Analysis and Design of Transmission Monopole Using STAAD Pro for Indian Condition

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Abstract

Grid Pinnacles are the most well-known kinds of Pinnacles embraced in development industry. These days, Monopole is likewise being utilized instead of cross section towers. A near report among Monopole and Grid type Pinnacles with various levels. Dead loads and Wind loads are considered for examination of the pinnacle utilizing STAAD Master programming which is made for dissecting various designs and pinnacles. Planning and examination to be hung on STAAD Expert keeping its level and stacking consistent and later correlation is completed from the outcomes got. Monopole is a development structure which requires less material and less space for establishment than contrasted with cross section towers. In this time, as populace is expanding, prerequisite of land and its expense is persistently expanding and consequently there is need of alteration in customary grid towers. The Grid tower transmission line plan in metropolitan regions, where required option to proceed is limitation. Pipe segment for monopole and a four-legged area for cross section tower have been picked as pinnacle profiles. The new age composite guides and Steel Built up guides' properties have been inspected for a fundamental methodology. The veracity of program will be check by first planning the physically planned transmission tower and monopole utilizing the product and think about results. Wind examination is done utilizing standard codes and programming. The way of behaving of pinnacle and shaft is dissected for various burden mixes. The greatest relocation values, shear powers and it are gotten to twist minutes. Subsequently, transmission tower and monopole ought to be planned thinking about both primary and electrical necessities for protected and affordable

Plan according to Indian code. It is closed from past review that transmission tower have lower parallel dislodging when contrasted with monopole. This is on the grounds that they have higher firmness. Transmission tower convey weighty electrical transmission transmitter at adequate and

Protected from the beginning monopole the thought is to arrive at a distinct resolution in regards to the prevalence of two designs.

Keywords: Monopole, metropolitan regions, examination, firmness

1.INTRODUCTION

Historically, transmission line systems all around the world, including in India, have been supported by steel lattice towers. The population has been growing quickly over the past three decades, and as a result, since the 1980s, the demand for electricity has also been alarmingly rising. Rapid urbanisation also occurs as a result of the population's explosive growth. As a result, there is no longer enough available land to accommodate transmission lines, and in the case of acquisition, the price is higher. Therefore, a different methodology would be to convert the vertical layout of the lattice tower structure into supporting structures for monopoles. In countries like India and those in the East-West and North-South regions of the world, they become a feasible substitute. The steel tubular poles are constructed using the most advanced manufacturing techniques.

1.1Problem Statement

The study will focus on a 220 kV single circuit transmission monopole located in STAAD Pro, modelling, design, and analysis are performed. Software.

2.OBJECTIVES

Current study focused on the analysis and design of transmission tower and monopole by using manual calculations and software.

1. The main objective of this research work is to analyse and design of transmission tower and monopole.
2. To compare and check wind performances in Different region.
3. To check the variations in lateral displacement and stiffness.
4. To review the tensions for the conductors and ground wire.
5. To analyse the variations in stresses or forces in cross arms members in tower and monopole.

3. LITERATURE REVIEW

3.1Vadim Borokhov. Presented in his paper,

Study non-abelian monopole operators in the infrared limit of three-dimensional SU(Nc) and N = 4 SU(2) gauge theories. Using large Nf expansion and operator-state isomorphism of the resulting superconformal ¯eld theories, we construct monopole operators which are (anti-)chiral primaries and compute their charges under the global symmetries. Predictions of three-dimensional mirror symmetry for the quantum numbers of these monopole operators are veried.

3.2.Fabio Paivaa, et.al, Presented in his paper,

The present study introduces and compares several testing stations around the world. The scope of performing tower testing is addressed, followed by singular requirements of tower testing stations and main standards related with the loading tests. The main equipment and technical characteristics of testing stations in countries like India, China, Japan, Spain, Brazil and others countries around the world are described in detail. The paper concludes with an explanation of the present global distribution of these facilities around the world and their relationship with the actual economic development. Additionally particular major features of the tower testing stations described.

3.3. Nuthnapa Triepaischajonsak, et.al, Presented in his

paper,

Effects of earthquake on large billboards become significant issue after occurrence of disasters recently in Thailand. Two set of measurements were carried out, finding natural frequencies of actual large billboard. First set of measurements was made using accelerometers and the last one was made using non-contact laser vibration measurement. The test results show that, at low frequency, these natural frequencies correspond to transient vibrations of earthquake motion. The distinguished vibration occur at frequencies between 0.09 to 85 Hz. A simple billboard model is also presented here. The solutions to the problem are present especially for suture zone in Thailand.

3.4. Mu-Chun Wang, et.al, Presented in his paper,

The precise design of antenna for communication and electrical consumer applications had become strictly demanded and desirable because the antenna was not only suitable to the efficiency of transmitting/receiving ability and the fashion shape in marketing consideration, but also satisfied several bandwidths in wireless communication technology. Furthermore, the antenna is the front-end component of the radio frequency (RF) system, responding to the feeble signal in the far/near field. There are several types of monopole antenna shape in the lectures. In this work, we propose a monopole scoop-shape antenna to apply in RFID application.

3.5. Bashyam Sugumaran1, et. al, Presented in his paper,

Frequency selective surfaces are made up of periodic surfaces which are used to remove the undesired electromagnetic waves. The FSS used as band-pass radomes reduces the radar cross-section area of the antennas out of their operating band. FSS also used as reflectors and circuit analog absorbers. It is utilized in body area communication as it has band rejection characteristics where the radiation of particular frequency does not affect the human body. The body area communication gains more interest in communication systems that permits wireless connectivity among low-power devices for monitoring vital signs of a human for an extensive range of applications such as sports, health, army, and lifestyle computing.

3.6. Marco A. Antoniades, et. al, Presented in his paper,transmission-line-based metamaterials are presented, and their application to the design of passive and active antennas is outlined. Transmission-line metamaterials, also termed negative-refractive-index transmission-line (NRI-TL) metamaterials, are formed by periodically loading a transmission line with lumped-element series capacitors and shunt inductors, and it is shown that they can support both forward and backward waves, as well as standing waves with a zero propagation constant.

3.7. Xiao-yu Bai, et. al, Presented in his paper

Although the deformations of the pile simulated by PLAXIS2D were slightly smaller than the values observed in the field, this finite element software can be reasonably used for the design and construction .of deep foundations under rock-soil layers. The maximum deformations were found at the upper part of the foundation with the "pile + one steel support + two anchor" support system, (at a maximum value of 6 mm, which meets design requirements). Due to the constraints of the retaining pile, ground settlement increased at first and then decreases far away from the foundation, with the maximum settlement appearing at 7.0-8.0 m from the foundation.

3.8. K Srilatha1, et. al, Presented in his paper,

A monopole antenna with enhanced gain, low Specific Absorption Rate (SAR) and low profile backed with an artificial magnetic conductor (AMC) for wireless communications is designed and presented in this article. This antenna presents AMC design, which isapplicableto reduce the SAR for the portion of the EM waves where electromagnetic pollution is commonly observed. To reduce the radiation of the back lobe and to improve the antenna gain, AMC is designed and backed under the monopole antenna. The antenna resonates in a single band which is from 2.38GHz to 2.44GHz with the reflection coefficient of 2.41Ghz. With the obtained band, the proposed model can be utilisedfor wearable applications.

3.9. Yuxi Song, et. al, Presented in his paper**,**

Transmission towers are truss structures which are used to support the transmission power lines. It is important to design the transmission towers because unsuitable dimensions could waste the steel or lead to the failure of transmission towers. The thickness of the beam is a critical parameter during the design of transmission tower, which is directly related with the safety of the transmission tower. In this paper, a finite element method in linear and 2-dimension was employed to simulate the mechanical behaviour of transmission tower. Based on the calculated results, the variations of the maximum stress and the maximum displacement with the increasing thickness were displayed. Both the stress and displacement decrease dramatically with the increasing thickness and reach to a stable value if the thickness is beyond a critical thickness

3.METHODOLOGY

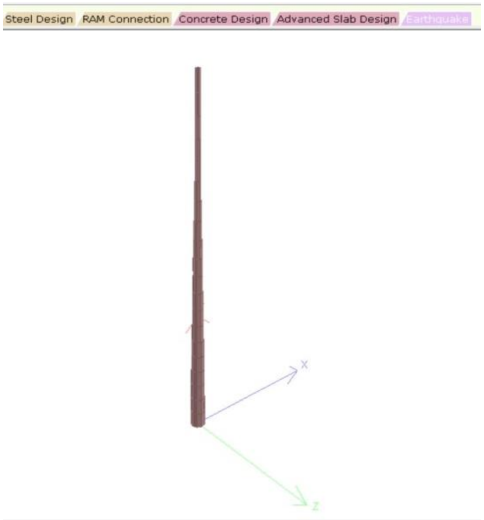

Fig 1. Modeling of Monopole on Staad Pro

The transmission tower and monopole are configuration by physically by utilizing limit state technique in light of IS 80 0, IS 802, IS 875 and blast factor strategy. In light of steps a nd equations included, a plan program will be ready in STA AD Expert. The veracity of program will be check by first pl anning the physically planned transmission tower and mono pole utilizing programming and think about results. An indis tinguishable technique will be followed for both. The progra m for planning a similar will create by utilizing STAAD Ma ster and its loyalty will check by first settling physically like wise in programming and afterward contrasting outcomes. T he transmission tower and monopole will plan for level 15M to 40M. 4-legged transmission

Pinnacle and 16 sided polygonal shape monopole will plan f or 220kV to 400kV power limit and further more check the i mpact of wind pressure.

The electrical power supply configuration is separated into mechanical and electrical parts. The mechanical part is conn ected with the guide emotionally supportive networks includ ing pinnacles, establishments, and other related things. The guide supporting construction is the vital component of a lin e, however the basic issues of a line are related with the guid es as it were.

The help structures are sufficient for the upward loads, yet h e strength of similar backings is lacking for atrocities create d to the guide's framework. Also, the security loads are conn ected with the mechanical qualities of the guide. These are a ddressed in the longitudinal bearing of the line. In the securit y stacks, the significant condition is the messed up wire con dition loads are portrayed for the steadiness of the monopole . Both dependability and Security load blends are applied to the monopole structure. The breeze loads along the level of t he supporting construction are found from the assigned boar d levels with important power the breeze loads on the guides are additionally found with the Blast factor strategy.

4. DESIGN CONFIGURATION

The design of monopole sections was carried out correspond ing to the ASCE 48-19 guidelines and as per IS 800:2007 as shown in table 3 & 4. Secondly, the sag-tensions calculation s of the conductor have calculated for ACSR (Aluminum co nductor steel reinforced) conductor for temperature, wind lo ading cases. The geometric properties are prescribed from IS 1161-2014 [25]. The revised code provisions of wind load i mpact on various wind sensitive structures were explored in [26-33]. Similarly, the revised code guidelines of the transm ission

tower loads were compared with the general wind load provi sions [34]. Identifying the Monopole can be useful for urban areas; the Hoarding design in city limits was also explained with the latest load combinations [35]. The IS 800:2007, ado pts the equation 1 for checking the member capacity with C ombined Axial Force and Bending Moment.

4 .1 Design Parameters:-

Table 1. Geometrical properties of Monopole

	Monopole Pipe Section	
Tower height(m)	Base Width (m)	Top width (m)
60	2.16	0.32

Table 2. Properties of ACSR conductor

Conductor material	ACSR	
Conductor size	30/7/3	mm
Overall Diameter of conductor(d)	21	mm
Area of the conductor for all stands (A)	2.6154	cm^2
Weight of the conductor (W)	0.973	Kg/m
Breaking strength of the conductor (UTS)	9130	kg
Coefficient of linear expansion (α)	0.00001773	per ^{O}C
Modulus of elasticity € Initial (EI)	78700000	kgf/cm^2
Final (EI)	62600000	kg/cm^2

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5. RESULTS AND DISCUSSION:-

Analysis of tower is administered by considering all kin ds of loading, differing types of Sections. All loads are c alculated manually as per IS 802 (part 1 and 2): 1995, IS 5613 (part 2): 1985, IS 875- 2015. The tower is analysed and designed using STAAD Pro. Maximum axial force, bending moment and maximum deflection values of tow er with different configuration are obtained by using ST AAD Pro.

5.1Maximum forces

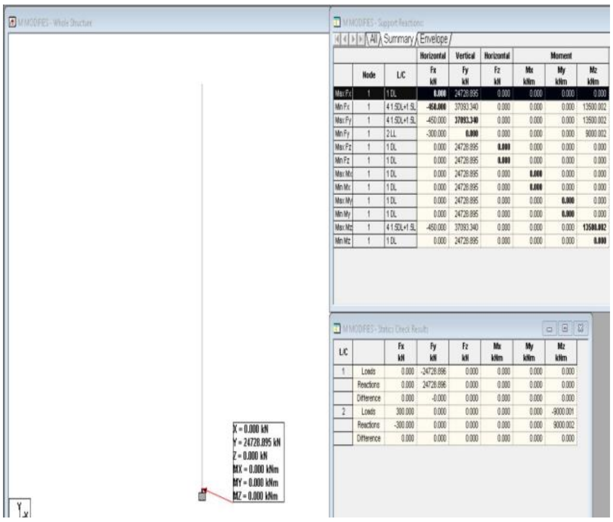

Fig2.Maximum Forces due to load

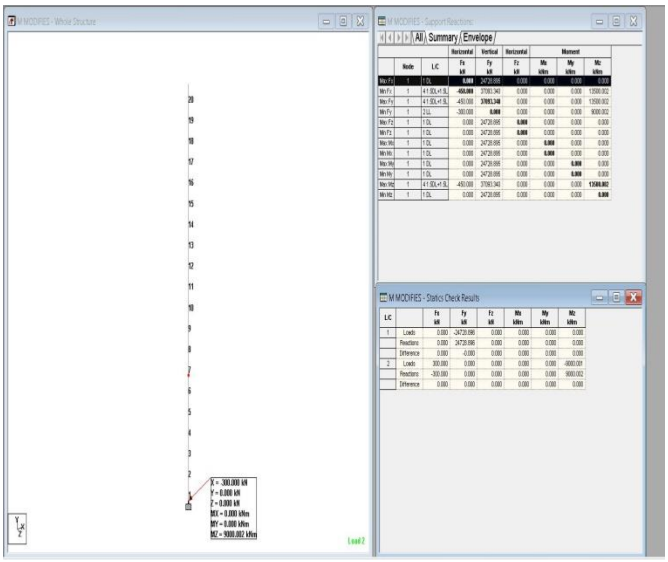

Fig3.Maximum Forces due to Load

		Horizontal	Vertical	Horizontal	Resultant	Rotational		
Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
1	1 DL	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2 LL	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3 DL+LL	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4 1.5DL+1.5L	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	1 DL	0.000	-0.062	0.000	0.062	0.000	0.000	0.000
	2 LL	0.007	0.000	0.000	0.007	0.000	0.000	-0.000
	3 DL+LL	0.007	-0.062	0.000	0.063	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.011	-0.094	0.000	0.094	0.000	0.000	-0.000
3	1 DL	0.000	-0.122	0.000	0.122	0.000	0.000	0.000
	2 LL	0.021	0.000	0.000	0.021	0.000	0.000	-0.000
	3 DL+LL	0.021	-0.122	0.000	0.123	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.032	-0.182	0.000	0.185	0.000	0.000	-0.000
4	1 DL	0.000	-0.177	0.000	0.177	0.000	0.000	0.000
	2 LL	0.040	0.000	0.000	0.040	0.000	0.000	-0.000
	3 DL+LL	0.040	-0.177	0.000	0.182	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.060	-0.266	0.000	0.273	0.000	0.000	-0.000
5	1 DL	0.000	-0.230	0.000	0.230	0.000	0.000	0.000
	2 LL	0.065	0.000	0.000	0.065	0.000	0.000	-0.000
	3 DL+LL	0.065	-0.230	0.000	0.239	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.097	-0.345	0.000	0.358	0.000	0.000	-0.000
6	1 DL	0.000	-0.279	0.000	0.279	0.000	0.000	0.000
	2 LL	0.093	0.000	0.000	0.093	0.000	0.000	-0.000
	3 DL+LL	0.093	-0.279	0.000	0.294	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.140	-0.418	0.000	0.441	0.000	0.000	-0.000
7	1 DL	0.000	-0.324	0.000	0.324	0.000	0.000	0.000
	2 LL	0.126	0.000	0.000	0.126	0.000	0.000	-0.000
	3 DL+LL	0.126	-0.324	0.000	0.348	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.189	-0.487	0.000	0.522	0.000	0.000	-0.000
8	1 DL	0.000	-0.367	0.000	0.367	0.000	0.000	0.000
	2 LL	0.162	0.000	0.000	0.162	0.000	0.000	-0.000
	3 DL+LL	0.162	-0.367	0.000	0.401	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.243	-0.550	0.000	0.601	0.000	0.000	-0.000
9	1 DL	0.000	-0.406	0.000	0.406	0.000	0.000	0.000
	2 LL	0.200	0.000	0.000	0.200	0.000	0.000	-0.000
	3 DL+LL	0.200	-0.406	0.000	0.452	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.301	-0.608	0.000	0.678	0.000	0.000	-0.000
10	1 DL	0.000	-0.441	0.000	0.441	0.000	0.000	0.000
	2 LL	0.241	0.000	0.000	0.241	0.000	0.000	-0.000
	3 DL+LL	0.241	-0.441	0.000	0.503	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.362	-0.662	0.000	0.754	0.000	0.000	-0.000
11	1 DL	0.000	-0.473	0.000	0.473	0.000	0.000	0.000
	2 LL	0.285	0.000	0.000	0.285	0.000	0.000	-0.000
	3 DL+LL	0.285	-0.473	0.000	0.552	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.427	-0.710	0.000	0.828	0.000	0.000	-0.000
12	1 DL	0.000	-0.502	0.000	0.502	0.000	0.000	0.000
	2 LL	0.329	0.000	0.000	0.329	0.000	0.000	-0.000
	3 DL+LL	0.329	-0.502	0.000	0.600	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.494	-0.753	0.000	0.900	0.000	0.000	-0.000
13	1 DL	0.000	-0.527	0.000	0.527	0.000	0.000	0.000
13	1 DL	0.000	-0.527	0.000	0.527	0.000	0.000	0.000
	2 LL	0.375	0.000	0.000	0.375	0.000	0.000	-0.000
	3 DL+LL	0.375	-0.527	0.000	0.647	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.563	-0.791	0.000	0.971	0.000	0.000	-0.000
14	1 DL	0.000	-0.549	0.000	0.549	0.000	0.000	0.000
	2 LL	0.422	0.000	0.000	0.422	0.000	0.000	-0.000
	3 DL+LL	0.422	-0.549	0.000	0.693	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.633	-0.824	0.000	1.039	0.000	0.000	-0.000
15	1 DL	0.000	-0.568	0.000	0.568	0.000	0.000	0.000
	2 LL	0.470	0.000	0.000	0.470	0.000	0.000	-0.000
	3 DL+LL	0.470	-0.568	0.000	0.737	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.704	-0.852	0.000	1.106	0.000	0.000	-0.000
16	1 DL	0.000	-0.583	0.000	0.583	0.000	0.000	0.000
	2 LL	0.518	0.000	0.000	0.518	0.000	0.000	-0.000
	3 DL+LL	0.518	-0.583	0.000	0.780	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.777	-0.875	0.000	1.170	0.000	0.000	-0.000
17	1 DL	0.000	-0.595	0.000	0.595	0.000	0.000	0.000
	2 LL	0.566	0.000	0.000	0.566	0.000	0.000	-0.000
	3 DL+LL	0.566	-0.595	0.000	0.821	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.849	-0.893	0.000	1.232	0.000	0.000	-0.000
18	1 DL	0.000	-0.604	0.000	0.604	0.000	0.000	0.000
	2 LL	0.614	0.000	0.000	0.614	0.000	0.000	-0.000
	3 DL+LL	0.614	-0.604	0.000	0.861	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.922	-0.906	0.000	1.292	0.000	0.000	-0.000
19	1 DL	0.000	-0.609	0.000	0.609	0.000	0.000	0.000
	2 LL	0.663	0.000	0.000	0.663	0.000	0.000	-0.000
	3 DL+LL	0.663	-0.609	0.000	0.900	0.000	0.000	-0.000
	4 1.5DL+1.5L	0.994	-0.913	0.000	1.350	0.000	0.000	-0.000
20	1 DL	0.000	-0.612	0.000	0.612	0.000	0.000	0.000
	2 LL	0.711	0.000	0.000	0.711	0.000	0.000	-0.000
	3 DL+LL	0.711	-0.612	0.000	0.938	0.000	0.000	-0.000
	4 1.5DL+1.5L	1.067	-0.918	0.000	1.407	0.000	0.000	-0.000
21	1 DL	0.000	-0.614	0.000	0.614	0.000	0.000	0.000
	2 LL	0.759	0.000	0.000	0.759	0.000	0.000	-0.000
	3 DL+LL	0.759	-0.614	0.000	0.976	0.000	0.000	-0.000
	4 1.5DL+1.5L	1.139	-0.921	0.000	1.465	0.000	0.000	-0.000

Table 3. Reaction Due To Loads on Nodes

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST PIP E	60.00	280.322
	TOTAL =	280.322

MEMBER	PROFILE	LENGTH (METE)	WEIGHT (KN)
1	ST PIP E	3.00	14.016
2	ST PIP E	3.00	14.016
3	ST PIP E	3.00	14.016
4	ST PIP E	3.00	14.016
5	ST PIP E	3.00	14.016
6	ST PIP E	3.00	14.016
7	ST PIP E	3.00	14.016
8	ST PIP E	3.00	14.016
9	ST PIP E	3.00	14.016
10	ST PIP E	3.00	14.016
11	ST PIP E	3.00	14.016
12	ST PIP E	3.00	14.016
13	ST PIP E	3.00	14.016
14	ST PIP E	3.00	14.016
15	ST PIP E	3.00	14.016
16	ST PIP E	3.00	14.016
17	ST PIP E	3.00	14.016
18	ST PIP E	3.00	14.016
19	ST PIP E	3.00	14.016
20	ST PIP E	3.00	14.016
		TOTAL =	280.322

5.2Axial force:-

The hub powers created in tower with tube segment diminis hed by 41% contrasted and channel area and 29% contrasted and point area. B. Regarding unwavering quality, security, a nd wellbeing, the lightest pinnacle prompts the most savvy tr ansmission line. The heaviness of transmission with tube are a is diminished by 65% contrasted and point segment and 41 % contrasted and round empty area. C. From the outcome ac quired, transmission tower with tube area is closed as ideal d esign arrangement.

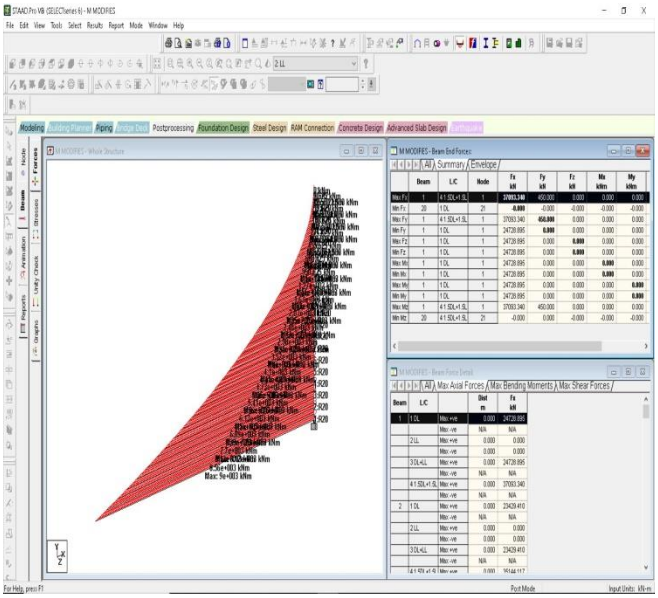

Fig 4.Axial Force Diagram

5.3Steel Take off

Steel take off is prepare by Staad pro in results

STEEL TAKE-OFF

PROFILE	LENGTH(METE)	WEIGHT(KN)
ST PIP3556H	57.00	24690.236
ST PIP2730H	3.00	735.980
	TOTAL =	25426.216

Table 5. Over all Steel Take off

6. CONCLUSION

In conclusion, the design of a transmission monopole plays a critical role in ensuring efficient and reliable transmission of electromagnetic signals. Through this research paper, we ha ve explored the various aspects involved in the design proce ss and highlighted the key considerations.

Firstly, we discussed the importance of understanding the fr equency range and operating conditions of the transmission system. This knowledge is vital for determining the appropri ate dimensions and materials for the monopole, ensuring opt imal performance and minimizing signal losses.

Additionally, we examined the impact of the monopole's gro und plane on its radiation pattern and impedance matching. Proper placement and sizing of the ground plane are crucial for achieving desired radiation characteristics and minimizin g reflections.

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8.BIOGRAPHIES

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