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Effect of Earthquake Load on Column Forces in Concrete Frame Structures with Different Type of RC Shear Walls under Different type of Soil Condition

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***Abstract* – Shear Wall is A Structural Element Used to Resist Lateral, Horizontal, Shear Forces Parallel to the Plane of the Wall By: Cantilever Action For Slender Walls Where The Bending Deformation is Dominant. Truss Action for Squat/Short Walls where the Shear Deformation is Dominant. Shear walls are analyzed to resist two types of forces: shear forces and uplift forces. Shear forces are created throughout the height of the wall between the top and bottom shear wall connections. Uplift forces exist on shear walls because the horizontal forces are applied to the top of the wall. These uplift forces try to lift up one end of the wall and push the other end down. In some cases, the uplift force is large enough to tip the wall over. Shear walls are analyzed to the provide necessary lateral strength to resist horizontal forces. Shear walls are strong enough, to transfer these horizontal forces to the next element in the load path below them. The seismic motion that reaches a structure on the surface of the earth is influenced by local soil conditions. The subsurface soil layers underlying the building foundation may amplify the response of the building to earthquake motions originating in the bedrock. Three types soil are considered here: Hard soil, Medium soil, soft soil. In the present work thirty story building with C Shape, Box shape, E Shape, I shape and Plus shape RC Shear wall at the center in Concrete Frame Structure with fixed support conditions under different type of soil for earthquake zone V as per IS 1893 (part 1) : 2002 in India are analyzed using software ETABS by Dynamic analysis. All the analyses has been carried out as per the Indian Standard code books. This paper aims to Study the effect of Seismic load on Column Forces in Different type of RC Shear Walls in Concrete Frame Structures under Different type of Soil Condition. Estimation of Column Forces such as; Column Axial Force, Column moment, Column shear Force, Column Torsion, Time period and frequency and Modal Load Participation Ratios is carried out. In dynamic analysis; Response Spectrum method is used.**

***Keywords* – Dynamic Analysis, Column Forces, Soft, Medium & Hard Soil, Time Period, Frequency and Modal Load Participation Ratios, C, Box, E, I and Plus Shapes RC Shear Wall, Software ETABS**

I. INTRODUCTION

Shear Wall Structure

The usefulness of shear walls in framing of buildings has long been recognized. Walls situated in advantageous positions in a building can form an efficient lateral-force-resisting system, simultaneously fulfilling other functional requirements. When a permanent and similar subdivision of floor areas in all stories is required as in the case of hotels or apartment buildings, numerous shear walls can be utilized not only for lateral force resistance but also to carry gravity loads.

The race towards new heights and architecture has not been without challenges. When the building increases in height, the stiffness of the structure becomes more important. Tall structures have continued to climb higher and higher facing strange loading effects and very high loading values due to dominating lateral loads. The design criteria for tall buildings are strength, serviceability, stability and human comfort. Thus the effects of lateral loads like wind loads, earthquake forces are attaining increasing importance and almost every designer is faced with the problem of providing adequate strength and stability against lateral loads.

Shear Wall–Frame Systems (Dual Systems), The system consists of reinforced concrete frames interacting with reinforced concrete shear walls are adequate for resisting both the vertical and the horizontal loads acting on them.

Shear Wall

Shear Wall is a Structural Element used to Resist Lateral/Horizontal/Shear Forces Parallel to the
Plane of the Wall by:

- Cantilever Action for Slender Walls where the Bending Deformation is Dominant.
- Truss Action for Squat/Short Walls where the Shear Deformation is Dominant.

Shear walls resist two types of forces: shear forces and uplift forces. Connections to the Structure above transfer horizontal forces to the shear wall. This transfer creates shear forces throughout the height of the wall between the top and bottom shear wall connections. The strength of the lumber, sheathing and fasteners must resist these shear forces or the wall will tear or "shear" apart uplift forces exist on shear walls because the horizontal forces are applied to the top of the wall. These uplift forces try to lift up one end of the wall and push the other end down. Uplift forces are greater on tall short walls and less on low long walls. Bearing walls have less uplift than non-bearing walls because gravity loads on shear walls help them resist uplift. Shear walls need holdown devices at each End when the gravity loads cannot resist all of the uplift. The holdown device then provides the necessary uplift resistance.

The Shear Wall sections are classified as below types:

a. Box Section
b. E – Section
c. C - Section

d. I – Section
e. PLUS– Section

The shape and location of shear wall have a significant effect on their structural behaviour under lateral loads. Lateral loads are distributed through the structure acting as a horizontal diaphragm, to the shear walls, parallel to the force of action. These shear walls resist horizontal forces because their high rigidity as deep beams, reacting to shear and flexure against overturning. A core eccentrically located with respect to the building shapes has to carry torsion as well as bending and direct shear.

The positions of shear walls within a building are usually dictated by functional requirements. These may or may not suit structural planning. The purpose of a building and consequent allocation of floor space may dictate required arrangements of walls that can often be readily utilized for lateral force resistance. Building sites, architectural interests or client's desire may lead the positions of walls that are undesirable from a structural point of view. However, structural designers are often in the position to advice as to the most desirable locations for shear walls in order to optimize seismic resistance.

Necessity of Shear Walls

Shear wall system has two distinct advantages over a frame system.

- It provides adequate strength to resist large lateral loads with-out excessive additional cost.
- It provides adequate stiffness to resist lateral displacements to permissible limits, thus reducing risk of non-structural damage.

Important features in Planning and design of shear walls

- They should be located such a way, they also act as fractional walls. And do not interfere with the architecture of the building. Enclosures around the lift are most commonly used system of shear cores.
- Shear walls should be placed along both the axis. So that lateral stiffness can be provided in both directions, particularly in the case of square buildings.
- To avoid torsion shear wall should be placed symmetrically about the axis.
- Shear walls should be continued up to foundation level.

Earthquake Load

The seismic weight of building is the sum of seismic weight of all the floors. The seismic weight of each floor is its full dead load plus appropriate amount of imposed load, the latter being that part of the imposed loads that may reasonably be expected to be attached to the structure at the time of earthquake shaking. It includes the weight of permanent and movable partitions, permanent equipment, a part of the live load, etc. Earthquake forces experienced by a building result from ground motions (accelerations) which are also fluctuating or dynamic in nature, in fact they reverse direction some what chaotically. In theory and practice, the lateral force that a building experiences from an earthquake increases in direct proportion with the acceleration of ground motion at the building site and the mass of the building (i.e., a doubling in ground motion acceleration or building mass will double the load). As the ground accelerates back and forth during an earthquake it imparts back-and-forth (cyclic) forces to a building through its foundation which is forced to move with the ground.

Important of Seismic Design Codes

Seismic codes help to improve the behavior of structures so that may withstand the earthquake effect without significant loss of life and property. Seismic codes are unique to a particular region or country. They take into account the local seismology, accepted level of seismic risk, building typologies, and materials and methods used in construction.

Shear Wall Analysis

Each shear wall acts like a column under vertical load from the supported floors and its self-weight. The wall shall be designed as a column, taking into account joint moments and additional moment due to slenderness. The horizontal shears at each floor level on a wall element produce shear and overturning moment in the wall, with the wall being regarded as a vertical cantilever beam fixed at base. Each section of wall has to be designed for vertical load, overturning moment and horizontal shear, taking advantage of increased stress or lowered load factors as the overturning moment and the horizontal shear are both the result of either wind or earthquake forces.

Geo-Technical Consideration

Site Selection:

The seismic motion that reaches a structure on the surface of the earth is influenced by local soil conditions. The subsurface soil layers underlying the building foundation may amplify the response of the building to earthquake motions originating in the bedrock.

Bearing Capacity of Foundation Soil

Three soil types are considered here:

I. **Hard** - Those soils, which have an allowable bearing capacity of more than 10t/m2.
II. **Medium** - Those soils, which have an allowable bearing capacity less than or equal to 10t/m2
III. **Soft** - Those soils, which are liable to large differential settlement or liquefaction during an earthquake.

The allowable bearing pressure shall be determined in accordance with IS: 1888-1982 load test (Revision 1992).

Shear Wall Components

Reinforced concrete and reinforced masonry shear walls are seldom-simple walls. Whenever a wall has doors, windows, or other openings, the wall must be considered as an assemblage of relatively flexible components like column segments and wall piers and relatively stiff elements like wall segments

1. **Column segments**: A column segment is a vertical member whose height exceeds three times its thickness and whose width is less than two and one-half times its thickness. Its load is usually predominantly axial. Although it may contribute little to the lateral force resistance of the shear wall is rigidity must be considered. When a column is built integral with a wall, the portion of the column that project from the face the wall is called a pilaster. Column segments shall be designed according to ACI 318 for concrete.
2. **Wall piers:** A wall pier is a segment of a wall whose horizontal length is between two and one-half and six times its thickness whose clear height is at least two times its horizontal length.

3. **Wall segments:** Wall segments are components that are longer than wall piers. They are the primary resisting components in the shear wall.

Importance of Seismic Design Codes

Ground vibration during earthquake cause forces and deformations in structures. Structures need to be designed withstand such forces and deformations. Seismic codes help to improve the behavior of structures so that may withstand the earthquake effect without significant loss of life and property. Countries around the world have procedures outlined in seismic code to help design engineers in the planning, designing, detailing and constructing of structures.

A) An Earthquake Resistant has four Virtues in it, Namely:

i) *Good Structural Configuration:*

Its size, shape and structural system carrying loads are such that they ensure a direct and smooth flow of inertia forces to the ground.

ii) *Lateral Strength:*

The maximum lateral (horizontal) force that it can resist is such that the damage induced in it does not result in collapse.

iii) *Adequate Stiffness:*

Its lateral load resisting system is such that the earthquake – indeed deformations in it do not damage its contents under low-to- moderate shaking.

iv) *Good Ductility*:

Its capacity to undergo large deformations under severe earthquake shaking even after yielding is improved by favorable design and detailing strategies.

B) *Indian Seismic Codes*

Seismic codes are unique to a particular region or country. They take into account the local seismology, accepted level of seismic risk, buildings typologies, and materials and methods used in construction.

The Bureau of Indian Standards (BIS) the following Seismic Codes:

IS 1893 (PART 1) 2002, *Indian Standard Criteria* for Earthquakes Resistant of Design Structures (5th revision).

IS 4326, 1993, Indian Standard Code of practice for Earthquake Resistant Design and Construction of Buildings. (2nd revision).

IS 13827, 1993, Indian Standard Guidelines for improving Earthquake Resistant of Earthen buildings.

IS 13828, 1993 Indian Standard Guidelines for improving Earthquake Resistant of Low Strength Masonry Buildings.

IS 13920, 1993, Indian Standard Code for practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces.

The regulations in these standards do not ensure that structures suffer no damage during earthquake of all magnitude. But, to the extent possible, they ensure that structures are able to respond to earthquake shaking of moderate intensities without structural damage and of heavy intensities wit out total collapse.

II. Literature Review

Generally, the building configuration which is conceived by architects and then accepted by developer or owner may provide a narrow range of options for lateral-load resistant systems that can be utilized by structural engineers. By observing the following fundamental principles relevant to seismic responses, more suitable structural systems may be adopted (Paulay and Priestley, 1992):

1. To perform well in an earthquake, a building should possess simple and regular configurations. Buildings with articulated plans such as T and L shapes should be avoided.
2. Symmetry in plans should be provided, wherever possible. Lack of symmetry in plan may lead to significant torsional response, the reliable prediction of which is often difficult.
3. An integrated foundation system should tie together all vertical structural elements in both principal directions. Foundation resting on different soil condition should preferably be avoided.
4. Lateral force resisting systems with significantly different stiffness such as shear walls and frames within one building should be arranged in such a way that at every level of the building, symmetry in lateral stiffness is not grossly violated. Thus, undesirable torsional effects will be minimized.
5. Regularity in elevation should prevail in both the geometry and the variation of story stiffness.

Kumbhare P.S. et al., (2012) carried out a study on shear wall frame interaction systems and member forces. It was found that shear wall frame interaction systems are very effective in resisting lateral forces induced by earthquake. Placing shear wall away from center of gravity resulted in increase in the most of the members forces. It follows that shear walls should be coinciding with the centroid of the building.

Based on the literature review, the salient objective of the present study have been identified as follows:

Behaviour of high rise structure with dual system with Different Type of RC Shear Walls (C, E, I, Box and Plus shapes) with seismic loading.

To examine the effect of different types of soil (Hard, medium and Soft) on the overall interactive behaviour of the shear wall foundation soil system.

The variation of maximum Column Axial Force, Column moment, Column shear Force and Column Torsion of the models has been studied.

The variation of Time period and frequency has been studied.

The variation of Modal Load Participation Ratios has been studied.

III. Methodology

a) A thorough literature review to understand the seismic evaluation of building structures and aims to Study the behaviour of high rise structure with dual system with Different Type of RC Shear Walls (C, Box, E, I and Plus shapes) under different type of soil condition with sei-

-smic loading.

b) Modelling a 30 storey high building for five different cases.

Details of the Building

A symmetrical building of plan 38.5m X 35.5m located with location in zone V, India is considered. Four bays of length 7.5m & one bays of length 8.5m along X - direction and four bays of length 7.5m & one bays of length 5.5m along Y - direction are provided. Shear Wall is provided at the center core of building model.

Structure 1 : In this model building with 30 storey is modeled as a (Dual frame system with shear wall (Plus Shape) at the center of building, the shear wall acts as vertical cantilever.

Structure 2 : In this model building with 30 storey is modeled as (Dual frame system with shear wall (Box Shape) at the center of building, the shear wall acts as vertical cantilever.

Structure 3 : In this model building with 30 storey is modeled as (Dual frame system with shear wall (C - Shape) at the center of building, the shear wall acts as vertical cantilever.

Structure 4 : In this model building with 30 storey is modeled as (Dual frame system with shear wall (E- Shape) at the center of building, the shear wall acts as vertical cantilever.

Structure 5 : In this model building with 30 storey is modeled as (Dual frame system with shear wall (I- Shape) at the center of building, the shear wall acts as vertical cantilever.

c) Carrying out the design check for the building as per prevailing Indian Standard for dead load, live load, and earthquake load.

d) Analyzing the building using linear static dynamic analysis i.e, Response Spectrum Analysis.

e) Analyzing the results and arriving at conclusions.

To avoid collapse during a major earthquake, members must be ductile enough to absorb and dissipate energy by post-elastic deformation. Redundancy in the structural system permits redistribution of internal forces in the event of the failure of key elements, when the element or system forces yields to fails, the lateral forces can be redistributed to a secondary system to prevent progressive primary failure.

Dynamic Analysis

Dynamic analysis shall be performed to obtain the design seismic force, and its distribution in different levels along the height of the building, and in the various lateral load resisting element.

Response Spectrum Method

This method shall be performed using the design spectrum specified in code or by a site-specific design spectrum for a structure prepared at a project site. The values of damping for building may be taken as 2 and 5 percent of the critical, for the purposes of dynamic of steel and reinforce concrete buildings, respectively. For most buildings, inelastic response can be expected to occur during a major earthquake, implying that an inelastic analysis is more proper for design. Therefore, analysis in practice typically use linear elastic procedures based on the response spectrum method. The response spectrum analysis is the preferred method because it is easier to use.

This method is also known as modal method or mode superposition method. It is based on the idea that the response of a building is the superposition of the responses of individual modes of vibration, each mode responding with its own particular deformed shape, its own frequency, and with its own modal damping.

According to IS-1893(Part-l): 2002, high rise and irregular buildings must be analyzed by response spectrum method using design spectra shown in Figure 4.1. There are significant computational advantages using response spectra method of seismic analysis for prediction of displacements and member forces in structural systems. The method involves only the calculation of the maximum values of the displacements and member forces in each mode using smooth spectra that are the average of several earthquake motions. Sufficient modes to capture such that at least 90% of the participating mass of the building (in each of two orthogonal principle horizontal directions) have to be considered for the analysis. The analysis is performed to determine the base shear for each mode using given building characteristics and ground motion spectra. And then the storey forces, accelerations, and displacements are calculated for each mode, and are combined statistically using the SRSS combination. However, in this method, the design base shear (V_B) shall be compared with a base shear (V_b) calculated using a fundamental period T.

In case design spectrum is specifically prepared for a structure at a particular project site, the same may be used for design at the discretion of the project authorities. Figure 4.1 shows the proposed 5% spectra for rocky and soils sites.

IV. Numerical Analysis

Load Combinations

As per IS 1893 (Part 1): 2002 Clause no. 6.3.1.2, the following load cases have to be considered for analysis:

1.5 (DL + IL)
1.2 (DL + IL ± EL)
1.5 (DL ± EL)
0.9 DL ± 1.5 EL

Earthquake load must be considered for +X, -X, +Y and –Y directions.

Table 1 : Details of The Building

Building Parameters	Details
Type of frame	Special RC moment resisting frame fixed at the base
Building plan	38.5m X 35.5m
Number of storeys	30
Floor height	3.5 m
Depth of Slab	225 mm
Size of beam	(300 × 600) mm
Size of column (exterior)	(1250×1250) mm up to story five
Size of column (exterior)	(900×900) mm Above story five
Size of column (interior)	(1250×1250) mm up to story ten
Size of column (interior)	(900×900) mm Above story ten
Spacing between frames	7.5-8.5 m along x - direction 7.5-5.5 m along y - direction
Live load on floor	4 KN/m2
Floor finish	2.5 KN/m2

Wall load	25 KN/m
Grade of Concrete	M 50 concrete
Grade of Steel	Fe 500
Thickness of shear wall	450 mm
Seismic zone	V
Important Factor	1.5
Density of concrete	25 KN/m3
Type of soil	Soft,Medium,Hard Soil Type I=Soft Soil Soil Type II=Medium Soil Soil Type III= Hard Soil
Response spectra	As per IS 1893(Part-1):2002
Damping of structure	5 percent

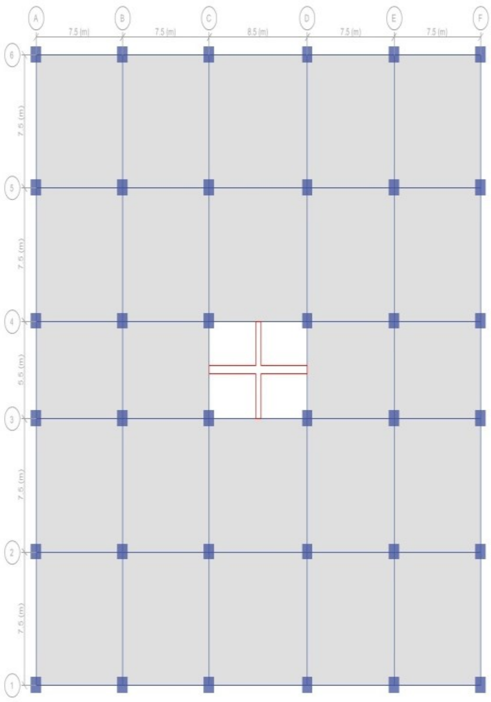

Fig. 1. Plan of the Structure 1.

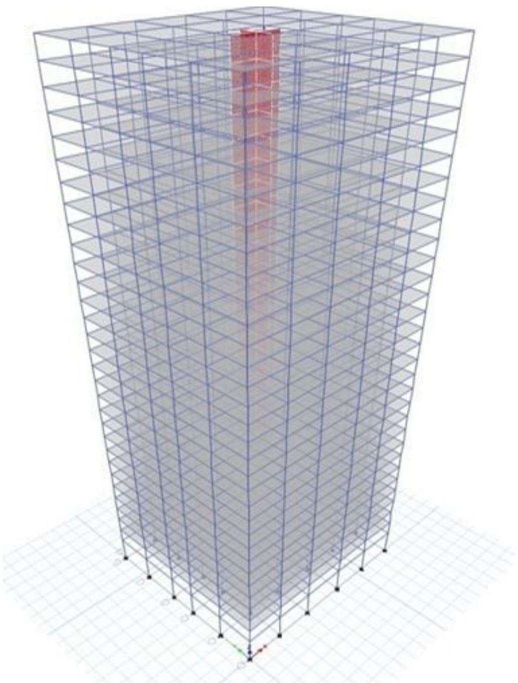

Fig. 2. 3D view showing shear wall location_for Structure 1

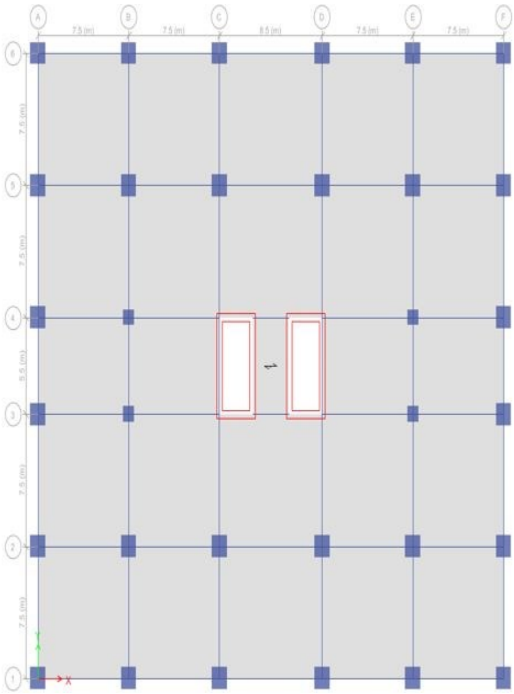

Fig. 3. Plan of the Structure 2

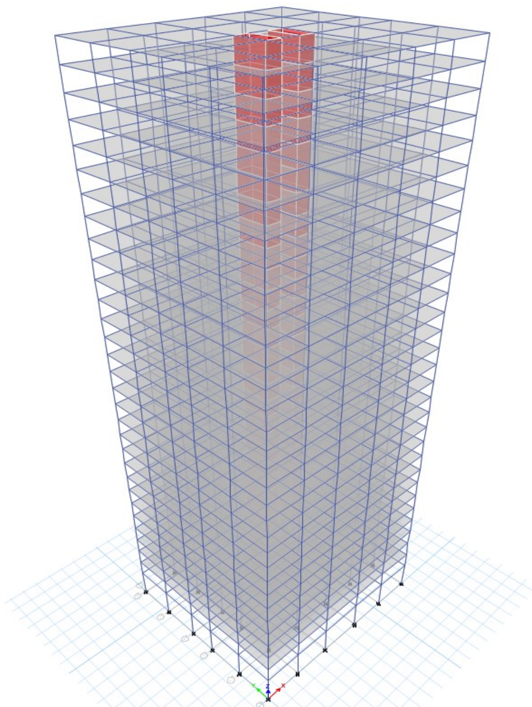

Fig. 4. 3D view showing shear wall location for Structure2

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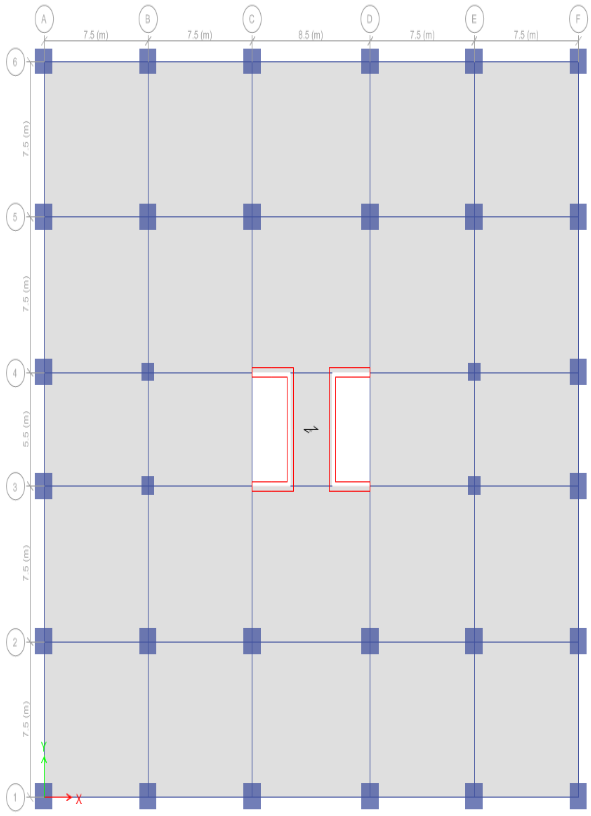

Figure 5. Plan of the Structure 3

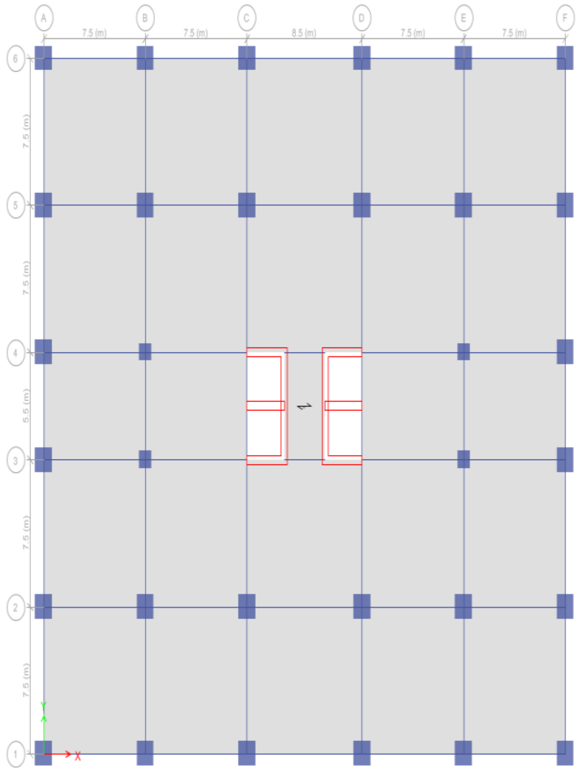

Fig. 7. Plan of the Structure 4

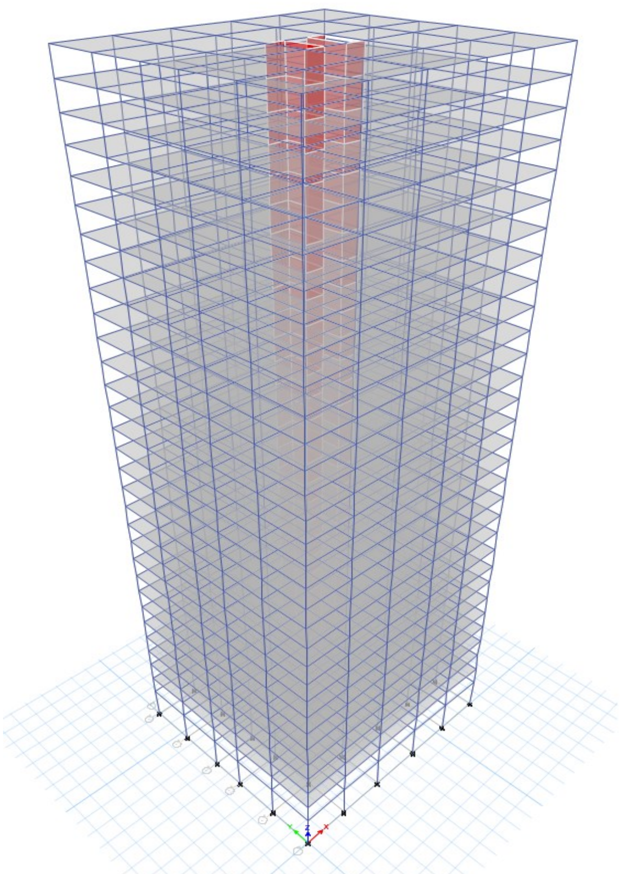

Fig. 6. 3D view showing shear wall location for Structure 3

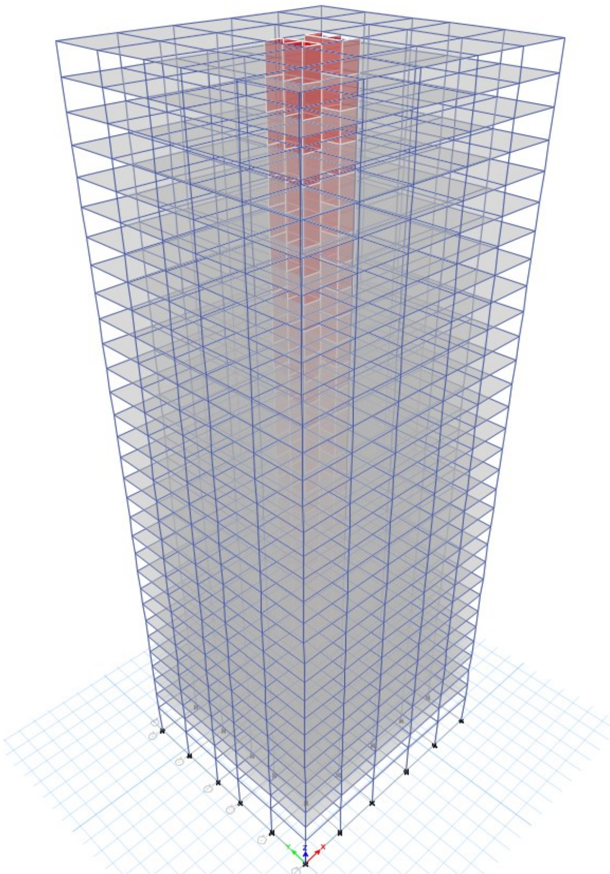

Fig. 8. 3D view showing shear wall location for Structure 4

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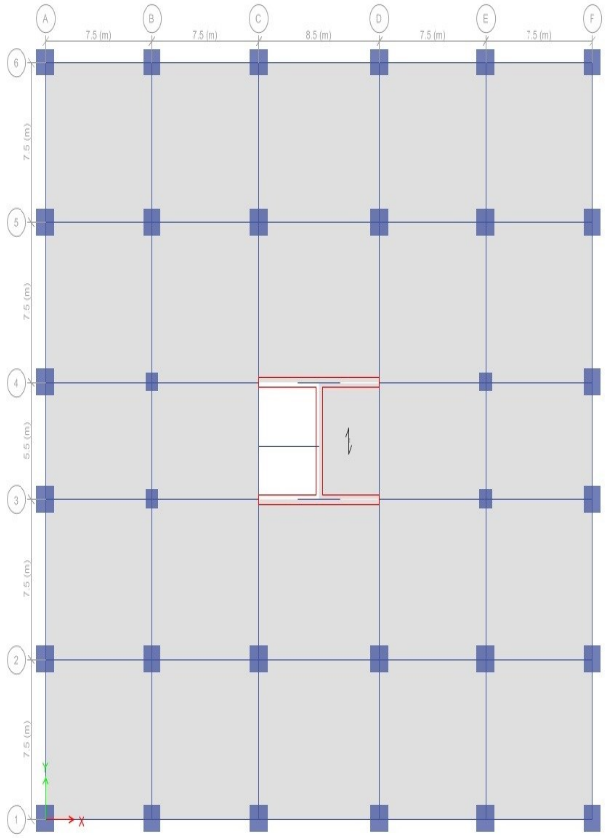

Fig. 9. Plan of the Structure 5

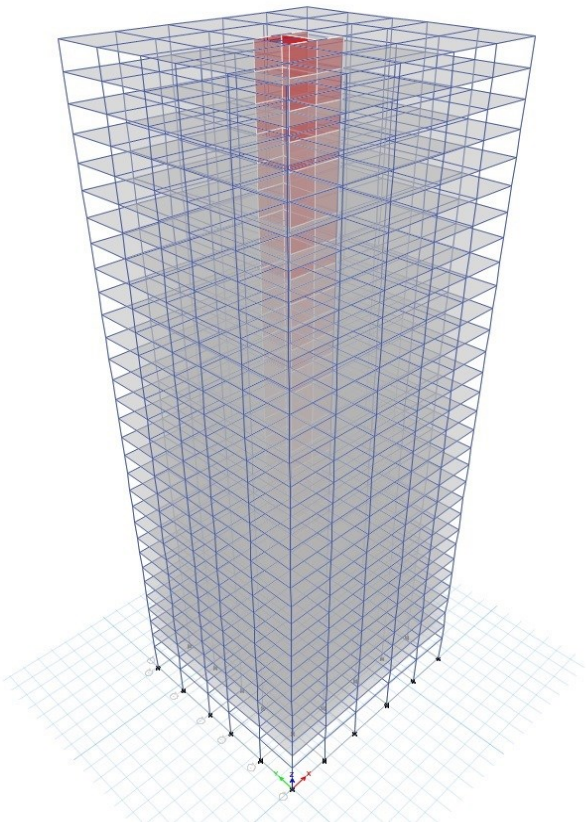

Fig. 10. 3D view showing shear wall location for Structure 5

V. Results and Discussions

Column Forces

Table 2. Column axial force, P for structures with the load combination 1.2 (DL+LL+EQXP) & 1.2 (DL+LL+EQYP) in soft soil

TABLE: Column Forces					Structure -1	Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	P	P	P	P	P
				m	kN	kN	kN	kN	kN
1ST	C34	67	1.2(DL+LL+EQXP)	0	-24171.0618	-24285.0493	-24629.8602	-24381.5444	-24398.1773
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	-24103.093	-24217.0806	-24561.8915	-24313.5757	-24330.2086
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	-24035.1243	-24149.1118	-24493.9227	-24245.6069	-24262.2398
1ST	C34	67	1.2(DL+LL+EQYP)	0	-23630.6382	-23276.1711	-23447.6424	-23345.1752	-23441.1649
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	-23562.6694	-23208.2023	-23379.6736	-23277.2065	-23373.1961
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	-23494.7007	-23140.2336	-23311.7049	-23209.2377	-23305.2274

Table 3: column axial force, P for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP) in medium soil

TABLE: Column Forces					Structure -1	Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	P	P	P	P	P
				m	kN	kN	kN	kN	kN
1ST	C34	67	1.2(DL+LL+EQXP)	0	-24937.4993	-25121.0698	-25571.6279	-25446.3503	-25240.6514
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	-24869.5305	-25053.1011	-25503.6591	-25378.3816	-25172.6826
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	-24801.5618	-24985.1323	-25435.6904	-25310.4128	-25104.7139
1ST	C34	67	1.2(DL+LL+EQYP)	0	-24202.5232	-23748.9954	-23963.8116	-23949.6572	-23939.1144
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	-24134.5545	-23681.0267	-23895.8428	-23881.6884	-23871.1456
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	-24066.5857	-23613.0579	-23827.8741	-23813.7197	-23803.1769

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Table 4: column axial force, P for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP) in hard soil

TABLE: Column Forces					Structure -1	Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	P	P	P	P	P
				m	kN	kN	kN	kN	kN
1ST	C34	67	1.2(DL+LL+EQXP)	0	-25597.4871	-25840.9764	-26382.5944	-26235.5482	-25966.1151
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	-25529.5184	-25773.0076	-26314.6257	-26167.5794	-25898.1464
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	-25461.5496	-25705.0389	-26246.6569	-26099.6107	-25830.1776
1ST	C34	67	1.2(DL+LL+EQYP)	0	-24694.9798	-24156.1497	-24408.2906	-24397.697	-24367.9043
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	-24627.011	-24088.181	-24340.3219	-24329.7283	-24299.9355
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	-24559.0423	-24020.2122	-24272.3531	-24261.7595	-24231.9668

Table 5. Column Moment, M for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP) in soft soil

TABLE: Column Forces					Structure -1	Structure -1	Structure -2	Structure -2	Structure -3	Structure -3	Structure -4	Structure -4	Structure -5	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	M2	M3	M2	M3	M2	M3	M2	M3	M2	M3
				m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1ST	C34	67	1.2(DL+LL +EQXP)	0	-244.0 118	979.4 715	-171.6 774	1061.1 112	-251.8 641	1421.2 435	-239.9 922	1271.7 973	-249.7 758	971. 7283
1ST	C34	67	1.2(DL+LL +EQXP)	1.45	-146.2 684	805.6 993	-84.4 168	912.7 196	-151.3 927	1219.8 181	-142. 186	1095.4 925	-150.8 748	826.9 906
1ST	C34	67	1.2(DL+LL +EQXP)	2.9	-48.5 251	631.9 271	2.8 438	764. 328	-50.9 213	1018.3 927	-44.3 799	919.1 878	-51.9 738	682.2 529
1ST	C34	67	1.2(DL+LL +EQYP)	0	1727.5 733	-24.70 75	1026. 407	-134.6 353	1218.6 199	-173.1 854	1153.6 344	-157.4 043	1174.9 664	-74.8 523
1ST	C34	67	1.2(DL+LL +EQYP)	1.45	1393.6 416	-70.5 194	893.9 723	-94. 628	1027.4 053	-112.2 758	974.8 851	-107.0 072	954.7 475	-81.4 083
1ST	C34	67	1.2(DL+LL +EQYP)	2.9	1059.71	-116.3 313	761.5 375	-54.6 207	836.1 907	-51.3 663	796.1 358	-56.6 101	734.5 287	-87.9 644

Table 6. Column Moment, M for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP)in medium soil

TABLE: Column Forces					Structure - 1	Structure - 1	Structure - 2	Structure - 2	Structure - 3	Structure - 3	Structure - 4	Structure - 4	Structure - 5	Structure - 5
Story	Column	Unique Name	Load Case/Combo	Station	M2	M3	M2	M3	M2	M3	M2	M3	M2	M3
				m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1ST	C34	67	1.2(DL+LL+EQXP)	0	-312.5242	1329.5266	-216.79	1461.8423	-325.8538	1958.0803	-325.927	1862.7469	-322.5699	1328.7543
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	-197.6708	1112.7719	-115.9939	1264.1942	-207.082	1683.6228	-206.7527	1610.877	-205.9796	1142.9081
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	-82.8175	896.0172	-15.1978	1066.5461	-88.3102	1409.1652	-87.5785	1359.0072	-89.3893	957.0619
1ST	C34	67	1.2(DL+LL+EQYP)	0	2368.8316	-36.1568	1412.6049	-164.3729	1674.0045	-210.3429	1686.2828	-200.7817	1615.0795	-94.5952
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	1896.6069	-78.8855	1214.6153	-105.7985	1396.0833	-128.025	1406.1652	-125.3418	1297.6668	-92.5144
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	1424.3822	-121.6142	1016.6256	-47.2242	1118.1621	-45.707	1126.0477	-49.9019	980.2541	-90.4336

Table 7. Column Moment, M for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP) in hard soil

TABLE: Column Forces					Structure - 1	Structure - 1	Structure -2	Structure - 2	Structure - 3	Structure -3	Structure -4	Structure -4	Structure -5	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	M2	M3	M2	M3	M2	M3	M2	M3	M2	M3
				m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1ST	C34	67	1.2(DL+LL+EQXP)	0	-371.5209	1630.9629	-255.6369	1806.9164	-389.5671	2420.3565	-389.6526	2300.9465	-385.2537	1636.1935
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	-241.934	1377.1956	-143.1853	1566.8529	-255.0367	2083.0102	-254.632	1993.0377	-253.431	1414.9482
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	-112.3471	1123.4282	-30.7336	1326.7894	-120.5062	1745.6638	-119.6113	1685.1289	-121.6082	1193.703
1ST	C34	67	1.2(DL+LL+EQYP)	0	2921.0262	-46.0159	1745.1642	-189.9802	2066.1412	-242.3397	2081.2226	-232.9453	1994.0659	-111.5961
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	2329.7158	-86.0897	1490.7245	-115.4176	1713.556	-141.5867	1725.9364	-138.9369	1592.9584	-102.078
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	1738.4055	-126.1634	1236.2848	-40.855	1360.9708	-40.8338	1370.6502	-44.9285	1191.851	-92.5599

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Table 8. Column Shear, V for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP)in soft soil

TABLE: Column Forces					Structure - 1	Structure - 1	Structure - 2	Structure - 2	Structure - 3	Structure - 3	Structure - 4	Structure - 4	Structure - 5	Structure - 5
Story	Column	Unique Name	Load Case/Combo	Station	V2	V3	V2	V3	V2	V3	V2	V3	V2	V3
				m	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
1ST	C34	67	1.2(DL+LL+EQXP)	0	119.8429	-67.4092	102.339	-60.1798	138.9141	-69.2906	121.5895	-67.4525	99.8191	-68.2076
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	119.8429	-67.4092	102.339	-60.1798	138.9141	-69.2906	121.5895	-67.4525	99.8191	-68.2076
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	119.8429	-67.4092	102.339	-60.1798	138.9141	-69.2906	121.5895	-67.4525	99.8191	-68.2076
1ST	C34	67	1.2(DL+LL+EQYP)	0	31.5944	230.2977	-27.5912	91.3343	-42.0066	131.8722	-34.7566	123.2754	4.5214	151.8751
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	31.5944	230.2977	-27.5912	91.3343	-42.0066	131.8722	-34.7566	123.2754	4.5214	151.8751
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	31.5944	230.2977	-27.5912	91.3343	-42.0066	131.8722	-34.7566	123.2754	4.5214	151.8751

Table 9. Column Shear, V for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP)in medium soil

TABLE: Column Forces					Structure - 1	Structure - 1	Structure - 2	Structure - 2	Structure - 3	Structure - 3	Structure - 4	Structure - 4	Structure - 5	Structure - 5
Story	Column	Unique Name	Load Case/Combo	Station	V2	V3	V2	V3	V2	V3	V2	V3	V2	V3
				m	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
1ST	C34	67	1.2(DL+LL+EQXP)	0	149.486	-79.2092	136.3091	-69.5145	189.2811	-81.9116	173.7034	-82.1892	128.1698	-80.4071
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	149.486	-79.2092	136.3091	-69.5145	189.2811	-81.9116	173.7034	-82.1892	128.1698	-80.4071
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	149.486	-79.2092	136.3091	-69.5145	189.2811	-81.9116	173.7034	-82.1892	128.1698	-80.4071
1ST	C34	67	1.2(DL+LL+EQYP)	0	29.4681	325.6722	-40.3961	136.5446	-56.771	191.6698	-52.0275	193.1845	-1.435	218.9053
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	29.4681	325.6722	-40.3961	136.5446	-56.771	191.6698	-52.0275	193.1845	-1.435	218.9053
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	29.4681	325.6722	-40.3961	136.5446	-56.771	191.6698	-52.0275	193.1845	-1.435	218.9053

Table 10. Column Shear, V for structurse with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP) in hard soil

TABLE: Column Forces					Structure - 1	Structure - 1	Structure - 2	Structure - 2	Structure - 3	Structure - 3	Structure - 4	Structure - 4	Structure - 5	Structure - 5
Story	Column	Unique Name	Load Case/Combo	Station	V2	V3	V2	V3	V2	V3	V2	V3	V2	V3
				m	kN	kN	kN	kN	kN	kN	kN	kN	kN	kN
1ST	C34	67	1.2(DL+LL+EQXP)	0	175.012	-89.3703	165.561	-77.5528	232.6527	-92.7796	212.3509	-93.1177	152.5829	-90.9122
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	175.012	-89.3703	165.561	-77.5528	232.6527	-92.7796	212.3509	-93.1177	152.5829	-90.9122
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	175.012	-89.3703	165.561	-77.5528	232.6527	-92.7796	212.3509	-93.1177	152.5829	-90.9122
1ST	C34	67	1.2(DL+LL+EQYP)	0	27.6371	407.8002	-51.4225	175.4757	-69.4848	243.1622	-64.8334	245.025	-6.5642	276.6258
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	27.6371	407.8002	-51.4225	175.4757	-69.4848	243.1622	-64.8334	245.025	-6.5642	276.6258
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	27.6371	407.8002	-51.4225	175.4757	-69.4848	243.1622	-64.8334	245.025	-6.5642	276.6258

Table 11. Column Torsion, T for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP) in soft soil

TABLE: Column Forces					Structure -1	Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	T	T	T	T	T
				m	kN-m	kN-m	kN-m	kN-m	kN-m
1ST	C34	67	1.2(DL+LL+EQXP)	0	-41.6175	-29.3334	-44.901	-42.3525	-43.8436
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	-41.6175	-29.3334	-44.901	-42.3525	-43.8436
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	-41.6175	-29.3334	-44.901	-42.3525	-43.8436
1ST	C34	67	1.2(DL+LL+EQYP)	0	45.3145	31.9525	48.8724	46.1375	48.5638
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	45.3145	31.9525	48.8724	46.1375	48.5638
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	45.3145	31.9525	48.8724	46.1375	48.5638

Table 12. Column Torsion, T for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP)in medium soil

TABLE: Column Forces					Structure -1	Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	T	T	T	T	T
				m	kN-m	kN-m	kN-m	kN-m	kN-m
1ST	C34	67	1.2(DL+LL+EQXP)	0	-56.5981	-39.8539	-61.0208	-61.1008	-59.584
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	-56.5981	-39.8539	-61.0208	-61.1008	-59.584
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	-56.5981	-39.8539	-61.0208	-61.1008	-59.584
1ST	C34	67	1.2(DL+LL+EQYP)	0	61.6294	43.4949	66.5111	66.66	66.09
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	61.6294	43.4949	66.5111	66.66	66.09
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	61.6294	43.4949	66.5111	66.66	66.09

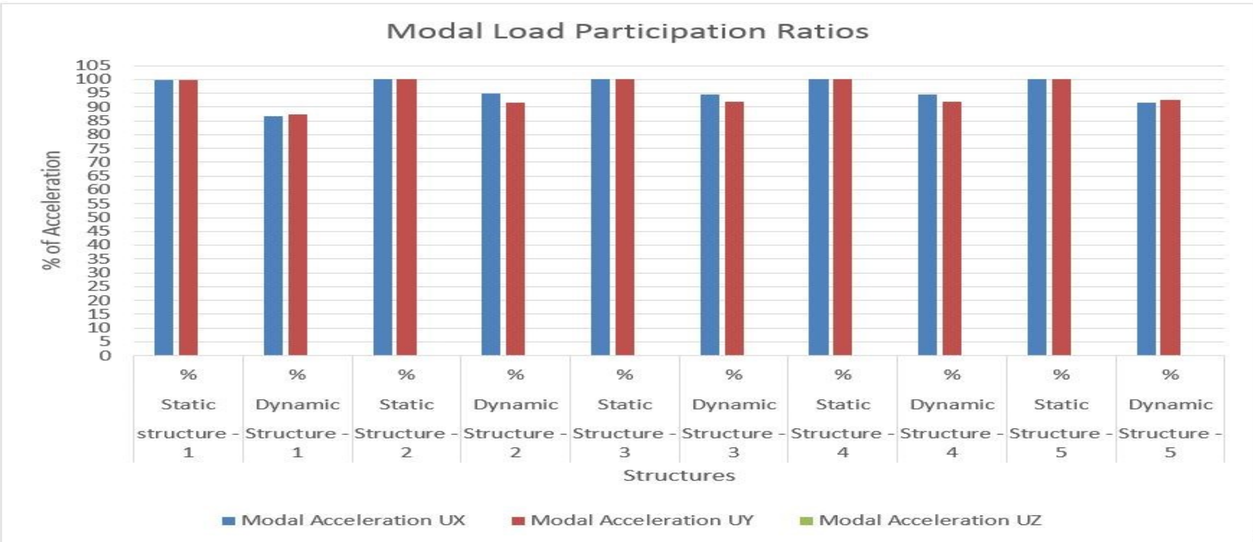
Table 13. Column Torsion, T for structures with the load combination 1.2 (DL+LL+EQXP) &1.2 (DL+LL+EQYP)in hard soil

TABLE: Column Forces					Structure -1	Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	T	T	T	T	T
				m	kN-m	kN-m	kN-m	kN-m	kN-m
1ST	C34	67	1.2(DL+LL+EQXP)	0	-69.4981	-48.9132	-74.9017	-75.004	-73.1383
1ST	C34	67	1.2(DL+LL+EQXP)	1.45	-69.4981	-48.9132	-74.9017	-75.004	-73.1383
1ST	C34	67	1.2(DL+LL+EQXP)	2.9	-69.4981	-48.9132	-74.9017	-75.004	-73.1383
1ST	C34	67	1.2(DL+LL+EQYP)	0	75.6784	53.4342	81.6999	81.8788	81.182
1ST	C34	67	1.2(DL+LL+EQYP)	1.45	75.6784	53.4342	81.6999	81.8788	81.182
1ST	C34	67	1.2(DL+LL+EQYP)	2.9	75.6784	53.4342	81.6999	81.8788	81.182

Table 14. Modal Load Participation Ratios

TABLE: Modal Load Participation Ratios			structure 1	Structure 1	Structure 2	Structure 2	Structure 3	Structure 3	Structure 4	Structure 4	Structure 5	Structure 5
Case	Item Type	Item	Static	Dynamic	Static	Dynamic	Static	Dynamic	Static	Dynamic	Static	Dynamic
			%	%	%	%	%	%	%	%	%	%
Modal	Acceleration	UX	99.82	86.71	99.99	94.7	99.98	94.59	99.99	94.54	99.97	91.54
Modal	Acceleration	UY	99.79	87.46	99.98	91.46	99.97	91.85	99.97	91.83	99.97	92.51
Modal	Acceleration	UZ	0	0	0	0	0	0	0	0	0	0

A plot for Modal Load Participation Ratios of Structures in Soft Soil, Medium Soil and Hard Soil has been shown here



Graph 1: Modal Load Participation Ratios of Structures in Soft Soil , Medium Soil and Hard Soil

Table 15. Modal Periods and Frequencies

		Structure -1		Structure -2	Structure -2	Structure -3	Structure -3	Structure -4	Structure -4	Structure -5	Structure -5
Case	Mode	Period	Frequency	Period	Frequency	Period	Frequency	Period	Frequency	Period	Frequency
		sec	cyc/sec	sec	cyc/sec	sec	cyc/sec	sec	cyc/sec	sec	cyc/sec
Modal	1	6.298	0.159	5.785	0.173	6.415	0.156	6.375	0.157	6.382	0.157
Modal	2	6.248	0.16	5.606	0.178	6.32	0.158	6.21	0.161	5.694	0.176
Modal	3	5.545	0.18	4.684	0.213	5.767	0.173	5.792	0.173	5.642	0.177
Modal	4	2.062	0.485	1.701	0.588	2.114	0.473	2.102	0.476	2.088	0.479
Modal	5	1.952	0.512	1.547	0.646	1.958	0.511	1.901	0.526	1.565	0.639
Modal	6	1.603	0.624	1.475	0.678	1.568	0.638	1.575	0.635	1.524	0.656
Modal	7	1.191	0.84	0.9	1.112	1.219	0.82	1.212	0.825	1.19	0.84
Modal	8	1.027	0.974	0.838	1.193	1.028	0.972	0.983	1.017	0.791	1.264
Modal	9	0.803	1.245	0.645	1.551	0.82	1.22	0.815	1.226	0.711	1.406
Modal	10	0.782	1.279	0.613	1.632	0.711	1.406	0.714	1.401	0.703	1.423
Modal	11	0.645	1.55	0.5	2.002	0.641	1.56	0.604	1.656	0.565	1.769
Modal	12	0.581	1.72	0.45	2.222	0.592	1.689	0.589	1.697	0.423	2.363

VI. Discussion on Results

When a structure is subjected to earthquake, it responds by vibrating. An example force can be resolved into three mutually perpendicular directions - two horizontal directions (X and Y directions) and the vertical direction (Z). This motion causes the structure to vibrate or shake in all three directions; the predominant direction of shaking is horizontal. All the structures are primarily designed for gravity loads-force equal to mass time's gravity in the vertical direction. Because of the inherent factor used in the design specifications, most structures tend to be adequately protected against vertical shaking. Vertical acceleration should also be considered in structures with large spans those in which stability for design, or for overall stability analysis of structures. The basic intent of design theory for earthquake resistant structures is that buildings should be able to resist minor earthquakes without damage, resist moderate earthquakes without structural damage but with some non-structural damage. To avoid collapse during a major earthquake, Members must be ductile enough to absorb and dissipate energy by post elastic deformation. Redundancy in the structural system permits redistribution of internal forces in the event of the failure of key elements. When the primary element or system yields or fails, the lateral force can be redistributed to a secondary system to prevent progressive failure.

The structures are supported on soil, most of the designers do not consider the soil structure interaction and its subsequent effect on structures during an earthquake. When a structure is subjected to an earthquake excitation, it interacts with the foundation and the soil, and thus changes the motion of the ground. This means that the movement of the whole ground-structure system is influenced by the type of soil as well as by the type of structure. Understanding of soil structure interaction will enable the designer to design structures that will behave better during an earthquake. The Axial force and Moment in the column increases when the type of soil changes from hard to medium and medium to soft. Since the column moment increase as the soil type changes, soil structure interaction must be suitably considered while designing frames for seismic force.

The result obtained from the analysis models will be discussed and compared as follows:

It is Observed that

The Time Period is 6.298 Sec for structure 1 and it is same for different type of soil.

The Frequency is 0.159 cyc/sec for structure1 and it is same for different type of soil.

The Time Period is 5.785 Sec for structure 2 and it is same for different type of soil.

The Frequency is 0.173 cyc/sec for structure 2 and it is same for different type of soil.

The Time Period is 6.415 Sec for structure 3 and it is same for different type of soil.

The Frequency is 0.156 cyc/sec for structure 3 and it is same for different type of soil.

The Time Period is 6.375Sec for structure 4 and it is same for different type of soil.

The Frequency is 0.157 cyc/sec for structure4 and it is same for different type of soil.

The Time Period is 6.382 Sec for structure5 and it is same for different type of soil.

The Frequency is 0.157 cyc/sec for structure5 and it is same for different type of soil.

Table 16: Comparation Percentage of Column Axial Forces in Soft soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	P	P	P	P
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	0%	2%	1%	1%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-2%	-1%	-1%	-1%

Table 17. Comparation Percentage of Column Axial Forces in medium soil of Structures 2, 3, 4, 5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	P	P	P	P
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	1%	2%	2%	1%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-2%	-1%	-1%	-1%

Table 18: Comparation Percentage of Column Axial Forces in hard soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	P	P	P	P
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	1%	3%	2%	1%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-2%	-1%	-1%	-1%

Table 19: Comparation Percentage of Column moment in soft soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	M	M	M	M
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	564%	4%	-5%	4%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-54%	-35%	-42%	-46%

Table 20. Comparation Percentage of Column moment in medium soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	M	M	M	M
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	-187%	5%	5%	5%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-55%	-35%	-34%	-46%

Table 21. Comparation Percentage of Column moment in hard soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	M	M	M	M
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	-127%	6%	5%	5%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-55%	-35%	-34%	-46%

Table 22. Comparation Percentage of Column shear in soft soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	V	V	V	V
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	-17%	14%	1%	-20%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	215%	175%	191%	-599%

Table 23: Comparation Percentage of Column shear in medium soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	V	V	V	V
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	-10%	21%	14%	-17%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	173%	152%	157%	2154%

Table 24: Comparation Percentage of Column shear in hard soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	V	V	V	V
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	-6%	25%	18%	-15%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	154%	140%	143%	521%

Table 25: Comparation Percentage of Column Torsion in soft soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	T	T	T	T
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	-42%	7%	2%	5%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-42%	7%	2%	7%

Table 26: Comparation Percentage of Column Torsion in medium soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	T	T	T	T
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	-42%	7%	7%	5%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-42%	7%	8%	7%

Table 27: Comparation Percentage of Column Torsion in hard soil of Structures 2,3,4,5 with Structure -1

TABLE: Column Forces					Structure -2	Structure -3	Structure -4	Structure -5
Story	Column	Unique Name	Load Case/Combo	Station	T	T	T	T
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	-42%	7%	7%	5%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-42%	7%	8%	7%

Table 28:Comparation Percentage of Column Axial Forces of medium soil and hard soil with soft soil for Structure -1

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	P	P
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	3%	6%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	2%	4%

Table 29:Comparation Percentage of Column Axial Forces of medium soil and hard soil with soft soil for Structure -2

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	P	P
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	3%	6%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	2%	4%

Table 30:Comparation Percentage of Column Axial Forces of medium soil and hard soil with soft soil for Structure -3

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	P	P
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	4%	7%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	2%	4%

Table 31:Comparation Percentage of Column Axial Forces of medium soil and hard soil with soft soil for Structure -4

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	P	P
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	4%	7%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	3%	4%

Table 32:Comparation Percentage of Column Axial Forces of medium soil and hard soil with soft soil for Structure -5

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station	P	P
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	3%	6%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	2%	4%

Table 33:Comparation Percentage of Column Moment of medium soil and hard soil with soft soil for Structure -1

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	M	M
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	20%	32%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	-7%	-14%

Table 34:Comparation Percentage of Column Moment of medium soil and hard soil with soft soil for Structure -2

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	M	M
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	25%	38%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	32%	46%

Table 35:Comparation Percentage of Column Moment of medium soil and hard soil with soft soil for Structure -3

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	M	M
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	27%	40%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	26%	40%

Table 36:Comparation Percentage of Column Moment of medium soil and hard soil with soft soil for Structure -4

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	M	M
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	30%	43%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	33%	46%

Table 37:Comparation Percentage of Column Moment of medium soil and hard soil with soft soil for Structure -5

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	M	M
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	22%	35%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	415%	169%

Table 38:Comparation Percentage of Column Shear of medium soil and hard soil with soft soil for Structure -1

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station	V	V
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	30%	44%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	26%	40%

Table 39:Comparation Percentage of Column Shear of medium soil and hard soil with soft soil for Structure -2

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station	V	V
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	56%	61%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	26%	40%

Table 40. Comparation Percentage of Column Shear of medium soil and hard soil with soft soil for Structure -3

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station	V	V
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	31%	45%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	26%	40%

Table 41. Comparation Percentage of Column Shear of medium soil and hard soil with soft soil for Structure -4

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station	V	V
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	36%	48%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	31%	43%

Table 42. Comparation Percentage of Column Shear of medium soil and hard soil with soft soil for Structure -5

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station	V	V
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	30%	44%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	26%	40%

Table 43. Comparation Percentage of Column Torsion of medium soil and hard soil with soft soil for Structure -1

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	T	T
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	0%	0%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	26%	40%

Table 44:Comparation Percentage of Column Torsion of medium soil and hard soil with soft soil for Structure -2

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	T	T
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	26%	40%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	27%	40%

Table 45:Comparation Percentage of Column Torsion of medium soil and hard soil with soft soil for Structure -3

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	T	T
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	26%	40%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	27%	40%

Table 46:Comparation Percentage of Column Torsion of medium soil and hard soil with soft soil for Structure -4

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	T	T
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	31%	44%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	31%	44%

Table 47:Comparation Percentage of Column Torsion of medium soil and hard soil with soft soil for Structure -5

TABLE: Column Forces					SOIL TYPE II	SOIL TYPE III
Story	Column	Unique Name	Load Case/Combo	Station m	T	T
1ST	C34	67	1.2(DL+LL+EQXP)	0,1.45,2.9	26%	40%
1ST	C34	67	1.2(DL+LL+EQYP)	0,1.45,2.9	27%	40%

It is Observed that Column Forces for Structure 1

The maximum column axial force is various with type of soil and placing of the shear wall. The Value of column axial force in soft soil>medium soil>hard soil.

The maximum column moment in Y-direction is influenced by the type of soil and placing of shear wall.

The Value of maximum column moment M2 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column moment M3 in X-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column moment M2 in Y-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column moment M3in Y-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Shear V2 in X-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column Shear V3 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Shear V2 in Y-direction for soft Soil>Medium soil > Hard soil.

The Value of maximum column Shear V3 in Y-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column Torsion, T in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Torsion, T in Y-direction for soft Soil <Medium soil < Hard soil.

It is observed that column forces for structure 2

The maximum column axial force is various with type of soil and placing of the shear wall. The Value of Column axial force in soft soil>medium soil>hard soil.

The maximum column moment in Y-direction is influenced by the type of soil and placing of shear wall.

The Value of maximum column moment M2 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column moment M3 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column moment M2 in Y-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column moment M3in Y-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Shear V2 in X-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column Shear V3 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Shear V2 in Y-direction for soft Soil>Medium soil > Hard soil.

The Value of maximum column Shear V3 in Y-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column Torsion, T in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Torsion, T in Y-direction for soft Soil <Medium soil < Hard soil.

It is Observed that Column Forces for Structure 3

The maximum column axial force is various with type of soil and placing of the shear wall. The Value of Column axial force in soft soil>medium soil>hard soil.

The maximum column moment in Y-direction is influenced by the type of soil and placing of shear wall.

The Value of maximum column moment M2 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column moment M3 in X-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column moment M2 in Y-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column moment M3in Y-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Shear V2 in X-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column Shear V3 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Torsion, T in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Torsion, T in Y-direction for soft Soil <Medium soil < Hard soil.

It is Observed that Column Forces for Structure 4

The column axial force is various with type of soil and placing of the shear wall. The Value of column axial force in soft soil>medium soil>hard soil.

The column moment in Y-direction is influenced by the type of soil and placing of shear wall.

The Value of column moment M2 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of column moment M3 in X-direction for soft Soil <Medium soil < Hard soil.

The Value of column moment M2 in Y-direction for soft Soil <Medium soil < Hard soil.

The Value of column moment M3in Y-direction for soft Soil >Medium soil > Hard soil.

The Value of column Shear V2 in X-direction for soft Soil <Medium soil < Hard soil.

The Value of column Shear V3 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of column Shear V2 in Y-direction for soft Soil >Medium soil > Hard soil.

The Value of column Shear V3 inY-direction for soft Soil <Medium soil <Hard soil.

The Value of column Torsion T, in X-direction for soft Soil >Medium soil > Hard soil.

The Value of column Torsion T, in Y-direction for soft Soil <Medium soil < Hard soil.

It is Observed that Column Forces for Structure 5

The maximum column axial force is various with type of soil and placing of the shear wall. The Value of column axial force in soft soil>medium soil>hard soil.

The maximum column moment in Y-direction is influenced by the type of soil and placing of shear wall.

The Value of maximum column moment M2 in X direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column moment M3 in X direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column moment M2 in Y direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column moment M3in Y direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Shear V2 in X-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column Shear V3 in X-direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Shear V2 in Y-direction for soft Soil>Medium soil > Hard soil.

The Value of maximum column Shear V3 in Y-direction for soft Soil <Medium soil < Hard soil.

The Value of maximum column Torsion, T in X direction for soft Soil >Medium soil > Hard soil.

The Value of maximum column Torsion, T in Y direction for soft Soil <Medium soil < Hard soil.

VII. Conclusions

In this paper, reinforced concrete shear wall buildings were analyzed with the procedures laid out in IS codes. Seismic performance of building model is evaluated.

From the above results and discussions, following conclusions can be drawn:

- The shear wall and it is position has a significant influenced on the time period. The time period is not influenced by the type of soil. The better performance for structure 2 because it has low time period.
- It is observed that the maximum column axial force is various with type of soil and placing of the shear wall.
- It is observed that the maximum column shear force in x-direction is influenced by the type of soil and placing of the shear wall.
- It is observed that the maximum column shear force in y-direction has no influence on the type of soil and placing shear wall.
- It is observed that the maximum column torsion is same for all columns in a structure, but is influenced by the type of soil and placing shear wall.
- It is observed that the maximum column moment in x-direction has no influence on the type of soil and placing shear wall.

- It is observed that the maximum column moment in y-direction is influenced by the type of soil and placing of shear wall.
- The Axial force and Moment in the column increases when the type of soil changes from hard to medium and medium to soft. Since the column moment increase as the soil type changes, soil structure interaction must be suitably considered while designing frames for seismic force.
- The moment resisting frame with shear walls are very good in lateral force such as earthquake and wind force. The shear walls provide lateral load distribution by transferring the wind and earthquake loads to the foundation. And also impact on the lateral stiffness of the system and also carries gravity loads.
- It is evident that shear walls which are provided from the foundation to the rooftop, are one of the excellent mean for providing earthquake resistant to multistory reinforced building with different type of soil.
- The vertical reinforcement that is uniformly distributed in the shear wall shall not be less than the horizontal reinforcement. This provision is particularly for squat walls (i.e. Height-to-width ratio is about 1.0). However, for walls whit height-to-width ratio less than 1.0, a major part of the shear force is resisted by the vertical reinforcement. Hence, adequate vertical reinforcement should be provided for such walls.
- Based on the analysis and discussion, shear wall are very much suitable for resisting earthquake induced lateral forces in multistoried structural systems when compared to multistoried structural systems whit out shear walls. They can be made to behave in a ductile manner by adopting proper detailing techniques.
- According to IS-1893:2002 the number of modes to be used in the analysis should be such that the total sum of modal masses of all modes considered is at least 90 percent of the total seismic mass. Here the maximum mass for structure 2 is 94.7 percent and minimum mass for structure 1 is 86.71 percent.

REFERENCES

[1] Duggal, S.K., "Earthquake Resistant Design of Structures" Oxford University Press, New Delhi 2010
[2] Chopra, A.K., "Dynamics of Structures: Theory and Application to Earthquake Engineering", Pearson Education, 4th edition, 2012.
[3] Bureau of Indian Standars, IS 456: 2000, "Plain and Reinforced Concrete-Code of practice", New Delhi, India.
[4] Bureau of Indian Standards: IS 13920 : 1993, "Ductile detailing of reinforced concrete structures subjected to seismic forces—Code of Practice", New Delhi, India.
[5] Bureau of Indian Standards: IS 875(part 1) : 1987, "Dead loads on buildings and Structures", New Delhi, India.
[6] Bureau of Indian Standards: IS 875 (part 2) : 1987, "Live loads on buildings and Structures", New Delhi, India.
[7] Bureau of Indian Standards: IS 1893 (part 1) : 2002, "Criteria for earthquake resistant design of structures: Part 1 General provisions and buildings", New Delhi, India.
[8] Berkeley *"ETABS Integrated Building Design Software"*, Computers and Structure, Inc., California, USA, February 2003.
[9] Gary R. scarer and Sigmund A. Freeman " Design drifts requirement for long period structures " , 1 3 ' World conference on earth quake engineering Vancouver, B.C, Canada ,Aug 2004 paper no-3292 .
[10] J.L. Humar and S.Yavari "Design of concrete shear wall buildings for earthquake induced torsion". 4'1" structural conference of the Canadian society for civil engineering June-2002.
[11] Mo and Jost, **"**the seismic response of multistory reinforced concrete framed shear walls using a nonlinear model**"**, Volume 15, Structure Engineering , Issue 3, 1993, Pages 155–166 .
[12] Paulay, T. & Priestley, M. J. N.. Seismic Design of Reinforced Concrete and Masonry Buildings, JOHN WILEY & SONS, INC, New York. 1992
[13] Anand, N. , Mightraj, C. and Prince Arulraj, G. "Seismic behaviour of RCC shear wall under different soil conditions" Indian geotechnical conference, Dec – 2010, pp 119-120.
[14] Anshuman, S., Dipendu Bhunia, Bhavin Ramjiyani,"Solution of shear wall location in multistory building", International journal of civil and structural engineering, Vol. 4, Issue 5, pp. 22-32, 2011.
[15] Chandiwala, A., "Earthquake Analysis of Building Configuration with Different Position of Shear Wall", International Journal of Emerging Technology and Advanced Engineering ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 2, Issue 12, December 2012.
[16] Chandurkar, P.P., Dr. Pajgade, P.S., "Seismic analysis of RCC building with and without shear wall", International Journal of Modern Engineering Research. Vol. 3, Issue 3, pp. 1805-1810, 2013.
[17] Rahangdale, H., Satone, S.R., "Design and analysis of multi-storied building with effect of shear wall", International journal of engineering research and application", Vol. 3, Issue 3, pp. 223-232, 2013.
[18] Agarwal, A.S., and Charkha, S.D., "Effect of change in shear wall location on storey drift of multistorey building subjected to lateral loads", International Journal of Engineering Research and Applications ISSN: 2248-9622 2(3), Vol. 2, Issue 3, May-Jun 2012, pp.1786-1793.
[19] 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 (An ISO 3297: 2007 Certified Organization)Vol. 2, Issue 9, September 2013.
[20] Gaikwad Ujwala Vithal, Effect of Shear Wall on Sesmic Behavior of Unsymmetrical Reinforced Concrete Structure, International Journal of Research and Scientific Innovation (IJRSI) Volume IV, Issue X, October 2017 | ISSN 2321–2705.
[21] Mahantesh S Patil 1, Dr. R B Khadiranaikar 2, Dynamic Analysis of High Rise RC Structure with Shear Walls and Coupled Shear Walls, International Journal of Advance Engineering and Research Development Volume 2,Issue 8, August -2015
[22] Mayur Sawant1, Prof. G.R. Patil2, Evaluation of Seismic Behaviour of RCC Building using Coupled Shear wall, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 04 Issue: 08 | Aug -2017 www.irjet.net p-ISSN: 2395-0072.
[23] C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan, Vipul V. Mehta, Some Concepts in Earthquake behaviour of Buildings, Gujarat State Disaster Management Authority Government of Gujarat, India.
[24] Professors Durgesh C. Rai, Sudhir K. Jain and C.V.R. Murty, Department of Civil Engineering, IIT Kanpur, short course on "Seismic Design of RC Structures" conducted at Ahmedabad, India during Nov 25-30, 2012.
[25] Mariopaz – Structural Dynamics: Theory & computations (Second Edition), CBS Publishers & Distributors-New Delhi, 2004.
[26] Makar Nageh *"How to Model and Design High Rise Building Using ETABS Program"*, Scientific Book House For Publishing and Distributing, Cairo, 2007.
[27] Onkar V. Sapate*, Dr. A. M. Pande** Displacement Control of High Rise Structures with the Provision of Shear Wall, International Journal of Engineering Research and Applications, Vol. 1, Issue 4,dec 2011, pp. 1515-1521
[28] Himalee Rahangdale *, S.R. Satone** Design and Analysis of Multistoreied Building with Effect of Shear Wall International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 3, Issue 3, May-Jun 2013, pp.223-232

[29] Abdur Rahman, Saiada Fuadi Fancy, Shamim Ara Bobby, Analysis of drift due to wind loads and earthquake loads on tall structures by programming language c, International Journal of Scientific & Engineering Research, Volume 3, Issue 6, June-2012 1 ISSN 2229-5518

[30] Kedavkar, K.D., Kodag, P.B., "Lateral load analysis of RCC building", Vol.3, Issue.3, pp-1428-1434, ISSN: 2249-6645, International Journal of Modern Engineering Research (IJMER), Vol.3, Issue.3, May-June. 2013 pp-1428-1434

[31] M. Ashraf*, Z.A. Siddiqi and M.A. Javed, Configuration of A Multistorey Building Subjected To Lateral Forces, Asian Journal of Civil Engineering (Building and Housing) VOL. 9, NO. 5 (2008) PAGES 525-537

[32] Mohammed Aejaz Ahmed1 Prof. Dr. Shreenivas Reddy Shahpur2 Prof. Brij Bhushan S3 Prof. Rohan Gurav4 Prof. Shaik Abdull5, Study on Effect of Wind Load and Earthquake Load on Multistorey RC Framed Buildings, IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 10, 2015 | ISSN (online): 2321-0613

[33] A. Rahman1, A. A. Masrur Ahmed2* and M. R. Mamun3, Drift analysis due to earthquake load on tall structures, Journal of Civil Engineering and Construction Technology Vol. 4(5), pp. 154-158, May 2012.