Comparative Structural Analysis of G+4 Building with and without Rooftop Telecommunication Tower

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Abstract

Due to the high increase in the telecommunication business, number of buildings carrying a roof top tower has been increased rapidly. To overcome the need of connecting peoples, mobile phone creates a vital role among us. For this, the network service provider expands their business by extending the coverage of their network. In urban areas, the scarcity of land is the major issue now days and companies are approaching to the rooftop telecommunication, since it resolves the land use and to extend the coverage by approaching the height. Most of the building were not originally designed to carry a roof top tower, but later converted to carry roof top towers due to the changed requirements. A typical residential building is considering for the analysis and design. This building is analysed by applying different types of loads and story displacement In this work, to overcome this issue that creates a negative effect over the parts of the building after installation, by the help of Staad pro software, a plan is selected and designed not according to tower need and then the tower is applied over the roof in different positions to analyze the parametric values and selecting a position that creates least negative effects.

Keywords: *Telecommunication Tower, story displacement*

Introduction

The Indian telecom service business is the fastest growing one in the world, with over seven million mobile subscribers being added every month. This expanding base possesses challenges to mobile operators in terms of augmenting and upgrading infrastructure to maintain to quality of services. A rapidly increasing subscriber base and a more stringent spectrum allocating regime may create a higher requirement of tower sites for operators to accommodate more subscribers.

Hence it became a costly and tedious task to identify sufficient land for construction of towers. This led to the extensive use of the rooftop of multi-storeyed buildings for installing communication towers. However many of these buildings were not designed to take care of tower load, particularly under earthquake conditions. Due to land consumption in urban area, the mobile towers are installed over the roof of the multistorey building to expand its range and to overcome the criteria of scarcity of land. The telecommunication tower which is installed on the roof is fixed into the columns or a framed structure over the roof. It is normally square in shape or can be inclined from its base, depending upon the design. It does not require guys to support it, it is now self-supported on its legs, preferably, triangular or square in shape. Due to its size and shape, it is heavy and can create a major disaster during an earthquake. Since seismic intensity is high in terms of horizontal loads, the multistorey building requires a position on which its negative effects are lesser. Since multistorey building is a host structure, its parts are not designed to overcome this problem, since it is not predefined that the tower will come over it in future. The other thing is the worst condition should not extend to other neighbouring structures.

Analysis of structure main importance is to obtain the plan of the particular building. Load combinations as per the Indian codal provisions are code 456:2000, IS code 875(PART 1, PART 2, PART 3). Modeling of the structure by

using the different software's like AUTO CAD and STAAD Pro. The sections must be checked for all the components with regards to strength and serviceability.

Literature Review

Research studies on "Modeling and Analysis of G+4 Building with and without Telecommunication Tower by using STAAD Pro"

Faria Aseem and Abdul Quadir(Nov 2017) studied the Effect of Rooftop Mounted Telecommunication Tower on Design of the Building Structure. This paper presents the results of design of (G+3) commercial building of plot area 144 sq.m with telecommunication tower mounted on its rooftop. Tower is of height 12m and the loads which are considered are dead load, live load and wind load. The concrete design was carried out by IS 456-2000, SP-16 & the steel design was carried out by IS 800-2007 by using STAAD PRO software.

- **Suyash Malviya and Sagar Jamle(April 2019)** studied Response of Multistorey Building with Rooftop Telecommunication Tower in Different Positions: An Approach to Efficient Case. In this work, to overcome issue that creates a negative effect over the parts of the building after installation, by the help of Staad pro software, a plan is selected and designed not according to tower need and then the tower is applied over the roof in different positions to analyze the parametric values and select a position that creates least negative effects under seismic zone IV. They concluded from study that the location of the telecommunication tower will affect the entire host structure under the influence of seismic forces. The location of the tower will affect the different parameters of the building components and as per result.
- **Vaibhav Italy and Rahul Sharma (October 2021)** studied Telecommunication Tower on Residential Apartment at Jabalpur City with Building Improvement Analysis. Based on the study there is many type of outcome and theories are carried out which is very important for further research work. some major points are given below Analysis the behavior of Telecommunication Tower on Residential Apartment. The maximum research is based on the optimum height, shear wall location and height, variations in outrigger depth etc. The belt truss &outrigger system most accepted method for withstanding under lateral loads. Study the behavior of Telecommunication Tower on Residential Apartment with outrigger system under seismic loading.

1. PLAN AND SPECIFICATIONS

A. Building Specifications

SI.No	Decription	Building data
1	Type of building	Resedential Building
2	Height of Building	14.4m
3	Number of Stories	4m
4	Height of each story	3m
5	Materials	M_{25} for columns and beams Fe- 415 for Steel
6	Column Size	0.3mx0.23m
7	Beam Size	0.3mx0.23m
8	Depth of Slab	0.125m

Tower Specifications

SI.NO	Decription	Tower data
1	Tower Height	26.5m
2	Tower Area	4.32mx4.29

Objectives:

- To study and design various elements of a building.
- To plan various components of a building (g+4) with column positioning.
- Detailing of beams, columns, slab with section proportioning.
- Modelling of the building in STAAD pro by giving all boundary conditions.
- To study storey drift and storey displacement of the structure.
- Analyse the wind load behaviour of building with and without tower.

Methodology

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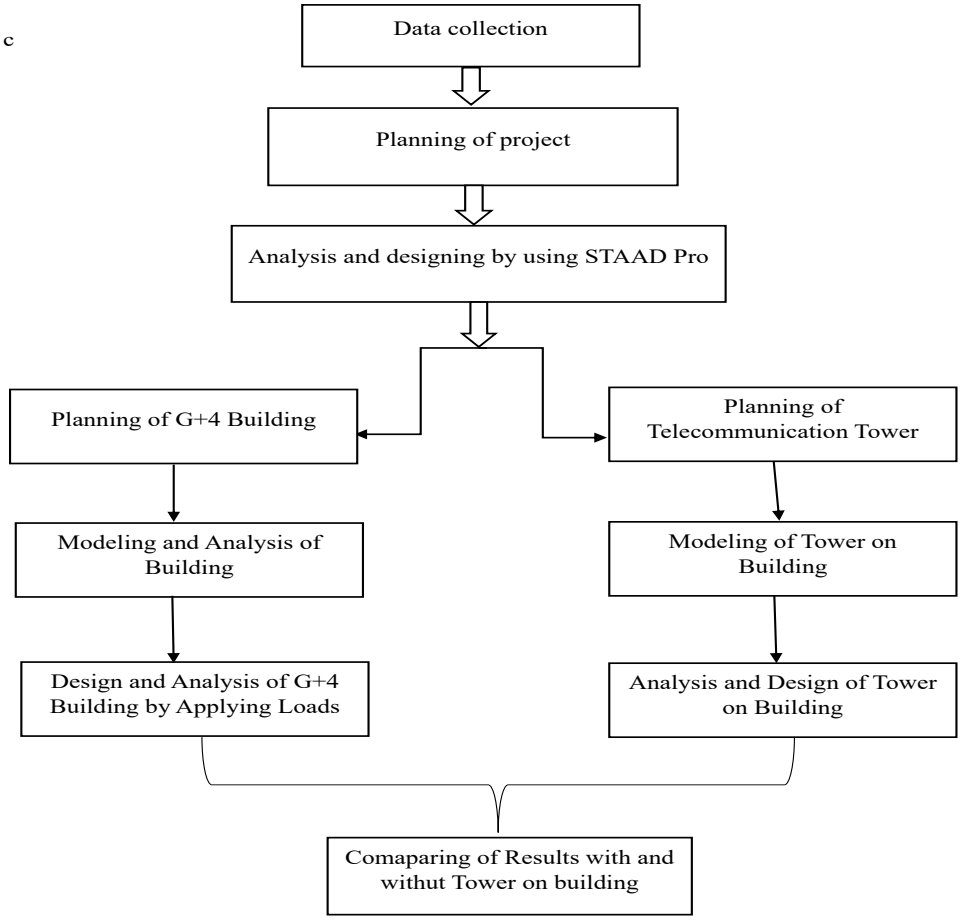
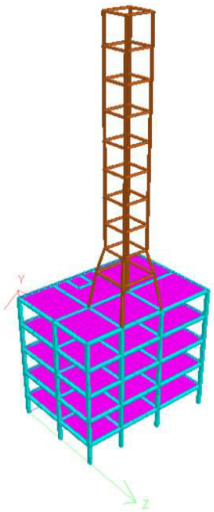


3D Rendering of Telecommunication Tower



Results And Discussions

Results of Both Structures

The following values are aquire from both structures of G+4 Building with and without telecommunication tower of beams and columns.

1. **Shear forces**
2. **Bending moment**
3. **Deflections**
4. **Design results**

Shear force values for beams

Loading type and beam number		With Tower				`Without Tower			
		Ydirection		Zdirection		Ydirection		Z direction	
		Fy	Mz	Fz	My	Fy	Mz	Fz	My
21	SW	3.16	0.42	-0.1	0.1	4.0	2.21	0.30	-0.55

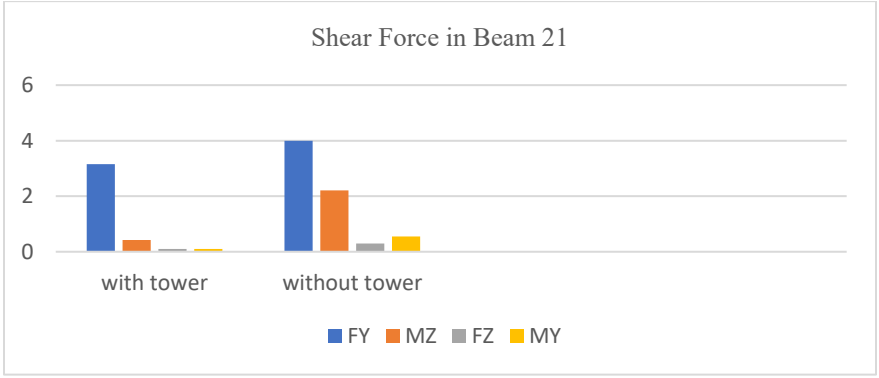


Fig: comparison of shear in beam 21

Shear force values for column

Loading type and beam number		With Tower				`Without Tower			
		Ydirection		Zdirection		Ydirection		Z direction	
		Fy	Mz	Fz	My	Fy	Mz	Fz	My
159	Sw	1.2	1.7	-0.03	0.07	0.2	0.3	-0.007	0.027

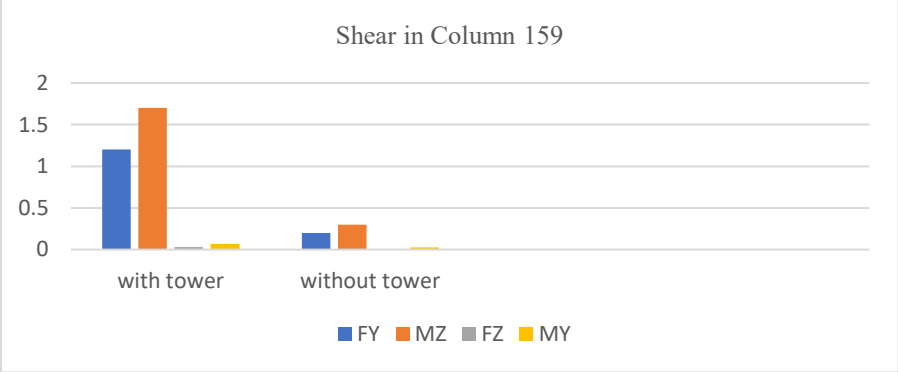


Fig: comparison of shear in column 159

Bending moment values for beams

Loading type and beam number		Without Tower				`With Tower			
		Zdirection		Ydirection		Zdirection		Y direction	
		Fy	Mz	Fz	My	Fy	Mz	Fz	My
21	Sw	3.16	0.42	-0.1	0.1	4.0	2.21	0.30	-0.5

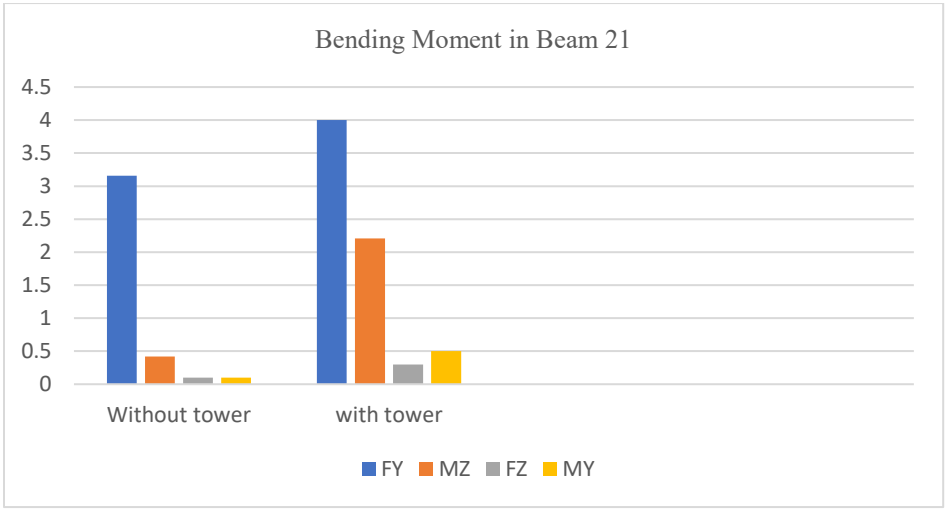


Fig: comparison of bending in beam 21

Bending moment values for column

Loading type and beam number		With Tower				`Without Tower			
		Zdirection		Ydirection		Zdirection		Y direction	
		Fy	Mz	Fz	My	Fy	Mz	Fz	My
159	Sw	1.2	1.7	-0.03	0.07	0.2	0.3	-0.007	0.027

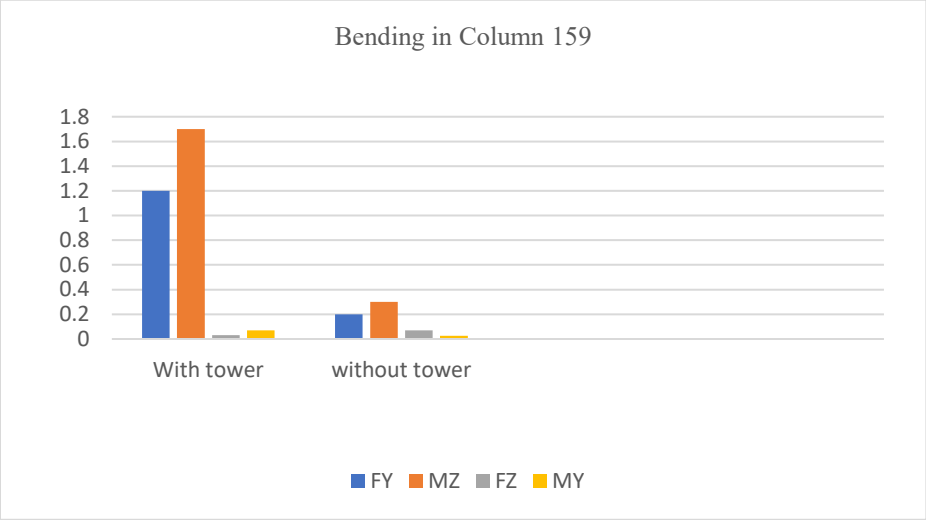


Fig: comparison of bending in column 159

Deflection of beam

Loading Type and Beam Number		With Tower			Without Towre		
		Direction			Direction		
		X	Y	Z	X	Y	Z
21	SW	-0.012	-0.012	-0.012	-1.34	-1.34	-1.34

Deflection of Column

Loading Type and Beam Number		With Tower			Without Tower		
		Direction			Direction		
		X	Y	Z	X	Y	Z
159	Self Weight	0.09	0.09	0.09	-0.28	-0.28	-0.28

Reinforcement required for Beam 21

With tower			Without tower		
Top		Bot-tom	Top		bot-tom
Right	Left		Right	Left	
3#12@ 199 to 2353.3	3#12@ 199 to 3530	3#12 31 to 3530	3#12@ 197.6to 2353	3#12@ 197.6to 3530	3#12@ 31 to 3530

Reinforcement required for column 159

Fy	Fc	Without tower				With tower			
		As	As%	Dia	No.of bars	As	As%	dia	No.of bars
415	250	557	1.15	16	4	883	1.3	12	8

CONCLUSION

It is been observed that the loads on RCC structure are not nominal and cannot be withstand by the existing member and need proper design check of the RCC structural member before installation of telecommunication tower on the existing structure. Considering the importance of the additional external loads due to telecommunication tower on a building structure, it is been concluded that the design of the columns get effected tremendously hence the telecommunication tower should not be installed on the building which are not designed for such loads. Further, rooftop towers cannot be based on analytical results obtained for a similar configuration situated at ground level, since the member forces in the tower mounted on rooftop are more than the member forces of tower installed at ground level. If ever it is been decided to install the telecommunication tower on the existing building, it is essential to check the design of building model with communication tower before installation otherwise structural failure may cause fatality to the victims as the structure is quit heavy and may cause the fatal injury.

REFERENCES

1. **Faria Aseem and Abdul Quadir(Nov 2017)** "studied the Effect of Rooftop Mounted Telecommunication Tower on Design of the Building Structure". International Research Journal of Engineering and Technology (IRJET)
2. **Suyash Malviya and Sagar Jamle(April 2019):** "Response of Multistorey Building with Rooftop Telecommunication Tower in Different Positions: An Approach to Efficient Case". International Research Journal of Engineering and Technology (IRJET).
3. **Vaibhav Italy and Rahul Sharma (october 2021):** "Telecommunication Tower on Residential Apartment at Jabalpur City with Building Improvement Analysis". International Journal of Research Publication and Reviews
4. **D. Akash and L.G. Kalurkar(April 2017):** "Analysis of Telecommunication Tower with Different Bracing System". IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).

5. **Suyash Malviya and Sagar Jamle (Feb 2019):** "Determination of Optimum Location of Rooftop Telecommunication Tower over Multistory Building under Seismic Loading". International Journal of Advanced Engineering Research and Science (IJAERS)
6. **Amiri and Boostan (2000):** "the dynamic response of antenna-supporting structures". 4th Structural Specialty Conference of the Canadian Society for Civil Engineering.
7. **S Kailash Kumar, G Prashanth and G Naveen Kumar (july 2019):** "Behaviour of Self-Supporting Communication Tower Subjected to Wind Load". International Journal of Innovative Technology and Exploring Engineering (IJITEE).
8. **Nitin Bhosale (2012)**:"Influence of Host Structure Characteristics on Response of Rooftop Telecommunication Towers", International Journal of Civil and Structural Engineering.