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Analysis of Shear Wall on the basis of Joint Displacement and Opening by using Etabs

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ABSTRACT:
The reinforced concrete shear wall is one of the most commonly used lateral load resisting inhigh rise building. Shear walls are the structural elements of the horizontal force resisting system,shear walls have high influence strength andstiffness and provided to resist not only gravity loads but alsolateral loads caused by seismic and wind. So many literatures are available to analyse and design of shear wall. An earthquake load is calculated as per IS 1893(PART-1)-2016 and applied to (G+14) storey R.C building in zone-IV. The analysis is performed using ETAB v.2017 Software package. The scope of the present work was to study seismic responses of the multi storey RC shear wall building opening and joint displacement for resisting lateral forces acting on structure.

KEYWORDS: Shear Wall,Etabs,IS code Design, Joint Displacement, Horizontal Opening of Shear wall,Verical Opening of shear wall, Story Drift

I. INTRODUCTION

In contrast to the worldwide rapid growth of high-rise buildings, no probabilistic assessment procedures have been developed for different risk like seismic evaluation of this special type of building group. Reinforced concrete buildings often have a vertical plate-like RC walls called as Shear Walls in addition to beams, slabs and columns. These shear wall usually start at foundation level and are continuous throughout the building height. Their thickness can be as minimum as 150mm or as maximum as 400mm in high rise buildings. Shear walls are mostly provided along both width and length of buildings. Shear walls as like as vertically-oriented wide beams that carry earthquake loads downwards to the foundation.

1.1 Classification of shear walls based on shape:

- Simple rectangular types and flanged walls
- Coupled shear walls
- Rigid frame shear wall
- Framed walls with infilledframes
- Column Supported Shear Wall
- Core type shear wall

1.2 Classification based on behaviour :

- Shear walls – Deflection and the strength are controlled by shear. They are usually low-rise shear walls.
- Ordinary- moment shear walls – Deflection and strength are controlled by flexure. They are usually high rise shear walls used to resist cyclones and high winds.
- Ductile – Moment shear walls: shear wall have good energy dissipation characteristic under reversed cyclic loads and special walls meant for seismic regions.

1.3 Problem Statement:

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

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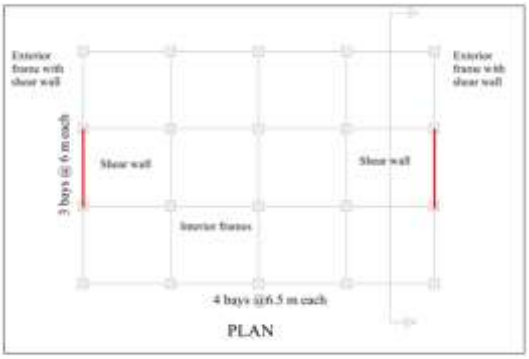

Fig 1 Typical plan of the building with shear wall

II. LITERATURE REVIEW

Satpute S G[1] D B Kulkarni[2] Vol. 2, No. 3, August 2013

This paper presents current study focuses on analyzing as a system-level effect, the influence of twist, on the displacement and strength demands of the building's individual seismic force resisting system wall components. In addition, the building center of rotation and center of strength are determined and the corresponding twist angles and moments and building torsional stiffness values are evaluated throughout the loading history.Also giving some information about opening.

G.S Hiremath[1], Md Saddam Hussain[2]Volume 3 Issue 10, October 2014

This paper focuses on Shear wall systems are the most commonly used lateral load resisting systems in multistory buildings. Shear walls have very high in plane strength and stiffness, which can be used to simultaneously resist large support gravity loads and horizontal loads, making them quite advantageous in many structural engineering applications. There are lots of literatures available to analyse and design the shear wall. In this paper, therefore, may focus is to determine the solution for shear wall location in multi-storey building. These analyses were performed using STAAD Pro. Three different cases of shear wall position for a 6 storey building have been analysed.

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. The performance characteristic such as stiffness, energy dissipation, strength and modes of failure of squat shear walls repaired with different retrofitting techniques are presented.

VirajBaileDr. A.A. Bage Issue 7, Vol. 7,(Part-2) July 2017

This paper deals with the study of statistical quantification of peak component acceleration (PCA) demands and peak floor acceleration (PFA) demands for acceleration sensitive nonstructural components attached to or suspended from shear-wall structures with fundamental periods from 0.15 to 1.5 S.The results from this study indicate that the relationship between the period of the component, the estimation of component acceleration demands should explicitly consider the modal periods of the structure and the dynamic properties of the supporting structure, the ground motion intensity and the location of the component within the structure.

III. METHODOLOGY

For the purpose of study a plan of G+14 floor levels hospital building were considered. Analyze building with providing reinforced concrete shear wall with the help of code provisions for gravity loads as per IS 456: 2000 and lateral load (earthquake loads) as per IS 1893(part-1):2016 and by using Etab software.

We take typical plan of the building and analyze a structure with RCC shear wall placed at middle of edges on Y-axis as shown in follows and compare the lateral displacement in X and Y directions respectively also compare horizontal and vertical opening of shear wall obtained by using software Etab which method gives minimum displacement,story drift value and also economical and safe for humans.

A. Factors Affecting Earthquake Design Of Structure:

- Natural frequency of the building
- Damping factor of the structure
- Type of foundation of the structure
- Importance of the building
- Ductility of the structure

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B. Required Indian Standard Code:

IS456:2000: Design for wall describes, use for plain and reinforced concrete 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 earthquakeloads.

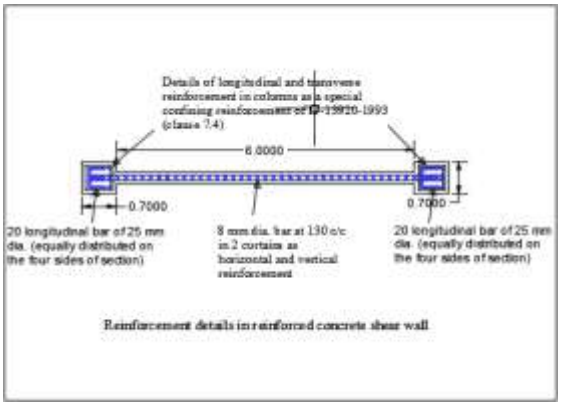
IS13920:2016: It gives the ductile detailing of shear wall as per clause 10, where 10.1.1 gives general requirements, 10.2.1 shear strength requirement, 10.3.1gives flexural strength requirement, boundaryelements.

Reinforcement Details by Shear StrengthRequirement Flexural and Boundary Elements

Analysis of Shear Wall Without and With In a Hospital Building

Model-1

REINFORCEMENT DETAILS



IV. ANALYSIS OF SHEAR WALL

A structural analytical model is proposed for modeling a nonlinear response of flexural-yielding reinforced concrete walls using standard structural analysis software. The program ETAB is used toimplement the proposed model for evaluating structural response by means of nonlinear response history analysis.

1.Opening of Shear Wall: Shear walls may have one or more openings for functional reasons such as doors, windows, and other types of openings in shear wall. The location and size of openings may vary depending on purposes of the openings

2.Joint Displacement: Due to dynamic forces like shaking of the ground,exploration of earthquake and due to wind blast in nearby area, there is necessity to find Joint displacement as well as Joint drift.The simple structure analysis is carry out manually but for complex structure ETABS can be used to calculate this parameter.

The typical plan of the building model are given below

Model 1 – typical floor plan of the structure without shear wall.

Model 2 – typical floor plan of the dual system with shear wall on side of the structure.

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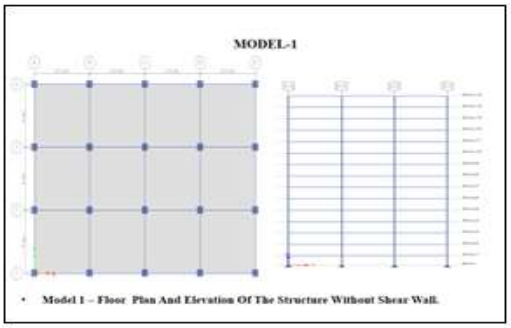
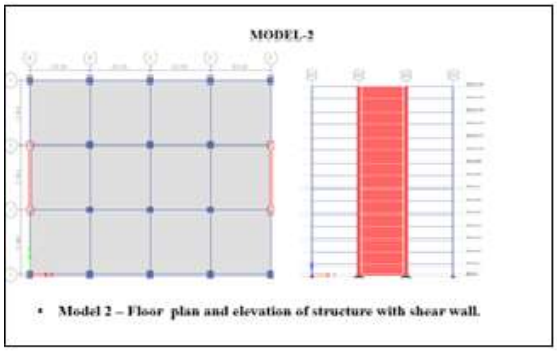


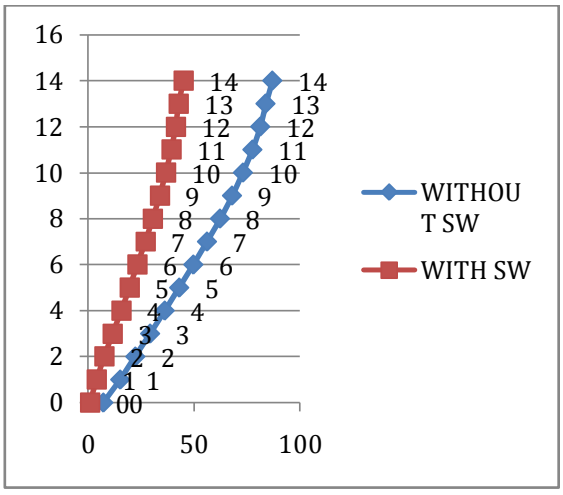
Model 1 – Floor Plan And Elevation Of The Structure Without Shear Wall.

Model-2



Model 2 – Floor plan and elevation of structure with shear wall.

Graph for Displacement for Model 1 and 2



Result of Displacement with and without shear wall

Sr. No.	Story No.	Displacement With Shear Wall	Displacement Without Shear Wall
1	Terrace	87.021	45.096
2	Story 13	83.81	42.83
3	Story 12	81.32	41.45
4	Story 11	77.63	39.36

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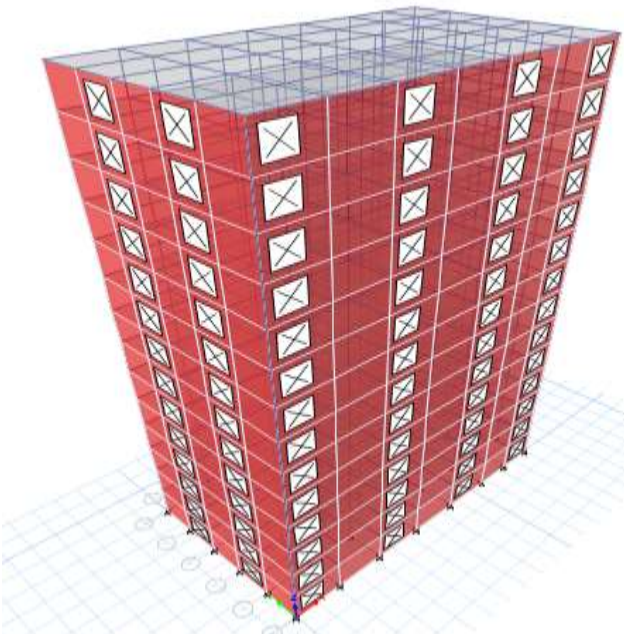
5	Story 10	73.15	36.8
6	Story 9	68.001	33.86
7	Story 8	62.31	30.59
8	Story 7	56.19	27.089
9	Story 6	49.75	23.395
10	Story 5	43.088	19.568
11	Story 4	36.26	15.662
12	Story 3	29.36	11.726
13	Story 2	22.37	7.829
14	Story 1	15.24	4.128
15	G.L.	7.28	0.999

OPENING OF SHEAR WALL :

Model of Horizontal Opening of Shear Wall
Model of Vertical Opening of Shear Wall



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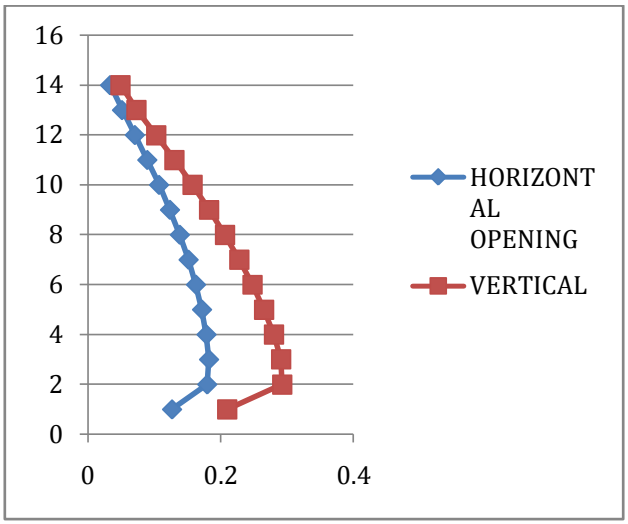
Graph for Opening of Shear Wall



Analysis of Opening of Shear Wall on the basis of Storey Drift

Horizontal Opening Drift	Vertical Opening Drift	Storey
0.03352	0.049332	14
0.051516	0.073586	13
0.070847	0.102703	12
0.08954	0.130704	11
0.10722	0.157328	10
0.123608	0.182615	9
0.138472	0.206292	8
0.151587	0.2281	7
0.162751	0.247796	6
0.171791	0.265156	5
0.178516	0.279918	4
0.182328	0.291102	3
0.179553	0.292432	2
0.126742	0.209989	1

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 Y-axis 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 effectiveand economical in high rise building.
- From the result of above graphs are showing that shear wall should be provided in high rise buildings as the performance of these

structures when subjected to different forces is not satisfactory.

- The study indicated that displacement is also reduced by 48.172 %
- We also analysed the Opening of Shear wall such as Horizontal and Vertical Opening on the basis of Storey Drift we got minimum results for Horizontal Opening.

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