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EFFECT OF WIND SPEED ON STRUCTURAL BEHAVIOUR OF SELF-SUPPORT ANGLE SECTIONED AND SELF-SUPPORT PIPE SECTIONED TELECOMMUNICATION TOWERS

G. Parasuram[1], U. Lekshmi[2]
[1]PG Student, PYDAH College of Engineering and Technology, Visakhapatnam, India.
[2]Assistant Professor, Department of Civil Engineering, PYDAH College of Engineering and Technology, Visakhapatnam, India.

Abstract: Self-Supporting angle sectioned and Self-supporting pipe sectioned Towers are the most common types of Telecommunication Towers adopted in construction industry. This paper presents a comparison between Self-support angle sectioned and Self-support pipe sectioned type Towers with different heights of 30m, 40m and 50m for basic wind speeds of 33m/sec, 47m/sec and 55m/sec. Dead load, Live loads and Wind loads are considered for analysis of the tower using STAAD-Pro software which is tailor made for analyzing Telecommunication Towers. It is concluded from this study that Self-Support pipe sectioned Towers have lower lateral displacements compared to the Self-support angle sectioned Towers of same height for same amount of loading. This is because they have lower slenderness ratio, which leads to increase of load carrying capacity. Also the steel quantity required for Self-Support pipe sectioned Tower is lesser than the Self-support angle sectioned Towers for a given tower height, wind speed and loading. The main problem in Self-support pipe sectioned Tower is regarding connection of members at the joint with the gusset plate due to their curved surface whereas in angle sectioned towers this problem is avoided. However Self-Support pipe sectioned Towers have more load carrying capacity than Self-support angle sectioned Towers.
Keywords: STAAD-Pro; self-supporting pipe sectioned tower; self-supporting Angle sectioned tower; lateral displacements.

I. INTRODUCTION

With the rapid and exponential increase in the usage of mobiles, a lot of attention is being paid on the telecommunication industry and telecommunication towers in the recent past. Each and every individual is carrying a mobile with him/her nowadays and the demand for Telecommunication services has increased. Telecommunication Towers are the only means for coverage area and network reliability. Civil Engineers are involved in the analysis and design of the towers that support the panel antennas, telecommunication equipment, platforms and their foundations. All the equipment like mounts, antennas etc. are mounted on the tower which requires Civil engineering expertise. Tower structural calculations include Applied Loads like wind load, dead load, seismic load and design strength of structural steel member on superstructure including connections and foundation. Communication Towers acts as vertical trusses and resists wind load by cantilever action. The bracing system for any towers are active in taking only the Tension forces based on the direction of wind. The tapered part of the Tower is advantageous, as it reduces the design forces. Telecommunication Towers are classified into different types based upon their structural action, their cross-section, the type of sections used and on the placement of tower. They are classified as Monopole, Self-Support and Guyed Towers based on their structural action. Self-supporting Towers are generally preferred than other type because they are effective in high load carrying system, lesser horizontal displacement than others. This paper deals with comparison between Self-support Angle sectioned and Pipe sectioned Towers in case of Total weight of structure and less horizontal displacement values. pipe sectioned Towers are more effective than Angle sectioned Towers because they have high radius of gyration for the same cross sectional area compared with Angle section, which leads to decrease in slenderness Ratio and increase in design compressive stress (f_{cd}) which finally increases the Load carrying capacity..

II. OBJECTIVE AND SCOPE OF THE STUDY

The objective of this study is to compare the performance of Self-support Angle sectioned and Self-Support Pipe sectioned Towers with respect to lateral displacements and quantity of steel required. Analysis and design of Self-Support Angle and pipe sectioned Towers were performed using STAAD-Pro software for three different heights with three different wind speeds and compared. The problem is assumed to be a linear-static problem and analysis was performed for basic wind speeds of 33m/sec, 47m/sec and 55m/sec and heights of 30m, 40m and 50m. The study does not include seismic forces. Further, for the scope of study considered, the connections are neither designed nor evaluated. The geometrical configurations for all these towers are maintained so that the towers are passing for the respective heights and basic wind speeds. Comparison of lateral displacements at the top of towers is made between the similar sized Self-support Angle sectioned and Self-Support pipe sectioned Towers.

III. METHODOLOGY

3.1 Material properties

Table 1 shows the material properties adopted for analysis and design of Self-support Angle sectioned and Self-Support pipe sectioned Towers. For all calculation purposes Young's Modulus of steel is adopted as 205000 MPa and Density of the steel is 7850 kg/m^3.

Self-support Towers (IS:2062-2011)	
Steel grade for legs- E410	Steel grade for bracing - E250
Yield stress-410 Mpa	Yield stress-250 Mpa
Tensile strength-540 Mpa	Tensile strength-410 Mpa

Table 1: Material properties adopted for analysis of towers

3.2 Loads considered for the study
3.2.1 Dead load
Dead load consists of self-weight of the structure and telecommunication equipment mounted on top of the tower. Typical equipment on a Self-Supporting Tower consists of T-Frame Mount with 3 Andrew SBNH-1D6565B panel antenna at and Andrew HP4-44 Dish.

3.2.2 Wind Parameters considered for the study (as per IS:875 (Part 3) - [31])
Probability Factor [k_1] is considered treating the Telecommunication Towers as "Important buildings and structures" category. The structure under consideration is used for Telecommunication purposes. Here, there should not be any break-down in the services. Therefore, the structure class is considered as Important. Structure Classification is Class B since all the tower models analysed within the scope of this project are between the heights of 20m to 50m (including 50m). Terrain Category [k_2] is Category 2. The tower is designed for coastal areas that receive tropical cyclones. This may, pose danger to the performance as there are trees that could be blown off damaging the structure. Thus Category 3 conditions may not be maintained effectively. Further Category 2 is more conservative. Topography Factor [k_3] is taken as Factor 1 assuming that the structure is on level ground and there will be no wind speed up due to raised crest level or topographic features nearby.

3.3 Load combinations considered for the study (as per IS:875 (Part 5) - [32]) Load combinations considered for design are
DL + Wind load
1.0 DL + 1.2 Wind load
1.0 DL + 1.5 Wind load

3.4 Analysis and design
Linear static analysis is performed for all the towers within scope of the study and sectional properties are obtained from the design as per IS: 800-2007 [33]. Table 2(a), 2(b) and 2(c) present the sectional properties of monopole towers of heights for 30m, 40m and 50m respectively (subjected to basic wind speed of 33m/sec., 47 m/sec. and 55 m/sec.). Table 3(a), 3(b), 4(a), 4(b), 5(a) and 5(b) present geometrical configuration with member notation and sectional properties of Self-Supporting Towers of heights for 30m, 40m and 50m subjected to basic wind speed of 33m/sec., 47 m/sec. and 55 m/sec.

Section no	Tower Elevation From top (in m)	No of storeys	Face width (m)	Member notation	Bracing pattern
1	0-2	1	Top-1.5	1(a)- legs	
			Bottom-1.5	1(b)-horizontals	
				1(c)-bracings	
2	2-4	1	Top-1.5	2(a)- legs	
			Bottom-1.5	2(b)-horizontals	
				2(c)-bracings	Single
3	4-6	1	Top-1.5	3(a)- legs	
			Bottom-1.5	3(b)-horizontals	
				3(c)-bracings	
4	6-8	1	Top-1.5	4(a)- legs	
			Bottom-1.5	4(b)-horizontals	diagonal
				4(c)-bracings	
5	8-10	1	Top-1.5	5(a)- legs	
			Bottom-1.5	5(b)-horizontals	
				5(c)-bracings	
6	10-12.5	1	Top-1.5	6(a)- legs	
			Bottom-1.94	6(b)-horizontals	bracing
				6(c)-bracings	
7	12.5-15	1	Top-1.94	7(a)- legs	
			Bottom-2.38	7(b)-horizontals	
				7(c)-bracings	
8	15-17.5	1	Top-2.38	8(a)- legs	
			Bottom-2.81	8(b)-horizontals	
				8(c)-bracings	pattern
9	17.5-20	1	Top-2.81	9(a)- legs	
			Bottom-3.25	9(b)-horizontals	
				9(c)-bracings	
10	20-30	4	Top-3.25	10(a)- legs	
			Bottom-5	10(b)-horizontals	
				10(c)-bracings	

Table 2 (a): Geometrical configuration with member notation of self-supporting angle and pipe sectioned towers of height 30m for all considered basic wind speeds

Section no	Tower Elevation From top (in m)	No of storeys	Face width (m)	Member notation	Bracing pattern
1	0-2	1	Top-1.8	1(a)- legs	
			Bottom-1.8	1(b)-horizontals	
				1(c)-bracings	
2	2-4	1	Top-1.8	2(a)- legs	
			Bottom-1.8	2(b)-horizontals	
				2(c)-bracings	Single
3	4-6	1	Top-1.8	3(a)- legs	
			Bottom-1.8	3(b)-horizontals	
				3(c)-bracings	
4	6-8	1	Top-1.8	4(a)- legs	
			Bottom-1.8	4(b)-horizontals	diagonal
				4(c)-bracings	
5	8-10	1	Top-1.8	5(a)- legs	
			Bottom-1.8	5(b)-horizontals	
				5(c)-bracings	
6	10-12.5	1	Top-1.8	6(a)- legs	
			Bottom-2.11	6(b)-horizontals	bracing
				6(c)-bracings	
7	12.5-15	1	Top-2.11	7(a)- legs	
			Bottom-2.42	7(b)-horizontals	
				7(c)-bracings	
8	15-17.5	1	Top-2.42	8(a)- legs	
			Bottom-2.73	8(b)-horizontals	
				8(c)-bracings	pattern
9	17.5-20	1	Top-2.73	9(a)- legs	
			Bottom-3.03	9(b)-horizontals	
				9(c)-bracings	
10	20-40	8	Top-3.03	10(a)- legs	
			Bottom-5.5	10(b)-horizontals	
				10(c)-bracings	

Table 2(b): Geometrical configuration with member notation of self-supporting angle and pipe sectioned towers of height 40m for all considered basic wind speeds

Section no	Tower Elevation From top (in m)	No of storeys	Face width (m)	Member notation	Bracing pattern
1	0-2	1	Top-2	1(a)- legs	Single diagonal bracing pattern
			Bottom-2	1(b)-horizontals	
				1(c)-bracings	
2	2-4	1	Top-2	2(a)- legs	
			Bottom-2	2(b)-horizontals	
				2(c)-bracings	
3	4-6	1	Top-2	3(a)- legs	
			Bottom-2	3(b)-horizontals	
				3(c)-bracings	
4	6-8	1	Top-2	4(a)- legs	
			Bottom-2	4(b)-horizontals	
				4(c)-bracings	
5	8-10	1	Top-2	5(a)- legs	
			Bottom-2	5(b)-horizontals	
				5(c)-bracings	
6	10-12.5	1	Top-2	6(a)- legs	
			Bottom-2.25	6(b)-horizontals	
				6(c)-bracings	
7	12.5-15	1	Top-2.25	7(a)- legs	
			Bottom-2.5	7(b)-horizontals	
				7(c)-bracings	
8	15-17.5	1	Top-2.5	8(a)- legs	
			Bottom-2.75	8(b)-horizontals	
				8(c)-bracings	
9	17.5-20	1	Top-2.75	9(a)- legs	
			Bottom-3	9(b)-horizontals	
				9(c)-bracings	
10	20-22.5	1	Top-3	10(a)- legs	
			Bottom-3.25	10(b)-horizontals	
				10(c)-bracings	
11	22.5-25	1	Top-3.25	11(a)- legs	
			Bottom-3.5	11(b)-horizontals	
				11(c)-bracings	
12	25-50	10	Top-3.5	12(a)- legs	
			Bottom-6	12(b)-horizontals	
				12(c)-bracings	

Table 2(c): Geometrical configuration with member notation of self-supporting angle and pipe sectioned towers of height 50m for all considered basic wind speeds

Member notation	Member Description (IS Angle Sections) for basic wind speed of		
	33 m/sec.	47 m/sec.	55 m/sec.
1(a)- legs	150x115x8	150x115x8	200x100x10
1(b)-horizontals	80x40x5	80x40x5	80x40x5
1(c)-bracings	150x75x8	150x75x8	150x75x8
2(a)- legs	200x150x10	200x150x10	200x150x10
2(b)-horizontals	80x40x5	80x40x5	80x40x5
2(c)-bracings	150x75x8	150x75x8	150x75x8
3(a)- legs	200x200x20	200x200x20	200x200x24
3(b)-horizontals	80x40x5	80x40x5	80x40x5
3(c)-bracings	150x75x9	150x115x8	150x115x8
4(a)- legs	200x200x24	200x200x25	200x200x25
4(b)-horizontals	100x50x6	100x50x6	80x40x5
4(c)-bracings	150x75x9	150x75x9	150x115x8
5(a)- legs	200x200x25	200x200x25	200x200x25
5(b)-horizontals	100x50x6	100x50x6	100x50x6
5(c)-bracings	150x115x8	150x75x8	150x75x9
6(a)- legs	200x200x25	200x200x25	200x200x25
6(b)-horizontals	100x65x6	100x65x6	100x75x6
6(c)-bracings	200x150x20	200x150x10	200x150x10
7(a)- legs	200x200x25	200x200x25	200x200x25
7(b)-horizontals	150x75x8	100x65x6	135x65x8
7(c)-bracings	200x150x20	200x150x10	200x150x10
8(a)- legs	200x200x25	200x200x25	200x200x25
8(b)-horizontals	200x100x10	150x75x9	150x75x9
8(c)-bracings	200x150x12	200x150x12	200x150x10
9(a)- legs	200x200x25	200x200x25	200x200x25
9(b)-horizontals	200x100x12	200x200x25	200x100x10
9(c)-bracings	200x200x25	200x200x25	200x200x25
10(a)- legs	200x200x25	200x200x25	200x200x25
10(b)-horizontals	200x200x25	200x200x25	200x200x25
10(c)-bracings	200x200x25	200x200x25	200x200x25

Table 3(a): Sectional properties of self-supporting angle sectioned tower of height 30m

Member notation	Member Description (IS pipe Sections) for basic wind speed of		
	33 m/sec.	47 m/sec.	55 m/sec.
1(a)- legs	1016H	1270L	1270L
1(b)-horizontals	889L	889L	889M
1(c)-bracings	1016M	1016M	1016M
2(a)- legs	1397L	1524M	1651L
2(b)-horizontals	1270L	1270L	1270L
2(c)-bracings	1270L	1270L	1270L
3(a)- legs	1683M	1937M	2191M
3(b)-horizontals	1397L	1524L	1651L
3(c)-bracings	1270L	1270L	1270M
4(a)- legs	1937M	2445H	2730H
4(b)-horizontals	1524M	1683H	1937L
4(c)-bracings	1270L	1397M	1524L
5(a)- legs	2445H	3239H	3556H
5(b)-horizontals	1651H	2191L	2191L
5(c)-bracings	1270M	1524M	1683H
6(a)- legs	3239H	3556H	3556H
6(b)-horizontals	1683H	1937M	2191M
6(c)-bracings	1937L	1937M	2191L
7(a)- legs	3239H	3556H	3556H
7(b)-horizontals	2191M	2191L	2445H
7(c)-bracings	2191M	2191M	2191M
8(a)- legs	3556H	3556H	3556H
8(b)-horizontals	2730H	2445H	2445H
8(c)-bracings	2191M	2191M	2191M
9(a)- legs	3556H	3556H	3556H
9(b)-horizontals	3239H	3239H	2730H
9(c)-bracings	3239H	3239H	3239H
10(a)- legs	3556H	3556H	3556H
10(b)-horizontals	3556H	3556H	3556H
10(c)-bracings	3556H	3556H	3556H

Table 3(b): Sectional properties of self-supporting pipe sectioned tower of height 30m

Member notation	Member Description (IS Angle Sections) for basic wind speed of		
	33 m/sec.	47 m/sec.	55 m/sec.
1(a)- legs	200x150x10	200x150x10	200x150x10
1(b)-horizontals	80x50x5	80x50x5	80x50x5
1(c)-bracings	150x75x9	150x75x9	150x75x9
2(a)- legs	200x150x12	200x150x12	200x150x12
2(b)-horizontals	100x50x6	100x50x6	100x50x6
2(c)-bracings	150x115x8	150x115x8	150x115x8
3(a)- legs	200x200x25	200x200x24	200x200x25
3(b)-horizontals	125x75x6	125x75x6	125x75x6
3(c)-bracings	150x115x8	150x115x8	150x115x8
4(a)- legs	200x200x25	200x200x25	200x200x25
4(b)-horizontals	135x65x8	125x75x6	125x75x6
4(c)-bracings	150x115x8	150x115x8	150x115x8
5(a)- legs	200x200x25	200x200x25	200x200x25
5(b)-horizontals	135x65x8	135x65x8	135x65x8
5(c)-bracings	150x115x8	150x115x8	150x115x8
6(a)- legs	200x200x25	200x200x25	200x200x25
6(b)-horizontals	135x65x8	135x65x8	135x65x8
6(c)-bracings	200x150x10	200x150x10	200x150x10
7(a)- legs	200x200x25	200x200x25	200x200x25
7(b)-horizontals	135x65x8	135x65x8	135x65x8
7(c)-bracings	200x150x10	200x150x10	200x150x10
8(a)- legs	200x20x25	200x200x25	200x200x25
8(b)-horizontals	200x100x10	150x75x9	150x75x9
8(c)-bracings	200x150x12	200x150x10	200x150x10
9(a)- legs	200x200x25	200x200x25	200x200x25
9(b)-horizontals	200x100x12	200x100x10	200x100x10
9(c)-bracings	200x200x25	200x200x25	200x200x25
10(a)- legs	200x200x25	200x200x25	200x200x25
10(b)-horizontals	200x200x25	200x200x25	200x200x25
10(c)-bracings	200x200x25	200x200x25	200x200x25

Table 3(c): Sectional properties of self-supporting angle sectioned tower of height 40m

Member notation	Member Description (IS pipe Sections) for basic wind speed of		
	33 m/sec.	47 m/sec.	55 m/sec.
1(a)- legs	1270L	1270M	1270M
1(b)-horizontals	1016H	1016H	1016H
1(c)-bracings	1270L	1270L	1270L
2(a)- legs	1651H	1937L	1937M
2(b)-horizontals	1397M	1397M	1683L
2(c)-bracings	1397L	1397L	1524L
3(a)- legs	2191L	2445H	2445H
3(b)-horizontals	1651H	1937L	1937L
3(c)-bracings	1651L	1651L	1683M
4(a)- legs	2445H	3239H	3239H
4(b)-horizontals	1937L	2191L	2191M
4(c)-bracings	1651H	1937L	1937L
5(a)- legs	3239H	3556H	3556H
5(b)-horizontals	2191M	2445H	2730H
5(c)-bracings	1651L	1937L	2191L
6(a)- legs	3556H	3556H	3556H
6(b)-horizontals	2191H	2730H	3239H
6(c)-bracings	1937M	2191H	2445H
7(a)- legs	3556H	3556H	3556H
7(b)-horizontals	2445H	3239H	3239H
7(c)-bracings	2191M	2730H	2730H
8(a)- legs	3556H	3556H	3556H
8(b)-horizontals	2730H	3239H	3239H
8(c)-bracings	2445H	3239H	3239H
9(a)- legs	3556H	3556H	3556H
9(b)-horizontals	3239H	3556H	3556H
9(c)-bracings	3239H	3239H	3239H
10(a)- legs	3556H	3556H	3556H
10(b)-horizontals	3556H	3556H	3556H
10(c)-bracings	3556H	3556H	3556H

Table 3(d): Sectional properties of self-supporting pipe sectioned tower of height 40m

Member notation	Member Description (IS Angle Sections) for basic wind speed of		
	33 m/sec.	47 m/sec.	55 m/sec.
1(a)- legs	150x115x8	150x115x8	150x115x8
1(b)-horizontals	100x65x6	100x65x6	100x65x6
1(c)-bracings	150x115x8	150x115x8	150x115x8
2(a)- legs	200x150x12	200x150x12	200x150x12
2(b)-horizontals	100x65x6	100x65x6	100x65x6
2(c)-bracings	150x115x8	150x115x8	150x110x8
3(a)- legs	200x200x24	200x200x24	200x200x25
3(b)-horizontals	125x75x6	125x75x6	125x75x6
3(c)-bracings	150x115x8	150x115x8	150x115x8
4(a)- legs	200x200x25	200x200x25	200x200x25
4(b)-horizontals	135x65x8	135x65x8	125x75x6
4(c)-bracings	20x100x10	200x100x10	150x115x8
5(a)- legs	200x200x25	200x200x25	200x200x25
5(b)-horizontals	135x65x8	135x65x8	135x65x8
5(c)-bracings	150x115x8	150x115x8	150x115x8
6(a)- legs	200x200x25	200x200x25	200x200x25
6(b)-horizontals	135x65x8	135x65x8	150x75x8
6(c)-bracings	200x150x10	135x65x8	200x150x10
7(a)- legs	200x200x25	200x200x25	200x200x25
7(b)-horizontals	200x100x10	150x75x9	135x65x8
7(c)-bracings	200x150x10	200x150x10	200x150x10
8(a)- legs	200x200x25	200x200x25	200x200x25
8(b)-horizontals	200x100x10	200x100x10	150x75x9
8(c)-bracings	200x150x12	200x150x12	150x75x9
9(a)- legs	200x200x25	200x200x25	200x200x25
9(b)-horizontals	200x100x12	200x100x10	200x10x10
9(c)-bracings	200x200x25	200x200x25	200x200x25
10(a)- legs	200x200x25	200x200x25	200x200x25
10(b)-horizontals	200x200x25	200x100x12	200x10x12
10(c)-bracings	200x200x25	200x200x25	200x200x25
11(a)- legs	200x200x25	200x200x25	200x200x25
11(b)-horizontals	200x200x25	200x200x25	200x200x25
11(c)-bracings	200x200x25	200x200x25	200x200x25
12(a)- legs	200x200x25	200x200x25	200x200x25
12(b)-horizontals	200x200x25	200x200x25	200x200x25
12(c)-bracings	200x200x25	200x200x25	200x200x25

Table 3(e): Sectional properties of self-supporting angle sectioned tower of height 50m

Member notation	Member Description (IS pipe Sections) for basic wind speed of		
	33 m/sec.	47 m/sec.	55 m/sec.
1(a)- legs	1270L	1270L	1270L
1(b)-horizontals	1270L	1270L	1270L
1(c)-bracings	1270M	1397L	1397L
2(a)- legs	1683L	1651M	1651M
2(b)-horizontals	1651L	1651M	1683M
2(c)-bracings	1651L	1524L	1524M
3(a)- legs	2191L	2191M	2191H
3(b)-horizontals	1937M	1937L	2191L
3(c)-bracings	1651H	1683M	1937L
4(a)- legs	2445H	2730H	3239H
4(b)-horizontals	2191L	2191H	2445H
4(c)-bracings	1937L	1937M	2191M
5(a)- legs	3239H	3556H	3556H
5(b)-horizontals	2191H	2445H	2730H
5(c)-bracings	1683M	1937L	2445H
6(a)- legs	3556H	3556H	3556H
6(b)-horizontals	2445H	3239H	3239H
6(c)-bracings	2191L	2445H	2445H
7(a)- legs	3556H	3556H	3556H
7(b)-horizontals	2445H	3239H	3556H
7(c)-bracings	2191H	2730H	3239H
8(a)- legs	3556H	3556H	3556H
8(b)-horizontals	3239H	3239H	3239H
8(c)-bracings	2445H	3239H	3239H
9(a)- legs	3556H	3556H	3556H
9(b)-horizontals	3239H	3556H	3556H
9(c)-bracings	3239H	3239H	3239H
10(a)- legs	3556H	3556H	3556H
10(b)-horizontals	3556H	3556H	3556H
10(c)-bracings	3239H	3556H	3556H
11(a)- legs	3556H	3556H	3556H
11(b)-horizontals	3556H	3556H	3556H
11(c)-bracings	3239H	3556H	3556H
12(a)- legs	3556H	3556H	3556H
12(b)-horizontals	3556H	3556H	3556H
12(c)-bracings	3556H	3556H	3556H

Table 3(f): Sectional properties of self-supporting pipe sectioned tower of height 50m

IV. RESULTS AND DISCUSSIONS

4.1 Results of self-supporting angle section and self - supporting pipe section towers of 30m Height

A comparison of lateral displacements and quantity of steel between self -supporting angle section and self - supporting pipe section Towers was performed and the results are presented in Fig. 1 to Fig. 19.

4.1.1 Lateral displacement and quantity of steel of 30m self-supporting angle section and 30 m self -supporting pipe section tower for 33m/sec basic wind speed

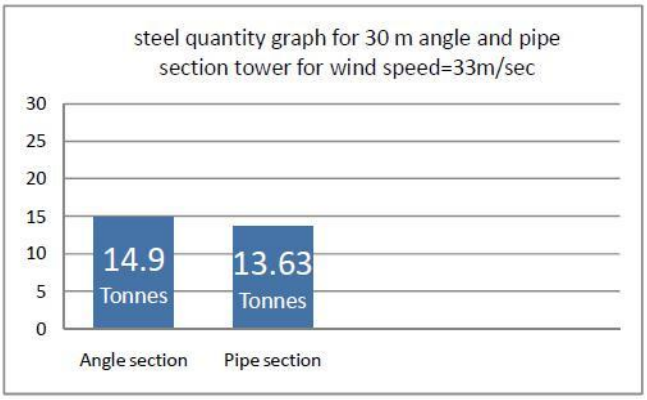

Figure 1.steel quantity for angle section and pipe section self -supporting towers

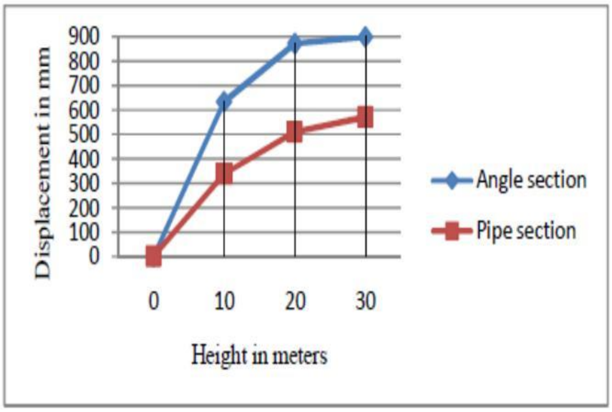

Figure 2.Lateral displacement Vs height graph for 3o m height angle and pipe Sectioned towers with wind speed = 33m/sec

From above figs 1,2 it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 30 m height with wind speed 33m/sec.

4.1.2 Lateral displacement and quantity of steel of 30m self - supporting angle section and 30 m self -supporting pipe section tower for 47m/sec basic wind speed

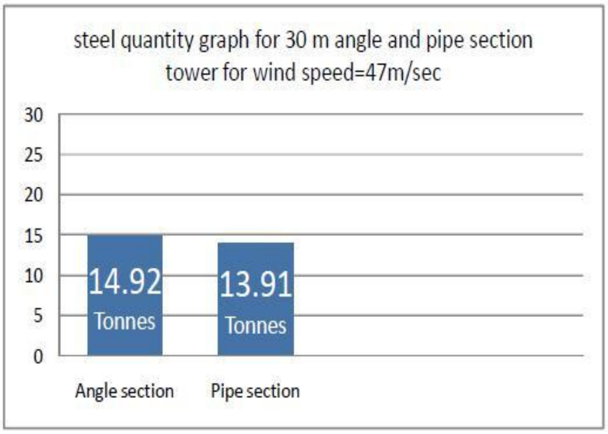

Figure 3.steel quantity for angle section and pipe section self -supporting towers

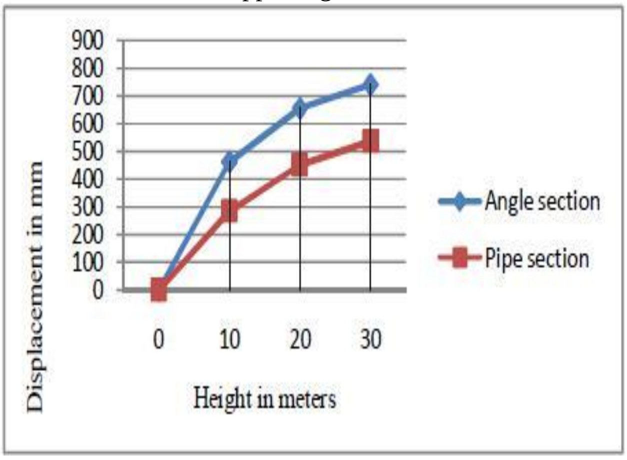

Figure 4.Lateral displacement Vs height graph for 30 m height angle and pipe Sectioned towers with wind speed = 47m/sec

From above figs.3,4it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 30 m height with wind speed 47sm/sec.

4.1.3 Lateral displacement and quantity of steel of 30m self - supporting angle section and 30 m self - supporting pipe section tower for 55m/sec basic wind speed

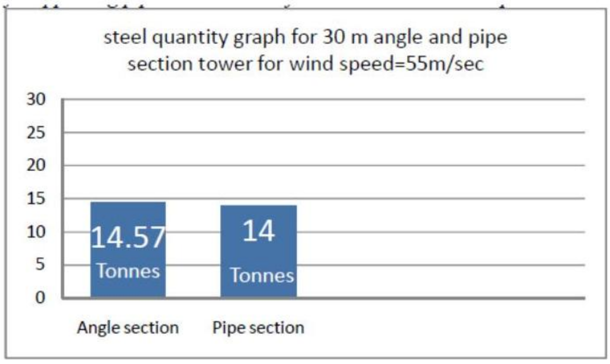

Figure 5.steel quantity for angle section and pipe section self supporting towers

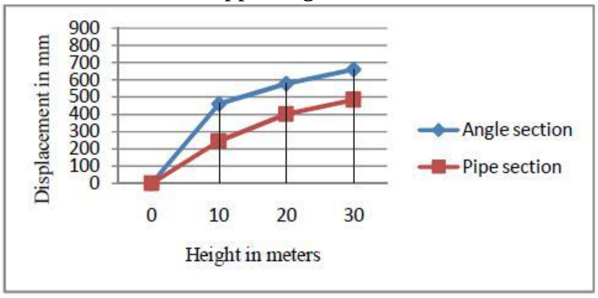

Figure 6. Lateral displacement Vs height graph for 30 m height angle and pipe Sectioned towers with wind speed = 55m/sec

From above figs.5,6 it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 30 m height with wind speed 55m/sec.

4.1.4 Lateral displacement and quantity of steel of 40m self - supporting angle section and40 m self -supporting pipe section tower for 33m/sec basic wind speed

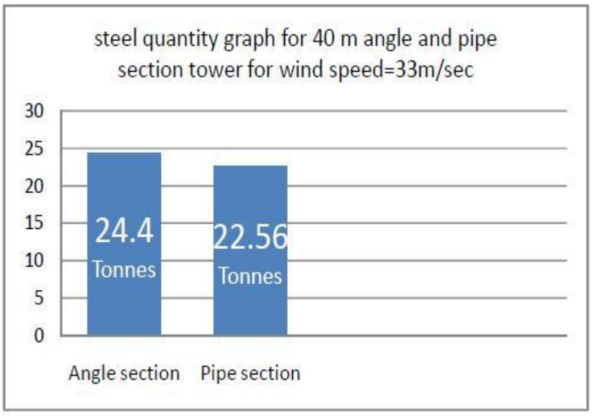

Figure 7.steel quantity for angle section and pipe section self -supporting towers

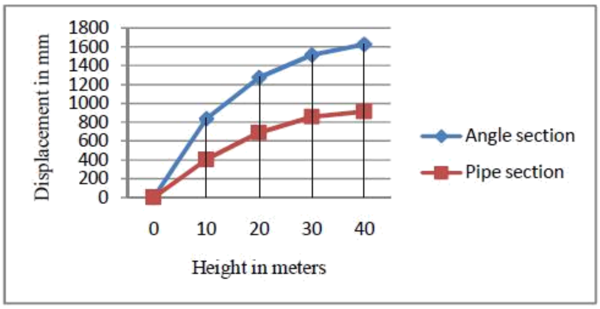

Figure 8.Lateral displacement Vs height graph for 40 m height angle and pipe Sectioned towers with wind speed = 33m/sec

From above figs.7,8.it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 40 m height with wind speed 33m/sec.

4.1.5 Lateral displacement and quantity of steel of 40m self -supporting angle section and40 m self -supporting pipe section tower for 47m/sec basic wind speed.

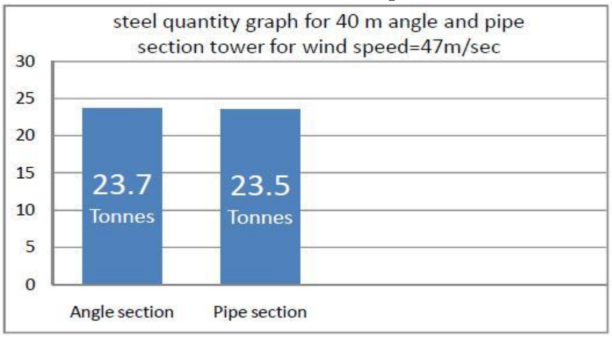

Figure 9.steel quantity for angle section and pipe section self -supporting towers

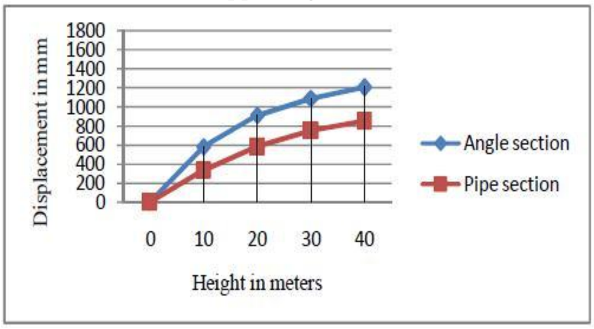

Figure 10.Lateral displacement Vs height graph for 40 m height angle and pipe Sectioned towers with wind speed = 47m/sec

From above figs.9,10.it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 40 m height with wind speed 47m/sec.

4.1.6 Lateral displacement and quantity of steel of 40m self -supporting angle section and40 m self -supporting pipe section tower for 55m/sec basic wind speed

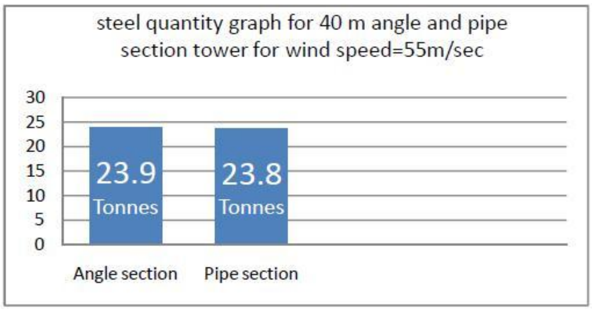

Figure 11.steel quantity for angle section and pipe section self -supporting towers

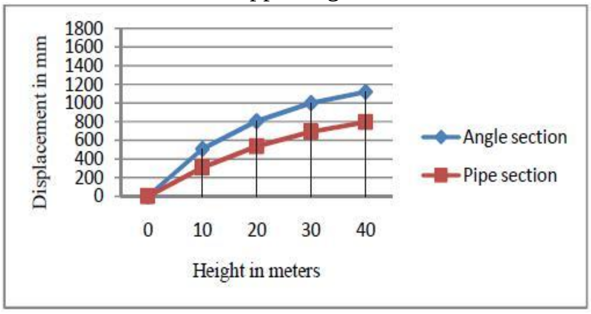

Figure 12.Lateral displacement Vs height graph for 40 m height angle and pipe Sectioned towers with wind speed = 55m/sec

From above figs.11,12..it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 40 m height with wind speed 55m/sec.

4.1.7 Lateral displacement and quantity of steel of 50m self -supporting angle section and50 m self -supporting pipe section tower for 33m/sec basic wind speed

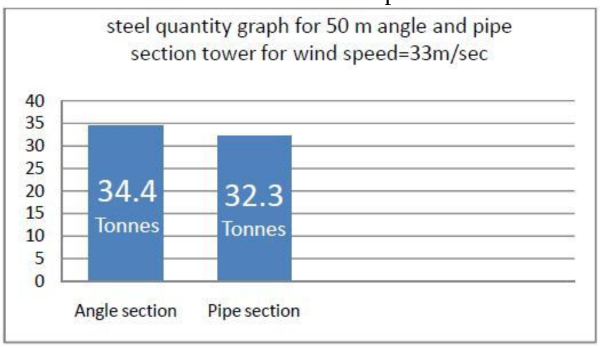

Figure 13.steel quantity for angle section and pipe section self -supporting towers

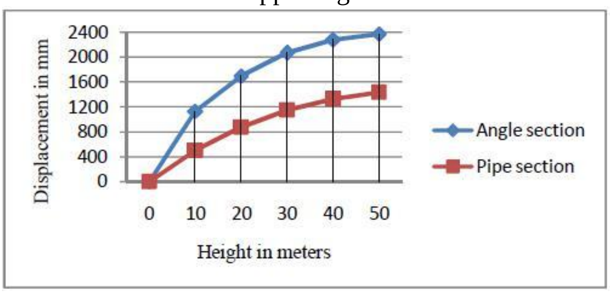

Figure 14.Lateral displacement Vs height graph for 50 m height angle and pipe Sectioned towers with wind speed = 33m/sec

From above figs.13,14..it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 50 m height with wind speed 33m/sec.

4.1.8Lateral displacement and quantity of steel of 50m self -supporting angle section and 50 m self -supporting pipe section tower for 47m/sec basic wind speed

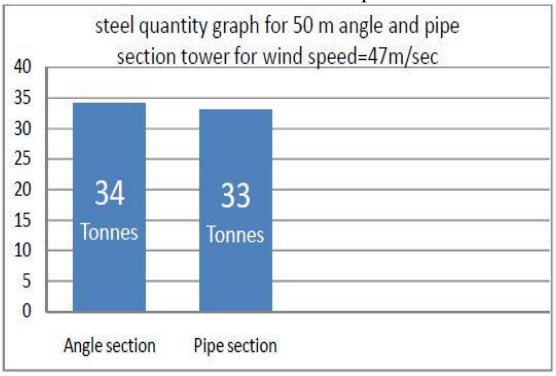

Figure 15.steel quantity for angle section and pipe section self -supporting towers

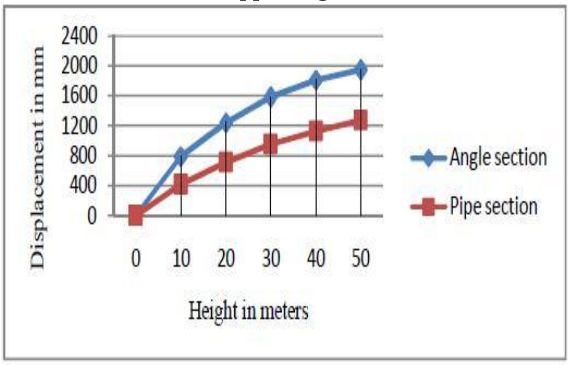

Figure 16.Lateral displacement Vs height graph for 50 m height angle and pipe Sectioned towers with wind speed = 47m/sec

From above figs.15,16..it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 50 m height with wind speed 47m/sec.

4.1.9 Lateral displacement and quantity of steel of 50m self -supporting angle section and 50 m self -supporting pipe section tower for 55m/sec basic wind speed

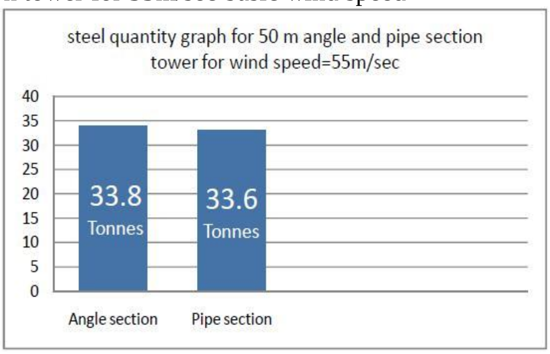

Figure 17.steel quantity for angle section and pipe section self -supporting towers

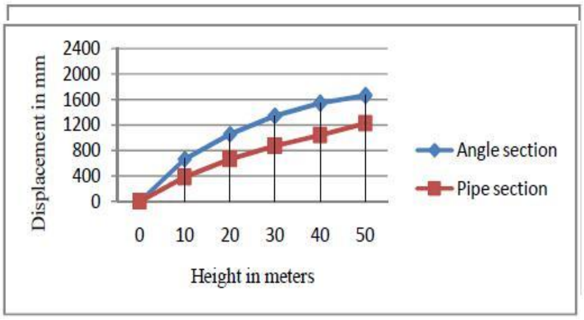

Figure 18.Lateral displacement Vs height graph for 50 m height angle and pipe Sectioned towers with wind speed = 47m/sec

From above figs.17,18..it was observed that pipe sectioned tower has low lateral displacement and steel quantity than angle sectioned tower for 50 m height with wind speed 55m/sec.

V. CONCLUSION

From the study it can be concluded that Self-Supporting pipe sectioned Towers have lower lateral displacements and total steel quantity compared to Self-supporting angle sectioned Towers of same height and same amount of loading due to the fact that they have higher stiffness.

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