OPTIMUM POSITON OF SHEAR WALL IN RC BUILDING SUBJECTED TO SEISMIC LOAD

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ABSTRACT: Shear walls are structural members used to elongate the strength of R.C.C. structures. These shear walls will be construct in each level of the structure, to form an effective box structure. Equal length shear walls are placed symmetrically on opposite sides of outer walls of the building. Shear walls are added to the building interior to provide more strength and stiffness to the building when the exterior walls cannot provide sufficient strength and stiffness. It is necessary to provide these shear walls when the tolerable span- width ratio for the floor or roof diaphragm is exceeded. The present work deals with a study on the improvement location of shear walls in symmetrical high rise building. Position of shear walls in symmetrical buildings has due considerations. In symmetrical buildings, the center of gravity and center of rigidity coincide, so that the shear walls are placed symmetrically over the outer edges or inner edges (like box shape). So, it is very necessary to find the efficient and ideal location of shear walls in symmetrical buildings to minimize the torsion effect. In this work a high rise building with different places of shear walls is considered for analysis. The multi storey building with 22 storey is analyzed for its displacement, strength and stability using ETABS-2015 software. For the analysis of the building for seismic loading with Zone-V is considered with soil medium. The analysis of the building is done by using equivalent static method.

1. INTRODUCTION

In high-rise buildings, it's necessary to produce enough rigidity for lateral wind or earthquake hundreds concrete wall panels are designed for buildings in unstable zones due to higher bearing capacity, higher malleability and stiffness. Beams and columns are large, and also the reinforcement on the beam and column connections is sort of significant so the joints are severely clogged and it is troublesome to put the concrete and vibrate at the joints Safety. This sensible problem needs the introduction of wall panels in tall buildings.

“Structural forms: Lateral masses can broaden excessive stresses, create rocking actions or motive vibrations, so it's miles very critical to have enough electricity of the shape towards vertical masses. The load resistance gadget or the form of the shape need to take in the electricity precipitated via way of means of those transverse forces via way of means of moving or deforming without collapsing. Determining the structural form of a excessive-upward push or excessive-upward push constructing might preferably best contain the association of the primary structural factors to correctly face up to the diverse combos of shear and gravity masses Internal making plans 1) The fabric and production 2) The kind and length of the horizontal load 3) The outside architectural remedy 4) The peak and proportions of the constructing and5) Planned region and set up of deliver structures The better and thinner a production, the greater critical its static aspect and the greater a appropriate production shape or a appropriate gadget ought to be decided on for the transverse load of the constructing. For tall homes designed for the equal motive and with the equal peak and materials, the performance of the shape may be as compared to its weight according to unit area.

Shear wall: Shear partitions are partitions which are used to withstand shear resulting from shear forces. Many rules make partition wall layout obligatory for tall buildings. Retaining partitions are supplied if the middle of gravity of the development location and the masses appearing at the shape range via way of means of extra than 30%. The concrete wall is supplied to convey the middle of gravity and the middle of hardness nearer within side the variety of 30%, i.e. the lateral pressure must now no longer boom much. These wall panels begin at the muse stage and make bigger to the complete top of the building. Wall panels are aligned in a vertical route as huge beams that face up to earthquakes downward and are typically supplied in each the width and period of the building. Wall panels on systems in earthquake inclined regions require unique info. The creation of the wall panels is simple, due to the fact the info of the wall reinforcement is highly smooth and smooth to use on site. Wall panels are powerful each in phrases of creation charges and in phrases of performance in minimizing earthquake harm to load-bearing and non-load-bearing elements.

Components of Shear Walls
RC wall panels and reinforced masonry wall panels are rarely lightweight walls that can withstand transverse forces. If a wall has alternating doors, windows, or openings, the wall should be viewed as a group of relatively versatile columnar parts and wall segments and comparatively rigid elements such as wall segments.

Column segments: Column segments are vertical participants which are extra than 3 instances the thickness and much less than 2 and a 1/2 of instances the width, the burden is typically specially axial, even though it is able to provide a few resistance to lateral forces of wall. Pillar is constructed integrally with wall, a part of the column sticking out from the wall is known as a pilaster. The load-bearing segments ought to be designed for concrete according with ACI 318.

Wall support: Wall helps are sections of wall whose horizontal period is among two, five and six instances their thickness, with a mesh peak of as a minimum two times the horizontal period.

Wall segment: A wall segment is a component of a wall panel, which is the main component of the load-bearing capacity in wall panels

Important features when planning and dimensioning wall panels: In all high-rise buildings, the question of sufficient rigidity and avoidance of large shifts is just as important as the correct load-bearing capacity. 2 decisive advantages over truss systems.

Necessity of Shear Walls:
1. It offers sufficient strength to withstand large lateral loads without unnecessary additional costs.
2. Provides sufficient rigidity to withstand lateral displacement up to allowable limits, reducing the risk of non-structural damage.

2. LITERATURE REVIEW

1. Youssef I. et.al; (2014): To investigate effects of changing the location, form, and size of wall panels in floor plan, this research presents a comparative analysis of a conventional multi-story reinforced concrete structure with twenty stories. During seismic analysis, the ESA technique and RS analysis are carried out at separate locations. To investigate structure's seismic characteristics, historical displacement, drift, and foundation shear, the software package ETABs v.16.2 is used for the seismic analysis. Historical drift values are within limitations in accordance with Egyptian regulation (ECL 201/2012).
2. VarshaR.Harnea:- Main objective of this study is to determine the area of the wall slab in a multi-story building. Building in question is 6-story RCC structure situated in NAGPUR and is subjected to Zone II seismic stress. As per the 2002 edition of IS 1893 (PART-I), the coefficient approach STAAD Pro wall surface converter was used to conduct these analyses. Wall slab function for a 6-story structure was examined in 3 unique scenarios. Wall panels must be installed in multi-story structures so that they can resist transverse stresses.
3. Priya Kewat, Kavita Golghate: Subject of his research is seismic behavior of multi-story buildings with and without wall panels. Specifically, he is interested in C- and T-shaped panels placed at structure's corners, edges, and center, with thicknesses ranging from 150 mm to 350 mm. Partition walls were provided to reduce lateral displacement and floor deflection values.
4. Ashish S. Agrawal, S.D.Charkha (2012): This put up offers the observe of a 25- tale constructing in Zone V with a initial observe this is analyzed through converting exclusive positions of wall panels of various shapes to decide parameters together with ground flow, axial load and displacement. ETAB package. In this newsletter we've tested the have an effect on of the placement of the shear wall with absolutely exclusive shapes for decisive parameters together with the flow of the structure, the axial load and the displacement. It became out that building famously exhibits jagged motion of right and left roof edges due to torsion & produces excessive moments and forces in bar as eccentricity grows.
5. Sandeep Gupta, et.al: Therefore, the purpose of this have a look at is to analyze the affect of the placement of the shear wall at the seismic behavior, the usage of a ordinary and abnormal shape in comparison with the shear wall in exclusive positions, for the reason that axial forces, the moments of bending and displacements are parameters. To be performed on this thesis, thru a complete have a look at of the literature and an evaluation of

10-tale homes for the seismic zones of Zone II and Zone IV

6. P.P.Chandurkar,et.al. (2013): Primary goal of this effort is to find optimal configuration for wall panels in structures with several stories. 4 distinct models were used to assess the wall panels' efficacy. Model 1 is a bare frame structure system while other three models are of double structure type. Zones II, III, IV, and V all subject tensor buildings to seismic loads. By removing and restoring yard wall's backing, we can determine lateral displacement, attic drifting, & first floor's overall cost in both scenarios.

7. P. B. Oni , et.al: In current body of work, 3 & 5-story building models with and without shear walls were examined. In accordance with IS: 1893 (Part 1) -2002, equivalent reaction spectroscopy and static methods are completed. using ETABS v9.1.1 tool for finite detail analysis. Unstable overall performance is evaluated using abuse pushover testing in accordance with ATC-40 guidelines for Earthquake Space V in India. Effect of building prime's version on the shear wall's structural response is also covered in study. This study demonstrates how well Push over evaluation compares to the two most used methods of evaluation, RSA & ESA. It is quite clear from research that curved shear wall will successfully redirect the lateral pressures that are acting on structure.

8. Rająt Bongilwar, et.al: Shear walls have a major effect on fragility of buildings, as this peek at shows. In order to test this theory, G+8 story buildings were considered with and without shear partitions and evaluated for a number of variables, including base shear, storey waft ratio, lateral displacing, bending second, and shear force. Models have been used to study significance of shear walls. The first version is bare-bones, without the shear wall; subsequent versions are entirely different, with the shear wall acting as a starting point for booting. FEM software application ETABS 2016 is utilized for modeling and analysis of all styles. Using Equivalent static approach, we were able to complete examination of all styles. Base shear, story drifting ratio, lateral displacement, bending second, and shear force are some of comparable metrics that have been used to complete results evaluation.

9. R.S.Mishrą, et.al (2015): Assessment of structure's seismic conduct is specialty of this examination. Using the following software: STAAD.PRO, IS 1893: 2002, IS 13920: 1993, and IS 456: 2000, the test became completed. Evaluation spans eleven stories with five bays per floor, each with a four-meter span; height from ground to ground is 3 meters; & height from main ground to floor ground is 2.80 meters. Building is going to be located in India's Bhilai, Chhattisgarh region, which is seismic area II. Using STAAD.PRO, we discovered that 1st and 5th floors had smooth soil. One approach to test whether a building can withstand a seismic load is to place a bracing wall at certain points around it. A shear wall may be found in three different locations: on the perimeter, in the middle, and in the center.

3. OBJECTIVES OF THE STUDY

3.1 Objectives:

1. The important motive of the project is also to learn as a comparison of seismic response to G+25 Buildings for optimal location of shear walls, that we can choose the best possible path Construction in earthquake areas.
2. The present test is an example of multi-story RC structures placed G + 25 in seismic zone -IV and examining the behavior of the structure in seismic areas.
3. To analyze a multistorey building with different location of shear wall and to compare its important parameters.

3.2 Scope of Study:

This examination is an example of multi-storey structures in G + 25 reinforced concrete placed in seismic zone-IV and allowing the behavior of the structure to be studied in seismic zone**.** The actual point of consideration is to discover the execution level and compare the working with the assistant of limit and request of the working for composed earth quake force, in the end reasonable design of working to be utilized as a part of that region is recommended.

1. The analysis is carried considering the building is placed on isolated footings.
2. Using Etabs modeling of G+25 is done.
3. RC building is analysed using Equivalent static method.
4. Seismic parameters are studied by providing shear wall at different location.
5. To check the impact of building having totally diverse positioning of shear wall.

4. METHODOLOGY

3D model is created and all studies are done using ETABS. Considering both geometric nonlinearity and material inelasticity, the program is prepared to seek for the geometric nonlinear behavior of 3D frames under static or dynamic loadings. Chemistry values, nonlinear static pushover, and nonlinear dynamic analyses are all within the software's capabilities. It also takes static masses, such as forces or displacements, as well as dynamic actions, like accelerations.

An effort to study seismic impact on G+25 multi-story RC-framed structures is being made in this research. This 26-story RC-framed structure was modelled using the ETABS 2020 program. We create RC building models with various shear-wall locations. The next step is to compare the outcomes. Zone IV seismic zones are considered, with Medium soil type. Seismic or earthquake load, DL load, and IS 875-PART-I and IS 875-PART-II, respectively, have been satisfied in these buildings according to IS 1893-2002. Evaluation is carried performed using the Equivalent technique. Time, tale drift, base shears, and deformation/displacement are some of the outcomes that are calculated. Once analysis is complete, the data are presented in a graph format that allows for the sequential discovery of conclusions.

4.1 **Models Description:** A total of seven models were prepared for seismic analysis, and results were compared.

1. Model-1-: Bare frame model
2. Model-2-: Bare frame model with shear wall along X-direction.
3. Model-3: Bare frame model with shear wall along Y-direction.
4. Model-4: Bare frame model with shear wall along X and Y-direction.
5. Model-5: Bare frame model with shear wall along X and Y-direction and core wall a centre.
6. Model-6: Bare frame model with shear wall along X-direction and core wall a centre
7. Model-7: Bare frame model with shear wall along Y-direction and core wall centre.

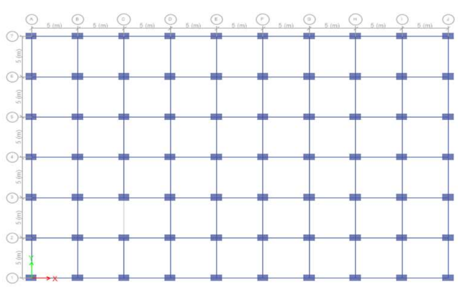


Fig-1a Plan of bare frame model

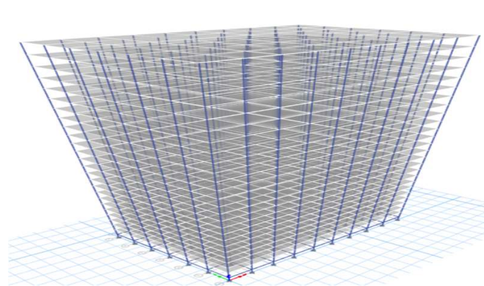


Fig-1b: 3D View of bare frame model

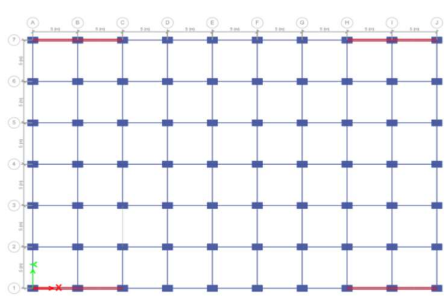


Fig-2a: Bare frame model having shear wall along X-direction

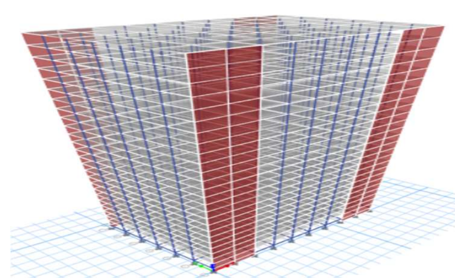


Fig-2b: 3D View of Bare frame model having shear wall along X-direction

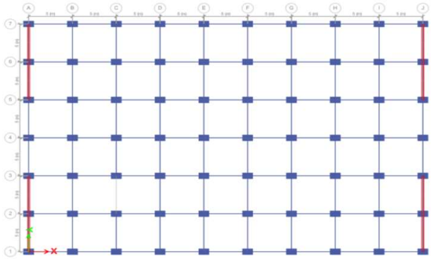


Fig-3a: Bare frame model having shear wall along Y-direction

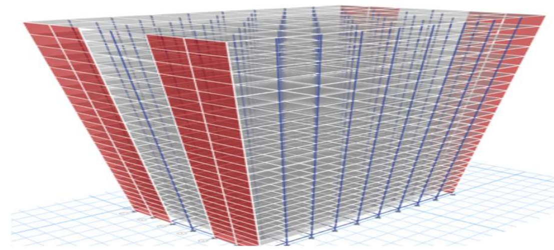


Fig-3b: 3D view of bare frame model having shear wall along Y-direction

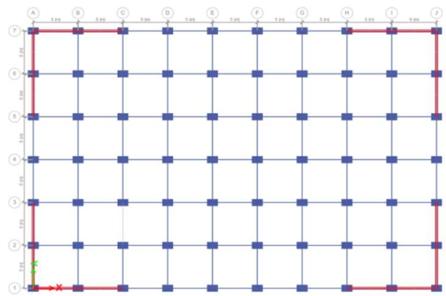


Fig-4a: Bare frame model having shear wall along X and Y-direction

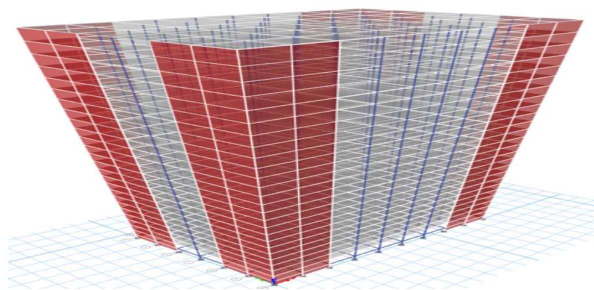


Fig-4b: 3D view of bare frame model having shear wall along X and Y-direction

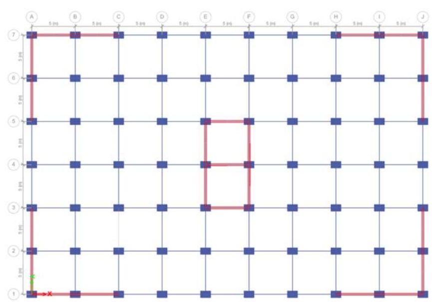


Fig-5a: Bare frame model having shear wall along X and Y-direction and core wall at center

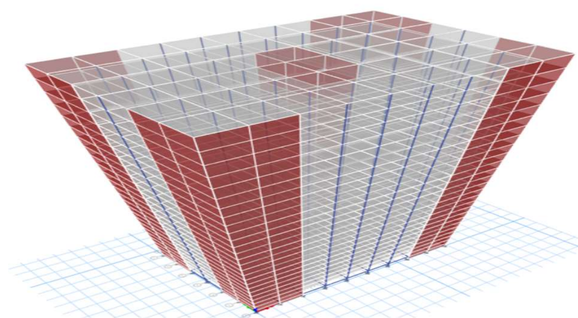
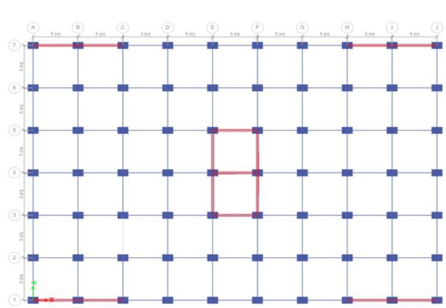


Fig-5b: 3D View of Bare frame model having shear wall along X and Y-direction and core wall at center



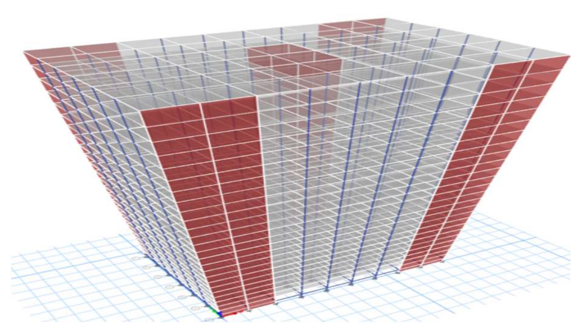
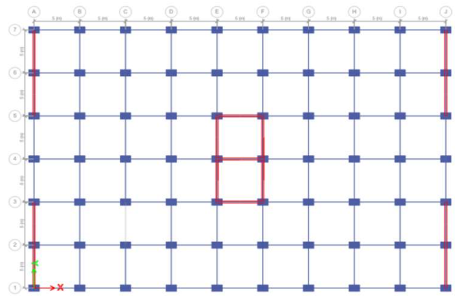


Fig-6a: Bare frame model with shear wall along-X and core wall at center

Fig-6b: 3D View of Bare frame model with shear wall along-X and core wall at center



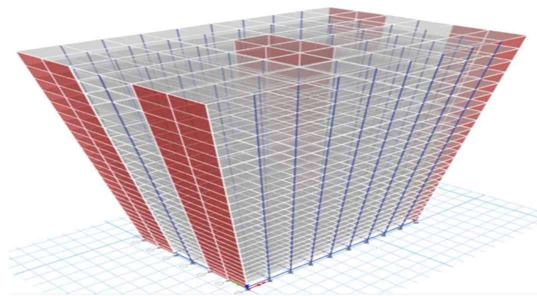


Fig-7a: Bare frame model with shear wall along-Y and core wall at center

Fig-7b: 3D View of Bare frame model with shear wall along-Y and core wall at center

4.2 Details of Structures:

Building type	Commercial Building
Frame type	Reinforced Concrete moment resisting
Total number of storey	G+25
Each storey Height	3.35m
Bottom storey Height	2.0m
Full height of building	85.75m
Plan of building	45mx30m
wall Thickness	230mm
LL	3.0 KN/sqm (As per IS-875-Part-II)
FF	1.0 KN/sqm
Concrete Grade	M40
Steel Grade	Fe-500N/mm^2
Unit weight of masonry	20-KN/cum
Column size	0.8mx1.2m
Beam size	300mm x 500mm
Thickness of slab	150mm
Shear wall thickness	230mm
Earth quake Zone	IV
Soil	medium
Response Reduction Factor	5 (SMRF)
Importance factor	1.5
Damping ratio	5%

4.3 **LOAD ANALYSIS**: Following loads are thought-about for analysis of RC high-rise building with completely different position of shear wall.

1. Dead load as per IS 875- 1987
2. Live load as per IS 875- 1987
3. Earthquake load as per IS 1893- 2002

5. METHODS OF SEISMIC ANALYSIS

5.1 General: 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 powers are endorsed in IS 1893:2016 (part-I).

5.2 LINEAR STATIC ANALYSIS (Equivalent Static Method):

5.3 LINEAR DYNAMIC ANALYSIS (Response Spectrum Analysis)

5.4 Time History Analysis

5.5 Pushover Analysis

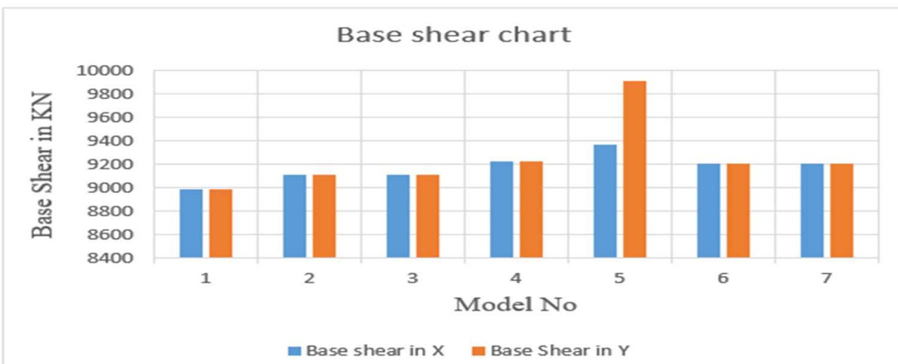
6. RESULTS AND DISCUSSION

6.1 **GENERAL:** Seismic loads are applied to the analysis of the ten construction models. The analysis of all different construction models takes place with the software ETABs 2020. The results of the analysis are shown as displacements, ground displacements and period, basic thrust of all construction models and compared.

6.2 Time Period: It's nothing however time needed for finishing one cycle of vibration to pass during a given point.

Graph-6.1 Time period in seconds of all models

6.3 **Base-Shear**: Determine maximum horizontal forces which will occur at structure's base as result of an earthquake.



Graph-6.2 Base shear in KN of all models

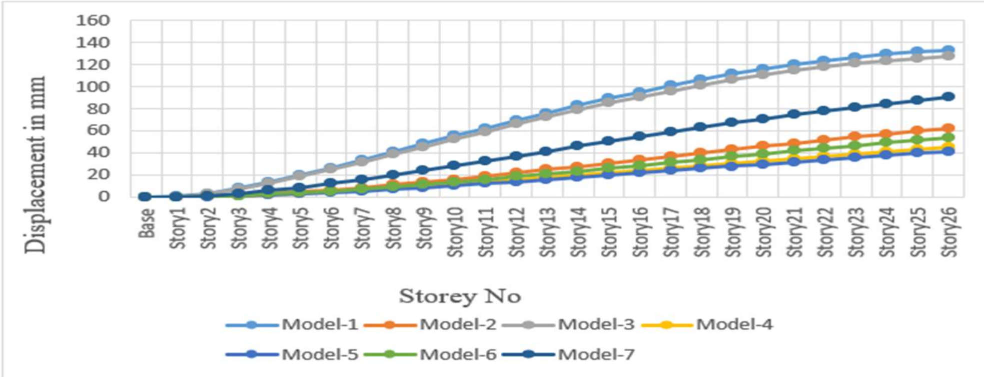
6.4 **Displacement:**

The behavior of the models in the presence of seismic loads is examined for understanding impact of seismic loads. Displacements that can occur due to various lateral loads are determined and tabulated for each model.

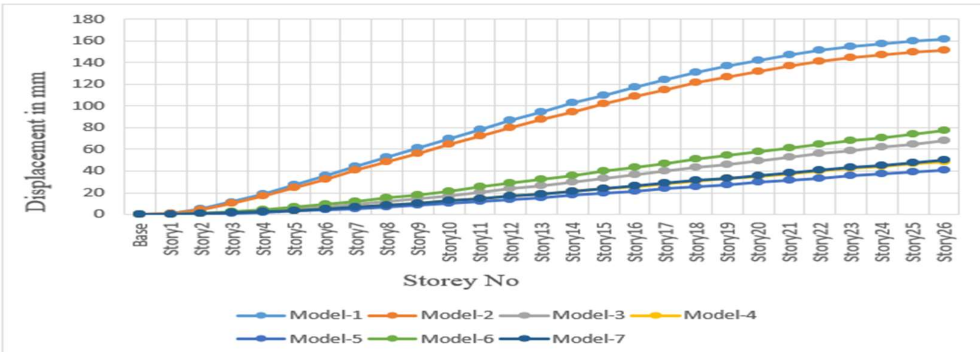
As per the **IS** that the most allowable displacement in any multistoried building is Hs/500, Where **Hs** is height of building.

Maximum allowable displacement for present models are

= 85.75/500 = 0.1715m.

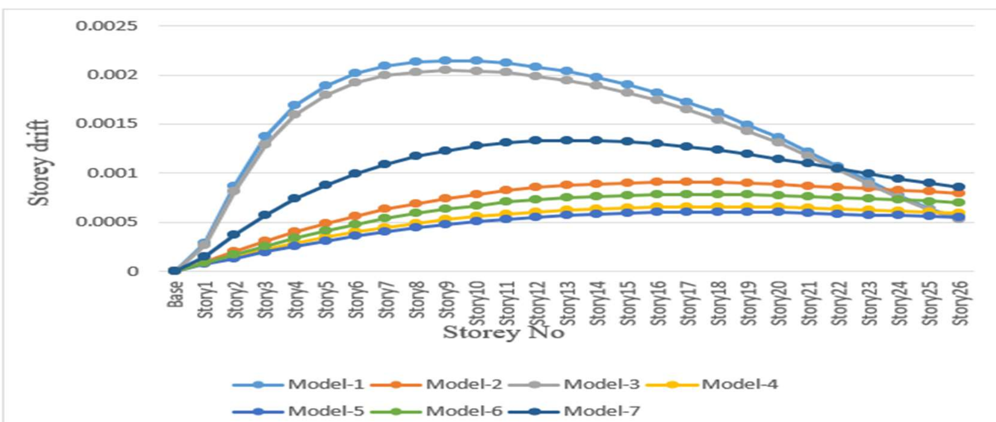


Graph-6.3 Displacement in mm of all models due to seismic load along X-direction

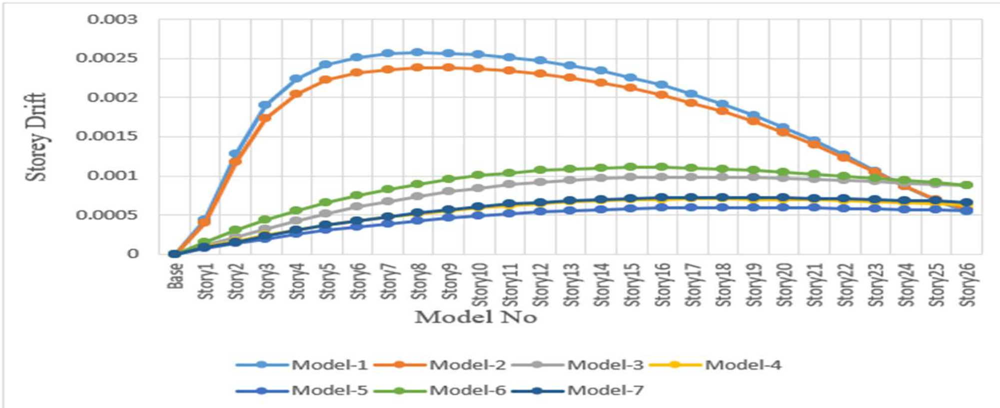


Graph-6.4 Displacement in mm of all models due to seismic load along Y-direction

6.5 Storey Drifts: Highest allowed drifting for each building is = 0.004H, as per IS 875 part 3 Highest allowable drift =0.004*3350= 13.40 mm for present models



Graph-6.5 Storey drifting of all models due to seismic load along X-direction



Graph-6.6 Storey drift of all models due to seismic load along Y-direction

7. OBSERVATION AND CONCLUSION

1. It is observed that the time period for model-1 and model-2 is almost same, and it is highest of all other models.
2. It is noticed that as the shear wall was placed only in Y-direction the time period gets reduces of about 6.77% compared to model-1.
3. It's seen as shear wall was placed both in X and Y direction the time period gets reduces by an amount equal to 49.15% compared to model-1.
4. It is also noted that when shear wall was placed along X and Y direction and core wall at center the displacement gets decreases by an amount equal to 52.54% compared to model-1.
5. The base shear for model-1 is less compared to all other models.
6. As we placed shear wall in X-direction the base shear gets increases of about 1.29% which is very small.
7. As we placed shear wall in Y-direction the base shear remains same as that of model-2.
8. It's seen as shear wall are placed in X &Y direction and also at center of building as core wall the base shear gets increases of about 4.03% compared to model-1.
9. Displacement is most pronounced for model-1.
10. As the shear wall is placed along X and Y direction it is observed that the displacement gets decreases of about 65.82% compared to model-1.
11. It is also noticed that as the shear wall placed along X-direction and core wall at center there is much reduction of displacement of about 59.43% compared to model-1.
12. For model-1, storey drifting is found to be minimal.
13. As the shear wall are placed then the storey drift gets increases.

7.1 SCOPE FOR FURTHER STUDY:

1. The present work is taken up for 26 storey building. Further work may extend for higher storey building.
2. The present work is taken for seismic load in zone-IV. The work may extended for zone-V.
3. Current research is taken for regular building. Work may extend for irregular building.
4. The work is taken for linear static analysis. It is extended for non-linear analysis.

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