Study on Optimum Location of Shear Wall and Bracing of a Multistory Building with Different Type of Soil Condition

A Thesis Submitted
In Partial Fulfillment of the Requirements
For the Degree
Of

MASTER OF TECHNOLOGY

In

Structural Engineering

By

Mohd Rizwan

(University Roll No. 1180444007)

Under the Guidance of

Mr. Bilal Siddiqui

(Assistant Prof.)

BABU BANARASI DAS UNIVERSITY

LUCKNOW

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CERTIFICATE

Certified that **MOHD RIZWAN** (1180444007) has carried out the research work presented in this Thesis entitled ***"STUDY ON OPTIMUM LOCATION OF SHEAR WALL AND BRACING WITH DIFFERENT TYPE OF SOIL CONDITIONS"*** for the award of **MASTER OF TECHNOLOGY (Structural Engineering)** from BABU BANARASI DAS UNIVERSITY, LUCKNOW under my supervision. The Thesis embodies results of original work, and studies are carried out by the student himself and the contents of the Thesis do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

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DECLARATION

I hereby declare that the Thesis entitled "**STUDY ON OPTIMUM LOCATION OF SHEAR WALL AND BRACING WITH DIFFERENT TYPE OF SOIL CONDITION**" in the partial fulfillment of the requirements for the award of the degree of Master of Technology (Structural Engineering) of **BABU BANARASI DAS UNIVERSITY**, is record of the own work carried under the supervision and guidance of **Mr. BILAL SIDDIQUI** to the best of my knowledge this Thesis has not been submitted to **BABU BANARASI DAS UNIVERSITY** or any other University or Institute for the award of any degree.

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ABSTRACT

In multistory building structure there quite a few parameters of concern which should be considered for the impact of earthquake and wind load. There are numerous ways by way of which the exhibition of a structure during the seismic movement can be improved. Bracing and shear wall is the best technique for parallel burden opposing framework as it is practical and simple to apply. In this project, G+14 storey building, along with effective location of bracing and shear wall at different type of soil type are being considered for the analysis. The performance of building will be evaluated on the basis of following parameters –Storey displacement, Storey drift, storey shear and Base shear. In this work, the effective location of shear walls and effective location of bracing at different type soil condition with the overall analysis to be carried out using E tab software.

ACKNOWLEDGEMENTS

I wish to express my deepest gratitude and indebtedness to my supervisors, **Mr. Bilal Siddiqui**, **Mr.Faheem Ahmad Khan** and to the Head of Department **Mr. Anupam Mehrotra** for their stimulating ideas, numerous constructive suggestions and guidance, continuous encouragement and invaluable support throughout this study. Without their advice, encouragement and support, this thesis would not be completed.

Finally, I would like to dedicate this research work to my family and friends (**Kirti Yadav**) whose continuous love and support guided me through difficult times.

Mohd Rizwan

(M-Tech. Structural Engineering)

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INTRODUCTION

1.1 General

Generally, it observes that the seismic layout of buildings has to satisfy as a minimum fundamental requirement first, the structure must behave elastically and defend particularly brittle nonstructural additives against minor earthquake ground shaking. Therefore, a structure need to have enough strength and elastic stiffness to limit structural displacement, which include inter storey drift. Second, the structure need to not disintegrate in a chief earthquake. For this case, significant damage of the shape and non-structural additives is acceptable. In order for a shape no longer to crumble and thereby reduce the loss of life, it must have big power dissipation ability during massive inelastic deformation. In general structure, structure which exhibit solid hysteretic loop carry out well beneath the massive inelastic cycle loading traits of major earthquake. Such solid hysteretic characteristics of structure may be obtained provided that the structural member and joints are designed to possess enough ductility

In seismic Analysis we come to understand that earthquake are maximum volatile, disturbing and unpredictable of all herbal disasters, in which it is very difficult to store life and engineering properties. Care has to take for each step of production of a constructing from foundation part When earthquakes take place, a constructing undergoes dynamic motion. Because of subject of inertia forces that may additionally act within the opposite direction to speeding up of earthquake excitation. These inertia forces normally called seismic masses delta by means of assuming forces externally to the constructing. To conquer those problem, we want to become aware of seismic overall performance of multistory building for the duration of numerous horizontal forces resisting system. This is due to the fact to make sure that the high rise building withstand during earthquake event. Hence, can save as many lives as possible. During earthquake the performance of a structure depends on many factor inclusive of stiffness, good enough lateral strength, simple and regular configuration etc.

At present India is developing at a very fast rate which requires increased demand of infrastructure facilities with the growth in population. Due to increase in population the demand of housing is also increasing, so to full fill the need for construction of housing and commercial buildings the use multi-storey building is highly in demand now days. These types of development require safety both for life and property because multi storey buildings are highly susceptible to additional lateral load due to earthquake and wind.

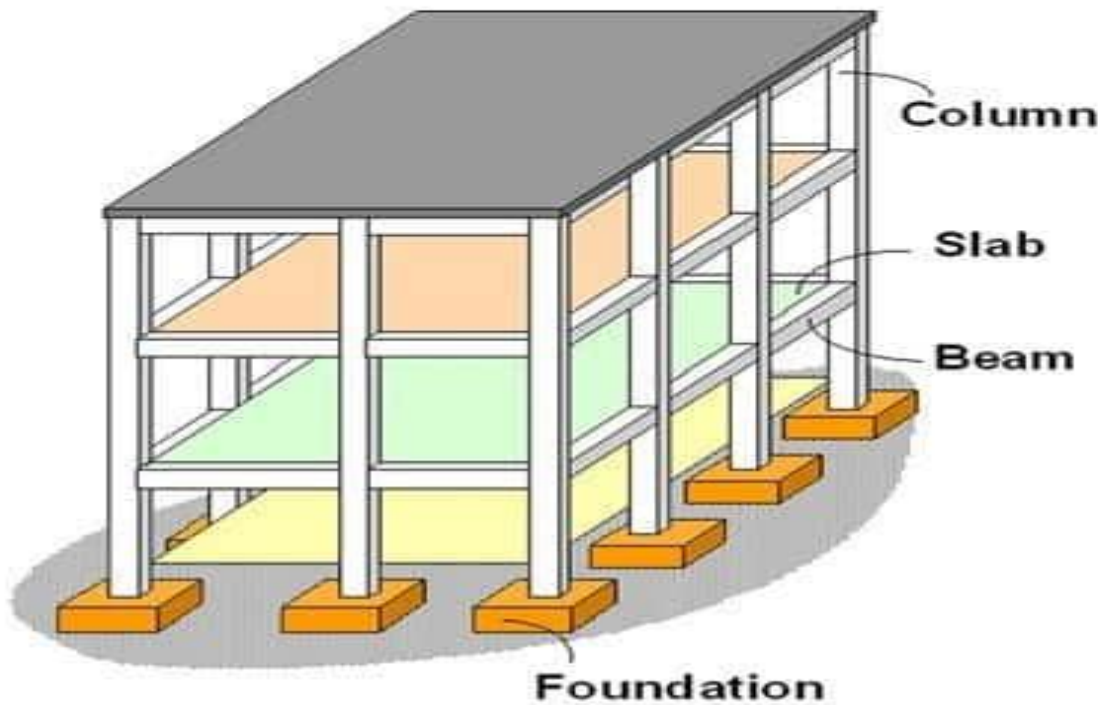

Fig 1.1 R C Frame Structure

Concrete has become universal building material and more appropriate structural forms such as shear wall and tube structures. The high dead load characteristics are no limited on the height of concrete building. Otherwise, the dead load from the concrete tends to be more significant in minimizing the sway deflection and floor vibration as well as instability problem. Tall building cannot be defined in specific terms related to height or number of floor. Building to be considered as tall when the structural analyses and design are affected by the lateral loads. The lateral loads begin to dominate the structural system and take on increasing importance in the overall building system when the building heights increase. Vertical load, lateral load effects on building are quite variable and increase rapidly with increase in height. The strength, rigidity and stability were three major factors to consider in design of such structures. Basically there are two ways to satisfy these requirements that may be by increasing the size of the member beyond to achieve the strength requirement or change the form of the structure into something more rigid and stable. Reinforced Concrete frames are the most common construction practices in India, with increasing numbers of high-rise structures adding up to the landscape. There are many important Indian cities that fall in highly active seismic zones. Such high-rise structures, constructed especially in highly prone seismic zones, should be analyzed and designed for ductility and should be designed with extra lateral stiffening system to improve their seismic performance and reduce damages. Generally, it is recognized that seismic design of buildings should satisfy at least two fundamental requirements. First, the structure must behave elastically and protect relatively brittle non-structural components against minor earthquake ground shaking. Therefore, a structure should have sufficient strength and elastic stiffness to limit structural displacements, such as inter story drift. Second, the structure must not collapse in a major earthquake. For this case, significant damage of the structure and non-structural components is acceptable. In order for a structure not to collapse and thereby minimize the loss of life, it must have large energy dissipation capacity during large inelastic deformations. In general, structural systems which exhibit stable hysteretic loops perform well under the large inelastic cyclic loadings characteristics of major earthquakes. Such stable hysteretic characteristics of a structure can be obtained provided that the structural members and joints are designed to possess sufficient ductility. Earthquakes are the most life damaging and destructive phenomenon; these are generated due to sudden release of energy in the earth crust that creates the seismic waves which appears at different instances with different intensity level. When earthquake occurs, the building collapse and damage due to earthquake. Ground motion which is radiated in all direction from epicenter. Due to the effect of earthquake, the building encounters supreme level of displacements, the inertial force which is caused due to tendency of a building to remain at rest. All though, the lateral instability is the major issue while designing a multistory building and seismic zones are also considered while designing a multi-storey building. The word ‘earthquake’ is used to express any seismic occurrence whether natural or caused by humans that can produce seismic influence around any particular area. Earthquakes are caused generally by rupture of geological faults inside the earth, but also by other events such as volcanic movement, landslides, mine blasts, and atomic tests. In Seismic Analysis, we come to know that earthquakes are the most volatile, disturbing and unpredictable of all natural disasters, in which it is very difficult to save life and engineering properties. Care has to take for each step of construction of a building from foundation part. When earthquakes take place, a building undergoes dynamic motion. Because of subjected to inertia forces that may act in the opposite direction to speeding up of earthquake excitations. These inertia forces normally called seismic loads dealt by assuming forces external to the building. To overcome these problems, we need to identify the seismic performance of various buildings through various analytical procedures. This is because to make sure that the various buildings withstand during earthquake events. Hence, can save as many lives as possible. During earthquake the performance of a structure depends on many factors such as stiffness, adequate lateral strength, simple and regular configurations etc.

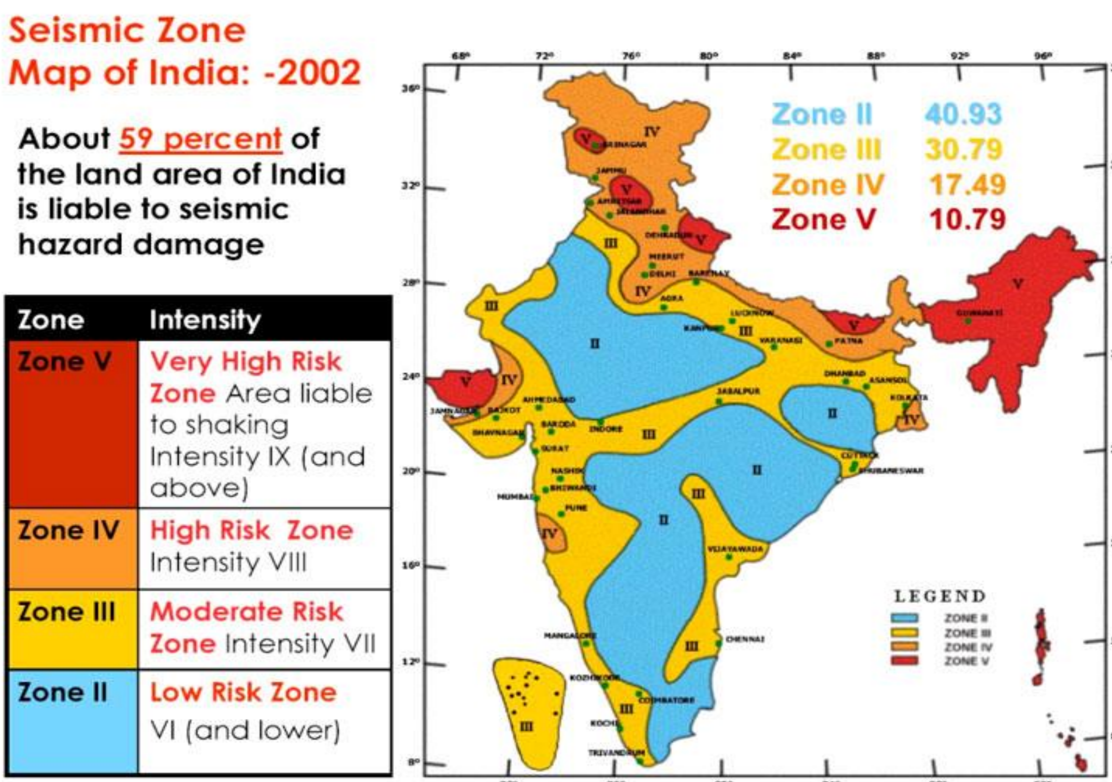

Fig 1.2 Seismic zones in India

During earthquake motions, deformations takes place across the elements of all loads bearing system. Due to theses deformations internal forces develop across the; load bearing system and results in displacement of the building. To make the stable and free from displacement the seismic analysis of the building must be done. In general steel is used as a construction material to increase ductility. Steel allows less time of construction and can be constructed in any season. these are light weight and can be easily modify according to the need of the architecture. The one from the two horizontal force resisting system is bracing system. The use of steel bracing system is a viable option for retrofitting a reinforced concrete frame for improved seismic performances. Steel braces provide required strength and stiffness, takes up less space, easy to handle during construction, can also be used as architectural element and is economic. Steel braces are effective as they take up axial stresses and due to their stiffness, reduce deflection along the direction of their orientation.

1.2 OBJECTIVES

The objective of this research is based on various techniques used to study the optimum location of R.C buildings with seismic zone 5 of India using bracing and shear wall system. This research the building design was carried out in ETABs software. which include all aspects of structural engineering the salient objectives of this research are:

1) To perform a comparative study of the different seismic parameters.
2) Comparison among building with effective location of bracing, effective location of shear wall and bare model with soil type 1,2 and 3 on the basis of story displacement, storey drift, Storey shear and base shear etc.
3) To perform the best suitable technique for seismic analysis. In this research, a multi-storey residential building is studied for earthquake and lateral forces using time history analysis and ETABs. This research is carried out by consider seismic zone 5, and for this zone, the behaviour assesses by taking the hard soil, medium soil and soft soil. A different response for storey displacements, storey drift, storey shear and base shear is plotted for zone 5 for hard soil, medium soil and soft type of soil.

1.2 SCOPE OF THE PRESENT STUDY

In the present research, modeling of the R.C.C structure under the time history method by taking Nine models i.e. simple RC frame structure, effective location of shear walls and effective location of bracing at soil condition 1,2 and 3 using ETABs and the results so obtained are compared.

1.3 ORGANIZATION OF THE THESIS

This thesis is organized as per detail given below:

Chapter 1: Introduction

Chapter 2: literature review

Chapter 3: Work methodology

Chapter 4: Analysis and Result

Chapter 5: Conclusions

1.4.1 Reinforced Concrete (RC) Shear Wall

Reinforced concrete (RC) shear partitions are specially designed structural partitions protected within the buildings to face up to horizontal forces which are prompted in the aircraft of the wall due to wind, earthquake and other forces. Shear wall have very excessive in-aircraft stiffness and strength, which can be used to simultaneously face up to large horizontal masses and aid gravity hundreds. reinforced concrete wall thickness varies from 140 mm to 500 mm, depending on horizontal forces due to wind, earthquake and so forth, constructing age, and thermal insulation requirements. In widespread, those walls are continuous throughout the constructing height; however, some partitions are discontinued at the road the front or basement stage to permit for industrial or parking areas. usually the wall format is symmetrical with recognize to as a minimum one axis of symmetry within the plan.

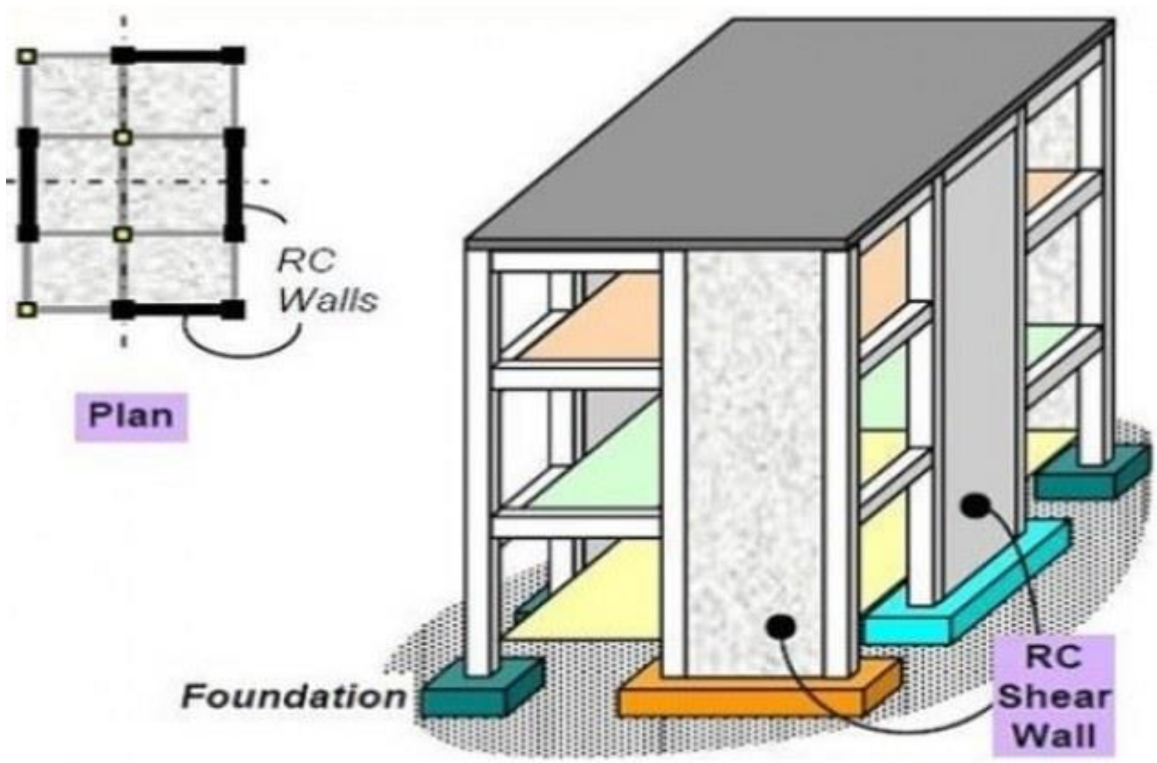

Fig 1.3- shear wall building

Shear walls offer lateral load resistance via moving the wind or earthquake load to basis. except, they impart lateral stiffness to the system and additionally carry gravity masses. whilst shear partitions are located in nice positions within the constructing, they are able to form a green lateral force resisting system

1.4.2 Functions of a Shear Wall

Shear wall are one of the splendid way of offering earthquake resistance to multistory bolstered concrete buildings. whilst RC Multi-Storey building is designed without shear partitions then column sizes are quite heavy and metal required is big. So there's lot of congestion at these joints and it is difficult to region and vibrate concrete at these locations and displacement is pretty heavy which induces heavy forces in member. Shear walls can also turn out to be crucial from the point of view of financial system and manage of horizontal displacement. The shape is still broken because of some or the opposite reason at some stage in earthquakes. Behaviour of shape for the duration of earthquake movement relies upon on distribution of weight, lateral stiffness and energy in both horizontal and planes of building. To lessen the impact of earthquake, strengthened concrete shear walls are used in the constructing. these may be used for improving seismic reaction of homes. Structural layout of homes for seismic loading is ordinarily worried with structural protection at some stage in principal Earthquakes. In tall buildings, it's miles very crucial to make sure ok lateral stif&iess to face up to lateral load. the availability of shear walls in constructing to attain lateral stiffness has been located to be powerful and cost effective. nicely designed and detailed homes with shear partitions have shown excellent overall performance in past earthquakes. the overpowering fulfillment of homes with shear walls in resisting robust earthquakes is summarized in the quote: "We cannot come up with the money for to construct concrete homes meant to face up to intense earthquakes without shear walls. ”:: Mark Fintel, a cited consulting engineer in united states. Shear walls in excessive seismic areas require special detailing. but, in beyond earthquakes, even homes with sufficient amount of walls that have been not particularly exact for seismic performance (but had enough properly-allotted reinforcement) had been stored from collapse. Shear wall buildings are a popular choice in many earthquake susceptible nations, like Chile, New Zealand and united states of America. Shear partitions are clean to assemble, due to the fact reinforcement detailing of partitions is exceptionally straight-ahead and therefore without difficulty applied at web page. Shear walls are green, each in terms of creation value and effectiveness in minimizing earthquake damage in structural and non-structural factors (like glass home windows and building contents).

1.4.3 External Forces Acting on Shear Wall

Shear walls face up to kinds of forces: shear forces and uplift forces. Shear forces are generated in desk bound homes by means of accelerations resulting from ground movement and by outside forces like wind and P-waves. This movement creates shear forces for the duration of the height of the wall and the pinnacle and backside shear wall connections. Uplift forces exist on shear partitions due to the fact the horizontal forces are also carried out to the top of the wall. these uplift forces tr}' to boost up one end of the wall and push the other cease down. In some cases, the uplift force is large sufficient to topple the wall over. Uplift forces are greater on tall short walls and much less on low lengthy partitions. Bearing walls have less uplift than non-bearing partitions/shear walls due to the fact gravity loads on shear partitions help them to withstand the uplift. Shear partitions ought to be positioned on every degree of the structure such as the crawl space.

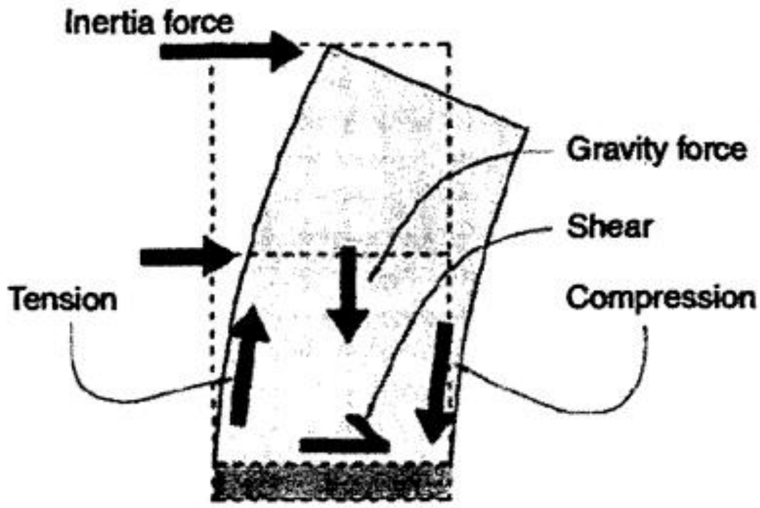

Fig 1.4 force acting on a shear wall

Shear walls must be brought to the constructing internally when the outside walls cannot provide sufficient power and lateral stiffness. Shear walls are most green whilst tiles are aligned vertically and are supported on basis walls or footing. whilst outdoors shear partitions do now not offer enough power, different parts of the constructing need additional power.

1.4.4 Architectural Aspects of Shear Wall

Shear walls are common used between column traces, in stair wells, lift wells, in shafts that residence other utilities. most RC homes with shear partitions additionally have columns; these columns generally bring gravity masses (i.e. those due to self-weight and contents of building). Shear walls offer big energy and lateral stiffiiess to buildings inside the route in their orientation, which extensively reduces lateral sway of the building and thereby reduces harm to shape and its contents. on account that shear walls carry large horizontal earthquake forces, the overturning outcomes on them are massive. thus, layout of their foundations calls for special interest. Shear walls ought to be supplied alongside preferably each period and width. but, if they're provided alongside most effective one course, a right grid of beams and columns in the vertical aircraft (referred to as a moment resistant frame) have to be supplied alongside the opposite direction to face up to strong earthquake results. Door or window openings can be supplied in shear partitions, but their length must be small to ensure least interruption to force flow via walls. furthermore, openings ought to be symmetrically placed. unique layout checks are required to ensure that the internet cross sectional area of a wall at a gap is enough to hold the horizontal earthquake force. Shear partitions in buildings need to be symmetrically positioned in plan to reduce unwell-effects of twist in homes. They could be located symmetrically along one or both directions in plan. In uneven homes, shear walls are more powerful when located alongside exterior perimeter of the constructing - one of these format increases resistance of the constructing to twisting.

1.4.5 Boundary Elements

Under the massive overturning results caused by horizontal earthquake forces, edges of shear walls experience high compressive and tensile stresses. To make sure that shear walls behave in a ductile manner, concrete in the wall quit regions have to be strengthened in a special manner to maintain those load reversals without losing energy. quit areas of a wall with expanded confinement are referred to as boundary factors. This unique confining transverse reinforcement in boundary factors is similar to that provided in columns of RC frames. every now and then, the thickness of the shear wall in those boundary elements is also expanded. RC walls with boundary factors have notably better bending energy and horizontal shear pressure carrying ability, and are therefore less vulnerable to earthquake damage than partitions without boundary elements.

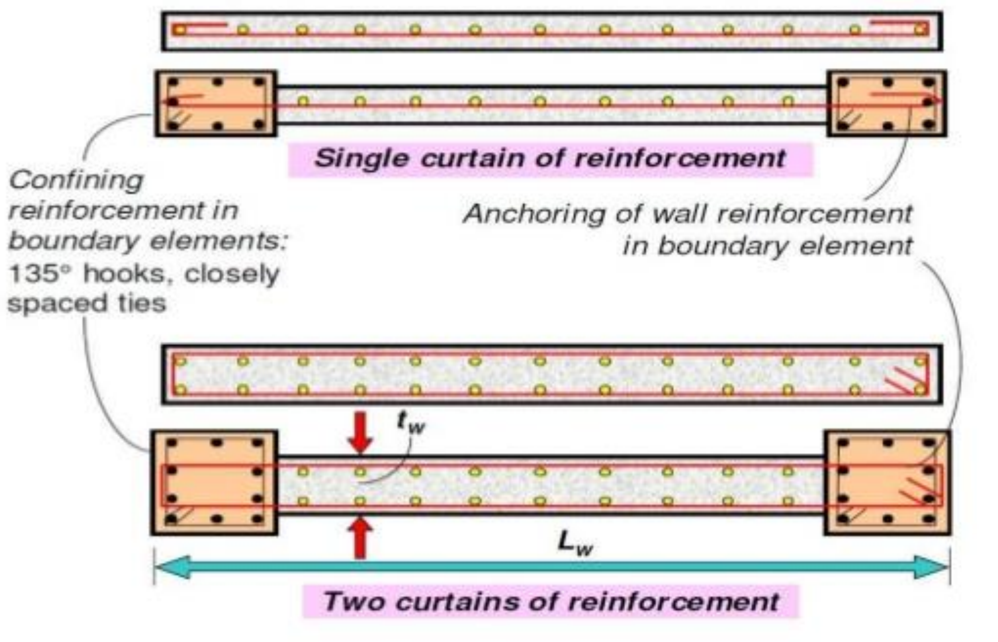

Fig 1.5 Boundary Element

1.4.6 Overall Geometry of Shear Walls

Shear partitions are rectangular in pass-phase, i.e. one dimension of the go-phase is a whole lot larger than the opposite. at the same time as rectangular pass-segment is common. L and C form sections also are used. Fig 1.6 skinny-walled hole RC shafts across the elevator middle of homes also act as shear walls, and must be taken gain of to withstand earthquake forces.

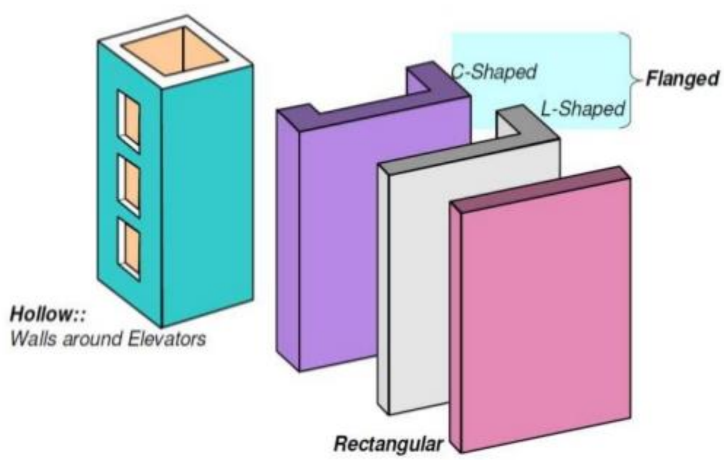

Fig 1.6 Different geometries of shear wall

1.5 Bracing System

A braced frame is a structural system commonly used in structures subject to lateral loads such as wind and seismic pressure. The members in a braced frame are generally made of structural steel, which can work effectively both in tension and compression. The beams and columns that form the frame carry vertical loads, and the bracing system carries the lateral loads. The positioning of braces, however, can be problematic as they can interfere with the design of the façade and the position of openings. Buildings adopting high-tech or post-modernist styles have responded to this by expressing bracing as an internal or external design feature. Braced frames are often the most economical method of resisting wind and earthquake load in multistory building. Members in a braced frame are not allowed to sway laterally (which can be done using shear wall or a diagonal steel sections, similar to truss). there are two types of bracing system. concentrically and eccentrically braced frame. Structures which are subjected to a lateral load must have adequate stiffness and strength which helps in controlling the deflection and also prevents any damage which may occur. Steel framed construction is a new concept in which lateral loads are better resisted by bracings. Steel braced frame models are effective means to transverse lateral forces caused by earthquake and wind forces in multi-story buildings. Bracings hold the structure stable by distributing the loads. Braced frames are less in weight than shear wall so it attracts less seismic forces. There are various types of Braced Frames such as concentrically braced frames and eccentrically braced frames. These Bracings are arranged in different configuration like X Bracing, V bracing, Inverted V bracing, Single diagonal Bracing. The resistance to lateral forces is provided by two bracing systems:

Vertical bracing -Bracing among column strains (in vertical planes) offers load paths for the transference of horizontal forces to floor stage. Framed homes require as a minimum three planes of vertical bracing to brace each guideline in plan and to withstand torsion about a vertical axis.

Horizontal bracing -The bracing at each floor (in horizontal planes) presents load paths for the transference of horizontal forces to the planes of vertical bracing. Horizontal bracing is wanted at every ground stage, however, the floor machine itself might also offer enough resistance. Roofs might also require bracing.

1.5.1 Types of bracing

1.5.1.1 Concentrically Braced Frames (CBFs):- CBFs increases the lateral stiffness of the frame and usually decrease the lateral drift. CBFs are conventionally designed braced frames in which the centre lines of the bracing members cross at the main joints in the structure, thus minimizing residual moments in the frame. The pros and cons of braced frames are essentially the opposite of moment frames; they provide strength and stiffness at low cost but ductility is likely to be limited and the bracing may restrict architectural planning.

1.5.1.2 X- bracing

Cross-bracing (or X-bracing) uses two diagonal members crossing each other. These only need to be resistant to tension, one brace at a time acting to resist sideways forces, depending on the direction of loading. As a result, steel cables can also be used for crossbracing. However, cross bracing on the outside face of a building can interfere with the positioning and functioning of window openings. It also results in greater bending in floor beams.

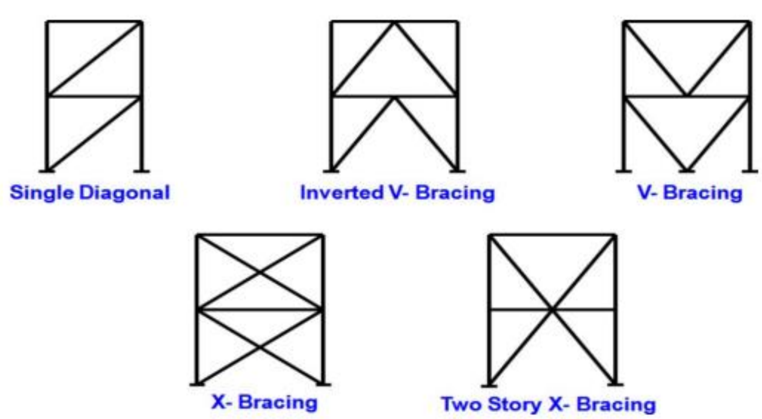

Fig 1.8 Concentric bracings

1.5.1.3 Diagonal braces:

Single bays of diagonal braces respond differently according to the direction of loading. Configuration may be much weaker and flexible in the direction causing compression in the braces, while configuration will be weaker and more flexible in the storey with compression braces, leading to the possibility of soft-storey formation. This is clearly not satisfactory. With more than one diagonally braced bay, the performance can revert to that of X-bracing if a suitable arrangement of bracing direction is chosen.

1.5.1.4 Eccentrically Braced Frames (EBFs): - Eccentrically bracing reduces the Lateral stiffness of the system and improve the Energy Dissipation capacity. In EBFs, some of the bracing members are arranged so that their ends do not meet concentrically on a main member, but are separated to meet eccentrically The eccentric link element between the ends of the braces is designed as a weak but ductile link which yields before any of the other frame members. It therefore provides a dependable source of ductility and, by using capacity design principles, it can prevent the shear in the structure from reaching the level at which buckling occurs in any of the members. The link element is relatively short and so the elastic response of the frame is similar to that of the equivalent CBF.

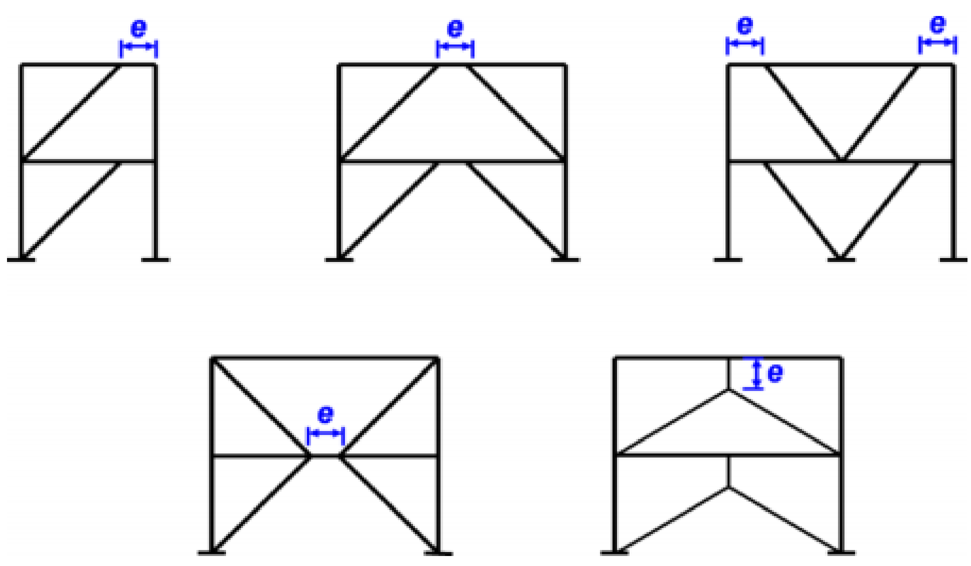

Fig 1.9 Eccentric bracing

The eccentric link element between the ends of the braces is designed as a weak but ductile link which yields before any of the other frame members. It therefore provides a dependable source of ductility and, by using capacity design principles, it can prevent the shear in the structure from reaching the level at which buckling occurs in any of the members.

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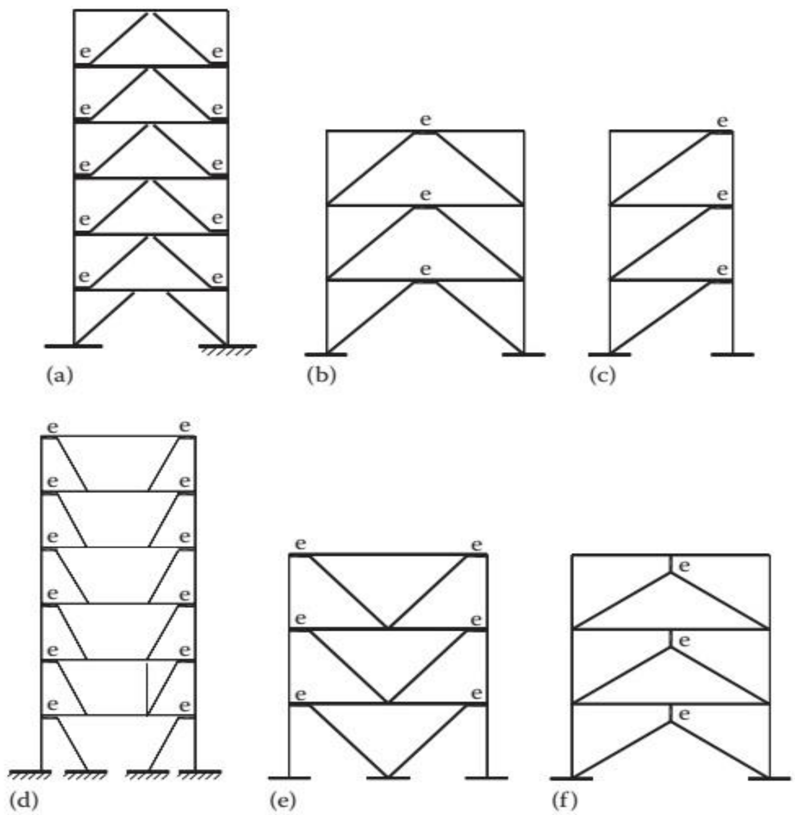


Fig 1.10 Eccentric element

The link element is relatively short and so the elastic response of the frame is similar to that of the equivalent CBF. The arrangement thus combines the advantageous stiffness of CBFs in its elastic response, while providing much greater ductility and avoiding problems of buckling and irreversible yielding which affect CBFs in their post-yield phase. Arrangements such as (a) and (b) in Fig above also have architectural advantages in allowing more space for circulation between bracing members than their concentrically braced equivalent. An alternative arrangement with similar characteristics is the knee-braced frame.

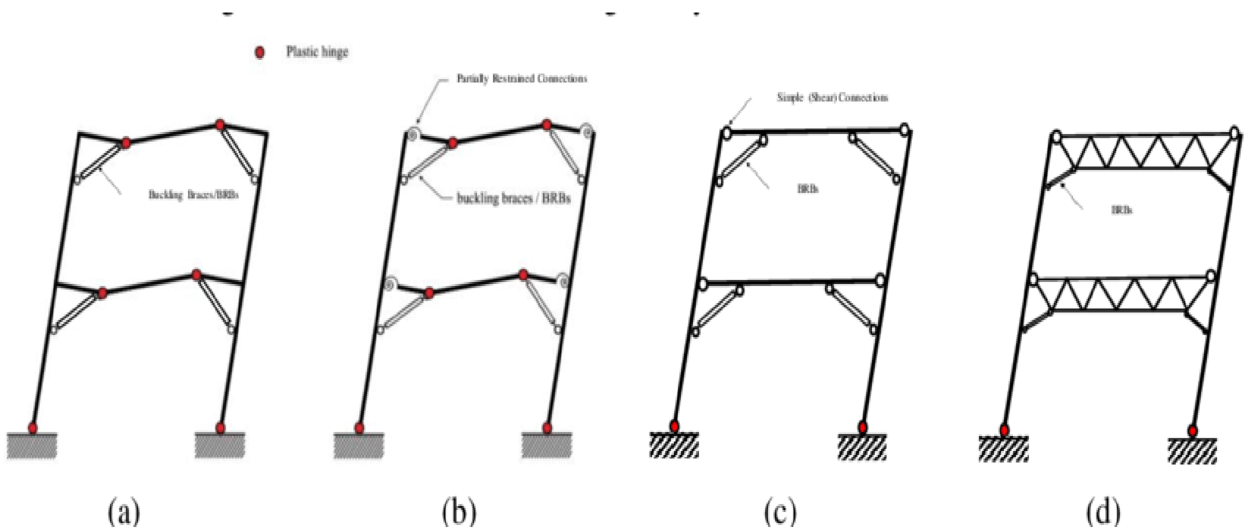


Fig 1.11 Knee braced frame

There is an another important bracing system which is now readily used by structural engineers for seismic analysis as discussed below:

1.5.1.5 K-braced systems:

These are not permitted, because buckling of the compression brace imposes an out-ofbalance force not on the horizontal beam (as in the case of V-braced systems) but on the column, and this is clearly unacceptable.

The design procedure for EBFs in both Eurocode 8 and AISC is similar. For an elastic analysis, the links are sized from the actions obtained from the seismic analysis, using the specified q or R factor. They can then be classified on the basis of their length e, shear strength Vp and flexural strength Mp as follows

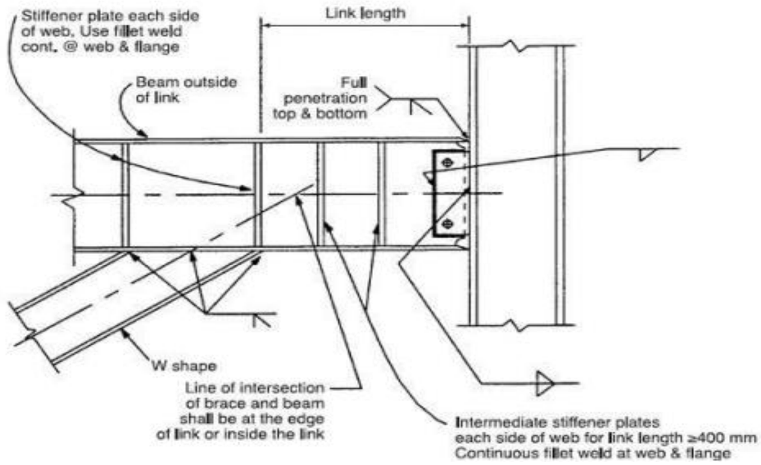


Fig 1.12 Knee bracing system

1.5.2 Arrangement of Tension and Compression Braces

Within any plane of bracing, the compression diagonal braces should balance the tension diagonal braces at each bracing level, in order to avoid tension braces contributing most to lateral resistance in one direction and compression braces in the other. This is to satisfy the general principle that the diagonal elements of bracings should be placed in such a way that the load deflection characteristics of the structure are the same for both positive and negative phases of the loading cycle

1.5.3 Distribution of Ductility Demand in Braces:

It is important to ensure a reasonably uniform distribution of ductility demand in the braces over the height of the structure. If this is not achieved, and the braces at one level yield well before the others, a weak storey might form, concentrating most of the ductility demand at that level. To avoid this, Euro code 8 places a restriction on the ratio of bracing member strength to strength required from the seismic design. The ratio between maximum and minimum values of this ratio must not exceed 125%. There is no similar requirement in AISC.

CHAPTER -2

LITERATURE REVIEW

2.1 General

A brief review of previous studies which focuses on recent contributions related to seismic analysis of multi-storey building using shear wall and bracing by various analysis method and past efforts most closely related to the needs of the present work.

Wang Q. et al. the study presented in this paper is aimed at determining analytically the influence of shear wall height on the response of fi-ame shear-wall buildings. Each structure is assumed to consist of two identical parallel nine-story, threespan fi-ames and a central shear wall built parallel to the frames. Wall height varies for different structures. The structures are designated FWl, FW4 and FW9. The structure FW9 included two nine-story, three-bay frames and a nine-story prismatic wall. The other structures FWl and FW4 are nominally identical to structure FW9 except that the wall extended only to the first and fourth floor level respectively. Because of the continuity provided by the frill height wall, stioxcture FW9 can be considered to represent a building having a reasonably uniform distribution of stiffiiess over the entire height. In contrast, structures FWl and FW4 are with the wall cutoff at the first and fourth floor level, respectively. To examine the effect of shear wall height on the maximum displacements, the structuresFWl, FW4 and FW9 are analyzed for the first 10 s of a simulated 1940 EI centre NS recorded during imperial valley earthquake with a peak acceleration of 0.32 g. Comparison of the maximum top-displacement response to the earthquake does not show any significant variation. What is clear, however, is that the extension of the shear wall over the entire height of the structure may not be necessary

Rai S. K. et al. linear static and non-linear static analysis of a 35-storeyed reinforced concrete frame building provided with conventional shear wall (nonstaggered) and a new kind of arrangement i.e. frame with staggered shear wall panels were done for determining parameters like lateral displacement and storey drift. Analysis was carried out by using standard package

ETABS. The various arrangements of staggered shear wall panels were investigated and critically assessed for their feasibility and advantages as compared to the conventional shear wall system. The non-linear static analysis of frame with shear wall/shear wall panels gives better understanding and more accurate lateral load evaluation of buildings, as the progression of damage can be determined. The primary objective was to achieve a configuration where the drift and inter-storey drift are minimum. Presence of zigzag shear walls enhances the strength and lateral stiffriess of the structure by reducing the lateral displacement and storey drift than other types of shear walls. Zigzag shear wall configuration is most effective for the structures in the earthquake prone areas.

Ashraf M. et al. carried out a study to deteraiine the optimum configuration of a multi-storey building by changing lift-well (with shear walls) location. Four different cases of lift-well (with shear walls) position for a 25 storey building have been analyzed as a space frame system using a standard package ETABS subjected to lateral and gravity loading in accordance with UBC provisions. They found that colunms and beams forces are found to increase on grids opposite to the changing position of Uft-well (with shear walls) away from the centroid of the building. Twisting moments in members are observed to be having increasing trend with enhancement in the eccentricity between geometrical centroid of the building and lift-well (with shear walls) position. Sfresses in shear wall elements have more pronounced effect in elements parallel to displaced direction of shear wall as compared to those in perpendicular direction. The lateral displacements of the building are uniform for a zero eccentricity case. On the confrary, the drift is more on grids on one side than that of the others in case of eccentric shear wall position. They concluded that the lift-well (with shear walls) should be placed at a point by coinciding center of gravity and centroid of the building.

Agrawal A. S. and Charkha S. D. a building of 25 storeys in zone V was considered in this paper. Placing Shear wall away from centre of gravity resulted in increase in most of the members forces. From analysis it was observed that lateral displacement of the building at top storey has been reduced due to presence of shear wall placed at centre.Tien the lift core placed in eccentric position it develops lateral displacement in both the direction with application of seismic force in Y direction. From studies it is cleared that drift is increased as height of building increased and reduced for top floor. The column which placed at the edge of the building is heavily axially loaded due to seismic forces. Location of shear walls affects static and dynamic axial load on the column. The lateral displacement of building is uni-directional and uniform for all the grids in the case of zero eccentricity for seismic loading. With the increase in eccentricity, the building shows non-uniform movement of right and left edges of roof due to torsion and induces excessive moments and forces in members.

Dharanya (A),et, al. in this take a look at they analyze the multi-storey constructing with soft story which in present enormously seismic vicinity has been analyzed. in this overall performance the shear wall and bracings are be compared. equivalent static technique of analysis ought to be carried out with the assist of ETABS software. the principle parameters are used to compared lateral displacements, base shear, tale go with the flow, axial force, shear pressure and time period. on this take a look at they are taken a G+4 story residential RC constructing with gentle story has to be analyzed with shear wall and move bracings. The constructing placed in quarter five.After dialogue it's far concluded that of the shape lateral stability is greater than the bracings of the shape. The natural time period of structure also pretty reduced after placing shear partitions and bracings.

Divya , et, al. on this paper they analyze the seismic behavior of shear wall and bracings device in RC body structure. This studies work focus on evaluate of assessment of shear wall and bracing system by using reaction spectrum technique with the assist of STAADPROVsi software program. This evaluation is helpful for so that you can reduce the harm due to earthquake, and also the value and effectiveness of shear wall. the principle parameters are used to investigate this structure is base shear, natural time period, story glide. The shape which needs to be analyzed is symmetrical G+10 residential constructing. After this evaluation they concluded that lateral displacement and deflection of the constructing reduces by way of the use of shear wall and bracing structures, shear wall production will provide big stiffness of the constructing. The lateral displacement of the constructing is reduced by way of the use of X-kind of bracings. The lateral deflection of column within the of shear wall furnished at canter is a good deal decreased in comparison to other location of SW. The X-form of concrete bracings is determined to be maximum efficient in terms if storey displacement.

Madan, et, al. in this have a look at they concluded that seismic evaluation with shear walls and braces for buildings. For an R.C.C building, The reaction of aggregate of braces and shear partitions has been applied to regular R.C.C building. The R.C.C building consisting of various mixtures of shear wall and R.C braces for 10, 15 and 20 storied frames have been taken into consideration on this study. The dynamic evaluation is of the building become accomplished by using three dimensional modeling the usage of STAAD-pro software and earthquake masses as in step with 15-1893:2002 (element-1). the primary parameters are used to in comparison are time period, displacement, tale waft. the belief of this look at turned into the shear walls decreased the most lateral displacement at the pinnacle 20, 15 and 10 tale the frames greater as compared to the braces decreased the most displacement in the same frame. The shear walls in middle bay and braces within the outer bays have been the most effective arrangements for lateral load resistance inside the elastic variety.

S.R Throat and P.J Salunke. They conducted or studied approximately seismic behavior of multi-story shear wall body as opposed to braced concrete frames. both static (seismic coefficient technique) and dynamic (response spectrum approach) procedures are used determine the seismic layout forces for this homes. The STADD-PROVsi is used for dynamic evaluation and stiffness evaluation of this shape. Axial forces and moments in the contributors and ground displacements are important parameters of this shape. The structure is 15-strory building; it has total eight plane frames in each the all guidelines. The X, ok, IV-form of braces is used on this shape. The building is assumed to be located in seismic area-three, story height is 4.5m. After analyzing the structure, more column axial pressure is inducing in braced frame than shear wall body. Columns and beam moments in braces body structure is a whole lot much less than shear wall body systems. The lateral displacements of frames are very much efficient in braced elements. go with the flow and horizontal deflection in braced body is a good deal less than shear wall body.

Sardar S. J. and Karadi U. N. within the venture, examine of 25 storeys constructing in area V become provided with some research which was analyzed by using changing diverse places of shear partitions for figuring out parameters like storey drift, storey shear and lateral displacement by way of the usage of fashionable package ETABS. advent of 3-D constructing version become finished for each linear static and linear dynamic technique of evaluation and impact of concrete core wall provided on the center of the building became also studied. it has been observed that the version-five (whilst shear wall positioned at centre and four shear walls positioned at periphery parallel to X and Y course) shows better location of shear wall when you consider that lateral displacement and inter-storey drift are less as compared to different models.

Harne V. R. taken into consideration a RCC building of six storeys positioned in Nagpur subjected to earthquake loading in zone-II. An earthquake load changed into calculated by using seismic coefficient technique the usage of IS: 1893 (element l)-2002. those analyses had been accomplished using STAAD seasoned. A have a look at become carried out to decide the power of RC shear wall of a multi-storey constructing via converting shear wall area. 3 specific cases of shear wall function for a 6-storey building had been analyzed: shear wall supplied alongside periphery, L type and move kind shear wall were taken on this examine and those were placed at unique location including outer edge, at comer and at center positions. three kinds of load mixtures have been taken into consideration out of which 1.5 (DL + EQX) gives the worst impact The evaluation of those models for one of a kind parameters like shear force, bending moment, lateral displacement, storey drift and storey shear has been supplied in phrases of graph and the effects had been discussed on the premise of these graph. The lateral deflection of column within the version of shear wall supplied alongside outer edge is reduced as compared to different two fashions. It reduces up to 33.33% and 32.06% compared to models with L type shear wall and move type shear wall respectively. It become concluded that version with shear wall supplied along outer edge is greater green than all different types of shear wall.

Prasad V.V. et al. this have a look at deals with the dedication of top-rated area of shear walls in U-formed building via converting distinct configurations. they've analyzed the multi-storey constructing through the use of static technique of analysis in ETABS. one-of-a-kind parameters studied on this evaluation were term for all systems in unique modes of building, base shear for exceptional soil conditions and maximum lateral displacement in all structures for extraordinary soil situations. it has been concluded that the shear walls and their positions have a substantial influence at the term. it has been observed that term decreases by way of including shear wall. The price of base shear is more for smooth soil, then medium soil after which tough soil. The lateral displacement comes out to be more in case of structure underneath tender soil, then medium soil, then tough soil. It decreases via including shear wall. the base shear is increasing by means of including shear walls because of increase in seismic weight of the constructing. they have got finally concluded that structure with minimum term is the choicest. 2.3 hole areas and trouble system From the above literature evaluate it's miles located that most of the studies paintings emphasized on limited configurations of shear walls in plan. further configurations of shear wall panels in elevation i.e. staggered shear wall panels and mixtures of shear partitions and RC braces in multi-storey homes aren't a great deal discussed in literature. the existing study is executed to address these gaps and offer the base for higher understanding and advanced usage of shear wall and bracings with different circumstance of soil.

CHAPTER 3
METHODOLOGY

3.1 General

The research methodology became started with hassle identity in RC multi-storey buildings underneath seismic pastime and putting in place the goals and scope of take a look at. Then all the associated historical past information have been amassed and studied for the literature evaluate for know-how updating. The fundamental part of this take a look at became structural modeling and computational analysis the use of equivalent static metho in ETABs. The consequences as a consequence obtained then being assessed, interpreted and in comparison.

The work methodology can be briefly divided into following:

1) Literature review and problem identification
2) Description of building plan
3) Problem formulation
4) Method of analysis
5) Structural modelling
6) Analysis and results using ETABs software
7) Conclusions

A RC Multi-storey building of G+14 storey was analyzed to resist the gravity loads and earthquake loads using ETABs software. Seismic parameters such as storey drift, storey displacement, storey shear and base shear were computed in the analysis phase using ETABs. The result obtained from the analysis was compared effective location of shear wall and bracing with different soil type. The equivalent static method was used which was most suited to the present problem and was used in the analysis and conclusions were made on the basis of analysis performed. This is the summary of the work methodology adopted in achieving the target objectives defined.

3.2 Description of Building Plan

For analysis a 15 storied high rise building is modelled in ETABs software. The building does not represent any real existing building. RC framed (G+14) multi-storey building have same floor plan with 6 bays of 6m each along longitudinal direction and along transverse direction. The building is 45.5m high .The building is analyzed by equivalent static method, which is a linear dynamic analysis. The dead load is taken as wall load and parapet wall load which depend upon the wall thickness and the height of wall. the thickness of wall is taken as 250 mm and the unit weight of brick is 20KN/m3 . The live load and the roof load are taken as 3 KN/m2 and 2.5 KN/m2 according to IS 875:1987 (part 2).

All the specifications of the frame are given in Table 1.

Table 3.1

1	Building type	Residential building
2	No of storeys	G+14
3	Bottom storey height	3.5m
4	Total height	45.5m
5	Floor height	3m
6	Size of column	600×600
7	Size of beam	300×450
8	Thickness of slab	150mm
9	Masonry wall thickness	250mm

10	Seismic zone	5
11	Importance factor	1
12	Response reduction factor	5
13	Soil type	1,2 and 3
14	Grade of concrete	M20
15	Grade of steel	Fe250
16	Unit weight of concrete	$25KN/m^3$
17	Unit weight of PCC	$24KN/m^3$
18	Unit weight of brick	$20KN/m^3$
19	Unit weight of plaster	$21KN/m^3$
20	Damping	5%
21	Live load	$3KN/m^3$
22	Roof	$2.5KN/m^3$
23	IS Code for earthquake	IS1893:2002(part1)
24	Self-weight factor	1
25	Bracing member	Steel I section

26	Wall load	13KN/m
27	Parapet wall load	7KN/m
28	IS Code of Concrete	IS 456:2000

3.2.1 Dimension of Bracing Members

We have taken steel I- section of Fe250 Whose Top depth is 250mm. the width of Top & bottom both flanges in I- section is taken as 150mm. The thickness of the Top and bottom flanges taken as 10mm and the thickness of the web in the I -section is taken as 8mm.

3.2.2 Load combination

Building is analyzed on the basis of Various load combinations in the limit state of design for reinforced concrete structures as per IS 1893:2002(part1).these all are given below:

1) 1.5(DL+IL)
2) 1.2 (DL+IL+EL_X)
3) 1.2 (DL+LL+EL_Y)
4) 1.2(DL+IL-EL_X)
5) 1.2(DL+IL-EL_Y)
6) 1.5(DL+EL_X)
7) 1.5(DL+EL_Y)
8) 1.5(DL-EL_X)
9) 1.5(DL-EL_Y)
10) 0.9DL+1.5EL_X
11) 0.9DL+1.5EL_Y
12) 0.9DL-1.5EL_X
13) 0.9DL-1.5EL_Y

As we know that 1.5(DL+IL) is not the Earthquake load combo. It is purely the gravity load combination. But when we are designing a structure, we need to consider all the different load combinations as specified by the respective design code . So, 1.5 (DL+LL) has nothing to do with the earthquake loading. 1.5(DL+LL) as defined in the IS-1893 code is one of the load combination as specified in IS 456 for the RCC structure. See below the factors these factors are same as IS 456:2000.

Load Combination	Limit State of Collapse			Limit States of Serviceability		
	DL	IL	WL	DL	IL	WL
(1)	(2)	(3)	(4)	(5)	(6)	(7)
DL + IL	1.5		1.0	1.0	1.0	-
DL + WL	1.5 or 0.9[1]	-	1.5	1.0	-	1.0
DL + IL + WL	1.2			1.0	0.8	0.8

Fig 3.1 Showing load combination

3.2.3 Problem Formulation

The study was focused on the behaviour of the multi-storey building on effective location of shear wall and bracing with different soil type under seismic activity. As it is clear from the previous studies that multi-storey buildings are unstable for seismic forces.

The analysis was done as per IS Code provision using ETABs software. In this comparison is done for G+14 multi storey residential building. The seismic data is taken according to the IS 1893(Part 1):2002 for the Zone 5 as given below in table 2.

Table 3.2 Seismic Data

1	Zone	5
2	Zone factor	0.36
3	Type of building	Residential building
4	Importance factor	1
5	Soil type	1,2 and 3
6	Soil condition	Hard , Medium and soft
7	Damping ratio	5%
8	Response reduction factor	5

3.3 Method of Analysis- seismic analysis carried out by:

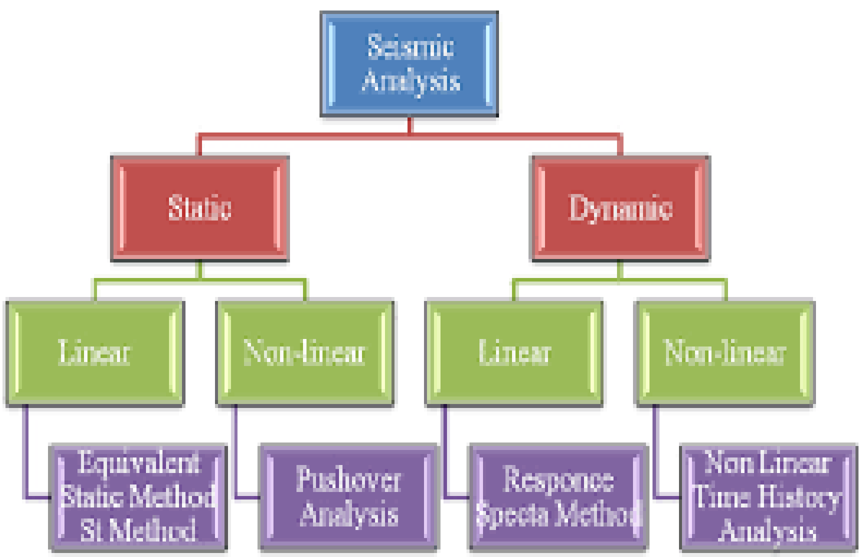


Fig 3.2 Method of analysis

3.3.1 Static Method

The design base shear shall be computed as a whole, and then be distributed along the height of the building based on simple formulas appropriate for the building with regular distributin of mass and stiffness according to IS Code 1893 (part 1): 2002. 3.4.1.1 Equivalent static method This approach defines a series of forces acting on a building to represent the effect of earthquake ground motion, typically defined by a seismic design response spectrum. It assumes that the building responds in its fundamental mode. For this to be true, the building must be low-rise and must not twist significantly when the ground moves. The response is read from a design response spectrum, given the natural frequency of the building (either calculated or defined by the building code). The applicability of this method is extended in many building codes by applying factors to account for higher buildings with some higher modes, and for low levels of twisting. To account for effects due to "yielding" of the structure, many codes apply modification factors that reduce the design forces (e.g. force reduction factors).

For determination of seismic forces, the country is classified in four seismic zones:

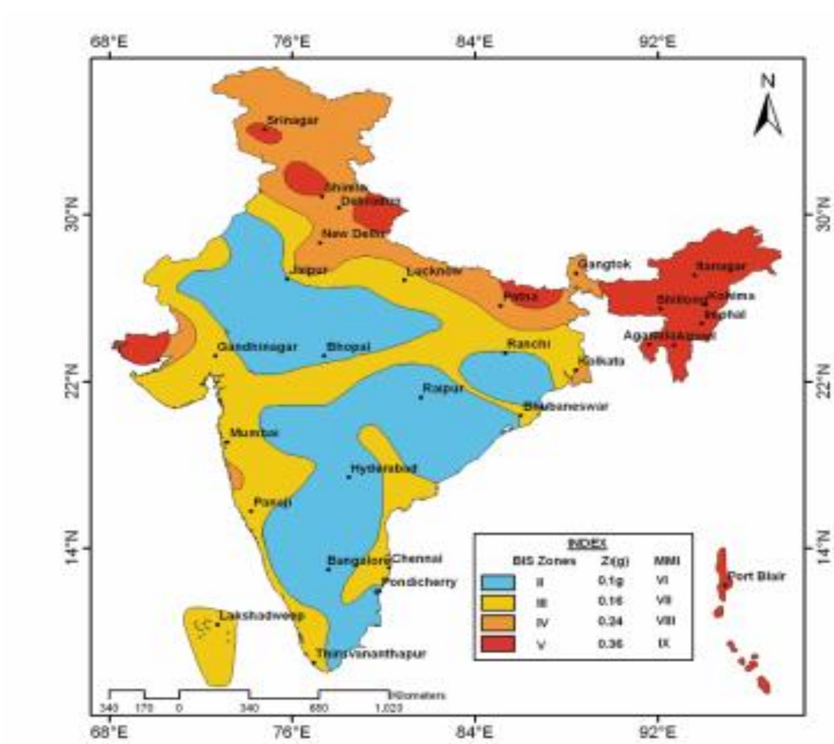


Fig 3.3 Seismic zone of India

Each zone has their own zone factor value and as per IS 1893 (Part 1):2002 these values are given below:

Seismic Zone Factor (1)	II (2)	III (3)	IV (4)	V (5)
Z	0.10	0.16	0.24	0.36

As per IS Code 1893(part 1) :2002 the following were the major steps for determining the seismic forces:

3.3.2 Determination of base shear

The total design lateral force or design base shear along any principal direction shall be determined by the following expression, (clause 7.6.1 of IS 1893 (part 1): 2002)

$$V_b = A_h * W$$

Where, A_h= Design horizontal seismic coefficient for structure

W= Seismic weight of the building

$$A_h = \frac{\left(\frac{Z}{2}\right)\left(\frac{Sa}{g}\right)}{\left(\frac{R}{I}\right)}$$

Where, R=response reduction factor

Z= zone factor

I= importance factor

Sa/g is the average response acceleration coefficient for rock and soil sites as given in figure 2 of IS 1893:2002 (part 1).

The values are given for 5% damping of the structure for Sa/g

For rocky, or hard soil sites

$$\frac{S_a}{g} = \begin{cases} 1+15T; & 0.00 \le T \le 0.10 \\ 2.50 & 0.10 \le T \le 0.40 \\ 1.00/T & 0.40 \le T \le 4.00 \end{cases}$$

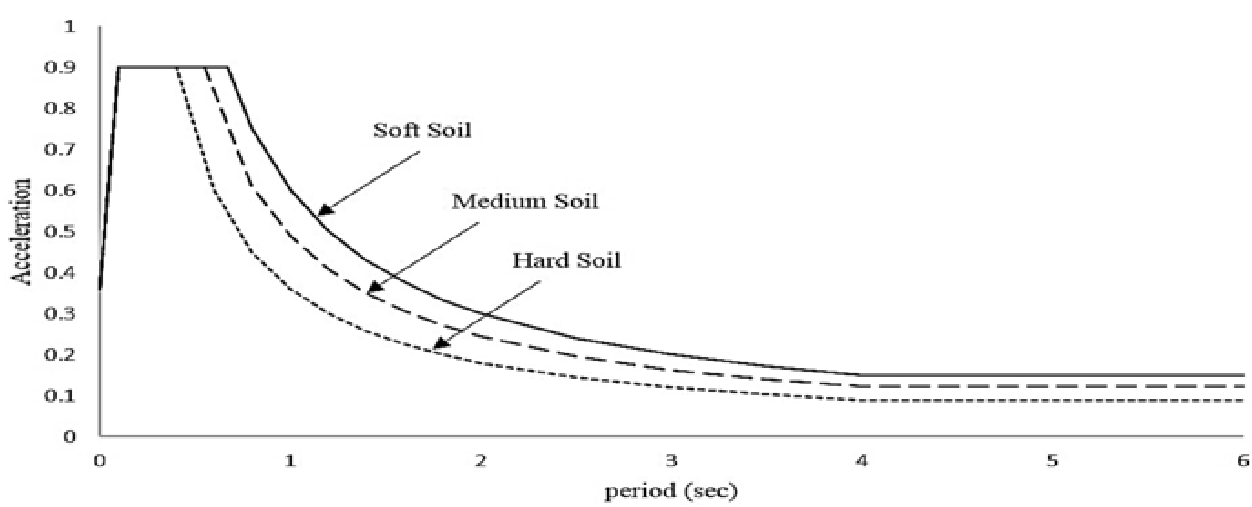
For medium soil sites

$$\frac{S_a}{g} = \begin{cases} 1+15T; & 0.00 \le T \le 0.10 \\ 2.50 & 0.10 \le T \le 0.55 \\ 1.36/T & 0.55 \le T \le 4.00 \end{cases}$$

For soft soil sites

$$\frac{S_a}{g} = \begin{cases} 1+15T; & 0.00 \le T \le 0.10 \\ 2.50 & 0.10 \le T \le 0.67 \\ 1.67/T & 0.67 \le T \le 4.00 \end{cases}$$

Where T is the fundamental natural period for buildings calculated as per clause 7.6 of IS 1893:2002 (part1) and shown further.



Lateral distribution of base shear In equivalent lateral force procedure, the magnitude of lateral force is based on the fundamentals period of vibration, IS 1893 (part 1):2002 uses of parabolic distribution of the lateral force along the height of the building as per the following expression:

$$Q_i = \left(\frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2} \right) V_B$$

Where,

Qi= Design lateral force at floor i

Wi= seismic weight of the floor i

hi= height of the floor i from the base

n= number of storeys of the building at which masses are located.

3.3.3 Fundamental natural time period

The approximate fundamental natural period of vibration (T), in seconds, of all other buildings, including moment resisting frame buildings with brick infill panels, maybe estimated by the empirical expression given in clause 7.6.2 of IS 1893(part 1):2002.

Ta=0.075h0.75 for RC frame building without brick infill wall

Ta= 0.085h0.75 for steel frame building without brick infill wall

Ta=0.09h/√d all other buildings including moment resisting RC frame with brick infill.

3.3.4 Nonlinear static analysis

In general, linear procedures are applicable when the structure is expected to remain nearly elastic for the level of ground motion or when the design results in nearly uniform distribution of nonlinear response throughout the structure. As the performance objective of the structure implies greater inelastic demands, the uncertainty with linear procedures increases to a point that requires a high level of conservatism in demand assumptions and acceptability criteria to avoid unintended performance. Therefore, procedures incorporating inelastic analysis can reduce the uncertainty and conservatism. This approach is also known as "pushover" analysis. A pattern of forces is applied to a structural model that includes non-linear properties (such as steel yield), and the total force is plotted against a reference displacement to define a capacity curve. This can then be combined with a demand curve (typically in the form of an acceleration displacement response spectrum (ADRS). This essentially reduces the problem to a single degree of freedom (SDOF) system. Nonlinear static procedures use equivalent SDOF structural models and represent seismic ground motion with response spectra. Story drifts and component actions are related subsequently to the global demand parameter by the pushover or capacity curves that are the basis of the non-linear static procedures.

3.3.5 Linear Dynamic Methods

Static procedures are appropriate when higher mode effects are not significant. This is generally true for short, regular buildings. Therefore, for tall buildings, buildings with torsion irregularities, or non-orthogonal systems, a dynamic procedure is required. In the linear dynamic procedure, the building is modeled as a multi-degree-of-freedom (MDOF) system with a linear elastic stiffness matrix and an equivalent viscous damping matrix. The seismic input is modeled using either modal spectral analysis or time history analysis but in both cases, the corresponding internal forces and displacements are determined using linear elastic analysis. In linear dynamic analysis, the response of the structure to ground motion is calculated in the time domain, and all phase information is therefore maintained. Only linear properties are assumed. The analytical method can use modal decomposition as a means of reducing the degrees of freedom in the analysis. The advantage of linear dynamic procedures with respect to linear static procedures is that higher modes can be considered. However, they are based on linear elastic response and hence the applicability decreases with increasing nonlinear behaviour, which is approximated by global force reduction factors. The type of linear dynamic methods is as follows.

3.3.6 Response Spectrum Analysis

Response spectrum analysis is a procedure for calculating the maximum response of a structure when applied with ground motion. Each of the vibration modes that are considered are assumed to respond independently as a single degree of freedom system. Design codes specify response spectra which determine the base acceleration applied to each mode according to its period (the number of seconds required for a cycle of vibration).Having determined the response of each vibration mode to the excitation, it is necessary to obtain the response of the structure by combining the effects of each vibration mode because the maximum response of each mode will not necessarily occur at the same instant, the statistical maximum response, where damping is zero, is taken as sum of squares (SRSS) of the individual responses. The results of response spectrum are all absolute extreme values and so they need to be combined as they do not correspond to any equilibrium state nor they take place at the same time. There are several methods to execute this , one of them being the (SRSS) method, Square root of sum of squares method. In this method , the maximum response in terms of given parameter, G (displacement, acceleration, velocity) may be estimated through the square root of sum of m modal response squares, contributing to global response:

$$G = \Sigma mn=1 (Gn)2$$

3.3.7 Nonlinear dynamic analysis

Nonlinear dynamic analysis utilizes the combination of ground motion records with a detailed structural model, therefore is capable of producing results with relatively low uncertainty. In nonlinear dynamic analyses, the detailed structural model subjected to a ground-motion record produces estimates of component deformations for each degree of freedom in the model and the modal responses are combined using schemes such as the square-root-sum-of-squares. In non-linear dynamic analysis, the non-linear properties of the structure are considered as part of a time domain analysis. This approach is the most rigorous, and is required by some building codes for buildings of unusual configuration or of special importance. However, the calculated response can be very sensitive to the characteristics of the individual ground motion used as seismic input; therefore, several analyses are required using different ground motion records to achieve a reliable estimation of the probabilistic distribution of structural response. Since the properties of the seismic response depend on the intensity, or severity, of the seismic shaking, a comprehensive assessment calls for numerous nonlinear dynamic analyses at various levels of intensity to represent different possible earthquake scenarios.

3.3.8 Time History Method

It is known as Time history analysis. It is an important technique for structural seismic analysis especially when the evaluated structural response is nonlinear. Time history analysis is a step-by- step analysis of the dynamic response of a structure to a specified loading that may vary with time. A full time history will give the response of a structure over time during and after the application of a load. To find the full time history of a structure's response A linear time history analysis overcomes all the disadvantages of a modal response spectrum analysis provided nonlinear behaviour is not involving. This method requires greater computational efforts for calculating the response at discrete times. It is used to determine the dynamic response of a structureto arbitrary loading

3.3.8 Method chosen for analysis – "The time history analysis"

3.4 Parameters considered for analysis

- Storey displacement
- Storey drift
- storey shear
- Base shear

3.4.1 Storey drift- It is the relative displacement of one level relative to other level above or below. According to IS 1893(Part 1):2002 (part 1), the storey drift should not exceed 0.004 times of relative storey height.

3.4.2 Storey displacement- It is the displacement of each storey with respect to ground level. According to IS 1893 (part1) :2002 the max value of displacement is 1/250 times of storey height with respect to ground.

3.4.3 Base shear - According to IS 1893 (Part 1):2002 it is the first (longest) modal time period of vibration.

3.4.4 Storey shear- As per IS 1893(Part 1):2002 the lateral stiffness is less than 70 percent of that in the storey above or less than 80 percent of average lateral stiffness of the three storey above.

3.5 Structural Modeling

Software ETABs is used for seismic analysis. to study the effective location of shear wall and bracing with different type soil condition. Different models are made and compared with different parameters of analysis. Complete analysis including structural modeling is performed in this software. For the purpose of this study, a RC framed (G+14) multistory building having same floor plan with 6 bays of 6m each along longitudinal direction and along transverse direction as shown in figure 3.4.

Nine models with effective location of shear wall and bracings at different type of soil condition different are selected in order to determine the behavior of structural steel and concrete during seismic activity. The columns are fixed at the ground and are taken as restrains. The total height of the building is 45.5. The bottom storey height is 3.5m and rest are of 3m. All the values of loads and dimensions are given in table no.3.1.the figure 3.3 shows the plan of the building.

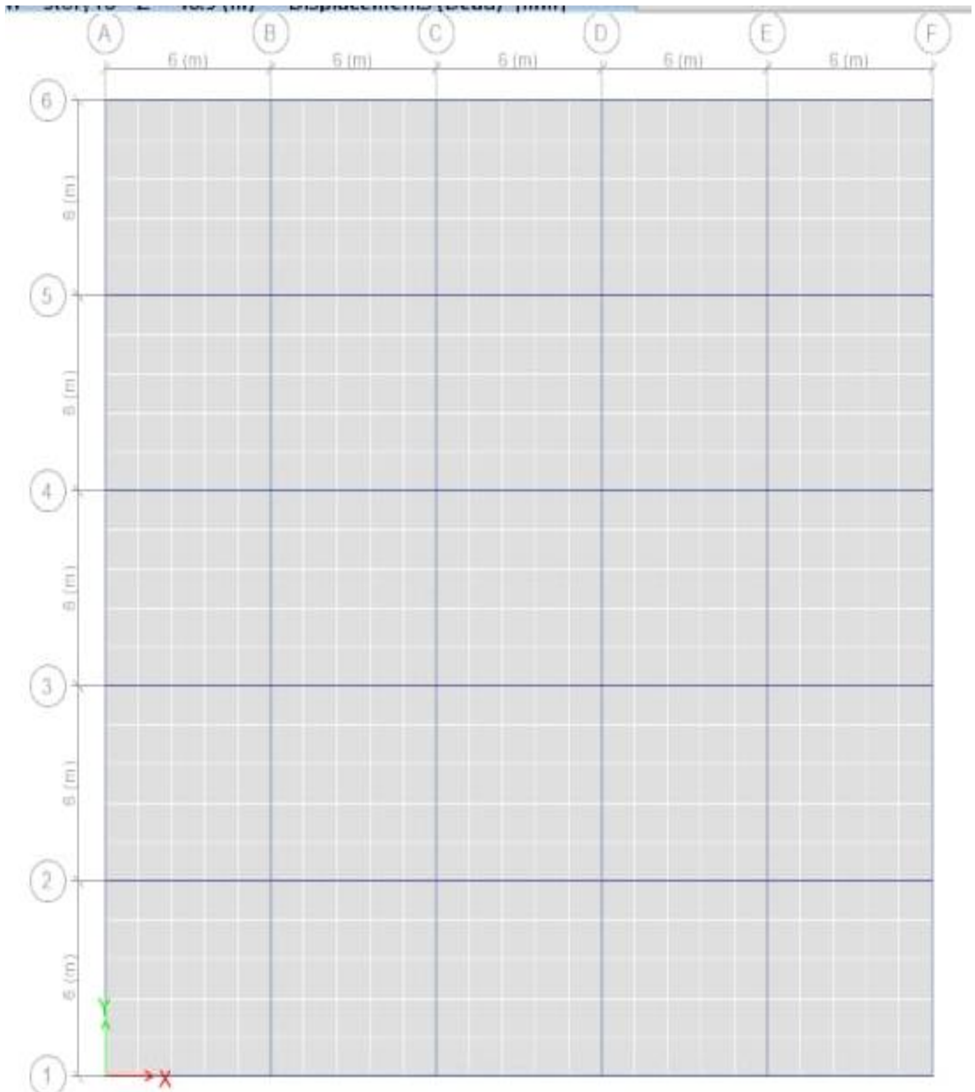


Fig 3.4 Plan of Building

MODEL 1 – BARE MODEL AT SOIL CONDITION 1

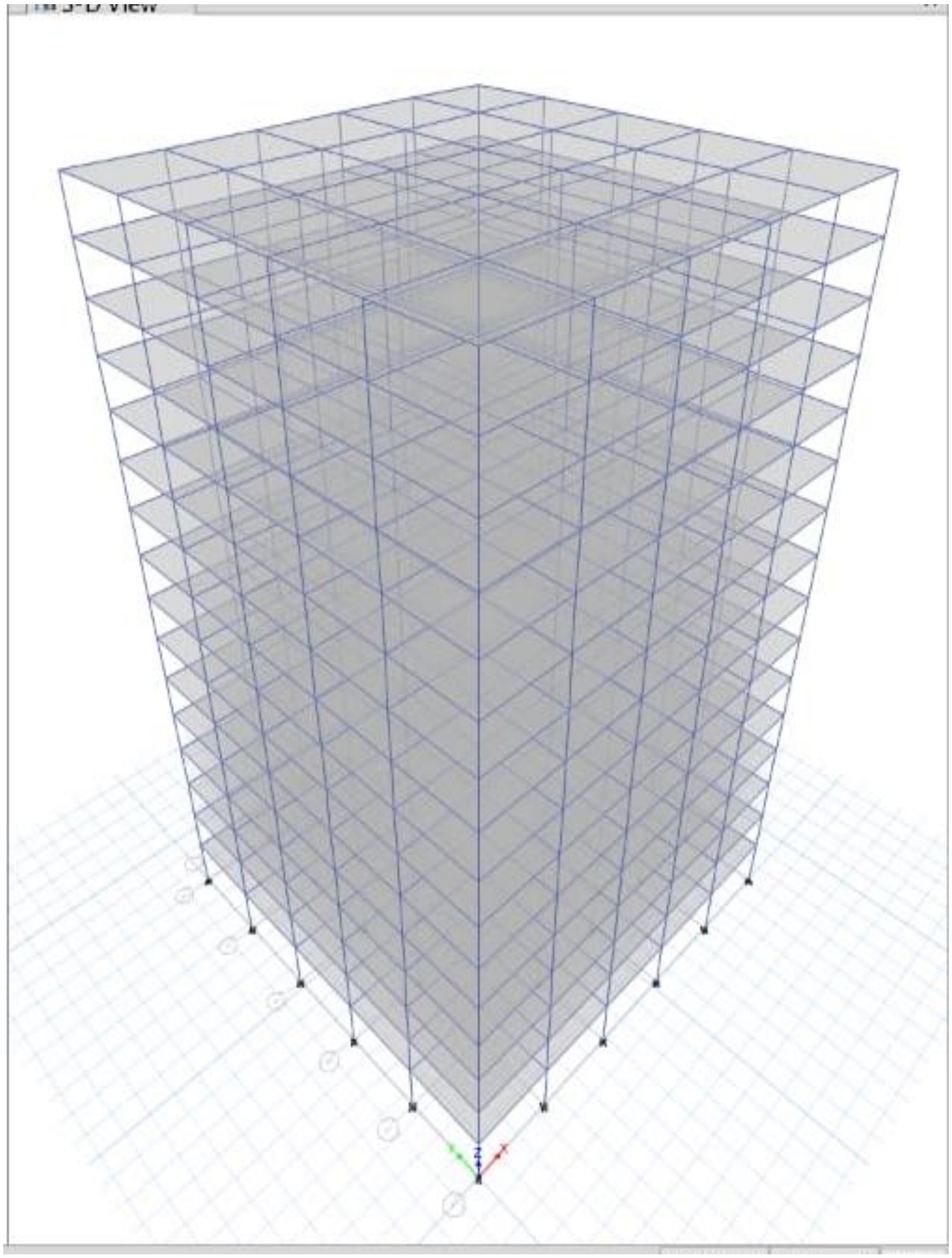


Fig 3.5 Bare Model 3D view

MODEL 2- EFFECTIVE LOCATION OF BRACING AT SOIL CONDITION 1

In this model we have applied X bracing all over the four sides of the building. Figure 3.6 shows the 3D view of the building with X bracing.

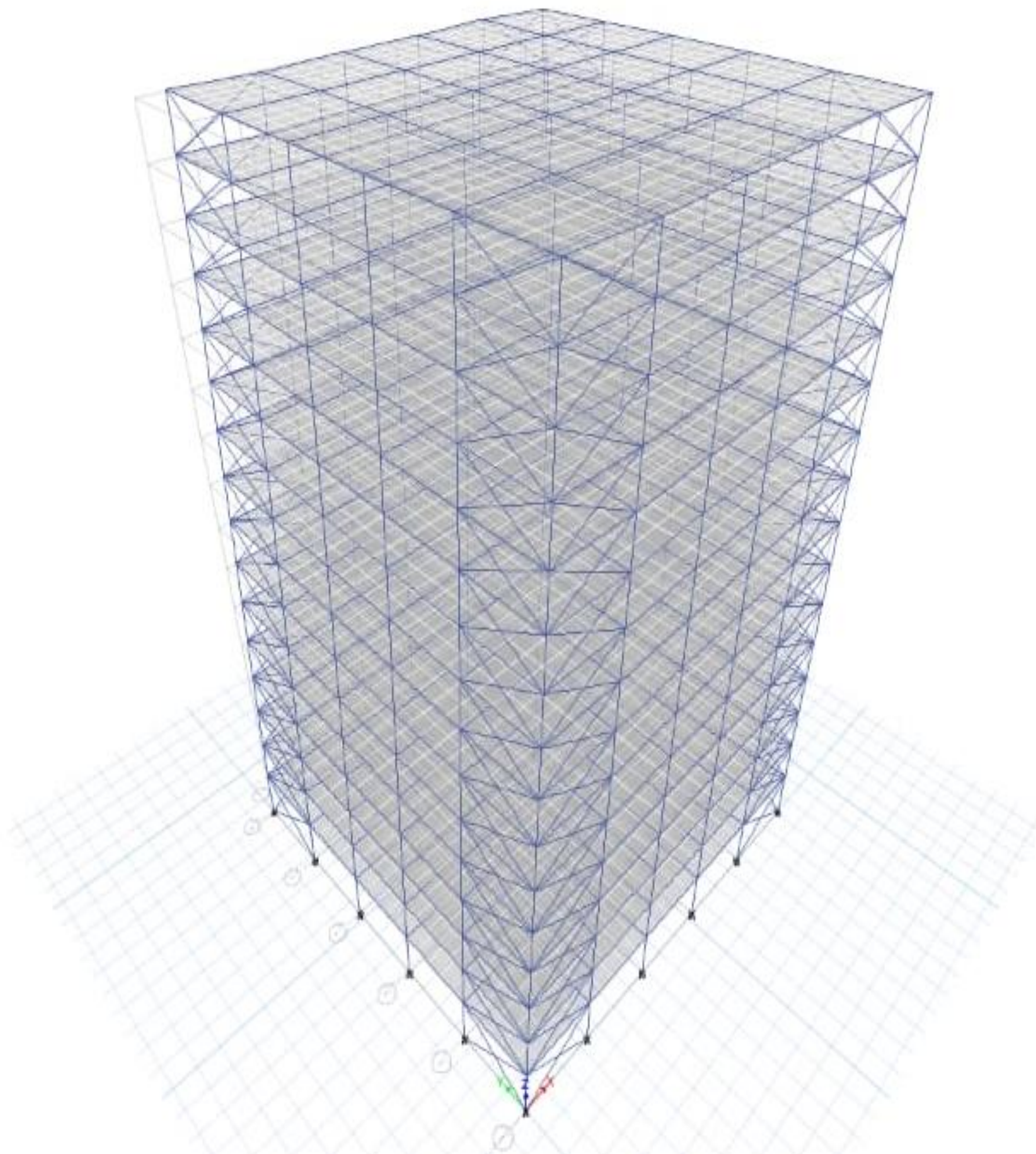


Fig 3.6 3D view of building with x bracing

MODEL 3 - EFFECTIVE LOCATION OF SHEAR WALL AT SOIL CONDITION 1

In this model we have applied shear wall all over the four sides corners of the building. Figure 3.7 shows the 3D view of the building with shear wall.

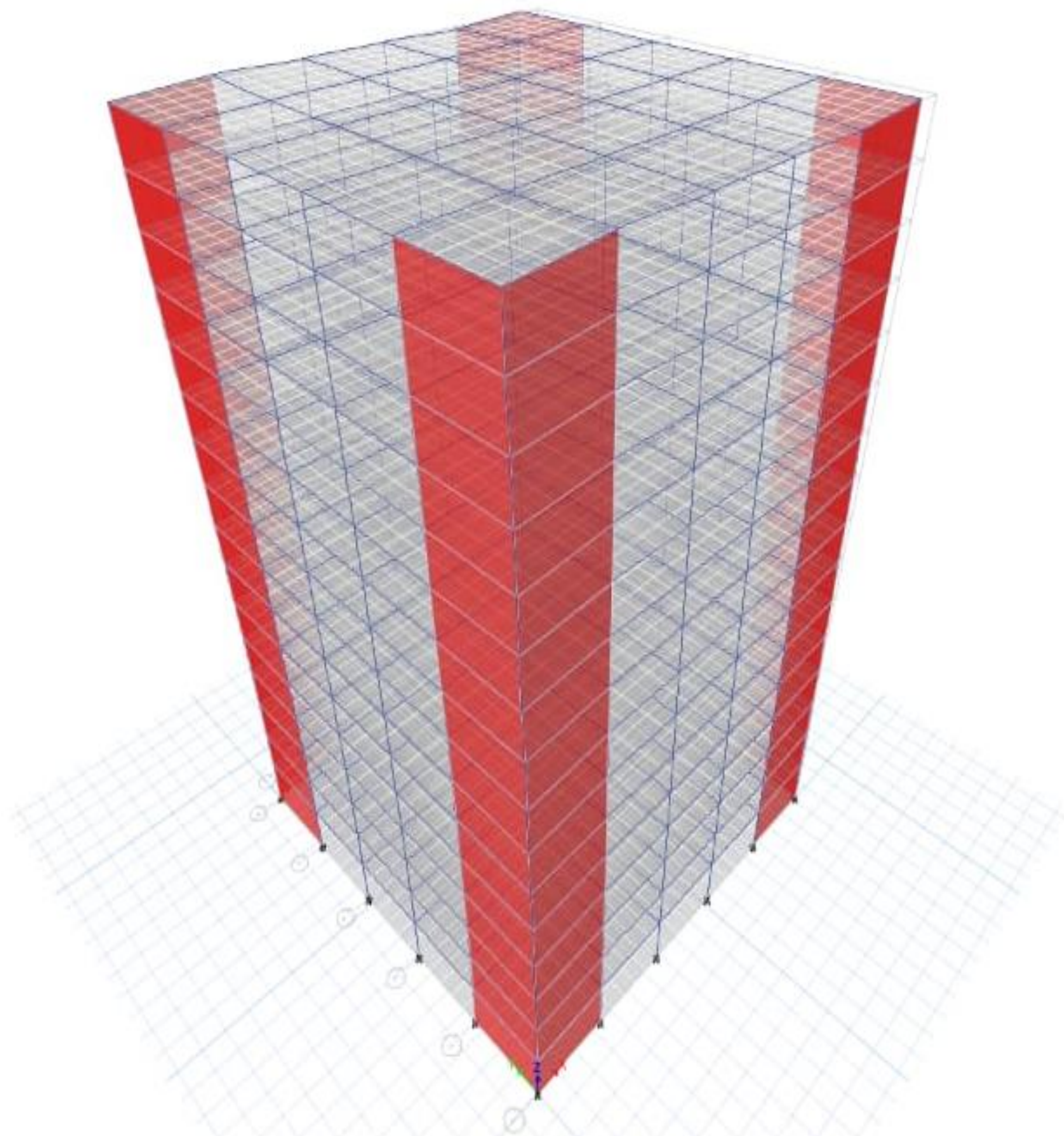


Fig 3.7 3D view of building with shear wall

MODEL 3 – BARE MODEL AT SOIL CONDITION 2

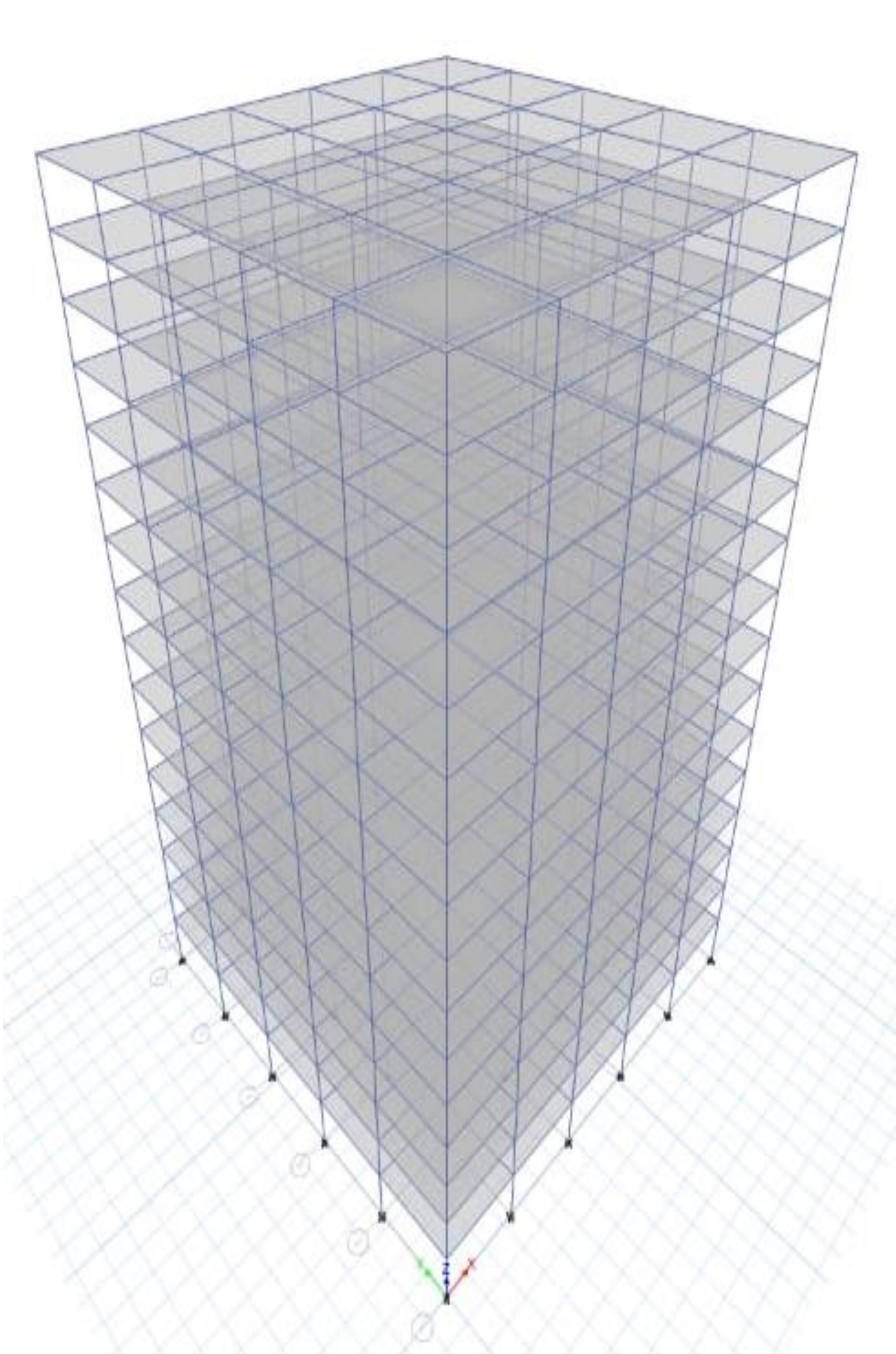


Fig 3.8 Bare Model at Soil Condition 2

MODEL 4- EFFECTIVE LOCATION OF BRACING AT SOIL CONDITION 2

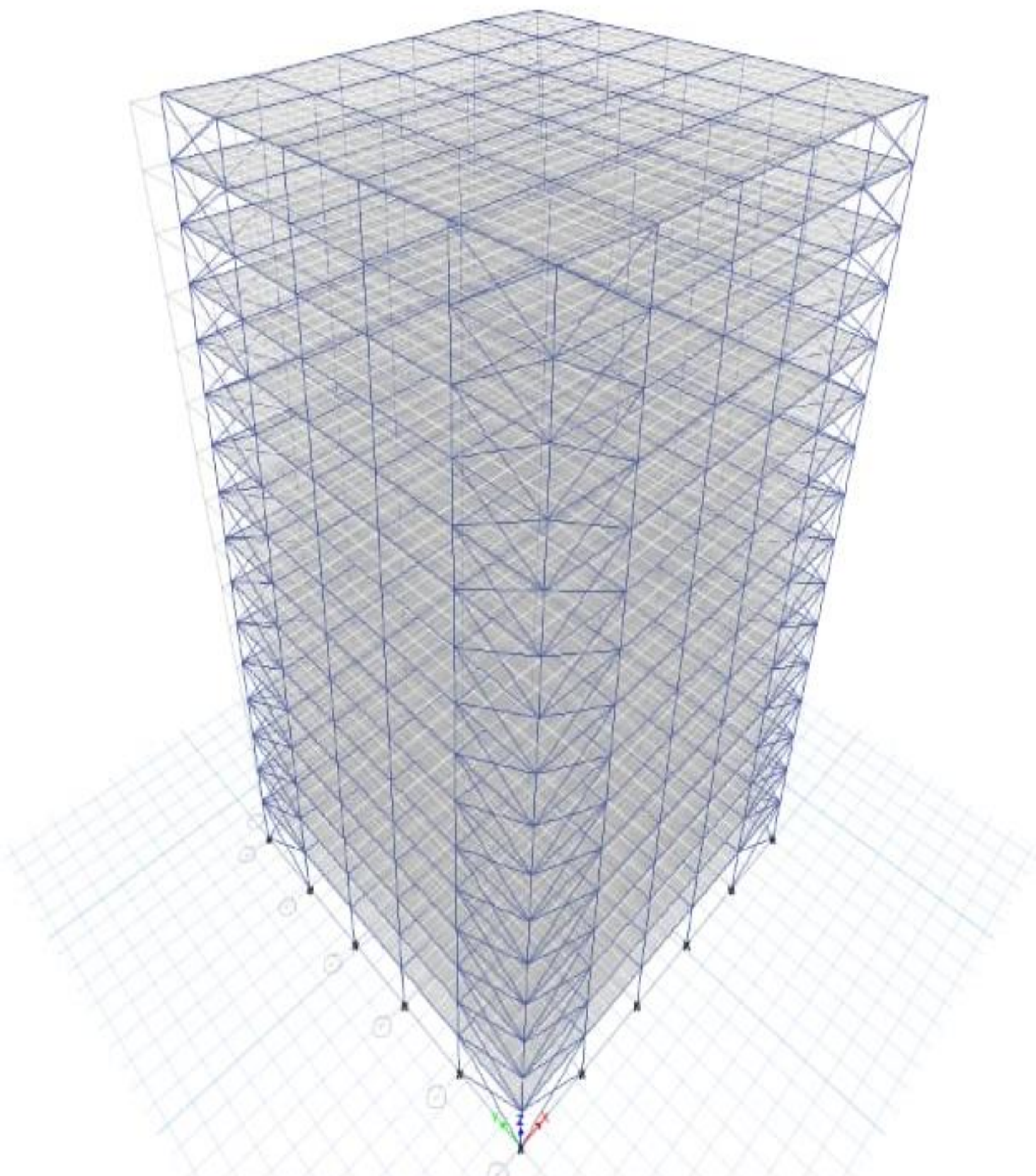


Fig 3.9 Effective location of bracing at soil condition 2

MODEL 6- EFFECTIVE LOCATION OF SHEAR WALL AT SOIL CONDITION 2

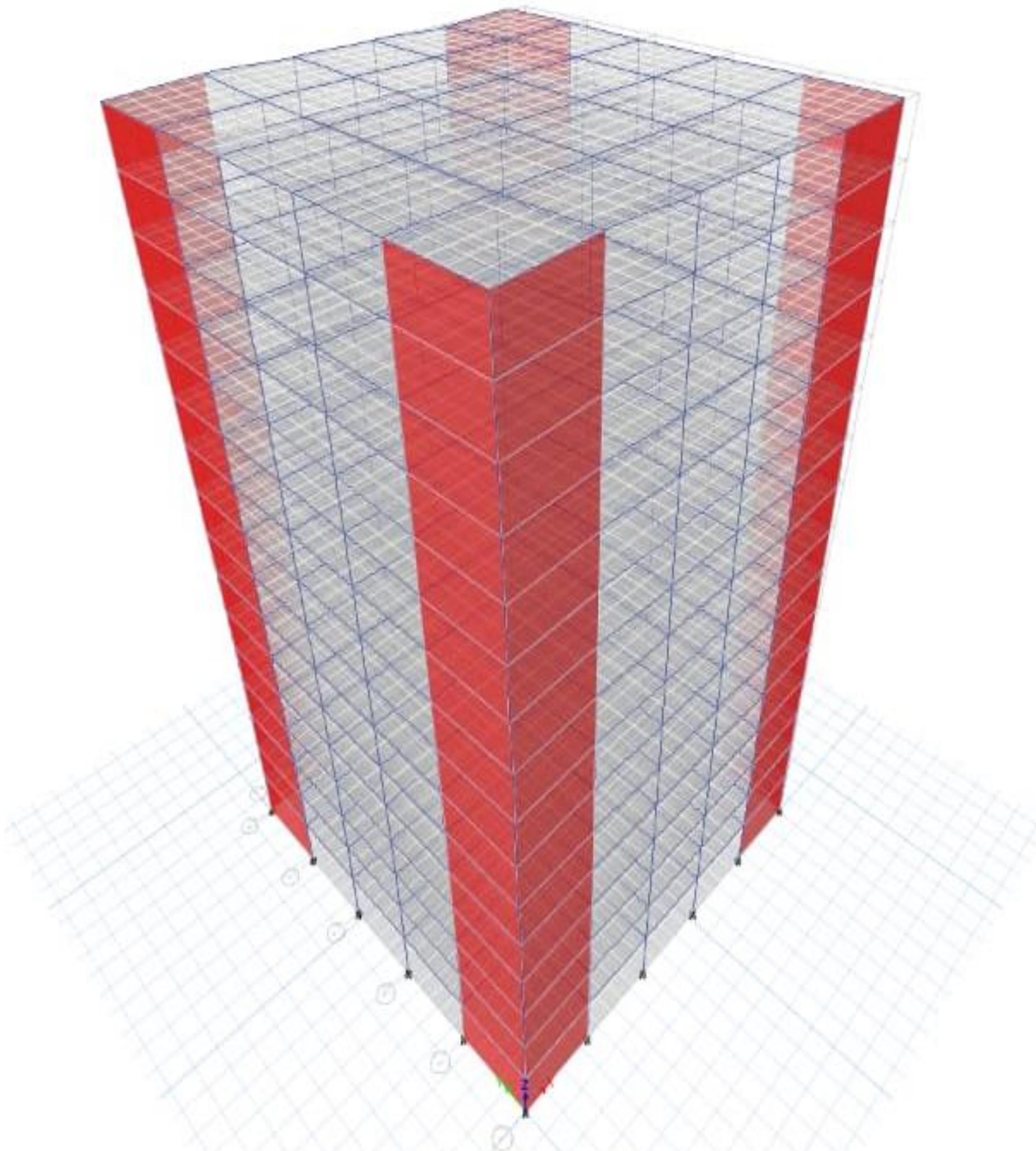


Fig 3.10 Effective location of shear wall

MODEL 7- BARE MODEL ST SOIL CONDITION 3

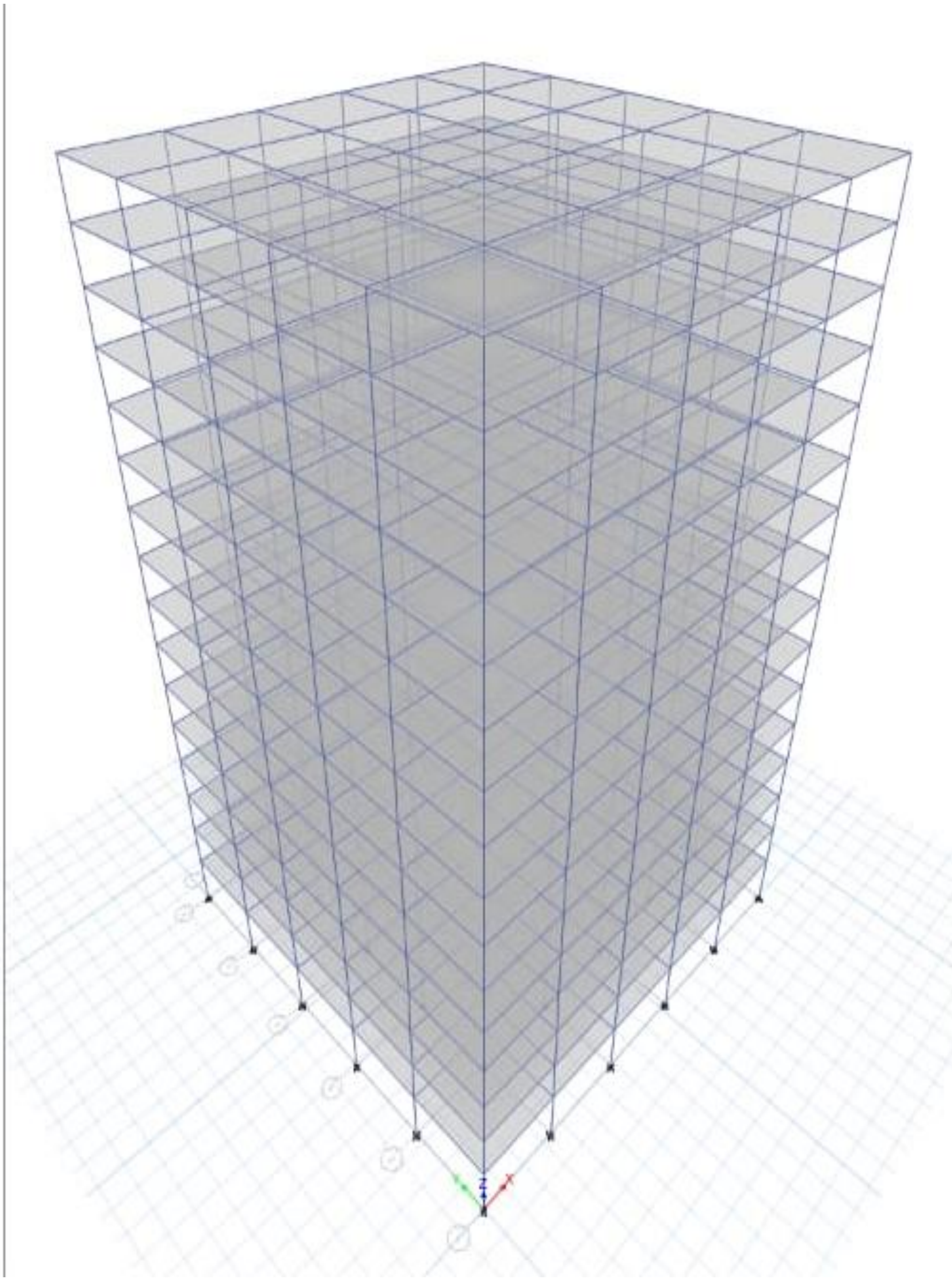


Figure 3.12 Bare model at soil condition 3

MODEL 8- EFFECTIVE LOCATION OF BRACING AT SOIL CONDITION 3

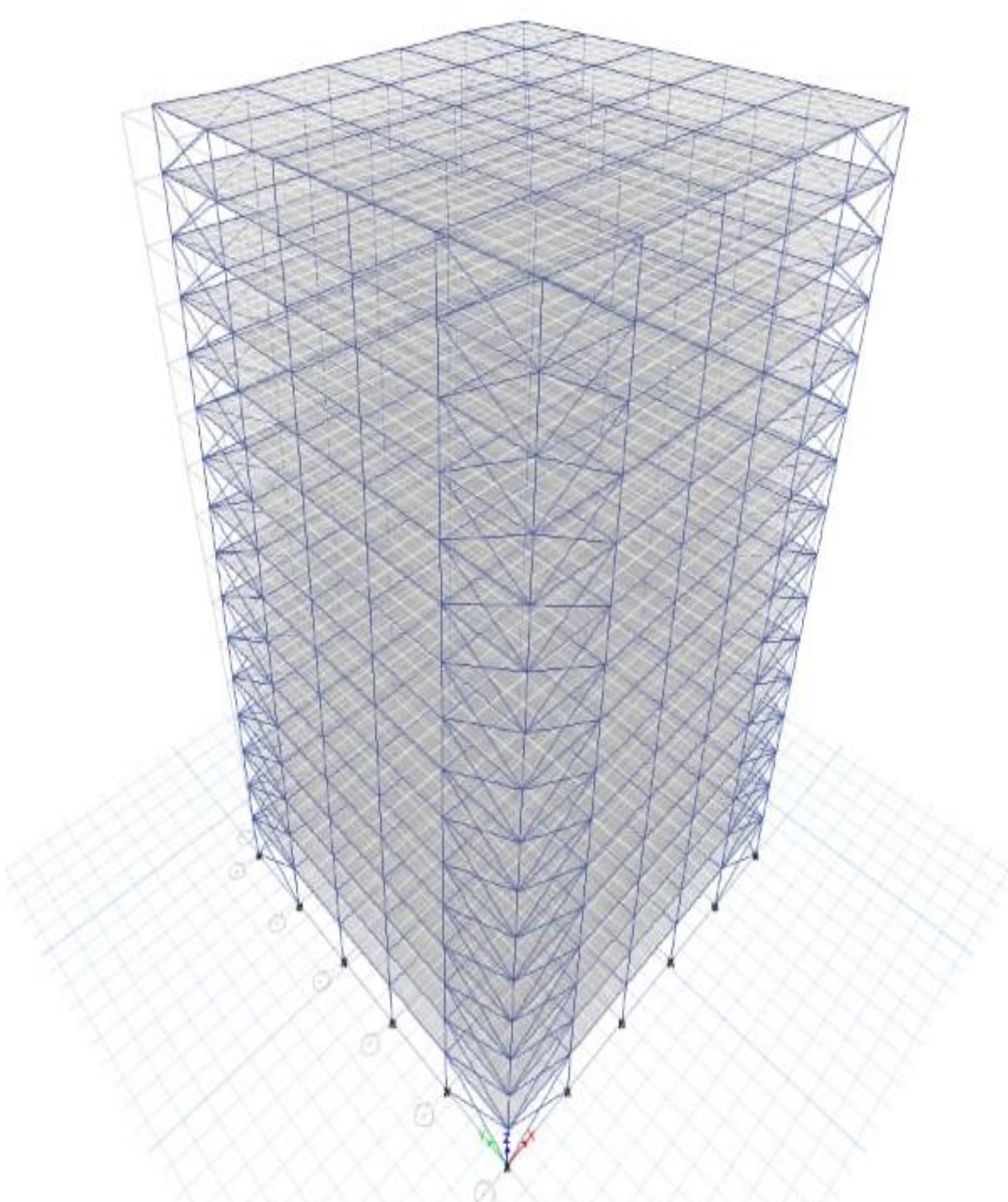


Fig 3.13 Effective location of Bracing

MODEL 9- EFFECTIVE LOCATION OF SHEAR WALL AT SOIL CONDITION 3

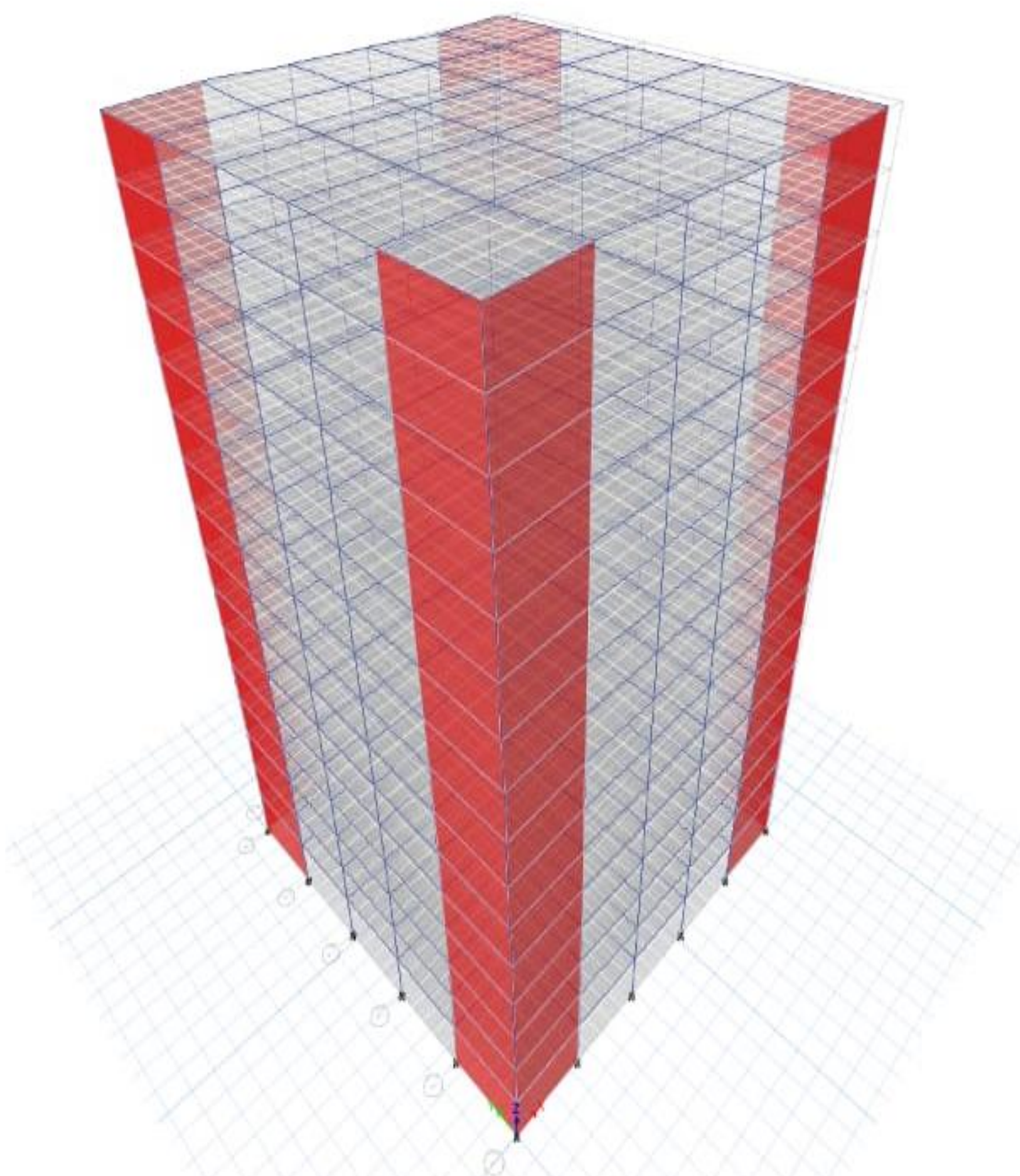


Fig 3.14 Effective location of Shear Wall

3.6 Analysis Using ETABs Software

The analysis has been done using ETABs software which involves following steps:-

1. Defining dimensions of the plan
2. Defining the members and material properties.
3. Assigning loads and load combinations
4. Run and check model to find errors
5. Run analysis
6. Extract results and discuss

As we know, we are using the time history method for seismic analysis of all four models of the structure. For that we need to define the time history function in the ETABs. For time history function we need to take a specific data on which our analysis is based. For this need we have taken Elcentro data which is the most accurate data of the earthquake in Mexico in 1940.

CHAPTER-4
RESULT

4. RESULT

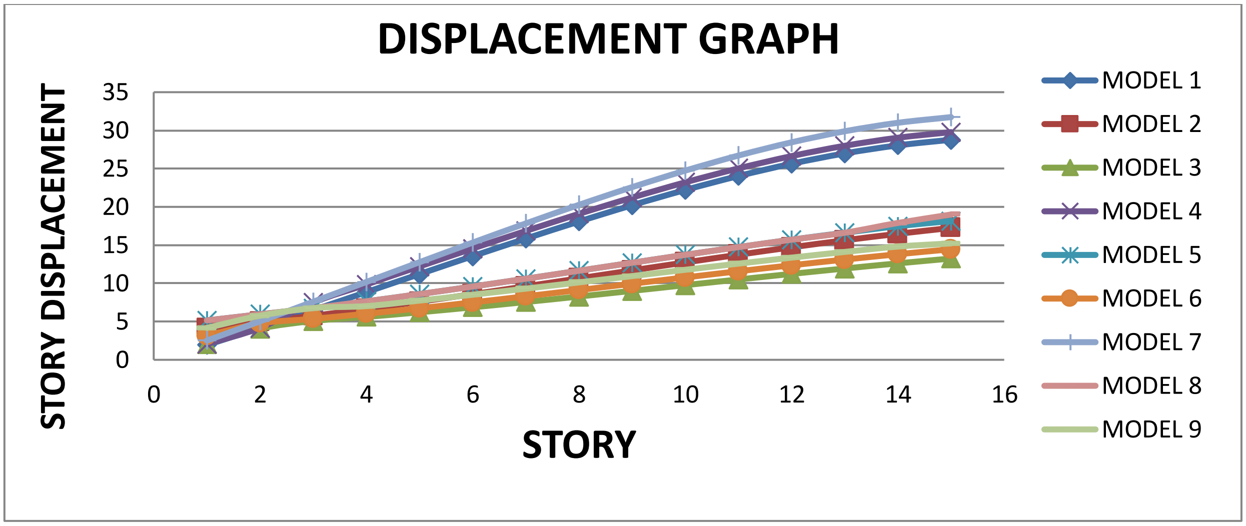
4.1 Storey Displacement

It is the displacement of each storey with respect to ground level. According to IS 1893 (part1) :2002 the max value of displacement is 1/250 times of storey height with respect to ground.

4.1.1 Max. Storey displacement (mm) comparison in x direction - The table and graph below shows the comparison of effective location of shear wall and bracing at different soil condition with bare frame in terms of storey displacement in X direction.

No of Storey	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9
15	33.335	19.18	12.756	33.90	21.34	13.882	39.38	25.81	19.26
14	31.03	17.88	12.10	33.67	19.26	12.556	36.895	24.12	18.76
13	29.876	16.90	11.98	31.10	17.90	12.23	33.45	23.45	18.12
12	27.868	15.16	11.354	28.79	16.90	11.98	31.90	19.34	17.86
11	25.10	14.20	10.981	26.453	15.16	11.345	30.42	18.6	17.10
10	22.10	13.45	10.116	22.90	24.20	10.334	28.10	17.34	16.81
9	20.18	12.92	9.556	21.34	13.45	9.98	26.880	16.2	15.87
8	18.68	12.1	9.028	18.234	12.92	9.245	24.11	15.20	14.76
7	15.734	11.34	8.10	16.54	12.1	8.58	21.45	13.45	13.90
6	13.603	10.11	7.90	14.20	11.34	8.11	18.98	12.92	12.20
5	11.415	9.10	6.938	12.301	10.11	7.21	15.775	11.36	11.56
4	8.551	7.90	6.4	8.641	8.90	6.56	11.56	10.90	10.35
3	6.806	6.12	5.901	7.90	6.15	6.10	9.56	7.15	9.34
2	4.227	5.8	5.245	5.10	4.90	5.234	6.67	4.90	7.90
1	1.86	2.91	4.55	1.90	2.90	4.90	2.80	1.87	5.36

Table 4.1- storey displacement Graph at x direction



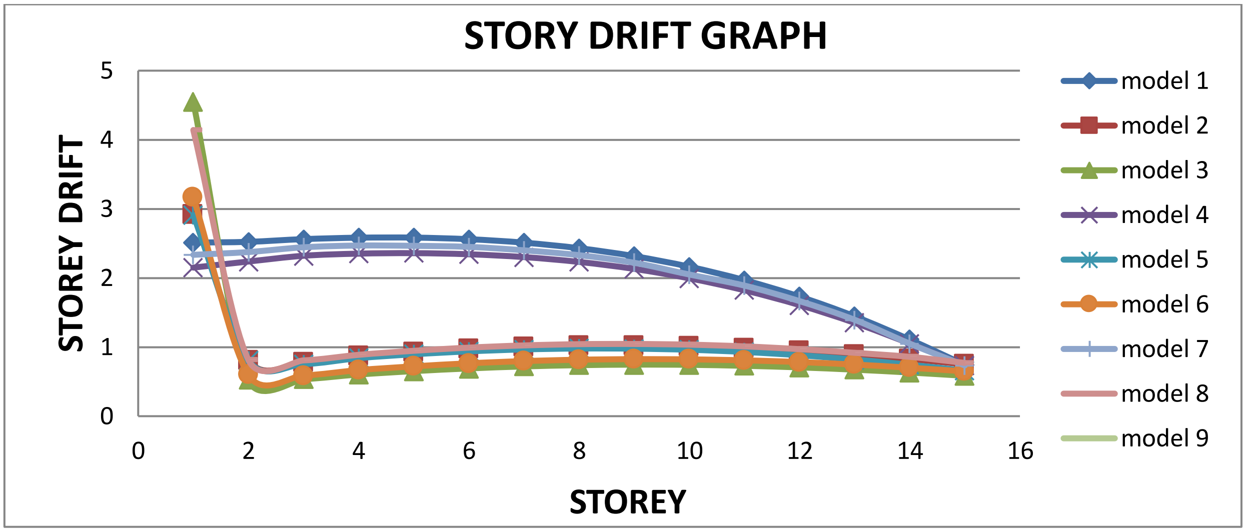
Graph 4.1 Storey Displacement in X direction

4.2 Storey Drift-It is the relative displacement of one level relative to other level above or below. According to IS 1893:2002 (part 1), the storey drift should not exceed 0.004 times of relative storey height.

4.2.1 Max. Storey drift (mm) comparison in X direction- The table 3 and the graph1 below shows the comparison of effective location of shear wall and bracing at different soil condition with bare frame in terms of storey drift in X direction.

No of Storey	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9
15	0.985	0.659	0.594	1.05	0.785	0.710	1.565	1.009	0.867
14	1.105	0.795	0.638	1.34	0.831	0.735	2.05	1.018	0.885
13	1.245	0.82	0.672	1.645	0.982	0.745	2.115	1.022	0.896
12	1.689	0.822	0.706	1.80	0.945	0.767	2.43	1.023	0.908
11	1.722	0.929	0.728	1.987	0.985	0.798	3.25	1.043	0.938
10	1.995	0.961	0.743	2.067	1.001	0.809	3.67	1.065	0.924
9	2.131	0.977	0.765	2.122	1.023	0.789	4.10	1.086	0.898
8	2.232	0.979	0.738	2.346	1.021	0.723	4.35	1.098	0.855
7	2.302	0.966	0.72	3.446	1.004	0.712	4.08	1.021	0.810
6	3.343	0.938	0.691	3.234	0.973	0.701	3.995	1.003	0.798
5	2.359	0.869	0.653	2.78	0.928	0.698	3.765	0.999	0.769
4	2.352	0.84	0.603	2.365	0.87	0.635	3.675	0.961	0.736
3	2.321	0.755	0.536	2.412	0.784	0.612	3.34	0.877	0.712
2	2.238	0.806	0.528	2.24	0.81	0.602	3.10	0.981	0.708
1	1.94	2.90	4.55	2.05	2.981	4.07	2.91	3.001	3.18

Table 4.3 Storey drift at X direction

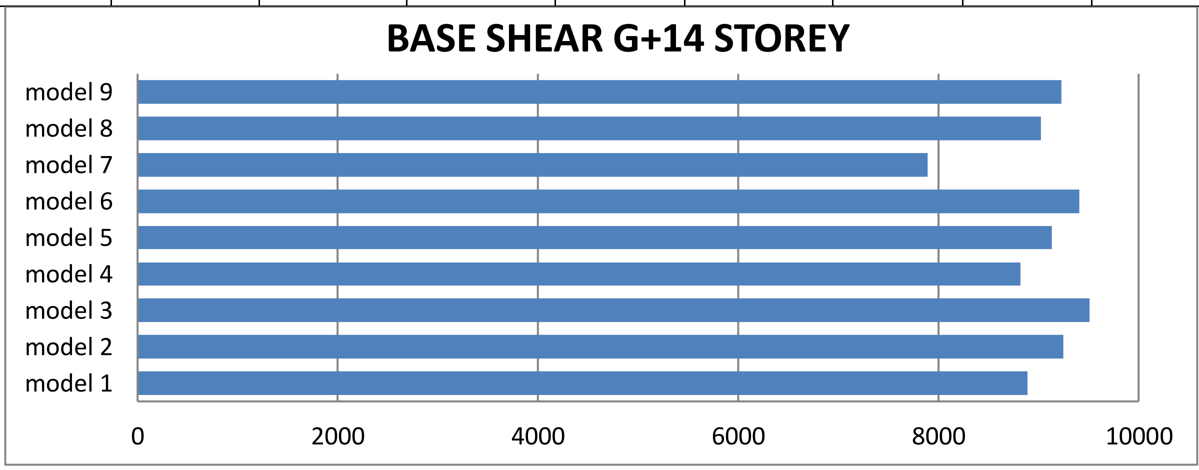


Graph 4.3 Storey Displacement at X direction

4.3 Base Shear

The table and graph below shows different base shear values for G+14 storey with different models.

M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9
8220.47	9248.25	9544.98	8167.90	9167.9	9509.82	7885.1	9008.7	9081.98



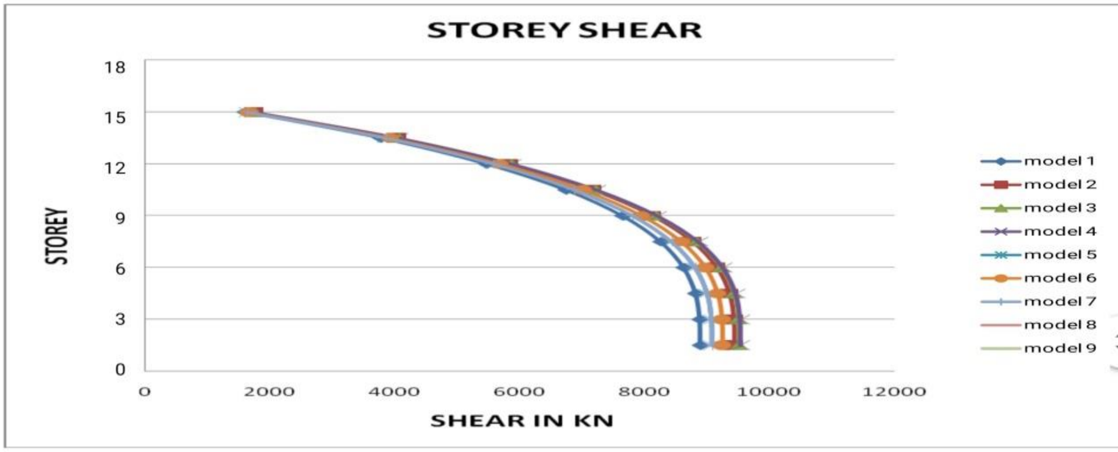
Graph 4.4 Base Shear

4.4 Storey Shear

The table and graph below shows different storey shear values for G+14 storey different models.

No of Storey	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9
15	1598.22	1631.9	1738.06	1503.4	1689.9	1750.31	1454.7	1576.8	1632.6
14	3772.85	3891.19	4066.5	3189.78	3897.76	4063.64	3286.51	3465.32	3854.1
13	5854.98	4876.18	5879.3	4876.7	5634.38	5866.43	4893.36	5765.7	5584.34
12	6954.23	5976.65	7240.91	5234.9	6187.76	6276.9	5278.87	6298.5	5987.32
11	7245.01	6978.8	7892.89	5835.65	6398.9	6897.98	5867.39	6578.54	6276.76
10	7645.76	7187.9	8215.79	6037.87	6549.82	7219.78	6754.53	7265.46	6883.6
9	7789.72	7389.76	8767.43	6429.58	7260.75	8188.75	6835.7	7456.69	7143.3
8	7856.98	7659.87	8802.87	6843.98	7874.21	8837.4	7189.38	7865.28	7478.32
7	7901.10	8107.65	8868.4	7423.68	8120.9	9102.76	7376.9	8097.49	7687.76
6	7981.56	8421.98	9045.43	7654.43	8481.2	9186.8	7492.90	8287.9	7813.43
5	8002.87	8665.70	9126.75	7865.46	8649.3	9229.79	7563.8	8528.94	8436.88
4	8078.09	8907.8	9263.19	7954.29	8954.29	9389.9	7687.42	8765.8	8812.81
3	8106.09	9045.76	9464.61	8012.9	9012.9	9429.99	7708.46	8864.56	9005
2	8205.35	9134.54	9537.12	8097.8	9097.8	9502.06	7786.21	8976.9	9074.19
1	8220.47	9248.25	9544.98	8167.90	9167.90	9509.82	7885.1	9008.7	9081.98

Table 4.4 Storey Shear at X direction



Graph 4.5 Storey Shear in X direction.

4.5 Discussion of Result

Storey displacement was decreased in model with shear wall and bracing. At soil condition 1 the storey displacement decreased in shear wall model 61.73 % and bracing model 42.46%. at soil condition 2, 59.05% in shear wall model and 37.05% in bracing model. At soil condition 3, 34.45% in shear wall models and 31.67% in bracing model with compare to bare model.

Storey shear is increased in the model with the shear wall and bracings. At soil condition 1 the storey shear increased in shear wall model 9.23% and 4.01% in bracing. At soil condition 2, 8.37% increase in shear wall model and 3.43% in bracing model. At soil condition 3, 6.38% increase in shear wall model and 2.65% in bracing model with compared to bare models.

Storey drift decreased in shear wall models and bracing models. At soil condition 1 the storey drift decreased in shear wall model 39.69% and 33.09% in bracing model. At soil condition 2, 32.38% in shear wall model and 25.23% in bracing models. At soil condition 3, 44.16% in shear wall model and 35.64% in bracing model.

Base shear is increased in the models of shear wall and bracings. At soil condition 1 the base shear is increased 7.37% in shear wall models and 4.04% in bracing model. at soil condition 2, 6.37% in shear wall models. And 3.36% in bracing model. At soil condition 3, 4.87% in shear wall and 2.57% in bracing model.

CHAPTER 5

CONCLUSTION

- The providing shear wall are more efficient in minimizing the lateral displacement of building as a drift and horizontal deflection influence in shear wall are much less when compare with bare frame and bracing system.
- Providing bracing is effective but the shear wall more effective with compare to bare model.
- The location of shear wall at corner at soil type 1 and 2 has more significant effect on the seismic response then the bare frame.
- When it comes to the storey drift, decreased in shear wall model at soil all type condition.
- The base shear values are based on the loads and masses of the building. It also subjected to the zone and the importance priority of the structure. The shear wall models have more base shear compared to bracing model.
- The model 3 at soil condition 1 are effective model compared to bracings model and bare models.
- Hard soil and medium soil condition are suitable for multistory building.

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APPENDIX

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Study on Seismic Behaviour of a Multistory Building by using X Bracing With Different Location of Shear Wall: A Review

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Abstract

In multistory structure there a lot of parameters of concern which should be considered for the impact of quake and wind load. There are numerous ways by which the exhibition of a structure during the seismic movement can be improved. Supporting and shear divider is the best technique for parallel burden opposing framework as it is practical and simple to apply. In this project, G+14 storey building, along with combination of shear wall and bracings are being considered for the analysis. The performance of building will be evaluated on the basis of following parameters –Storey displacement, Storey drift, Base shear, story time period. In this work, the combination of shear walls and bracings are provided at different locations at core, corner and middle of the side with the overall analysis to be carried out using Etabs9.7 software

***Key Words**: ETAB, Seismic analysis, Bracings, Shear wall.*

1. Introduction

At present India is developing at a very fast rate which requires increased demand of infrastructure facilities with the growth in population. Due to increase in population the demand of housing is also increasing, so to full fill the need for construction of housing and commercial buildings the use multi-storey building is highly in demand now days. These types of development require safety both for life and property because multi storey buildings are highly susceptible to additional lateral load due to earthquake and wind. Earthquakes are the most life damaging and destructive phenomenon; these are generated due to sudden release of energy in the earth crust that creates the seismic waves which appears at different instances with different intensity level. When earthquake occurs, the building collapse and damage due to earthquake. Ground motion which is radiated in all direction from epicenter. Due to the effect of earthquake, the building encounters supreme level of displacements, the inertial force which is caused due to tendency of a building to remain at rest. All though, the lateral instability is the major issue while designing a multistory building and seismic zones are also considered while designing a multi-storey building.

SEISMIC ZONE:- The earthquake zoning map of India divides India into 4 seismic zones (Zone 2, 3, 4 and 5). According to the present zoning map, zone 5 expects the highest level of seismicity whereas zone 2 is associated with the lowest level of seismicity. Structures which are subjected to a lateral load must have adequate stiffness and strength which helps in controlling the deflection and also prevents any damage which may occur. Steel framed construction is a new concept in which lateral loads are better resisted by bracings. Steel braced frame models are effective means to transverse lateral forces caused by earthquake and wind forces in multi-story buildings. Bracings hold the structure stable by distributing the loads. Braced frames are less in weight than shear wall so it attracts less seismic forces.

1.1 Cross-bracing (x bracing)

Cross-bracing (or X-bracing) uses two diagonal members crossing each other. These only need to be resistant to tension, one brace at a time acting to resist sideways forces, depending on the direction of loading. As a result, steel cables can also be used for cross-bracing. cross bracing on the outside face of a building can interfere with the positioning and functioning of window openings. It also results in greater bending in floor beams.

1.2 Shear wall

Shear divider is an assistant framework made for propped sheets would somehow called shear sheets to counter the impacts of equivalent weight following up on the structure. Generally, shear divider is portrayed as essential part arranged will stand up to association of shear divider. Wind seismic weights need assistance in every practical sense as a relatable point stacks that shear dividers are needed to pass on. Shear dividers stand up in-plane weights need assistance related along its stature. RC Multi-Story structures need assistance satisfactory for confining both extraordinary and level weight. Shear dividers contradict two sorts of forces: Shear powers and Raise powers. Shear powers are made in stationary structures by expanding speeds coming about as a result of ground advancement and by outside powers like breeze and waves. Raise powers exist on shear dividers because the level forces are applied to the most elevated purpose of the divider.

2. Research Investigation

[1] kumar.n (2019) The analysis is done on G+12story building using seismic coefficient method. Inverted x bracing reduces the bending moment and shear force compared to x type bracing. Story drift and node displacement are minimum for inverted x braced frame. There is a considerable effect of arrangement of bracing on seismic performance of building.

[2] Alashkar (2019) speaks to a similar investigation of seismic fortifying of RC structures by steel bracings and solid shear dividers frameworks. He thought about on the retrofitting systems for steel bracings and shear dividers. It has been discovered that including shear divider is adequate as it decreases shears, removals of casings. Despite what might be expected, steel bracings on retrofitting framework are beneficial and financial. If there should arise an occurrence of supporting frameworks, X-bracings have been seen as increasingly powerful. The fundamental methodology of this paper is to explain the correlations, exhibitions of multi-story building outline considering shear divider and X-type steel bracings for RCC structures.

[3] Gowardhan (2018) reviewed on comparative seismic analysis of steel frame with and without bracing by using software. This research has depended upon the affectivity of steel bracings in steel structures. A comparison has been deliberated between structure with and without steel bracings resistant to seismic effects. It has been found that seismic bracings increase the stiffness against lateral loadings and it might be a good practice to use bracings as retrofitting scheme.

[4] Parasiya et al (2017) has showed a review on comparative analysis of brace frame with conventional lateral load resisting frame in rc structure using software. It has been represented that the parameters of bracings, locations & stiffness of bracings have notable effect on the performance of a building.

[5] Asif Gani (2017) Proposed an innovative design methods based on balancing the control yield mechanism, secondary yield mechanism and critical failure mode to improve seismic performance of gusset plate connection used in concentrically braced frame system. Recommendation are examine for modeling the inelastic and post buckling behaviour of the brace for pushover and dynamic time history performance.

[6] A.H. Salmanpour (2017) Study shows that the buckling Restrained braced frames (BRBFs) can more readily satisfy the collapse prevention criteria than the special concentrically braced frames (SCBFs) because the collapse prevention probability of BRBF model is less than 2% and the immediate occupancy probability of BRBF model is 66% where as the collapse prevention probability is about 43%, a value much higher than 2%.

[7] N.Ozhendekci (2015) studied nine eccentrically braced steel frames with various geometries with static pushover analysis. The rotation of load pattern and maximum link rotations pattern are similar and not similar respectively in pushover and inelastic dynamic analysis for EBFs with shear link.

[8] S. Sabouri-Ghomi (2015) an introduction and application of easy going steel (EGS) theory for improvement of behavior of X bracing system is discussed. The lateral stiffness ductility and energy absorption capacity of the system increase and lateral drift decreases with EGS. Stability of the system increases.

[9] E.M. Hines (2015) Understood the need for further analysis determine the capacity design load on EBF column. A strong view should be given to design links as weak as possible. It discussed that longer, weaker links at the Top of the building experience problem due to higher mode effect. This paper advises to study the relationship bi/w EBF system ductility and column over strength demand with maximum link rotation capacity.

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3. Conclusion

This study came to a conclusion that the providing x bracing with different location of share wall are safest structure. providing shear wall and bracing are more efficient in reducing lateral displacement of the structure. Drift and horizontal deflection influence in combine shear wall and bracing are much less when compared with shear wall structure and bracing structure.

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Study on Optimum Location of Shear Wall and Bracing of a Multistory Building With Different Type of Soil Condition

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Abstract

In multistory building structure there quite a few parameters of concern which should be considered for the impact of earthquake and wind load. There are numerous ways by way of which the exhibition of a structure during the seismic movement can be improved. Bracing and shear wall is the best technique for parallel burden opposing framework as it is practical and simple to apply. In this project, G+14 storey building, along with effective location of bracing and shear wall at different type of soil type are being considered for the analysis. The performance of building will be evaluated on the basis of following parameters –Storey displacement, Storey drift, storey shear and Base shear. In this work, the effective location of shear wall and effective location of bracing at different type soil condition with the overall analysis to be carried out using E tab software.

Key Words: *ETAB, Seismic analysis, Bracings, Shear wall.*

1. INTRODUCTION

Generally, It is observe that seismic layout of buildings have to satisfy as a minimum fundamental requirements. First, the structure must behave elastically and defend particularly brittle non-structural additives against minor earthquake ground shaking. Therefore, a structure need to have enough strength and elastic stiffness to limit structural displacements, which includes inter story drift. Second, the structure need to not disintegrate in a chief earthquake. For this case, significant damage of the shape and non-structural additives is acceptable. In order for a shape no longer to crumble and there by reduce the loss of life, it must have big power dissipation ability during massive inelastic deformation. In general structure, structure which exhibit solid hysteretic loop carry out well beneath the massive inelastic cycle loading traits of major earthquake. Such solid hysteretic characteristics of structure may be obtained provided that the structural member and joints are designed to posses enough ductility.

In Seismic Analysis, we come to understand that earthquakes are the maximum volatile, disturbing and unpredictable of all herbal disasters, in which it is very difficult to store life and engineering properties. Care has to take for each step of production of a constructing from foundation part When earthquakes take place, a constructing undergoes dynamic motion. Because of subject of inertia forces that may additionally act within the opposite direction to speeding up of earthquake excitation. These inertia forces normally called seismic masses delta by means of assuming forces externally to the constructing. To conquer those problem, we want to become aware of seismic overall performance of multistory building for the duration of numerous horizontal forces resisting system. This is due to the fact to make sure that the high rise building withstand during earthquake event. Hence, can save as many lives as possible. During earthquake the performance of a structure depends on many factor inclusive of stiffness, good enough lateral strength, simple and regular configuration etc.

2. OBJECTIVE

The objective of this research is targeted on the technique which are used to study the seismic behavior of RC building with seismic zone 5 of india. The whole design was executed in ETABs which are covers all aspects of structural engineering. More specifically, the silent target of this study are:

1) To perform a comparative study of the various seismic parameters.
2) To model G+14 storey building with simple RC frame structure, effective location of shear wall and bracings using ETABS software.
3) To study storey displacement, storey drift, storey shear and base shear simple RC frame structure, bracings and shear wall.
4) To model building in seismic Zone V.
5) To model building in hard, medium and soft soil.

In this paper, an RC multi-storey residential building is studied for earthquake using Time history method in the ETABs software. This analysis is find out by considering seismic zone 5, and for this zone, the behaviour assesses by taking the Hard, medium, soft soil. A different response for displacements, storey drift and other parameters are plotted for zone 5 for hard, medium, soft soil type of soil.

3. STRUCTURAL MODLING

A RC framed (G+14) multistory building having same floor plan with 6 bays of 4m each along longitudinal direction and along transverse direction as shown in figure 1. Nine models with simple RC frame structure, effective location of shear wall and effective location of bracing at soil condition 1, 2 and 3 were selected. The columns are fixed at the ground and are taken as restrains. The bottom storey height is 3.5m and rest are of 3m. All the values of loads and dimensions are given in table No.1.The load cases considered in the seismic analysis are as per IS 1893:2002 (part 1). Figure 1 shows the geometrical configuration of the building. The model was prepared for simple RC frame and with effective location of shear wall and bracing. Table1 show the material properties of the members structure:

Table 1: Material and section properties

1	Building type	Residential building
2	No of storey	G+14
3	Bottom storey height	3.5m
4	Total height	45.5m
5	Floor height	3m
6	Size of column	600×600
7	Size of beam	300×450
8	Thickness of slab	150mm

9	Masonry wall thickness	250mm
10	Seismic zone	5
11	Importance factor	1
12	Response reduction factor	5
13	Soil type	1,2 and 3
14	Grade of concrete	M20
15	Grade of steel	Fe250
16	Unit weight of concrete	$25KN/m^3$
17	Unit weight of PCC	$24KN/m^3$
18	Unit weight of brick	$20KN/m^3$
19	Unit weight of plaster	$21KN/m^3$
20	Damping	5%
21	Live load	$3KN/m^3$
22	Roof	$2.5KN/m^3$
23	IS Code for earthquake	IS1893:2002(part1)
24	Self weight factor	1
25	Bracing member	Steel I section
26	Wall load	13KN/m
27	Parapet wall load	7KN/m
28	IS Code of Concrete	IS 456:2000

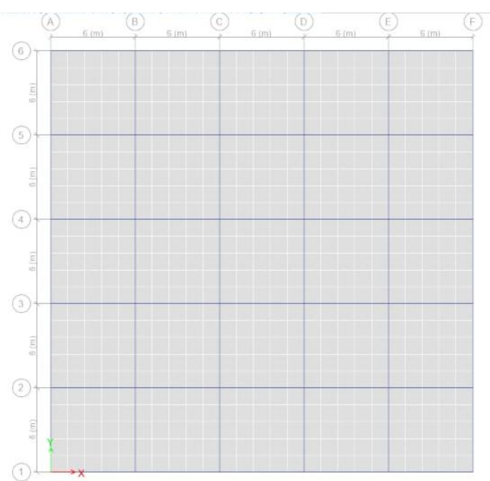


Figure 1- plan of building

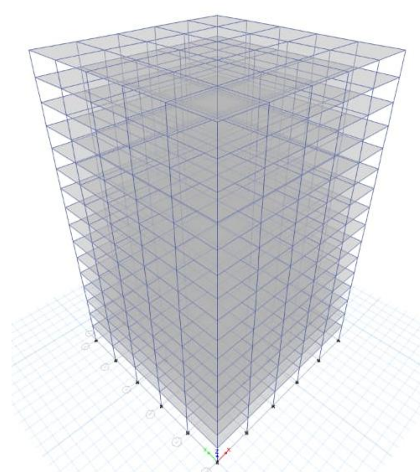


Figure 2- 3D view of RC frame structure building

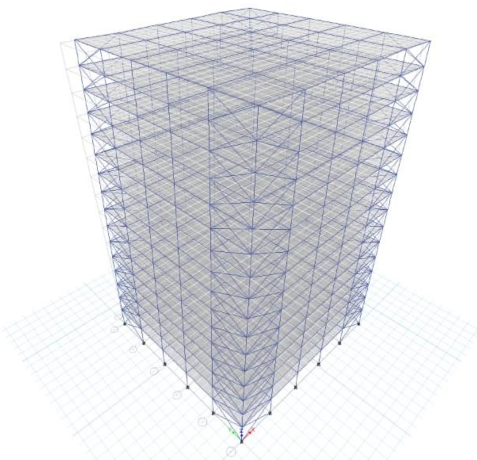


Figure 3- Bracing at soil type 1

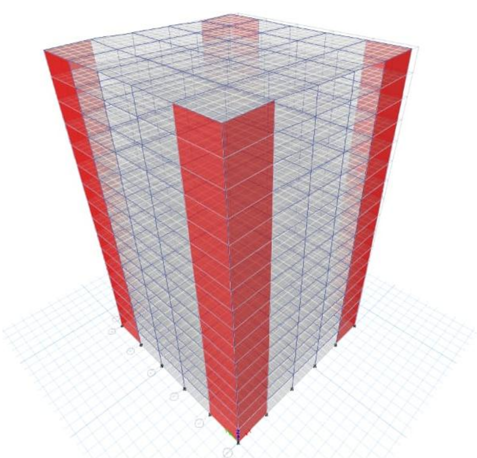


Figure 4- shear wall at soil type 1

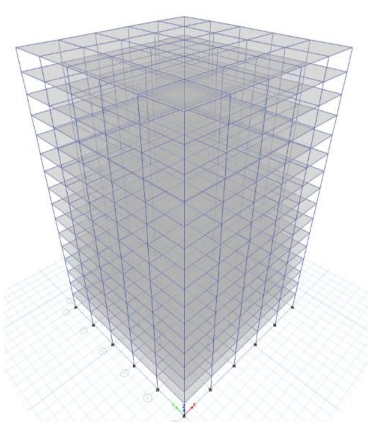


Figure 5- simple RC frame structure at soil type 2

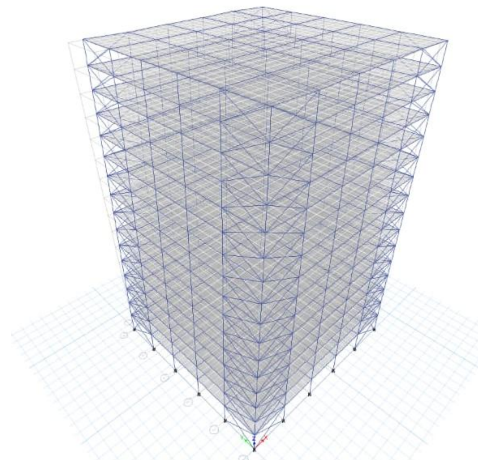


Figure 6- Bracing at soil type 2

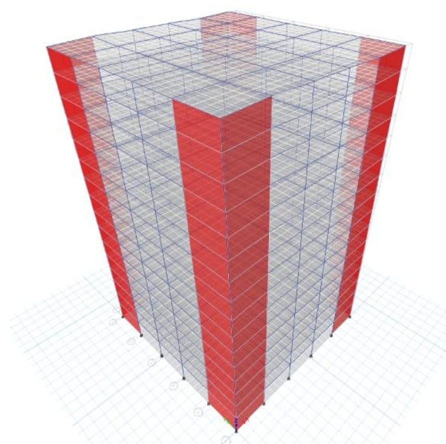


Figure 7- shear wall at soil type 2

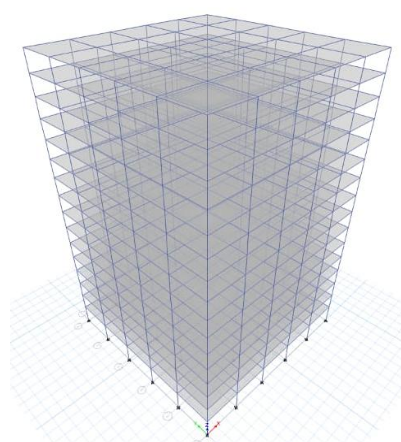


Figure 8- simple RC frame structure at soil type 3

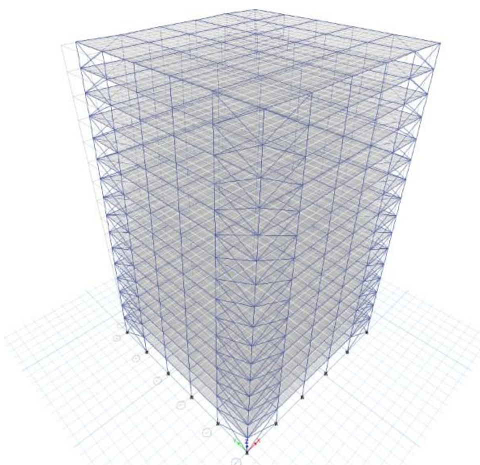


Figure 9-bracing at soil type 3

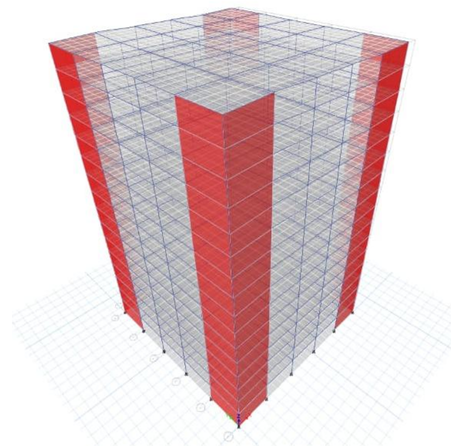


Figure 10- shear wall at soil type 3

3.1 ETABs Overview

ETABs is used for seismic analysis and study the optimum position of shear wall and bracing of a multistory building at specific soil condition are compared with specific parameter of evaluation. Complete evaluation including structural modeling is accomplished in this software program. The evaluation has been accomplished by the use of ETABs software which Involve following steps:-

1. Defining dimensions of the plan
2. Defining the members and material properties
3. Assigning loads and load combinations
4. Run and check model to find errors
5. Run analysis
6. Results and discuss

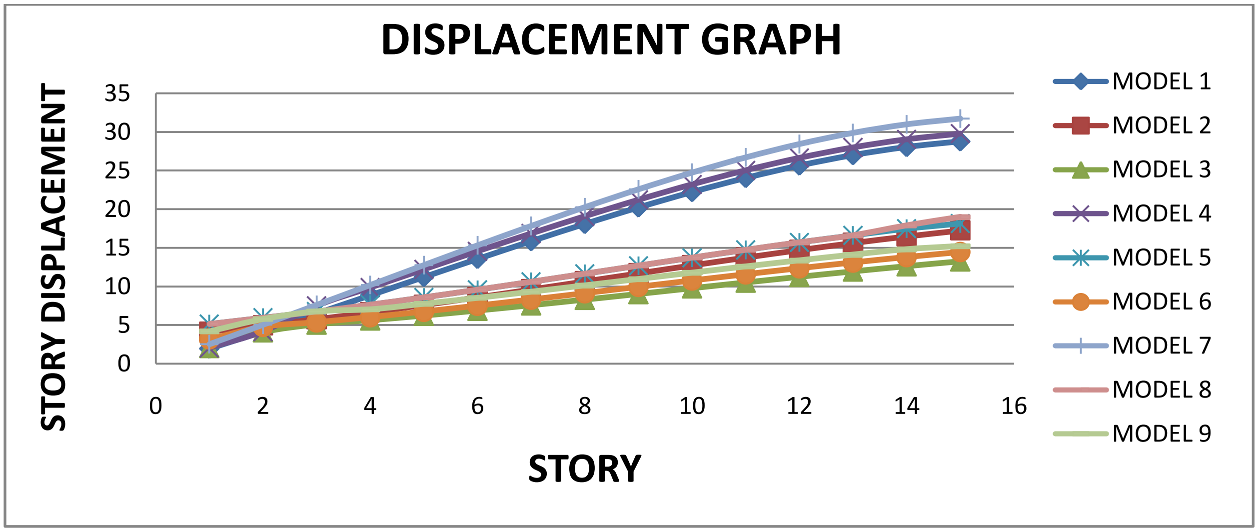
4. RESULTS

4.1 Story Displacement

It is the displacement of every storey with appreciate to ground level. According to IS 1893 (part1) :2002 the maximum value of displacement is 1/250 times of storey height with respect to ground. Maximum Storey displacement in mm comparison in x direction-the table and graph below shows the comparison of effective location of shear wall and bracings at various soil conditions in terms of storey displacement in X direction.

No of Storey	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9
15	33.335	19.18	12.756	33.90	21.34	13.882	39.38	25.81	19.26
14	31.03	17.88	12.10	33.67	19.26	12.556	36.895	24.12	18.76
13	29.876	16.90	11.98	31.10	17.90	12.23	33.45	23.45	18.12
12	27.868	15.16	11.354	28.79	16.90	11.98	31.90	19.34	17.86
11	25.10	14.20	10.981	26.453	15.16	11.345	30.42	18.6	17.10
10	22.10	13.45	10.116	22.90	24.20	10.334	28.10	17.34	16.81
9	20.18	12.92	9.556	21.34	13.45	9.98	26.880	16.2	15.87

8	18.68	12.1	9.028	18.234	12.92	9.245	24.11	15.20	14.76
7	15.734	11.34	8.10	16.54	12.1	8.58	21.45	13.45	13.90
6	13.603	10.11	7.90	14.20	11.34	8.11	18.98	12.92	12.20
5	11.415	9.10	6.938	12.301	10.11	7.21	15.775	11.36	11.56
4	8.551	7.90	6.4	8.641	8.90	6.56	11.56	10.90	10.35
3	6.806	6.12	5.901	7.90	6.15	6.10	9.56	7.15	9.34
2	4.227	5.8	5.245	5.10	4.90	5.234	6.67	4.90	7.90
1	1.86	2.91	4.55	1.90	2.90	4.90	2.80	1.87	5.36



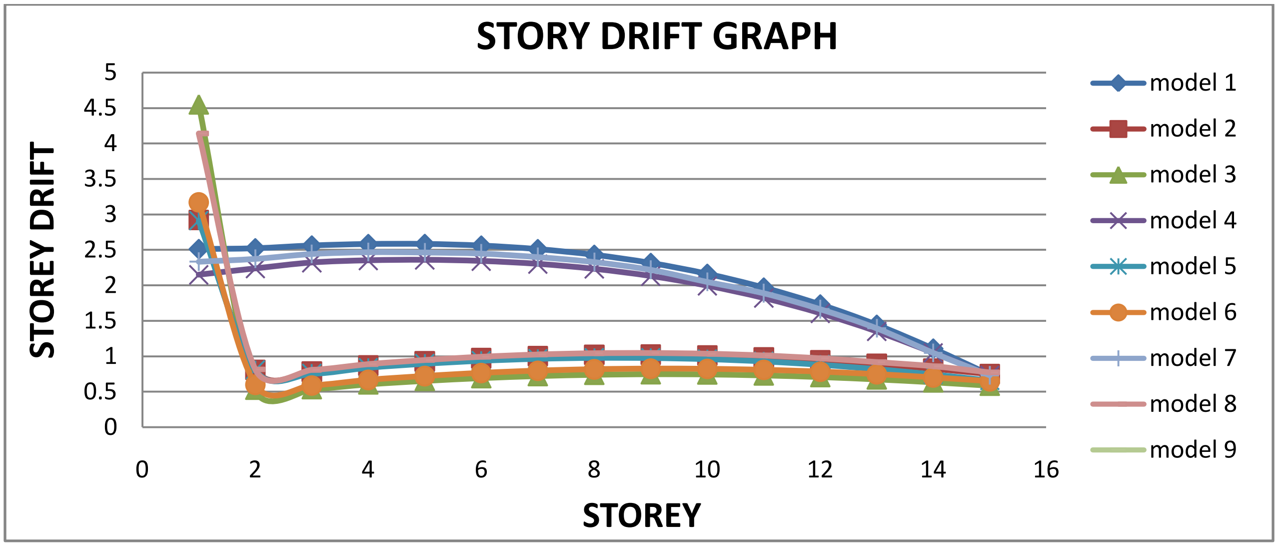
4.2 Storey Drift

According to IS 1893:2002 part 1, the storey drift of building should not be exceed 0.004 times of relative storey height.

Maximum Storey drift in mm comparison in X direction the table and the graph below shows the comparison of effective location of shear wall and bracing at various soil conditions in terms of storey drift in X direction.

No of Storey	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9
15	0.985	0.659	0.594	1.05	0.785	0.710	1.565	1.009	0.867
14	1.105	0.795	0.638	1.34	0.831	0.735	2.05	1.018	0.885
13	1.245	0.82	0.672	1.645	0.982	0.745	2.115	1.022	0.896
12	1.689	0.822	0.706	1.80	0.945	0.767	2.43	1.023	0.908
11	1.722	0.929	0.728	1.987	0.985	0.798	3.25	1.043	0.938
10	1.995	0.961	0.743	2.067	1.001	0.809	3.67	1.065	0.924
9	2.131	0.977	0.765	2.122	1.023	0.789	4.10	1.086	0.898
8	2.232	0.979	0.738	2.346	1.021	0.723	4.35	1.098	0.855
7	2.302	0.966	0.72	3.446	1.004	0.712	4.08	1.021	0.810
6	3.343	0.938	0.691	3.234	0.973	0.701	3.995	1.003	0.798
5	2.359	0.869	0.653	2.78	0.928	0.698	3.765	0.999	0.769
4	2.352	0.84	0.603	2.365	0.87	0.635	3.675	0.961	0.736

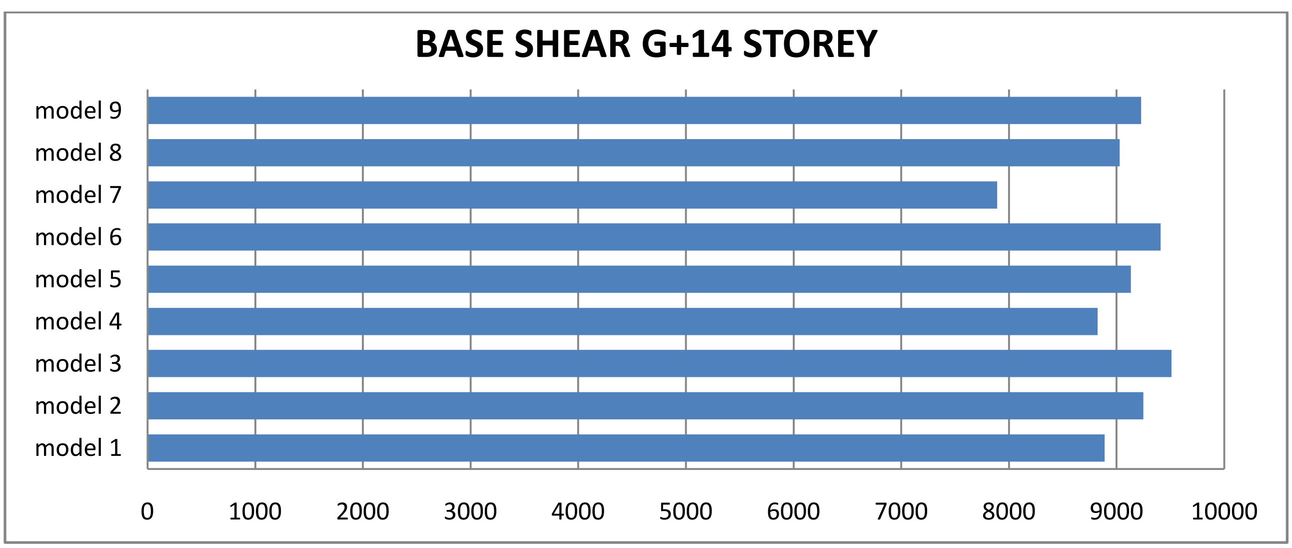
3	2.321	0.755	0.536	2.412	0.784	0.612	3.34	0.877	0.712
2	2.238	0.806	0.528	2.24	0.81	0.602	3.10	0.981	0.708
1	1.94	2.90	4.55	2.05	2.981	4.07	2.91	3.001	3.18



4.3 Base Shear

The table and graph below shows different base shear values for G+14 storey with different models.

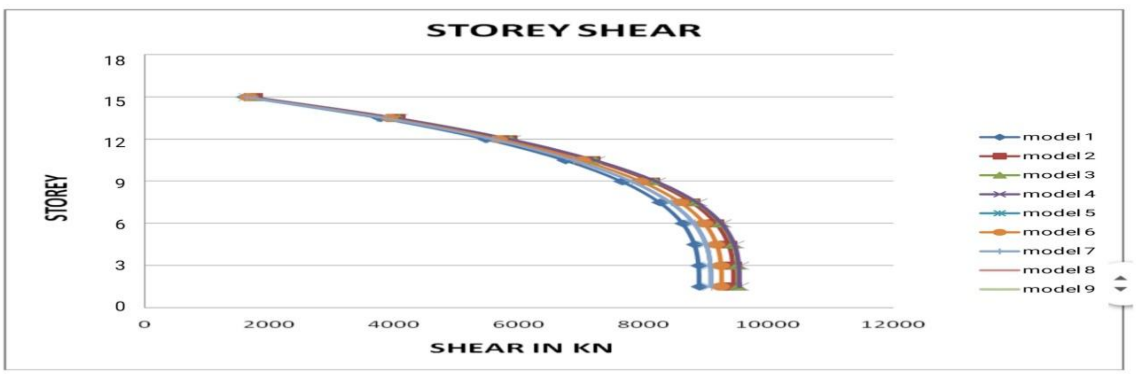
M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9
8220.47	9248.25	9544.98	8167.90	9167.9	9509.82	7885.1	9008.7	9081.98



4.4 Storey Shear

The table and graph below shows different storey shear values for G+14 storey different models.

No of Storey	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9
15	1598.22	1631.9	1738.06	1503.4	1689.9	1750.31	1454.7	1576.8	1632.6
14	3772.85	3891.19	4066.5	3189.78	3897.76	4063.64	3286.51	3465.32	3854.1
13	5854.98	4876.18	5879.3	4876.7	5634.38	5866.43	4893.36	5765.7	5584.34
12	6954.23	5976.65	7240.91	5234.9	6187.76	6276.9	5278.87	6298.5	5987.32
11	7245.01	6978.8	7892.89	5835.65	6398.9	6897.98	5867.39	6578.54	6276.76
10	7645.76	7187.9	8215.79	6037.87	6549.82	7219.78	6754.53	7265.46	6883.6
9	7789.72	7389.76	8767.43	6429.58	7260.75	8188.75	6835.7	7456.69	7143.3
8	7856.98	7659.87	8802.87	6843.98	7874.21	8837.4	7189.38	7865.28	7478.32
7	7901.10	8107.65	8868.4	7423.68	8120.9	9102.76	7376.9	8097.49	7687.76
6	7981.56	8421.98	9045.43	7654.43	8481.2	9186.8	7492.90	8287.9	7813.43
5	8002.87	8665.70	9126.75	7865.46	8649.3	9229.79	7563.8	8528.94	8436.88
4	8078.09	8907.8	9263.19	7954.29	8954.29	9389.9	7687.42	8765.8	8812.81
3	8106.09	9045.76	9464.61	8012.9	9012.9	9429.99	7708.46	8864.56	9005
2	8205.35	9134.54	9537.12	8097.8	9097.8	9502.06	7786.21	8976.9	9074.19
1	8220.47	9248.25	9544.98	8167.90	9167.90	9509.82	7885.1	9008.7	9081.98



4.5 Discussion of Result

Storey displacement was decreased in model with shear wall and bracing. At soil condition 1 the storey displacement decreased in shear wall model 61.73 % and bracing model 42.46%. at soil condition 2, 59.05% in shear wall model and 37.05% in bracing model. At soil condition 3, 34.45% in shear wall models and 31.67% in bracing model with compare to bare model.

Storey shear is increased in the model with the shear wall and bracings. At soil condition 1 the storey shear increased in shear wall model 9.23% and 4.01% in bracing. At soil condition 2, 8.37% increased in shear wall model and 3.43% in bracing model. At soil condition 3, 6.38% increased in shear wall model and 2.65% in bracing model with compared to bare models.

Storey drift decreased in shear wall models and bracing models. At soil condition 1 the storey drift decreased in shear wall model 39.69% and 33.09% in bracing model. At soil condition 2, 32.38% in shear wall model and 25.23% in bracing models. At soil condition 3, 44.16% in shear wall model and 35.64% in bracing model.

Base shear is increased in the models of shear wall and bracings. At soil condition 1 the base shear are increased 7.37% in shear wall models and 4.04% in bracing model . at soil condition 2, 6.37% in shear wall models. And 3.36% in bracing model. At soil condition 3, 4.87% in shear wall and 2.57% in bracing model.

5. CONCLUSION

- The providing shear wall are more efficient in minimizing the lateral displacement of building as a drift and horizontal deflection influence in shear wall are much less when compare with bare frame and bracing system.
- Providing bracing is effective but the shear wall more effective with compare to bare model.
- The location of shear wall at corner at soil type 1 and 2 has more significant effect on the seismic response then the bare frame.
- When it comes to the storey drift, decreased in shear wall model at soil all type condition.
- The base shear values are based on the loads and masses of the building. It also subjected to the zone and the importance priority of the structure. The shear wall models have more base shear compared to bracing model.
- The model 3 at soil condition 1 are effective model compared to bracings model and bare models.
- Hard soil and medium soil condition are suitable for multistory building.

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