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A Case Study on Usage of Actual Soil Condition below Multi-Storied Building under Seismic Loading at Indore City

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Abstract: The people try to live in high rise structures due to increase in the demands of high rise structure with architectural impact. Soil profile beneath the structure also plays an important role to make the superstructure along with the sub-structure on its location. A Structure is said to acceptable if it satisfies the design criteria and hold itself in the same location to oppose the lateral forces. To show the importance of the soil below the construction area, soil investigations were carried out at Indore city. Total 11 bore hole database has used in this research. We have analyzed about different bore holes location for efficient building construction and effectiveness of residential apartment. After observing the necessary needs and fixing the objectives, we have created 11 (G+6) models and different cases named as CaseL1 to Case L11. The input parameters of soil profile used in this research is based on a part of Indore city area. After analysis of output parameters, the main points have been noted down the project concluded that efficient location for construction will be Case L with least result parameters under seismic loads.
Keywords: Transverse Direction, Soil Profile, Residential Apartment, Soil Investigation

I. INTRODUCTION

There has been significant progress in the construction of high-rise buildings in the last two decades. A significant number of these buildings have been constructed in the central region such Indore, Bhopal etc. and many more are either planned or already under construction. There are several properties of tall buildings that can have a significant impact on the design of the building, including that the weight of the building increases non-linearly as the height increases, and thus the vertical load that can be supported by the foundation can be significant. Parameters vary by location or by different areas of the crust. Soil Bearing Capacity and foundation depth is major concern from them. So it is required to analysis the buildings structure such that it is satisfy the ground data such, SBC of soil, Depth of foundation, Earthquake zones, wind parameters etc. through it. The fig 1.1 shown that the super structure rested on the sub structures (foundation and sub soil), so it is necessary to both are taken the load transfer mechanics and with stand against the all the laterals and axial loads. Ground–structure interaction; The effect of a structure consists of the effect between the soil (ground) and the structure built on it. The process by which the influence of soil affects the movement of the structure and the movement of the soil is called soil-structural influence (SSI). The order of the soil is divided from the ground to the ground, and the soil to the point where it meets the main rock. Analytical Approaches for Soil Structure Interaction: Two different approaches i.e. The Direct approach The Substructure approaches have been adopted to analyze the problem of soil-building effects and add the effect of soil suitability to the dynamic analysis. The need for a current scenario is why the behaviour of the soil is being investigated under different loads. New structures are not only in demand but also become the need of hour to fulfil personnel requirement and deeds. To accomplish such kind of needs structural reform has becomes mandatory to comply with safety norms and make possible such kind of structural arrangement. Various structural theories are proposed along with multiple solutions i.e. structural measures are suggested to satisfy this need while maintaining safety of building to resist lateral forces. Successively reviewing various research papers to combat lateral loading spawned by seismic action or wind action for seismic zone III it has been concluded that structural designers have done remarkable work to satisfy mankind necessities by providing some complex but credulous structural systems to ensure structure safety and workability too. Besides several structural arrangements shear wall at core combining to perform as dual system with different grades of concrete in outrigger and wall belt supported system would not be examined so far to optimize the building architecture and configuration against lateral loading. The sole purpose of present research is to investigate the performance of multistory buildings or theme based architecture when subjected to lateral loading generated due to earthquake or wind force and their mitigation strategies to sustain in such kind of delinquent situations. To attain prescribed aim, the optimum case among various cases will be examined as per new codal provisions.

II. OBJECTIVE OF THE WORK

The following objectives are taken in this project

1) To study about soil and its basic parameters with its methods.
2) To Study the various past research based on SSI, theoretical and analytical approach.
3) To modelG+6multi-storeyapartment cases for different bore hole cases.
4) To compare a different models case to find optimized structure.
5) To analyse all the cases by RSA (Response Spectrum Analysis) under dynamic analysis.
6) To assist the different parametric result such as Storey displacement, base shear, overturning moments, storey shears etc. into it.

III.METHODOLOGY AND MODELLING APPROACH

For seismic analysis of multistory building response spectrum method and time history analysis method is recommended for different building configuration as per available input data and requirement of structure. In the present study several frames with variable structural configuration are modeled in Staad pro software and analyzed by Response Spectrum Method as per guidelines given in IS 1893(1):2016 for seismic Zone III. In the current study several models framed with a view of sage of actual soil condition below Multi-storeyed Building under seismic loading of Indore city; analyzed against various seismic parameters to obtain optimum result.

Table 1: Description of parameters taken for analysis

Building configuration	G + 6
Building type	Residential Apartment
Total plinth area	525 m^2
Building Length	5m @ 5 bays
Building Width	5m @ 5 bays
Height of building from footing	31.5 m
Height of each floor and GF height	3.5 m and 4 m
Depth of footing	3 m
Beam dimensions	500 mm x 300 mm with M30 grade
	400 mm x 300 mm with M30 grade
Column dimensions	550 mm x 450 mm with M30 grade
Slab thickness	130 mm
Staircase waist slab	130 mm
Shear wall thickness	125 mm
Material properties	Concrete Grade used: (M30) Steel Rebar used: (Fe 500 HYSD)

IV. TYPES OF MODELS USED FOR ANALYSIS OF STRUCTURE

There are different cases considered for different storied building of different building height, so that response of the seismic behavior of the structure can be predicted. Different models are shown in table 3.2 below:-

Table 2: List of models framed with assigned abbreviation

S. No.	Models framed for analysis	Abbreviation
1.	Residential Apartment (G+6) with Bore Hole Value = 1	Case L1
2.	Residential Apartment (G+6) with Bore Hole Value = 2	Case L2
3.	Residential Apartment (G+6) with Bore Hole Value = 3	Case L3
4.	Residential Apartment (G+6) with Bore Hole Value = 4	Case L4
5.	Residential Apartment (G+6) with Bore Hole Value = 5	Case L5
6.	Residential Apartment (G+6) with Bore Hole Value = 6	Case L6
7.	Residential Apartment (G+6) with Bore Hole Value = 7	Case L7
8.	Residential Apartment (G+6) with Bore Hole Value = 8	Case L8
9.	Residential Apartment (G+6) with Bore Hole Value = 9	Case L9
10.	Residential Apartment (G+6) with Bore Hole Value = 10	Case L10
11.	Residential Apartment (G+6) with Bore Hole Value = 11	Case L11

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A. Details of the Models

Fig. 1 to Fig. 7 showed the details of all model cases.

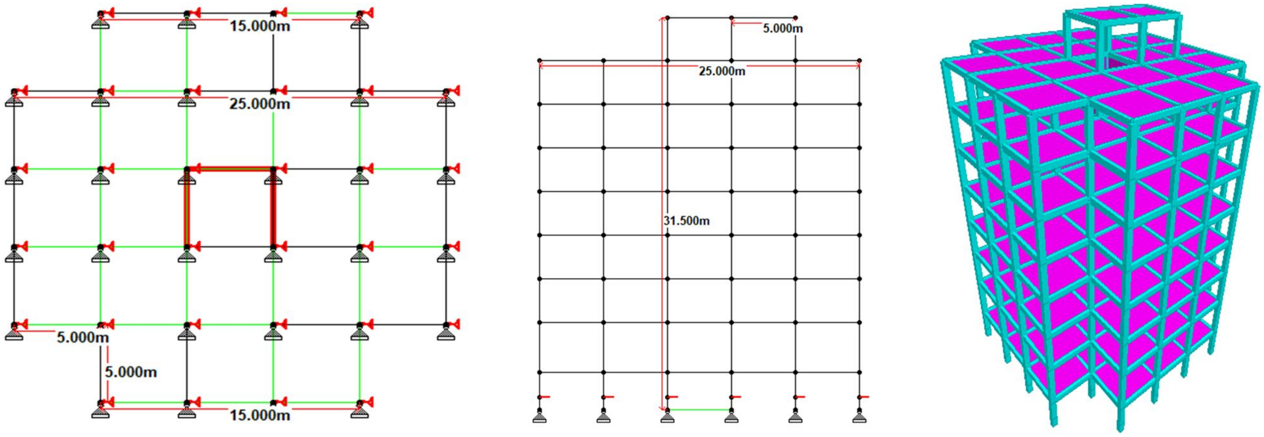

Fig. 1: a) Plan of the Structure   b) Front View of the Structure   c) 3D View of the Structure

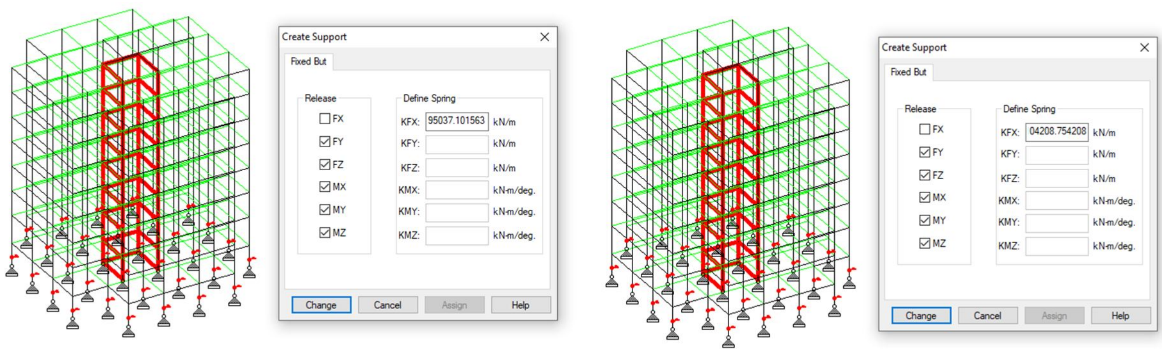

Fig. 2: Case L1 and L2: Residential Apartment (G+6) with Bore Hole Value = 1 and 2

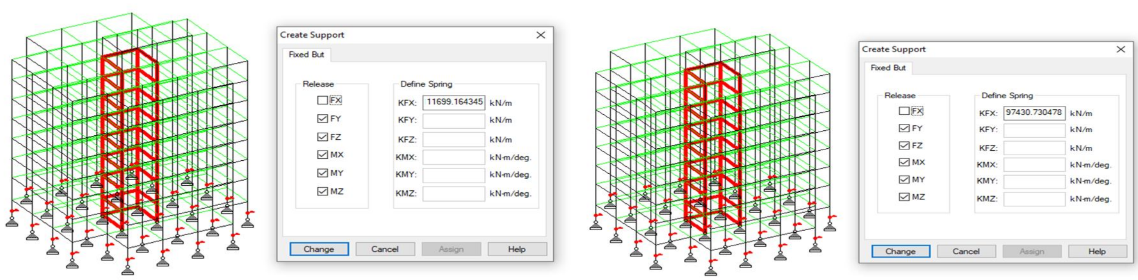

Fig. 3: Case L3 and L4: Residential Apartment (G+6) with Bore Hole Value = 3 and 4

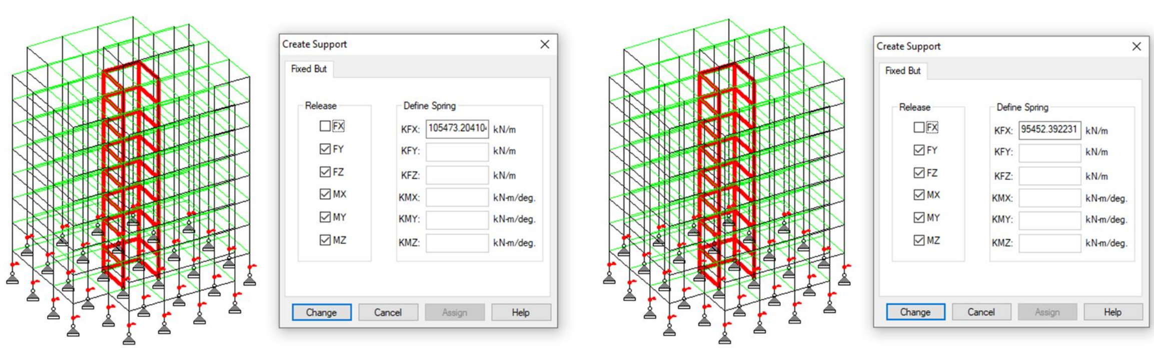

Fig. 4: Case L5 and L6: Residential Apartment (G+6) with Bore Hole Value = 5 and 6

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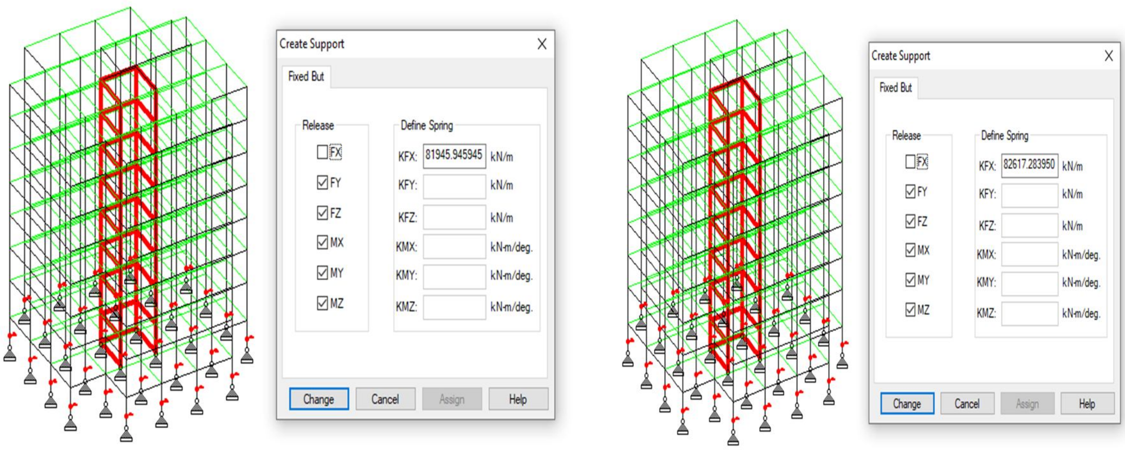

Fig. 5: Case L7 and L8: Residential Apartment (G+6) with Bore Hole Value = 7 and 8

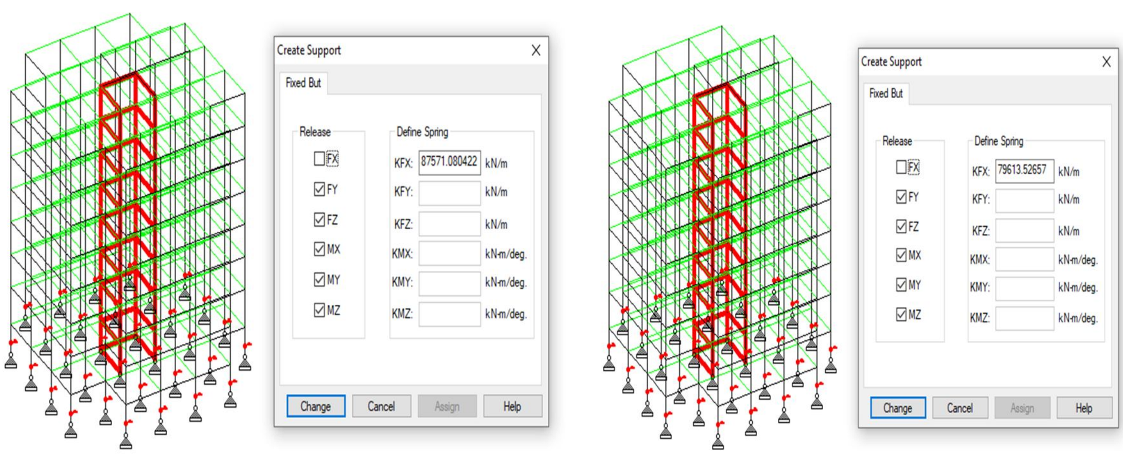

Fig. 6: Case L9 and L10: Residential Apartment (G+6) with Bore Hole Value = 9 and 10

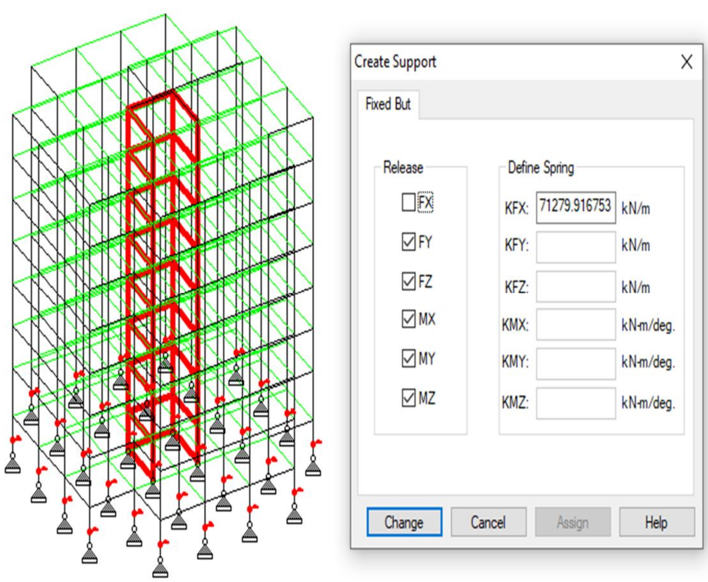

Fig. 7: Case L11: Residential Apartment (G+6) with Bore Hole Value = 11

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V. RESULT PARAMETERS TAKEN

Based on the various model cases (model 1 to 11) the following results are taken in the account to find out the effective model approach. The results are as follows:

A. Parameter 1: Maximum Displacement

Table 3: Max. Displacement Residential Apartment (G+6) with all Bore Hole Values

Cases	Maximum Displacement (mm)	
	For X Direction	For Z Direction
Case L1	133.531	92.078
Case L2	133.254	92.051
Case L3	133.049	92.030
Case L4	133.456	92.071
Case L5	133.218	92.047
Case L6	133.518	92.077
Case L7	133.984	92.124
Case L8	133.969	92.121
Case L9	133.780	92.103
Case L10	134.073	92.133
Case L11	134.416	92.168

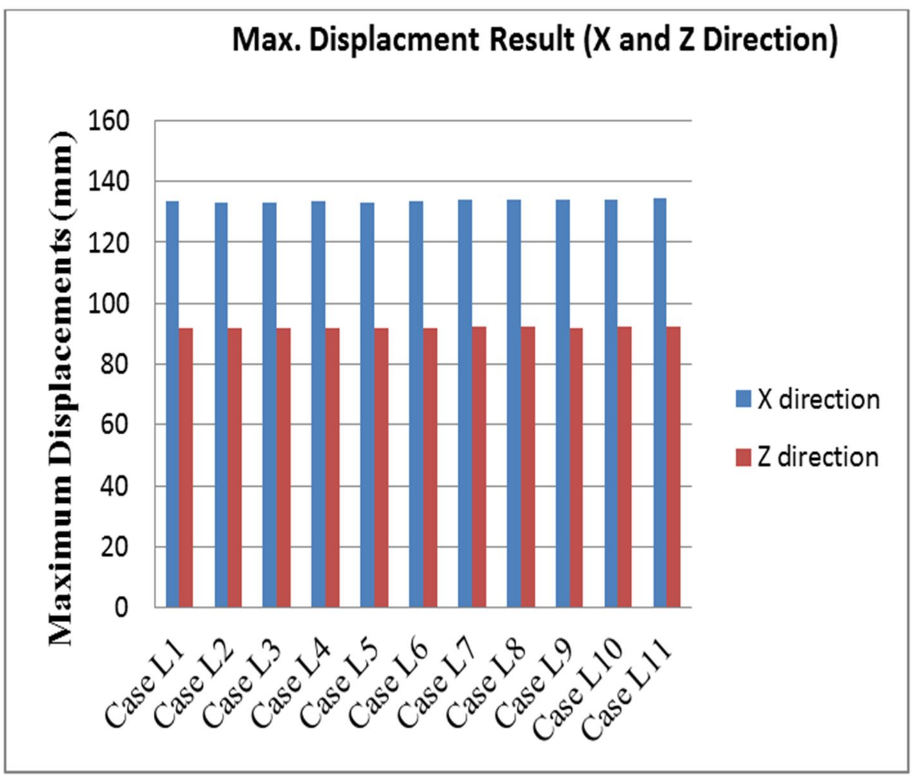

Fig. 8: Graphical Representation of Max. Displacement for Residential Apartment (G+6) with all Bore Hole Values

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B. Parameter 2: Base Shear

Table 4: Base Shear for all for Residential Apartment (G+6) with all Bore Hole Values

Cases	Base Shear (KN)	
	X direction	Z direction
Case L1	4961.87	4850.08
Case L2	4959.14	4850.12
Case L3	4957.05	4850.15
Case L4	4961.14	4850.09
Case L5	4958.78	4850.12
Case L6	4961.74	4850.09
Case L7	4966.13	4850.03
Case L8	4965.90	4850.04
Case L9	4964.25	4850.06
Case L10	4966.94	4850.02
Case L11	4969.95	4849.99

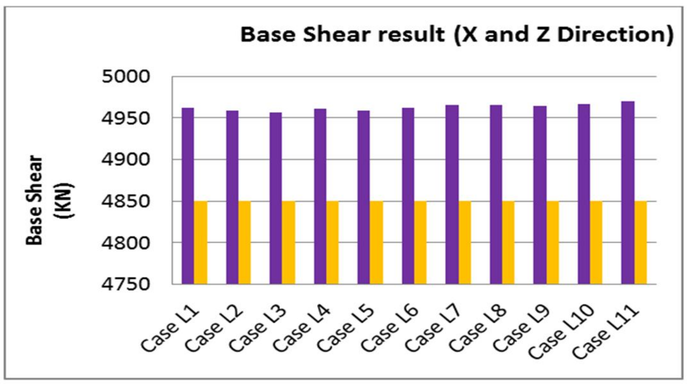

Fig. 9: Graphical Representation of Base Shear for all for Residential Apartment (G+6) with all Bore Hole Values

C. Parameter 3: Maximum Axial Forces in Colum

Table 5: Max. Axial Forces in Column for all for Residential Apartment (G+6) with all Bore Hole Values

Cases	Column Axial Force (KN)
Case L1	8271.548
Case L2	8257.321
Case L3	8246.631
Case L4	8267.705
Case L5	8255.461
Case L6	8270.874
Case L7	8294.412
Case L8	8293.156
Case L9	8284.183
Case L10	8298.85
Case L11	8315.742

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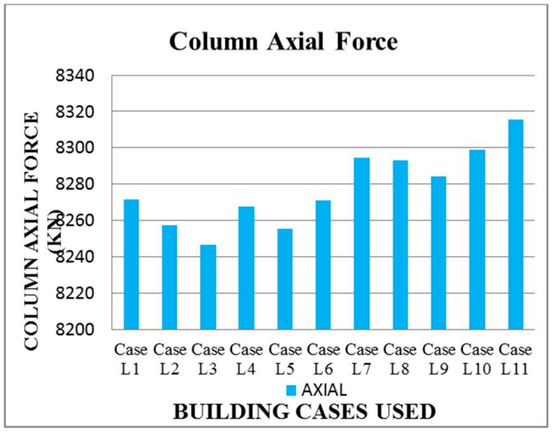

Fig. 10: Graphical Representation of Max. Axial Forces in Column for all for Residential Apartment (G+6) with all Bore Hole Values

D. Parameter 4: Maximum Torsional Moments in Beam

Table 6: Maximum Torsional Moments in Beam for Residential Apartment (G+6) with all Bore Hole Values

Case	Beam Torsional Moments (KN.m)
Case L1	9.546
Case L2	9.546
Case L3	9.535
Case L4	9.544
Case L5	9.539
Case L6	9.546
Case L7	9.557
Case L8	9.556
Case L9	9.552
Case L10	9.559
Case L11	9.567

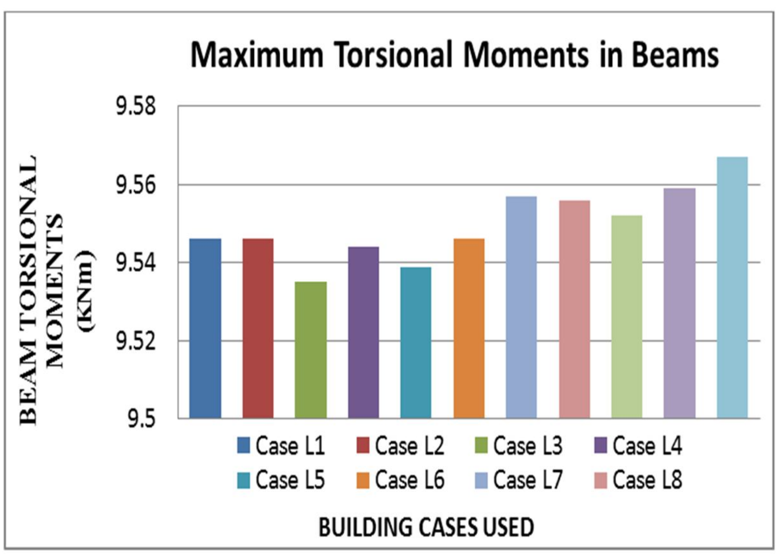

Fig. 11: Graphical Representation of Maximum Torsional Moments in Beam for Residential Apartment (G+6) with all Bore Hole Values

E. Parameter 5: Maximum Torsional Moments in Columns

Table 7: Maximum Torsional Moments in Columns for all for Residential Apartment (G+6) with all Bore Hole Values

Cases	Column Torsional Moments (KNm)
Case L1	14.004
Case L2	13.995
Case L3	13.989
Case L4	14.002
Case L5	13.994
Case L6	14.004
Case L7	14.019
Case L8	14.018
Case L9	14.012
Case L10	14.021
Case L11	14.032

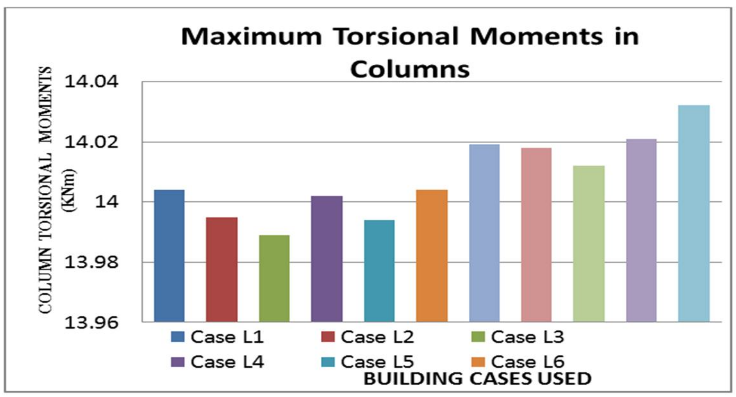

Fig. 12: Graphical Representation of Maximum Torsional Moments in Columns for Residential Apartment (G+6) with all Bore Hole Values

VI. CONCLUSION

We have analyzed about different bore holes location for efficient building construction and effectiveness of residential apartment. After observing the necessary needs and fixing the objectives, we have created 11 (G+6) models in Staad pro software. The input parameters of soil profile used in this research is based on a part of Indore city area. After analysis of output parameters, the main points have been noted down and provided in conclusion part.

On the basis of above parameters following results are obtained from this comparative study.

1) On comparing it has been concluded that the maximum displacement in X direction obtained with a minimum value respectively for Case L3 again maximum displacement in Z direction obtained for case ST2 with a minimum value.
2) As per comparative results, Case L3 for base shear forces in X direction and Z direction shows minimum values respectively with efficient among all cases.
3) As per comparative results in Axial Force, Case L3 is very effective than other cases.
4) On analyzing the Torsional Moment in beams other than Regular building, Case L3 is very efficient where torsion in column provides the same results.

Comparing all the cases Case L3 is the best case among all cases.

As we have studied in this research and also which has shown in the above results that Case L3 is the best suited case and efficient with respect to location of construction, hence one should kept in mind before the same and use the soil investigation report if possible.

VII. FUTURE SCOPE

The following future worked as carried out to get the knowledge of different soil conditions to find deeper concept and new considerable idea through it. These are as follows:-

1) Locations based assessment of the structure to get optimizes location for earthquake resisting building.
2) Use of different types of structural form such steel, bundled tube, bracing etc and comparisons between them.
3) Dimensional analysis: variations in the depth, size of the belt truss and wall.
4) Earthquake approach comparison such as RSA & THA.
5) Dynamic wind analysis such as CFD analysis or wind tunnel.
6) Different software such as midas, sofistik etc. in new upcoming era.
7) Outputs based on the different grades of concrete and steel Rebar.

VIII. ACKNOWLEDGEMENT

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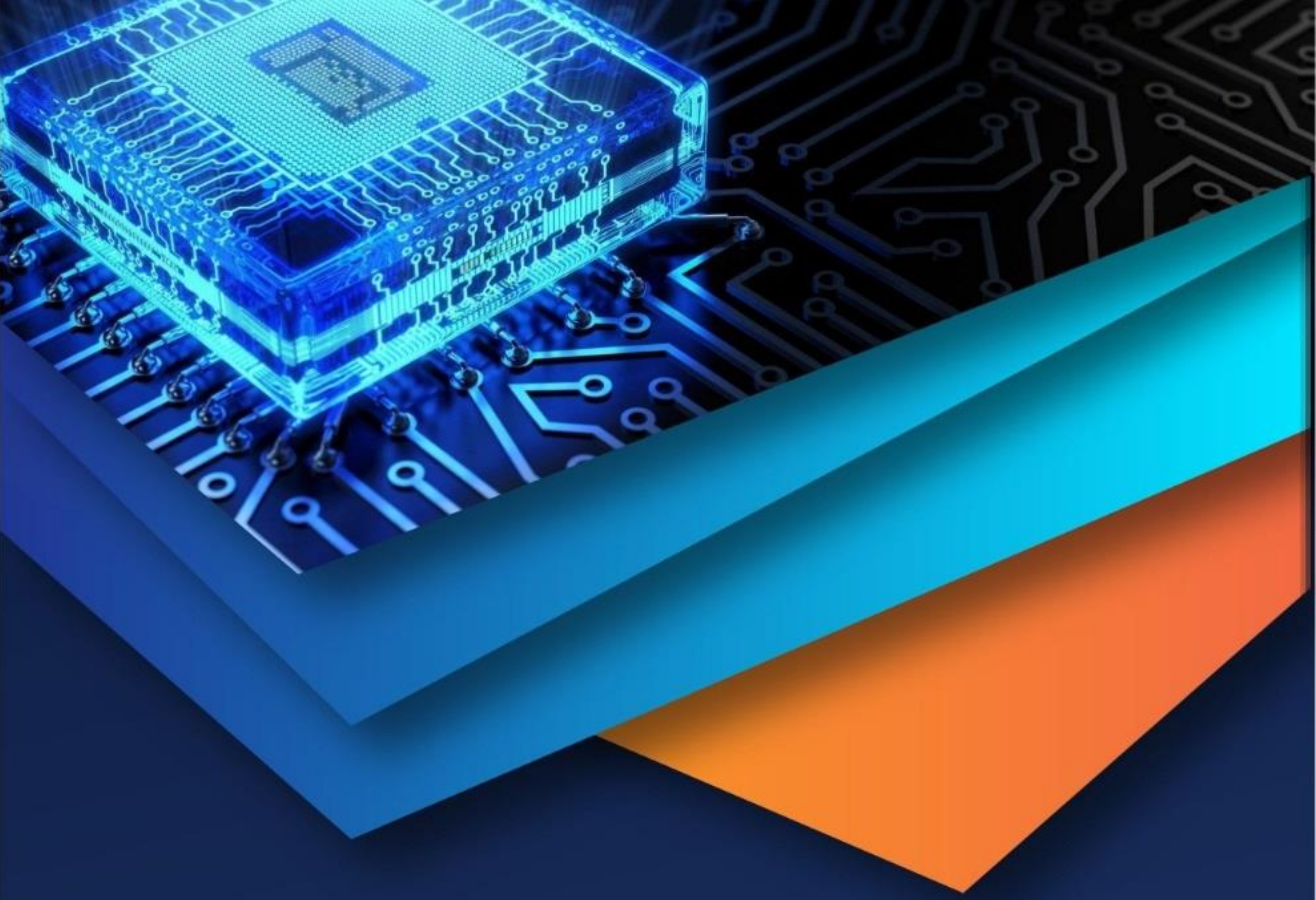
REFERENCES

[1] Michael P. Crisp, Mark Jaksa & et.al. (2020) "Optimal Testing Locations in Geotechnical Site Investigations" Geosciences, MDPI, Pp 1-18.
[2] Ibrahim Oz, Sevket Murat Senel & et. al. (2020) "Effect of Soil-Structure Interaction on the Seismic Response of Existing Low and Mid-Rise RC Buildings" Appiled Science, MDPI, Pp 2-21, doi:10.3390/app10238357
[3] Mansi Jajoriya, Arvind Vishwakarma & et. al. (2020) "Assessment on Different Arrangement of Grouping of Piles by Response Spectrum Method" Journal of Xi'an University of Architecture & Technology Volume XII, Issue V, 2020 ISSN No: 1006-7930, pp 469-480.
[4] Mansi Jajoriya, Arvind Vishwakarma & et. al. (2020) "A Review: Earthquake Analysis of Pile Group with Different Variations in Dimensions & Parameters" International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429 Volume 8 Issue V, Pp 2639-2642.
[5] S. Amaresh Babu, Ahmed Zubedi (2019) "Study on Soil Structure Interaction and Base Isolated System for Seismic Performance of Structures Resting on Different Types of Soils" International Journal of Engineering Development and Research (IJEDR), Volume 7, Issue 4, ISSN: 2321 -9939 Paper-IJEDR1904104, Pp 618-627.
[6] Runbahadur Singh, Oshin Victor &et. al. (2019) "Seismic analysis of buildings on different types of soil with and without shear wall: A review" International Conference on Sustainable Materials and Structures for Civil Infrastructures (SMSCI2019), AIP Conf. Proc. 2158, Pp 020007-1–020007-5, https://doi.org/10.1063/1.5127131
[7] S. M. Hussain, S. K. Tengli (2018) "Study on Torsional Effects of Irregular Buildings Under Seismic Loads" International Journal of Applied Engineering Research, ISSN 0973 -4562, Volume 13, Number 7, Pp 55-60
[8] D. V. Karandikar (2018) "Challenges to Quality Control in Bored Cast-In-Situ Piling in Growing Urban Environment" Indian Geotech Journal, 48(2): Pp 360–376 https://doi.org/10.1007/s40098-017-0277-z
[9] Nawaraj Kapil, Karthik N.M &et. al. (2016) "Case Study on a Structural Building Subjected to Earthquake Forces Considering Soil Structure Interaction" International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321 -8169 Volume: 4 Issue: 5, Pp 234 – 237
[10] Ghalimath A.G, More Sheetal. A &et. al. (2015) "Analytical Approaches for Soil Structure Interaction" International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056 Volume: 02 Issue: 05, p-ISSN: 2395-0072 , Pp 595-600.
[11] S. K. K. Chhetr, K. B. Thapa (2015) "Soil Structure Interaction and Seismic Design Code Provision" Proceedings of IOE Graduate Conference, Pp. 75–87
[12] B. R. Jayalekshmi, H. K. Chinmay (2014) "Effect of Soil Flexibility on Seismic Force E valuation of RC Framed Buildings with Shear Wall: A Comparative Study of IS 1893 and E UROCODE8." Hindawi Publishing Corporation Journal of Structures, Volume 2014, Article ID 493745, Pp1-15, http://dx.doi.org/10.1155/2014/493745,
[13] S. E. A. Raheem, M. M. Ahmed &et. al. (2014) "Soil-Structure Interaction Effects on Seismic Response of Multi-Story Buildings on Raft Foundation" Journal of Engineering Sciences, Assiut University Faculty of Engineering Vol. 42 No. 4, Pp 905-930
[14] H. Matinmanesha, M. SalehAsheghabadi (2011) "Seismic Analysis on Soil-Structure Interaction of Buildings over Sandy Soil" The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction. Procedia Engineering, 1737–1743, 1877–7058, doi:10.1016/j.proeng.2011.07.218
[15] Pradip Sarkar, Biju Kumar Patir&et. al. (2004) "Survey And Assessment of Seismic Safety of Multi-storeyed Buildings In Guwahati, India" 3th World Conference on Earthquake Engineering Vancouver, B.C., Canada, Pp 1212
[16] S. C. Handa, Swami Saran, &et. al. (1984) "Geotechnical Investigations for Foundation Design for Multi- storied Building" International Conference on Case Histories in Geotechnical Engineering, Missouri University of Science and Technology Scholars' Mine , pp 1167-1172., http://ICCHGE1984-2013.



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