ANALYSIS AND DESIGN OF SHEARWALLS FOR EARTH QUAKE RESISTANT BUILDINGS USING ETABS

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ABSTRACT
The use of sophisticated structural analysis methods has become crucial in the design of earthquake-resistant structures as a result of rising seismic activity and the need for safer infrastructure. Shear walls are important structural components that are known to improve lateral stability during seismic events. This study investigates how ETABS software might be used to innovate the design and analysis of shear walls. The study examines several shear wall designs and materials to evaluate their performance under seismic stresses by utilising ETABS' robust modelling, simulation, and optimisation capabilities. Across a range of building heights and seismic susceptibility zones, the study compares typical and optimised shear wall locations, cross-sectional dimensions, and reinforcing details. The findings show that while preserving material economy, careful placement and design modifications greatly increase structural durability. For structural engineers looking to use cutting-edge technologies like ETABS to build performance-based, economical, and code-compliant designs, the findings provide useful insights. The overall objective of creating more intelligent, secure, and sustainable urban constructions in seismically active areas is furthered by this research.

I. INTRODUCTION

GENERAL:

In India, shear walls are being used in the construction of several medium-rise residential complexes to give reinforced concrete frames earthquake protection. For practical purposes, these shear walls may contain windows, doors, and duct apertures. The behaviour of a structure and the tension in the shear wall are influenced by the quantity, position, and size of apertures.

High-rise building constructions usually use framed structures with shear walls as their structural framework. Additionally, this structural structure would contain several holes for stairwells, lifts, etc. In the study of this type of construction, the shear wall and frames are often modelled using plane stress elements and beam elements, respectively. To depict the link between the shear wall core and frames, a plan stress element should have drilling degrees of freedom. Otherwise, the shear wall cannot receive the bending force at the end of a beam.

The apertures might be rather big, as in the case of movie theatres, conference rooms, and function halls. The quantity, position, dimensions, and form of openings influence how the structure behaves in terms of deflection and member stress. These gaps have a significant impact on the analysis's effectiveness and precision.

FRAME:

Rectangular parts, beams, and columns joined in the same plane by stiff joints make up a rigid jointed R.C. frame. The construction stiffness of the columns, beams, and connections in the plane determines the lateral stiffness of such a frame. The frame might be in line with the façade or with one of the building's inner walls. The main benefit of rigid frames is their open, rectangular layout, which permits fast door and window installation and design flexibility. Up to around 25 storeys for steel framing and up to 15 stories for concrete framing, the rigid frame theory appears to be cost-effective. In order to limit drift, economical large numbers are required above these relatively modest lateral flexibilities of the frame.

The bending resistance of the girders, columns, and connections, as well as the axial rigidity of the columns in tall frames, are the primary factors that determine the horizontal stiffness of a rigid frame. The shear produces the cumulative horizontal shear above any story of ridig frames that are resisted by shear in columns. At mid-story height levels, the story-height columns will bend in a double curve with points of contraflexure. Attached girders, which also bend in double curvature, with points of contraflexure at around mid-span, resist the moments imparted to a junction from the column above and below.

Each story's horizontal deflection and frame racking are made possible by these girder and column deformations. A rigid frame structure's overall deflected form as a result of racking has an upward concavity shear configuration. There is a low inclination at the top and a maximum inclination close to the base.

Because reinforced concrete connections are inherently stiff, rigid frame architecture works best with reinforced concrete buildings. Although steel frame structures also employ the rigid frame architecture, moment-resistant steel connections are often expensive. The amount of external shear at any given level of the rigid frame directly affects the size of the columns and girders, which subsequently grow towards the base. Because of this, the floor framing design cannot be repeated, unlike certain braced frames.

MASONRY IN FILLED FRAMES

When designing a multistory structure, the main factor to be taken into account is the lateral stiffness against forces caused by wind or earthquakes. Using the composite stiffness and strength of the structural framework and the infill walls is one way to improve the lateral stiffness of a multistory structure. The most popular material for building in-filled frames is brick masonry. The way an in-filled frame interacts with the frame determines how it behaves. Panel proportion and the calibre of an infill job serve as the behavior's guiding principles. The system's behaviour is also significantly influenced by the infill's placement.

The mortar fractures under lateral stresses, resulting in separation and sliding at the frame-infill contact. The structural behaviour changes as a result of the stiffness loss brought on by this infill cracking. Failure arises from the constant reduction of stiffness and moment of inertia caused by cracking.

SHEAR WALL

Vertical stiffening components called shear walls are made to withstand lateral stresses from earthquakes and winds. Shear walls' structural behaviour under lateral pressures is greatly influenced by their placement and form. Parallel to the force of action, lateral loads are dispersed to the shear walls via the structure functioning as a horizontal diaphragm. Because of their great stiffness as deep beams, these shear walls react to shear and flexure to prevent overturning and withstand horizontal stresses. A core that is eccentrically positioned in relation to the building forms must be able to support tension in addition to bending and direct shear. However, when wind hits on the facades with direct surface textures (i.e., roughness) or when wind does not act via the centre of the building's mass, torsion may also emerge in buildings with symmetrical shear wall configurations (Schueller, 1977).

Compared to horizontal rigid frames, shear walls are substantially more rigid. Shear walls are therefore cost-effective up to 35 floors. When shear walls and frames are coupled in low- to medium-rise buildings, it is acceptable to assume that the shear walls will absorb all lateral stress, allowing the frame to be built for gravity loads alone.

A shear wall's resistance rises in direct proportion to its thickness. Wideness, however, has a far greater impact.

One specific yet extremely prevalent type of shear wall construction is a connected shear wall structure. It is made up of two or more shear walls that are in the same plane, or nearly the same plane, and are joined at floor levels by rigid slabs or beams. Because of this, the horizontal rigidity is significantly higher than if the walls were a collection of independent, uncoupled cantilevers.

SHEAR WALL COMPONENTS:

Shear walls made of reinforced concrete and reinforced masonry are seldom straightforward structures. A wall must be viewed as an assembly of relatively rigid parts, such as wall segments, and relatively flexible components, such as column segments and wall piers, whenever it contains doors, windows, or other openings.

1. **Column segments:** A vertical element that is more than three times as tall as it is thick and less than two and a half times as wide as it is thick is called a column segment. Typically, its load is primarily axial. Its stiffness must be taken into account even though it might not have a significant impact on the shear wall's lateral force resistance. A pilaster is the part of a column that protrudes from the wall's face when it is constructed integrally with the wall. The design of column segments must adhere to ACI 318 for concrete.
2. **Wall piers:** A wall pier is a section of a wall with a clear height of at least twice its horizontal length and a horizontal length between two and a half and six times its thickness.
3. **Wall segments:** Components that are longer than wall piers are called wall segments. They are the shear wall's main resisting elements.

NECESSITY, IMPORTANCE FEATURES IN PLANNING AND DESIGN OF SHEAR WALLS:

The issue of ensuring sufficient stiffness and avoiding significant displacements is just as crucial for all high-rise structures as ensuring sufficient strength. Therefore, compared to a frame system, a shear wall system offers two clear benefits.

- Without incurring significant extra costs, it has sufficient strength to withstand severe lateral stresses.
- It lowers the chance of non-structural damage by providing enough rigidity to withstand lateral displacements to acceptable limits.
- They must to be positioned such that they serve as useful walls as well. Additionally, avoid interfering with the building's architecture. The most often utilised shear core system is the enclosures surrounding the lift.
- Shear barriers must to be positioned on both axes. in order to offer lateral rigidity in both directions, especially for square structures.
- Shear walls should be positioned symmetrically about the axis to prevent torsion.
- Shear walls have to be extended all the way to the foundation..

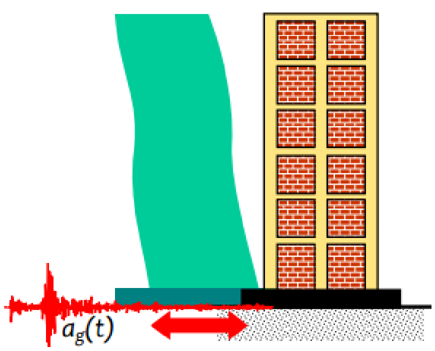
Earthquake:

Techniques for earthquake analysis that take into account the forces that occur during an earthquake. The magnitude of the earthquake determines how strong these forces are.

Dynamic actions on buildings-wind and earthquake

Both wind and earthquakes can create dynamic motions on structures. However, there are clear differences in designing for earthquake impacts and wind forces. Force is the foundation of the initiative philosophy of structural design, which is congruent with wind design. In force-type loading, the exposed surface area of the structure is subjected to pressure. Displacement-type loading occurs when a building is designed to withstand earthquakes because the ground at its base moves randomly (Figure 1.1), creating inertia forces inside the structure that lead to strains. This difference can also be expressed using the building's load-deformation curve, where the demands on the structure are displacement (i.e., horizontal axis) in displacement-type loading imposed by earthquake shaking and force (i.e., vertical axis) in force-type loading imposed by wind pressure.

The wind force acting on the structure consists of a relatively minor oscillation component superimposed on top of a non-zero mean component. As a result, under wind pressures, the structure may see slight variations in the stress field; nevertheless, reversal of stresses only happens when the wind direction changes, which only happens over an extended period of time. However, during an earthquake, the ground moves cyclically around the structure's neutral position. As a result, during the brief earthquake, the stresses in the building caused by seismic activity undergo several complete reversals.



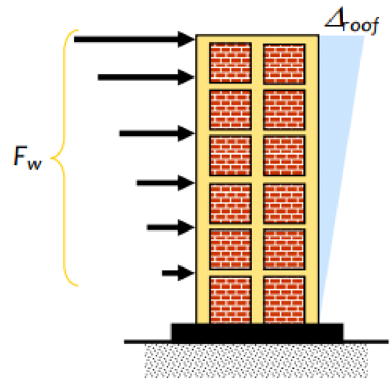


Figure 1: Disparities in how a building's design is affected by earthquake-related natural events, such as ground movement at the base and wind pressure on exposed areas.

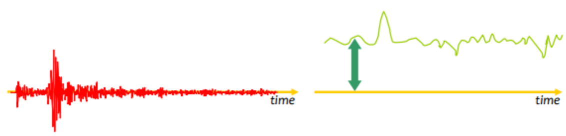


Figure 2: Characteristics of temporal changes of design actions: oscillatory, cytic and wind pressure, earthquake ground motion, and zero. mean

Basic aspects of seismic design

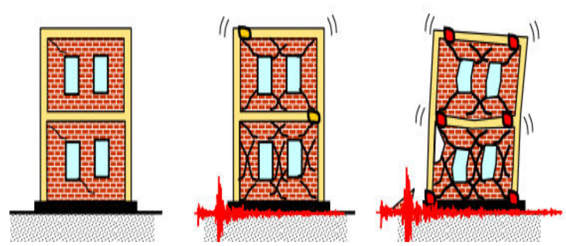


Figure 3: Designing to Resist Earthquakes Building philosophy is as follows: moderate shaking causes little structural damage and some non-structural damage, severe (infrequent) shaking causes structural damage but no collapse, and small (frequent) shaking causes little to no damage.

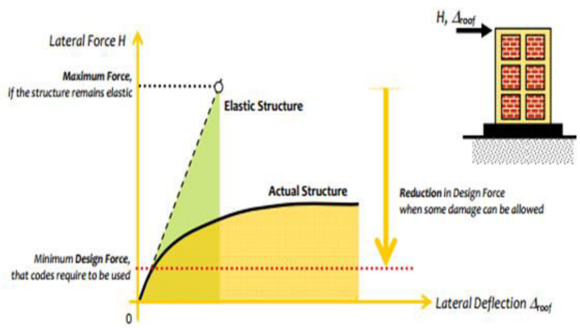


Figure 4: Fundamental earthquake design strategy: To get the design forces, compute the maximum elastic forces and subtract one.

Figure 5: Earthquake-resistant but not earthquake-proof: Normal constructions under damaged buildings are susceptible to damage during an earthquake.

OBJECTIVE OF THE STUDY

The project's primary goals are as follows:

1. To design an earthquake-resistant structure and use IS 1893:2002 to investigate the seismic behaviour of multistory buildings.
2. In order to evaluate multistory structures with and without shear walls at various sites.
3. Comparing the outcomes of story drift, shear force, bending moment, and building torsion in multistory structures without shear walls at various sites.
4. To examine the structures using response spectrum analysis in ETABS V9.7.4.

SUMMARY:

An overview of shear walls and their ability to withstand wind and seismic stresses is given in this section. Vertical components of the horizontal force-resisting system are called shear walls. Every level of the building, including the crawl area, should have shear walls. Shear walls of the same length should be symmetrically positioned on each of the building's four external walls to create an efficient box construction. When the outer walls are unable to offer enough strength and stiffness, or when the floor or roof diaphragm's permitted span-width ratio is exceeded, shear walls should be added to the inside of the structure. The span-width ratio for subfloors with traditional diagonal sheathing is 3:1. Accordingly, unless the external shear walls are insufficiently strong or rigid, a structure that is 25 feet wide and has this subfloor won't need interior shear walls until it is more than 75 feet long.

Shear walls are resistant to both shear and uplift pressures. The shear wall receives horizontal pressures from connections to the structure above. Between the top and bottom shear wall connections, this transfer produces shear pressures throughout the wall's height. The wall will break or "shear" apart if the timber, sheathing, and fasteners are not strong enough to withstand these shear pressures.

For shear walls to withstand horizontal seismic stresses, they must have the lateral strength required. Shear walls will transmit these horizontal forces to the subsequent element in the load path underneath them if they are sufficiently strong. These additional elements in the load stream might be slabs, footings, foundation walls, floors, or additional shear walls. Additionally, shear walls offer lateral rigidity to stop excessive side-swaying of the floor or roof above. Shear walls will keep components of the roof and floor framing from slipping off their supports if they are sufficiently rigid. Additionally, structures that are adequately rigid will often sustain less nonstructural damage.

II. LITERATURE REVIEW

Ehsan Salimi Firoozabad, Dr. K. Rama Mohan Rao, Bahador Bagheri.,et al1 (2012)

The primary goal of the current study is to ascertain how shear wall arrangement affects a building's seismic performance. Buildings with varying numbers of storeys and varied layouts with the same plan have undergone time history examination. To address the impact of shear wall layout on building seismic performance, top story displacements have been measured and compared across all models. In order to study the analysis and construction of models based on IS codes, SAP 2000 software was employed.

This study found that shifting the shear wall positions can at least double the top story drift, resulting in a 100% reduction in the building's drift from the highest value to the lowest. The IS code's maximum drift constraint of 0.004 is met for all building heights when the ELCENTRO earthquake occurs, however the TABAS earthquake does not meet this requirement. Both the ELCENTRO and TABAS earthquakes satisfy the maximum drift limitation for configuration number six, indicating that the position of shear walls is crucial in determining drift limitation. The seismic behaviour of structures cannot be guaranteed by the number of shear walls; hence, adding more shear walls won't always result in improved seismic behaviour.

Shahzad Jamil Sardar and Umesh. N. Karadi., et al2 (2013)

In this project, a 25-story structure in zone V is studied with considerable examination. The standard software ETAB is used to analyse the data by changing the location of the shear wall in order to determine characteristics such as storey drift, storey shear, and displacement. 3D building model development for linear static and linear dynamic methods of analysing and influencing the concrete core wall at the building's centre.

In order to determine and compare the base shear, this study concluded that seismic analysis of reinforced concrete frame structures is done using both static and dynamic analysis. It was discovered that model-5 exhibits the highest base shear along longitudinal and transverse directions when compared to the other models. Model-5 exhibits less displacement in the longitudinal direction than the other models, according to similar static analysis. Model 5 exhibits less displacement in the longitudinal direction than the other models in response spectrum analysis. Model-5 has less interstorey drift than the other models in a longitudinal direction, according to similar static analysis. Model 5 exhibits less inter-story drift in response spectrum analysis than other models in a longitudinal orientation. Shear walls improve the structure's strength and stiffness and can have a significant impact on how a frame structure behaves during earthquakes. Since there is less lateral displacement and inter-story drift than with previous models, it has been discovered that the model-5 displays a superior shear wall position.

Najma Nainan., et al3 (2012)

Both static and dynamic loads are often applied to structures on Earth. Dynamic loads change throughout time, whereas static loads remain constant. Generally speaking, all applied loads are assumed to be static when designing most civil engineering structures. Because the structure is rarely subjected to dynamic loads, the effect of dynamic load is not taken into account; also, taking dynamic load into account during analysis complicates and prolongs the solution. This tendency to ignore dynamic forces can occasionally lead to catastrophe, especially during earthquakes. Shear walls made of reinforced concrete (RC) are used in structures to withstand lateral stresses brought on by earthquakes and wind. They are typically found in shafts housing other utilities, stair wells, lift wells, and in between column lines. Through the passage of seismic or wind stresses to the foundation, shear walls offer lateral load resistance. In addition, they support gravity loads and give the system lateral stiffness. The seismic performance of a building structure is greatly enhanced by a well-designed shear wall system. For towering structures, safety and the least amount of structural damage may be the most important requirements. The structure must possess appropriate ductility, lateral stiffness, and lateral strength in order to satisfy these specifications. The designer may decide to use the shear wall-concrete frame among the several structural solutions. Therefore, the impact of shear wall height on the building frame's dynamic response is included in this study.

It was determined from this study that an analytical investigation of the dynamic response of seismo-resistant building frames was completed. The dynamic response of building frames is used to determine the storey displacements for different shear wall heights. One can infer the following conclusion from the study. The displacement continues to diminish if the shear wall's height is increased to the midpoint of the building frames. However, there won't be much of a reduction in displacement if the shear wall is extended the whole length of the structure. As a result, high-rise structures do not require shear walls throughout their height. That is, the shear wall's reaction to lateral stresses is minimal when it is higher than the building's midpoint.

Mr.K.LovaRaju, Dr.K.V.G.D.Balaji., et al4 (2015)

The non-linear analysis of the frame for different shear wall placements in a building frame is the subject of this study. The goal of the current study is to determine the best position for shear walls in multi-story buildings. Three of the models are dual type structural systems, whereas model one is a bare frame structural system. According to Code Provision IS1893-2002, an earthquake load is applied to an eight-story structure that is situated in zones II, III, IV, and V. ETABS software has been used to do the analysis. For several models, pushover curves have been created and compared. It has been noted that in cases of displacement and base shear, a construction with a shear wall at the proper position is more significant.

Four eight-story building models are taken into consideration in this study; one is bare frame, and the other three have shear walls positioned in positions 1, 2, and 3 in all seismic zones, with corresponding baseshear and lateral displacements derived from the pushover curve using Etabs software. The presence of a shear wall affects the structure's strength and lateral displacement during seismic activity. When compared to the frame without a shear wall, the shear wall in position three performs better and the base shear increases by 9.82%. The shear wall in position three minimises lateral movement by 26.7% and performs better than the frame without a shear wall. For both new and existing structures, it is beneficial to have shear walls in the right places since this improves the structure's performance.

III. MODELLING OF SHEAR WALL

Shear wall models created for the lateral load analysis of multistory buildings in elastic regions are shown in this chapter. because building structural modelling techniques are examined independently. Studies on shear wall modelling may also be conducted using two- and three-dimensional methods.

3.1 TWO DIMENSIONAL (PLANAR) SHEAR WALL MODELS

Several shear wall models that were created for the two-dimensional elastic analysis of multistory building structures are mentioned in the literature. This section provides a review of various models.

3.1.1 EQUIVALENT FRAME MODEL (WIDE COLUMN ANALOGY)

For the study of planar linked shear wall constructions, Clough et al. [47], Candy [48], and MacLeod [49] created the comparable frame model. Only lateral load analysis of rectangular building frames without torsion could be done with this model. McLeod [50,51] and McLeod and Hosny [52] enhanced it for the study of nonplanar shear walls in the 1970s.

The analogous frame approach, also referred to as the broad column analogy, substitutes an idealised frame structure made up of a column and stiff beams at floor levels for each shear wall. The column is positioned at the centroidal axis of the wall and is given the axial area and inertia of the wall. At each level of the framework are the stiff beams that link the column to the connecting beams [8]. Figure 3.1 shows an example model. In contrast to other frame parts, stiff arms' axial area and inertia values are given extremely high values in this technique.

The comparable frame approach is particularly well-liked in design offices for the study of multistory shear wall-frame buildings because of its ease of use.

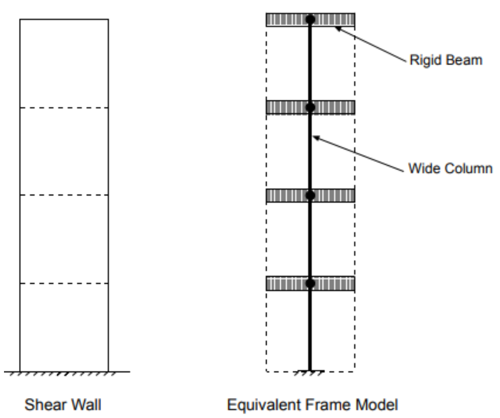


Fig 6: Equivalent Frame Model of a Shear Wall

3.1.2 ANALOGOUS FRAME METHOD

Smith et al. [53] devised an alternate technique for simulating both planar and nonplanar shear walls. Their study's goal was to eliminate the excessive shear deformations and false flexure caused by the traditional equivalent frame method's discontinuous modelling of continuous vertical connections between neighbouring planar wall components. The braced frame analogy and the braced broad column analogy are the two distinct frame models they suggested for shear wall analysis in their study.

With diagonal braces, the braced wide column analogy is comparable to the traditional wide column analogy that was previously discussed. Rigid horizontal beams that are the same length as the wall's width and joined by a single central column make up a single module. The ends of the beams are joined by hinged-end diagonal braces [53]. Figure 3.2 depicts a typical braced broad column module. Figure 3.3 shows a braced broad column analogy of a planar shear wall.

The following three equations establish the stiffness characteristics of the braces (Ad, axial area of the diagonal brace) and the column (Ic, column moment of inertia and Ac, column area):

$$I_c = \frac{tb^3}{12} \tag{3.1}$$

$$\frac{12EI_c}{h^3} + \frac{2EA_d \cos^2\theta}{l} = \frac{btG}{h} \tag{3.2}$$

$$\frac{EA_c}{h} + \frac{2EA_d \sin^2\theta}{l} = \frac{EA_w}{h} \tag{3.3}$$

The calculation of the axial, shear, and bending stiffnesses of matching wall segments served as the basis for these equations. The shear wall's thickness and breadth are denoted by t and b in the equations, the modulus of elasticity by E, and the shear wall's height by h.

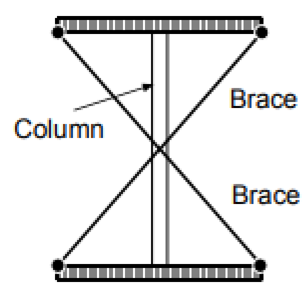


Fig 7: Braced Wide Column Module

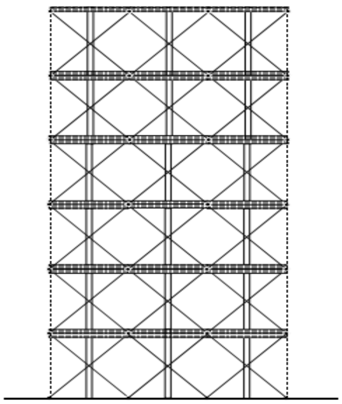


Fig 8: A Planar Shear Wall Modelled by Braced Wide Column Analogy

3.1.3 FINITE ELEMENT MODELS

A two-dimensional shear wall is broken up into smaller, finite-size, and finite-number components for finite element modelling. These components might be quadrilateral, rectangular, or triangular. The two-dimensional shell element is the most often utilised plane stress element for shear wall analysis. At each node, it has three degrees of freedom: two translations and one rotation. The finite element approach is frequently utilised for a variety of engineering challenges, not just designing multistory structures. A finite element model of a connected shear wall is shown in Figure 3.5. Figure 3.6 shows a rectangular shell element.

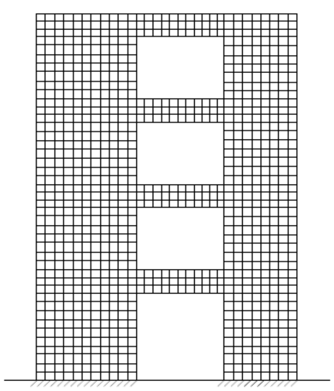


Fig 9: Finite Element Model of a Coupled Shear Wall

3.1.4 PLANE STRESS ELEMENT WITH AUXILIARY BEAM

A rectangular plane stress element with two translation degrees of freedom at each node—also known as a membrane element—and a frame element with three degrees of freedom at either end make up the proposed model. Smith and Coull [1] suggested this for simulating shear wall-beam couplings. The stiff auxiliary beam, which may be positioned either vertically or horizontally, transfers the moment and the wall's rotation to the external beam (Figure 3.7 and 3.8).

Another shear wall concept is suggested in the same paper, which consists of membrane components combined with continuous stiff auxiliary beams placed at floor levels to transfer rotation and moments. This paradigm is illustrated in Figure 3.9. A shear wall module between two floor levels is modelled using a single membrane element. To depict the system's torsional rigidity, a fake column is placed at one of the wall assembly's edges in the model. All other stiffness values are set to zero, and the column is given a torsion constant that is equal to the sum of the torsional constants of the individual walls.

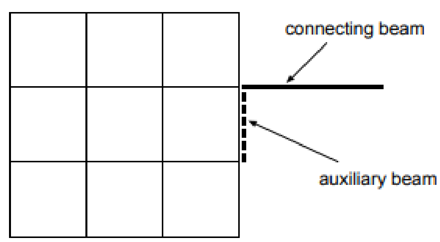


Fig 10: Plane Stress Elements with Vertical Auxiliary Beam

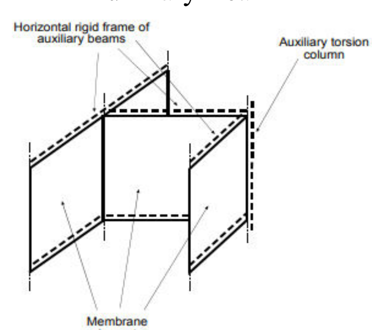


Fig 11: Membrane Elements with Rigid Beams at Floor Levels and Auxiliary Torsion Column

3.2 SHEAR WALL MODELS FOR THREE DIMENSIONAL ANALYSIS

Shear wall models are often modified versions of two-dimensional models that are utilised in three-dimensional structural research. The most popular of these models are examined in the pages that follow.

3.2.1 EQUIVALENT FRAME MODEL

Many people utilise a two-dimensional (planar) equivalent frame model as a three-dimensional model, particularly when analysing tall structures with reinforced concrete cores. In order to analyse the shear wall cores of tall structures, MacLeod [50, 51, 65], MacLeod and Hosny [52], and Lew and Narow [66] investigated the equivalent frame model. The comparable frame model was employed by Ghuneim [67] and Dikmen [68] to analyse tunnel form buildings in three dimensions. With the further criterion that the crossing walls be vertically compatible, the model is exactly the same as the two-dimensional corresponding frame. A triangular reinforced concrete core and its corresponding frame model are seen in Figures 3.10 and 3.11 [66].

According to Smith and Girgis [69], the traditional broad column model has several drawbacks, particularly when it comes to examining closed or partially closed core walls that are exposed to torsion. They found that the column components used to simulate the walls suffer from parasitic moments when these kinds of walls are exposed to shear loads. As a result, compared to finite element modelling, comparatively large values for shear deformations and rotations are produced in a closed or partially closed section core represented using broad column analogies. Additionally, Kwan [55] listed the causes of mistakes when using the broad column analogy to three-dimensional analysis.

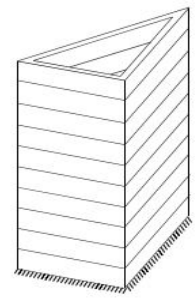


Fig 12: Triangular Core [66]

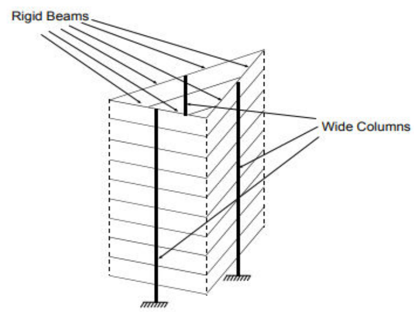


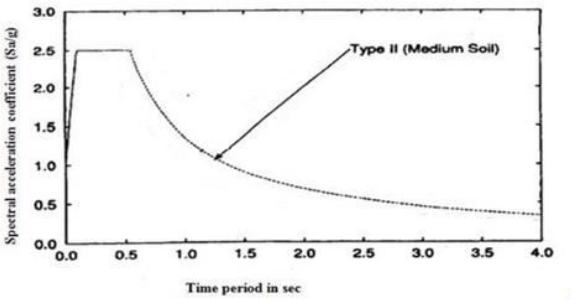
Fig 13:Equivalent Frame Model of a Triangular Core [66] of core structures.

IV. METHODOLOGY AND MODELLING OF BUILDING

4.1 METHODOLOGY:

RESPONSE SPECTRUM METHOD:

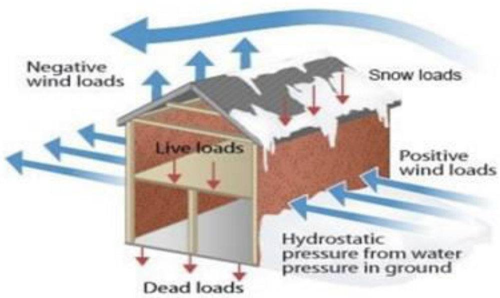
the illustration of the idealised single-degree-of-freedom system's maximum reaction to ground vibrations during earthquakes, with a certain period and damping. The code IS 1893-2002 (part 1) is followed in the execution of this study. Seismic zone factor and soil type should be supplied here using IS 1893-2002 (part 1). The ETABS 2013 program is used to analyse the building using the standard response spectrum for the kind of soil under consideration. The usual response spectrum for medium soil types is displayed in the following diagram, which may be expressed as time period versus spectral acceleration coefficient (Sa/g).



Response spectrum for medium soil type for 5% damping.

4.2 DIFFERENT TYPES OF LOADS ACTING ON THE STRUCTURE

Vertical, horizontal, and longitudinal loads are the three general categories of loads that are applied to buildings and other structures. Dead loads, living loads, and impact loads make up the vertical loads. Wind and seismic loads are included in the horizontal loads. When designing bridges, gantry girders, and other structures, longitudinal loads—that is, tractive and braking forces—are taken into account.



V. RESULTS AND ANALYSIS

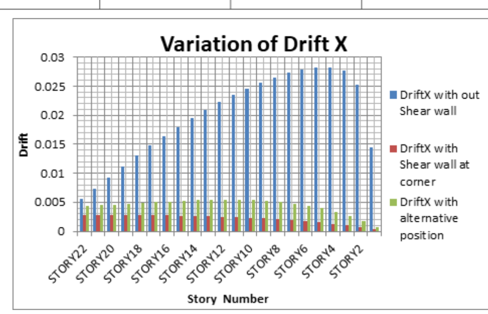
5.1 Story Drift:

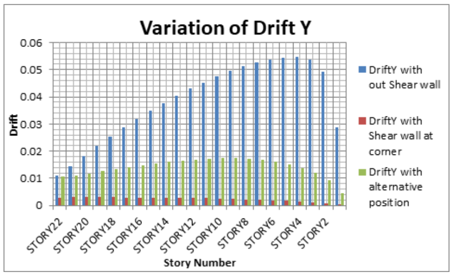
X-Direction

Story	DriftX with out Shear wall	DriftX with Shear wall at corner	DriftX with alternative position
STORY22	0.005584	0.002766	0.004437
STORY21	0.007351	0.002782	0.004515
STORY20	0.00927	0.002791	0.004614
STORY19	0.011168	0.002791	0.004733
STORY18	0.012998	0.002782	0.004863
STORY17	0.014744	0.002761	0.004996
STORY16	0.016398	0.00273	0.005123
STORY15	0.017959	0.002689	0.005237
STORY14	0.019461	0.002637	0.005329
STORY13	0.02088	0.002575	0.005392
STORY12	0.022214	0.002501	0.00542
STORY11	0.023459	0.002415	0.005405
STORY10	0.024606	0.002314	0.005338
STORY9	0.025641	0.002198	0.005212
STORY8	0.026546	0.002063	0.005016
STORY7	0.027295	0.001907	0.004743
STORY6	0.027859	0.001728	0.004383
STORY5	0.028197	0.001521	0.003923
STORY4	0.028226	0.001283	0.00335
STORY3	0.027654	0.00101	0.002644
STORY2	0.025206	0.000699	0.001787
STORY1	0.01442	0.000334	0.000742

Y-Direction

Story	DriftY with out Shear wall	DriftY with Shear wall at corner	DriftY with alternative position
STORY22	0.011064	0.002985	0.010547
STORY21	0.014338	0.003008	0.011148
STORY20	0.018095	0.003022	0.011868
STORY19	0.021781	0.003027	0.012618
STORY18	0.025319	0.00302	0.013367
STORY17	0.028685	0.003003	0.014103
STORY16	0.031872	0.002976	0.014812
STORY15	0.034883	0.002938	0.015474
STORY14	0.037728	0.00289	0.016067
STORY13	0.040413	0.002831	0.01657
STORY12	0.042941	0.002758	0.016967
STORY11	0.045307	0.00267	0.017245
STORY10	0.047493	0.002566	0.017382
STORY9	0.049472	0.002442	0.017357
STORY8	0.051207	0.002297	0.017142
STORY7	0.052653	0.002128	0.016715
STORY6	0.053758	0.001934	0.016052
STORY5	0.054452	0.001711	0.01512
STORY4	0.054596	0.001458	0.013852
STORY3	0.053675	0.001174	0.012088
STORY2	0.049284	0.000859	0.009401
STORY1	0.028635	0.000494	0.004426





The movement laterally is referred to as "drift". The phenomenon known as "story drift" occurs when a floor in a multi-story building shifts away from the level beneath it. The total of the floor and roof displacements for each story, normalised by the story height, is the interstory drift that occurs when a structure wobbles during an earthquake. For example, for a 10-foot-high storey, an interstory drift of 0.10 indicates that the roof is one foot off the floor below.

A bigger drift increases the likelihood of damage. Severe damage, defined as peak interstory drift values larger than 0.06, may pose a risk to human health if the values exceed 0.025. It is probable that the structure will collapse when values exceed 0.10.

The figures and tables above demonstrate that the story drift (lateral displacement) values in the shear wall at the corner are lower than those in the other two scenarios (generic building and alternative site). Therefore, compared to other high-rise, conventional structures, buildings located close to terrain shear walls at corners are prone to less load impacts.

5.2 STORY SHEARS AND OVER TURNING MOMENTS

The global coordinate system reports for narrative shears and overturning moments are P, VX, VY, T, MX, and MY. The forces are referenced at the very beginning of the story, just below the story level, and at the very end, just above the story level below that. Narrative level forces are expressed from bottom to top using the same sign convention as frame elements, with the tale represented by the j-end and the frame element by the i-end of the story. As previously stated, the overturning moments and narrative shears are regularly recorded at Global Z, Global X, and Global Y. The internal forces influencing the frame components include

- P, the axial force
- V2, the shear force in the 1-2 plane
- V3, the shear force in the 1-3 plane
- T, the axial torque (about the 1-axis)
- M2, the bending moment in the 1-3 plane (about the 2-axis)
- M3, the bending moment in the 1-2 plane (about the 3-axis)

:

These internal forces and moments are visible in the cross sections of every frame piece.

Shear force at the cross section of the beam may be defined as an imbalanced vertical force acting to the right or left of the section.

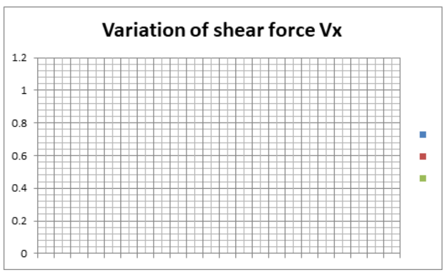
5.2.1 Shear force

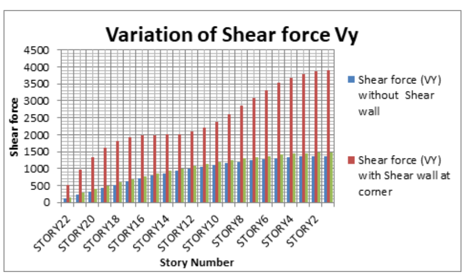
X-Direction:

Story	Shear force (VX) without Shear wall	Shear force (VX) with Shear wall at corner	Shear force (VX) with Shear wall at alternative position
STORY22	110.12	406.17	149.25
STORY21	219.08	724.16	298.06
STORY20	324.4	933.94	438.87
STORY19	425.25	1047.82	571.55
STORY18	520.98	1087.06	695.94
STORY17	611.2	1081.07	811.87
STORY16	695.76	1063.16	919.22
STORY15	774.73	1061.48	1017.85
STORY14	848.38	1088.5	1107.67
STORY13	917.06	1138.92	1188.65
STORY12	981.15	1199.63	1260.8
STORY11	1040.96	1262.32	1324.19
STORY10	1096.67	1329.45	1378.98
STORY9	1148.27	1411.99	1425.4
STORY8	1195.53	1521.18	1463.79
STORY7	1238.05	1659.29	1494.57
STORY6	1275.27	1816.1	1518.28
STORY5	1306.55	1972.77	1535.57
STORY4	1331.3	2109.01	1547.23
STORY3	1348.99	2209.48	1554.19
STORY2	1359.43	2267.85	1557.52
STORY1	1363.15	2288.76	1558.46

Y-Direction:

Story	Shear force (VY) without Shear wall	Shear force (VY) with Shear wall at corner	Shear force (VY) with Shear wall at alternative position
STORY22	112.72	516.35	143.3
STORY21	223.64	973.51	277.9
STORY20	330.4	1338.91	395.06
STORY19	432.29	1614.22	497.12
STORY18	528.82	1804.84	589.81
STORY17	619.68	1920.73	678.76
STORY16	704.79	1977.07	766.37
STORY15	784.23	1994.81	851.38
STORY14	858.25	2000.12	931.2
STORY13	927.18	2021.8	1004.45
STORY12	991.32	2085.39	1071.84
STORY11	1050.92	2205.66	1134.96
STORY10	1106.11	2382.31	1194.4
STORY9	1156.86	2602.17	1249.07
STORY8	1202.95	2845.41	1297.21
STORY7	1244.01	3091.33	1338.21
STORY6	1279.6	3321.69	1373.32
STORY5	1309.2	3522.26	1404.63
STORY4	1332.37	3683.33	1432.96
STORY3	1348.79	3799.82	1456.57
STORY2	1358.41	3871.35	1472.14
STORY1	1361.84	3901.99	1477.88





The information in the tables and graphs above demonstrates that the situation without a shear wall had the largest shear force when compared to the other two scenarios (alternative position and corner position). A high-rise building is less vulnerable to shear pressures if it does not have a shear wall. Typical structures.

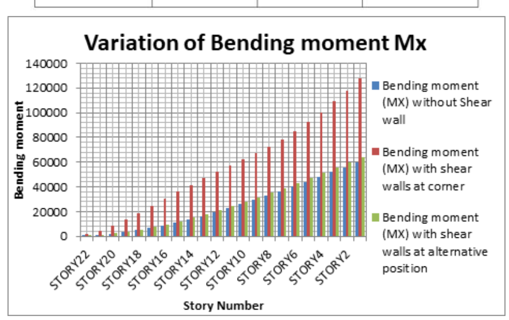
5.2.2 Bending Moment:

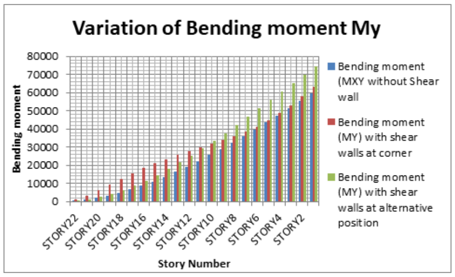
X-Direction:

Story	Bending moment (MX) without Shear wall	Bending moment (MX) with shear walls at corner	Bending moment (MX) with shear walls at alternative position
STORY22	338.148	1549.047	429.905
STORY21	1009.045	4468.975	1262.944
STORY20	2000.106	8482.62	2444.15
STORY19	3296.563	13315.21	3922.251
STORY18	4881.926	18703.47	5660.422
STORY17	6738.557	24405.75	7640.038
STORY16	8848.264	30212.7	9855.978
STORY15	11192.86	35957.83	12307.18
STORY14	13754.6	41527.24	14988.64
STORY13	16516.57	46867.37	17888.82
STORY12	19462.77	51989.28	20992.11
STORY11	22578.2	56967.62	24282.57
STORY10	25848.65	61932.2	27745.68
STORY9	29260.44	67051.09	31367.28
STORY8	32800.06	72505.84	35131.46
STORY7	36453.82	78462.86	39019.86
STORY6	40207.44	85047.15	43013.17
STORY5	44045.89	92324.99	47093.64
STORY4	47953.21	100299.2	51246.33
STORY3	51912.66	108916.5	55458.03
STORY2	55907.17	118084	59714.86
STORY1	59920.69	127688.2	64001.5

Y-Direction:

Story	Bending moment (MXY without Shear wall	Bending moment (MY) with shear walls at corner	Bending moment (MY) with shear walls at alternative position
STORY22	330.366	1218.498	447.744
STORY21	987.591	3389.612	1341.932
STORY20	1960.694	6183.738	2658.557
STORY19	3236.068	9300.398	4373.208
STORY18	4797.993	12488.48	6461.015
STORY17	6629.29	15563.1	8896.636
STORY16	8712.011	18414.58	11654.29
STORY15	11028.1	21006.23	14707.84
STORY14	13559.95	23360.26	18030.85
STORY13	16290.82	25534.58	21596.8
STORY12	19205.06	27598.21	25379.19
STORY11	22288.17	29614.67	29351.75
STORY10	25526.63	31639.93	33488.68
STORY9	28907.56	33733.77	37764.88
STORY8	32418.38	35975.25	42156.25
STORY7	36046.24	38469.51	46639.95
STORY6	39777.63	41336.76	51194.77
STORY5	43598	44684.25	55801.47
STORY4	47491.55	48573.98	60443.16
STORY3	51441.2	53003.06	65105.73
STORY2	55429.04	57907.72	69778.28
STORY1	59437.86	63188.95	74453.66



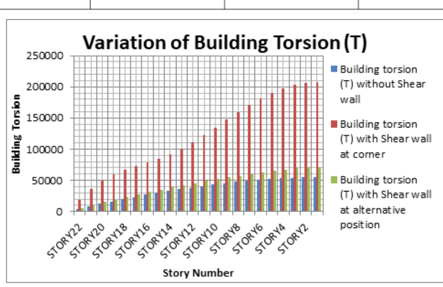


The bending moment at the cross section of the beam may be expressed as an algebraic sum of the moments of the forces operating to the right and left of that cross section.

The data above indicates that, in contrast to the other two situations (alternative position and corner position), the bending moment was higher in the scenario without a shear wall. Therefore, conventional high-rise constructions without shear walls are less affected by the bending moment.

5.3 Building Torsion:

Story	Building torsion (T) without Shear wall	Building torsion (T) with Shear wall at corner	Building torsion (T) with Shear wall at alternative position
STORY22	4234.634	18879.2	5404.464
STORY21	8402.912	35534.31	10503.22
STORY20	12417.5	48849.09	15037.58
STORY19	16255.78	59023.56	19195.1
STORY18	19903.79	66579.57	23238.52
STORY17	23357.78	72525.75	27297.2
STORY16	26623.86	78155.45	31313.62
STORY15	29715.94	84423.63	35148.24
STORY14	32652.09	91823.95	38725.15
STORY13	35449.95	100575.4	42108.41
STORY12	38122.12	110708.2	45424.28
STORY11	40672.7	122064.1	48709.88
STORY10	43095.48	134296	51870.72
STORY9	45374.05	146912.6	54770.97
STORY8	47483.28	159355.6	57379.76
STORY7	49391.96	171074.8	59853.33
STORY6	51066.03	181581.6	62392.15
STORY5	52472.07	190485.1	65016.05
STORY4	53580.89	197518.3	67527.95
STORY3	54371.53	202556.6	69608.08
STORY2	54837.47	205635	70951.93
STORY1	55004.57	206950.8	71444.53



A torque is a force that rotates around an axis, which might be the centre of mass or a fixed point, by twisting or turning.

Another way to think about torque is the ability of a spinning item, such a gear or shaft, to overcome turning resistance.

The aforementioned tables and graphs demonstrate that the shear wall at the corner achieved the highest building torsional value when compared to the other two cases (alternate placement and corner position). Consequently, building torsional stresses have less of an impact on high-rise structures without shear walls. Typical structures.

VI. CONCLUSION

The importance of ETABS as a potent tool for the analysis and design of shear walls for earthquake-resilient buildings has been shown by this work. Strategic changes in shear wall location, geometry, and reinforcement details have been shown via extensive modelling and simulation to greatly improve a building's resistance to seismic pressures. The creative methods made possible by ETABS enhance structural performance and maximise material use, promoting sustainability and safety. According to the comparison research, contemporary design tactics that are informed by software-based insights perform better than traditional approaches in terms of cost-effectiveness and seismic stability. These results highlight the significance of incorporating cutting-edge design techniques into seismic design procedures and provide a useful resource for planners, researchers, and engineers working to construct structurally sound structures in seismically active regions. Further investigation and improvement of these digital techniques will raise the bar for earthquake-resistant building requirements.

REFERENCES

1. Ehsan Salimi Firoozabad, Dr. K. Rama Mohan Rao, Bahador Bagheri, Effect of Shear Wall Configuration on Seismic

Performance of Building, Proc. of Int. Conf. on Advances in Civil Engineering 2012

2. Shahzad Jamil Sardar and Umesh. N. Karadi, "EFFECT OF CHANGE IN SHEAR WALL LOCATION ON STOREY DRIFT OF MULTISTOREY BUILDING SUBJECTED TO LATERAL LOADS", International Journal of Innovative Research in Science,Engineering and Technology, Vol. 2, Issue 9, September 2013.
3. Najma Nainan, Alice T V, Dynamic Response Of Seismo resistant BuildingFrames,International Journal of Engineering Science and Technology (IJEST) ISSN : 0975-5462 Vol. 4 No.05 ,May 2012.
4. Mr.K.LovaRaju, Dr.K.V.G.D.Balaji, Effective location of shear wall on performance of building frame subjected to earthquake load, International Advanced Research Journal in Science, Engineering and Technology, ISSN 2394-1588 Vol. 2, Issue 1, January 2015.
5. Varsha R. Harne, Comparative Study of Strength of RC Shear Wall at Different Location on Multi-storied Residential Building, International Journal of Civil Engineering Research.ISSN 2278-3652 Volume 5, Number 4 (2014), pp. 391- 400
6. Syed Khasim Mutwalli1 , Dr. Shaik Kamal Mohammed Azam2, "Dynamic Response of High Rise Structures Under The Influence of Shear Walls", Int. Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 4, Issue 9(Version 6), September 2014, pp.87-96.
7. R.S.Mishra1, V.Kushwaha2, S.Kumar3, "A Comparative Study of Different Configuration of Shear Wall Location in Soft Story Building Subjected to Seismic Load.", International Research Journal of Engineering and Technology (IRJET), Volume: 02 Issue: 07 | Oct-2015.
8. Zeeshan Baseer and Syed Farrukh Anwar," EFFECT OF PERFORATION OF SHEAR WALL ON VARIOUS DESIGN PARAMETERS OF A HIGH RISE BUILDING", GLOBAL JOURNAL OFENGINEERING SCIENCE AND RESEARCHES.