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ANALYSIS OF MULTI STOREY BUILDING WITH ROOF MOUNTED TELECOMMUNICATION TOWER

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ABSTRACT

In today's world the telecommunication sectors is growing dynamically and the trend of mobile communication is increasing rapidly day by day. A large portion of world's population lives in regions of seismic hazards. Earthquake cause significant loss of life and damage to property every year therefore different techniques are available to resist the seismic effect like use of seismic dampers, bracing systems, shear walls, etc. In this study we mainly focus on shear wall. Generally, for telecommunication purpose, the four-legged lattice tower are widely used. Due to scarcity of land, there is a need of vertical expansion and this results in installation of telecommunication tower at rooftop of tall structures. But the failure of such tall structures mounted with telecommunication tower at roof top may occur. During the earthquake causes failure of such structures is major concern therefore, by introducing the shear wall and study the effect of different position of shear wall for building. The present study investigates severity of earthquake for Mumbai region. In this study, we have considered G+10 building with roof top telecommunication tower and different positions of shear wall. we have compared various parameters such as storey displacement, storey drift, twisting moment & base shear. Design load that are given in software were compared along with manual calculation using IS: 1893:2002. We used ETABS Software for analysis. In different cases we compare which is most effective position of shear wall, using Response Spectrum Method.

Keywords: Shear Wall, CR, CM, E-Tabs, Tower.

I. INTRODUCTION

A large portion of India is susceptible to damaging levels of earthquake hazards. Steel communication tower installed on building roofs has started in decades time and installation has increased on roof top will completely different from steel tower installed on the ground, especially for seismic load. Hence the responses of this type of structures under earthquake are very important. In case of low-rise building, effect of earthquake is not so important during designing. But as height of the building goes on increasing, the effect of both earthquake & wind load increases. Therefore, it is essential to consider effects of lateral loads induced from earthquake. If the magnitude the earthquake is large the structure should design to resist high seismic magnitude using different seismic resisting techniques. Now-a-days multistoried buildings are rapidly constructed everywhere in the world .. Shear walls are most common structural system which provides lateral stiffness and stability against the lateral loads. In frame structure, the shear walls behavior is similar to the column which is subjected to combined flexure and axial load. Shear walls require proper designing and detailing in high seismic regions. Therefore, it is necessary to determine the efficient, effective and ideal location of shear wall. This paper represents the analysis of effect of shear wall position When telecommunication tower at its critical position.

II. METHODOLOGY

1) To study the previous case studies
2) Identification of need of research.
3) To visit the building with roof mounted telecommunication tower.
4) To compare the results of manual analysis & software analysis for G+2 Building (Static analysis) Data collection.
5) To modelling of G+10 Building with telecommunication tower on E-tabs Software. And analyze the different position of tower. (Without shear wall)

6) To identify Ideal position &critical position from the results.
7) To introduce the shear wall to critical position of tower and analyze it.
8) To analyze and compare the result
9) Analytical work is to be carried out.
10) Interpretation of results & conclusion.

III. RELEVENCE OF WORK

As structure with telecommunication tower on roof, which not gives better resistance to the seismic & wind loads. By introducing the shear wall to the building, the stresses developed due to telecommunication tower can be reduced. Which gives better results towards stability & resistance, to torsion, seismic & wind loads as compared to structure without shear wall.

A] First of all to check the followed procedure while using e-tabs is right or wrong, For our understanding/conformation we compare the results of static analysis for G+2 Building by manually and using E-tabs software. The plan is as shown in fig.

Table 1

Size of column	**= 300 × 600 mm**
Size of beam	= 230 × 450 mm
Depth of slab	= 150 mm
Height of floor	= 3 m
No. of bays in X and Y direction	= 3
Length of X and Y direction bays	= 4 m

Story no.	**Height of floor**	**Lateral force in kN**	
		Manual analysis	Software analysis
Story 3	9	161.501	194.4214
Story 2	6	101.515	89.9431
Story 1	3	25.38	22.4858

The results of above specified building is shown above.

From the above analysis, the values of manual and software are approximately same.

So, the followed procedure is correct. So, we can proceed further, for G+10 building with only software analysis

B] The structural modelling of G+10 building has been designed in E-tabs consist of different (At corner & At center) position of rooftop tower. This commercial building has been modeled in E-tabs software and model descriptions as per its properties, material, its geometry and loading provided are listed in Table 1. Details of loading provided as dead loads and live loads are listed in Table 2. shows the details of loading combinations as per IS 1893 recommendations. Details of rooftop tower placing cases in multistory building are shown in Table 5 and Figure 1 shows the locations of rooftop tower placing. Figure 2 to Figure 6 shows different rooftop telecommunication tower location placing that are taken into account in this research work.

Table 2

No. OF Storeys	G+10
Beam size	300 x 300 mm
Column Size	500 x 500 mm
Slab thickness	125 mm
Floor to floor Height	3.2 m
Region	Mumbai

Zone	III
Type of building	Commercial
Heigt of tower	15 m
Leg	ISA 100x100x10 mm
Bracings	ISA 65 x65 x5 mm
Live load	4 kn/m^2
Floor finish	1 kN/m^2
Wind speed	44 m/s

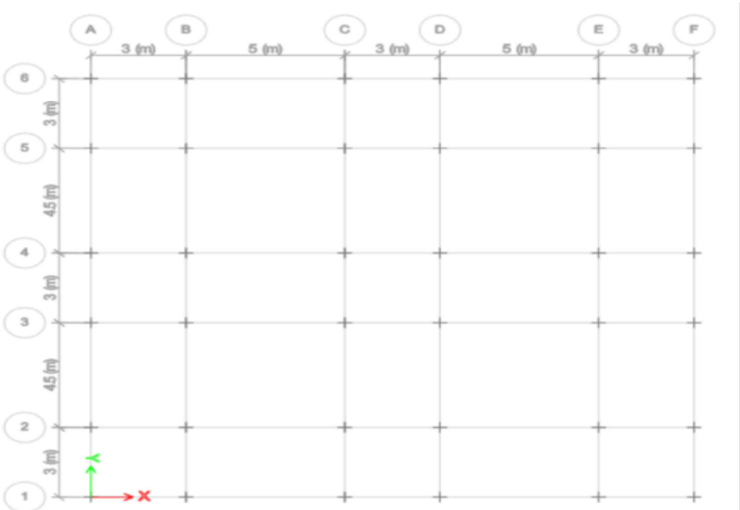


Fig 1

For the dynamic analysis we used Response Spectrum method. As Response spectrum is one of the useful tools of earthquake engineering for analyzing the performance of structures especially in earthquakes, since many systems behave as single degree of freedom systems. Thus, if you can find out the natural frequency of the structure, then the peak response of the building can be estimated by reading the value from the ground response spectrum for the appropriate frequency. In most building codes in seismic regions, this value forms the basis for calculating the forces that a structure must be designed to resist (seismic analysis).

IV. MODELING AND ANALYSIS

As most of the telecommunication are mounted in the center of the building, which results in more stability towards earthquake due to uniform distribution of loads, But in case of some restrictions like Owners Policy, Water Tank Position, Availability of carpet area, location of stair case, lift, etc. We cannot mount tower at the center position. So, by changing the position of tower from center to one of the corners of building, as the corner can be anyone. We analyzed different cases of telecommunication tower as shown in the fig. And according to it we have select most ideal position of tower and worst case of telecommunication, and further analysis is carried out.

Therefore,

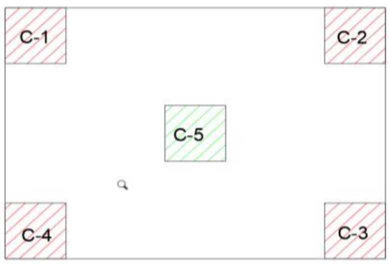


Fig 2

Table 3

CASES	STOREY DISPLACEMENT
CASE-1	59.52
CASE-2	58.578
CASE-3	58.578
CASE-4	58.541

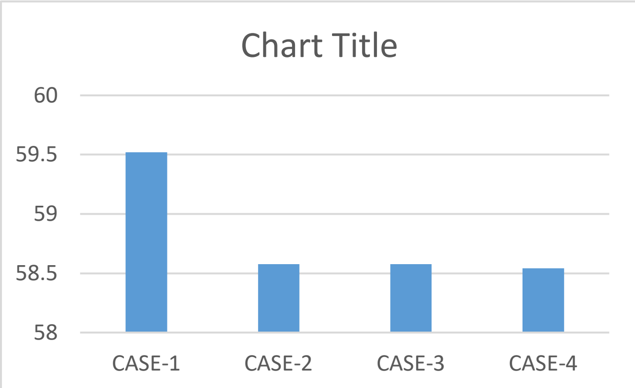
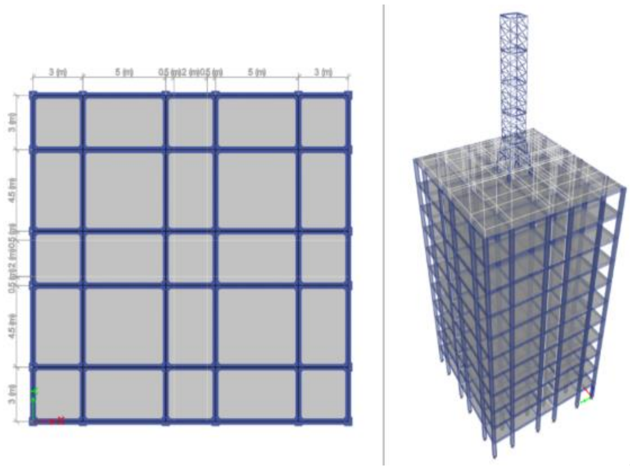


Fig 3



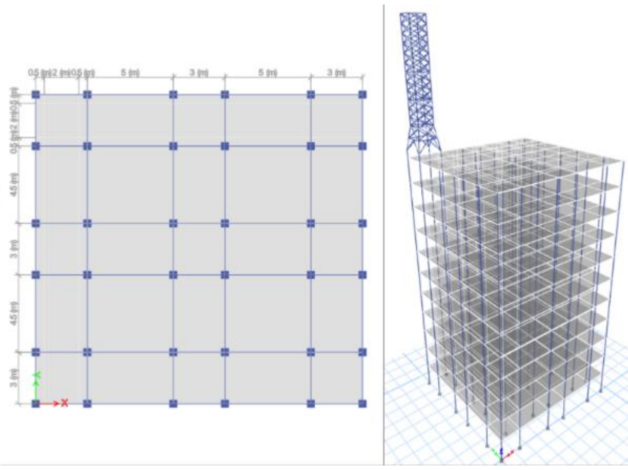


Fig 4: shows the G+10 storey building with telecommunication tower at center.

Fig 5: shows the G+10 storey building with telecommunication tower at one of the corners

V. RESULTS AND DISCUSSION

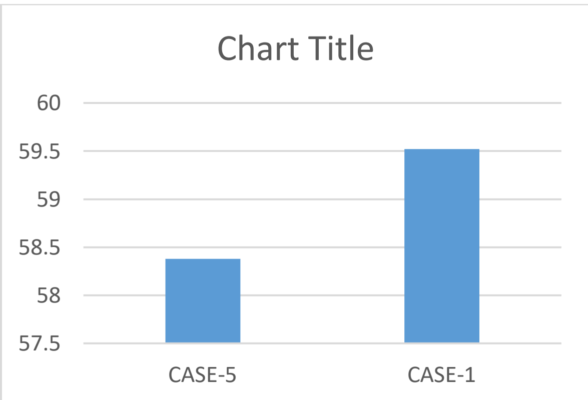


Figure 6

Table 4

CASES	STOREY DISPLACEMENT
CASE-5	58.38
CASE-1	59.52

CASES	TWISTING MOMENT
CASE-5	771039.443
CASE-1	785076.223

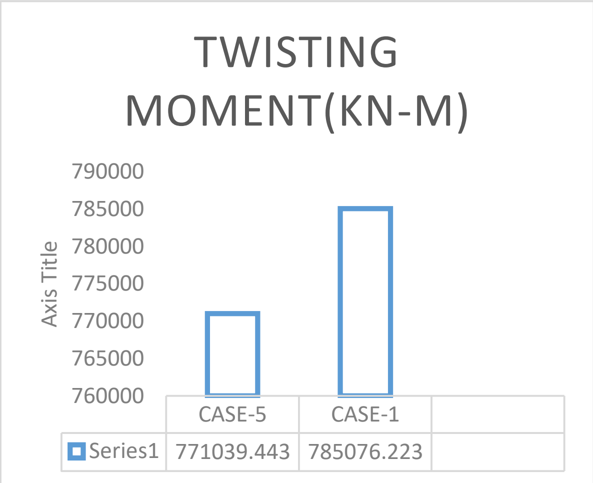


Fig 7

VI. CONCLUSION

On the basis of this study, we conclude that case-5 in which telecommunication tower is located at center of building is a ideal position And Case-1 in which telecommunication tower is located at corner position is worst toward seismic effect. Therefore need to provide shear wall to minimize the worst conditions of seismic effect.

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