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Shear Wall Analysis on the basis of Storey Drift by using Etabs

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ABSTRACT:Multi-storeyed structures are gaining wide popularity days. Generally, any structurewhich hasheightmorethan 35 misconsidered asahigh-risestructure.Duetothe increasingneedofthe high-rise structure in the urban areas, construction of many of high-rise structure are in progress andhundredsofthemwilltakeplaceinfuture, butthemostimportantaspectinthiswholescenario is the safety and sustainability of these structures against natural disasters such asearthquake. The main objective of this project is to study different types, openings and location for resisting lateral forces acting on structure. The analysis is carried out using analytical method as well as ETABS software.

KEYWORDS: Shear Wall, IS Code Design, Etabs, Storey Drift, Base Shear, Rectangular, Core, Column Supported.

I. INTRODUCTION

Shear walled frame building is chosen for study purpose because shear wall is an efficient way of stiffening the structure. The forces in these walls are predominantly shear forces, though a slender wall will also incur significant bending. Since shear walls carry large horizontal earthquake forces, the overturning effects on them are large. Thus, design of their foundations requires special attention. Shear walls should be provided along preferably both length and width. However, if they are provided along only one direction, a proper grid of beams and columns in the vertical plane (called a moment-resistant frame) must be provided along the other direction to resist strong earthquake effects.

The twelve-floor limit is also seen as a compromise between ambitionand manageability for use in classification of buildings in a worldwide database. Through advancements in material properties, construction techniques and structural knowledge, more complex but efficient structural form has emerged. They are typically some combination of tube and outrigger system, use either concrete or steel composite systems, and are thereby generally referred to as hybrid systems. The analysis methods for RC high-rise buildings have special requirements differentfrom low-to-middle rise buildings, especiallyfor the typical structural system that consists of slender members in frames and more RC stocky structural walls.

1.1 Classification of shear walls based onshape

Shear Wall are classified as follows:

1. Rectangular Type of Shear Wall
2. Core Type Shear Wall
3. Column Supported

1. Rectangular Type of Shear Wall:

It is free type free standing walls Barbell type of shear wall is formed when a wall is provided between two columns. The columns are then called boundary elements. This type was the first to be used in construction. These shear walls are subjected to bending and shear by the action of in plane vertical loads and longitudinal shear. Minimum steel over the inner 0.7 – 0.8 L of the wall and placement of the remaining steel at the ends for a length of 0.15 – 0.12 L on either side is more efficient than uniform distribution of steel.

2. Core Type Shear Wall:

In some buildings elevators and other service areas can be grouped in a core which serves to withstand lateral loads. Unsymmetric produces twisting and if twisting is not present, these walls act as simple shear walls. Cores with designed lintels at regular intervals as in elevator, shafts have good resistance againsttorsion.

3. Column Supported Shear Wall:

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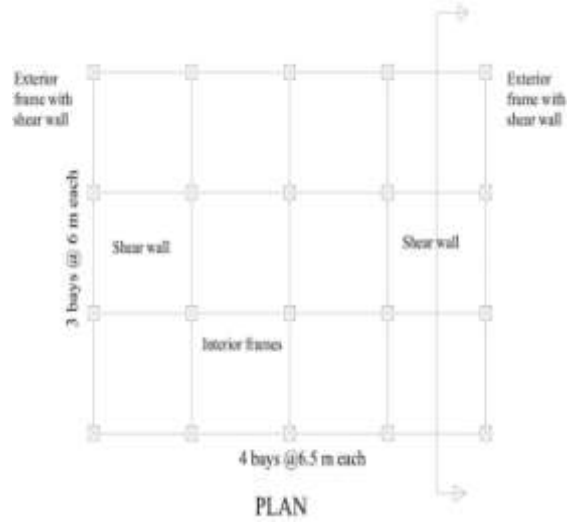
In such column supported shear walls, the discontinuity in geometry at the lowest level should be taken care of in the design.

1.2 Problem Statement:

- G + 14 Storey R.C Public building (Hospitalbuilding)
- Zone factor, Zone - IV, Z =0.24
- Building frame system - (SMRF) - Reduction factor, R =0.5
- Hospital building - Importance factor - I =1.5
- Floor to floor height =3.1m
- Roof and floor slab thickness = 200mm
- Beam's dimension = 500 x 500mm
- Column size = 700 x 700mm
- Grade of concrete = M25 and steelFe-415

Fig 1 Typical plan of the building with shear wall



TYPICAL PLAN OF THE BUILDING WITH SHEAR WALL

II. LITERATURE REVIEW

Shahzad Jamil Sardar [1] Umesh. N. Karadi[2] Vol. 2, Issue 9, September 2013: This paper mainly focused on Multi-storeyed structures is gaining wide popularity now days. Generally, any structure which has height more than 35 metres is considered as a high-rise structure. Due to the increasing need of the high-rise structures in the urban areas, construction of many of high-rise structures are in progress and hundreds of them will take place in future. But the most important aspect in this whole scenario is the safety and sustainability of these structures against natural disasters such as earthquake.

G.S Hiremath[1], Md Saddam Hussain Volume 3 Issue 10, October 2014: This paper focuses on Shear wall systems are one of the most commonly used lateral load resisting systems in high-rise buildings. Shear walls have very high in plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications. There are lots of literatures available to design and analyse the shear wall. However, the decision about the location of shear wall in multi-storey building is not much discussed in any literatures.

Prutha Vyas Volume 3, Issue 4, 2016: This paper investigated that Shear walls are normally preferred in RC buildings and other important structures to resist the lateral forces due to earthquakes, wind storms, or impact loads. They are frequently encountered in earthquake resistant designs recently. This paper compiles the review of literature on structural behavior of RC shear walls under cyclic loading, before and after repair under similar loading condition. The performance characteristic such as strength, stiffness, energy dissipation, and modes of failure of squat shear walls repaired with different retrofitting techniques arepresented.

Dr. Suresh Borra, P.M.B. RajKiran Nanduri2, Sk. Naga Raju3[(9)] (AJER) e-ISSN: 2320- 0847 p-ISSN: 2320-0936 Volume-4: This paper analyses that Concrete shear walls or

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structural walls are often used in multistory buildings to resist lateral loads such as wind, seismic and blast loads. Such walls are used when the frame system alone is insufficient or uneconomical to withstand all the lateral loads or when partition walls can be made load bearing, replacing columns and beams. The analysis and design of buildings with shear walls became simple using commercially available computer programs based on the finite element method (FEM) and subsequent implementation of stress integration techniques to arrive at generalized forces (axial, shear, and moments). On the other hand, design engineers without such facilities or those with computer facilities lacking such features use simple method of analysis and design by taking the entire dimensions of the walls.

III. METHODOLOGY

The response of the structure during an earthquake depends on the characteristic of the ground motion, the surrounding soil and the structure itself. The dynamic response of a structure supported on a soft soil may differ substantially in amplitude and frequency from the response of an identical structure supported on a very stiff soil or rock. Earthquake resistant design of shear wall as per IS - 13920:2016.

A. Design Aspect:

Earthquakes can occur on both landand sea, at any place on the surface of the earth where there is a major fault. When earthquake occurs on land it affects the manmade structure surrounding its origin leading to human lose. When a major earthquake occurs underneath the ocean or sea, it not only affects the structures near it, but also produces large tidal waves known as Tsunami, thus affecting the places far away from its origin. All the structures are designed for the combined effects of gravity loads and seismic loads to verify that sufficient vertical and lateral strength and stiffness are achieved to satisfy the structural concert and acceptable deformation levels prescribed in the governing building code. Because of the innate factor of safety 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 ofstructures.

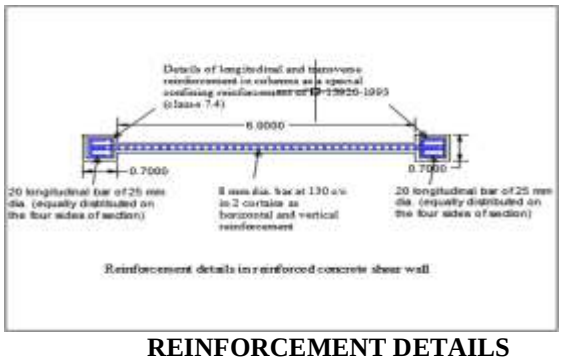
B. Required Indian Standard Code:

IS456:2000: Design for wall describes, design of horizontal shear in clause 32.4 given details of how shear wall have to be constructed.

IS1893-2016(Part-1): Criteria of Earthquake resistant Buildings Part and the estimation of earth quakeloads.

IS13920:2016: It gives the ductile detailing of shear wall as per clause 9, where 9.1 gives general requirements,9.2 shear strength requirement, 9.3 gives flexural strength requirement, 9.4 boundaryelements.

Reinforcement Details by Shear Strength Requirement Flexural and Boundary Elements –



REINFORCEMENT DETAILS

IV. ANALYSIS OF SHEAR WALL

Shear wall are one of the excellent means of providing earthquake resistance to multi-storeyed reinforced concrete building**.** The structure is still damaged due to some or the other reason during earthquakes. Behaviour of structure during earthquake motion depends on distribution of weight, stiffness and strength in both horizontal and planes of building. To reduce the effect of earthquake reinforced concrete shear walls are used in the building. These can be used for improving seismic response of buildings. Structural design of buildings for seismic loading is primarily concerned with structural safety during major

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Earthquakes, in tall buildings, it is very important to ensure adequate lateral stiffness to resist lateral load.

5.1 Storey Drift: Lateral drift or story drift is nothing but the amount of side sway between any two adjacent stories of a building which is caused by lateral loads i.e., wind and earthquake. In case of single-story building, Horizontal deflection of a wall is due to horizontal movement between two supports under wind or earthquake loading.

5.2 Base Shear: Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. Calculations of base shear (V) depend on: soil conditions at the site. proximity to potential sources of seismicactivity.

5.3 Analysis of Types of Shear Wall on the basis of Storey Drift:

1.

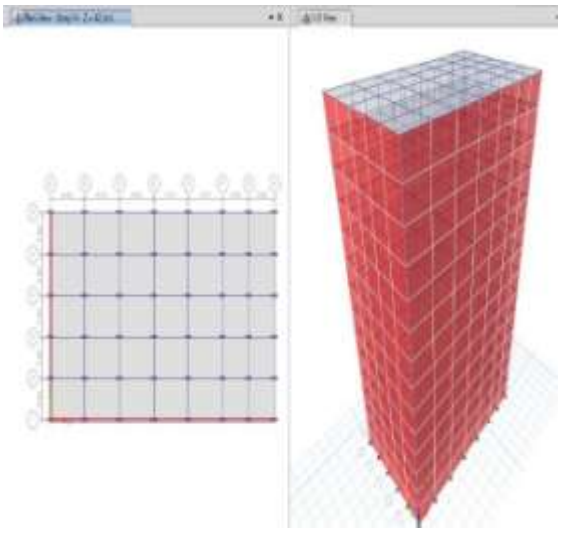

Fig no 3 Rectangular Shear Wall

2.

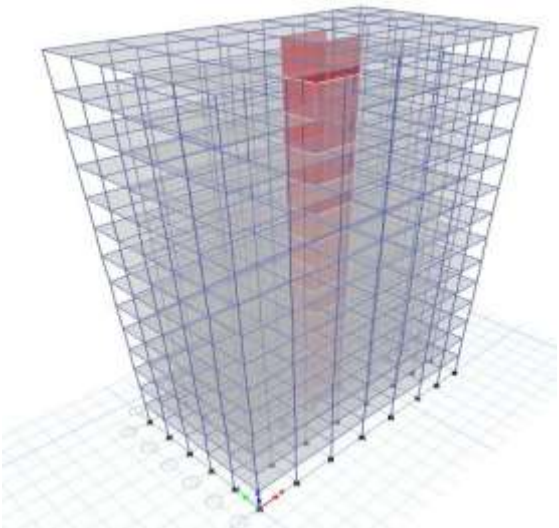

Fig no 4 Core Shear Wall

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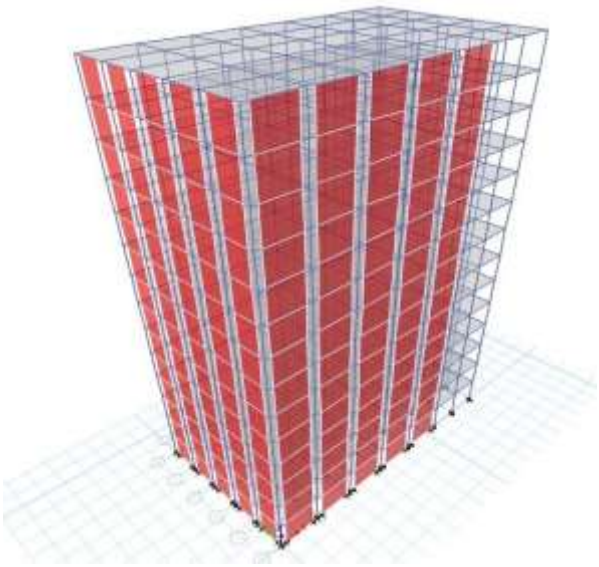

3.

Fig no 5 Column Supported Shear Wall

After drawing model in Etabs, we analysed and found the maximum storey drift as shown below:

Table no 5.4.4 Maximum Drift value at each storey

STOREY	Column supported SW	Core SW	Rectangular SW
14	0.003416	0.004573	0.003449
13	0.005146	0.005485	0.005079
12	0.006612	0.006444	0.006554
11	0.007801	0.007342	0.00767
10	0.008746	0.008079	0.008501
9	0.009494	0.008662	0.009129
8	0.010098	0.009122	0.009634
7	0.010617	0.009492	0.010093
6	0.011088	0.009797	0.010551
5	0.011527	0.010021	0.010998
4	0.01193	0.010094	0.011418
3	0.01224	0.009865	0.011748
2	0.012049	0.008997	0.011674
1	0.009526	0.006234	0.008512

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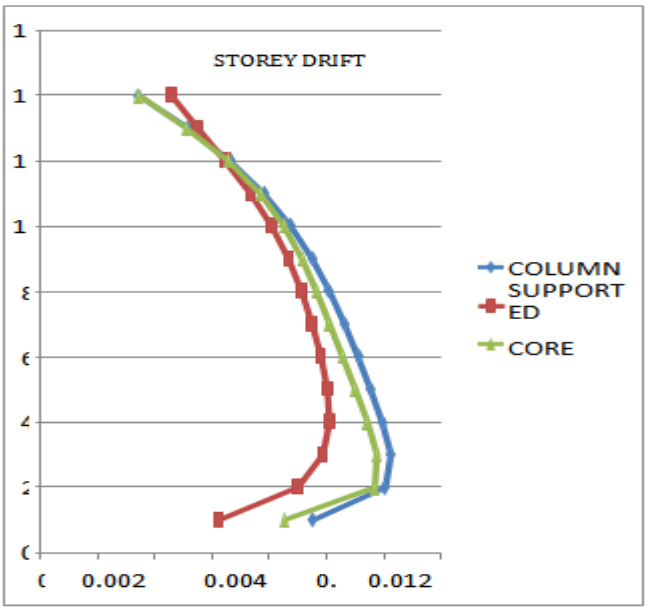

V. CONCLUSION

- This paper focuses on improving the resistance and stability of high rise building against the different loads and forces (mainly seismic forces) it is subjected to during its life time.
- From all the above analysis, it is observed that in 14 story building, constructing with shear wall along short span at middle (model 2) is effective in resisting seismic forces as compare to building without shear wall. It is also observed that the shear wall is economical and effective in high risebuilding.
- From the above graphical results it is evident that shear wall should be provided in high rise buildings as the performance of these structures when subjected to different forces is not satisfactory.
- After analyzing the types of Shear wall such as Rectangular, Core and Column Type Shear Wall on the basis of Storey Drift we found the results are found to be less or drift is minimum for Core type ShearWall.

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