iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** XI **Month of publication:** November 2021

DOI: https://doi.org/10.22214/ijraset.2021.38821

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XI Nov 2021- Available at www.ijraset.com

Comparative Parametric Analysis of Opening Area Usage of Shear Wall in Different Percentages Relating to Wall Area Used for Multistorey Building

Krishna Pal Singh
P. G. Student, School of Engineering & Information Technology, Sanskriti University, Mathura, India.

Abstract: ***It is highly recommend that the structure should be efficient in terms of the cost in diverse manner. To reduce the overall cost of the project, the cost cutting should be done in every construction stages. The dual systems in building structure consist of structural walls and moment resisting frames. The structural wall members are made up of RCC, which is a costly structural member. The purpose of current study is to explore the reduction in shear wall area in multi-storey building for reduction of overall project cost. Total 5 buildings abbreviated as SOA, SOB, SOC, SOD and SOE framed in analytical software supposed to be situated at Seismic Zone III. After the comparative result analysis, it proves that, the reduction in shear wall area should be adapted to a certain limit due to load transfer criteria of the members 20 % wall deduction is sufficient. Building SOD with 80% coverage performs best of all.***

Keywords: Deduction Area, Earthquake Effects, Opening Area, Shear Wall, Response spectrum, Wall Area Reduction, Wall Deduction Ratio.

I. INTRODUCTION TO SHEAR WALL

The shear walls are designed not only to stand firm against gravity or vertical loads (loads due to its self-weight and other living/ moving loads), but also from lateral loads of winds and earthquakes. The walls are structurally incorporated with floors/roofs and other lateral walls running crossways at right angles, thereby giving all the three dimensional stability to the building. The walls have to resist the uplift forces due to the pull of wind. It has to resist the force that aim to push the walls over. The walls also have to resist lateral forces of wind that try to push the walls in and drag them away from the building. Shear walls are quick to build as the method implemented for construction is concreting the members using the formwork.

II. CLASSIFICATION OF SHEAR WALL

There are many types of reinforced concrete shear walls:-

Table 1: Various types of shear wall as per current scenario

Type 1	Simple rectangular type shear wall
Type 2	Coupled shear wall
Type 3	Rigid frame shear wall
Type 4	Framed walls with infill frame
Type 5	Column supported shear wall
Type 6	Core type shear wall

III. CONCEPT OF OPENING IN SHEAR WALL

When provisions of opening in Shear wall has allotted, the Cantilever shear walls act as coupled shear walls and have connected with coupling beams. As per structural engineering point of view, the opening has to be decided within the limit to secure the structural resisting components by adverse seismic effects is the first part. The second part consist of architectural point of view, the multi-storeyed buildings may consist of openings in rows which are essential for indoor lightening and with green building concepts in both internal and external walls.

Shear walls are especially important in high-rise buildings subject to lateral wind and seismic forces. Generally, shear walls are either plane or flanged in section, while core walls consist of channel sections. The walls do not need extra finishing or plastering. Opening in shear wall can be provided in:-

©IJRASET: All Rights are Reserved

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XI Nov 2021- Available at www.ijraset.com

Table 2: Various concepts of building as per previous reviews

Concept 1	Structure generally provided with any type of shear walls.
Concept 2	Shear wall components in Dual System buildings.
Concept 3	Structure generally provided with Shear walls around lift areas.

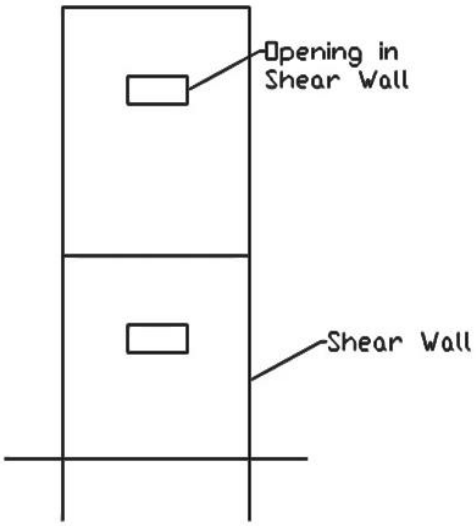


Fig. 1: Frame with Shear wall having very small opening

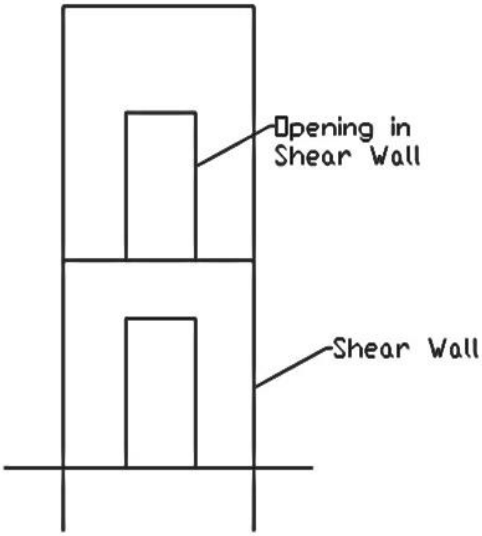


Fig. 2: Frame with Shear wall having medium opening

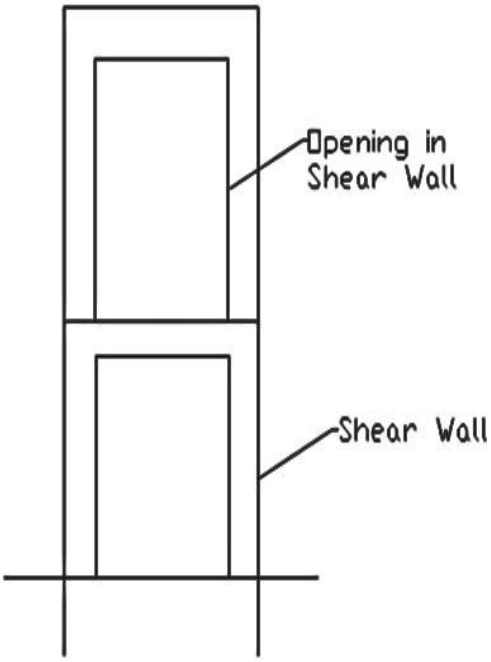


Fig. 3: Frame with Shear wall having very large opening

This study is totally based on maintaining the rigidness of the structure along with counteracting the seismic force effects, usage of Outriggers and Belt Supported System has been done.

©IJRASET: All Rights are Reserved

IV. OBJECTIVES OF THE PRESENT STUDY

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:-

A. To take five different buildings, comparing them among each other by using Response Spectrum Method of dynamic analysis using Staad pro software.
B. To calculate maximum displacement and drift values and then comparing all the 5 buildings.
C. To compare base shear, that shows response result of the 5 dual configuration buildings.
D. To determine maximum Axial Forces and Shear Forces in columns at ground level for various buildings.
E. To show the variation of maximum Bending Moments in columns for all five multistorey buildings.
F. To investigate maximum Shear Forces in beams parallel to X and Z direction.
G. To study and compare maximum Bending Moments in beams along X and Z direction.
H. To evaluate maximum Torsional Moments in beams along X and Z directions.
I. Use of response spectrum method in with and without opening dual configuration multistorey structure.
J. To explore the possibilities of overall structural resistance by minimal use of shear wall area.

To obtain the best building with opening threshold criteria, all buildings are thoroughly observed and compared their parametric values.

V. LIST OF MODELS FRAMED FOR ANALYSIS OF STRUCTURE

Various models are framed for analysis and assessment of structure to accomplish the aforesaid objectives of the current study.

Table 3: List of buildings framed with assigned abbreviation

S. No.	Buildings framed for analysis when Shear Wall used at corners	Abbreviation
1.	Building with 100 % shear wall area used	SOA
2.	Building with 88.88 % shear wall area used	SOB
3.	Building with 85.80 % shear wall area used	SOC
4.	Building with 80 % shear wall area used	SOD
5.	Building with 66.66 % shear wall area used	SOE

Table 4: List of buildings with used and deducted Shear Wall area

S. No.	Abbreviation	Wall Deduction Ratio	Bay Size	Deduction Area (L x B)	Percentage Deduction
1.	SOA	-	5 m x 4 m	0 m x 0 m	0 %
2.	SOB	5 / 9	5 m x 4 m	0.55 m x 4 m	11.11 %
3.	SOC	5 / 7	5 m x 4 m	0.71 m x 4 m	14.28 %
4.	SOD	5 / 5	5 m x 4 m	1 m x 4 m	20 %
5.	SOE	5 / 3	5 m x 4 m	1.66 m x 4 m	33.33 %

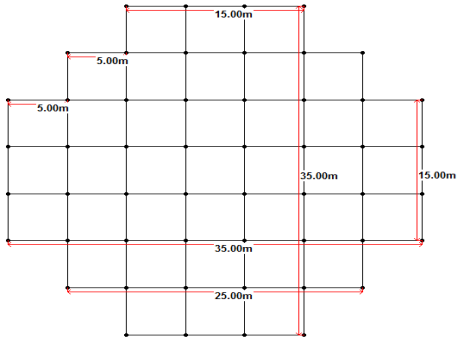


Fig. 4: Plan of all buildings

©IJRASET: All Rights are Reserved

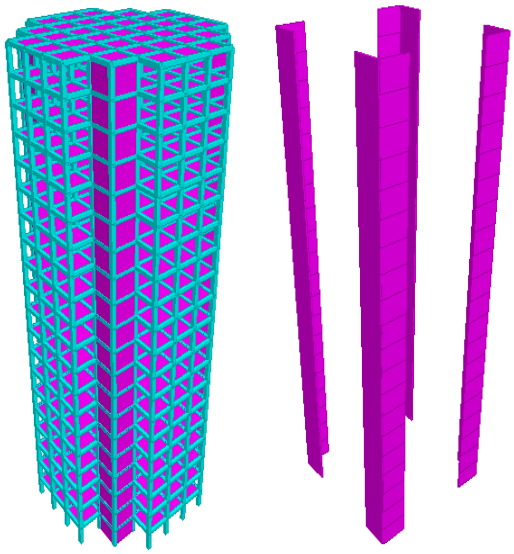


Fig. 5: Building SOA: Shear wall without opening

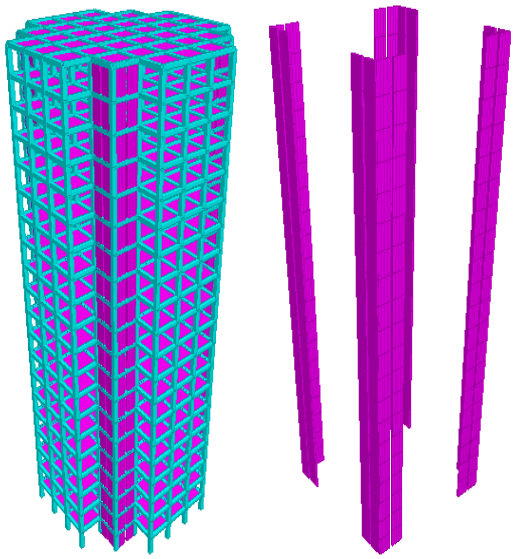


Fig. 6: Building SOB: Shear wall with 11.11 % opening

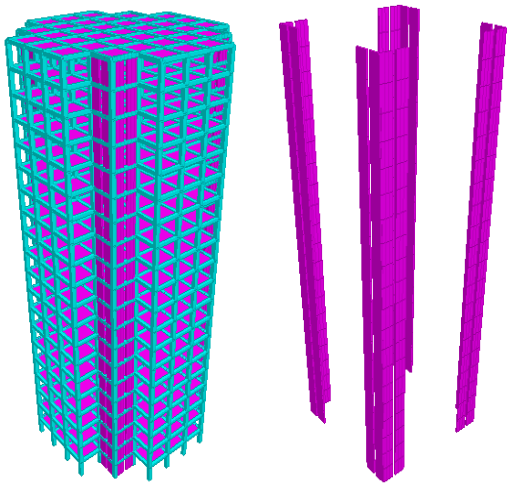


Fig. 7: Building SOC: Shear wall with 14.28 % opening

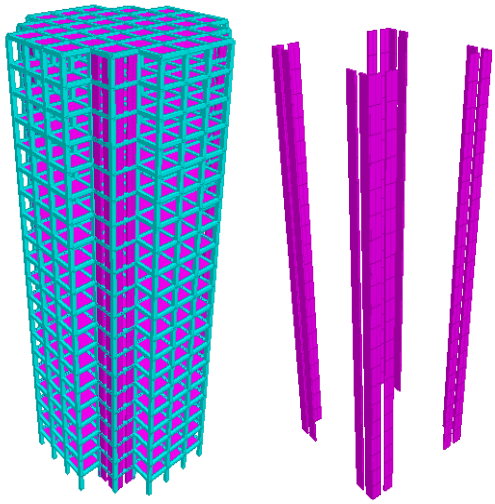


Fig. 8: Building SOD: Shear wall with 20 % opening

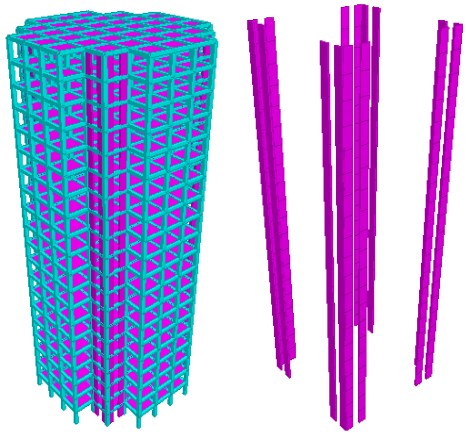
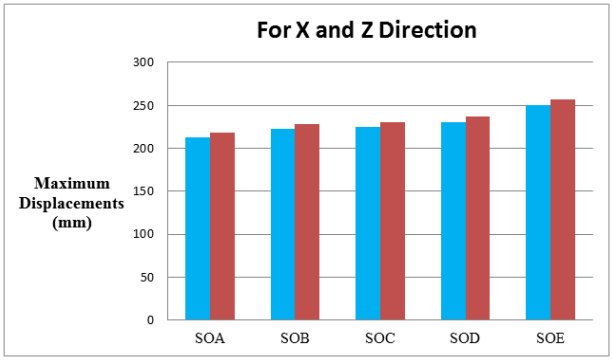


Fig. 9: Building SOE: Shear wall with 33.33 % opening

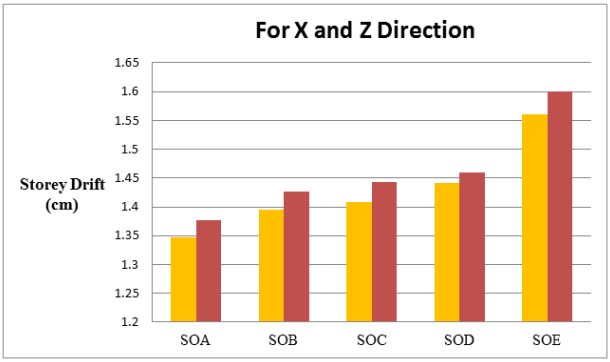
©IJRASET: All Rights are Reserved

VI. RESULTS ANALYSIS

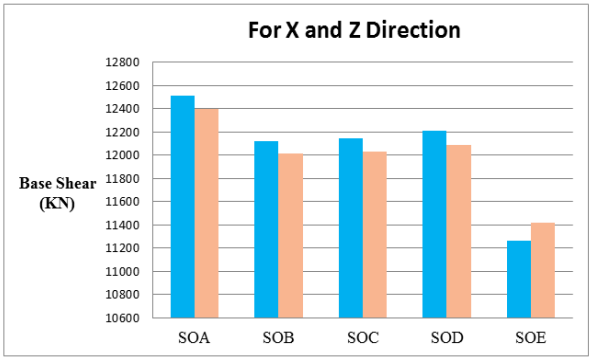
As per theme for increasing the stability of the structure, parameters such as the nodal displacement in both seismic directions, storey drift in both seismic directions, etc. obtained by application of loads and their combinations on various cases of the multistorey building have discussed. The results of each parameter with its maximum values are discussed with its graphical form for comparative analysis below:-



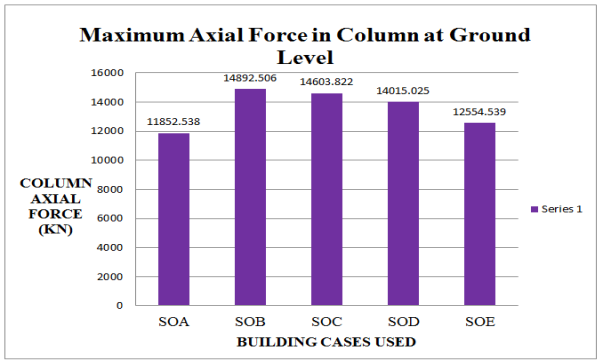
Graph 1: Maximum Displacement in X and Z direction for all 5 Buildings in Zone III



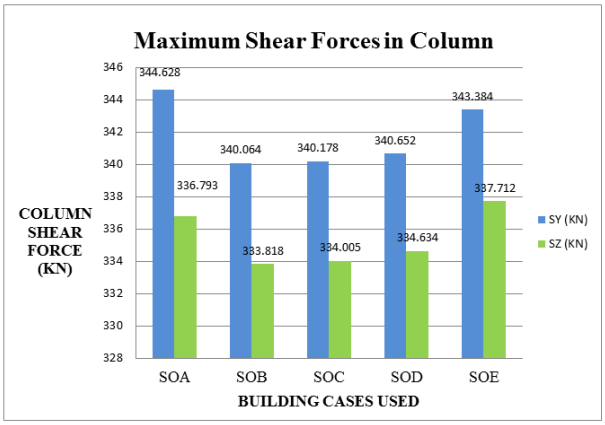
Graph 2: Storey Drift in X and Z direction for all 5 Buildings in Zone III



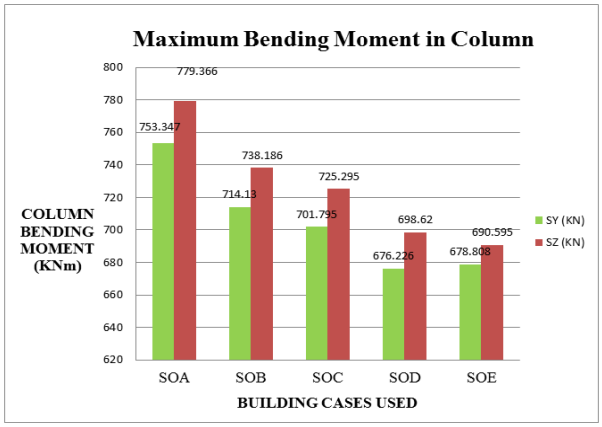
Graph 3: Base Shear in X and Z direction for all 5 Buildings in Zone III



Graph 4: Maximum Axial Forces in Column at ground level for all 5 Buildings in Zone III



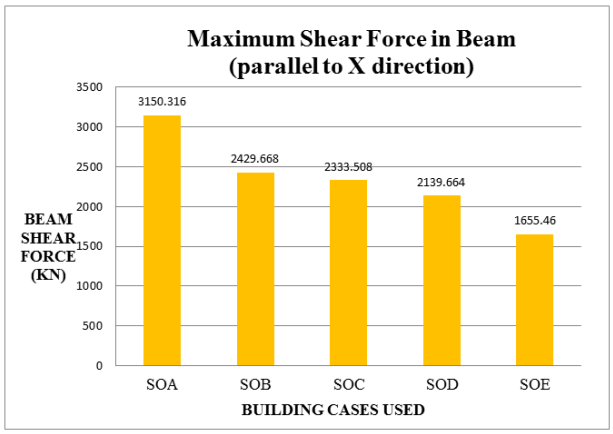
Graph 5: Maximum Shear Forces in Columns for all 5 Buildings in Zone III



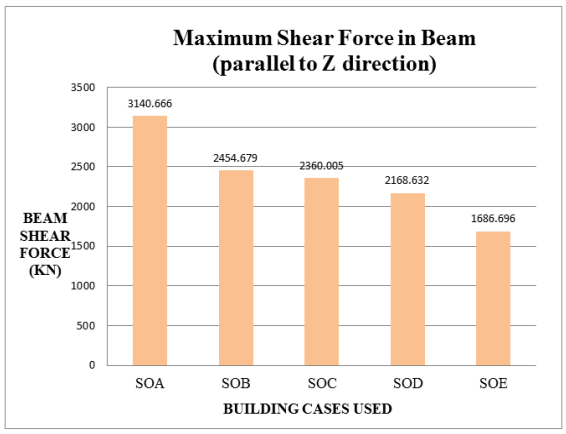
Graph 6: Maximum Bending Moment in Columns for all 5 Buildings in Zone III

©IJRASET: All Rights are Reserved

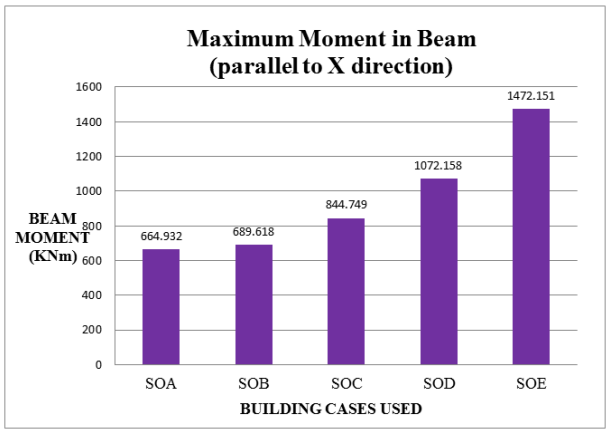
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XI Nov 2021- Available at www.ijraset.com



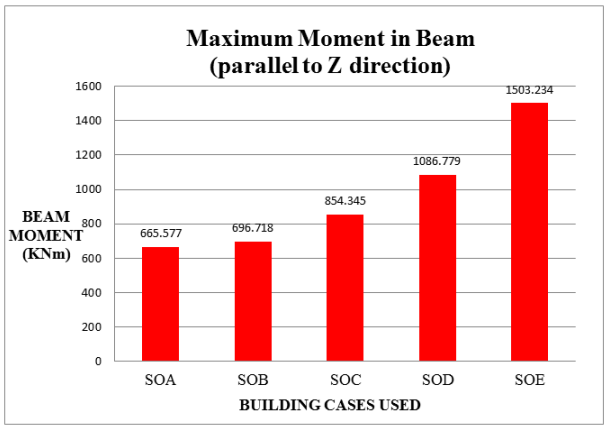
Graph 7: Maximum Shear Forces in beams parallel to X direction for all 5 Buildings in Zone III



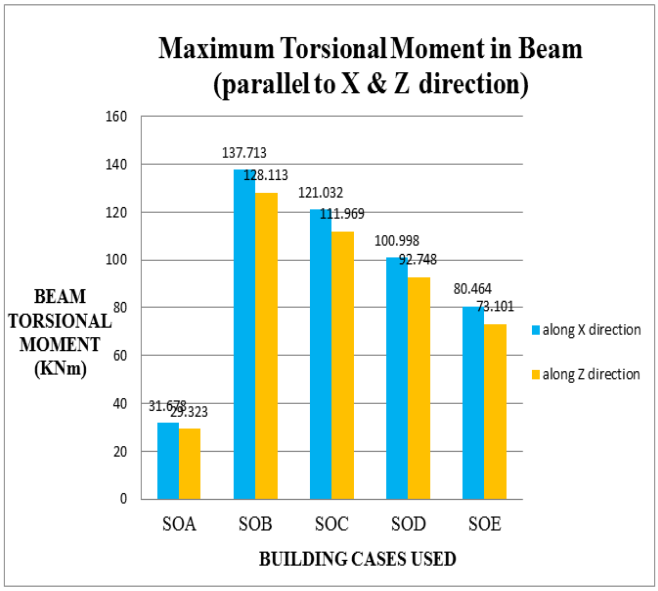
Graph 8: Maximum Shear Forces in beams parallel to Z direction for all 5 Buildings in Zone III



Graph 9: Maximum Bending Moment in beams parallel to X direction for all 5 Buildings in Zone III



Graph 10: Maximum Bending Moment in beams parallel to Z direction for all 5 Buildings in Zone III



Graph 11: Maximum Torsional Moment in beams parallel to X & Z direction for all 5 Buildings in Zone III

©IJRASET: All Rights are Reserved

VII. CONCLUSIONS

The conclusion can be pointed out are as follows:-

A. Maximum displacement in X direction and Z direction increases and when it crosses the limit of 20 %, the structural components fails and it needed to have increase in dimension. Building SOD will be economical.
B. The storey drift will behave same as displacements in both X and Z directions, first it shows incremental values and at certain height, it again decreases. Indian Standardization limit is L/250 i.e. 0.004, when applied to the structure, all buildings behaves safe except SE, fails from 35.5 m height. For this parameter, building SOD will be safe and efficient.
C. Base shear values decreases as the weight of the structure decreases when cutting the percentage area of shear wall. For this, in both X and Z directions, building SOD shows the best parametric values at 20 % shear wall opening.
D. Values of Maximum Axial forces in column decreases when shear wall area decreases, but column fails when axial force values are lower beyond 14015.025 KN limit and therefore building SOD shows the safest value for axial forces.
E. Shear forces in column in both Y and Z direction increase with reduction in Shear wall area, the members fail beyond building SOD values. Hence building SOD shows the safest values for shear forces in column.
F. The moment values in column decreases from building SA to SE and beyond building SOD, the member fails. Hence building SOD shows the safest values for bending moment in columns.
G. Beam in both X and Z direction shows least values of shear forces in building SOD and beyond this, the beam fails.
H. For moments in beam in both X and Z direction, the values increases gradually and beyond the limit, it seems that up to building SOD the structural components are safe and beyond this, the beam fails.
I. Torsion in beam shows limiting parametric values up to building SOD when there will be deduction in shear wall area.

Total 5 different buildings used in this work. The main focus in this work is to show how the values differ from each other when decreasing the shear wall area.

It is found from above study that when there will be excess use of opening beyond the 20 % limit, the stiffness of the structure will be less and the structural components will fail. Due to load transfer criteria of the members 20 % wall deduction is sufficient. Building SOD with 80% coverage performs best of all.

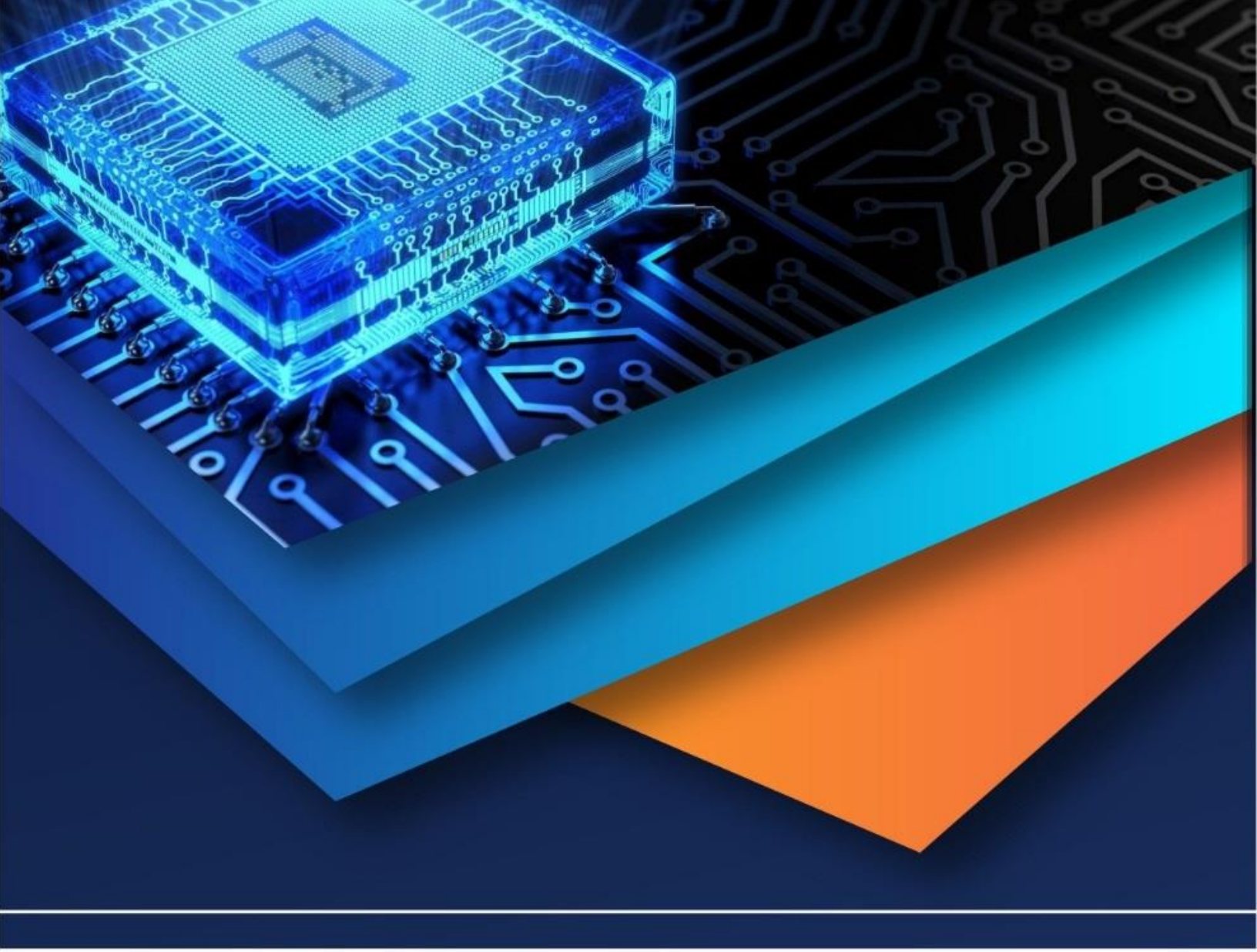
REFERENCES

[1] 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, https://dx.doi.org/10.22161/ijaers.5.9.36
[2] Ashok kankuntla, Prakarsg Sangave, Reshma Chavan, (2016), “Effects of Opening in Shear Wall”, Vol. 13, no. 1, ISSN: 2278-1684, pp. 01-06.
[3] Mahdi Hosseini, N. V. Ramana Rao. (2015), “Earthquakes Analysis of High Rise Buildings with Shear Wall at the Center Core and Center of Each Side of the External Perimeter with Opening”, Vol. 5, no. 12, ISSN: 2319-7064, pp. 59-71.
[4] Ravi Manne, Snigdha Kantheti, (2020), "COVID-19 and Its Impact on Air Pollution", International Journal for Research in Applied Science & Engineering Technology (IJRASET), ISSN: 2321-9653, Vol. 08, Issue 11, pp. 344-346, DOI: https://doi.org/10.22214/ijraset.2020.32139
[5] 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
[6] 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.
[7] Markanday Giri, Sagar Jamle and Kundan Meshram (2020), “Response Spectrum Analysis”, LAP LAMBERT Academic Publishing, Mauritius.
[8] 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.
[9] 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, https://dx.doi.org/10.22161/ijaers.6.4.36
[10] Peyman Ghaderi, Allaedin Behravesh, (2018), “Survey of Influence of Opening Area to Wall Area Ratio on Stiffness Yielding Resistance of Concrete Shear Wall System”, ISSN: 2575-8950, Vol. 5, no. 5, 29-33.
[11] 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

©IJRASET: All Rights are Reserved

[12] 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.
[13] 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.
[14] Shivangi Gupta, Rohit Rai, Smiriti Mishra, (2018), "Analysis of Shear Wall with Opening", Vol. 5, no. 3, ISSN: 2395-0056, pp. 1024-1025.
[15] Sruthy K S, Dr. C Justine Jose, (2017), "Effects of Openings on Reinforced Concrete Coupled Shear Wall", Vol. 8, no. 11, ISSN: 2229-5518, pp. 42-51.
[16] Vishal A Itware, Dr Uttam B. Kalwane, (2015), "Effects of Openings in Shear Wall on Seismic Response of Structure", Vol. 5, no. 7, ISSN: 2248-9622, pp. 41-45.
[17] 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.
[18] 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.

©IJRASET: All Rights are Reserved



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)