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Comparative Analysis of RC Building Using Dampers and with Shear Wall under Wind Load

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ABSTRACT

Now a day's many tall structures and high rise towers and Building are being built all around the world. Designer facing two measure problem first is earthquake and second is wind load. It is important to reduce the static wind load effect or lateral load on high rise building. In this research paper presenting the three technology which is use in G+30 high rise building to reduce the static wind load is TMD (tuned mass damper), FD (friction damper) and Shear wall. The 31 story symmetric building modal without any damper with TMD, with Friction damper and with shear wall are analyzed by static wind analysis method. Work is considered to carry out the effectiveness of TMD, Friction damper and Shear wall where dampers are design for same damping value. The result of model frequencies displacement will be compared of four models. It concluded the responses of building is reduce by using of dampers and shear wall.

KEYWORDS: wind analysis, comparative analysis, TMD (tuned mass damper), friction damper, shear wall

I. INTRODUCTION

Buildings are defined as structures utilized by the people as shelter for living, working or storage. As now a days there is shortage of land for building more buildings at a faster growth in both residential and industrial areas the vertical construction is given due importance because of which Tall Buildings are being built on a large scale. Wind in general has two main effects on the Tall buildings

Firstly it exerts forces and moments on the structure, Secondly it distributes the air in and around the building mainly termed as Wind Pressure. Sometimes because of unpredictable nature of wind it takes so devastating form during some Wind Storms that it can upset the internal ventilation system when it Pass into the building. For these reasons the study of air -flow is becoming integral with the planning a building and its environment.

In the last few years, many wind studies have been carried out on a particular shape and particular height of building. The analysis of wind load in tall building has been suggested as below the IS code IS 875 part III has provided certain guideline on the basis of which the building structures can be designed when subjected to wind loads. The literature survey in the performance and behaviour of building structures when subjected to wind loads suggests that the requirement of establishing a methodology for studying the response of building structure to wind loads has become extremely important.

Tuned Mass Damper (TMD), is a devise which combination of a mass string and a damper that attached to structure for reducing the lateral load on structure. They work on the principal that the frequency of damper is tuned to particular structure frequency. Energy is dissipated the damper inertia force acting on the structure. The properties of damper are calculating by the following formula.

$$\text{Mass Ratio } \mu = m/M$$

$$\text{Optimum frequency of damper } f_d = f_n/1+\mu$$

Where m = mass of TMD

M = model mass of structure

μ = mass ratio

f_d = first natural frequency of the damper

f_n = first natural frequency of structure.

And the other optimum parameter used in this work for single TMD as the optimum frequency ratio, damping ratio, spring stiffness and damping are as

$$\alpha_{opt} = 1/1 + \mu \sqrt{(2-\mu)/2}$$

$$\xi_{opt} = \sqrt{[3\mu/8(1+\mu)] \sqrt{(2/2-\mu)}}$$

$$K_d = 4\pi^2 \mu \xi [M/(T+T)]$$

$$C_d = 4\pi^2 \mu \xi (M/T)$$

Where α_{opt} = optimum frequency ratio

ξ_{opt} = damping ratio

K_d = spring stiffness and

C_d = Damping

Friction damper is use to conserve the structure from damage during an wind pressure acting on building. The static response of the structure refers to the manner of response to the lateral loading which depends on its shape, mass structure form, self damping, geometry.

As we can observe the cyclic force deformation behaviour of friction damper is described as.

$$K_{eq} = [+F_c - (-F_c)] / (\delta^+ - \delta^-)$$

$$\epsilon_{eq} = 1/2\pi [\text{area of loop} / F_{max} \delta_{max}]$$

Where K_{eq} = equivalent stiffness

ϵ_{eq} = damping

Shear wall is a structural member in a reinforced concrete framed structure to resist lateral forces such as wind forces. Shear walls are generally used in high-rise buildings subject to lateral wind and seismic forces.

II. MODELING & ANALYSIS

For these study work G+30 story RCC frame building heaving length at ground are 55x55 of symmetrical of 110m typical height. The plan and elevation of model are shown in figure. The analytical model of structure is prepared and analyses are done. The effect of soil interacted on structure has been neglected and the columns are considered fixed at the base. Tuned mass damper is placed on the top story of the building define as damper link member with one end fixed with structure and other end is freely attached by mass of damper. The stiffness and damping proprieties of damper is assigned as per calculation. The friction damper is placed in building as diagonally like bracing. Shear wall are placed on middle columns of the building. All four models are analyzed by using ETABs 2015. The static wind load method are adopted in this study.

Structural modelling

Table 1: structural properties of model

Grade of concrete	M-25
Weight per unit volume	25Kn/m
Modulus of elasticity E (MPa)	25000.0
Poisson ratio U	0.2
Coefficient of thermal expansion α (1 ^o /c)	5.5×10^{-6}
Shear modulus, G (MPa)	11410.89
Grade of steel	Fe-500
Weight per unite volume (KN/M ²)	78.5Kn/m ³
Modulus of elasticity, E (MPa)	2×10^5
Coefficient of thermal expansion	0.0000117
Slab thickness (mm)	150 mm
Size of beams	300x500
Size of column	750x750 mm 600x600 mm 500x500 mm
Floor finishing load (dead load)	1.25Kn/m ²
Live load	2.5Kn/m ²
Wall loading (on each beam)	13.65Kn/m ²

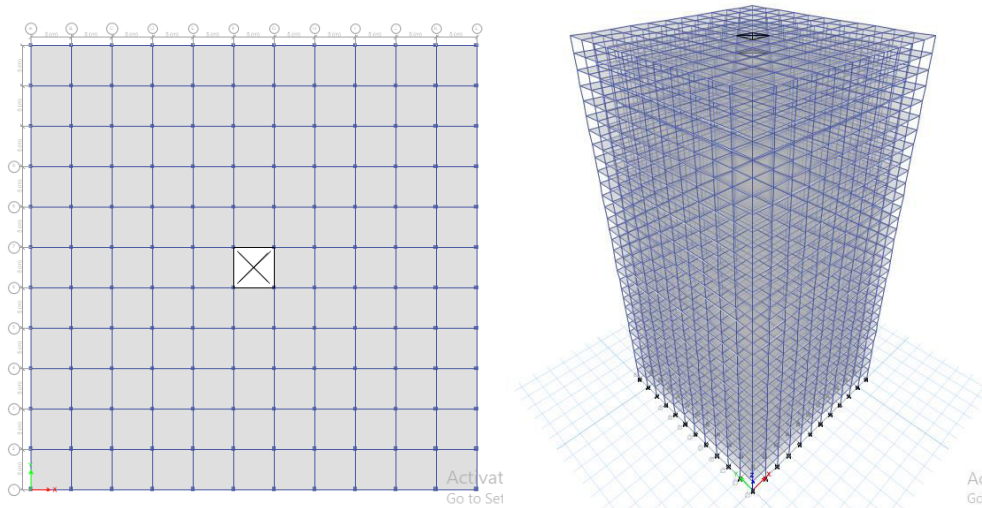


Figure 1: G+30 story building elevation and plan

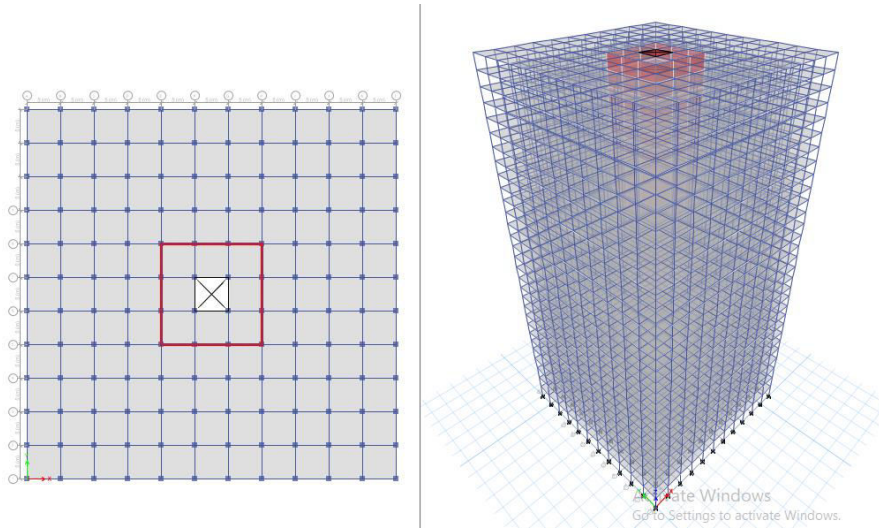


Figure -2 : View and plan of RCC Building with shear wall

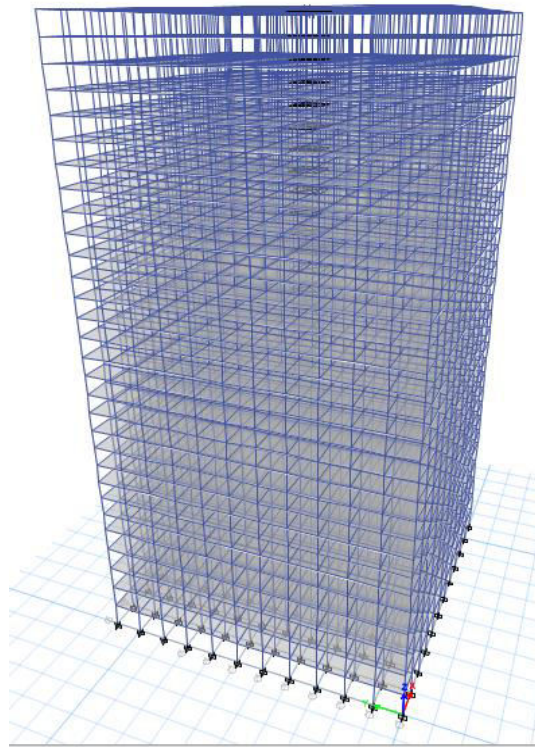


Figure- 3 : View of RCC Building with TMD

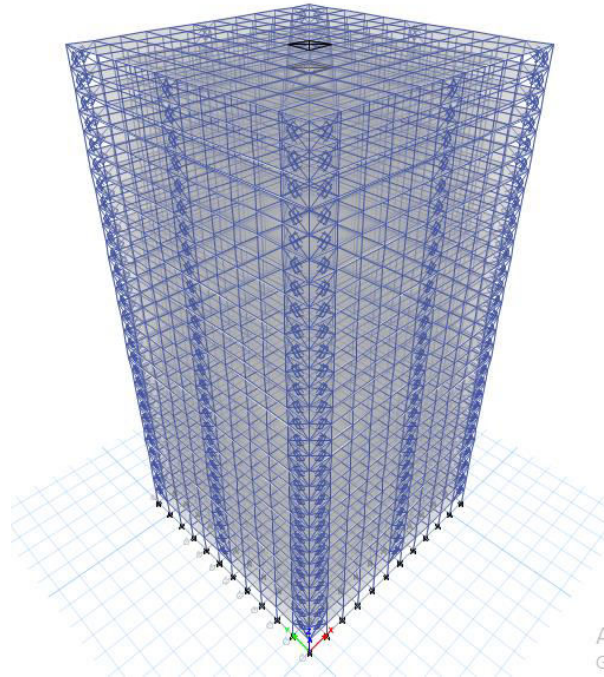


Figure- 4 : View of RCC Building with Friction damper

Damper Properties

The single tuned mass damper which is provide on the top of the building and the friction damper which is applied at the corners and at the canter column of building. This dampers having following properties are.

Table 2 : Properties of tuned mass Dampers (TMD)

Mass of building M	1435000 KN
Natural time period of building T	1.9 sec
Critical damping ratio	0.06
Mass ratio μ	0.04
Mass of damper m	8970 KN
Optimum frequency ratio α_{opt}	1.568
Optimum damping ratio ϵ_{opt}	0.105
Spring stiffness of Damper K_d	87800KN/M
Damping of Damper C_d	6400 KN-M/S ²

Table 2 : Properties of Friction Damper

Slip load	1200KN
Brace section	ISMB200
Stiffness of element	149883.99
Yielding load	1200KN
Post yield stiffness ratio	0.0001
Yielding Exponent	10



III. RESULTS & DISCUSSION

In this research work static analysis of wind is down with using ETABs software according with IS code 875(Part 3). The result of story displacement of four model (basic model, model with shear wall, model with tuned mass damper and model with Friction damper) are compared in modal analysis.

Model analysis results

Comparison of building models with or without shear wall show in figure-5, the story displacement. It is clear the displacement in basic model building is in between 200 and 250 mm and the displacement in model heaving shear wall is in between 50 and 100. Therefore shear wall reduce displacement in building.

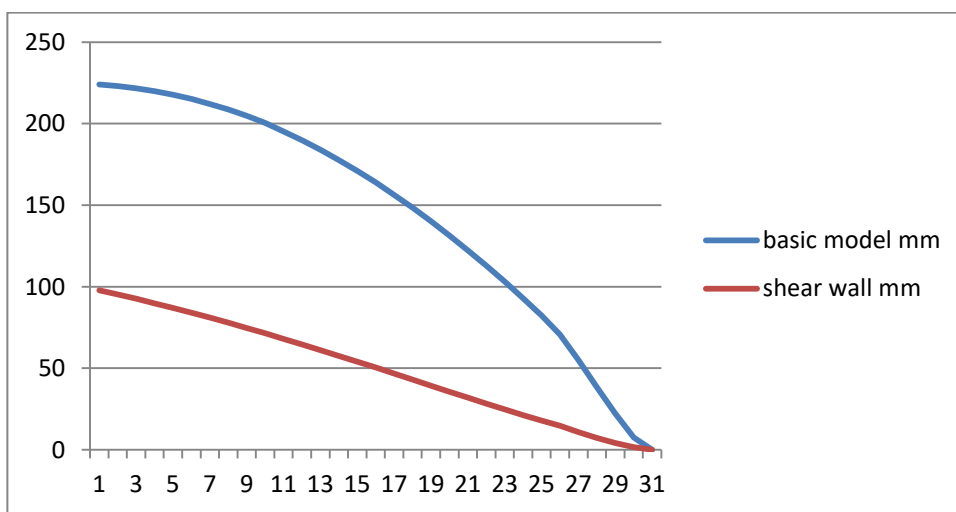


Figure 5: Comparison between basic model and model with shear wall

Comparison of building models with or without TMD (Tuned Mass damper) show in figure-6, the story displacement. It is clear the displacement in basic model building is near 250 mm and the displacement in model heaving TMD is near 200mm. Therefore TMD reduce displacement in building.

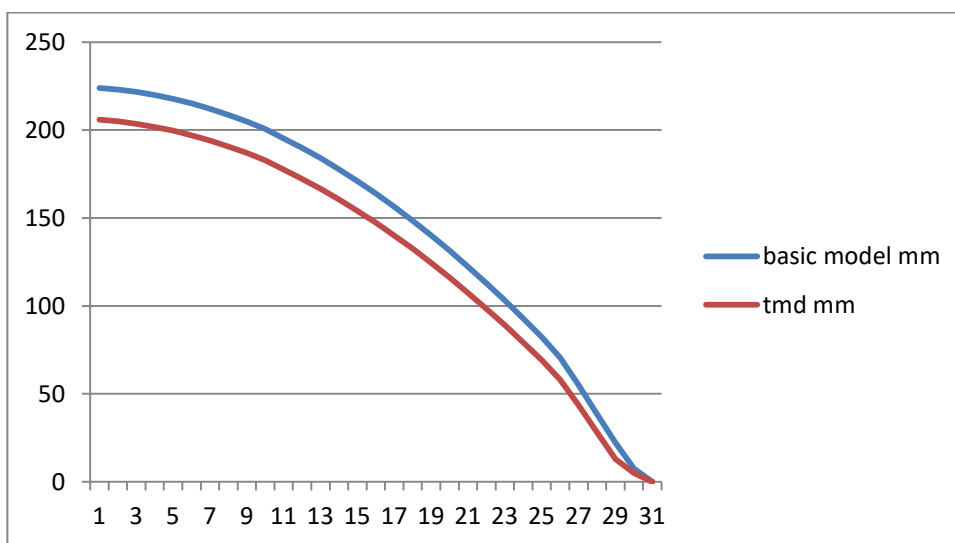


Figure 6: Comparison between basic model and model with TMD



Comparison of building models with or without FD (Friction damper) show in figure-7, of story displacement. It is clear that displacement in basic model building is near 250 mm and the displacement in model heaving friction damper is near 210mm. Therefore FD reduces displacement in building.

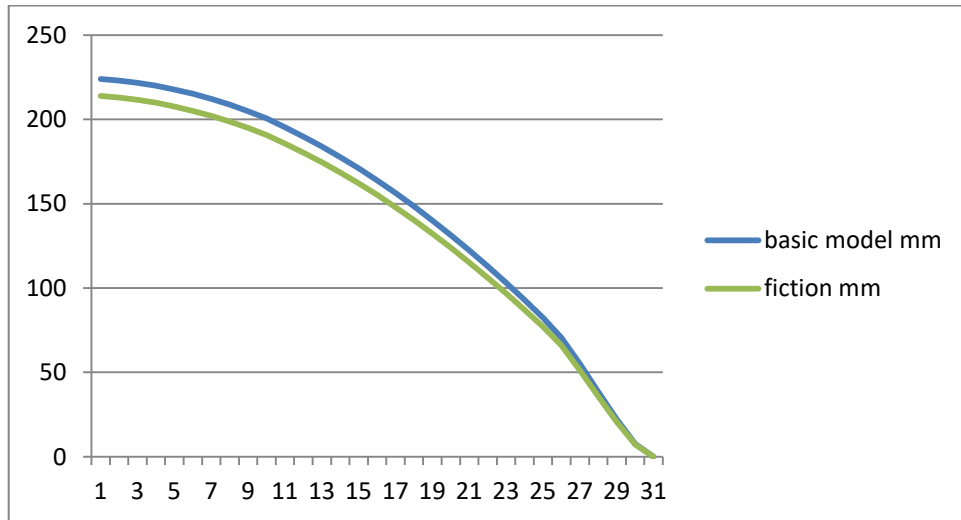


Figure 7: Comparison between basic model and model with friction damper

Comparison of building models with TMD (Tuned Mass damper) or with FD (Friction damper) show in figure-7, the story displacement. It is clear the displacement in FD model building is near 210mm and the displacement in model heaving TMD is near 230mm. Therefore FD reduces displacement in building more then TMD, means FD perform batter then TMD.

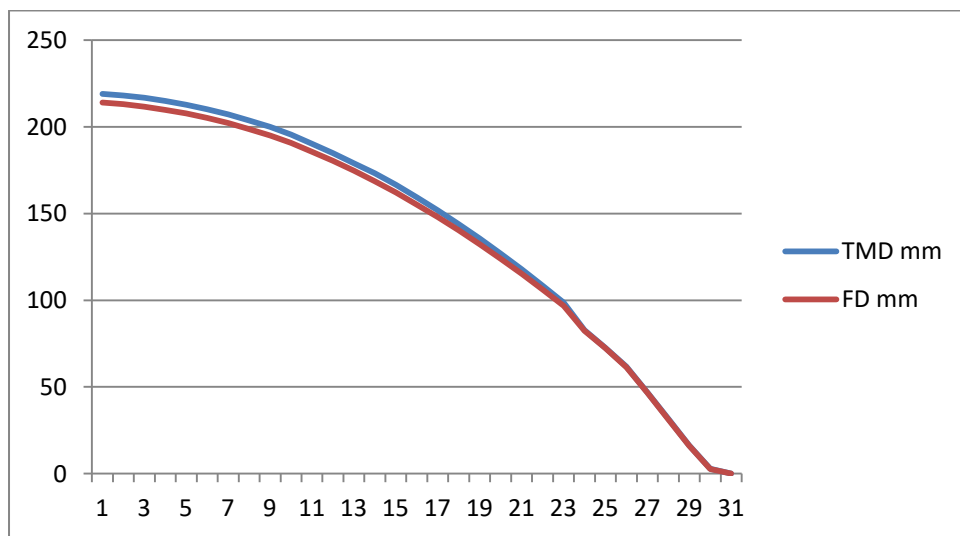


Figure 7: Comparison between model TMD and model with FD model



Overturning moment, it is clear by the figure 8 the overturning moment is minimum in TMD model and maximum in basic model. The difference in the value of moment is shear wall reduce the moment 30% for basic model, the friction damper reduce the moment 50% for basic model and the tuned mass damper reduce the model 65% for basic model, therefore TMD performs better than friction damper and shear wall.

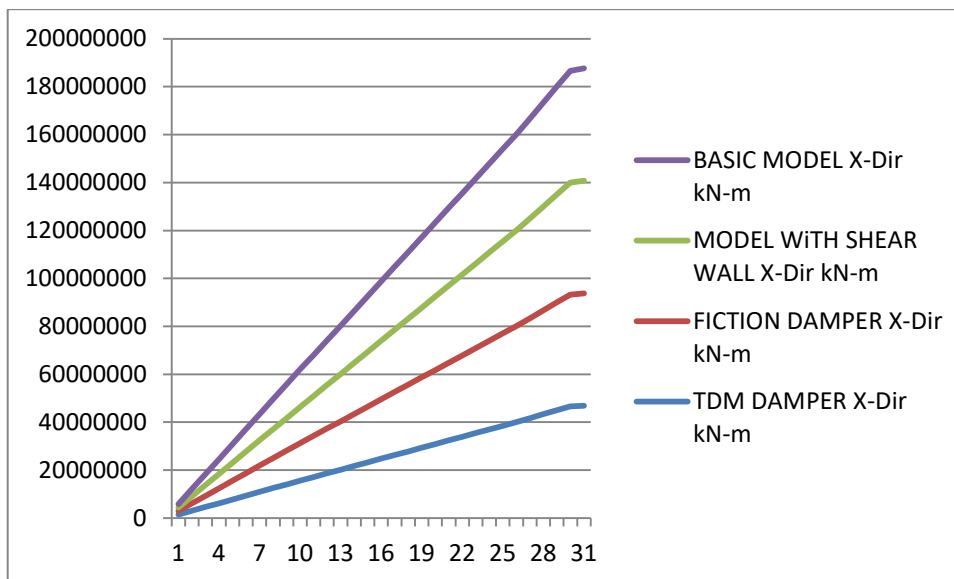


Figure 8: Comparison of overturning moment between models

IV. CONCLUSION

The study explains the behaviour of dampers and shear wall on structural system under the performance of static wind load for which the following conclusion can be drawn based on the result:

- A. The analysis shows that the displacement and overturning moment of the model is decreases by using shear wall dampers.
- B. The value of displacement under static analysis of wind is decrease 15% in TMD model, 25% in FD model and 45% in shear force model approx.
- C. The value of overturning moment under static wind load analysis is decreases by 25% in shear force model, 45% in FD model and 65% in TMD model.
- D. After comparing all model the shear wall give maximum result in story displacement.
- E. In comparison of TMD and FD, the friction damper gives maximum result in story displacement then the tuned mass damper.
- F. In comparison of overturning moment TMD gives the maximum result

REFERENCES

1. “A comparative study of wind standard for tall building” By ‘A.U.Weerasuriyan and M.T.R.Jayasinghe’,1998.
2. “Wind loads for high-rise building constructed in Sri Lanka” By ‘M D Wijeratne and M T R Jayasinghe’ ,1998.
3. “Comparative inter-laboratory study of wind loading on low industrial building”, By ‘Bogusz Bienkiewicz, Munehito Endo, Joseph A. Main, and William P. Fritz,2001.

4. "The Analysis of Large space shear wall structure under Wind Load Force" By 'Li Jian Zhou, Ming Kang Shan, Jin Zhou He, Yuan Gang Fan', 2012,
5. "Global Structure Analysis of Central core Supported Tall Building Compared With Fem", By 'Bianca R. Parv and Monica P. Nicoreac', 2012.
6. "Behaviour of multi-storied building under the effect of wind load" By 'Swati D. Ambadkar, Vipul S. Bawner', 2012.
7. "Comparative analysis of a 15 story flat plate building with and without shear wall and diagonal bracing under wind and seismic load" By 'Rajib Kumar Biswas 1, Md. Meraj Uddin 2, Md. Arman Chowdhury 3, Md. Al-Imran Khan 4', 2013.
8. "Application of Tuned Mass Damper in Structures under Seismic Excitation" By 'R. Vijayasathy 1, V. Finney H.', 2013.
9. "Dynamic Analysis of Multi-storied Regular Building" By 'Mohit Sharma Dr. Savita Maru', 2014.
10. "Critical analysis of frame building structure by wind force" By Sandeep T., Dr. Valsson V., 2014.
11. "Wind response control of 76-stories benchmark building with distributed multiple Tuned Mass Dampers" By 'Said Elias and Vasant Matsagar', 2014.
12. "application of tuned mass damper in structure under wind load" By 'Farhana Naznin 1, Partha Pratim Das 2 and Nayanmoni' 2015.
13. "Seismic & Wind Analysis of Multi-story Building" By 'A. A. Kale, S. A. Rasal' 2015.
14. "response spectrum analysis of building" By Ashwini A. Gadling., 2016.
15. "Comparative study on wind analysis of multi-story RCC and composite structure for different plan configuration" By 'Shaikh Muffassir, L.G. Kulukar' 2016
16. "Parametric study of optimal design parameters of tuned mass dampers for mitigation of seismic response of building" By 'S. Elias, R. Rupakhety, and S. Olafsson', 2016. "Analysis of tall building with shear wall of RCC and steel plate" By 'Ashish Kumar Gupta Dr. Saleem Akhtar, Dr. Aslam Hussain', 2016.
17. "Analysis and design of RCC shear walls with and without openings" By 'Ashwini A. Gadling*, Dr. P. S. Pajgade' 2016.
18. "Wind analysis and design of tall buildings" By 'Tharaka Gunawardena 1*, Shiromal Fernando 2, Priyan Mendis' 2017.
19. "Analysis of a tall structure using STAAD pro providing different wind intensities" By 'Mahesh Ram Patel, R.C. Singh' 2017.
20. "Structure improvement for tall building under wind load, comparative study" By 'Nicola Longarini, 1 Luigi Cabras, 2 Marco Zucca, 1 Suvash Chapain, 3 and Aly Mousaad Aly' 2017.
21. "A review on shear wall in high-rise buildings" By 'Sonali Pandey, Dr. Krishna Murari, Ashish Pathak, Chandan Kumar' 2017.
22. "Wind analysis of multi-story building: A review" By 'Vikrant Trivedi-1, Sumit Pahwa', 2018.
23. "comparative study on wind load analysis using different standards" By 'Md. Ahsan Md. Hameed, Amit Yennawar', 2018.
24. "A review paper on appropriate location of shear in building to reduce reinforcement consumption by STAAD.Pro V8" By 'Madan Singh, Rajiv Banerjee, Dr. Syed Aqeel Ahmad, Anwar Ahmad', 2018.
25. "Analysis of RC building by using friction damper" By 'Reşitpaşa Mahalleşi, Katar Cadedesi, Teknokent', 2018.
26. "Optimum location of shear wall in a building" By 'Mr. Madhu sudhan rao.kondapalli', 2018.
27. "analyzed the effect of across and along wind loads acting on tall building" By 'Aiswaria G.R., Dr. Jisha S.V.', 2018.
28. "Wind Analysis over Multi-storey Building Having Flat Slab-Shear Wall Interaction" By 'Mariyam 1, Sagar Jamle 2' 2019.
29. "Study on Seismic and Gust Wind Effects on G+30 Residential Mivan Structure Using Different Stiffness Modifiers for Structural and Non Structural Walls" By 'Mohd Ismail Zabeeh, S. M. Hashmi', 2020.
30. "Application of Tuned mass damper for structure vibration control: A state of the art review" By 'Fateme Rahimi, Reza Aghayari, Bijan Samali', 2020.
31. "Behaviour of tall building using tuned mass dampers" By 'Ubair Gul Khan Mirza Aamir Baig', 2020.



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