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Reduction of Base Shear Over Actual Soil In Multistorey Building under Earthquake Effects

Kamal Muvel[1], Prof. Prachi Chincholikar[2]
[1]*M. Tech. Scholar,* [2]*Assistant Professor, Department of Civil Engineering, Vikrant Institute of Technology and Management, Indore (M.P.), India*

Abstract: ***Multi-storeyed buildings are tall structures with multiple floors designed for diverse purposes. Base shear represents the total lateral force a building's foundation must withstand during seismic events. Reducing base shear enhances structural safety, design efficiency, and overall building performance. It enables cost-effective designs and fosters sustainability in multi-storeyed constructions. Effective management of base shear is pivotal for ensuring safety and optimizing the structural integrity of high-rise buildings. This research paper aims to reduce the base shear in multi-storeyed buildings. To achieve this objective, a comprehensive analysis was conducted on a G+15 storey building with series of seven model cases abbreviated form BSR Case 1 to BSR Case 7. The comparative analysis revealed that when sizes of the column at a particular level decreases, the base shear decreases that enhances the structural parameters and hence BSR Case 7 observed as optimum case that reduces the base shear and performance of multi-storeyed building.***
Keywords: Base Shear Reduction, Column Sizes, Size Change Levels, Multi-Storey Building, Seismic Activities.

I. MULTISTOREY BUILDING: AN INTRODUCTION

A multistorey building, often referred to as a high-rise or skyscraper, is a tall structure that contains multiple floors or stories. These buildings are designed to accommodate a large number of occupants, often for residential, commercial, or mixed-use purposes, within a relatively small footprint. The construction and design of multistoried buildings require meticulous planning, advanced engineering techniques, and adherence to strict safety standards due to the challenges posed by their height and complexity.

A. Base Shear: Understanding the Concept

In structural engineering, base shear is a fundamental concept used to describe the total lateral force that a building's foundation must withstand during an earthquake or other lateral load conditions. It represents the total horizontal force exerted on the base of the structure, which is generated due to the building's mass and its dynamic response to ground motions. Base shear is crucial in designing the foundation and structural elements of multistoried buildings to ensure their stability and safety during seismic events.

B. Benefit of Reducing Base Shear in Multistoried Buildings

Reducing the base shear in multistoried buildings offers several significant benefits:

1) *Enhanced Structural Safety:* By minimizing the lateral forces exerted on the foundation, the risk of structural damage or failure during seismic events is reduced. This ensures the safety of occupants and minimizes the potential for catastrophic consequences.
2) *Optimized Design Efficiency:* Implementing strategies to decrease base shear allows engineers to design more efficient and cost-effective structural systems. This can lead to savings in construction materials and overall project costs.
3) *Improved Performance:* A reduction in base shear can enhance the overall performance of multistoried buildings, enabling them to withstand a wider range of lateral loads and environmental conditions without compromising structural integrity.
4) *Increased Sustainability:* By incorporating measures to decrease base shear, such as the use of innovative structural systems or advanced materials, multistoried buildings can achieve higher levels of sustainability. This includes reduced energy consumption, extended lifespan, and lower environmental impact over the building's lifecycle.

After understanding and effectively managing base shear it is essential for the safe and efficient design of multistoried buildings. By implementing strategies to reduce base shear, engineers and designers can enhance the structural performance, safety, and sustainability of these iconic structures.

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II. PROCEDURE AND 3D MODELLING OF THE STRUCTURE

Seismic analysis of semi commercial building is conducted using a software-based approach. The earthquake data is collected according to the IS 1893(PART1):2016 standards. The analysis of the building is performed utilizing the response spectrum analysis method. Detailed information about the model and input parameters is provided below.

Table 1: Model Description

Models	Description
BSR 1	Columns of same sizes over entire building
BSR 2	Columns of same sizes upto G+15 and change above G+15
BSR 3	Columns of same sizes upto G+14 and change above G+14
BSR 4	Columns of same sizes upto G+13 and change above G+13
BSR 5	Columns of same sizes upto G+12 and change above G+12
BSR 6	Columns of same sizes upto G+11 and change above G+11
BSR 7	Columns of same sizes upto G+10 and change above G+10

Table 2: Input details for Semi-Commercial Building for all cases

Constraint	Assumed data for all buildings
Total cases	1+6 =7 cases
Type of Building	Semi commercial G+15
Plinth area	784 sq. m
Depth of foundation	3.5m
GF height	4.2m
Height of each floor	3.66m
Total height of building	66.26m
Size of beam	0.55 x 0.40
Size of column	0.50 x 0.65
	0.50 x 0.45
Slab thickness	140 mm
Shear wall thickness	200 mm
Staircase waist slab	135 mm

Table 3: Input details for seismic analysis

Constraint	Assumed data for all buildings
Soil used	Actual soil
	Depth of footing 3.5 m
	Soil resistance = 11.02 Ton / sq. m = 11020 KN / sq. m
	Deflection = 215 mm = 0.215m
	K = P/ Delta = 11020/0.215 =51255.813 KN/m
Seismic zone	III
Zone factor (Z)	0.16
Damping ratio	5% = 0.05
Response reduction factor (RF)	Ordinary shear walls with special moment resisting frames = 4
Importance factor	1.2

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III. RESEARCH OBJECTIVES

Following heads shows the point of comparison of result parameters between various models during earthquake forces for building and its various cases. They are as follows:-

1) To determine the minimum nodal displacement case in X and Z direction with most efficient case that reduces base shear of building under earthquake effects.
2) To determine minimum base shear response case in X and Z direction with most efficient case that reduces base shear of building under earthquake effects.
3) To determine minimum axial forces case with most efficient case that reduces base shear of building under earthquake effects.
4) To determine minimum column shear forces response case in YY and ZZ axis with most efficient case that reduces base shear of building under earthquake effects.
5) To determine minimum column bending moment response case in YY and ZZ axis with most efficient case that reduces base shear of building under earthquake effects.
6) To determine minimum torsional moment in column and beam member response case with most efficient case that reduces base shear of building under earthquake effects.
7) To determine minimum beam shear forces response case in YY and ZZ axis with most efficient case that reduces base shear of building under earthquake effects.
8) To determine minimum beam bending moment response case in YY and ZZ axis with most efficient case that reduces base shear of building under earthquake effects.

The main theme of the current work is to demonstrate and recommend the efficiency of reduction of base shear by changing the size of column member at different floor levels.

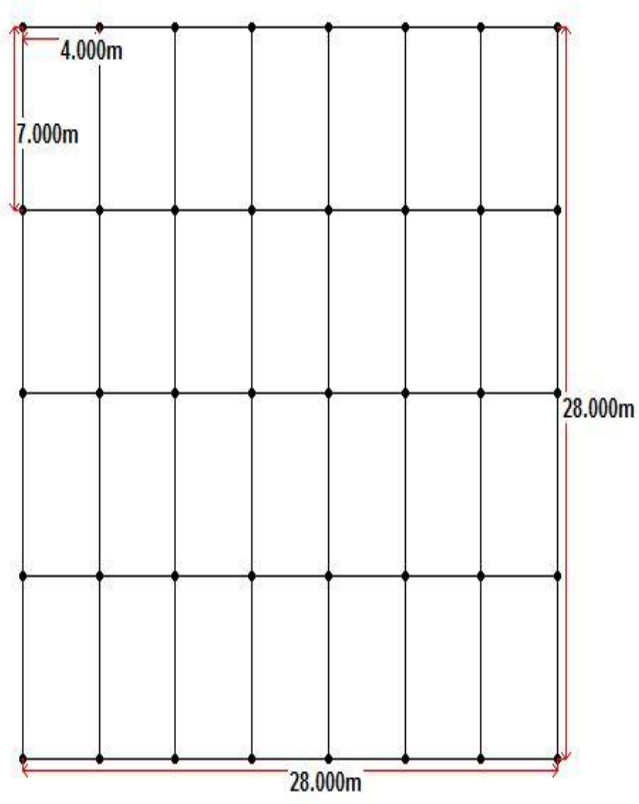

Fig. 1: Plan of Structure

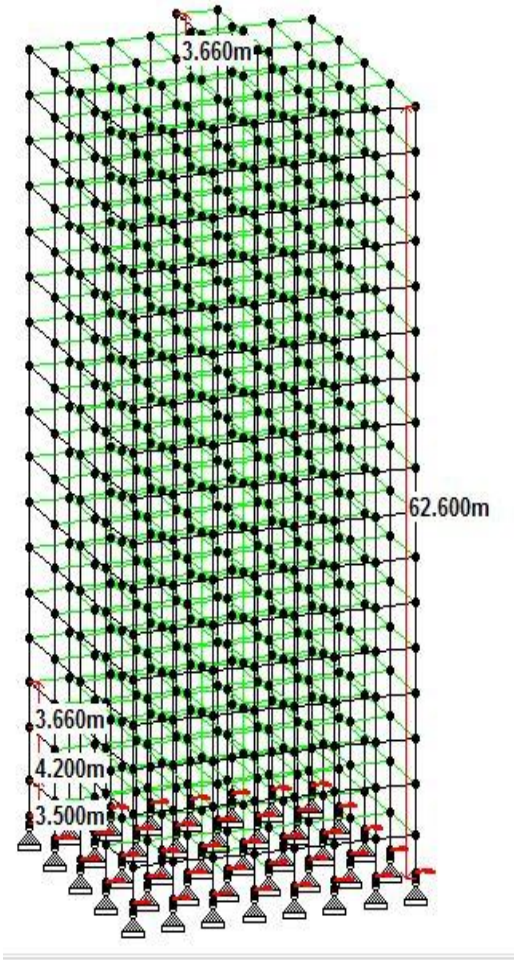

Fig. 2: 3D Beam Column Frame view

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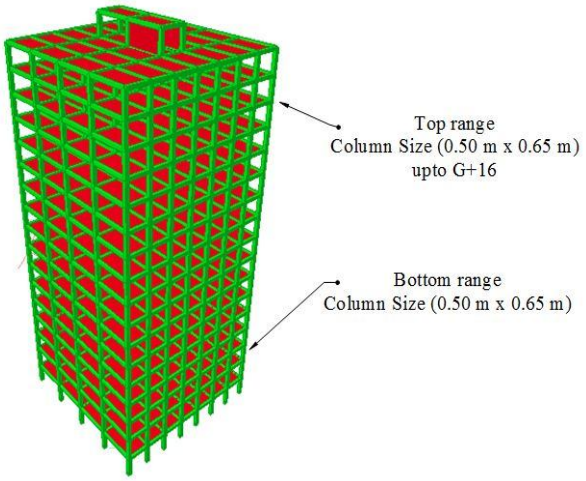


Fig. 3: 3D view of BSR Case 1

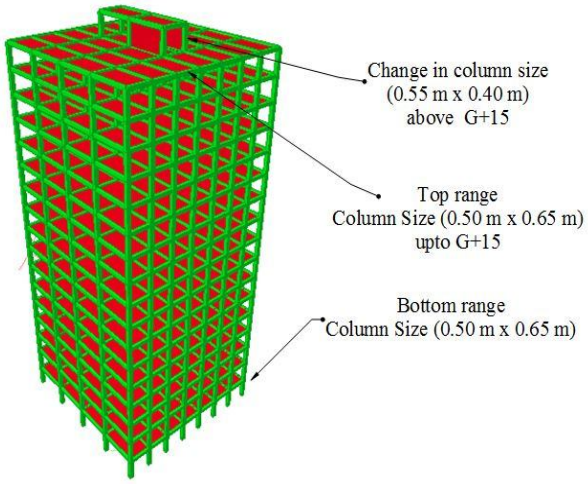


Fig. 4: 3D view of BSR Case 2

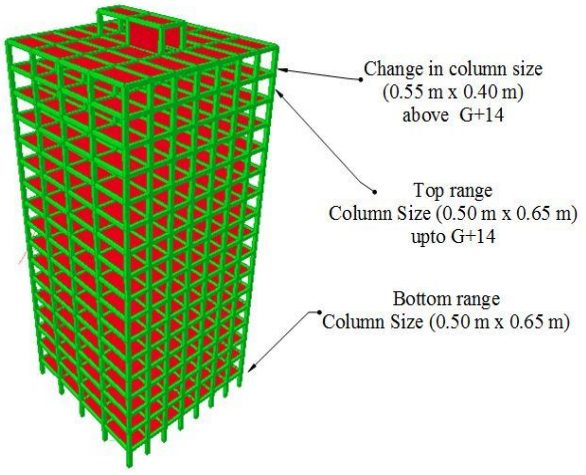


Fig. 5: 3D view of BSR Case 3

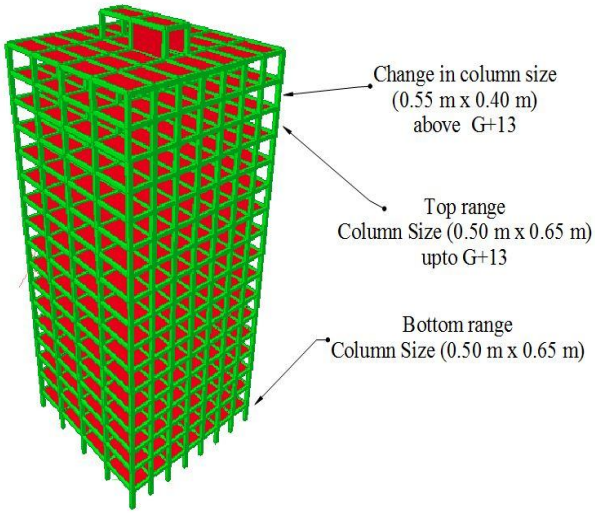


Fig. 6: 3D view of BSR Case 4

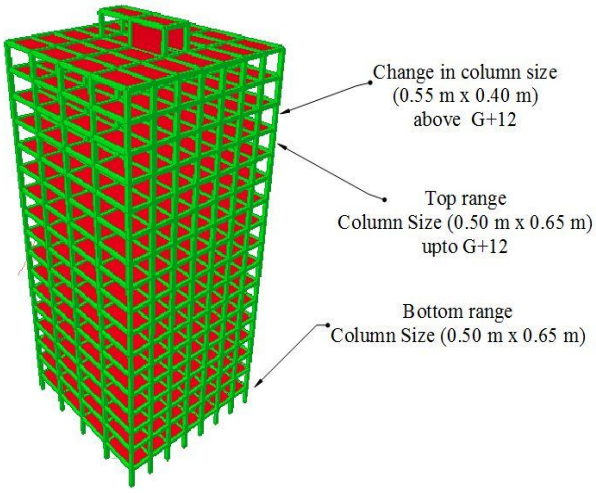


Fig. 7: 3D view of BSR Case 5

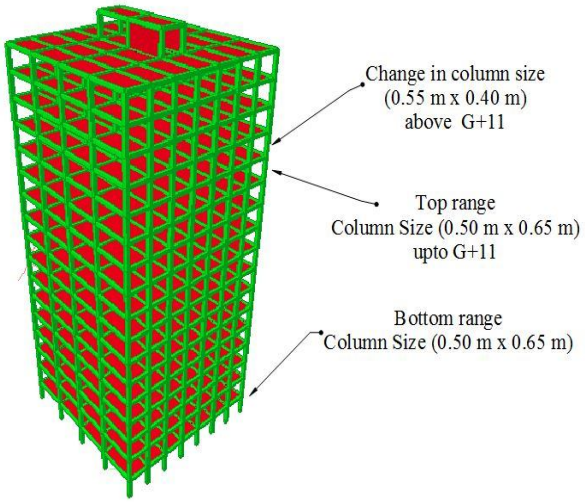


Fig. 8: 3D view of BSR Case 6

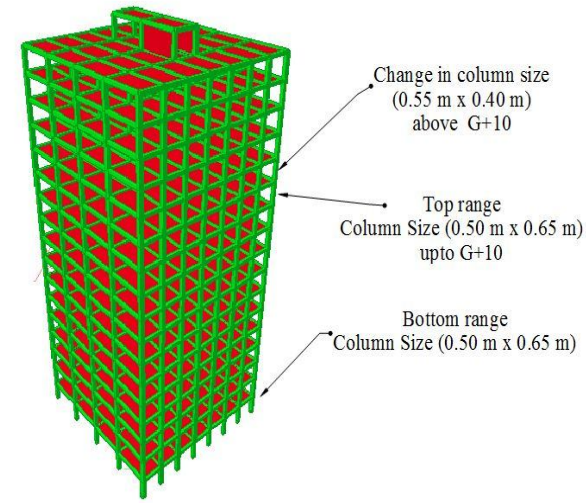


Fig. 9: 3D view of BSR Case 7

IV. RESULTS ANALYSIS

The application of loads and their combinations on different cases as per the Indian Standard 1893:2016 code of practice yield result parameters:-

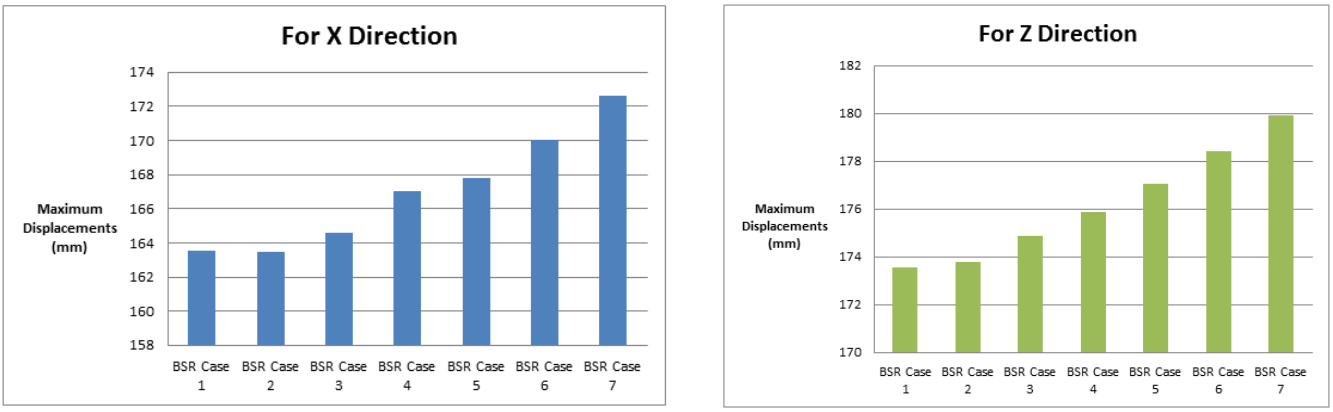


Fig. 10: Maximum Displacement in X and Z direction

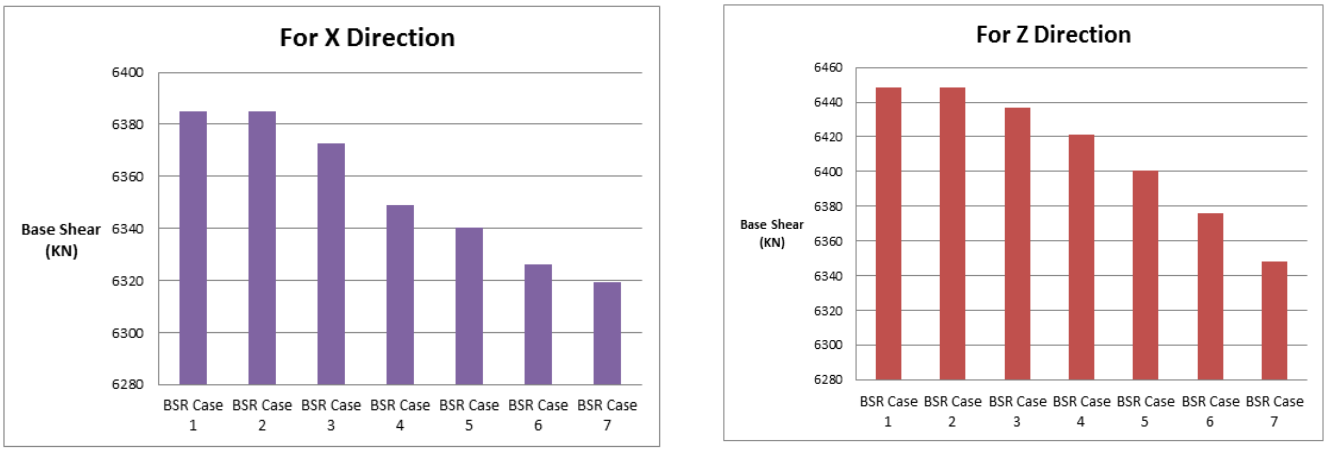


Fig. 11: Base Shear in X and Z direction

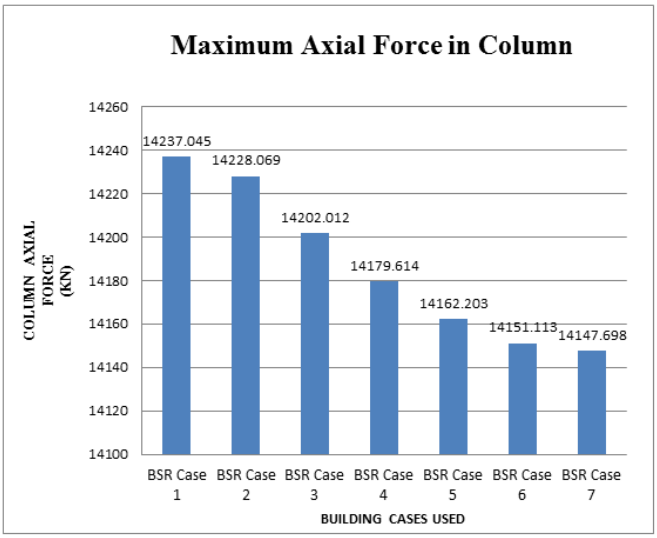
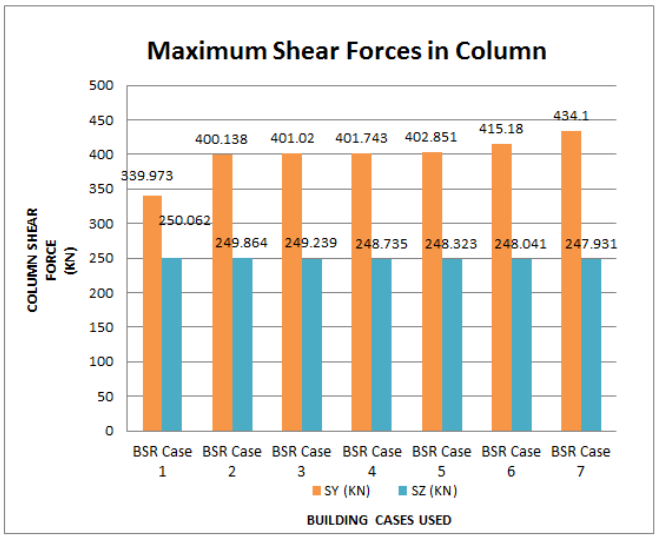


Fig. 12: Axial Forces in Column



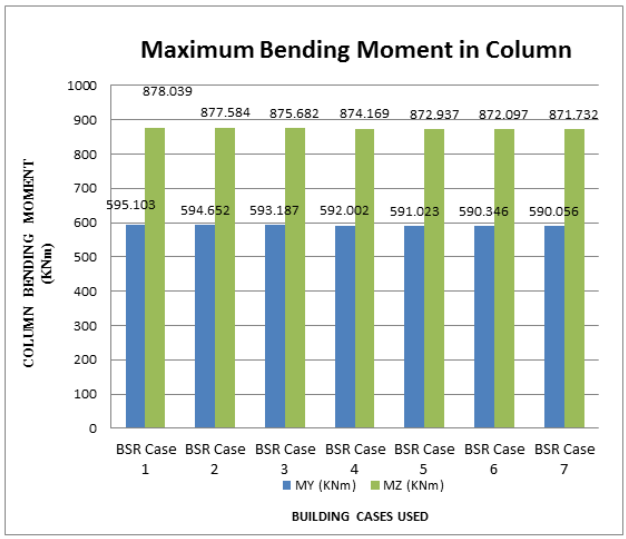
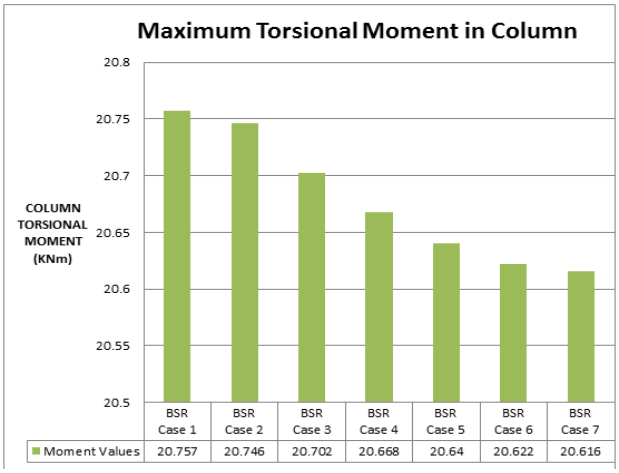


Fig. 13: Maximum Shear Forces and Bending Moments in Columns



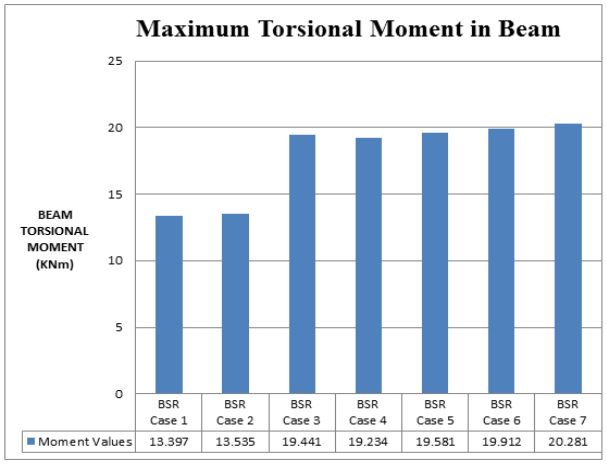


Fig. 14: Maximum Torsion in Beam and Column

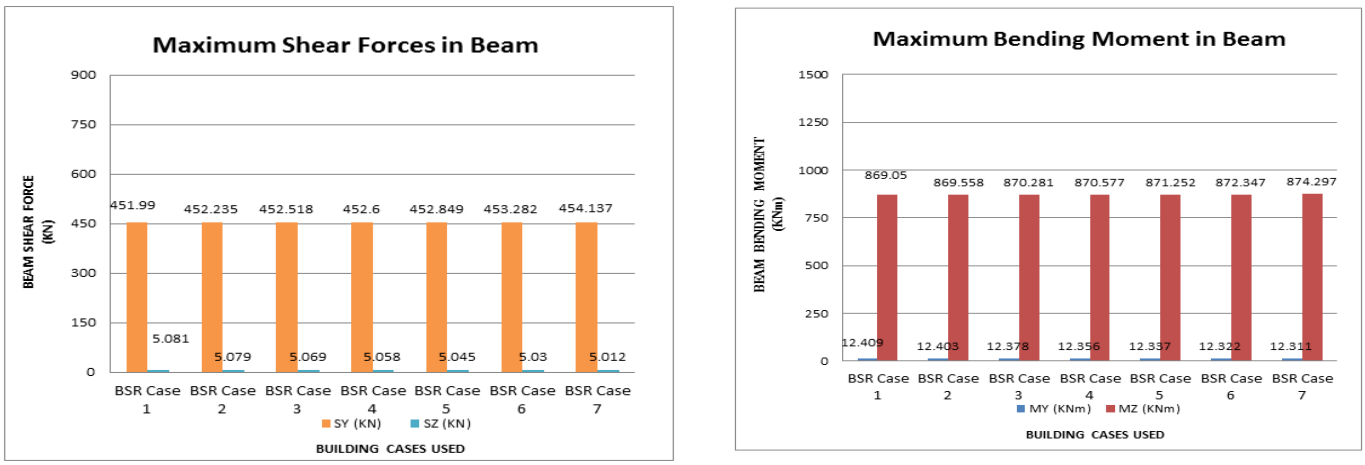


Fig. 15: Maximum Shear Forces and Bending Moments in Beams

V. CONCLUSIONS

The conclusion can be pointed out are as follows:-

1) Maximum displacement in X direction has a minimum value observed at BSR Case 1 and BSR Case 2 with a parametric value of 163.518 mm & 163.469 mm. For Z direction, it has a minimum value observed at BSR Case 1 and BSR Case 2 with a parametric value of 173.578 mm & 173.786 mm respectively.

2) Base Shear has gradually reduced and shows optimum above G+10 by implementing lesser size of column at top floors subsequently decreases the weight of the structure. For this parameter, BSR Case 7 proves to be an efficient parametric case for both X and Z directions.

3) The decreasing weight of the structure is directly proportional to the decrease in axial forces in column. Maximum Axial Forces in Column decreases gradually to BSR Case 7. Observing the least parameter, BSR Case 7 obtained as an efficient Case with a parametric value of 14147.698 KN among all base shear reduction.

4) The shear forces along both Y-Y axis increases and Z-Z axis it decreases and hence BSR Case 1 and BSR case 7 proves to be an efficient case for shear forces in column members.

5) The bending moment along both Y-Y axis and ZZ axis decreases with a minimum value to BSR case 7 with a value of 590.056 KNm and 871.732 KNm respectively.

6) The torsional moment in column decreases as the weight of the column with the structure decreases. With this, BSR Case 7 proves to be an efficient case with a minimum value of 20.616 KNm.

7) The torsional moment in beam increases from BSR Case 1 with least value of 20.281 KNm.

8) The shear forces in beam in both the directions shows minimum values of 451.990 KN in BSR Case 1 along Y axis and 5.012 KN in BSR Case 7 along Z axis.

9) Also, the Bending Moment along both Y-Y axis and Z-Z axis in column increases gradually from BSR Case 1 and decreases to BSR Case 7 for all base shear reduction cases.

10) Observing all the parameters, the main aim of this work has achieved with lessening the Base Shear parameter in both X and Z direction in semi commercial building (G+15) under seismic loading. Building BSR Case 7 observed and obtained as efficient case and should be recommended when this type of approach will be adopted in any earthquake zones.

VI. ACKNOWLEDGEMENTS

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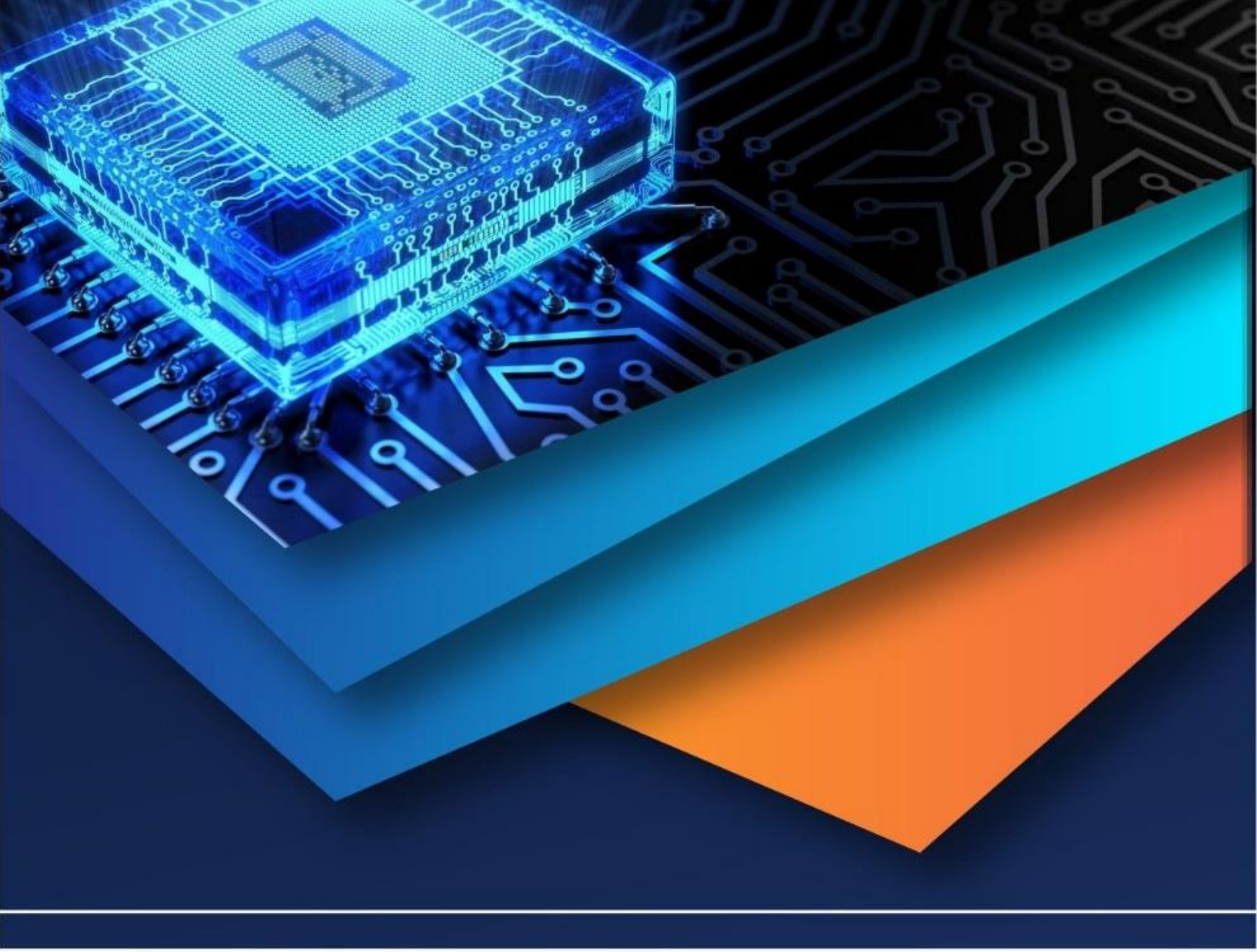
REFERENCES

[1] Mohd Zain Kangda, Manohar D. Mehare, Vipul R. Meshram, (2015), "Study of base shear and storey drift by dynamic analysis", International Journal of Engineering and Innovative Technology (IJEIT), ISSN: 2277-3754, Volume 4, Issue 8, pp. 92-101.

[2] Chiyun Zhong, Constantin Christopoulos, (2023), "Seismic response of slender MDOF structures with self-centering base shear and moment mechanisms", Earthquake Engineering & Structural Dynamics, Wiley, pp. 1-20.
[3] Ms. Priyanka Soni1, Mr. Purushottam Lal Tamrakar, Vikky Kumhar, (2016), "Structural Analysis of Multistory Building of Different shear Walls Location and Heights", International Journal of Engineering Trends and Technology (IJETT), ISSN: 2231-5381, Volume 32, Issue 1, pp. 50-57.
[4] Ruchi Sharma, Jignesh A. Amin, (2015), "Effects of opening in shear walls of 30- storey building", Journal Of Materials And Engineering Structures, ISSN: 2170-127X, pp. 44-55.
[5] Masato Sakurai, Hiroshi Kuramoto, Tomoya Matsui And Tomofusa Akita, (2008), "Seismic Performance Of Rc Shear Walls With Multi-Openings", The 14th World Conference on Earthquake Engineering, Beijing, China, pp. 1-8.
[6] Oguzhan Bayrak and Shamim A. Sheikh, (2004), "Seismic Performance Of High Strength Concrete Columns Confined With High Strength Steel", 13th World Conference on Earthquake Engineering Vancouver, B.C., Canada, Paper No. 1181
[7] Ibrahim G. Shaaban Maher A. Adam, (2015), "Seismic Behavior Of Beam-Column Connections In High Strength Concrete Building Frames".
[8] G. Vimal Arokiaraj and G. Elangovan, (2022), "A Study on Self-Consolidate Concrete in Experimental Reinforced-Concrete Beam Column Structures with Alccofine and Steel Fiber", Advances in Civil Engineering, Hindawi, Volume 2022, Article ID 7874066, 19 pages.
[9] Yonghui Hou, Shuangyin Cao, Xiangyong Ni and Yizhu Li, (2019), "Research on Concrete Columns Reinforced with New Developed High-Strength Steel under Eccentric Loading", Materials, Volume 12, paper 2139, pp. 1-16.
[10] Andres Lepage, Hooman Tavallali, Santiago Pujol, and Jeffrey M. Rautenberg, (2012), "High-Performance Steel Bars and Fibers as Concrete Reinforcement for Seismic-Resistant Frames", Advances in Civil Engineering, Hindawi, Volume 2012, Article ID 450981.
[11] S. R. Uma, Sudhir K. Jain, (2006), "Seismic design of beam-column joints in RC moment resisting frames – Review of codes", Structural Engineering and Mechanics, Volume 23, Issue 5, pp. 579-597.
[12] Satpute S G and D B Kulkarni, (2013), "Comparative Study Of Reinforced Concrete Shear Wall Analysis In Multistoreyed Building With Openings By Nonlinear Methods", Int. J. Struct. & Civil Engg. Res., ISSN: 2319 – 6009, Volume 2, Issue 3, pp. 183-193.
[13] Sang Whan Han, N.Y. Jee, (2005), "Seismic behaviors of columns in ordinary and intermediate moment resisting concrete frames", Engineering Structures, 27,pp. 951–962
[14] IS: 1893:2016 (Part 1), "Criteria for earthquake design of structures", Part 1 – General provisions and buildings, Bureau of Indian Standards, New Delhi, India.
[15] Sagar Jamle, Dr. M.P. Verma, Vinay Dhakad, (2017), "Flat Slab Shear Wall Interaction for Multistoried Building under Seismic Forces", International Journal of Software & Hardware Research in Engineering (IJSHRE) ISSN: 2347-4890 Vol.-05, Issue-3, pp. 14-31.
[16] Sagar Jamle, Dr. M.P. Verma, Vinay Dhakad, (2017), "Flat Slab Shear Wall Interaction for Multistoried Building Analysis When Structure Length is greater than width under seismic Forces", International Journal of Software & Hardware Research in Engineering (IJSHRE) ISSN: 2347-4890 Vol.-05, Issue-3, pp. 32-53.
[17] Prakash Mandiwal, Sagar Jamle, (2018), "Use of Polyethylene Glycol as Self Curing Agent in Self Curing Concrete - An Experimental Approach", International Research Journal of Engineering and Technology, (ISSN: 2395-0072(P), 2395-0056(O)), vol. 5, no. 11, pp. 916-918.
[18] Surendra Chaurasiya, Sagar Jamle, (2018), "Determination of Efficient Twin Tower High Rise Building Subjected to Seismic Loading", International Journal of Current Engineering and Technology, INPRESSCO, E-ISSN 2277 – 4106, P-ISSN 2347 – 5161, Vol. 8, No. 5, pp. 1200 – 1203, DOI: https://doi.org/10.14741/ijcet/v.8.5.1.
[19] Archit Dangi, Sagar Jamle, (2018), "Determination of Seismic parameters of R.C.C. Building Using Shear Core Outrigger, Wall Belt and Truss Belt Systems". International Journal of Advanced Engineering Research and Science(ISSN : 2349-6495(P) | 2456-1908(O)),vol. 5, no. 9, pp.305-309 AI Publications, doi:10.22161/ijaers.5.9.36
[20] Mohd. Arif Lahori, Sagar Jamle, (2018), "Investigation of Seismic Parameters of R.C. Building on Sloping Ground", International Journal of Advanced Engineering Research and Science, (ISSN: 2349-6495(P), 2456-1908(O)), vol. 5, no. 8, pp.285-290 AI Publications, doi: 10.22161/ijaers 5.8.35.
[21] Suyash Malviya, Sagar Jamle, (2019) ,"Determination of Optimum Location of Rooftop Telecommunication Tower over Multistory Building under Seismic Loading", International Journal of Advanced Engineering Research and Science(ISSN : 2349-6495(P) | 2456-1908(O)),vol. 6, no. 2, 2019, pp. 65-73, AI Publications, doi:10.22161/ijaers.6.2.9.
[22] Suyash Malviya, Sagar Jamle, (2019), "Response of Multistorey Building with Rooftop Telecommunication Tower in Different Positions: An Approach to Efficient Case", International Research Journal of Engineering and Technology, (ISSN: 2395-0072(P), 2395-0056(O)), vol. 6, no. 4, pp. 3783-3790.
[23] Yash Joshi, Sagar Jamle, (2019), "Effect of Curtailed Shear Wall on Dynamic Analysis of RC Building", International Journal of Management, Technology And Engineering, (ISSN: 2249-7455(O)), vol. 9, no. 7, pp. 223-230.
[24] Yash Joshi, Sagar Jamle, Kundan Meshram, (2019), "Dynamic Analysis of Dual Structural System", International Journal of Research and Analytical Reviews, (ISSN: 2348-1269 (O), 2349-5138 (P)), vol. 6, no. 2, pp. 518-523.
[25] Rajesh Chouhan, Sagar Jamle, Kundan Meshram, (2019), "Dynamic Analysis of Tuned Mass Damper Steel Structure: A Review", International Journal of Management, Technology And Engineering, (ISSN: 2249-7455(O)), vol. 9, no. 7, pp. 212-216.
[26] Rajesh Chouhan, Sagar Jamle, Kundan Meshram, (2019), "Dynamic Analysis of Tuned Mass Damper on Steel Structure: A Technical Approach", International Journal of Research and Analytical Reviews, (ISSN: 2348-1269 (O), 2349-5138 (P)), vol. 6, no. 2, pp. 956-960.
[27] Neeraj Patel, Sagar Jamle, (2019), "Use of Shear Wall Belt at Optimum Height to Increase Lateral Load Handling Capacity in Multistory Building", International Journal for Research in Engineering Application & Management (ISSN : 2454-9150),vol. 4, no. 10, pp. 596-603, doi: 10.18231/2454-9150.2018.1372.
[28] Neeraj Patel, Sagar Jamle, (2019), "Use of Shear Wall Belt at Optimum Height to Increase Lateral Load Handling Capacity in Multistory Building: A Review", International Journal of Advanced Engineering Research and Science(ISSN : 2349-6495(P) | 2456-1908(O)),vol. 6, no. 4, pp. 310-314, AI Publications, doi:10.22161/ijaers.6.4.36
[29] Taha A. Ansari, Sagar Jamle, (2019), " Performance Based Analysis of RC Buildings with Underground Storey Considering Soil Structure Interaction", International Journal of Advanced Engineering Research and Science (ISSN: 2349-6495(P) | 2456-1908(O)),vol. 6, no. 6, pp. 767-771, AI Publications, doi:10.22161/ijaers.6.6.89.

[30] Taha A. Ansari, Sagar Jamle, (2019), "Performance Based Seismic Analysis of Regular R.C. Building", International Journal of Management, Technology And Engineering, ISSN: 2249-7455, Vol. 09, no. 07, pp. 342-351, DOI:16.10089.IJMTE.2019.V9I7.19.28639.
[31] Markanday Giri, Sagar Jamle, (2019), "A Review on Response Spectrum Analysis over Flat Slab-Shear Wall Interface", International Research Journal of Engineering and Technology, (ISSN: 2395-0072(P), 2395-0056(O)), vol. 6, no. 5, pp. 5173-5177.
[32] Mariyam, Sagar Jamle, (2019), "A Technical Approach to Flat Slab Multistorey Building under Wind Speed of 39 m/s", International Research Journal of Engineering and Technology, (ISSN: 2395-0072(P), 2395-0056(O)), vol. 6, no. 5, pp. 7629-7636.
[33] Mariyam, Sagar Jamle, (2019), "Wind Analysis over Multistorey Building Having Flat Slab-Shear Wall Interaction: A Review", International Journal of Advanced Engineering Research and Science, (ISSN: 2349-6495(P), 2456-1908(O)), vol. 6, no. 5, pp. 340-344, AI Publications, https://dx.doi.org/10.22161/ijaers.6.5.45.
[34] Prakash Mandiwal, Sagar Jamle, (2019), "Tensile Strength & Durability Study on Self-Curing Concrete as a Partial Replacement of Cement by PEG-400", International Journal for Research in Engineering Application & Management(ISSN : 2454-9150),vol. 4, no. 10, pp. 244-248, doi: 10.18231/2454-9150.2018.1314
[35] Surendra Chaurasiya, Sagar Jamle, (2019), "Twin Tower High Rise Building Subjected To Seismic Loading: A Review". International Journal of Advanced Engineering Research and Science (ISSN : 2349-6495(P) | 2456-1908(O)), vol. 6, no. 4, pp. 324-328, AI Publications, doi:10.22161/ijaers.6.4.38.
[36] Archit Dangi, Sagar Jamle, (2019), Stability Enhancement of Optimum Outriggers and Belt Truss Structural System", International Research Journal of Engineering and Technology, (ISSN: 2395-0072(P), 2395-0056(O)), vol. 6, no. 2, pp. 772-780.
[37] Mohd. Arif Lahori, Sagar Jamle, (2019), "Response of Multistory Building Located on 200 and 300 Sloping Ground under Seismic Loading", International Research Journal of Engineering and Technology, (ISSN: 2395-0072(P), 2395-0056(O)), vol. 6, no. 1, pp. 1063-1069.
[38] Markanday Giri, Sagar Jamle and Kundan Meshram (2020), "Response Spectrum Analysis", LAP LAMBERT Academic Publishing, Mauritius.
[39] Sapan Chawla, Sagar Jamle, Kundan Meshram, (2020), "A Review on Economical Design of Intz Water Tank as per IS-875-III, for Wind Speed in India", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 1, pp. 147-151. https://dx.doi.org/10.22161/ijaers.71.19
[40] Romesh Malviya, Sagar Jamle, Kundan Meshram, (2020), "Examination on Increasing Stability of Multistoried Building: A Theoretical Review", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 1, pp. 162-164. https://dx.doi.org/10.22161/ijaers.71.22
[41] Romesh Malviya, Sagar Jamle, (2020), "Increasing Stability of Multistoried Building using Different Grades of Concrete in Column Member Sets at Different Locations", International Journal of Current Engineering and Technology, (ISSN: 2277-4106 (O), 2347-5161(P)), vol. 10, no. 2, pp. 208-213. https://doi.org/10.14741/ijcet/v.10.2.3
[42] Sapan Chawla, Sagar Jamle, Kundan Meshram, (2020), "An Analytical Approach to find out the Efficient Design of Intz Water Tank as per Different Breeze Speed of India", International Journal of Current Engineering and Technology, (ISSN: 2277-4106 (O), 2347-5161(P)), vol. 10, no. 1, pp. 48-52. https://doi.org/10.14741/ijcet/v.10.1.9
[43] Prafoolla Thakre, Sagar Jamle, Kundan Meshram, (2020), " Opening Area Effect of Shear Wall in Multistorey Building under Seismic Loading", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 2, pp. 122-129. https://dx.doi.org/10.22161/ijaers.72.17
[44] Mohit Kumar Prajapati, Sagar Jamle, (2020), "Strength irregularities in multistoried building using base isolation and damper in high Seismic zone: A theoretical Review", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 3, pp. 235-238. https://dx.doi.org/10.22161/ijaers.73.37
[45] Gagan Yadav, Sagar Jamle, (2020), "Opening Effect of Core Type Shear Wall Used in Multistoried Structures: A Technical Approach in Structural Engineering", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 3, pp. 344-351. https://dx.doi.org/10.22161/ijaers.73.50
[46] Durgesh Kumar Upadhyay, Sagar Jamle, (2020), "A Review on Stability Improvement with Wall Belt Supported Dual Structural System Using Different Grades of Concrete", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 3, pp. 293-296. https://dx.doi.org/10.22161/ijaers.73.43
[47] Gagan Yadav, Sagar Jamle, (2020), "Use of Shear Wall with Opening in Multistoried Building: A Factual Review", International Journal of Current Engineering and Technology, (ISSN: 2277-4106 (O), 2347-5161(P)), vol. 10, no. 2, pp. 243-246. https://doi.org/10.14741/ijcet/v.10.2.9
[48] Durgesh Kumar Upadhyay, Sagar Jamle, (2020), "Stability Enhancement in Wall Belt Supported Dual Structural System using Different Grades of Concrete", International Journal of Current Engineering and Technology, (ISSN: 2277-4106 (O), 2347-5161(P)), vol. 10, no. 2, pp. 237-242. https://doi.org/10.14741/ijcet/v.10.2.8
[49] Pankaj Kumar Dhakad, Sagar Jamle, (2020), "Base Shear Reduction by using Optimum Size of Beams with same Grade of Concrete: An Informative Review", International Journal of Current Engineering and Technology, (ISSN: 2277-4106 (O), 2347-5161(P)), vol. 10, no. 2, pp. 259-262. https://doi.org/10.14741/ijcet/v.10.2.12
[50] Manoj Patidar, Sagar Jamle, (2020), "Optimization of Stability of Multistoried Structure by Changing Grades of Concrete in Shear Wall Member", Journal of Xi'an University of Architecture & Technology, ISSN: 1006-7930, vol. 12, no. 4, pp. 2479-2497. https://doi.org/10.37896/JXAT12.04/979
[51] Pankaj Kumar Dhakad, Sagar Jamle, (2020), "Base Shear Reduction by Using Optimum Size of Beams in Top Floors with Different Grades in Multistoried Building at Different Levels", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 4, pp. 293-296. https://dx.doi.org/10.22161/ijaers.74.20
[52] Sagar Jamle, Nirmal Delmiya, Rahul Singh, (2020), "Efficient Use of UPV Meter: A Non Destructive Test of Concrete by Fragmentation Analysis", Journal of Xi'an University of Architecture & Technology, ISSN: 1006-7930, vol. 12, no. 4, pp. 3385-3394. https://doi.org/10.37896/JXAT12.04/1078
[53] Manoj Patidar, Sagar Jamle, (2020), "Use of different Grades of Concrete in Shear Wall: A Comprehensive Review", International Journal of Advanced Engineering Research and Science, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 4, pp. 355-359. https://dx.doi.org/10.22161/ijaers.74.44



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