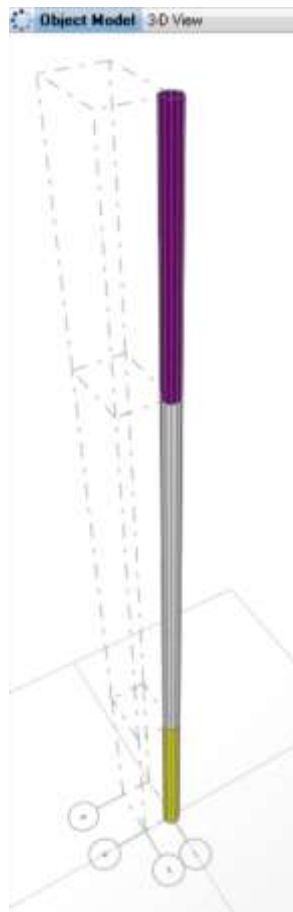


Structural Calculation Report

Project Information

- Structure Type: Round shape
 - Total Height: 4 meters
- Application: lightning protection
- Location: Wind speed base 130 km/h
 - Material: Steel ST37
- Hot Dip Galvanized According To ASTM A123

3D View lighting Pole



1- LOADING

1-1 Dead Load

The weight of ladder and cage are considered equal to 10 Kg at top of pole.

1-3 Wind Load calculations (based on INBR-06-1398)

q , is the reference wind pressure (kg/m^2)

Where:

$$V=130(\text{km/h}) \longrightarrow q=0.80 (\text{kN/m}^2) = \underline{80} (\text{kg/m}^2)$$

$$F = I_w \cdot C_f \cdot q \cdot C_g \cdot C_e \cdot A$$

A = Diameter (m)

I_w , is the important factor and from clause 6-1-2 is equal to 1 for main structure.

C_e , is the wind loading coefficient and from clause 5-10-6-1 is equal to $C_e = (z/10)^{0.2} \geq 0.9$

$$z=0.0 \text{ m to } z=4 \text{ m} \longrightarrow C_e = 0.9$$

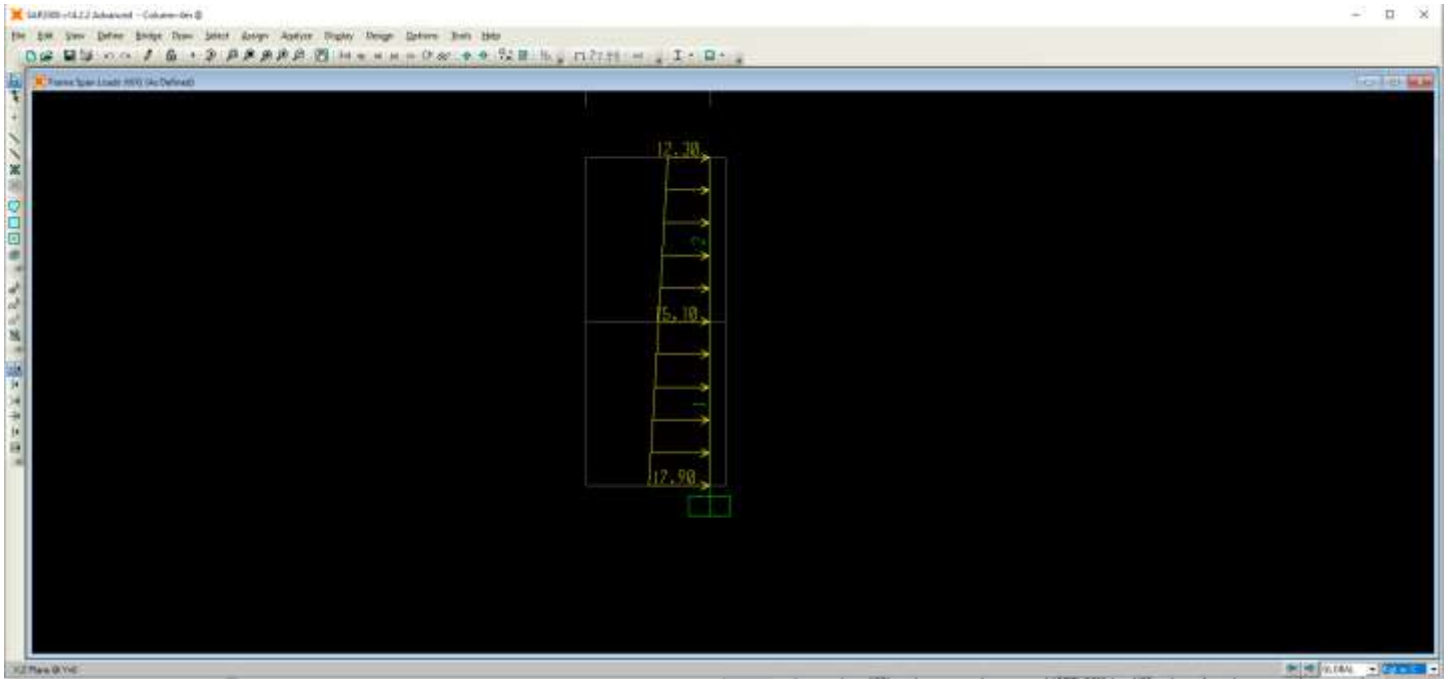
C_g , is the wind gust effect coefficient from clause 1-8-10-6 is equal to 2

$$F(1) = 1 \cdot 1.4 \cdot 80 \cdot 2 \cdot 0.9 \cdot 0.65 = 131 (\text{Kg/m})$$

$$F(2) = 1 \cdot 1.4 \cdot 80 \cdot 2 \cdot 1 \cdot 0.52 = 114.6 (\text{Kg/m})$$

$$F(3) = 1 \cdot 1.4 \cdot 80 \cdot 2 \cdot 1.1 \cdot 0.45 = 108 (\text{Kg/m})$$

$$F(4) = 1 \cdot 1.4 \cdot 80 \cdot 2 \cdot 1.2 \cdot 0.30 = 80.7 (\text{Kg/m})$$



Wind Load (Kg/m)

2- Load Combinations

TABLE: Combination Definitions						
Combo Name	ComboType	AutoDesign (Yes/No)	CaseType	CaseName	ScaleFactor (Unitless)	SteelDesign
D+0.75(W)	Linear Add	No	Linear Static	DEAD	1	Strength
D+0.75(W)			Linear Static	WX	0.75	
D+0.75(W)			Linear Static	LIVE	0.75	
Drift	Linear Add	No	Linear Static	DEAD	1	None
Drift			Linear Static	WX	1	
Drift			Linear Static	LIVE	1	
D+L	Linear Add	No	Linear Static	DEAD	1	Strength
D+L			Linear Static	LIVE	1	
D	Linear Add	No	Linear Static	DEAD	1	Strength
D+W	Linear Add	No	Linear Static	DEAD	1	Strength
D+W			Linear Static	WX	1	
0.6D+W	Linear Add	No	Linear Static	WX	1	Strength
0.6D+W			Linear Static	DEAD	0.6	

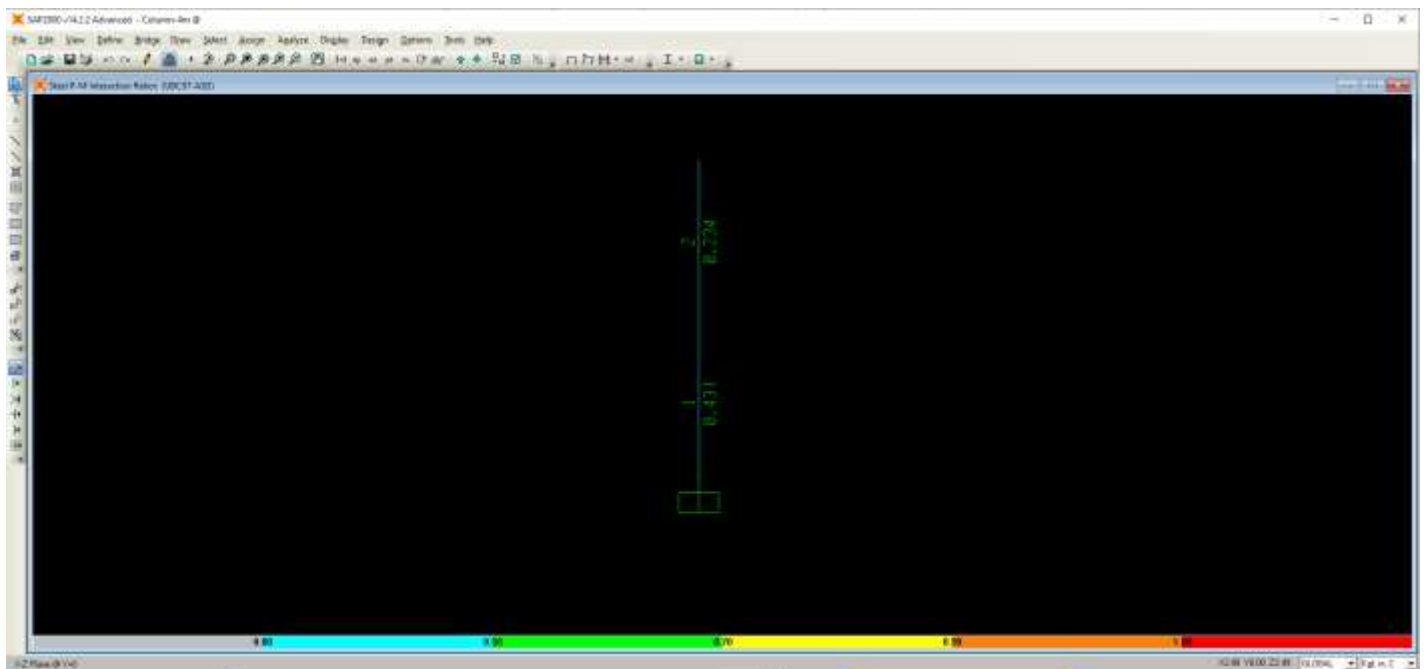
3- Load Pattern

TABLE: Load Pattern Definitions		
Load Pattern	Design Type	SelfWtMult Unitless
DEAD	DEAD	1.1
WX	WIND	0
LIVE	LIVE	0

4- Structure Analysis & Design

4-1 Stress Ratio

Steel members stress check is carried out in accordance with INBR 10-1401 for mentioned load combinations. Following figure show the stress ratio of main members for the most critical case.

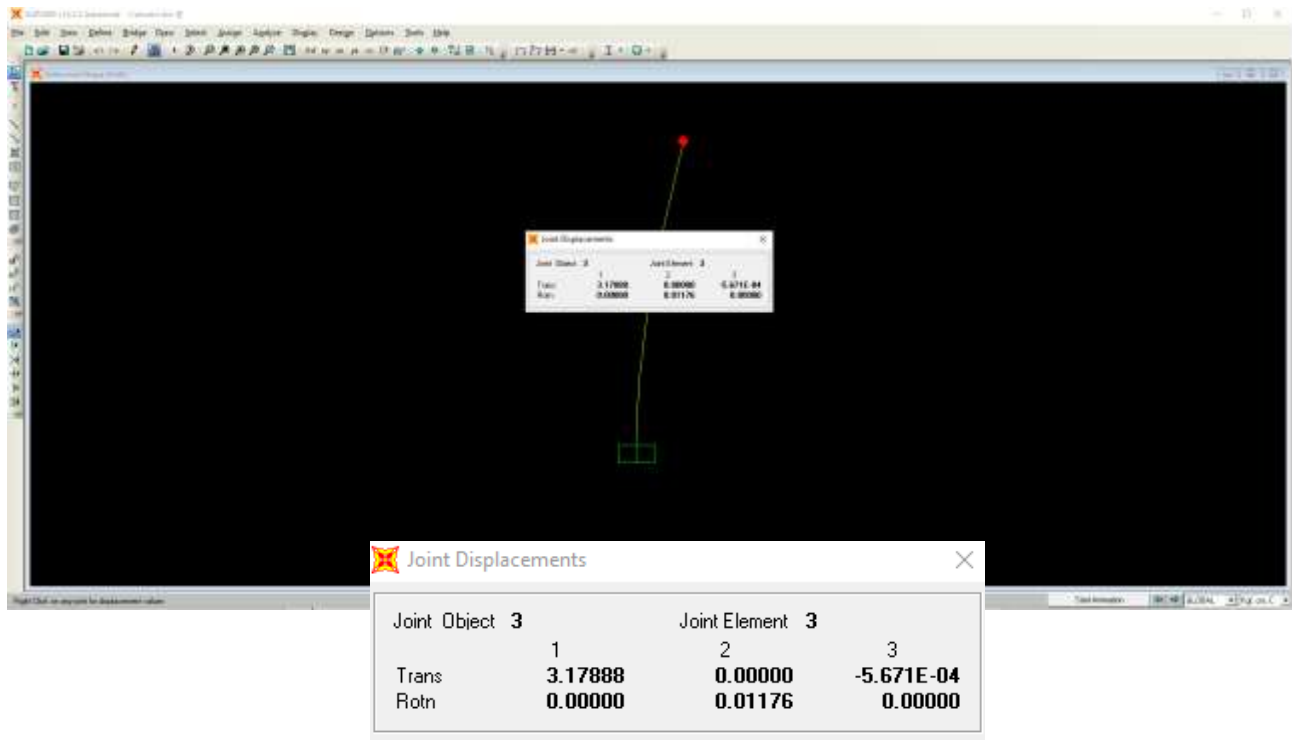


Stress Ratio of Main Pole

The best design stress ratio should be between 0.7 and 0.8; less than 0.7 is considered over-design & higher than 1.0 is not accepted.

4-2 Displacement & Drift

Considering maximum allowable lateral drift ratio of $0.04 \times (h+w)$ in accordance with article 6.5.1 of “BS EN 40-3-3:2013” code, drift is in allowable range, as follows:



Drift of Main Pole (cm)

$$\Delta_{all} = 0.04 \times (400 + 3) = 16.12 \text{ cm} > 3.17888 \rightarrow \text{OK}$$

TABLE: Auto Wave 3 - Wave Characteristics - General						
WaveChar	WaveType	KinFactor	SWaterDepth	WaveHeight	WavePeriod	WaveTheory
Text	Text	Unitless	mm	mm	Sec	Text
Default	From Theory	1	45000	18000	12	Linear

TABLE: Case - Static 1 - Load Assignments			
Case	LoadType	LoadName	LoadSF
Text	Text	Text	Unitless
DEAD	Load pattern	DEAD	1
WX	Load pattern	WX	1

TABLE: Groups 3 - Masses and Weights					
GroupName	SelfMass	SelfWeight	TotalMassX	TotalMassY	TotalMassZ
Text	Kgf-s2/mm	Kgf	Kgf-s2/mm	Kgf-s2/mm	Kgf-s2/mm
ALL	0.0022	21.31	0.0022	0.0022	0.0022

TABLE: Groups 1 - Definitions		
GroupName	Text	ALL
Selection	Yes/No	Yes
SectionCut	Yes/No	Yes
Steel	Yes/No	Yes
Concrete	Yes/No	Yes
Aluminum	Yes/No	Yes
ColdFormed	Yes/No	Yes
Stage	Yes/No	Yes
Bridge	Yes/No	Yes
AutoSeismic	Yes/No	No
AutoWind	Yes/No	No
SelDesSteel	Yes/No	No
SelDesAlum	Yes/No	No
SelDesCold	Yes/No	No
MassWeight	Yes/No	Yes
Color	Text	Red

TABLE: Groups 3 - Masses and Weights

GroupName	SelfMass	SelfWeight	TotalMassX	TotalMassY	TotalMassZ
Text	Kgf-s2/mm	Kgf	Kgf-s2/mm	Kgf-s2/mm	Kgf-s2/mm
ALL	0.0022	21.31	0.0022	0.0022	0.0022

TABLE: Load Case Definitions

Case	Text	DEAD	WX
Type	Text	LinStatic	LinStatic
InitialCond	Text	Zero	Zero
ModalCase	Text		
BaseCase	Text		
DesTypeOpt	Text	Prog Det	Prog Det
DesignType	Text	DEAD	WIND
AutoType	Text	None	None
RunCase	Yes/No	Yes	Yes
CaseStatus	Text	Finished	Finished
GUID	Text		
Notes	Text		

TABLE: Connectivity - Frame

Frame	JointI	JointJ	IsCurved	Length	CentroidX	CentroidY	CentroidZ	GUID
Text	Text	Text	Yes/No	mm	mm	mm	mm	Text
1	1	2	No	2000	1500	0	1000	
2	2	3	No	2000	1500	0	3000	

TABLE: Assembled Joint Masses

Joint	U1	U2	U3	R1	R2	R3
Text	Kgf-s2/mm	Kgf-s2/mm	Kgf-s2/mm	Kgf-mm-s2	Kgf-mm-s2	Kgf-mm-s2
1	0.0006488	0.0006488	0.0006488	0	0	0
2	0.0011	0.0011	0.0011	0	0	0
3	0.0004376	0.0004376	0.0004376	0	0	0

TABLE: Element Forces - Frames

Frame	Station	OutputCase	CaseType	P	V2	V3	T	M2	M3	FrameElem	ElemStation
Text	mm	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm	Text	mm
1	0	DEAD	LinStatic	- 33.44	0	0	0	0	0	1-1	0
1	1000	DEAD	LinStatic	- 26.44	0	0	0	0	0	1-1	1000
1	2000	DEAD	LinStatic	- 19.44	0	0	0	0	0	1-1	2000
1	0	D+0.75(W)	Combination	- 33.44	45.3	0	0	0	85000	1-1	0
1	1000	D+0.75(W)	Combination	- 26.44	32.4	0	0	0	46237.5	1-1	1000
1	2000	D+0.75(W)	Combination	- 19.44	20.55	0	0	0	19850	1-1	2000
1	0	Drift	Combination	- 33.44	60.4	0	0	0	113333	1-1	0
1	1000	Drift	Combination	- 26.44	43.2	0	0	0	61650	1-1	1000
1	2000	Drift	Combination	- 19.44	27.4	0	0	0	26466.7	1-1	2000
1	0	D	Combination	- 33.44	0	0	0	0	0	1-1	0
1	1000	D	Combination	- 26.44	0	0	0	0	0	1-1	1000
1	2000	D	Combination	- 19.44	0	0	0	0	0	1-1	2000
1	0	D+W	Combination	- 33.44	60.4	0	0	0	113333	1-1	0
1	1000	D+W	Combination	- 26.44	43.2	0	0	0	61650	1-1	1000
1	2000	D+W	Combination	- 19.44	27.4	0	0	0	26466.7	1-1	2000
1	0	0.6D+W	Combination	- 20.06	60.4	0	0	0	113333	1-1	0
1	1000	0.6D+W	Combination	- 15.86	43.2	0	0	0	61650	1-1	1000