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Comparative Study of Multi Storey Building under Action of Shear Wall Using ETAB Software

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ABSTRACT: From the past records of earthquake, there is increase in the demand of earthquake resisting building which can be fulfilled by providing the shear wall incorporated in building to resist lateral forces produce in plane of wall due to wind, earthquake & other forces. In R.C.C building without shear wall, the beam and column size are quite heavy and there is lot of congestion of reinforcement at the joint and it is difficult to place and vibrate concrete at these places and displacement is quite heavy which induces heavy forces in member. The analysis is by carried out of R.C.C building with different posting of shear wall on floor plan of by using E-TABS software. It gives the idea of analysis of R.C.C building with different configuration. The main objective of earthquake engineers is to design and build a structure in such a way that damage to the structure during the earthquake is minimize. For verification a Multi-storey building example is taken. The results of which are compared with the results of E-TABS. An earthquake analysis is applied to a building which is located in Zone III as per code provision IS-1893 & as per that resulting lateral displacement, storey drift, storey shear is calculated. The analysis of building with core shear wall and edge shear wall is done.

KEYWORDS: Etab, RCC, Static Analysis, Dynamic Analysis, Share Wall.

I. INTRODUCTION

There has been a considerable increase in the construction of tall buildings both residential and commercial and the modern trend is towards more tall and slender structures. Thus the effects of lateral loads like wind loads, earthquake loads and blast forces are attaining increasing importance and almost every designer is faced with the problems of providing adequate strength and stability against lateral loads. Shear wall system is one of the most commonly used lateral load resisting system in high rise buildings. Shear wall has high in plane stiffness and strength which can be used to simultaneously resist large horizontal loads, and support gravity loads, which significantly reduces lateral sway of the building and thereby reduces damage to structure and its contents. When shear walls are situated in advantageous positions in the building, they can form an efficient lateral force resisting system by reducing lateral displacements under earthquake loads. Therefore it is very necessary to determine effective, efficient and ideal location of shear wall. Modern trends towards high rise buildings increase recently due to the high increase in the number of tall buildings, both residential and commercial. In every parts of the world flat slab construction are widely used in reinforced concrete structures because; this system reduces the costs of form work and construction time and easy installation. Without beams floor slab system directly supports columns. In comparison with earlier high rise buildings, today's tall buildings are becoming more and more slender and leading to the possibility of more sway. From lateral loads such as wind, seismic loads shear walls provide the stability to the structure. These shear walls transfer the lateral loads to the foundation by their shearing resistance and resistance to overturning. In the present work, summarized the importance of flat slab construction and revealed the relevance of shear wall in a flat slab multi-storied building. In modern civilization tall buildings have rapidly developed worldwide. Tall buildings are symbols of

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civilized, congested and populated society. It certainly resembles the economic growth, the force and the image of a civilization. A Tremendous variety of field of study shapes and complicated structural layouts are designed. The design of tall buildings essentially involves an approximate analysis, conceptual design, preliminary design and what's more, advancement, to securely convey gravity and horizontal burdens. The design criterion is strength, serviceability, stability and also human comfort. High-rise buildings are constructed everywhere in the world. The structural design of high-rise buildings depends on dynamic analysis for winds and earthquakes. Now a day's performance of computer progresses remarkably, almost structural designers use the software of computer for the structural design of high-rise buildings. Hence, after that the structural plane and outline of high rise buildings are determined, the structural design of high-rise buildings which checks structural safety for the individual structural members is not necessary outstanding structural ability by the use of structural software on the market. However, it is not an exaggeration to say that the performance of high-rise buildings is almost determined in the preliminary design stages which work on multifaceted examinations of the structural form and outline.

II. LITERATURE REVIEW

1. **Kevadkar and Kodag (2013)** :Are investigated the concept of using steel bracing is one of the advantageous concepts which can be used to strengthen structure. Shear wall and steel bracing increases the level of safety since the demand curve intersect near the elastic domain. Capacity of the steel braced structure is more as compare to the shear wall structure. Steel bracing has more margin of safety against collapse as compare with shear wall.
2. **Agrawal and Charkha (2012)** :are investigation reveals that the significant effects on deflection in orthogonal direction by the shifting the shear wall location. Placing Shear wall away from center of gravity resulted in increase in most of the members forces.
3. **Chandurkar and Pajgade (2013)** :are investigated Changing the position of shear wall will affect the attraction of forces, so that wall must be in proper position. If the dimensions of shear wall are large then major amount of horizontal forces are taken by shear wall. Providing shear walls at adequate locations substantially reduces the displacements due to earthquake.
4. **Greeshma and Jaya (2006)** :are investigation the proper connection detailing of shear wall to the diaphragm. The shear wall and diaphragm connection with hook deflects more when compared to the other two configurations. Hence, the shear wall- diaphragm connection with hook was more efficient under dynamic lateral loadings. Multi-storey buildings are adequate for resisting both the vertical and horizontal load. When such building is designed without shear wall, beam and column sizes are quite heavy and there is problem arises at these joint and it is congested to place and vibrate concrete at these places and displacement is quite heavy which induces heavy forces in building member. Shear wall may become essential from the point of view of economy and control of horizontal displacement.
5. **5.Mohamed A El- Shaer's et al:** paper showed the lateral analysis for tall buildings due to the seismic performance for different reinforced concrete slab systems. The author studied three systems, flat slab, ribbed slab, and paneled beam slab. The three systems constitute the most attractive and commonly used floor systems, especially in high-rise constructions. In high seismicity regions, the declared non-ductile flat slab system poses a significant risk; brittle punching failure arises from the transfer of shearing forces and unbalanced moments between slab and columns that may trigger a progressive building collapse.
6. **P. S. Lande and A. B. Raut** : presents a study of investigations carried out in order to identify the seismic response of systems a) flat slab building b) flat slab with parametric beams c) flat slab with shear walls d) flat slab with drop panel. e) Conventional building the aforementioned hypothetical systems were studied for two different

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storey heights located in zone v. and analyzed by using ETABS Nonlinear version 9.7.3. Linear dynamic analysis i.e. response spectrum analysis is performed on the system to get the seismic behavior.

III. ANALYSIS METHOD

As per the Indian Standard code for Earthquake IS: 1893-2002, seismic analysis can be performed by three methods. 1. Static Method A. Equivalent Static Coefficient Method 2. Dynamic Methods A. Time history Method B. Response Spectrum Method

• Software Implementation:

Etabs software is exclusively made for modeling, analysis and design of buildings. Various facilities in the Etabs are listed below:

1. Etabs has feature known as similar story. By which similar stories can be edited and modeled simultaneously. Due to which building is modeled very speedily.
2. Etabs can perform various seismic coefficients, Response Spectrum, Static Non-linear, Time History, Construction sequence and many more analysis with good graphics.
3. Etabs provide object based modeling. It takes slab as area object, column, beam, brace as line object and support, mass, and loads as point objects.
4. Etabs automates templates for typical structures like steel deck, waffle slab, flat slab, Ribbed Slab etc.
5. Etabs can do optimization of steel section.
6. Etabs has a facility to design composite beam. Also composite deck can be modeled in Etabs.

Software validation:

For verification of software a G+6 storey building example is taken from Nicee website. The results of which are compared with the results of Etabs.

Data for Building:

Plan Dimension: 18 m x 18 m
Typical Storey Height: 5 m
Bottom storey Height: 4.1 m
Slab Thickness: 100 mm
Column Size: 600 x 600 mm
Main Beam: 300 x 600 mm
Secondary Beam: 200 x 500 mm
Sear wall: 180 mm
Wall: 230 mm thick about periphery
Load: Live load 4 kN/m² on Floor and 1 kN/m² on roof
Floor finish: 1 kN/m²
Water Proofing: 2 kN/m²
Earthquake Data: Zone III, Type II soil and Importance Factor 1.5

LOADS COMBINATIONS:

1. RCC 1.5 (DL + LL)
2. 1.2 (DL + LL ± EQ_x)
3. 1.2 (DL + LL ± EQ_y)
4. 1.5 (DL ± EQ_x) 1.5 (DL ± EQ_y) 0.9 DL ± 1.5 EQ_x 0.9 DL ± 1.5 EQ_y

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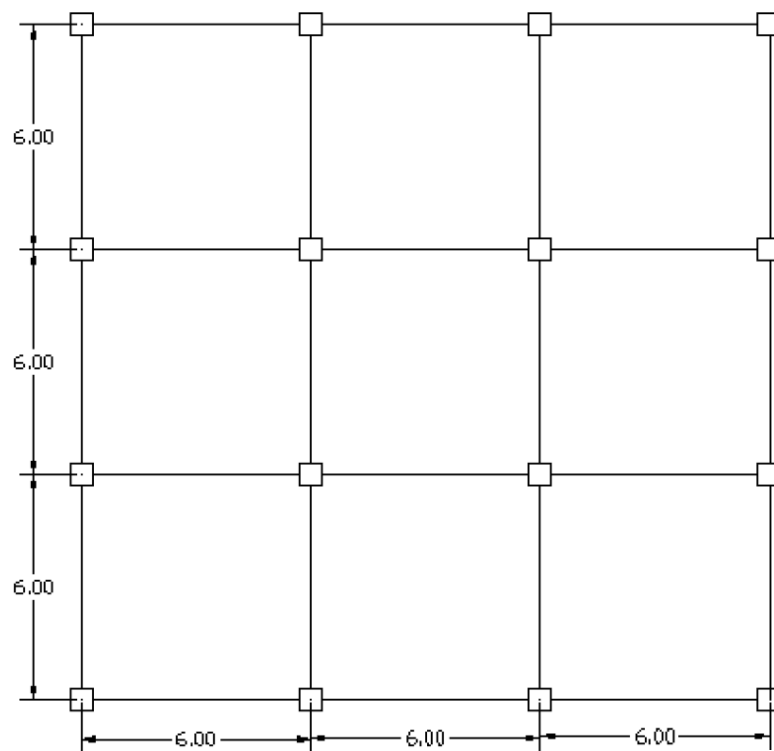
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Material Data

Material	Weight (kN/m ³)	Modulus of Elasticity (E) (kN/m ²)	Shear Modulus (G)	Poissons Ratio	Coeffi. Of Thermal Expansion
Concrete (fck=M25)	25	25x10 ⁶	10416666.7	0.2	9.9x10 ⁻⁶
Steel (Fe-415)	78.5	2x10 ⁸	76884615	0.3	11.7x10 ⁻⁶



plan View of Building

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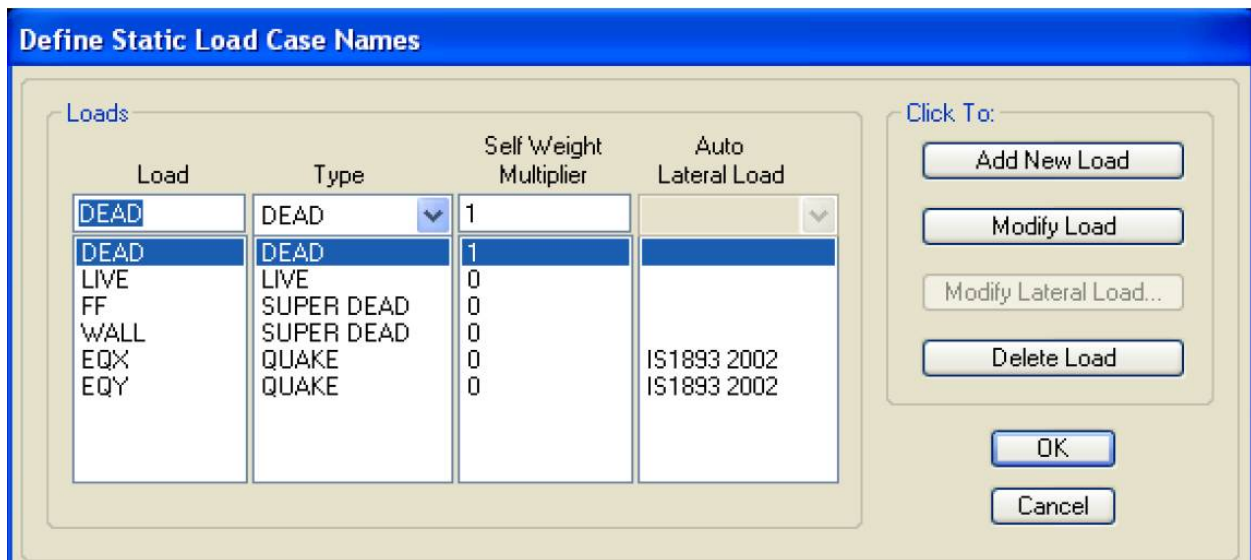
Comparison of Software verification result

Storey	Storey Shear (kN)		Storey Displacement (mm)		Drift (mm)	
	Manual	Etabs	Manual	Etabs	Manual	Etabs
7	480	459.28	79.43	80.80	7.23	7.02
6	860	845.96	72.20	73.81	12.19	12.03
5	1104	1091.95	60.01	61.78	15.68	15.69
4	1242	1231.29	44.33	46.09	17.58	17.79
3	1304	1294.04	26.75	28.30	17.26	17.87
2	1320	1310.22	9.49	10.43	9.08	10.58
1	1320	1310.90	0	0.05	0	0

Modeling of Building Using ETABS

For shear wall minimum thickness required as per IS: 13920 are 150 mm. So 200 mm thickness is taken. As panel size of building for shear wall is same for all type of models, thickness of shear wall is kept same for all.

For loading purpose Live load, Dead load is applied as area load. Earthquake load is applied as per IS 1893-2002. For defining load only once in dead load case self-weight multiplier is taken one.



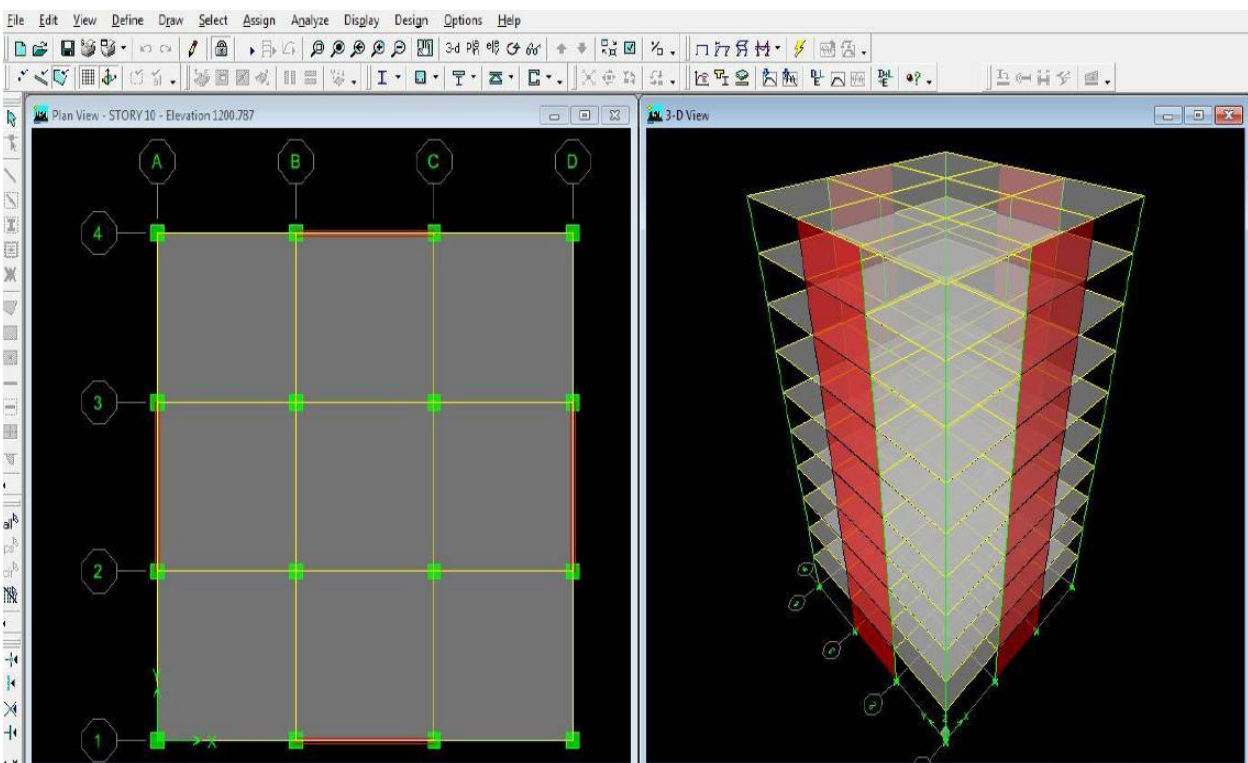
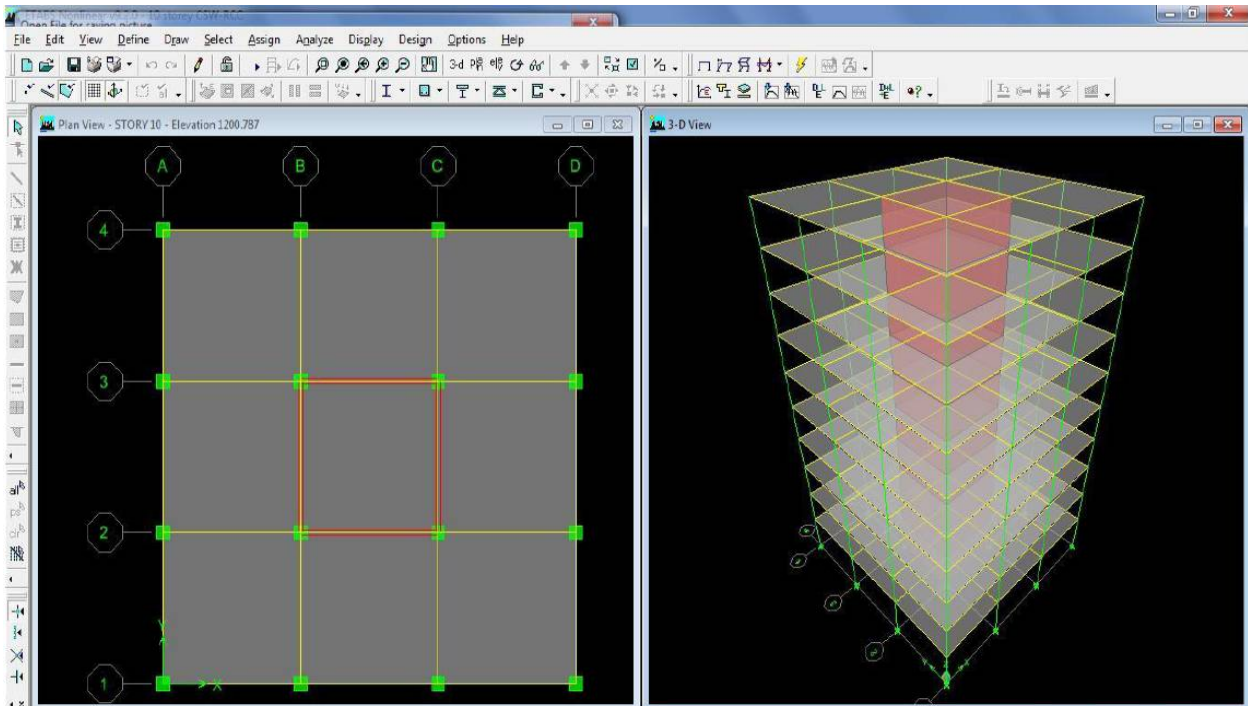
Load	Type	Self Weight Multiplier	Auto Lateral Load
DEAD	DEAD	1	
DEAD	LIVE	0	
LIVE	SUPER DEAD	0	
FF	SUPER DEAD	0	
WALL	QUAKE	0	IS1893 2002
EQX	QUAKE	0	IS1893 2002
EQY			

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IV. ANALYSIS, RESULT AND DISCUSSION

1. Storey drift, Base shear distribution, Storey displacement, time period, frequency, stiffness are tabulated and compared. As building symmetrical about X and Y axis, all comparison is made for X direction.
2. Seismic response is checked for different location of shear wall. Shear walls are provided at center and at edge. Now onwards shear wall at core is referred as CSW (Core Shear Wall) and at edge as ESW (Edge shear Wall).

Storey Displacement: Storey drift is calculated from the storey displacement. More storey displacement indicates less stiffness of structure.

Storey Stiffness: Stiffness is calculated by assuming that supports are fixed and load is applied at floor level. Horizontal displacement is measured at floor level and lateral stiffness is calculated by dividing horizontal deflection to lateral load. In other words stiffness is the force needed to cause unit displacement and is given by slope of force displacement relationship. Strength is a maximum force that a system can take.

Time Period, Frequency and Storey Drift: The stiffer structures have lesser natural period and their response is governed by the ground acceleration; most buildings fall in this category. The flexible structures have larger natural period and their response is governed by the ground displacement, for example, large span bridges.

V. CONCLUSION

1. The analysis of building with Core shear wall and edge shear wall shows that Shear wall at core shows stiffer behaviour.
2. When shear walls are provided on edge maximum storey displacement of buildings is increased comparing to when shear walls are provided on center portion.
3. When dynamic analysis is done storey drift decreases.
4. When shear wall is placed on edge time period of building increases.
5. When shear walls are provided on edge storey drift of buildings is increased comparing to when shear walls are provided on center portion.
6. For good seismic performance a building should have adequate lateral stiffness. Low lateral stiffness leads to large deformation and strains, damage to non-structural component, discomfort to occupant.

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