IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A SEISMIC STUDY ON LATERAL LOAD RESISTING SYSTEMS AT VARIABLES HEIGHTS CONSIDERING DIFFERENT SOIL CONDITIONS

[1]Syed Mujtaba Ali Firas, [2]Prof. Nadeem Pasha

[1]Student, [2]Professor,

[1]Department of Structural Engineer,

[1]Khaja Bandanawaz University, Kalaburagi, Karnataka, INIDIA.

Abstract: Civil engineering deals with constructing different types of structures with ensuring safety, durability and serviceability. Now days "earthquake "is phenomena that affects the structures with their safety and serviceability. The amount of damage that earthquake can done to structures is depend on Type of building, Type of soil, Technology used for earthquake resistance, and last but not the least Location of building. An effect of earthquake is largely depend on type of soil in which foundation of building is done because earthquake changes the motion of ground that results the failure foundation. So it is important to study the behavior of different soil at the time of construction of structures. Also earthquake can resisted by various technologies used in building, one of these are shear wall. It improves the structural performance of building subjected to lateral forces due to earthquake excitation. This study focuses on behaviour of different types of soil at the time of earthquake occurrence with bracing and shear wall impact on structures for G+5 RCC building and G+11 RCC building and comparing the result of displacement, storey drift, base shear, and time period.

I. INTRODUCTION

Today's high-rise buildings are growing more thin, which increases risk of sway in compared to previous high-rise structures. Earlier structures were planned for gravity loads, but because of their height and seismic zone, the engineers now have to account for lateral loads because of earthquake and wind forces. This presents new issues for engineers. When designing earthquake-resistant building structures, seismic zone factor plays a significant role, since the zone factor fluctuates from low to highly severe. Soil type is a significant consideration in construction of earthquake-resistant buildings, since kind of soil alters structure's behaviour and design. So, in order to accommodate all of the lateral pressures, we must construct structure in such way that it can survive the largest amount of time possible without causing damage to society as a whole.

For as long as humanity has been, we have been fascinated by height and have always tried to strive for stars. For thousands of years, civilizations have shown their power and riches via impressive and gigantic monuments like the pyramids and skyscrapers. It is common for skyscrapers to be designed in accordance with lateral loads. It has become more difficult for structural engineers to fulfil drift criteria while also limiting the structure's architectural effect as buildings have become higher and narrower. Developments into finite element technique as well as structural design and analysis software have led to a wide range of new architectural and structural shapes. There are many problems ahead for the profession, and increasing dependence on computer modeling may not be answer. Changing the way buildings are planned and constructed will need a better knowledge of structural behaviour and use of computational tools to facilitate this.

II. OBJECTIVES OF STUDY

2.1 OBJECTIVES

1. Equivalent static approach in all zones for all kinds of soils is used to determine lateral displacements, drift, base shear, and time period at varying heights for bare frame.
2. Using the Equivalent static Method throughout every zone and for all soil types, determine lateral displacements, drift, base shear, and time periods for frames with shear walls.
3. At various heights and in all soil types zones using equivalent static method, determine lateral displacement, drift, base shear, and time period.

2.2 SCOPE OF WORK

1. The modelling and evaluation was done for RC framed building
2. Infill Walls have not been considered however, the mass of infill was considered
3. By applying seismic zone factors comparing the result of Base shear, Time period, displacement and drift.
4. By varying the height of structures the study was carried out and results were compared.
5. For comparing result of model including shear wall as well as bracing in higher seismic zone.

III. METHODOLOGY

1. In India, there is an area of interest in a difficult zone..
2. Research and evaluation of academic works.
3. Studying shear wall efficacy into all models with variable height of structures.
4. Study of bracing performance in all models with variable height of structures.
5. Evaluate and analyze outcomes with or without shear wall, within zone-V for hard,\s moderate and softer soil

3.1 ANALYTICAL MODELLING

1. The work had been performed for studying impact of seismic load upon a structure with variable height.
2. Analysis is carried out in seismic zone V.
3. The soil type used as hard, medium, soft soils.
4. After analyzing completely all models in E-tabs the parameters like story drift, story displacement, time period and Base shear is noted.
5. Lastly all models are compared.

3.2 MODEL DESCRIPTION

A total of 30 models have been prepared with 15 models of 20m height and remaining 15 models of 40m height.

Model (1-5) Hard soils and seismic zone V was considered

MODEL -1 :-A G+5 RC Bare framed building.
MODEL-2:-A G+5 RC framed structureincluding shear wall into middle along X and Y direction.
MODEL-3:- A G+5 RC framed structureincluding shear wall around corners.
MODEL-4:-A G+5 RC framed building with bracings in middle along X and Y direction.
MODEL-5:-A G+5 RC framed building with bracings at corners.

Model (6-10) medium soils and seismic zone V was considered

MODEL-6 :- A G+5 RC Bare framed building.
MODEL-7:- A G+5 RC framed structureincluding shear wall into middle along X and Y direction.
MODEL-8:- G+5 RC framed building with shear wall at corners.
MODEL-9:-A G+5 RC framed building with bracings in middle along X and Y direction.
MODEL-10:- A G+5 RC framed building with bracings at corners.

Model (11-15)Soft soils and seismic zone V was considered

MODEL-11:- A G+5 RC Bare framed building.
MODEL-12:- A G+5 RC framed structureincluding shear wall into middle along X & Y direction.
MODEL-13:- A G+5 RC framed building with shear wall at corners.
MODEL-14:-A G+5 RC framed building with bracings in middle along X and Y direction.
MODEL-15:- A G+5 RC framed building with bracings at corners.

Model (16-20) Hard soils and seismic zone V was considered

MODEL-16:- A G+11 RC Bare framed building.
MODEL-17:-A G+11RC framed building with shear wall in middle along X and Y direction.
MODEL-18:- A G+11 RC framed building with shear wall at corners.
MODEL-19:-A G+11 RC framed building with bracings in middle along X and Y direction.
MODEL-20:- A G+11 RC framed building with bracings at corners.

Model (21-25) Medium soils and seismic zone V was considered

MODEL-21:- A G+11 RC Bare framed building.
MODEL-22:-A G+11 RC framed building with shear wall in middle along X & Y direction.
MODEL-23:- A G+11 RC framed building with shear wall at corners.
MODEL-24:- A G+11RC framed building with bracings in middle along X and Y direction.
MODEL-25:- A G+11 RC framed building with bracings at corners.

Model (26-30) Soft soils and seismic zone V was considered

MODEL-26:- A G+11 RC Bare framed building.
MODEL-27:-A G+11RC framed building with shear wall in middle along X and Y direction.
MODEL-28:-A G+11 RC framed building with shear wall at corners.
MODEL-29:-A G+11 RC framed building with bracings in middle along X and Y direction.
MODEL-30:- A G+11 RC framed building with bracings at corners.

3.3 Different types of models develop in E-tabs

MODEL-1:- A G+5 RC Bare framed building.(hard soils)
MODEL-6:- A G+5 RC Bare framed building.(Medium soils)
MODEL-11:- A G+5 RC Bare framed building.(Soft soils)

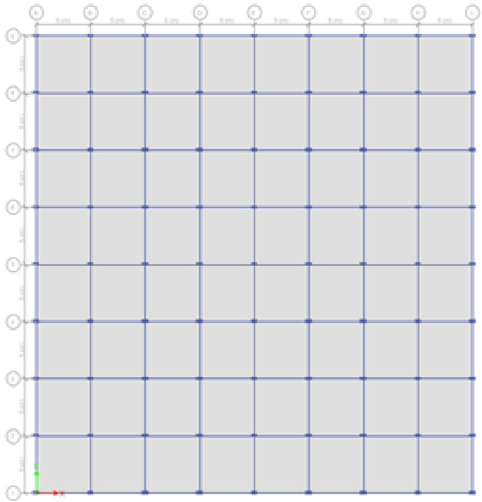


Figure 1a: Plan of model-1,6,11

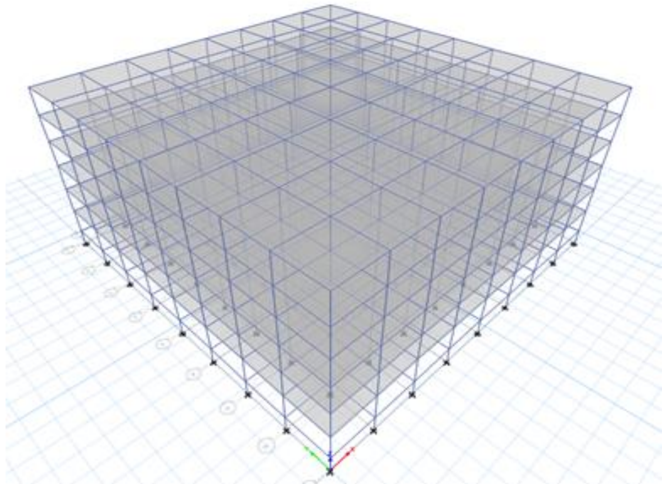
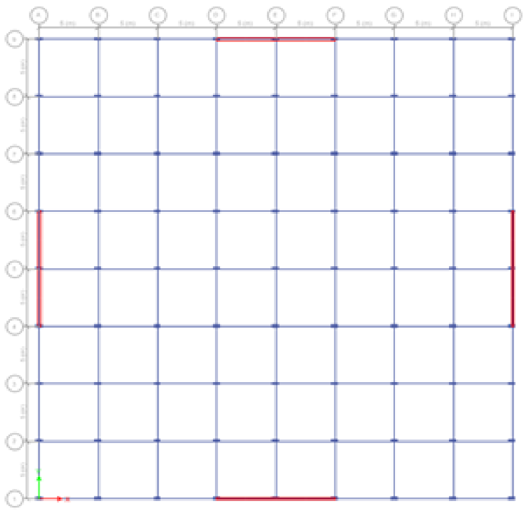


Fig1b: 3D view of model-1, 6, 11

MODEL-2:-A G+5 RC framed structure including shear wall into middle along X & Y direction. (Hard soils)
MODEL-7: A G+5 RC framed structure including shear wall into middle along X and Y direction (Medium soils)
MODEL-12:- A G+5 RC framed structure including shear wall into middle along X and Y direction. (Soft soils)



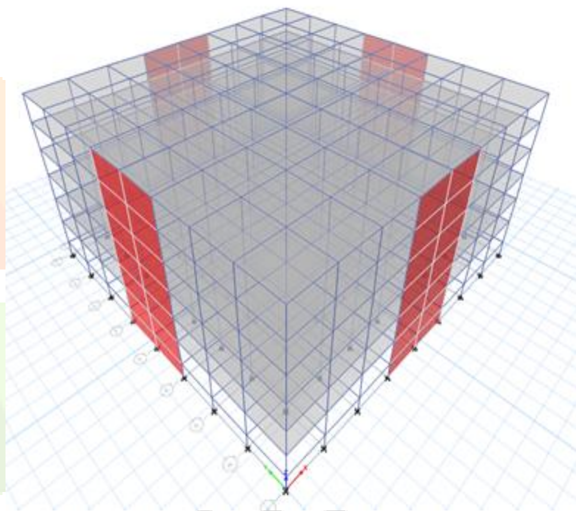


Figure2.a: Plan of model-2, 7, 12Figure 2.b: 3D View of model-2, 7, 12

3.4 Details of Structures:

Building type	Commercial Building
Frame type	Reinforced Concrete moment resisting frame
No of stories	G+5, G+11
Story height	3350mm
Bottom storey height	2000mm
Height of building	22.10 m for G+5 42.2m for G+11
Plan of building	40mx40m,
Thickness of wall	230mm
Live load	3.5KN/m^2(As per IS-875-Part-II)
FF	1.0 KN/sqm
Concrete grade	M40
Steel grade	Fe-500N/mm^2
Brick masonry Unit weight	20 KN/cum
Size of column	C-300 x 600 mm for G+5, C-600x900mm for G+11
Beam size	300 x 450mm
Slab thickness	150mm
Shear wall thickness	230mm

Bracing	ISMB400
Earth quake zone	5
Soil assumed	Hard, Medium, soft
Response Reduction Factor	5 (SMRF)
IF- importance factor	1.5
Damping factor	5%

3.5 LOAD ANALYSIS:

The following loads are taken into account for the multi-storey building analysis in different earth quake zones and different column shapes.

1. DL
2. LL
3. EQL as per IS-1893:2002

3.5.1 : Dead load:

Dead weights are the constantly existing loads. Dead weights depend on the unit weight of the material Dead weights include the dead weight of walls, ceilings, beams, supports, etc. also the permanent accessories that are present in the structure.The unit weight of material which is used in building are given in the IS - 875 (part-I)-1987.A regular load in a structure (which include a bridge, building, or machine) this is because of the load of the members, the supported structure, and everlasting attachments or accessories.

3.5.2 Live load:

Live load is a civil engineering time period that refers to a load that could extrade over time. The weight of the burden is variable or shifts locations, including while humans are on foot round in a constructing. Anything in a constructing that isn't constant to the shape can bring about a stay load, seeing that it is able to be moved round.

Live masses (additionally referred to as carried out or imposed loads or variable actions) can extrade through the years and are regularly the end result of using a structure. Typical payloads can include; People, wind on a bump, furniture, vehicles, the weight of books in a library, etc.

3.5.3 Seismic load as per IS-1893:2002:

The layout seismic base shear (V_b) or the overall layout lateral pressure alongside any precept route is computed through the use of the relation from IS 1893-2002 -- **Vb = Ah x W**

IV. METHODS OF SEISMIC ANALYSIS

These days, the constructions are intended to oppose in a tremor as indicated by horizontal power plan. Seismic create waves which move from the beginning of its area with speeds relying upon the force and greatness of the tremor. The effect of seismic on the designs relies upon the firmness of the construction, solidness of the dirt media, stature and area of the construction, and so forth the quake powersare endorsed in IS 1893:2016 (part-I).

Here is list of the many seismic analysis techniques that may be used.

1. Equivalent static technique
2. Response spectrum technique
3. Time history technique
4. Pushover analysis

Equivalent static method:

Such technique of figuring out the layout lateral pressure is likewise referred to as the equal static technique or technique of seismic coefficients or linear static technique. within side the formulation in step with the leaflet. First, the rated simple thrust for the complete given constructing is calculated after which the ensuing simple thrust is sent over the complete constructing height. The shear pressure in every ground degree is sent to individuals.

Seismic Base Shear (Vb)

The style worth of the fundamental seismic shear force (V_b) or the entire design shear force on any main direction is calculated victimization the magnitude relation from IS 1893 (Part 1), page 17, section 7.2.1

$\mathbf{V_b}$ = Ah x W

Where

Ah=$(Z/2)\times(I/R)\times(Sa/g)$

Here

Z = earth quake zone Factor which was given in IS 1893-2000 page 10.

I=Importance Factor

R=Response Reduction factor

Sa/g=Response Acceleration Coefficient.

W=Seismic Weight of Building

The design force should be Distribution by using the following eqn.
design Base-Shear (V_b) may be dispensed alongside peak of constructing through usage of the underneath relation.

$Q_i = V_b \times (Wihi^2 / Wjhj^2)$

Here

Q_i = lateral design force upon floor i

W_i=Seismic floor weight,

h_i = floor height measured from base

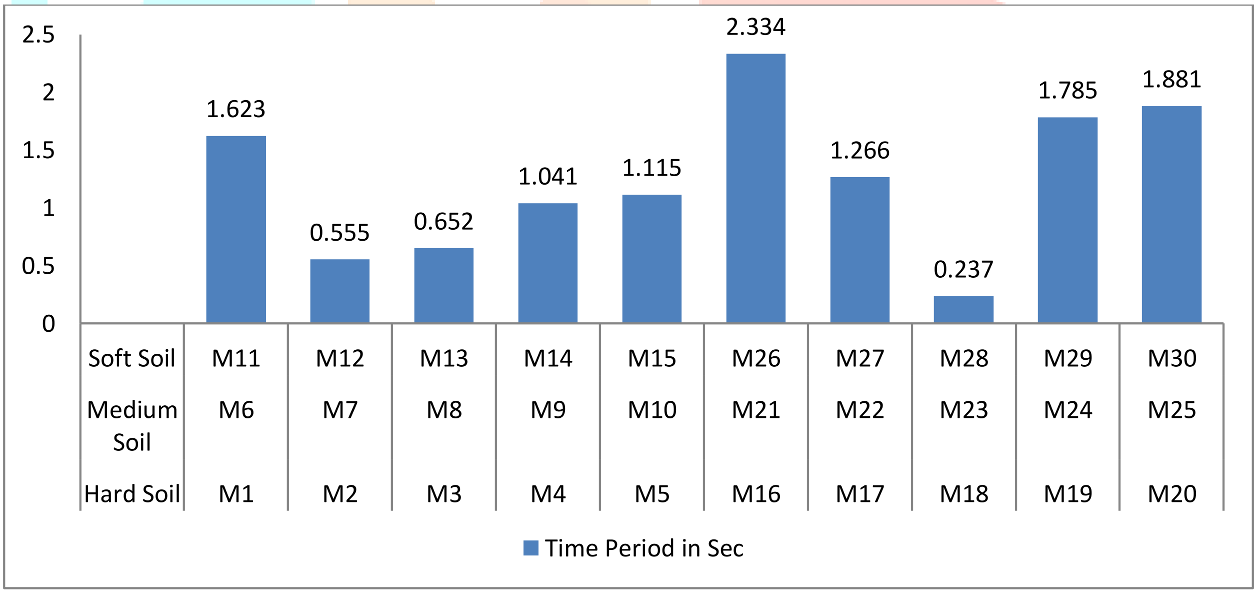
n=Number of storey's into building.

V RESULTS AND DISCUSSION

5.1 GENERAL: Earth quake effects are used to study about theThirty models. The analysis of all different building models is carried out with software ETABs 2015. Study results such as the displacements, the deviations of the floor slabs and the period, the basic shear of all building models are displayed and compared.

5.2 Time Period: It's described as time it takes for completing a cycle of vibration for moving to very particular point.

Model No			Time Period in Sec
Hard Soil	**Medium Soil**	**Soft Soil**	
M1	M6	M11	1.623
M2	M7	M12	0.555
M3	M8	M13	0.652
M4	M9	M14	1.041
M5	M10	M15	1.115
M16	M21	M26	2.334
M17	M22	M27	1.266
M18	M23	M28	0.237
M19	M24	M29	1.785
M20	M25	M30	1.881



5.3 Displacement:

Storey displacement is defined as it is the displacement of considered floor with reference to the base of a structure, usually the base of a building being aground.

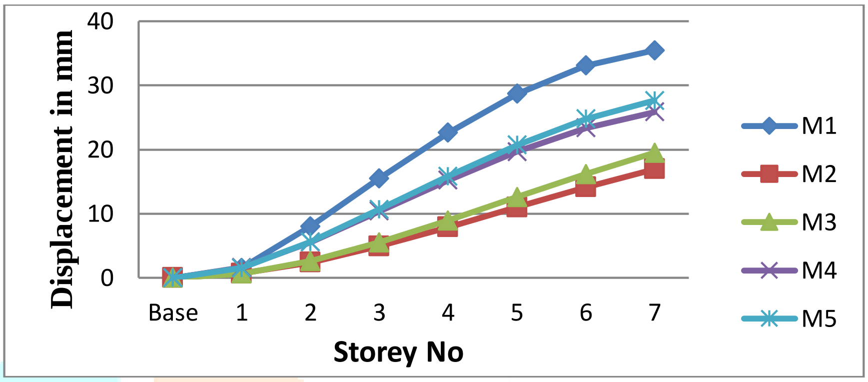
Deflection limit is H/500 here H-is height of structure as per clause 5.6.l Indian standard -800:2007

Allowable deflection for (G+5) 22100/500 = 44.20m m

For G+11: 44200/500 = 88.40mm

Table 5.3.1: Below table shows displacement in mm of various models due to ESA alongside X-direction.

Storey No	M-1	M2	M3	M4	M5
7	35.463	16.976	19.477	25.838	27.652
6	33.077	14.123	16.156	23.343	24.768
5	28.69	11.023	12.574	19.662	20.696
4	22.622	7.883	8.944	15.201	15.854
3	15.493	4.924	5.521	10.38	10.687
2	8.011	2.399	2.613	5.554	5.614
1	1.541	0.685	0.64	1.616	1.538
Base	0	0	0	0	0



Graph 6.2: Displacement in mm due to ESA along X-direction

VI OBSERVATION AND CONCLUSION

1. The time period for model M1 is highest as compare to other models from model M1 to M5.
2. Similarly time period for model M16 is highest as compare to other models from model M16 to M20.
3. It's perceived as the base shear increases as type of soil changes.
4. The base shear is minimum for model M1as the shear wall is placed the base shear increases.
5. The displacement is maximum for bare frame model (G+5). As the shear wall is placed the displacement decreases.
6. Similarly displacement is maximum for bare frame model (G+13). As the shear wall is placed the displacement decreases.
7. The storey drift is minimum for bare frame model.
8. The storey drift increases as the shear wall increases.
9. Provision of shear wall is more effective if we placed SW at middle along X and Y direction for reducing displacement.
10. Provision of bracing is also effective for reducing displacement.
11. The provision of shear wall at centre is more effective than placing of shear wall at corners.
12. Also provision of bracing at middle is more effective than placing of bracing at corners.
13. Hence it can conclude that placing of SW at centre is more effective than placing at corners.

6.1 SCOPE FOR FURTHER STUDY:

1. The work is carried out for seismic analysis; hence the work may extend for wind analysis.
2. The work is taken by considering shear wall and bracing further work may extend for dampers.
3. The work is carried out for RCC work further work may extend for steel building.
4. The work is carried out for G+5, G+11, further work may extend for higher storey.
5. The work is carried out for Equivalent static analysis, further work may taken up by considering response spectrum analysis, time history analysis.

REFERENCES

1. **Runbahadur Singh , Oshin Victor and ShilpaIndra Jain:** Seismic Analysis of Buildings on Different Types of Soil with and without Shear Wall , Proceedings of the International Conference on Sustainable Materials and Structures for Civil Infrastructures (SMSCI2019)
2. **G V RAMA RAO, J C SUNIL & R VIJAYA:** Soil-structure interaction effects on seismic response of open groundstorey buildings, Indian Academy of Sciences 22 MAY 2021
3. **TejParkar , N.G. Gore:** Review on Behaviour of Lateral Load Resisting System for High-Rise Building, International Journal of Management, Technology And Engineering**ISSN NO : 2249-7455**

4. **HariDevenderAnchoori, SeshaSrinivasBollapragada:**Effect of Lateral Loads and Soil Structure Interface on Structural Performance of RCC Chimney, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-9 Issue-1, October 2019

5. **SurajSangtiani, Simon J, Satyanarayana J and DheerajSangtiani:** Performance Of Tall Buildings Under Lateral Loads With Different Type Of Structural Systems, International Journal of Civil Engineering and Technology (IJCIET)Volume 8, Issue 3, March 2017,

6. **Umesh L Mali, S.N.Patil**: Review on lateral load resisting system for different geometric shapes of high-rise buildings, Publication Since 2012 | ISSN: 2321-9939 | ©IJEDR 2020

7. **AbhijeetBaikerikar, KanchanKanagali:** Study Of Lateral Load Resisting Systems Of Variable Heights In All Soil Types Of High Seismic Zone, IJRET: International Journal of Research in Engineering and Technology

8. **K.ShaikshavaliSmt .B. Ajithal l:** Lateral Systems in Tall Buildings for Medium Soil Type and Different Seismic Zones, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181
9. **NEHRP Consultants Joint Venture A partnership of the Applied Technology Council and the Consortium of Universities for Research in Earthquake Engineering**: Soil-Structure Interaction for Building Structures, September 2012 National Institute of Standards and TechnologyPatrick D. Gallagher, Under Secretary of Commerce.