FX / PHASE	=	0.00	=	0.00 Kgs	TOTAL FY / PHASE	=	-1430.00 Kgs	TOTAL FZ / PHASE	=	2477.00 Kgs	
FX / NODE	=	0.00	=	0.00 Kgs	FY / NODE	=	-1430.00 Kgs	FZ / NODE	=	2477.00 Kgs	
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load	Wind on Cond.	Wind on T-Insu.				Wind on S-Insu.					
TOTAL FZ / PHASE	=	0.00	+	0.00	=	0.00 Kgs	91.00				
FZ / NODE	=	0.00	+	0.00	=	0.00 Kgs	91.00				
Cond. Tension	Cond. Tension				Cond. Tension	Conductor Tension	Cond. Tension		Conductor Tension		
TOTAL FX / PHASE	=	0.00	=	0.00 Kgs	TOTAL FY / PHASE	=	-4425.00 Kgs	TOTAL FZ / PHASE	=	7663.00 Kgs	
FX / NODE	=	0.00	=	0.00 Kgs	FY / NODE	=	-4425.00 Kgs	FZ / NODE	=	7663.00 Kgs	

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** LOAD EVALUATION FOR 400kV TOWER MKD. "4T7" (WITH DEVIATION IN PLAN & ELEVATION)**

GENERAL NOTES & WIND PRESSURE EVALUATION :-

*** LOADS**

- a) All Dead & Live Loads shall be as per = I.S. 802
b) All Wind Loads shall be as per = I.S. 802

*** FACTOR OF SAFETY**

- a) IN NORMAL / BROKEN WIRE CONDITION = 2.0
b) IN SHORT-CIRCUIT CONDITION = 1.50

*** WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015**

- a) Basic Wind Speed Vb = 39 m/s (As Per Technical Specifications)
b) Reliability level = 1.00 (As Per Technical Specifications)
c) Terrain Category = 1.00 (As Per Technical Specifications)
d) Factor for Converting 3 Sec Gust in 10 Min Avg Wind K0 = 1.375 (As Per IS802 (P1/S1)-2015)
e) Meteorological Wind Speed, VR = Vb/K0 VR = 28.36 m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
f) Risk Coefficient for corresponding Reliability level K1 = 1.00 (As Per Table-2 of IS802 (P1/S1)-2015)
g) Terrain Roughness Coefficient for corresponding Terrain Category K2 = 1.08 (As Per Table-3 of IS802 (P1/S1)-2015)
h) Design Wind Speed, Vd = VR x K1 x K2 Vd = 30.63 m/s (As Per Cl. 8.3 of IS802 (P1/S1)-2015)
i) Design Wind Pressure Pd = 0.6 x Vd x Vd = 57.41 Kg/sqm (As Per Cl. 8.4 of IS802 (P1/S1)-2015)

*** CONDUCTOR DETAILS**

- a) Description = **ACSR MOOSE**
b) Dia. of conductor = **31.77** mm (As per Electrical Input)
c) Weight of conductor = **2.004** Kg/m (As per Electrical Input)
d) Tension per phase = **2860** Kg/phase (Normal Condition)
= **8848** Kg/phase (Short-Circuit Condition)
f) No. of Sub conductor per phase = **2** (As per Electrical Input)
g) No. of tension insulator / phase = **2** (As per Electrical Input)
h) No. of suspension insulator / phase = **1** (As per Electrical Input)
i) Length of wire on left side, L1 = **91.3** m (As per T.S. 2.26, Cl 7.9,) /(As Per site conditions)
j) Length of wire on right side, L2 = **91.3** m
k) Conductor span = 121.30 m
Left side Span (50%) = (91.30) x 0.50 = 45.65 m
Right side Span (50%) = (91.30) x 0.50 = 45.65 m
Add 10 m for Jumpers/ droppers = 30.00 m
l) Angle of Deviation
In plan = **30** deg.
In Elevation = **30** deg.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

- Wind Load on Tension Insulator

a) Diameter of insulator, di	=	135.00 mm	
b) Length of insulator, Li	=	2.49 m	
c) Net area Exposed, Ai = Li.di	=	0.34 sqm	
d) Ratio of Li / di		18.43	
e) Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)
f) Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)
g) Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	45.34 Kgs	Say = 46.00 Kgs
h) Wind Load on Tension insulator in Longitudinal Direction	=	46.00 Kg	

- Wind Load on Suspension Insulator

a) Diameter of insulator, di	=	135.00 mm	
b) Length of insulator, Li	=	4.98 m	
c) Net area Exposed, Ai = Li.di	=	0.67 sqm	
d) Ratio of Li / di		36.85	
e) Drag Co-efficient for insulators	Cdi =	1.200	(As Per Cl. 9.3 of IS802 (P1/S1)-2015)
f) Gust Response Factor	Gi =	1.960	(As Per Table-6 of IS802 (P1/S1)-2015)
g) Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	=	90.69 Kgs	Say = 91.00 Kgs
h) Wind Load on Suspension insulator in Longitudinal Direction	=	91.00 Kg	

- Wind Load on Conductor

a) Diameter of conductor, dc	=	31.77 mm	
b) Length of conductor, Lc	=	60.65 m	
c) Net area Exposed, Lc.dc	=	1.93 sqm	
d) Drag Co-efficient for wires & Cables	Cdc =	1.0000	(As Per Cl. 9.2 of IS802 (P1/S1)-2015)
e) Gust Response Factor	Gc =	2.1000	(As Per Table-7 of IS802 (P1/S1)-2015)
f) Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	=	232.30 Kg	Say = 233.00 Kgs
g) Wind Load on Conductor in Longitudinal Direction	=	233.00 Kg	

- Loads due to Conductor Tension

a) Normal Condition	=	2145.00 Kgs
b) Short Circuit Tension	=	6636.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

* TRANSVERSE LOADS:	
- Wind Load on Tension Insulator	
a) Diameter of insulator, di	= 135.00 mm
b) Length of insulator, Li	= 4.31 m
c) Net area Exposed, Ai = Li.di	= 0.58 sqm
d) Ratio of Li / di	31.91
e) Drag Co-efficient for insulators	Cdi = 1.200 (As Per Cl. 9.3 of IS802 (P1/S1)-2015)
f) Gust Response Factor	Gi = 1.960 (As Per Table-6 of IS802 (P1/S1)-2015)
g) Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	= 78.54 Kgs Say = 79.00 Kgs
h) Wind Load on Tension insulator in Transverse Direction	= 79.00 Kg
- Wind Load on Suspension Insulator	
a) Diameter of insulator, di	= 135.00 mm
b) Length of insulator, Li	= 4.98 m
c) Net area Exposed, Ai =Li.di	= 0.67 sqm
d) Ratio of Li / di	36.85
e) Drag Co-efficient for insulators	Cdi = 1.200 (As Per Cl. 9.3 of IS802 (P1/S1)-2015)
f) Gust Response Factor	Gi = 1.960 (As Per Table-6 of IS802 (P1/S1)-2015)
g) Wind Load, Fwi = Pz x Cfi x Ai x Cdi x Gi x n	= 90.69 Kgs Say = 91.00 Kgs
h) Wind Load on Suspension insulator in Transverse Direction	= 91.00 Kg
- Wind Load on Conductor	
a) Diameter of conductor, dc	= 31.77 mm
b) Length of conductor, Lc	= 105.05 m
c) Net area Exposed, Lc.dc	= 3.34 sqm
d) Drag Co-efficient for wires & Cables	Cdc = 1.0000 (As Per Cl. 9.2 of IS802 (P1/S1)-2015)
e) Gust Response Factor	Gc = 2.1000 (As Per Table-7 of IS802 (P1/S1)-2015)
f) Wind Load, Fwc = Pz x dc x Lc x Cdc x Gc x n	= 402.36 Kg Say = 403.00 Kgs
g) Wind Load on Conductor in Transverse Direction	= 403.00 Kg
- Loads due to Conductor Tension	
a) Normal Condition	= 1239.00 Kgs
b) Short Circuit Tension	= 3832.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

# SUMMARY OF DIFFERENT LOAD CASES FOR STAAD INPUT :-											
Dead load		Self Wt. Cond.		Self Wt. T-Insu.							
TOTAL FY / PHASE		=	487.00	+	99.80	=	586.80	Kgs			
FY / NODE		=	243.50	+	49.90	=	293.40	Kgs			
Dead load		Self Wt. Cond.		Self Wt. T-Insu.							
TOTAL FY / PHASE		=	0.00	+	0.00	=	0.00	Kgs			
FY / NODE		=	0.00	+	0.00	=	0.00	Kgs			
- JOINT LOAD ON NODE NO. : 0.00											
		Lineman With Tool									
TOTAL FY		=	150.00			=	150.00	Kgs			
FY / NODE		=	37.50			=	37.50	Kgs			
* LOAD CASE - 1 : NC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load		Wind on Cond.		Wind on T-Insu.				Wind on S-Insu.			
TOTAL FX / PHASE		=	403.00	+	79.00	=	482.00	Kgs	91.00		
FX / NODE		=	201.50	+	39.50	=	241.00	Kgs	91.00		
Cond. Tension			Conductor Tension		Cond. Tension			Conductor Tension			
TOTAL FX / PHASE			=	1239.00	Kgs	TOTAL FY / PHASE		=	-1430.00	Kgs	TOTAL FZ / PHASE = 2145.00 Kgs
FX / NODE			=	1239.00	Kgs	FY / NODE		=	-1430.00	Kgs	FZ / NODE = 2145.00 Kgs
* LOAD CASE - 2 : SC + WIND PARALLEL TO GANTRY BEAM (WIND ALONG X)											
- JOINT LOAD ON NODE NO. : 0.00											
Wind load		Wind on Cond.		Wind on T-Insu.				Wind on T-Insu.			
TOTAL FX / PHASE		=	403.00	+	79.00	=	482.00	Kgs	91.00		
FX / NODE		=	201.50	+	39.50	=	241.00	Kgs	91.00		
Cond. Tension			Cond. Tension		Cond. Tension			Conductor Tension			
TOTAL FX / PHASE			=	3832.00	Kgs	TOTAL FY / PHASE		=	-4425.00	Kgs	TOTAL FZ / PHASE = 6636.00 Kgs
FX / NODE			=	3832.00	Kgs	FY / NODE		=	-4425.00	Kgs	FZ / NODE = 6636.00 Kgs

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

* <u>LOAD CASE - 3 : NC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>									
- JOINT LOAD ON NODE NO. : 0.00									
Wind load	Wind on Cond.	Wind on T-Insu.				Wind on S-Insu.			
TOTAL FZ / PHASE =	233.00	+	46.00	=	279.00 Kgs	91.00			
FZ / NODE =	116.50	+	23.00	=	139.50 Kgs	91.00			
Cond. Tension	Cond. Tension		Cond. Tension	Conductor Tension		Cond. Tension	Conductor Tension		
TOTAL FX / PHASE =	1239.00	=	1239.00 Kgs	TOTAL FY / PHASE =	-1430.00 Kgs	TOTAL FZ / PHASE =	2145.00 Kgs		
FX / NODE =	619.50	=	1239.00 Kgs	FY / NODE =	-1430.00 Kgs	FZ / NODE =	2145.00 Kgs		
* <u>LOAD CASE - 4 : SC + WIND PERPENDICULAR TO GANTRY BEAM (WIND ALONG Z)</u>									
- JOINT LOAD ON NODE NO. : 0.00									
Wind load	Wind on Cond.	Wind on T-Insu.				Wind on S-Insu.			
TOTAL FZ / PHASE =	233.00	+	46.00	=	279.00 Kgs	91.00			
FZ / NODE =	116.50	+	23.00	=	139.50 Kgs	91.00			
Cond. Tension	Cond. Tension		Cond. Tension	Conductor Tension		Cond. Tension	Conductor Tension		
TOTAL FX / PHASE =	3832.00	=	1239.00 Kgs	TOTAL FY / PHASE =	-4425.00 Kgs	TOTAL FZ / PHASE =	6636.00 Kgs		
FX / NODE =	1916.00	=	1239.00 Kgs	FY / NODE =	-4425.00 Kgs	FZ / NODE =	6636.00 Kgs		

LOAD EVALUATION FOR TOWER-4T7

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP		
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)		
* <u>GEOMETRY FOR MAINBUS MKD."4T7"</u>			
TRANSVERSE FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES
LONGITUDINAL FACE DETAILS			
1)	BACK TO BACK OF STRUCTURE AT 0.0 M LEVEL	=	3.500 M
2)	HEIGHT OF SEGMENT - 1	=	19.900 M
3)	BACK TO BACK OF STRUCTURE AT 19.900	=	2.200 M
4)	ANGLE OF INCLINATION OF MAIN LEG	=	1.871 DEGREES
5)	HEIGHT OF SEGMENT - 2	=	2.200 M
6)	BACK TO BACK OF STRUCTURE AT 22.100	=	2.200 M
7)	ANGLE OF INCLINATION OF MAIN LEG	=	0.000 DEGREES
8)	HEIGHT OF SEGMENT - 3	=	5.900 M
9)	BACK TO BACK OF STRUCTURE AT 28.000	=	0.150 M
10)	ANGLE OF INCLINATION OF MAIN LEG	=	9.856 DEGREES

TABLE 1.1 - DATA FOR THE DESIGN OF THE SIDEWALK								
SR. NO.	LEVEL m	SEGMENT m	T. WIDTH m	L. WIDTH m	WIDTH' T m	WIDTH' L m	ANGLE T - FACE	ANGLE L - FACE
PL	28.0000	0.0000	0.1500	0.1500	0.15	0.15	0.000	0.000
PK	26.6000	1.4000	0.6364	0.6364	0.39	0.39	74.311	74.311
PJ	25.1000	1.5000	1.1576	1.1576	0.90	0.90	59.120	59.120
PI	23.6000	1.5000	1.6788	1.6788	1.42	1.42	46.605	46.605
PH	22.1000	1.5000	2.2000	2.2000	1.94	1.94	37.720	37.720
PG	19.9000	2.2000	2.2000	2.2000	2.20	2.20	45.000	45.000
PF	17.6000	2.3000	2.3503	2.3503	2.28	2.28	45.312	45.312
PE	15.3000	2.3000	2.5005	2.5005	2.43	2.43	43.480	43.480
PD	13.0000	2.3000	2.6508	2.6508	2.58	2.58	41.764	41.764
PC	10.0000	3.0000	2.8467	2.8467	2.75	2.75	47.503	47.503
PB	7.0000	3.0000	3.0427	3.0427	2.94	2.94	45.533	45.533
PA	3.5000	3.5000	3.2714	3.2714	3.16	3.16	47.949	47.949
	0.0000	3.5000	3.5000	3.5000	3.39	3.39	45.951	45.951

WIDTH' = PLAN WIDTH AT THE GIVEN LEVEL - SEGMENT HEIGHT x TAN θ

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** SOLIDITY RATIO FOR LONGITUDINAL FACE FOR TOWER MKD."4T7"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	130x130x10	2.200	100x100x10	3.111	-	0.000	90x90x6	2.200	1.462	4.840	0.302	1.700
PG	130x130x10	2.300	100x100x10	3.235	-	0.000	90x90x6	2.200	1.515	5.233	0.290	1.710
PF	130x130x10	2.300	100x100x10	3.343	-	0.000	-	0.000	1.330	5.578	0.238	1.762
PE	130x130x10	2.300	100x100x10	3.453	-	0.000	-	0.000	1.353	5.924	0.228	1.772
PD	130x130x12	3.000	75X75X5	4.069	45x45x5	3.534	-	0.000	1.794	8.246	0.218	1.782
PC	130x130x12	3.000	75X75X5	4.204	45x45x5	3.602	-	0.000	1.821	8.834	0.206	1.794
PB	130x130x16	3.500	75X75X5	4.713	45x45x5	4.107	-	0.000	2.086	11.050	0.189	1.811
PA	130x130x16	3.500	75X75X5	4.870	45x45x5	4.185	-	0.000	2.118	11.850	0.179	1.821

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.130 \times 3.5 \times 2 + 0.075 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.118
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.118 / 11.849$	=	0.179
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	$= \text{Main leg} \times \text{length} \times 2 + \text{Bracing} \times \text{Length} \times 2 + \text{Secondary Bracing} \times \text{Length} \times 2 + \text{Horizontal} \times \text{Length}$		
	$= (0.13 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.330
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.329 / 5.578$	=	0.238

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** WIND LOAD ON LONGITUDINAL FACE FOR TOWER MKD."4T7"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliabilty level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/ (As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)

f) Design Wind Speed, Vd = VR x K1 x K2

g)	Gust Co-efficient			
	Value of Gt for height upto 10 m	Gt	=	1.70
	Value of Gt at height of 20 m	Gt	=	1.85
	Value of Gt at height of 30 m	Gt	=	1.96
	Value of Gt at height of 40 m	Gt	=	2.07
	Value of Gt at height of 50 m	Gt	=	2.13

- h) Design Wind Pressure , Pd = 0.6 x Vd²
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T7" - TABLE 1

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.36	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.36	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.36	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.36	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.36	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.36	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.36	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.36	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.36	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.36	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.36	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.36	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T7" - TABLE 2

A Segment No. from Top	B Segment Top Levels (metres)	C Design Speed Vz (metres/sec)	D Design Pressure Pz (kg/metre2)	E Gross Area of Parts Ag (metres ²)	F Solidity Ratio (Actual)	G Force co-efficient Cdt	H Gust Coefficient Gt	I Wind Load Pz x Cdt x Gt x Ae (kg)
PL	28.0000	30.6327	57.4098	0.5505	0.6779	1.6000	1.9600	67.1878
PK	26.6000	30.6327	57.4098	1.3456	0.3120	1.7000	1.9600	80.2967
PJ	25.1000	30.6327	57.4098	2.1273	0.2129	1.7871	1.9600	91.0921
PI	23.6000	30.6327	57.4098	2.9091	0.1697	1.8303	1.9600	101.6756
PH	22.1000	30.6327	57.4098	4.8400	0.3020	1.7000	1.9600	279.6399
PG	19.9000	30.6327	57.4098	5.2328	0.2896	1.7104	1.9600	291.6193
PF	17.6000	30.6327	57.4098	5.5784	0.2384	1.7616	1.8500	248.8077
PE	15.3000	30.6327	57.4098	5.9239	0.2284	1.7716	1.8500	254.5873
PD	13.0000	30.6327	57.4098	8.2462	0.2175	1.7825	1.8500	339.5977
PC	10.0000	30.6327	57.4098	8.8342	0.2062	1.7938	1.7000	318.8850
PB	7.0000	30.6327	57.4098	11.0496	0.1888	1.8112	1.7000	368.7331
PA	3.5000	30.6327	57.4098	11.8499	0.1787	1.8213	1.7000	376.4607
	0.0000							0.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T7" - TABLE 3

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	279.6399	190.6578	22.1000	4213.5364	96.0000	96.0000
PG	2.3000	19.9000	291.6193	285.6296	19.9000	5684.0287	143.0000	143.0000
PF	2.3000	17.6000	248.8077	270.2135	17.6000	4755.7570	136.0000	136.0000
PE	2.3000	15.3000	254.5873	251.6975	15.3000	3850.9715	126.0000	126.0000
PD	3.0000	13.0000	339.5977	297.0925	13.0000	3862.2024	149.0000	149.0000
PC	3.0000	10.0000	318.8850	329.2413	10.0000	3292.4133	165.0000	165.0000
PB	3.5000	7.0000	368.7331	343.8090	7.0000	2406.6633	172.0000	172.0000
PA	3.5000	3.5000	376.4607	372.5969	3.5000	1304.0893	187.0000	187.0000
	0.0000	0.0000	0.0000	188.2304	0.0000	0.0000	95.0000	95.0000
			2818.5828	2818.5828		36697.4224	1415.0000	1415.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** SOLIDITY RATIO FOR TRANSVERSE FACE FOR TOWER MKD."4T7"**

Part	Main Leg	Length m	Bracing	Length m	Secondary Bracing	Length m	Horizontal Member	Length m	Exposed Area	Gross Area	Solidity Ratio	Force co- efficient Cdt
PL	75X75X5	1.400	50x50x5	1.454	-	0.000	-	0.000	0.373	0.551	0.678	1.600
PK	75X75X5	1.500	50x50x5	1.748	-	0.000	-	0.000	0.420	1.346	0.312	1.700
PJ	75X75X5	1.500	50x50x5	2.064	-	0.000	-	0.000	0.453	2.127	0.213	1.787
PI	75X75X5	1.500	50x50x5	2.452	-	0.000	-	0.000	0.494	2.909	0.170	1.830
PH	130x130x10	2.200	100x100x10	3.111	-	0.000	90x90x6	2.200	1.462	4.840	0.302	1.700
PG	130x130x10	2.300	100x100x10	3.235	-	0.000	90x90x6	2.200	1.515	5.233	0.290	1.710
PF	130x130x10	2.300	100x100x10	3.343	-	0.000	-	0.000	1.330	5.578	0.238	1.762
PE	130x130x10	2.300	100x100x10	3.453	-	0.000	-	0.000	1.353	5.924	0.228	1.772
PD	130x130x12	3.000	75X75X5	4.069	45x45x5	3.534	-	0.000	1.794	8.246	0.218	1.782
PC	130x130x12	3.000	75X75X5	4.204	45x45x5	3.602	-	0.000	1.821	8.834	0.206	1.794
PB	130x130x16	3.500	75X75X5	4.713	45x45x5	4.107	-	0.000	2.086	11.050	0.189	1.811
PA	130x130x16	3.500	75X75X5	4.870	45x45x5	4.185	-	0.000	2.118	11.850	0.179	1.821

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

#	Sample Calculation for Part - PA		
#	Exposed Area for Part - PA		
	$= (0.130 \times 3.5 \times 2 + 0.075 \times 4.870 \times 2 + 0.045 \times 4.185 \times 2) \times 5\% \text{ for connections}$	=	2.118
#	Gross Area for Part-PA		
	= Average Width x Height for Segment - PA		
	$= (3.5 + 3.2714) / 2 \times 3.5$	=	11.850
#	Solidity Ration for Part -PA		
	= Exposed Area / Gross Area		
	$= 2.118 / 11.849$	=	0.179
#	Sample Calculation for Part - PF		
#	Exposed Area for Part - PF		
	= Main leg x length x 2 + Bracing x Length x 2 + Secondary Bracing x Length x 2 + Horizontal x Length		
	$= (0.13 \times 2.3 \times 2 + 0.1 \times 3.343 \times 2) \times 5\% \text{ for connections}$	=	1.330
#	Gross Area for Part-PF		
	= Average Width x Height for Segment - PF		
	$= (2.3503 + 2.5005) / 2 \times 2.3$	=	5.578
#	Solidity Ration for Part -PF		
	= Exposed Area / Gross Area		
	$= 1.329 / 5.578$	=	0.238

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** WIND LOAD ON TRANSVERSE FACE FOR TOWER MKD."4T7"**

WIND PRESSURE EVALUATION AS PER IS 802 (PART-1/SEC-1) - 2015

a)	Basic Wind Speed	Vb =	39.00	m/sec (As per Technical Specification)
b)	Reliabilty level		1.00	(As Per Technical Specifications)
c)	Terrain Category		1.00	(As Per Technical Specifications)
d)	Factor for Converting 3 Sec Gust in 10 Min Avg Wind	K0 =	1.375	(As Per IS802 (P1/S1)-2015)
e)	Meteorological Wind Speed, VR = Vb/K0	VR =	28.36	m/s (As Per Cl. 8.2 of IS802 (P1/S1)-2015)
-	Risk Coefficient for corresponding Reliability level	K1 =	1.00	(As Per Table-2 of IS802 (P1/S1)-2015)
-	Terrain Roughness Coefficient for corresponding Terrain Category	K2 =	1.08	(As Per Table-3 of IS802 (P1/S1)-2015)
- f) Design Wind Speed, Vd = VR x K1 x K2
- g) Gust Co-efficient
- | | | | |
|----------------------------------|-----------|----------|-------------|
| Value of Gt for height upto 10 m | Gt | = | 1.70 |
| Value of Gt at height of 20 m | Gt | = | 1.85 |
| Value of Gt at height of 30 m | Gt | = | 1.96 |
| Value of Gt at height of 40 m | Gt | = | 2.07 |
| Value of Gt at height of 50 m | Gt | = | 2.13 |
- h) Design Wind Pressure , Pd = 0.6 x Vd^2
- Gross Areas are calculated as height of segment x Average width of panel and same has been used to evaluate wind load.
 - Solidity ratio is calculated for actual sizes of members and force coefficient is calculated from Table 5 for actual solidity ratio and same is used for wind load calculation.
 - Force Coefficients are as per Table 5 i.e overall force coefficients for towers composed of flat sided members.
 - Wind Load = Gross Exposed Area x Assummed solidity x Coefficient x Pressure.
 - Wind Load at given level = 50 % load from panel above + 50 % load from panel below.
 - In TABLE - 1 the design wind speed is calculated as per IS 802 Part I/SEC I where vaules of k2 have been interpolated for various heights.
 - In TABLE - 2 the design wind pressure has been calculated as per IS -802 Part I/SEC I and wind load on panels are caculated using the above mentioned formula.
 - In TABLE - 3 the wind perpendicular to the Longitudinal face has been calculated at various levels as per above mentioned note and are distributed equally on each node.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T7" - TABLE 1

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	D Width of Segment (metres)	E Gross Area of Parts (metres ²)	F Basic Wind Speed Vb (metres/sec)	G Meteorological Wind Speed VR	H Risk Coefficient K1	I Terrain Roughness Coefficient K2
PL	1.4000	28.0000	0.1500	0.5505	39.0000	28.3636	1.0000	1.0800
PK	1.5000	26.6000	0.6364	1.3456	39.0000	28.3636	1.0000	1.0800
PJ	1.5000	25.1000	1.1576	2.1273	39.0000	28.3636	1.0000	1.0800
PI	1.5000	23.6000	1.6788	2.9091	39.0000	28.3636	1.0000	1.0800
PH	2.2000	22.1000	2.2000	4.8400	39.0000	28.3636	1.0000	1.0800
PG	2.3000	19.9000	2.2000	5.2328	39.0000	28.3636	1.0000	1.0800
PF	2.3000	17.6000	2.3503	5.5784	39.0000	28.3636	1.0000	1.0800
PE	2.3000	15.3000	2.5005	5.9239	39.0000	28.3636	1.0000	1.0800
PD	3.0000	13.0000	2.6508	8.2462	39.0000	28.3636	1.0000	1.0800
PC	3.0000	10.0000	2.8467	8.8342	39.0000	28.3636	1.0000	1.0800
PB	3.5000	7.0000	3.0427	11.0496	39.0000	28.3636	1.0000	1.0800
PA	3.5000	3.5000	3.2714	11.8499	39.0000	28.3636	1.0000	1.0800
	0.0000	0.0000	3.5000					

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

EVALUATION OF WIND LOAD AS PER IS -802 PART I/SEC I ON TOWER "4T7" - TABLE 3

A Segment No. from Top	B Height of Segments (metres)	C Segment Top Levels (metres)	I Wind Load (kg)	E Distribution of Wind Load (kg)	F Height of Application (metres)	G Moment Force x Ht. (kg - metres)	H Load Left (kg)	I Load Right (kg)
PL	1.4000	28.0000	67.1878	33.5939	28.0000	940.6293	17.0000	17.0000
PK	1.5000	26.6000	80.2967	73.7422	26.6000	1961.5436	37.0000	37.0000
PJ	1.5000	25.1000	91.0921	85.6944	25.1000	2150.9290	43.0000	43.0000
PI	1.5000	23.6000	101.6756	96.3838	23.6000	2274.6587	49.0000	49.0000
PH	2.2000	22.1000	279.6399	190.6578	22.1000	4213.5364	96.0000	96.0000
PG	2.3000	19.9000	291.6193	285.6296	19.9000	5684.0287	143.0000	143.0000
PF	2.3000	17.6000	248.8077	270.2135	17.6000	4755.7570	136.0000	136.0000
PE	2.3000	15.3000	254.5873	251.6975	15.3000	3850.9715	126.0000	126.0000
PD	3.0000	13.0000	339.5977	297.0925	13.0000	3862.2024	149.0000	149.0000
PC	3.0000	10.0000	318.8850	329.2413	10.0000	3292.4133	165.0000	165.0000
PB	3.5000	7.0000	368.7331	343.8090	7.0000	2406.6633	172.0000	172.0000
PA	3.5000	3.5000	376.4607	372.5969	3.5000	1304.0893	187.0000	187.0000
	0.0000	0.0000	0.0000	188.2304	0.0000	0.0000	95.0000	95.0000
			2818.5828	2818.5828		36697.4224	1415.0000	1415.0000

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** EARTH WIRE LOAD EVALUATION FOR TOWER MKD."4T7"**

(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)

*** WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

*** EARTH WIRE LOADING :-**

a)	Length of wire on left side, L1 =	=	91.30	m
b)	Length of wire on right side, L2 =	=	91.30	m
c)	Earthwire Span (L1 + L2)/2	=	91.30	m
d)	Diameter of Earth Wire	=	10.980	mm
e)	Weight of Earth Wire	=	0.600	Kg/m
f)	Total Weight of Earth Wire per Tower	=	54.780	Kg
g)	Earth Wire Tension	=	1000.00	Kg
h)	Wind Force Co-efficient for Wires & Cables, Cf	=	1.20	(refer table 27 of IS875-1987, part III)
i)	Wind on Earth-Wire, Pz x Cf x Area	=	57.41 x 1.20 x 1.0025	
		=	69.06	Kg
	Wind Load on Earth-Wire in Longitudinal Dirn.	=	0.00	Kg
	Wind Load on Earth-Wire in Transverse Dirn.	=	70.00	Kg
k)	Angle of Deviation			
	In Plan	=	0.00	°
	In Elevation	=	0.00	°
		Vertical	Long.	Transverse
	Load Due to Normal Tension Due to Deviations in kg	0.00	1000.00	0.00

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn.	=	70	Kg
Load Due to Normal Tension Due to Deviation	=	0	Kg

Vertical Loads :-

Weight of Earth-wire	=	55	Kg
Load Due to Normal Tension Due to Deviation	=	0	Kg
Say	=	55	Kg

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn.	=	0	Kg
Load Due to Normal Tension Due to Deviation	=	1000	Kg
Say	=	1000	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

* **WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

* **EARTH WIRE LOADING :-**

a) Length of wire on left side, L1 = 91.30 m
b) Length of wire on right side, L2 = 91.30 m
c) Earthwire Span (L1 + L2)/2 = 91.30 m
d) Diameter of Earth Wire = 10.980 mm
e) Weight of Earth Wire = 0.600 Kg/m
f) Total Weight of Earth Wire per Tower = 54.780 Kg
g) Earth Wire Tension = 1000.00 Kg
h) Wind Force Co-efficient for Wires & Cables, Cf = 1.20 (refer table30 of IS875-2015, part III)
i) Wind on Earth-Wire, Pz x Cf x Area = 57.41 x 1.20 x 1.0025
= 69.06 Kg

Wind Load on Earth-Wire in Longitudinal Dirn. = 35.00 Kg

Wind Load on Earth-Wire in Transverse Dirn. = 60.00 Kg

k) Angle of Deviation
In Plan = 30.00 °
In Elevation = 0.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	0.00	866.03	500.00

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn.	=	60	Kg
Load Due to Normal Tension Due to Deviation	=	500	Kg
Say	=	<u>560</u>	Kg

Vertical Loads :-

Weight of Earth-wire	=	55	Kg
Load Due to Normal Tension Due to Deviation	=	0	Kg
Say	=	<u>55</u>	Kg

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn.	=	35	Kg
Load Due to Normal Tension Due to Deviation	=	866	Kg
Say	=	<u>901</u>	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

* **WIND LOAD EVALUATION**

Design Wind Pressure, Pz = 57.41 Kg/m²

* **EARTH WIRE LOADING :-**

a) Length of wire on left side, L1 = 91.30 m
b) Length of wire on right side, L2 = 91.30 m
c) Earthwire Span (L1 + L2)/2 = 91.30 m
d) Diameter of Earth Wire = 10.980 mm
e) Weight of Earth Wire = 0.600 Kg/m
f) Total Weight of Earth Wire per Tower = 54.780 Kg
g) Earth Wire Tension = 1000.00 Kg
h) Wind Force Co-efficient for Wires & Cables, Cf = 0.90 (refer table30 of IS875-2015, part III)
i) Wind on Earth-Wire, Pz x Cf x Area = 57.41 x 0.90 x 1.0025
= 51.80 Kg

Wind Load on Earth-Wire in Longitudinal Dirn. = 0.00 Kg

Wind Load on Earth-Wire in Transverse Dirn. = 45.00 Kg

k) Angle of Deviation
In Plan = 0.00 °
In Elevation = 30.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	-500.00	866.03	0.00

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn.	=	45	Kg
Load Due to Normal Tension Due to Deviation	=	0	Kg
Say	=	<u>45</u>	Kg

Vertical Loads :-

Weight of Earth-wire	=	55	Kg
Load Due to Normal Tension Due to Deviation	=	-500	Kg
Say	=	<u>-445</u>	Kg

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn.	=	0	Kg
Load Due to Normal Tension Due to Deviation	=	866	Kg
Say	=	<u>866</u>	Kg

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

* **WIND LOAD EVALUATION**

Design Wind Pressure, P_z = 57.41 Kg/m²

* **EARTH WIRE LOADING :-**

a) Length of wire on left side, L1 = 91.30 m
b) Length of wire on right side, L2 = 91.30 m
c) Earthwire Span (L1 + L2)/2 = 91.30 m
d) Diameter of Earth Wire = 10.980 mm
e) Weight of Earth Wire = 0.600 Kg/m
f) Total Weight of Earth Wire per Tower = 54.780 Kg
g) Earth Wire Tension = 1000.00 Kg
h) Wind Force Co-efficient for Wires & Cables, Cf = 0.90 (refer table30 of IS875-2015, part III)
i) Wind on Earth-Wire, $P_z \times C_f \times \text{Area}$ = 57.41 x 0.90 x 1.0025
= 51.80 Kg

Wind Load on Earth-Wire in Longitudinal Dirn. = 25.00 Kg

Wind Load on Earth-Wire in Transverse Dirn. = 40.00 Kg

k) Angle of Deviation
In Plan = 30.00 °
In Elevation = 30.00 °

	Vertical	Long.	Transverse
Load Due to Normal Tension Due to Deviations in kg	-500.00	750.00	433.01

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

Transverse Loads :-

Wind Load on Earth-Wire in Transverse Dirn.	=	40	Kg
Load Due to Normal Tension Due to Deviation	=	433	Kg
Say	=	<u>473</u>	Kg

Vertical Loads :-

Weight of Earth-wire	=	55	Kg
Load Due to Normal Tension Due to Deviation	=	-500	Kg
Say	=	<u>-445</u>	Kg

Longitudinal Loads :-

Wind Load on Earth-Wire in Longitudinal Dirn.	=	25	Kg
Load Due to Normal Tension Due to Deviation	=	750	Kg
Say	=	<u>775</u>	Kg

PICTORIAL VIEW OF STAAD MODEL

		Job No.	Sheet No. 1	Rev
Software licensed to Anhera Enterprise Connected User: Madhusudan Patel				
Job Title		Part	Ref	
Client		By	Date 02-JULY-24	Chd
File TOWER 4T7.STD		Date Time 17-Jul-2024 14:07		

Job Information

	Engineer	Checked	Approved
Name:			
Date:	02-JULY-24		
Comments:			
Structure Type:	TRUSS		

Geometry

Entity Type	Count	Highest
Nodes	59	207
Analytical Members	174	829

Load Cases

Load Case Type	Count
Primary	19
Combination	32

Included in this printout are data for:

All	The Whole Structure

Load Case Table

Included in this printout are results for load cases:

L/C	Type	Name
1	Primary	DEAD LOAD + LIVE LOAD
2	Primary	WIND ALONG X DIRECTION(PARALLEL TO BEAM)
3	Primary	WIND ALONG Z DIRECTION (PERPENDICULAR TO BEAM)
4	Primary	NC(0P-0E) +WIND PARALLEL TO BEAM
5	Primary	SC(0P-0E) +WIND PARALLEL TO BEAM
6	Primary	NC(0P-0E) +WIND PERPENDICULAR TO BEAM
7	Primary	SC(0P-0E) +WIND PERPENDICULAR TO BEAM
8	Primary	NC(30P-0E) +WIND PARALLEL TO BEAM
9	Primary	SC(30P-0E) +WIND PARALLEL TO BEAM
10	Primary	NC(30P-0E) +WIND PERPENDICULAR TO BEAM
11	Primary	SC(30P-0E) +WIND PERPENDICULAR TO BEAM

		Job No.	Sheet No. 2	Rev
Software licensed to Anhera Enterprise Connected User: Madhusudan Patel				
Job Title		Part	Ref	
Client		By	Date 02-JULY-24	Chd
File TOWER 4T7.STD		Date Time 17-Jul-2024 14:07		

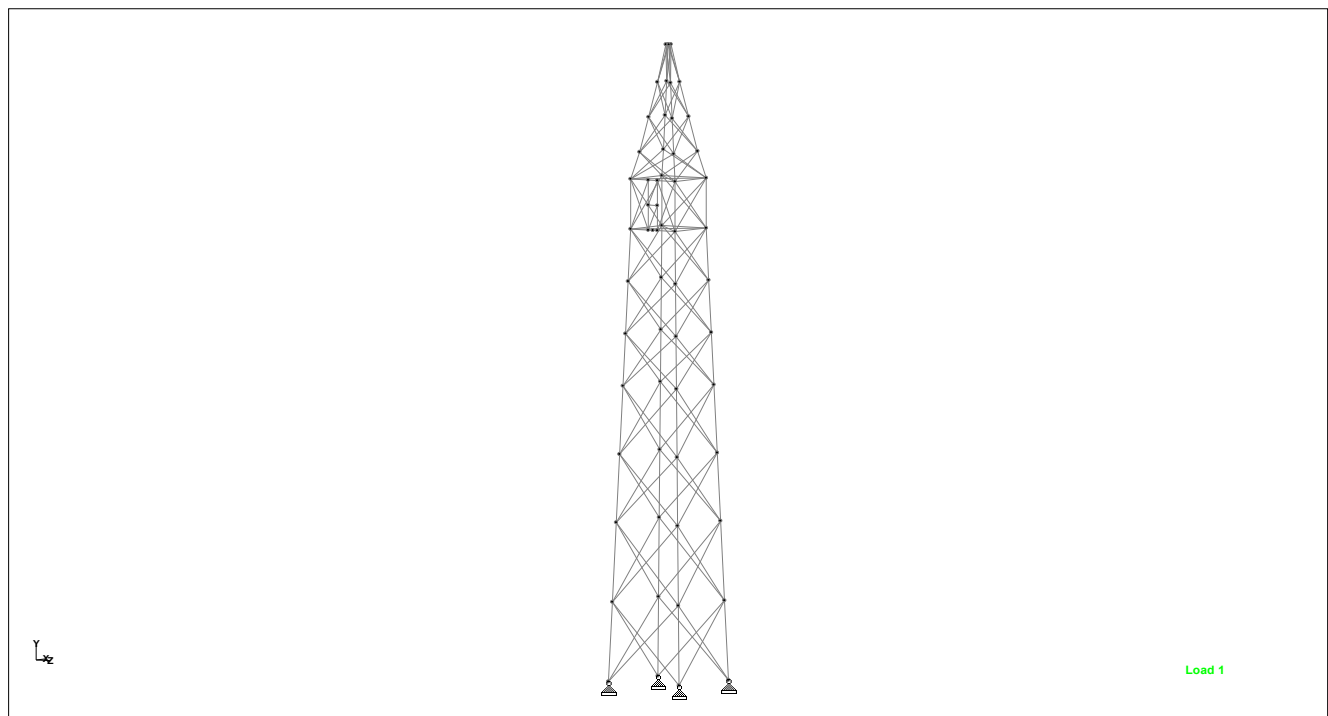
Load Case Table Cont...

L/C	Type	Name
12	Primary	NC(0P-30E) +WIND PARALLEL TO BEAM
13	Primary	SC(0P-30E) +WIND PARALLEL TO BEAM
14	Primary	NC(0P-30E) +WIND PERPENDICULAR TO BEAM
15	Primary	SC(0P-30E) +WIND PERPENDICULAR TO BEAM
16	Primary	NC(30P-30E) +WIND PARALLEL TO BEAM
17	Primary	SC(30P-30E) +WIND PARALLEL TO BEAM
18	Primary	NC(30P-30E) +WIND PERPENDICULAR TO BEAM
19	Primary	SC(30P-30E) +WIND PERPENDICULAR TO BEAM
101	Combination	2(DL + NC + WIND PARALLEL TO BEAM)
201	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
102	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
202	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
103	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
203	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
104	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
204	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
105	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
205	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
106	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
206	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
107	Combination	2(DL +NC + WIND PARALLEL TO BEAM)
207	Combination	1.5(DL +SC + WIND PARALLEL TO BEAM)
108	Combination	2(DL +NC + WIND PERPENDICULAR TO BEAM)
208	Combination	1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
301	Combination	DL + NC + WIND PARALLEL TO BEAM
401	Combination	DL +SC + WIND PARALLEL TO BEAM
302	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
402	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
303	Combination	DL +NC + WIND PARALLEL TO BEAM
403	Combination	DL +SC + WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 3	Rev
Job Title	Part		Ref
Client	By	Date02-JULY-24	Chd
FileTOWER 4T7.STD	Date Time17-Jul-2024 14:07		

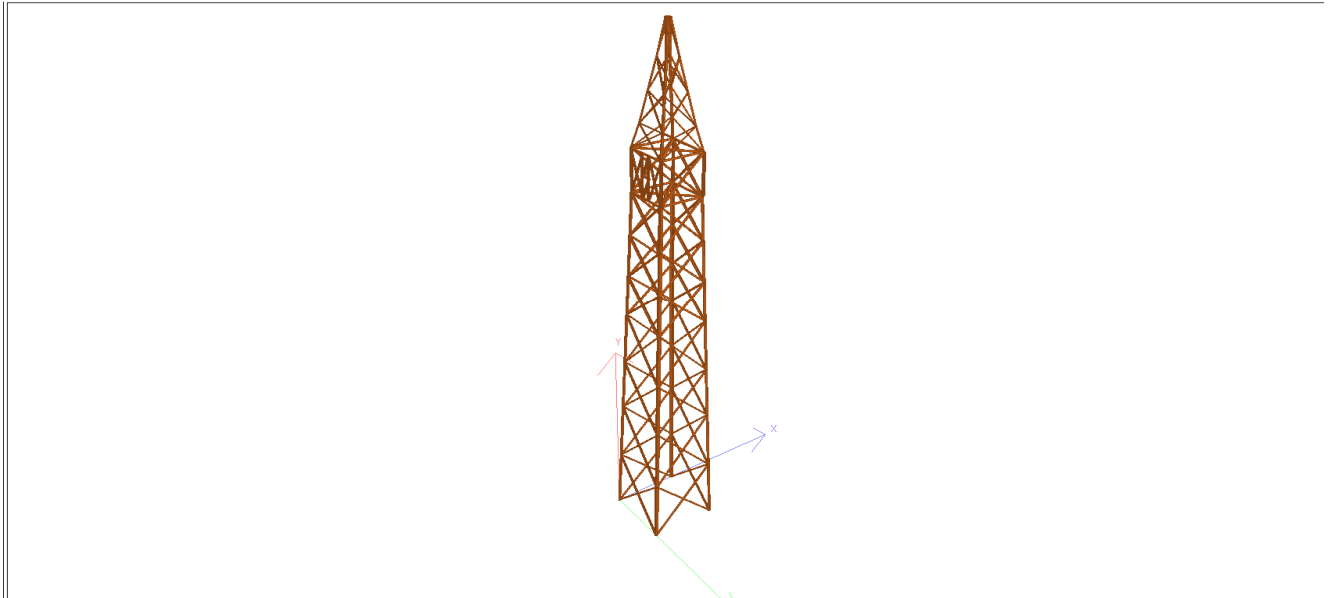
Load Case Table Cont...

L/C	Type	Name
304	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
404	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
305	Combination	DL +NC + WIND PARALLEL TO BEAM
405	Combination	DL +SC + WIND PARALLEL TO BEAM
306	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
406	Combination	DL +SC + WIND PERPENDICULAR TO BEAM
307	Combination	DL +NC + WIND PARALLEL TO BEAM
407	Combination	DL +SC + WIND PARALLEL TO BEAM
308	Combination	DL +NC + WIND PERPENDICULAR TO BEAM
408	Combination	DL +SC + WIND PERPENDICULAR TO BEAM

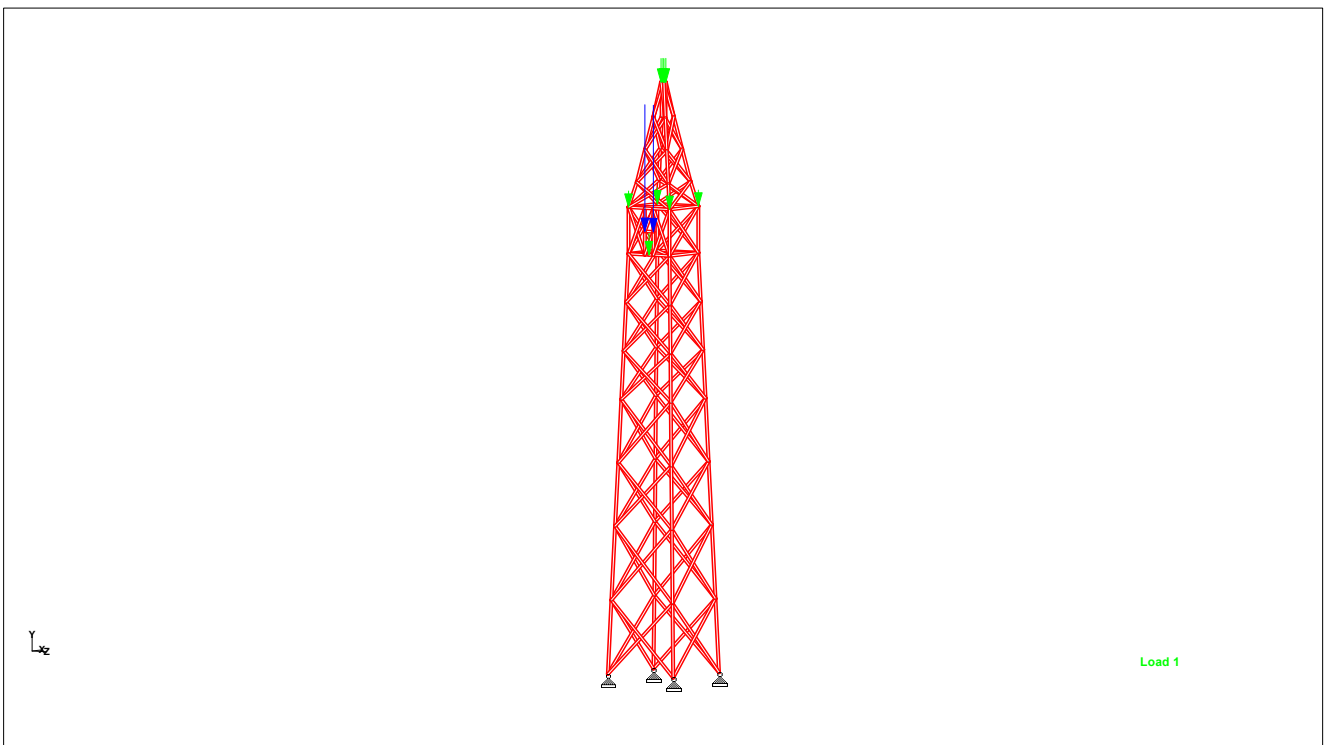


Whole Structure

Job No.	Sheet No. 4	Rev
Job Title	Part	Ref
Client	By y	Date 02-JULY-24 Chd
File TOWER 4T7.STD	Date Time 17-Jul-2024 14:07	

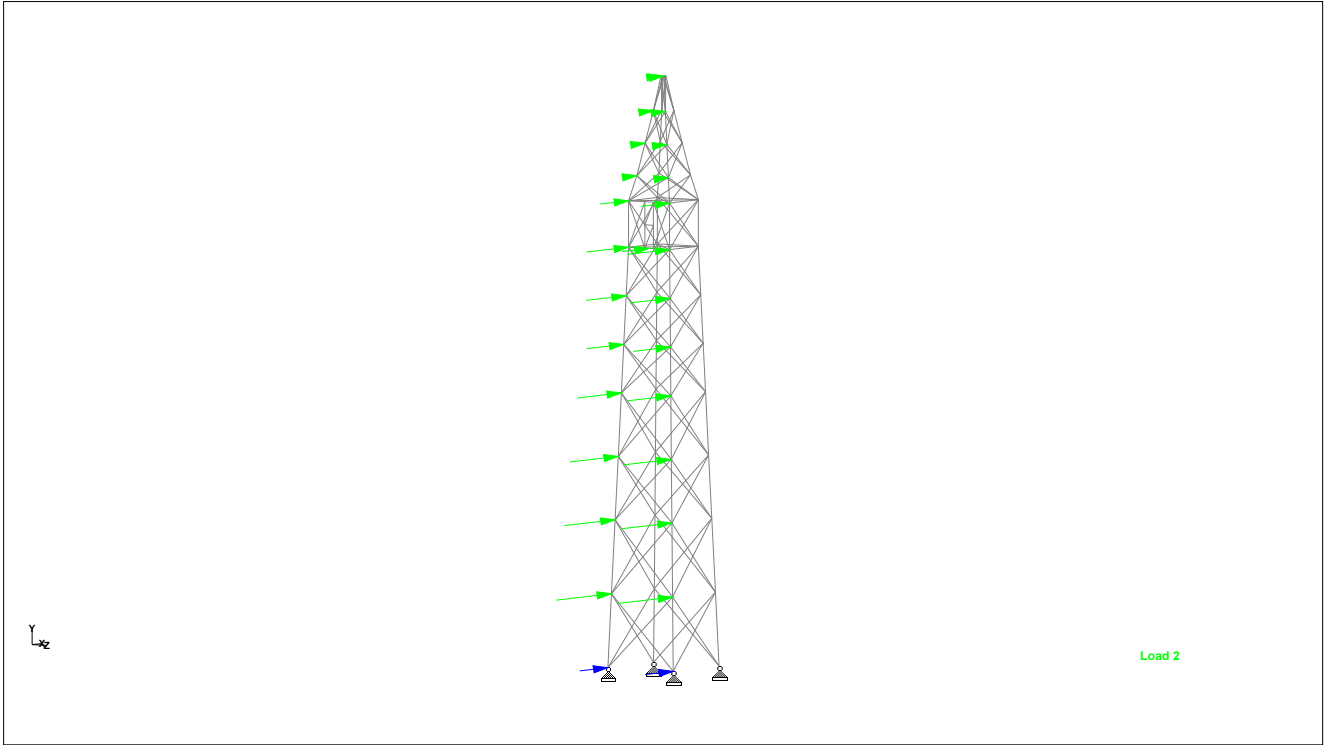


3D Rendered View

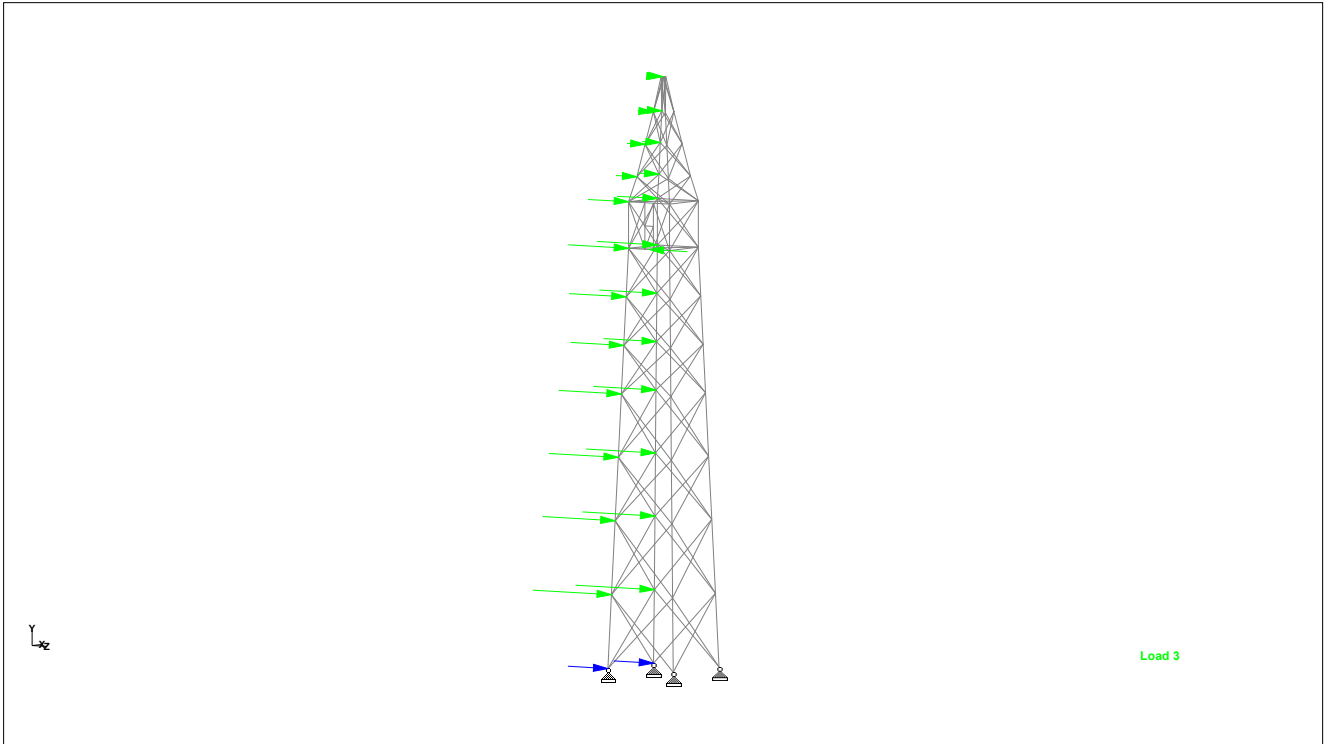


DEAD LOAD+LIVE LOAD

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 5	Rev
	Part		Re f
Job Title	Client	By y	Date 02-JULY-24 Chd
File TOWER 4T7.STD		Date Time 17-Jul-2024 14:07	

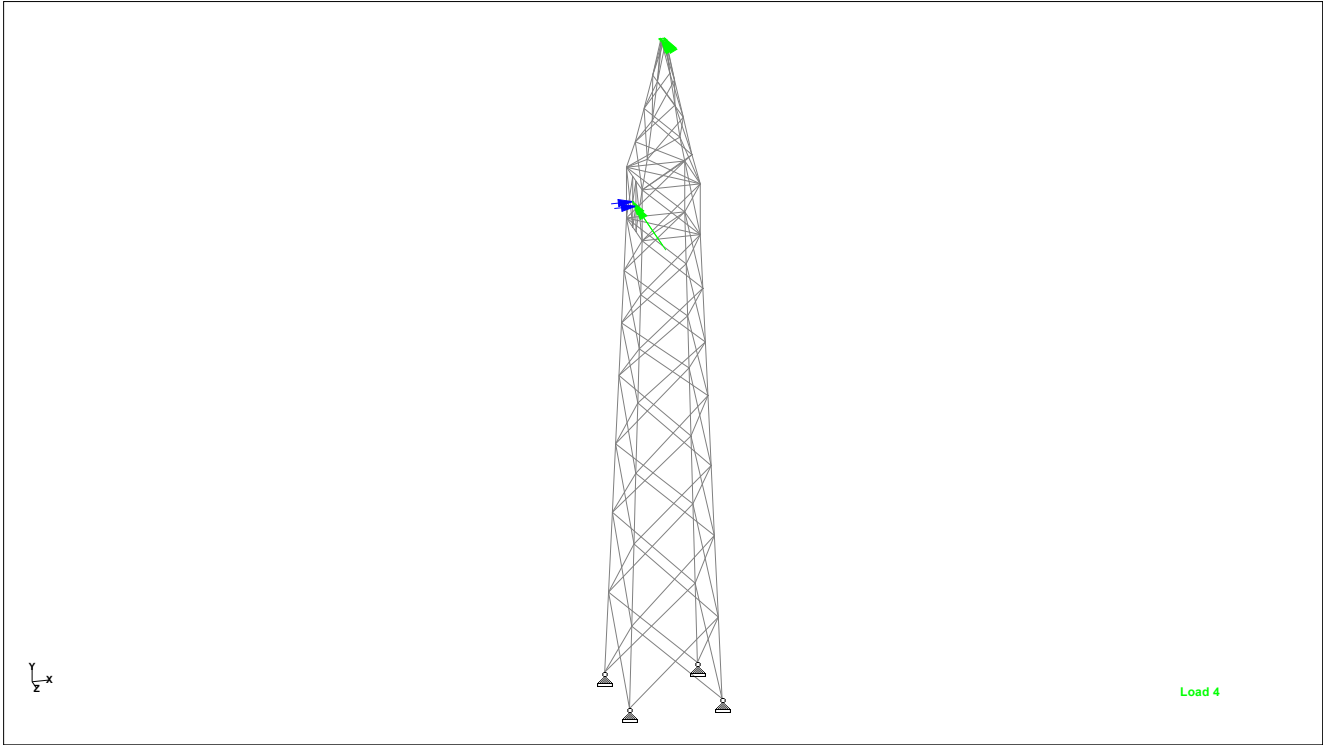


WIND ALONG X DIRECTION(PARALLEL TO BEAM)

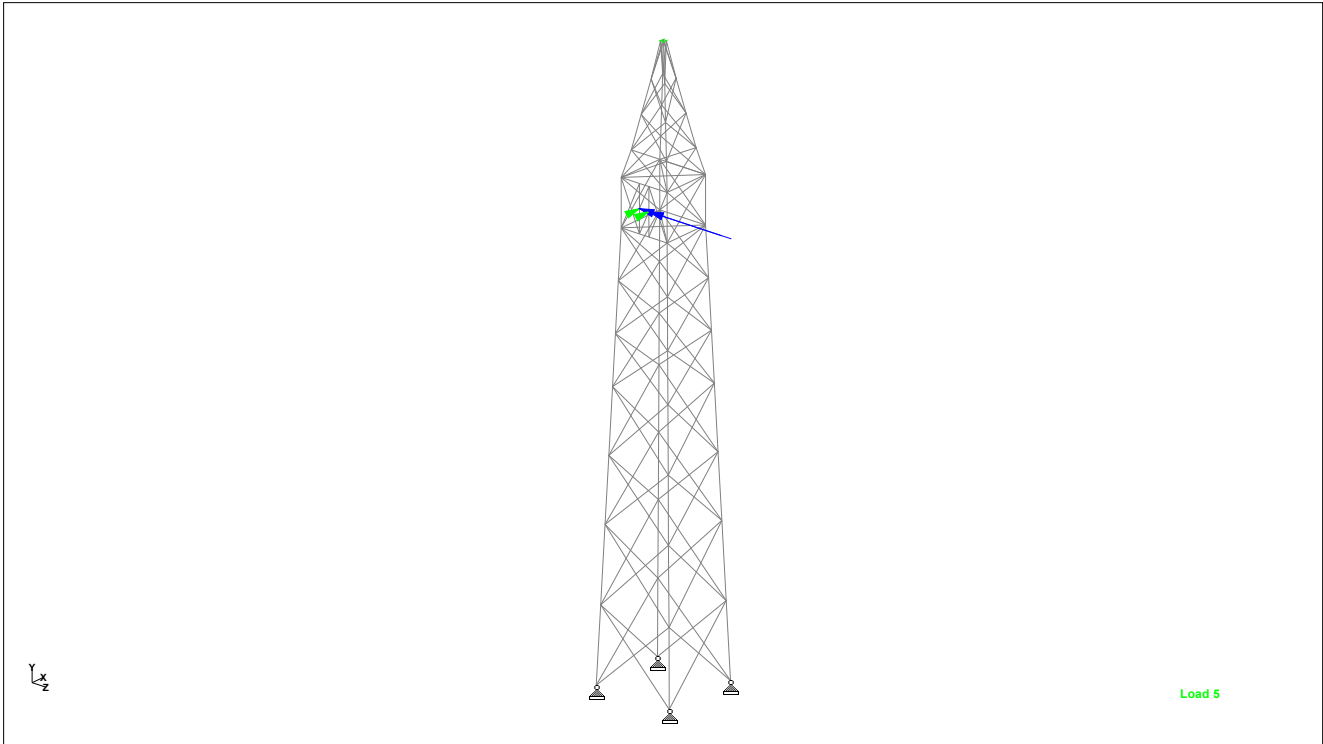


WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel		Job No.	Sheet No. 6	Rev
Job Title		Part		Ref
Client		By	Date 02-JULY-24	Chd
File TOWER 4T7.STD		Date Time 17-Jul-2024 14:07		

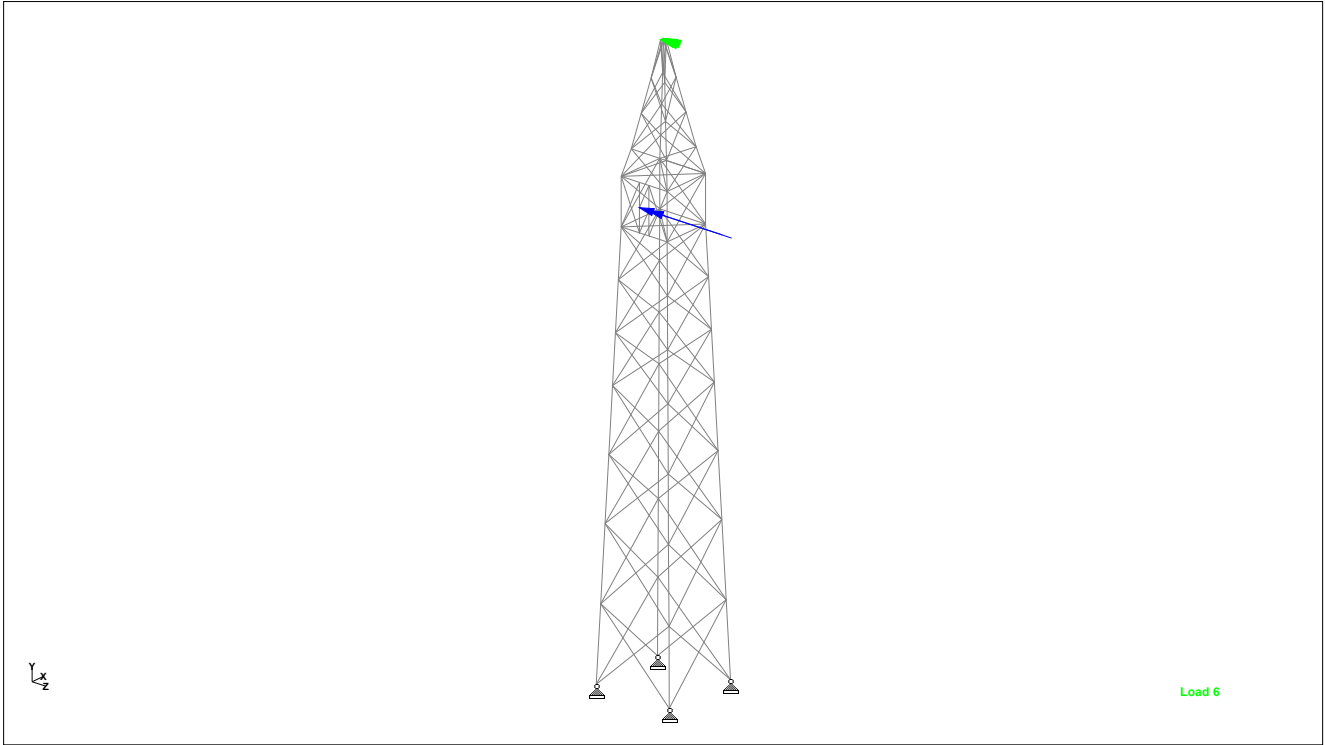


NC(0P-0E) +WIND PARALLEL TO BEAM

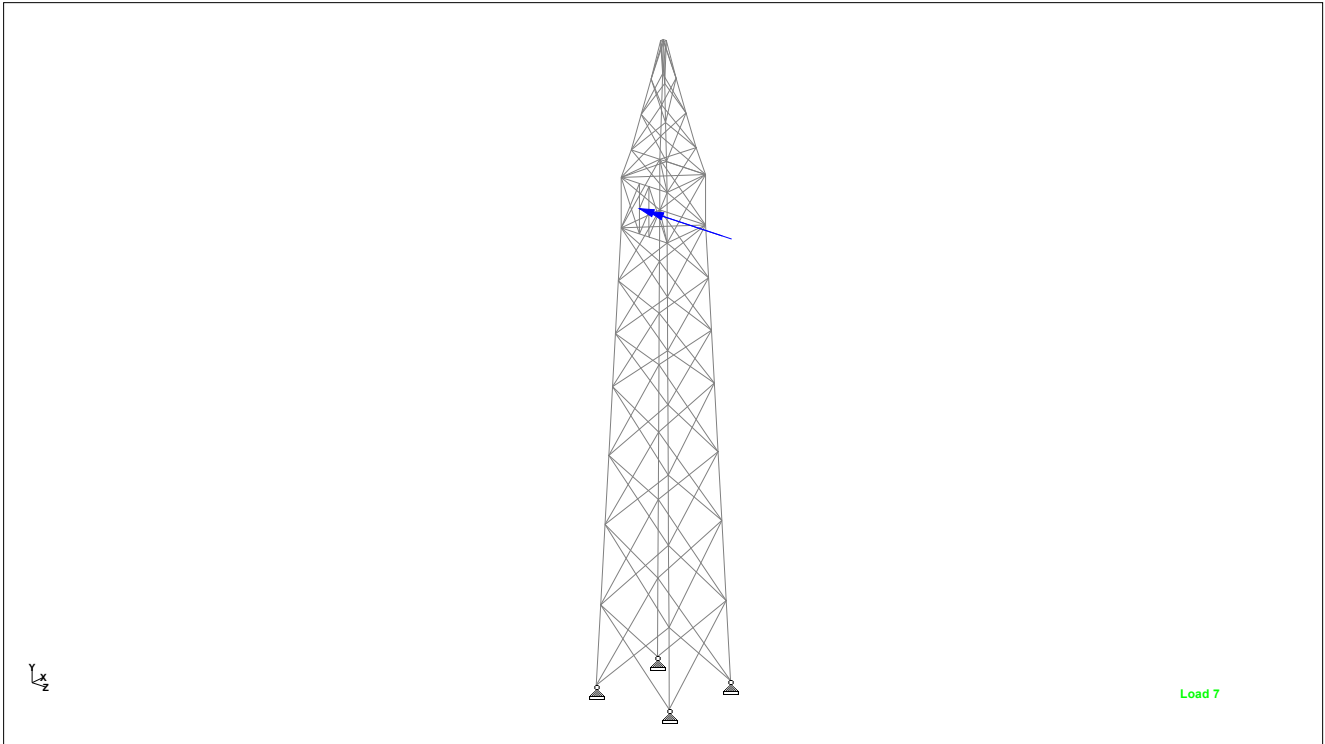


SC(0P-0E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 7	Rev
	Job Title		Part
Client	By	Date 02-JULY-24	Ref
File TOWER 4T7.STD	Date Time 17-Jul-2024 14:07		

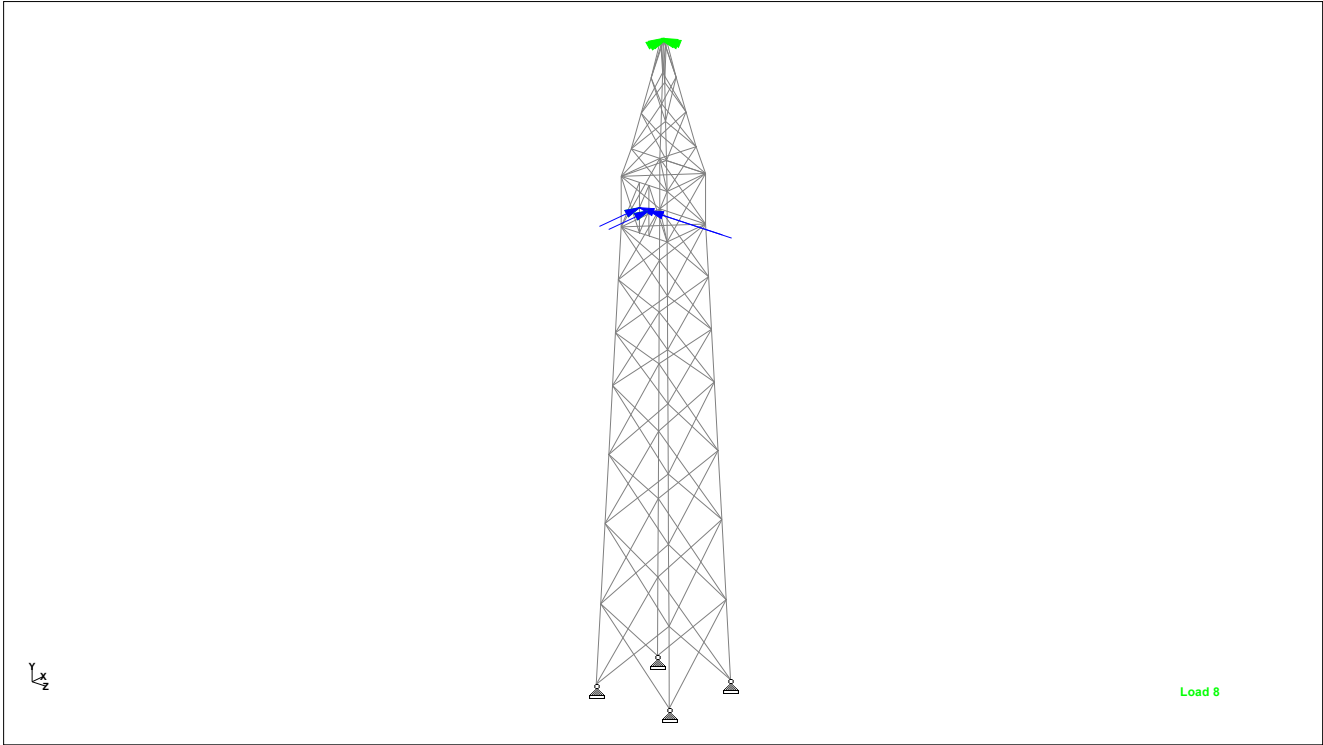


NC(0P-0E) +WIND PERPENDICULAR TO BEAM

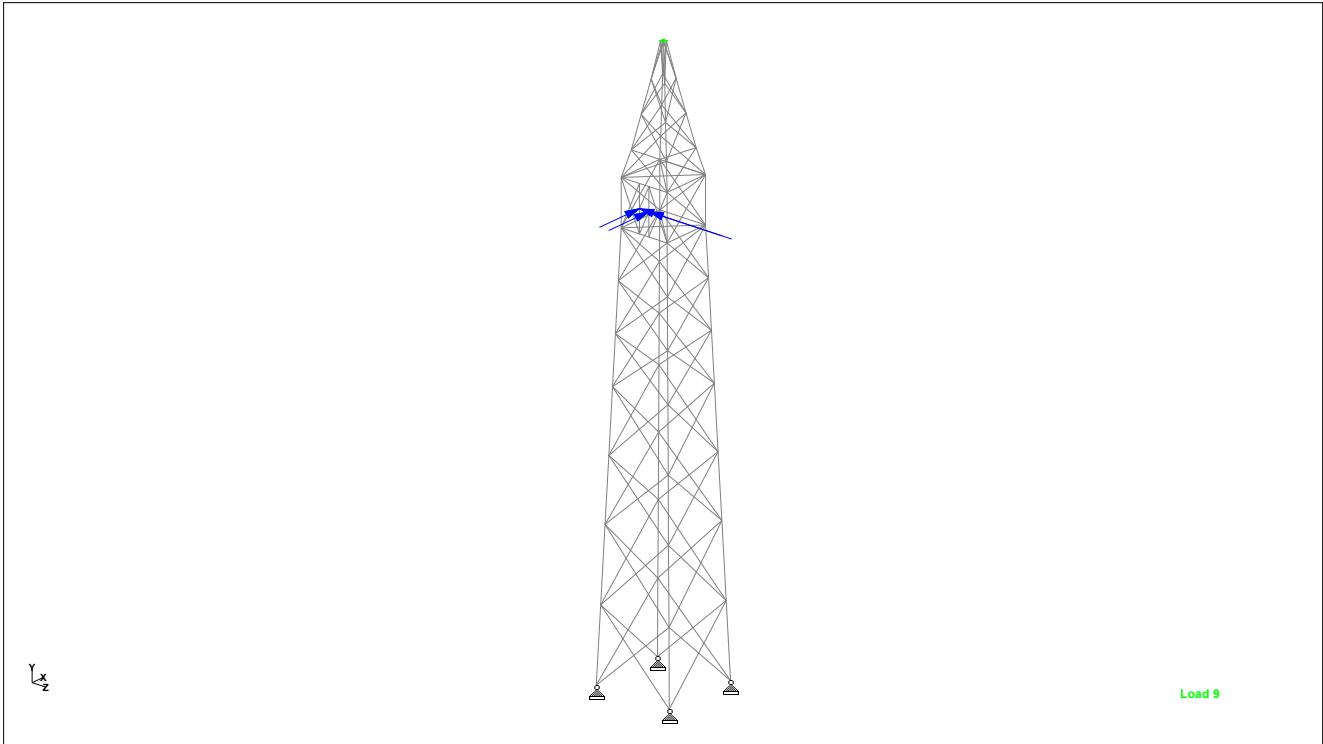


SC(0P-0E) +WIND PERPENDICULAR TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 8	Rev
	Job Title		Part
Client	By	Date 02-JULY-24	Ref Chd
File TOWER 4T7.STD		Date Time 17-Jul-2024 14:07	

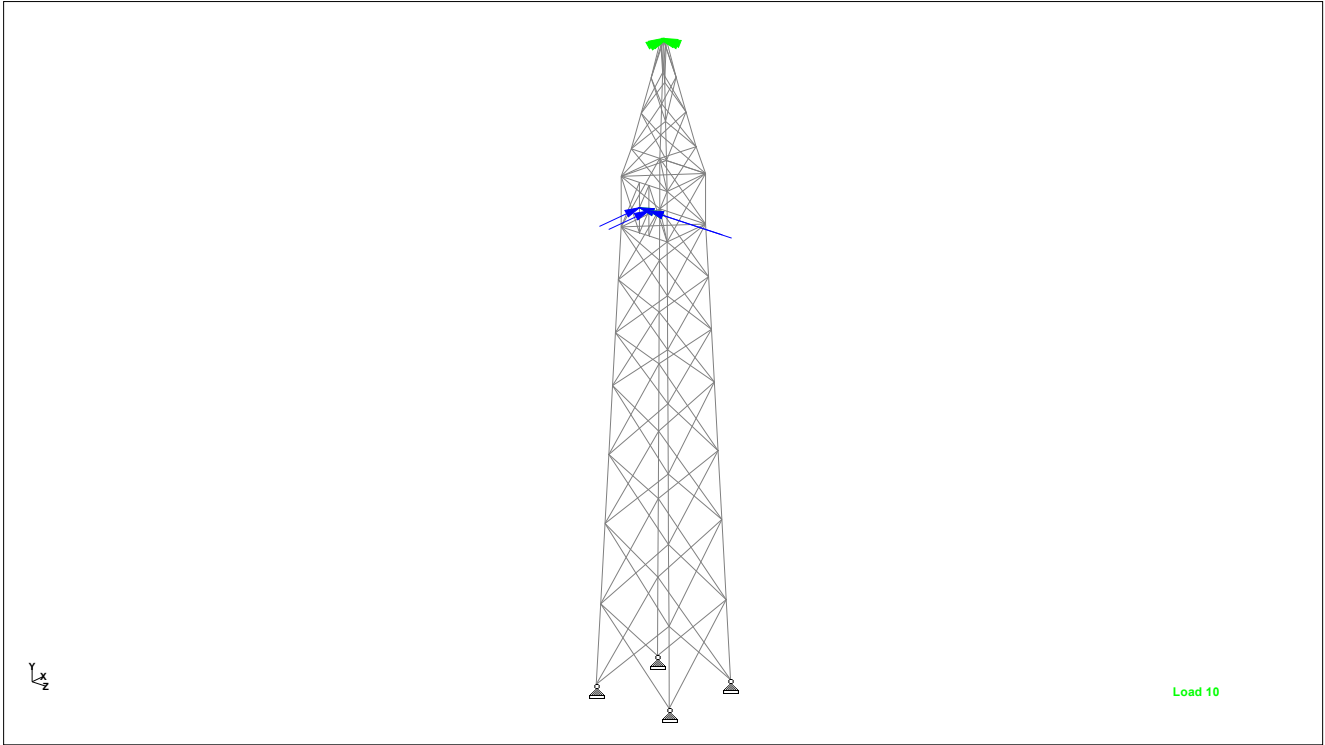


NC(30P-0E) +WIND PARALLEL TO BEAM

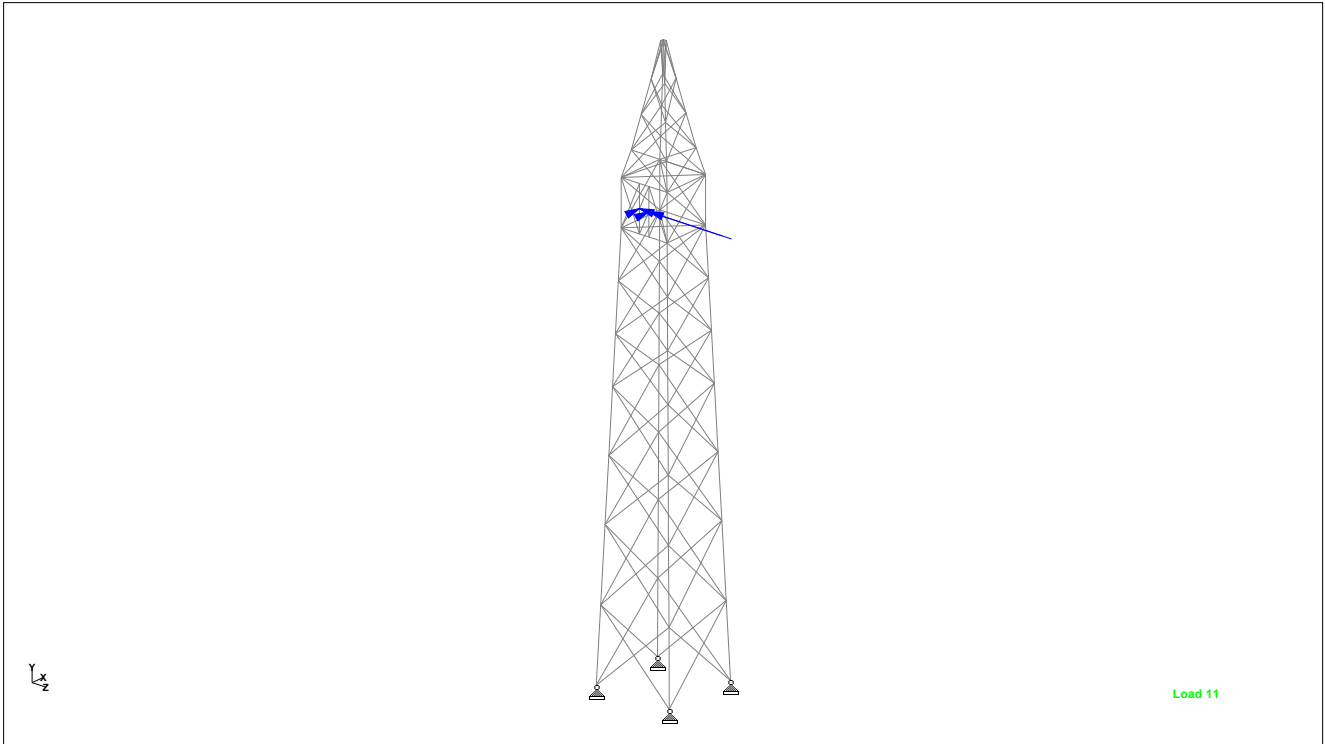


SC(30P-0E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 9	Rev
	Part		Ref
Job Title	By	Date 02-JULY-24	Chd
Client	Date Time 17-Jul-2024 14:07		
File TOWER 4T7.STD			

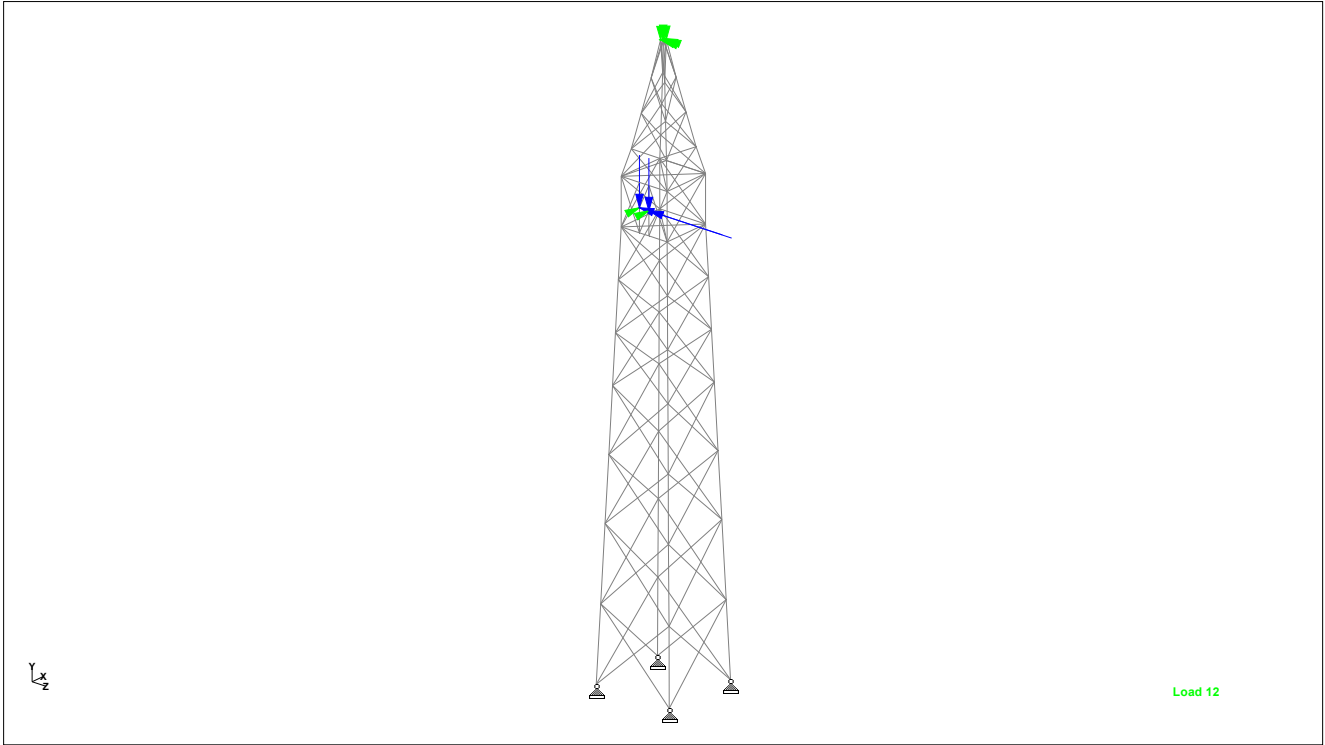


NC(30P-0E) +WIND PERPENDICULAR TO BEAM

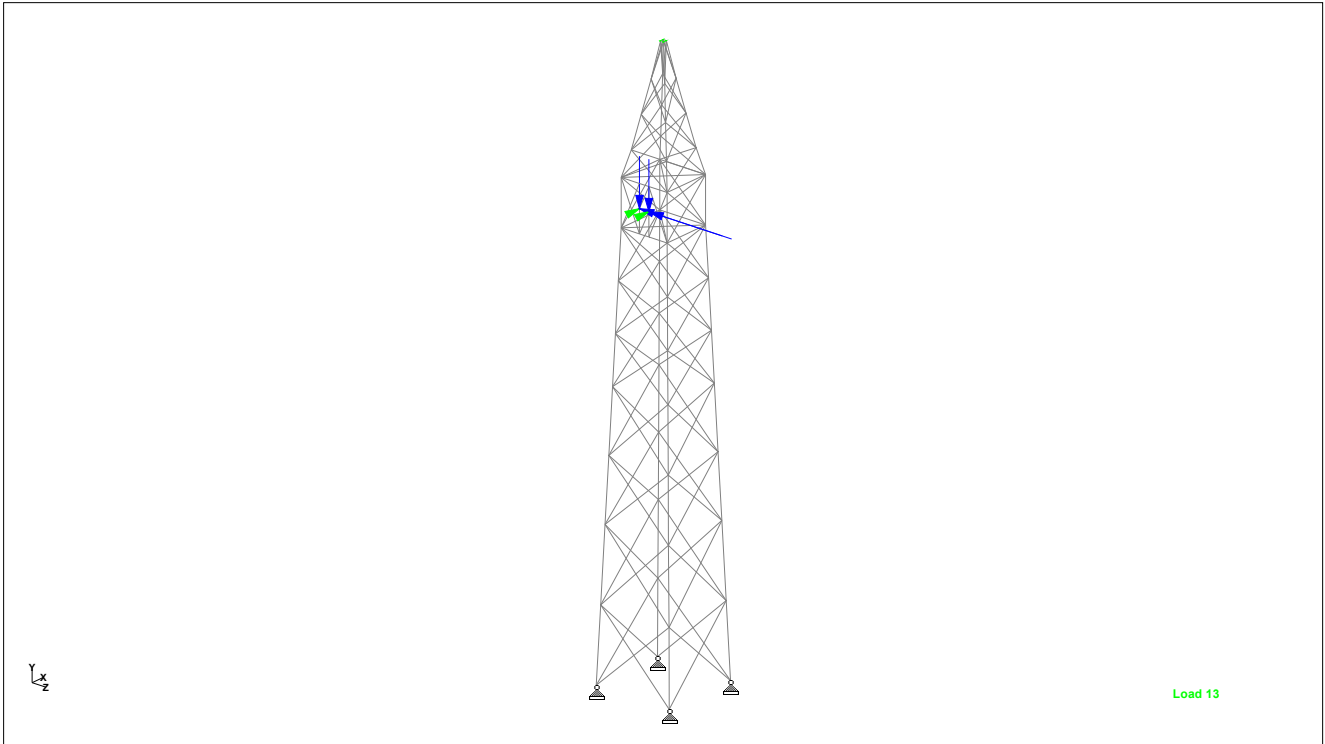


SC(30P-0E) +WIND PERPENDICULAR TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 10	Rev
Job Title	Part		Ref
Client	By	Date 02-JULY-24	Chd
File TOWER 4T7.STD	Date Time 17-Jul-2024 14:07		

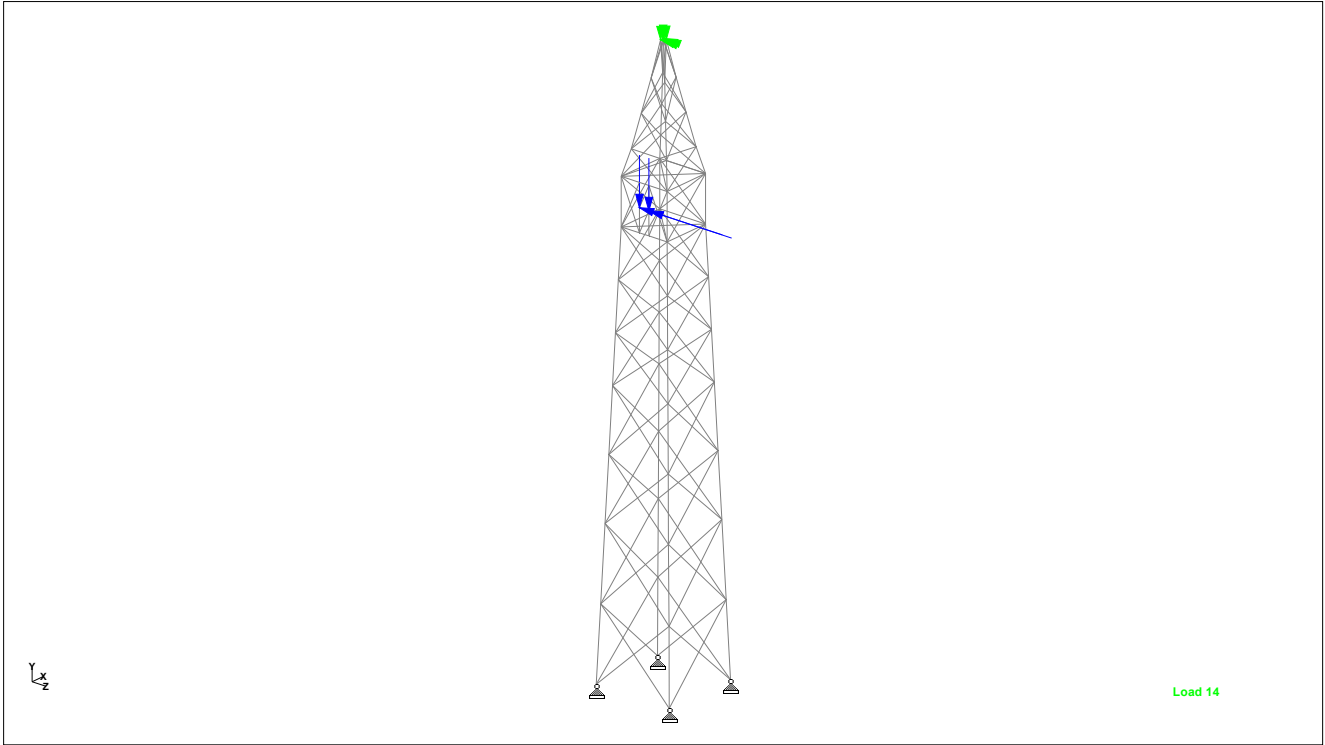


NC(0P-30E) +WIND PARALLEL TO BEAM

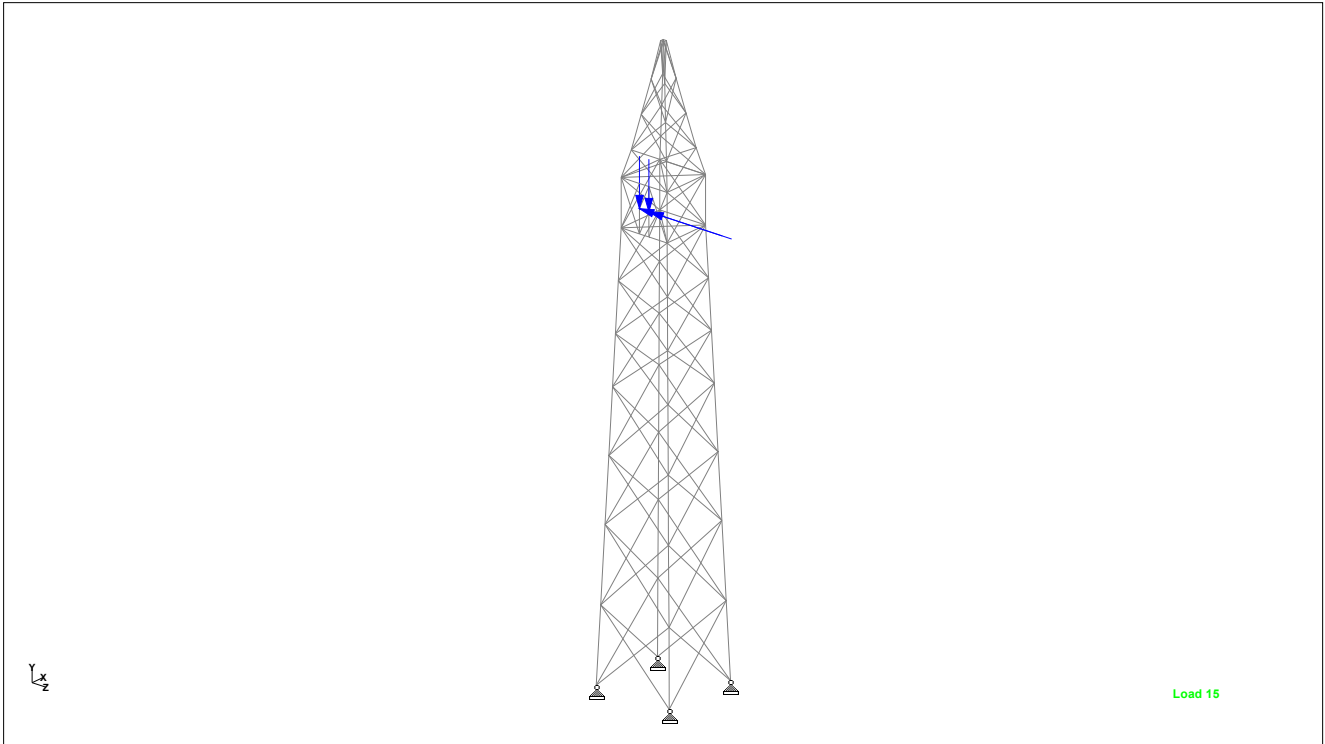


SC(0P-30E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 11	Rev
	Part		Ref
Job Title	Client	By y	Date 02-JULY-24 Chd
File TOWER 4T7.STD		Date Time 17-Jul-2024 14:07	

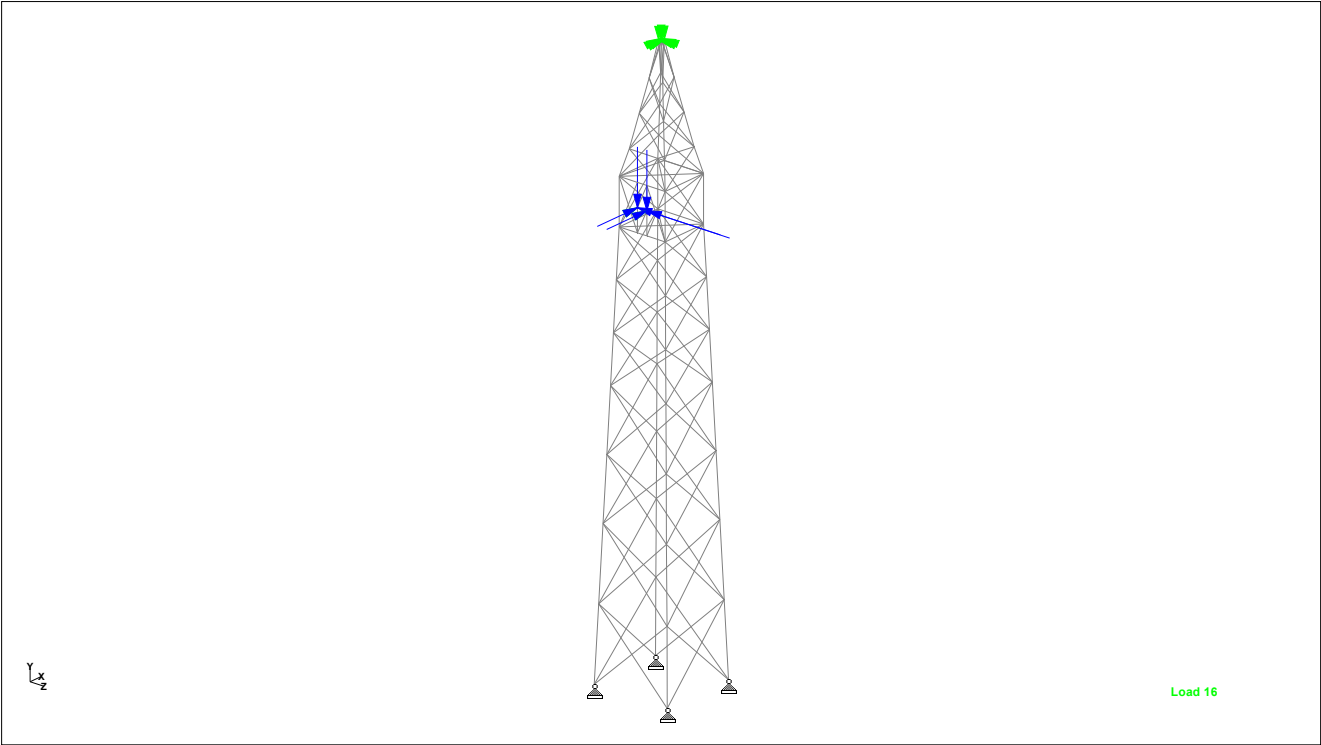


NC(0P-30E) +WIND PERPENDICULAR TO BEAM

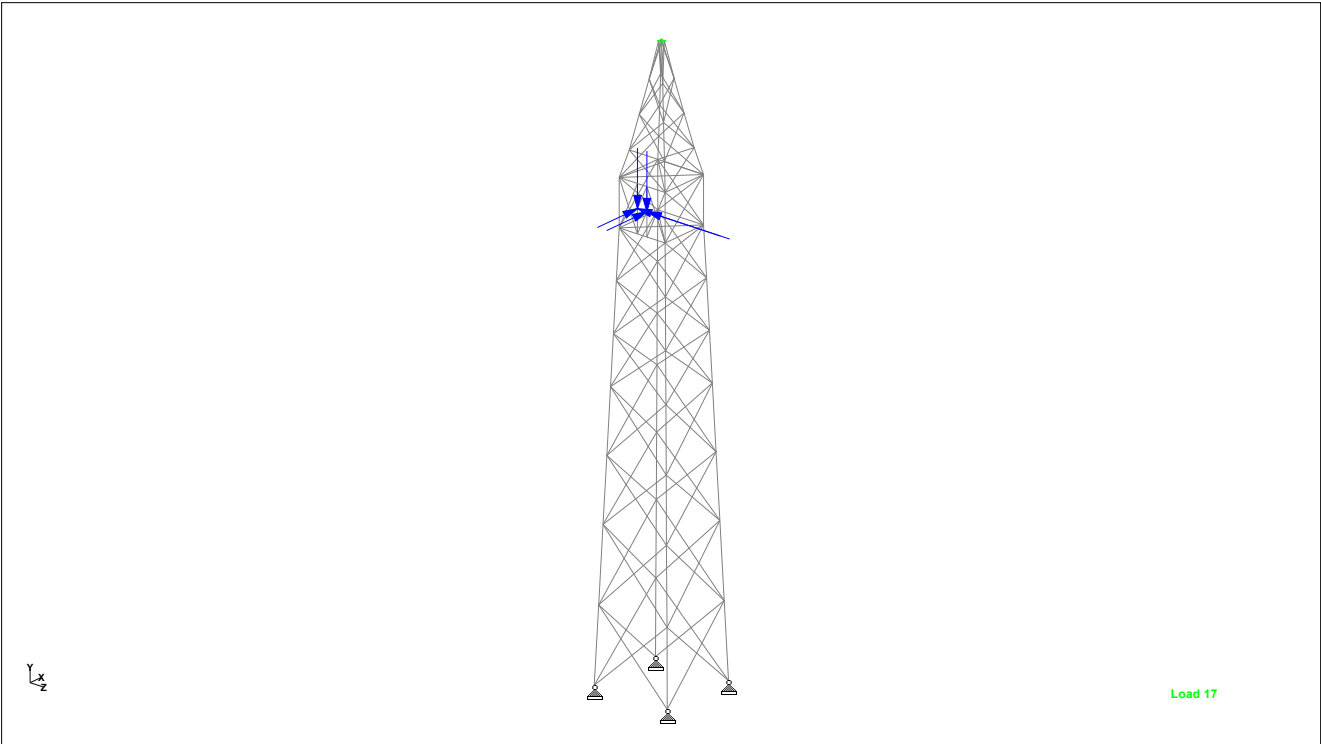


SC(0P-30E) +WIND PERPENDICULAR TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 12	Rev
	Job Title		Part
Client	By	Date 02-JULY-24	Chd
File TOWER 4T7.STD	Date Time 17-Jul-2024 14:07		

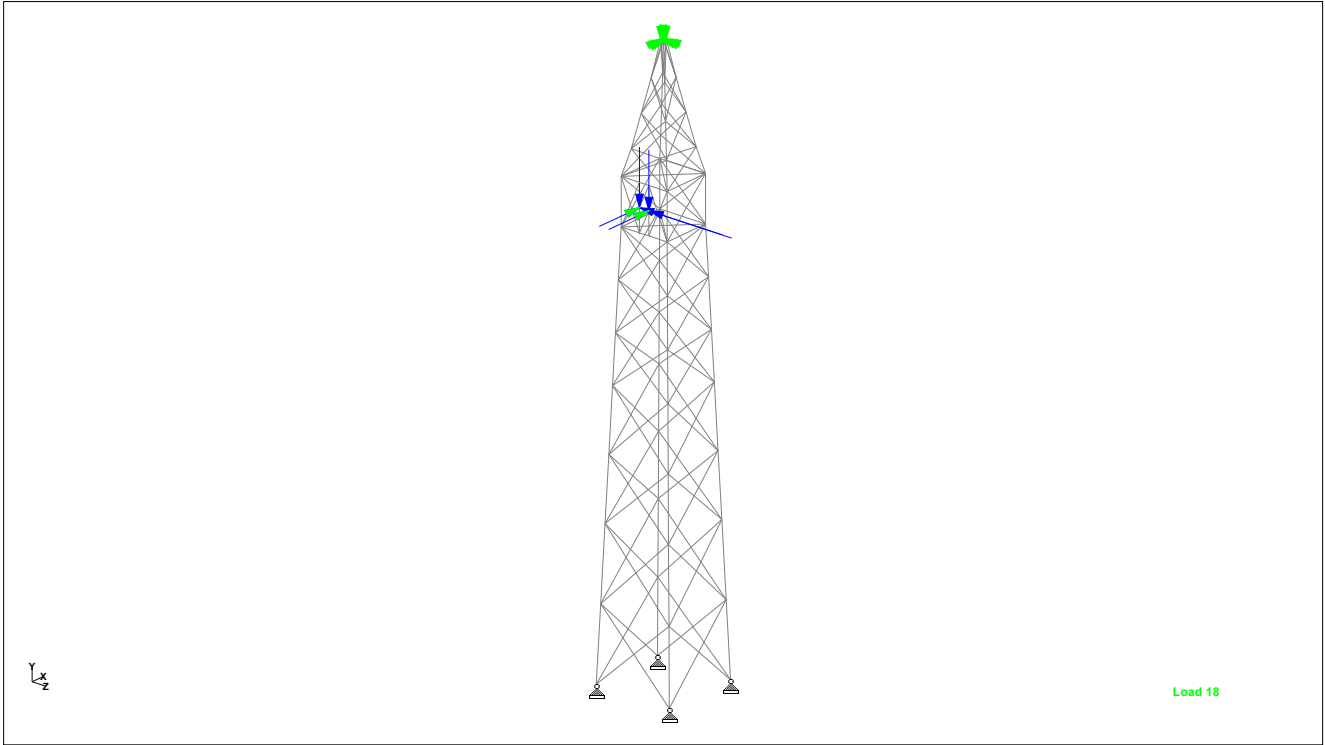


NC(30P-30E) +WIND PARALLEL TO BEAM

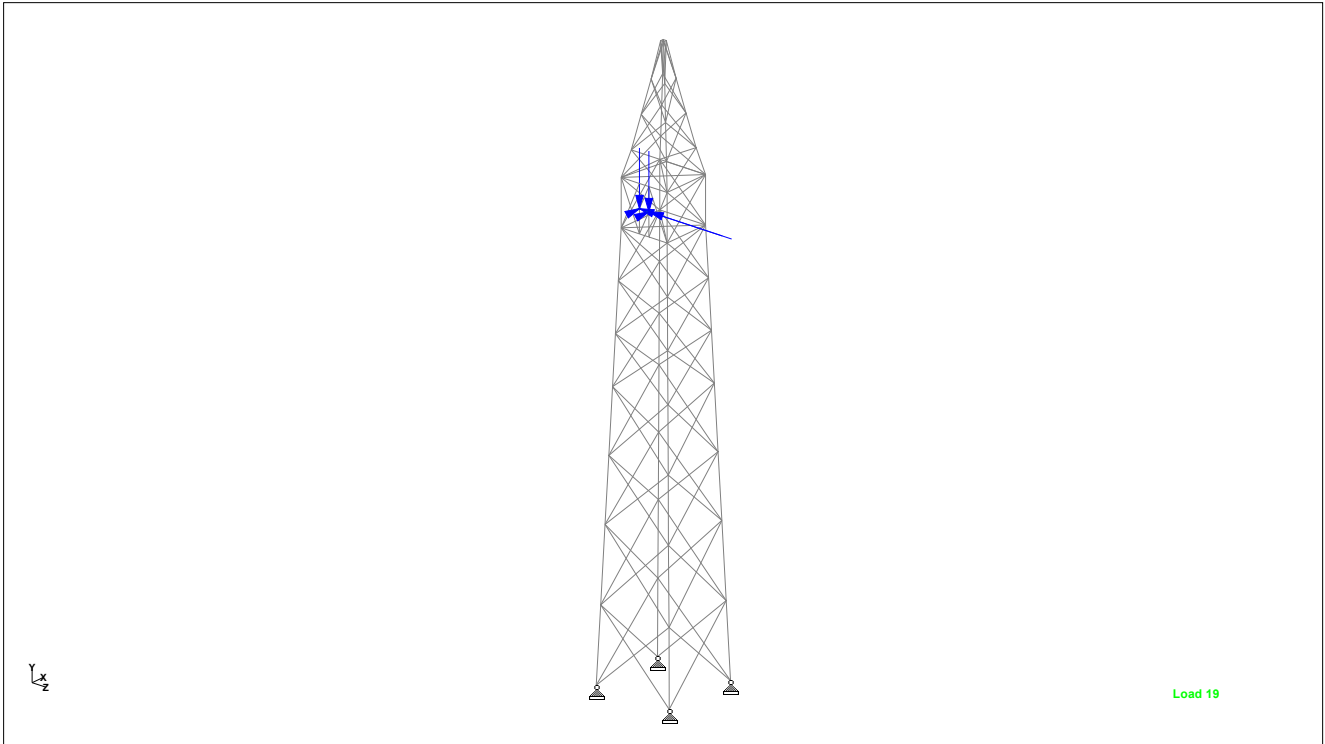


SC(30P-30E) +WIND PARALLEL TO BEAM

Bentley® Software licensed to Anhera Enterprise Connected User: Madhusudan Patel	Job No.	Sheet No. 13	Rev
	Part		Ref
Job Title	Client	By y	Date 02-JULY-24 Chd
File TOWER 4T7.STD		Date Time 17-Jul-2024 14:07	



NC(30P-30E) +WIND PERPENDICULAR TO BEAM



SC(30P-30E) +WIND PERPENDICULAR TO BEAM

STAAD ANALYSIS & DESIGN

PAGE NO. 1

```
*****
*
*          STAAD.Pro 2023
*          Version  23.00.03.25
*          Proprietary Program of
*          Bentley Systems, Inc.
*          Date=    AUG 24, 2024
*          Time=    17: 3:13
*
* Licensed to: Anhera Enterprise
*****
```

```
1. STAAD TRUSS
INPUT FILE: Z:\Data\PROJECTS\2024\24P041-MAHAN-GODREJ\DESIGN\400 KV TOW.. .STD
2. START JOB INFORMATION
3. ENGINEER DATE 02-JULY-24
4. END JOB INFORMATION
5. INPUT WIDTH 79
6. UNIT METER KN
7. JOINT COORDINATES
8. 1 0 0 0; 2 3.5 0 0; 3 0 0 3.5; 4 3.5 0 3.5; 5 0.65 19.9 0.65; 6 2.85 19.9 0.65
9. 7 0.65 19.9 2.85; 8 2.85 19.9 2.85; 9 0.65 22.1 0.65; 10 2.85 22.1 0.65
10. 11 2.85 22.1 2.85; 12 0.65 22.1 2.85; 13 1.675 28 1.675; 14 1.825 28 1.675
11. 15 1.825 28 1.825; 16 1.675 28 1.825; 17 0.114 3.5 0.114; 18 0.114 3.5 3.386
12. 19 3.386 3.5 0.114; 20 3.386 3.5 3.386; 21 0.227 7 0.227; 22 0.227 7 3.271
13. 23 3.271 7 0.227; 24 3.271 7 3.271; 25 0.327 10 0.327; 26 0.327 10 3.173
14. 27 3.173 10 0.327; 28 3.173 10 3.173; 29 0.425 13 0.425; 30 0.425 13 3.075
15. 31 3.075 13 0.425; 32 3.075 13 3.075; 33 0.5 15.3 0.5; 34 0.5 15.3 3
16. 35 3 15.3 0.5; 36 3 15.3 3; 37 0.575 17.6 0.575; 38 0.575 17.6 2.925
17. 39 2.925 17.6 0.575; 40 2.925 17.6 2.925; 41 0.911 23.282 0.911
18. 42 0.911 23.282 2.6; 43 2.6 23.282 2.6; 44 2.6 23.282 0.911
19. 45 1.171 24.815 1.171; 46 1.171 24.815 2.34; 47 2.34 24.815 2.34
20. 48 2.34 24.815 1.171; 49 1.432 26.347 1.432; 50 1.432 26.347 2.078
21. 51 2.078 26.347 2.078; 52 2.078 26.347 1.432; 201 0.65 19.9 1.975
22. 202 0.65 22.1 1.975; 203 0.65 19.9 1.525; 204 0.65 22.1 1.525
23. 205 0.65 21 1.525; 206 0.65 21 1.975; 207 0.65 19.9 1.75
24. MEMBER INCIDENCES
25. 1 1 17; 2 3 18; 3 2 19; 4 4 20; 5 5 6; 6 6 8; 7 8 7; 8 7 201; 9 9 10; 10 10 11
26. 11 11 12; 12 12 202; 13 5 9; 14 7 12; 15 8 11; 16 6 10; 17 9 41; 18 12 42
27. 19 11 43; 20 10 44; 21 13 16; 22 16 15; 23 15 14; 24 14 13; 25 17 21; 26 18 22
28. 27 19 23; 28 20 24; 29 21 25; 30 22 26; 31 23 27; 32 24 28; 33 25 29; 34 26 30
29. 35 27 31; 36 28 32; 37 29 33; 38 30 34; 39 31 35; 40 32 36; 41 33 37; 42 34 38
30. 43 35 39; 44 36 40; 45 37 5; 46 38 7; 47 39 6; 48 40 8; 49 41 45; 50 42 46
31. 51 43 47; 52 44 48; 53 45 49; 54 46 50; 55 47 51; 56 48 52; 57 49 13; 58 50 16
32. 59 51 15; 60 52 14; 117 5 10; 118 6 9; 119 6 11; 120 8 10; 121 7 11; 122 8 12
33. 125 8 5; 126 7 6; 127 9 11; 128 12 10; 702 3 20; 703 20 22; 704 22 28
34. 705 28 30; 706 30 36; 707 36 38; 708 38 8; 709 7 40; 710 40 34; 711 34 32
35. 712 32 26; 713 26 24; 714 24 18; 715 18 4; 716 1 18; 717 3 17; 718 17 22
36. 719 18 21; 720 21 26; 721 22 25; 722 25 30; 723 26 29; 724 29 34; 725 30 33
37. 726 33 38; 727 34 37; 728 37 7; 729 38 5; 730 2 17; 731 1 19; 732 19 21
38. 733 17 23; 734 23 25; 735 21 27; 736 27 29; 737 25 31; 738 31 33; 739 29 35
```

STAAD TRUSS

-- PAGE NO. 2

39. 740 35 37; 741 33 39; 742 39 5; 743 37 6; 744 4 19; 745 2 20; 746 20 23
40. 747 19 24; 748 24 27; 749 23 28; 750 28 31; 751 27 32; 752 31 36; 753 32 35
41. 754 35 40; 755 36 39; 756 39 8; 757 40 6; 758 9 44; 759 10 41; 760 41 48
42. 761 44 45; 762 45 52; 763 48 49; 764 49 14; 765 52 13; 766 10 43; 767 11 44
43. 768 44 47; 769 43 48; 770 48 51; 771 47 52; 772 52 15; 773 51 14; 774 11 42
44. 775 12 43; 776 43 46; 777 42 47; 778 47 50; 779 46 51; 780 51 16; 781 50 15
45. 782 9 42; 783 12 41; 784 41 46; 785 42 45; 786 45 50; 787 46 49; 788 50 13
46. 789 49 16; 814 201 207; 815 202 204; 816 203 5; 817 204 9; 818 204 205
47. 819 202 206; 820 205 203; 821 206 201; 822 205 206; 823 202 205; 824 206 203
48. 825 204 5; 826 202 7; 827 207 203; 828 203 9; 829 201 12
49. DEFINE MATERIAL START
50. ISOTROPIC STEEL
51. E 2.05E+08
52. POISSON 0.3
53. DENSITY 76.8195
54. ALPHA 1.2E-05
55. DAMP 0.03
56. G 7.88462E+07
57. TYPE STEEL
58. STRENGTH RY 1.5 RT 1.2
59. END DEFINE MATERIAL
60. MEMBER PROPERTY INDIAN
61. 1 TO 4 25 TO 28 TABLE ST ISA130X130X16
62. 29 TO 36 TABLE ST ISA130X130X12
63. 13 TO 16 37 TO 48 TABLE ST ISA130X130X10
64. 17 TO 20 49 TO 60 TABLE ST ISA75X75X5
65. 702 TO 705 712 TO 723 730 TO 737 744 TO 750 -
66. 751 TABLE ST ISA75X75X5
67. 117 TO 122 706 TO 711 724 TO 729 738 TO 743 752 TO 756 -
68. 757 TABLE ST ISA100X100X10
69. 758 TO 789 TABLE ST ISA50X50X5
70. 5 TO 12 125 TO 128 814 TO 817 827 TABLE ST ISA90X90X6
71. 21 TO 24 TABLE ST ISA45X45X5
72. 825 826 828 829 TABLE ST ISA75X75X5
73. 822 TO 824 TABLE ST ISA100X100X10
74. 818 TO 821 TABLE ST ISA100X100X10
75. CONSTANTS
76. BETA 45 MEMB 14
77. BETA 135 MEMB 15
78. BETA 225 MEMB 16
79. BETA 315 MEMB 13
80. MATERIAL STEEL ALL
81. *****
82. SUPPORTS
83. 1 TO 4 PINNED
84. *****
85. LOAD 1 DEAD LOAD + LIVE LOAD
86. SELFWEIGHT Y -1.15
87. JOINT LOAD
88. **WEIGHT OF CONDUCTOR & INSULATOR
89. **WEIGHT OF MEN WITH TOOL
90. 9 TO 12 FY -0.375
91. **WEIGHT OF SUSPENSION
92. JOINT LOAD
93. **WEIGHT OF EARTH WIRE
94. 13 TO 16 FY -0.55

STAAD TRUSS

-- PAGE NO. 3

```
95. 207 FY -0.499
96. 205 206 FY -2.934
97. *****
98. LOAD 2 LOADTYPE NONE TITLE WIND ALONG X DIRECTION(PARALLEL TO BEAM)
99. JOINT LOAD
100. **WIND LOAD ON TOWER
101. 1 3 FX 0.95
102. 17 18 FX 1.87
103. 21 22 FX 1.72
104. 25 26 FX 1.65
105. 29 30 FX 1.49
106. 33 34 FX 1.26
107. 37 38 FX 1.36
108. 5 7 FX 1.43
109. 9 12 FX 0.96
110. 41 42 FX 0.49
111. 45 46 FX 0.43
112. 49 50 FX 0.37
113. 13 16 FX 0.17
114. 207 FX 0.91
115. *****
116. LOAD 3 LOADTYPE NONE TITLE WIND ALONG Z DIRECTION(PERPENDICULAR TO BEAM)
117. JOINT LOAD
118. **WIND LOAD ON TOWER
119. 1 2 FZ 0.95
120. 17 19 FZ 1.87
121. 21 23 FZ 1.72
122. 25 27 FZ 1.65
123. 29 31 FZ 1.49
124. 33 35 FZ 1.26
125. 37 39 FZ 1.36
126. 5 6 FZ 1.43
127. 9 10 FZ 0.96
128. 41 44 FZ 0.49
129. 45 48 FZ 0.43
130. 49 52 FZ 0.37
131. 13 14 FZ 0.17
132. 207 FZ -0.91
133. **WIND LOAD ON BEAM
134. *****
135. **BEAM-G2(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATION)
136. **TOWER -4T2
137. *****
138. LOAD 4 LOADTYPE NONE TITLE NC(0P-0E) +WIND PARALLEL TO BEAM
139. JOINT LOAD
140. 205 206 FX 2.78
141. 205 206 FZ -14.3
142. 13 TO 16 FX 0.175 FZ -2.5
143. **NORMAL TENSION FORCE
144. *WIND LOAD ON CONDUCTOR & INSULATOR
145. **WIND LOAD ON SUSPENSION
146. **WIND LOAD ON EARTH WIRE & NORMAL TENSION FORCE
147. *****
148. LOAD 5 LOADTYPE NONE TITLE SC(0P-0E) +WIND PARALLEL TO BEAM
149. JOINT LOAD
150. 205 206 FX 2.78
```

STAAD TRUSS

-- PAGE NO. 4

151. 205 206 FZ -44.24
152. 13 TO 16 FX 0.175
153. **SHORT CIRCUIT FORCE
154. *WIND LOAD ON CONDUCTOR & INSULATOR
155. **WIND LOAD ON SUSPENSION
156. **WIND LOAD ON EARTH WIRE
157. *****
158. LOAD 6 LOADTYPE NONE TITLE NC(0P-0E) +WIND PERPENDICULAR TO BEAM
159. JOINT LOAD
160. 205 206 FZ -14.3
161. 13 TO 16 FZ -2.5
162. **NORMAL TENSION FORCE
163. **WIND LOAD ON SUSPENSION
164. **NORMAL TENSION FORCE
165. *****
166. LOAD 7 LOADTYPE NONE TITLE SC(0P-0E) +WIND PERPENDICULAR TO BEAM
167. JOINT LOAD
168. 205 206 FZ -44.24
169. **SHORT CIRCUIT FORCE
170. **WIND LOAD ON SUSPENSION
171. *****
172. LOAD 8 LOADTYPE NONE TITLE NC(30P-0E) +WIND PARALLEL TO BEAM
173. JOINT LOAD
174. 205 206 FX 2.8
175. 205 206 FX 14.3 FZ -24.77
176. 13 TO 16 FX 1.4 FZ -2.25
177. *****
178. LOAD 9 LOADTYPE NONE TITLE SC(30P-0E) +WIND PARALLEL TO BEAM
179. JOINT LOAD
180. 205 206 FX 2.8
181. 205 206 FX 44.24 FZ -76.63
182. 13 TO 16 FX 0.15 FZ -0.00875
183. *****
184. LOAD 10 LOADTYPE NONE TITLE NC(30P-0E) +WIND PERPENDICULAR TO BEAM
185. JOINT LOAD
186. 205 206 FZ -1.62
187. 205 206 FX 14.3 FZ -24.77
188. 13 TO 16 FX 1.25 FZ -2.17
189. *****
190. LOAD 11 LOADTYPE NONE TITLE SC(30P-0E) +WIND PERPENDICULAR TO BEAM
191. JOINT LOAD
192. 205 206 FZ -1.62
193. 205 206 FX 14.43 FZ -76.63
194. *****
195. LOAD 12 LOADTYPE NONE TITLE NC(0P-30E) +WIND PARALLEL TO BEAM
196. JOINT LOAD
197. 205 206 FX 2.78
198. 205 206 FY -14.3 FZ -24.77
199. 13 TO 16 FX 0.1125 FY -1.25 FZ -2.17
200. *****
201. LOAD 13 LOADTYPE NONE TITLE SC(0P-30E) +WIND PARALLEL TO BEAM
202. JOINT LOAD
203. 205 206 FX 2.78
204. 205 206 FY -44.25 FZ -76.63
205. 13 TO 16 FX 0.1125
206. *****

STAAD TRUSS

-- PAGE NO. 5

207. LOAD 14 LOADTYPE NONE TITLE NC(0P-30E) +WIND PERPENDICULAR TO BEAM
208. JOINT LOAD
209. 205 206 FY -14.3 FZ -24.77
210. 13 TO 16 FY -1.25 FZ -2.17
211. *****
212. LOAD 15 LOADTYPE NONE TITLE SC(0P-30E) +WIND PERPENDICULAR TO BEAM
213. JOINT LOAD
214. 205 206 FY -44.25 FZ -76.63
215. *****
216. LOAD 16 LOADTYPE NONE TITLE NC(30P-30E) +WIND PARALLEL TO BEAM
217. JOINT LOAD
218. 205 206 FX 2.41
219. 205 206 FX 12.39 FY -14.3 FZ -21.45
220. 13 TO 16 FX 1.183 FY -1.25 FZ -1.94
221. *****
222. LOAD 17 LOADTYPE NONE TITLE SC(30P-30E) +WIND PARALLEL TO BEAM
223. JOINT LOAD
224. 205 206 FX 2.41
225. 205 206 FX 38.32 FY -44.25 FZ -66.36
226. 13 TO 16 FX 0.1 FZ -0.0625
227. *****
228. LOAD 18 LOADTYPE NONE TITLE NC(30P-30E) +WIND PERPENDICULAR TO BEAM
229. JOINT LOAD
230. 205 206 FX 12.39 FY -14.3 FZ -21.45
231. 205 206 FX 1.39
232. 13 TO 16 FX 1.083 FY -1.25 FZ -1.875
233. *****
234. LOAD 19 LOADTYPE NONE TITLE SC(30P-30E) +WIND PERPENDICULAR TO BEAM
235. JOINT LOAD
236. 205 206 FX 1.39
237. 205 206 FX 12.39 FY -44.25 FZ -66.36
238. *****
239. *LOAD COMBINATIONS FOR MEMBER DESIGN (FACTORED)
240. *****
241. *****
242. LOAD COMB 101 2(DL + NC + WIND PARALLEL TO BEAM)
243. 1 2.0 2 2.0 4 2.0
244. *****
245. LOAD COMB 201 1.5(DL +SC + WIND PARALLEL TO BEAM)
246. 1 1.5 2 1.5 5 1.5
247. *****
248. LOAD COMB 102 2(DL +NC + WIND PERPENDICULAR TO BEAM)
249. 1 2.0 3 2.0 6 2.0
250. *****
251. LOAD COMB 202 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
252. 1 1.5 3 1.5 7 1.5
253. *****
254. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVAT
255. *****
256. LOAD COMB 103 2(DL +NC + WIND PARALLEL TO BEAM)
257. 1 2.0 2 2.0 8 2.0
258. *****
259. LOAD COMB 203 1.5(DL +SC + WIND PARALLEL TO BEAM)
260. 1 1.5 2 1.5 9 1.5
261. *****
262. LOAD COMB 104 2(DL +NC + WIND PERPENDICULAR TO BEAM)

STAAD TRUSS

-- PAGE NO. 6

263. 1 2.0 3 2.0 10 2.0
264. *****
265. LOAD COMB 204 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
266. 1 1.5 3 1.5 11 1.5
267. *****
268. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVAT
269. *****
270. LOAD COMB 105 2(DL +NC + WIND PARALLEL TO BEAM)
271. 1 2.0 2 2.0 12 2.0
272. *****
273. LOAD COMB 205 1.5(DL +SC + WIND PARALLEL TO BEAM)
274. 1 1.5 2 1.5 13 1.5
275. *****
276. LOAD COMB 106 2(DL +NC + WIND PERPENDICULAR TO BEAM)
277. 1 2.0 3 2.0 14 2.0
278. *****
279. LOAD COMB 206 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
280. 1 1.5 3 1.5 15 1.5
281. *****
282. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVAT
283. *****
284. LOAD COMB 107 2(DL +NC + WIND PARALLEL TO BEAM)
285. 1 2.0 2 2.0 16 2.0
286. *****
287. LOAD COMB 207 1.5(DL +SC + WIND PARALLEL TO BEAM)
288. 1 1.5 2 1.5 17 1.5
289. *****
290. LOAD COMB 108 2(DL +NC + WIND PERPENDICULAR TO BEAM)
291. 1 2.0 3 2.0 18 2.0
292. *****
293. LOAD COMB 208 1.5(DL +SC + WIND PERPENDICULAR TO BEAM)
294. 1 1.5 3 1.5 19 1.5
295. *****
296. *LOAD COMBINATIONS FOR FOUNDATION & BASE PLATE DESIGN (UNFACTORED)
297. *****
298. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVATI
299. *****
300. LOAD COMB 301 DL + NC + WIND PARALLEL TO BEAM
301. 1 1.0 2 1.0 4 1.0
302. *****
303. LOAD COMB 401 DL +SC + WIND PARALLEL TO BEAM
304. 1 1.0 2 1.0 5 1.0
305. *****
306. LOAD COMB 302 DL +NC + WIND PERPENDICULAR TO BEAM
307. 1 1.0 3 1.0 6 1.0
308. *****
309. LOAD COMB 402 DL +SC + WIND PERPENDICULAR TO BEAM
310. 1 1.0 3 1.0 7 1.0
311. *****
312. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 0 DEGREE DEVIATION IN ELEVAT
313. *****
314. LOAD COMB 303 DL +NC + WIND PARALLEL TO BEAM
315. 1 1.0 2 1.0 8 1.0
316. *****
317. LOAD COMB 403 DL +SC + WIND PARALLEL TO BEAM
318. 1 1.0 2 1.0 9 1.0

STAAD TRUSS

-- PAGE NO. 7

```

319. *****
320. LOAD COMB 304 DL +NC + WIND PERPENDICULAR TO BEAM
321. 1 1.0 3 1.0 10 1.0
322. *****
323. LOAD COMB 404 DL +SC + WIND PERPENDICULAR TO BEAM
324. 1 1.0 3 1.0 11 1.0
325. *****
326. *BEAM-GBG & GBF(WITH 0 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVAT
327. *****
328. LOAD COMB 305 DL +NC + WIND PARALLEL TO BEAM
329. 1 1.0 2 1.0 12 1.0
330. *****
331. LOAD COMB 405 DL +SC + WIND PARALLEL TO BEAM
332. 1 1.0 2 1.0 13 1.0
333. *****
334. LOAD COMB 306 DL +NC + WIND PERPENDICULAR TO BEAM
335. 1 1.0 3 1.0 14 1.0
336. *****
337. LOAD COMB 406 DL +SC + WIND PERPENDICULAR TO BEAM
338. 1 1.0 3 1.0 15 1.0
339. *****
340. *BEAM-GBG & GBF(WITH 30 DEGREE DEVIATION IN PLAN & 30 DEGREE DEVIATION IN ELEVA
341. *****
342. LOAD COMB 307 DL +NC + WIND PARALLEL TO BEAM
343. 1 1.0 2 1.0 16 1.0
344. *****
345. LOAD COMB 407 DL +SC + WIND PARALLEL TO BEAM
346. 1 1.0 2 1.0 17 1.0
347. *****
348. LOAD COMB 308 DL +NC + WIND PERPENDICULAR TO BEAM
349. 1 1.0 3 1.0 18 1.0
350. *****
351. LOAD COMB 408 DL +SC + WIND PERPENDICULAR TO BEAM
352. 1 1.0 3 1.0 19 1.0
353. *****
354. PERFORM ANALYSIS

```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	59	NUMBER OF MEMBERS	174
NUMBER OF PLATES	0	NUMBER OF SOLIDS	0
NUMBER OF SURFACES	0	NUMBER OF SUPPORTS	4

Using 64-bit analysis engine.

SOLVER USED IS THE IN-CORE ADVANCED MATH SOLVER

TOTAL PRIMARY LOAD CASES = 19, TOTAL DEGREES OF FREEDOM = 165
TOTAL LOAD COMBINATION CASES = 32 SO FAR.

STAAD TRUSS

-- PAGE NO. 8

*WARNING- ZERO STIFFNESS IN DIRECTION 1 AT JOINT 201 EQN.NO. 145
LOADS APPLIED OR DISTRIBUTED HERE FROM ELEMENTS WILL BE IGNORED.
THIS MAY BE DUE TO ALL MEMBERS AT THIS JOINT BEING RELEASED OR
EFFECTIVELY RELEASED IN THIS DIRECTION.

*WARNING- ZERO STIFFNESS IN DIRECTION 1 AT JOINT	202 EQN.NO.	148
*WARNING- ZERO STIFFNESS IN DIRECTION 1 AT JOINT	203 EQN.NO.	151
*WARNING- ZERO STIFFNESS IN DIRECTION 1 AT JOINT	204 EQN.NO.	154
*WARNING- ZERO STIFFNESS IN DIRECTION 1 AT JOINT	205 EQN.NO.	157
*WARNING- ZERO STIFFNESS IN DIRECTION 1 AT JOINT	206 EQN.NO.	160
*WARNING- ZERO STIFFNESS IN DIRECTION 1 AT JOINT	207 EQN.NO.	163
*WARNING- ZERO STIFFNESS IN DIRECTION 2 AT JOINT	207 EQN.NO.	164

355. LOAD LIST 101 102 201 202

356. *****

357. PARAMETER 1

358. CODE AISC UNIFIED 2016

359. STEEL TAKE OFF LIST ALL

STAAD TRUSS

-- PAGE NO. 9

STEEL TAKE OFF

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST ISA130X130X16	28.03	8.441
ST ISA90X90X6	30.05	2.423
ST ISA130X130X10	36.43	7.024
ST ISA75X75X5	176.67	9.867
ST ISA45X45X5	0.60	0.020
ST ISA130X130X12	24.03	5.519
ST ISA100X100X10	106.15	15.576
ST ISA50X50X5	63.36	2.331
TOTAL =		51.200

***** END OF DATA FROM INTERNAL STORAGE *****

360. FINISH

***** END OF THE STAAD.Pro RUN *****

**** DATE= AUG 24,2024 TIME= 17: 3:14 ****

STAAD TRUSS

-- PAGE NO. 10

```
*****
*   For technical assistance on STAAD.Pro, please visit   *
*   http://www.bentley.com/en/support/                   *
*                                                         *
*   Details about additional assistance from               *
*   Bentley and Partners can be found at program menu    *
*   Help->Technical Support                               *
*                                                         *
*               Copyright (c) Bentley Systems, Inc.      *
*               http://www.bentley.com                   *
*****
```

MEMBER & CONNECTION BOLT DESIGN FOR
TOWER-4T7

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** DESIGN OF MAINLEG MEMBERS FOR 400KV MAINBUS MKD."4T7"**

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

A DESIGN OF MAIN-LEG FOR PART - PA,PB

- a) Angle Section tried & adopted = 130 x 130 x 16
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 76683.59 kg
Maximum Tension in main leg for Panel = 71921.06 kg
- c) Effective Length of Angle, L1 & L2 = 3504.00 & 3504.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1752.00 / 25.40 = 68.98 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1752.00 / 39.40 = 44.47 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 39.2000$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 33.60$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 33.60 = 85653.1$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 68.98
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 8.13 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2165.18$ Kg/sqcm.
k) Permissible Compressive Load = $2165.18 \times 39.2000 = 84875.0$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 16 mm = 16184.36 Kgs
No. of 16mm bolts required, = $84875.00 / 12711.17 = 6.68$ nos. Say **7.00 no.**
- p) Ultimate Maximum Compression per Leg = $76683.59 \times 1.00 = 76683.59$ Kg.
- q) Ultimate Maximum Tension per Leg = $71921.06 \times 1.00 = 71921.06$ Kg.
- r) Factor of Safety
In Compression = $84875.0 / 76683.59 = 1.11 > 1.0000$ It is Safe
In Tension = $85653.1 / 71921.06 = 1.19 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

B DESIGN OF MAIN-LEG FOR PART - PC, PD

- a) Angle Section tried & adopted = 130 x 130 x 12
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 56449.63 kg
Maximum Tension in main leg for Panel = 51910.672 kg
- c) Effective Length of Angle, L1 & L2 = 3003.00 & 3003.00 mm resply.
- d) Slenderness ratio $0.5 \cdot L1 / r_{vv} = 1501.50 / 25.60 = 58.65 < 120$ hence o.k.
 $0.5 \cdot L2 / r_{xx} = 1501.50 / 39.90 = 37.63 < 120$ hence o.k.
- e) Gross Area of Cross Section, $A_g = 29.90$ sqcm.
- f) Net Area of Cross Section $A_e = A_g - 2dt = 25.70$ sqcm.
- g) Minimum guaranteed yield Stress of Material $F_y = 250$ Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = $2549.20 \times 25.70 = 65514.4$ Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 58.65
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.83 < 13.28
Value of $F_y = 2549.20$ Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 2271.53$ Kg/sqcm.
k) Permissible Compressive Load = $2271.53 \times 29.9000 = 67918.8$ Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161) = 12711.17$ Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 12 mm = 12138.27 Kgs
No. of 16mm bolts required, = $65514.43 / 12138.27 = 5.40$ nos. Say **6.00 no.**
- p) Ultimate Maximum Compression per Leg = $56449.63 \times 1.00 = 56449.63$ Kg.
- q) Ultimate Maximum Tension per Leg = $51910.67 \times 1.00 = 51910.67$ Kg.
- r) Factor of Safety
In Compression = $67918.8 / 56449.63 = 1.20 > 1.0000$ It is Safe
In Tension = $65514.4 / 51910.67 = 1.26 > 1.0000$ It is Safe

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

C DESIGN OF MAIN-LEG FOR PART - PE, PF, PG,PH

- a) Angle Section tried & adopted = 130 x 130 x 10
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 36153.66 kg
Maximum Tension in main leg for Panel = 31040.211 kg
- c) Effective Length of Angle, L1 & L2 = 2302.00 & 2302.00 mm resply.
- d) Slenderness ratio L1/rvv = 2302.00 / 25.70 = 89.57 < 120 hence o.k.
L2/rxx = 2302.00 / 40.20 = 57.26 < 120 hence o.k.
- e) Gross Area of Cross Section, Ag = 25.10 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 21.60 sqcm.
- g) Minimum guaranteed yield Stress of Material Fy = 250 Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 21.60 = 55062.7 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 89.57
Limiting b/t ratio = $210 / (F_y)^{0.5}$ = 13.28
Actual b/t ratio = 13.00 < 13.28
Value of Fy = 2549.20 Kg/sqcm.
Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$ = 125.66
Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$ = 1901.61 Kg/sqcm.
k) Permissible Compressive Load = 1901.61 x 25.1000 = 47730.5 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161)$ = 12711.17 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 10 mm = 10115.22 Kgs
No. of 16mm bolts required, = $47730.46 / 10115.22$ = 4.72 nos. Say **5.00 no.**
- p) Ultimate Maximum Compression per Leg = 36153.66 x 1.00 = 36153.66 Kg.
- q) Ultimate Maximum Tension per Leg = 31040.21 x 1.00 = 31040.21 Kg.
- r) Factor of Safety
In Compression = $47730.5 / 36153.66$ = **1.32 > 1.0000 It is Safe**
In Tension = $55062.7 / 31040.21$ = **1.77 > 1.0000 It is Safe**

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

C DESIGN OF MAIN-LEG FOR PART - PI, PJ,PK,PL

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Refer STAAD OUTPUT FOR MEMBER FORCES (Values are Factor Loads)
Maximum compression in main leg for Panel = 4801.30 kg
Maximum Tension in main leg for Panel = 4279.957 kg
- c) Effective Length of Angle, L1 & L2 = 1688.00 & 1688.00 mm resply.
- d) Slenderness ratio L1/rvv = 1688.00 / 14.60 = 115.62 < 120 hence o.k.
L2/rxx = 1688.00 / 23.10 = 73.07 < 120 hence o.k.
- e) Gross Area of Cross Section, Ag = 7.27 sqcm.
- f) Net Area of Cross Section Ae=Ag-2dt = 5.52 sqcm.
- g) Minimum guaranteed yield Stress of Material Fy = 250 Mpa
- h) Permissible Tensile Stress = 2549 Kg/sqcm.
- i) Permissible Tensile Load = 2549.20 x 5.52 = 14071.6 Kgs
- j) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 115.62
Limiting b/t ratio = $210 / (F_y)^{0.5}$ = 13.28
Actual b/t ratio = 15.00 > 13.28
Value of Fy = Fcr (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$ = 125.66
Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$ = 1341.48 Kg/sqcm.
k) Permissible Compressive Load = 1341.48 x 7.2700 = 9752.6 Kgs
- l) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in Double shear = $(2 \times 3.1415/4 \times d \times d \times 3161)$ = 12711.17 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
No. of 16mm bolts required, = $9752.58 / 5057.61$ = 1.93 nos. Say **2.00 no.**
- p) Ultimate Maximum Compression per Leg = 4801.30 x 1.00 = 4801.30 Kg.
- q) Ultimate Maximum Tension per Leg = 4279.96 x 1.00 = 4279.96 Kg.
- r) Factor of Safety
In Compression = $9752.6 / 4801.30$ = **2.03 > 1.0000 It is Safe**
In Tension = $14071.6 / 4279.96$ = **3.29 > 1.0000 It is Safe**

* DESIGN OF BRACINGS FOR TOWER MKD. "4T7"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF BRACINGS - GA, JA

a)	Angle Section tried & adopted	=	75	x	75	x	5
b)	Length of Angle, L2	=	4871.00				mm
c)	Slenderness $0.25 \cdot L2 / r_{vv}$	=	1217.75	/	14.60	=	83.41 < 200 hence o.k.
	Slenderness $0.5 \cdot L2 / r_{xx}$	=	2435.50	/	23.10	=	105.43 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	7.2700 sqcm.				
e)	Net Area of Cross Section Ae = A1 + A2.k assuming 1 No.s 16mm Dia. Bolts						
	$v =$	=	2.7500	+	3.6250	x	0.6947 = 5.2684 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy	= 250 Mpa				
g)	Permissible Tensile Stress	= 2549.20 Kg/sqcm.					
h)	Permissible Tensile Load	= 2549.20 x 5.2684 = 13430.3 Kgs					
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	105.43				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	15.00 > 13.28				
	Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.)	=	2325.91 Kg/sqcm.				
	Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	$F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y$	=	1507.26 Kg/sqcm.				
j)	Permissible Compressive Load	=	1507.26 x 7.2700 = 10957.8 Kgs				
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58 Kgs				
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	5 mm	=	5057.61 Kgs		
	No. of 16mm bolts required,	=	10957.80	/	5057.61		
		=	2.17 nos. Say				
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	9107.433	kg			
	Maximum Tension in Bracing	=	9092.409	kg			
m)	In Compression	=	10957.8	/	9107.43	=	1.20 > 1.0 safe
	In Tension	=	13430.3	/	9092.41	=	1.48 > 1.0 safe

3.00 no.

B DESIGN OF BRACINGS - GB, JB

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Length of Angle, L2 = 4204.00 mm
- c) Slenderness $0.25 \cdot L2 / r_{vv}$ = 1051.00 / 14.60 = 71.99 < 200 hence o.k.
 Slenderness $0.5 \cdot L2 / r_{xx}$ = 2102.00 / 23.10 = 91.00 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 7.2700 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
 assuming 1 No.s 16mm Dia. Bolts
 $v = 2.7500 + 3.6250 \times 0.6947 = 5.2684$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 5.2684 = 13430.3 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 91.00
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 15.00 > 13.28
 Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ (KL/r / C_e)^2 \}] \times F_y = 1716.11$ Kg/sqcm.
 j) Permissible Compressive Load = 1716.11 x 7.2700 = 12476.1 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
 Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 5 mm = 5057.61 Kgs
 No. of 16mm bolts required, = 12476.13 / 5057.61 = 2.47 nos. Say **3.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 10435.849 kg
 Maximum Tension in Bracing = 10261.355 kg
- m) In Compression = 12476.1 / 10435.85 = **1.20 > 1.0 safe**
 In Tension = 13430.3 / 10261.36 = **1.31 > 1.0 safe**

C DESIGN OF BRACINGS - GC, JC

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L2 = 3453.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1726.50 / 19.40 = 88.99 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 3453.00 / 30.50 = 113.21 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 19.0000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 113.21
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ (KL/r) / C_e \}^2] \times F_y = 1514.66$ Kg/sqcm.
- j) Permissible Compressive Load = 1514.66 x 19.0000 = 28778.5 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ t = 10 mm = 10115.22 Kgs
No. of 16mm bolts required, = 28778.52 / 6355.58 = 4.53 nos. Say **5.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 11959.302 kg
Maximum Tension in Bracing = 12109.924 kg
- m) In Compression = 28778.5 / 11959.30 = **2.41 > 1.0 safe**
In Tension = 36948.8 / 12109.92 = **3.05 > 1.0 safe**

D DESIGN OF BRACINGS - GD, JD

- a) Angle Section tried & adopted = 50 x 50 x 5
- b) Length of Angle, L2 = 2286.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1143.00 / 9.70 = 117.84 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 2286.00 / 23.10 = 98.96 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 4.7900 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 1.5000 + 2.3750 \times 0.6545 = 3.0545$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 3.0545 = 7786.6 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 117.84
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 10.00 < 13.28
Value of F_y = 2549.20 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ (KL/r) / C_e \}^2] \times F_y = 1428.46$ Kg/sqcm.
- j) Permissible Compressive Load = 1428.46 x 4.7900 = 6842.3 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 6355.58 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
No. of 16mm bolts required, = 6842.34 / 5057.61 = 1.35 nos. Say **2.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 1533.451 kg
Maximum Tension in Bracing = 1454.129 kg
- m) In Compression = 6842.3 / 1533.45 = **4.46 > 1.0 safe**
In Tension = 7786.6 / 1454.13 = **5.35 > 1.0 safe**

* DESIGN OF BRACINGS FOR TOWER MKD. "4T7"

DESIGN BASIS & REFERENCES :

- 1) FOR DESIGN OF MEMBERS, IS 802 - PART - I / Sec 2 : 1992 HAS BEEN REFERED TO.
- 2) FOR PROPERTIES OF EACH MEMBER, IS 808 : 1989 HAS BEEN REFERED TO.
- 3) FOR CALCULATING SLENDERNESS RATIO, CL. 6 and CL. B-8 of IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 4) FOR LIMITING SLENDERNESS RATIO VALUES, CL. 6.3 OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 5) PERMISSIBLE TENSILE STRESS IS TAKEN AS MINIMUM GUARANTEED YIELD STRESS i.e. 255MPa
- 6) NET AREA OF MAIN LEG MEMBERS IS WORKED OUT AS TOTAL AREA LESS AREA OF 2 BOLT HOLES
SINCE THESE ARE CONNECTED ON BOTH FLANGES, WHEREAS NET AREA FOR BRACINGS IS
WORKED OUT AS $(A1 + A2.K)$, WHERE $K = 3A1/(3A1 + A2)$. REFER CLAUSES 8.1 AND 9.1 OF IS 802
(part 1/sec 2) : 1992.
- 7) FOR PERMISSIBLE STRESSES IN BOLTS, CL. 5.4 (TABLE 1) OF IS 802 (part 1/sec 2) : 1992 IS REFERED.
- 8) THE MEMBER FORCES ARE OBTAINED FROM STAAD ANALYSIS AND THESE ARE FACTORED VAULES.

A DESIGN OF VERTICAL MEMBER - SU

a)	Angle Section tried & adopted	=	100	x	100	x	10
b)	Length of Angle, L2	=	2200.00				mm
c)	Slenderness $0.5 \times L2 / r_{vv}$	=	1100.00	/	19.40	=	56.70 < 200 hence o.k.
	Slenderness $L2 / r_{xx}$	=	2200.00	/	30.50	=	72.13 < 200 hence o.k.
d)	Gross Area of Cross Section, Ag	=	19.0000 sqcm.				
e)	Net Area of Cross Section Ae = A1 + A2.k assuming 1 No.s 16mm Dia. Bolts						
	$v =$	=	7.7500	+	9.5000	x	0.7099 = 14.4943 sqcm.
f)	Minimum guaranteed yield Stress of Material	Fy	= 250 Mpa				
g)	Permissible Tensile Stress	= 2549.20 Kg/sqcm.					
h)	Permissible Tensile Load	= 2549.20 x 14.4943 = 36948.8 Kgs					
i)	Permissible Compressive Stress Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.						
	Governing Slenderness ratio	=	72.13				
	Limiting b/t ratio = $210 / (F_y)^{0.5}$	=	13.28				
	Actual b/t ratio	=	10.00 < 13.28				
	Value of Fy	=	2549.20 Kg/sqcm.				
	Value of Ce = $3.1415 \times \text{sq. root of } (2 \times E / F_y)$	=	125.66				
	Fa = $[1 - 0.5 \{ KL/r / Ce \}^2] \times F_y$	=	2129.25 Kg/sqcm.				
j)	Permissible Compressive Load	=	2129.25 x 19.0000 = 40455.7 Kgs				
k)	No. of 16mm bolts required,						
	Permissible Shear Stress for 5.6 class bolts	=	310 Mpa	=	3161 Kg/sqcm.		
	Permissible Bearing Stress for 5.6 class bolts	=	620 Mpa	=	6322 Kg/sqcm.		
	Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$	=	6355.58 Kgs				
	Capacity for 5.6 class in bearing = $(6322 \times d \times t)$	t =	10 mm	=	10115.22 Kgs		
	No. of 16mm bolts required,	=	36948.80 / 6355.58 = 5.81 nos. Say				
		=	6.00 no.				
l)	Refer STAAD OUTPUT for Maximum Forces in Bracing						
	Maximum Compression in Bracing	=	28023.061 kg				
	Maximum Tension in Bracing	=	27680.646 kg				
m)	In Compression	=	40455.7	/	28023.06	=	1.44 > 1.0 safe
	In Tension	=	36948.8	/	27680.65	=	1.33 > 1.0 safe

B DESIGN OF BRACINGS - SV

- a) Angle Section tried & adopted = 100 x 100 x 10
- b) Length of Angle, L2 = 1188.00 mm
- c) Slenderness L2/rvv = 1188.00 / 19.40 = 61.24 < 200 hence o.k.
 Slenderness L2/rxx = 1188.00 / 30.50 = 38.95 < 200 hence o.k.
- d) Gross Area of Cross Section, Ag = 19.0000 sqcm.
- e) Net Area of Cross Section Ae = A1 + A2.k
 assuming 1 No.s 16mm Dia. Bolts
 $v = 7.7500 + 9.5000 \times 0.7099 = 14.4943 \text{ sqcm.}$
- f) Minimum guaranteed yield Stress of Material $F_y = 250 \text{ Mpa}$
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 14.4943 = 36948.8 Kgs
- i) Permissible Compressive Stress
 Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
 Governing Slenderness ratio = 61.24
 Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
 Actual b/t ratio = 10.00 < 13.28
 Value of $F_y = 2549.20 \text{ Kg/sqcm.}$
 Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ (KL/r / C_e)^2 \}] \times F_y = 2246.52 \text{ Kg/sqcm.}$
- j) Permissible Compressive Load = 2246.52 x 19.0000 = 42683.9 Kgs
- k) No. of 16mm bolts required,
 Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
 Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
 Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161) = 9930.60 \text{ Kgs}$
 Capacity for 5.6 class in bearing = $(6322 \times d \times t) \quad t = 10 \text{ mm} = 10115.22 \text{ Kgs}$
 No. of 16mm bolts required, = 36948.80 / 9930.60 = 3.72 nos. Say **4.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
 Maximum Compression in Bracing = 35935.026 kg
 Maximum Tension in Bracing = 27315.116 kg
- m) In Compression = 42683.9 / 35935.03 = **1.19 > 1.0 safe**
 In Tension = 36948.8 / 27315.12 = **1.35 > 1.0 safe**

C DESIGN OF BRACINGS - SA

- a) Angle Section tried & adopted = 75 x 75 x 5
- b) Length of Angle, L2 = 2368.00 mm
- c) Slenderness $0.5 \cdot L2 / r_{vv}$ = 1184.00 / 14.60 = 81.10 < 200 hence o.k.
Slenderness $L2 / r_{xx}$ = 2368.00 / 23.10 = 102.51 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 7.2700 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2 \cdot k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 2.7500 + 3.6250 \times 0.6947 = 5.2684$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 5.2684 = 13430.3 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 102.51
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1552.01$ Kg/sqcm.
- j) Permissible Compressive Load = 1552.01 x 7.2700 = 11283.1 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 5$ mm = 5057.61 Kgs
No. of 16mm bolts required, = 11283.12 / 5057.61 = 2.23 nos. Say **3.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 7211.183 kg
Maximum Tension in Bracing = 9494.624 kg
- m) In Compression = 11283.1 / 7211.18 = **1.56 > 1.0 safe**
In Tension = 13430.3 / 9494.62 = **1.41 > 1.0 safe**

D DESIGN OF BRACINGS - AA,AB,DA,DB

- a) Angle Section tried & adopted = 90 x 90 x 6
- b) Length of Angle, L2 = 3111.00 mm
- c) Slenderness $0.5 \times L2/r_{vv}$ = 1555.50 / 17.50 = 88.89 < 200 hence o.k.
Slenderness $L2/r_{xx}$ = 3111.00 / 27.70 = 112.31 < 200 hence o.k.
- d) Gross Area of Cross Section, A_g = 10.5000 sqcm.
- e) Net Area of Cross Section $A_e = A_1 + A_2.k$
assuming 1 No.s 16mm Dia. Bolts
 $v = 4.1700 + 5.2200 \times 0.7056 = 7.8531$ sqcm.
- f) Minimum guaranteed yield Stress of Material F_y = 250 Mpa
- g) Permissible Tensile Stress = 2549.20 Kg/sqcm.
- h) Permissible Tensile Load = 2549.20 x 7.8531 = 20019.2 Kgs
- i) Permissible Compressive Stress
Refer Cl. 5.2 of IS 802 part 1/sec 2 : 1992 for calculation of permissible stress.
Governing Slenderness ratio = 112.31
Limiting b/t ratio = $210 / (F_y)^{0.5} = 13.28$
Actual b/t ratio = 15.00 > 13.28
Value of $F_y = F_{cr}$ (as per cl. 5.2.2.2.) = 2325.91 Kg/sqcm.
Value of $C_e = 3.1415 \times \text{sq. root of } (2 \times E / F_y) = 125.66$
 $F_a = [1 - 0.5 \{ KL/r / C_e \}^2] \times F_y = 1396.98$ Kg/sqcm.
- j) Permissible Compressive Load = 1396.98 x 10.5000 = 14668.3 Kgs
- k) No. of 16mm bolts required,
Permissible Shear Stress for 5.6 class bolts = 310 Mpa = 3161 Kg/sqcm.
Permissible Bearing Stress for 5.6 class bolts = 620 Mpa = 6322 Kg/sqcm.
Capacity for 5.6 class in single shear = $(3.1415/4 \times d \times d \times 3161)$ = 9930.60 Kgs
Capacity for 5.6 class in bearing = $(6322 \times d \times t)$ $t = 6$ mm = 6069.13 Kgs
No. of 16mm bolts required, = 14668.25 / 6069.13 = 2.42 nos. Say **3.00 no.**
- l) Refer STAAD OUTPUT for Maximum Forces in Bracing
Maximum Compression in Bracing = 9163.336 kg
Maximum Tension in Bracing = 9614.047 kg
- m) In Compression = 14668.3 / 9163.34 = **1.60 > 1.0 safe**
In Tension = 20019.2 / 9614.05 = **2.08 > 1.0 safe**

BASE PLATE & ANCHOR BOLT DESIGN

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T7" (NORMAL CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

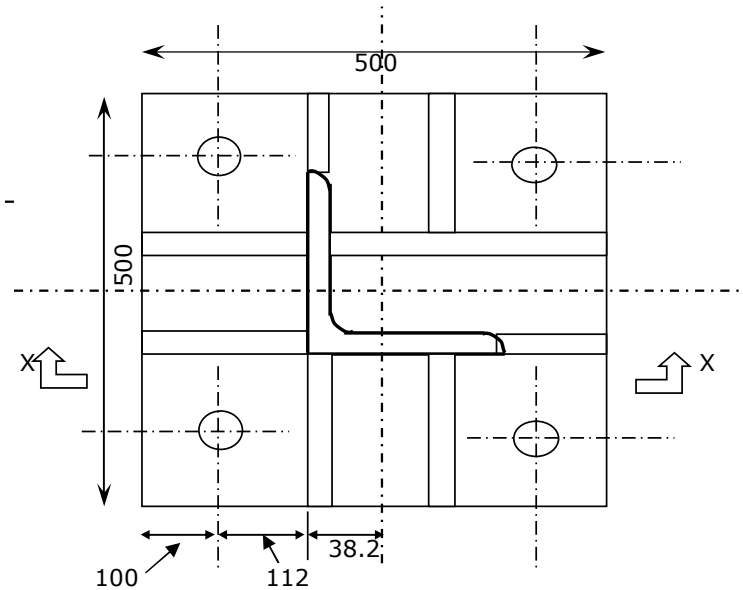
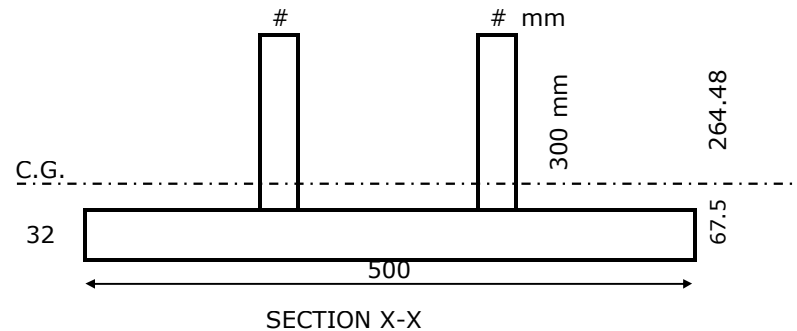
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	27963.47
B) MAXIMUM TENSION PER LEG	24762.00	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	1117.53	1998.51
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	2117.64	1434.41
E) RESULTANT SHEAR	2394.43	2460.00
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 27963.473 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 24762.004 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 27963.473 Kgs (Working)
b) Maximum Tensile Load per Leg = 24762.004 Kgs (Working)
c) Perm. bearing Stress - M25 concrete = 101.94 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm ($A_1 = B \times D$)
f) Main leg angle = L130x130x16
g) Base Plate Size adopted b x l = 500.00 x 500.00 x 32.00 mm ($A_2 = b \times l$)
h) Net Area of Base Plate provided = 500.000 x 500.000 = 2500.000 sqcm
i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)



C Section modulus

Moment of Inertia @ C G axis Ixx	= 192195126.44 mm ⁴
Section Modulus Zxx(top)	= 726683.01 mm ³
Section Modulus Zxx(bottom)	= 2846608.10 mm ³
Minimum Section Modulus Zxx(top)	= 726.683 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $27963.473 / 2500.000 + 0.000 / 20833.333$
= 11.185 Kg/sqcm.
< 101.937 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 211.80 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions.

- c) Bending moment @ face of Stiffener = $11.1854 \times 50.000 \times 21.180^2 / 2.000$
= 125442.015 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
- b) Edge distance of Bolts = 100.00 mm
- c) Nominal Diameter of Bolts = 42.00 mm
- d) Diameter of Bolt Hole = 46.000 mm
- e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $211.800 - 100.000$
= 111.800 mm
- f) C/C of outer line of bolts, 'a' = $500.000 - 100.000 - 100.000$
= 300.000 mm
- g) Tension per bolt, $t = P/4 + Mx/n.a + My/n.a$ = $24762.004 / 4.000 + 0.000 / 60.000$
= 6190.501 Kgs
- h) Bending moment @ face of Stiffener = $2.000 \times 6190.5010 \times 11.180$
= 138419.602 Kg-cm
- Maximum bending moment = 138419.602 Kg-cm
- Minimum section modulus Z_{min} = 726.683 cm³
- i) Maximum bending stress = 190.4814 Kg / sq. cm
< 1850.000 Kg / sq. cm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

Corner portion

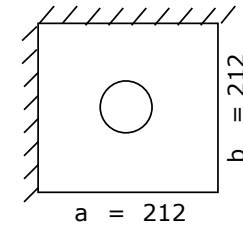
$$\text{Max. } s_b = \beta q b^2 / t^2$$

$$a = b = 212 \text{ mm}$$

$$a / b = 1 \quad \beta = 1.769 \quad q = 11.1854$$

$$s_b = 1.769 \times 11 \times 21.18^2 / 3.20^2 = 866.82$$

Allowable bending stress (1.00 x 1850) < 1850



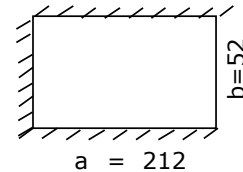
Middle portion

$$a = 212 \text{ mm} \quad b = 52 \text{ mm}$$

$$a / b = 4.042 \quad \beta = 0.798 \quad q = 11.1854$$

$$s_b = 0.798 \times 11 \times 5.24^2 / 3.20^2 = 23.93$$

Allowable bending stress (1.00 x 1850) < 1850



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(Stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	24762.00 Kgs.
c) Thus force / cm of weld length	=	77.38 Kgs.
d) Resistance /cm ² of weld	=	1100.00 Kgs.
e) Throat Size of weld required	=	0.07 cms
f) Thus fillet thickness required	=	1.00 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

H Design of Anchor Bolts

Diameter of Bolt	=	42 mm
Nos. of Bolts per Leg	=	4
Root area of M42 bolts, $A_e=0.785 \cdot A_g$	=	1088 mm ²
Gross area of M42 bolts, A_g	=	1385 mm ²

Check for Normal Condition :-

Axial Tension in Each Bolt P_t	=	6190.5 Kgs.	
Tensile stress, $f_t = P_t/A_e$	=	$\frac{6190.5}{10.88}$	
	=	569.20 Kg/cm ²	< 1200.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.00	Hence Safe
Shear Force In Each Bolt , P_s	=	2394.43 / 4	= 598.61 kg
Shear stress, $f_s = P_s/A_g$	=	$\frac{598.61}{13.85}$	
	=	43.21 Kg/cm ²	< 800.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.00	Hence Safe

Combined stress check for Normal Condition :-

$$f_s/F_s + f_t/F_t < 1.40 \quad (\text{ref. cl.8.9.4.5 IS:800-1984})$$

$$\frac{569.20}{1200} + \frac{43.21}{800} = 0.53 \quad \text{Hence Safe.}$$

Anchor length For Normal Condition :-

$$\begin{aligned} \text{Anchor Length, } L_e &= \frac{\text{Pull per bolt}}{(\pi \times d \times \tau_{bd})} \\ &= \frac{6190.50}{13.19 \times 8.00} \quad (\tau_{bd} = 8 \text{ kg/cm}^2, \text{Refer Table-21, IS:456,2000}) \\ \text{Thus length of embedment 'L'} &= 58.65 \text{ cms.} \end{aligned}$$

PROVIDE 4 NOS. 42 MM DIA. ANCHORE BOLT WITH MIN. 600MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

*** DESIGN OF BASE PLATE & ANCHOR BOLT FOR 400KV TOWER MKD."4T7" (SHORT CIRCUIT CONDITION)**

A MAXIMUM COMPRESSION / TENSION PER LEG :

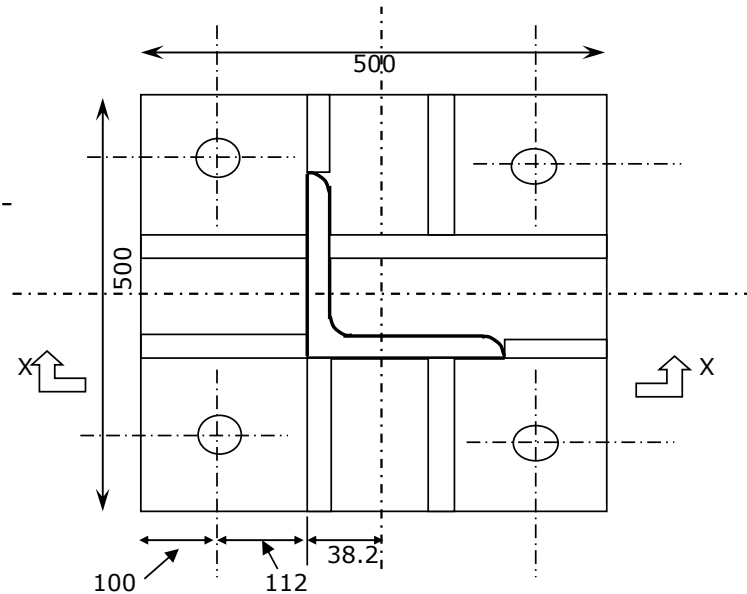
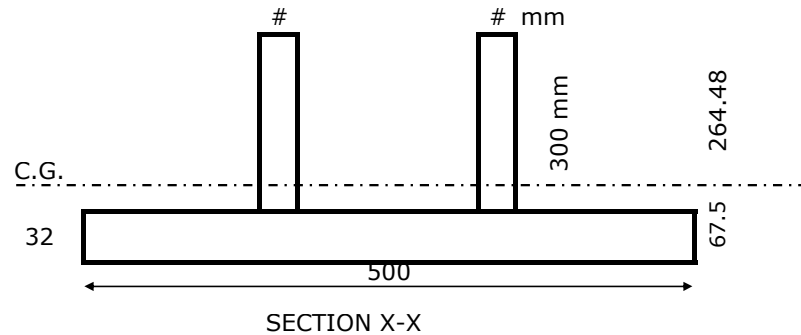
FORCES PER LEG FROM STAAD OUTPUT	TENSION LEG	COMPR. LEG
A) MAXIMUM COMPRESSION PER LEG	0.00	54515.91
B) MAXIMUM TENSION PER LEG	51036.81	0.00
C) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG X-AXIS	1201.71	3783.54
D) SHEAR CORESPONDING TO MAX COMP./TEN. LEG ALONG Z-AXIS	5306.99	2954.80
E) RESULTANT SHEAR	5441.34	4800.62
F) MOMENT @ MAJOR AXIS	0.00	0.00
G) MOMENT @ MINOR AXIS	0.00	0.00

THUS MAXIMUM COMPRESSIVE DESIGN FORCE PER LEG / BASE PLATE = 54515.906 Kgs.
AND MAXIMUM TENSILE DESIGN FORCE PER LEG / BASE PLATE = 51036.812 Kgs.

B DESIGN OF BASE PLATE :

- a) Maximum Compressive Load per Leg = 54515.906 Kgs (Working)
b) Maximum Tensile Load per Leg = 51036.812 Kgs (Working)
c) Perm. bearing Stress - M25 concrete = 101.94 Kg/sqcm. ($\sqrt{A_1/A_2} \times 0.25 \times f_{ck}$) (Refer CL-34.4, IS:456,2000)
d) Permissible stress σ_{bs} in Base plate (IS-800 clause 5.4.3) = 1850.00 Kg/sqcm.
e) Assuming pedestal dimension L x B = 800.00 x 800.000 mm (A1 = BxD)
f) Main leg angle = L130x130x16
g) Base Plate Size adopted b x l = 500.00 x 500.00 x 32.00 mm (A2 = b x l)
h) Net Area of Base Plate provided = 500.000 x 500.000 = 2500.000 sqcm
i) Height & thickness of stiffner = 300 x 12 mm

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)



C Section modulus

Moment of Inertia @ C G axis Ixx	= 192195126.44 mm ⁴
Section Modulus Zxx(top)	= 726683.01 mm ³
Section Modulus Zxx(bottom)	= 2846608.10 mm ³
Minimum Section Modulus Zxx(top)	= 726.683 cm ³

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

D Check for Bending Compression :

- a) Actual Base Pressure, $P/A + M/Z$ = $54515.906 / 2500.000 + 0.000 / 20833.333$
= 21.8064 Kg/sqcm.
< 101.937 Kg/sqcm. 'hence o.k.
- b) Maximum projection of Base plate beyond face of Leg angle/Stiffeners = 211.80 mm

The maximum compression will be at one corner of base plate. The corner portion of base plate is cantilevered out from two stiffener plates provided in orthogonal directions. Thus bending moment on 1cm width of base plate is assumed to be shared equally in perpendicular directions:

- c) Bending moment @ face of Stiffener = $21.8064 \times 50.000 \times 21.180^2 / 2.000$
= 244554.211 Kg-cm

E Check for Bending Tension :

- a) Number of Bolts per Leg = 4.00
b) Edge distance of Bolts = 100.00 mm
c) Nominal Diameter of Bolts = 42.00 mm
d) Diameter of Bolt Hole = 46.000 mm
e) Effective Lever arm for Bending due to Tension (centreline of bolts to stiffener) = $211.800 - 100.000$
= 111.800 mm
f) C/C of outer line of bolts, 'a' = $500.000 - 100.000 - 100.000$
= 300.000 mm
g) Tension per bolt, $t = P/4 + Mx/n.a + My/n.a$ = $51036.812 / 4.000 + 0.000 / 60.000$
= 12759.203 Kgs
h) Bending moment @ face of Stiffener = $2.000 \times 12759.2030 \times 11.180$
= 285295.779 Kg-cm
- Maximum bending moment = 285295.779 Kg-cm
Minimum section modulus Z_{min} = 726.683 cm^3
i) Maximum bending stress = $392.6000 \text{ Kg / sq. cm}$
< 1850.000 Kg / sq. cm

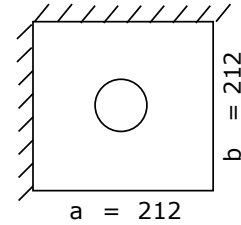
Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

F Check for bending stress in base plate between stiffner supports

Referring 'FORMULE FOR STRESS AND STRAIN' by RAYMOND ROARK

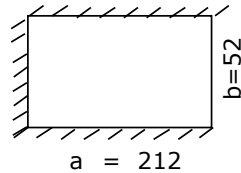
Corner portion

$$\begin{aligned} \text{Max. } s_b &= \beta q b^2 / t^2 \\ a = b &= 212 \text{ mm} \\ a / b &= 1 \quad \beta = 1.769 \quad q = 21.8064 \\ s_b &= 1.769 \times 22 \times 21.8^2 / 3.20^2 = \mathbf{1689.91} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



Middle portion

$$\begin{aligned} a &= 212 \text{ mm} \quad b = 52 \text{ mm} \\ a / b &= 4.042 \quad \beta = 0.798 \quad q = 21.8064 \\ s_b &= 0.798 \times 22 \times 5.24^2 / 3.20^2 = \mathbf{46.66} \\ \text{Allowable bending stress } (1.25 \times 1850) &< \mathbf{2312.5} \end{aligned}$$



G Check for weld connection at bottom plate :

a) Total weld length (periphery of main leg)+(stiffner)	=	320.00 cms
b) Total vertical force (tensile)	=	51036.81 Kgs.
c) Thus force / cm of weld length	=	159.49 Kgs.
d) Resistance /cm ² of weld	=	1375.00 Kgs.
e) Throat Size of weld required	=	0.12 cms
f) Thus fillet thickness required	=	1.64 mm

However Provide 6.00 mm fillet weld throught the periphery of main leg

As 6 mm fillet weld is provided and also as stiffners are provided, weld joint is safe @ base plate.

Project :-	CONSTRUCTION 400 kV SWITCHYARD AT 2X800 MW(Ph-II) MAHAN ULTRA SUPER CRITICAL THERMAL POWER PROJECT AT SINGRAULI ,MP
Title :-	DESIGN FOR 400KV GANTRY TOWER (4T7)

H Design of Anchor Bolts

Diameter of Bolt	=	42 mm
Nos. of Bolts per Leg	=	4
Root area of M42 bolts, $A_e=0.785 \cdot A_g$	=	1088 mm ²
Gross area of M42 bolts, A_g	=	1385 mm ²

Check for Short Circuit Condition :-

Axial Tension in Each Bolt P_t	=	12759.2 Kgs.

Tensile stress, $f_t = P_t/A_e$	=	$\frac{12759.2}{10.88}$

	=	1173.18 Kg/cm ²	<	1500.0 Kg/cm ²
Permissible tensile stress, F_t	=	1200 x 1.25		Hence Safe

Shear Force In Each Bolt , P_s	=	5441.34 / 4	=	1360.34 kg
Shear stress, $f_s = P_s/A_g$	=	$\frac{1360.34}{13.85}$		

	=	98.19 Kg/cm ²	<	1000.0 Kg/cm ²
Permissible Shear stress, F_s	=	800.00 x 1.25		Hence Safe

Combined stress check for Short Circuit Condition :-

$f_s/F_s + f_t/F_t$	<	1.40	(ref. cl.8.9.4.5 IS:800-1984)

$\frac{1173.18}{1500} + \frac{98.19}{1000}$	=	0.88	Hence Safe.

Anchor length For Short Circuit Condition :-

Anchor Length, L_e	=	$\frac{\text{Pull per bolt}}{(\pi \times d \times \tau_{bd})}$	
	=	$\frac{12759.20}{13.19 \times 10.64}$	($\tau_{bd} = 8 \text{ kg/cm}^2$,Refer Table-21, IS:456,2000) (33% INCREASE)
Thus length of embedment 'L'	=	90.88 cms.	

PROVIDE 4 NOS. 42 MM DIA. ANCHORE BOLT WITH MIN. 950MM EMBEDMENT LENGTH TO MAKE BOLT SAFE IN BONDING.