Seismic Analysis of Flat Slab Building with Shear Wall

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***Abstract*—In present construction practice flat slab systems has become widely used in reinforced concrete buildings. In RC buildings flat slab system exhibit several advantages over conventional moment resisting frames. Flat slab system reduces floor height to meet the architectural and economical demand. However, under earthquake loading, the structural effectiveness of flat slab constructions is hindered by its alleged inferior performance. Shear walls are used to resist lateral forces parallel to the plane of the wall. Large forces are generated due to seismic action resist by high in plane stiffness and strength of shear wall. Mainly to avoid the total collapse of the buildings under seismic forces, shear wall act as a flexural member. In this paper, study of 14 storey building in zone IV is considered, and is analysed with flat slab by changing various shapes of shear wall to determine different parameters like storey shear, storey displacement, storey drift and time period. Analysis is done using ETABS V.16.Software. Response spectrum analysis i.e. linear dynamic analysis is performed on the system to get the seismic behaviour.**

Keywords*— *Flat slab, Shear wall, Response spectrum analysis, Lateral loads, Storey drift

I. INTRODUCTION

The modern trend is towards taller and slender structures and there has been a considerable increase in the construction of tall buildings both residential and commercial. In the building type of structures, the primary purpose of all kinds of structural systems is to transfer gravity loads effectively. Lateral loads like wind loads, earthquake loads and blast forces are attaining importance and every designer is facing with the problems of providing stability and adequate strength against lateral loads. Therefore, it is very important for the structure to have sufficient strength against vertical loads together with adequate stiffness to resist lateral forces.

Without the aid of beams, solid concrete slabs of uniform depths called flat plates are transfer loads directly to the supporting columns. Today, the most commonly used slab systems used for multi-storied buildings are Flat plates. Their lack of resistance to lateral loads is the main disadvantage of Flat plates or Flat slab. Hence, in high rise constructions special features like shear walls to be provided. Shear wall can be defined as structural elements, which provide strength, stability and stiffness lateral loads deriving strength. To reduce ill-effects of twist of buildings, shear walls must be located symmetrically in plan.

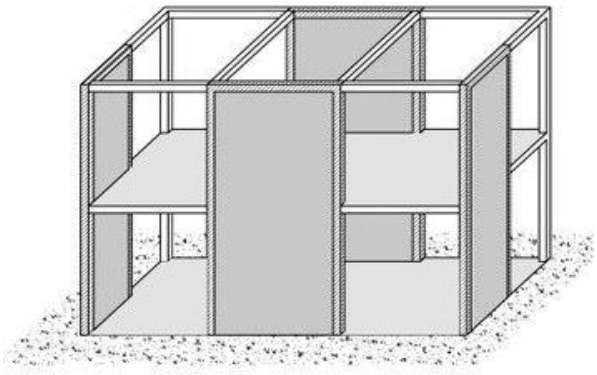


Fig.1. Shear Wall Building

II. SCOPE AND METHODOLOGY OF THE STUDY

In the present paper, an attempt is made to study and compare the effects of earthquake on a multi storied building for different shapes of shear walls using Extended Three-dimensional Analysis of Building Systems (ETABS).

III. STRUCTURAL MODELING AND ANALYSIS

Linear dynamic (Response Spectrum) analysis with rigid floor diaphragms used to evaluate the seismic response of multi-storey building. Etabs V.16. is used for the analysis of structure. Building situated in Seismic zone IV and soil type is II.

A. Details of Structural Elements and Materials Used

Table 1 Material Properties

Grade of concrete	M35
Grade of steel	Fe 500
Modulus of Elasticity of steel, E_s	20,0000MPa
Modulus of Elasticity of Concrete	35000MPa
Floor to floor height	3m
Plinth height above GL	1.5m
Slab thickness	200mm
External wall	200mm
Column	350 x 350mm
Beam	300 x 600mm
Live load on all floors & roof	4 kN/m^2
Floor Finish	1 kN/m^2
Partition load	1 kN/m^2

B. Geometry of the Considered Model

Table 2 Model Geometry

No. of Storeys	14
No. of Bays in X Direction	5
Bay Width in X Direction	6m
No. of Bays in Y Direction	5
Bay Width in Y Direction	6m
Storey Height	3m

With the help of five different shape of shear wall studied the effectiveness of shear wall. Six models were analysed for comparing time period, lateral displacement, storey shear and storey drift.

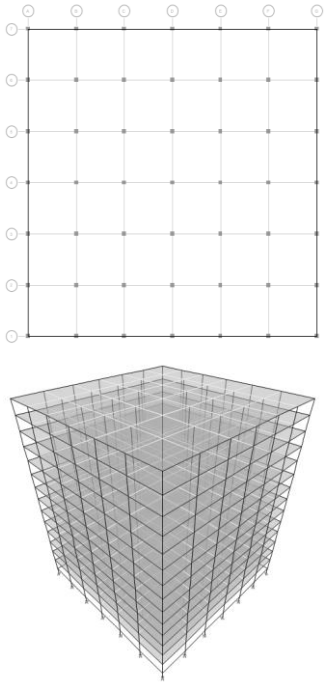


Fig.2 Plan and 3-D View of Proposed Building (Without Shear Wall – Bare Frame)

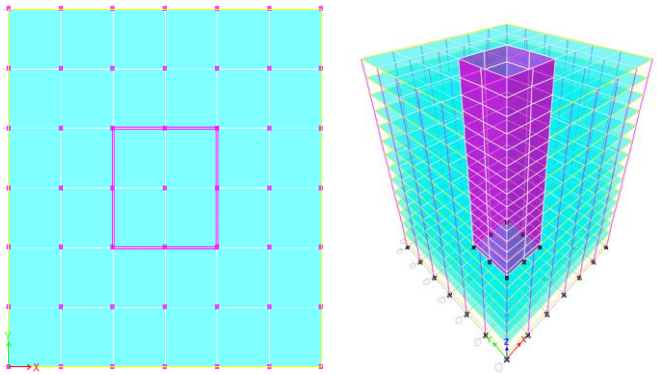


Fig.3 Plan and 3-D View of Model with Box Type Shear Wall

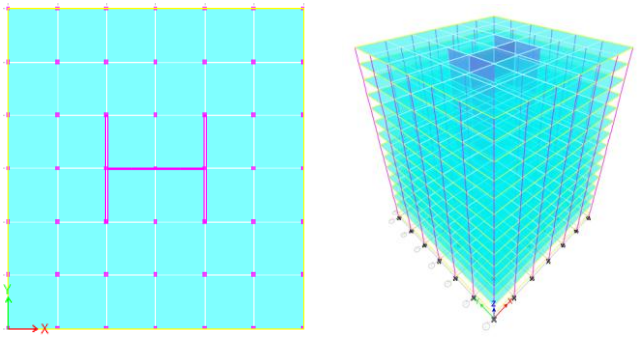


Fig.4 Plan and 3-D View of Model with H-Shaped Shear Wall

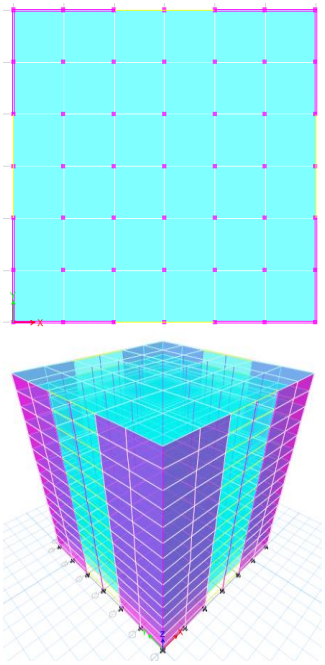


Fig.5 Plan and 3-D View of Model with L-Shaped Shear Wall

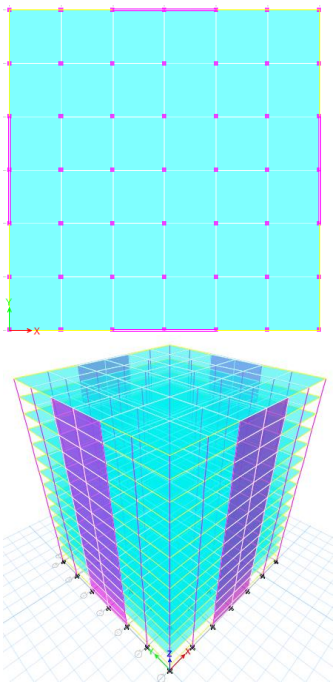


Fig.6 Plan and 3-D View of Model with Straight Shear Wall

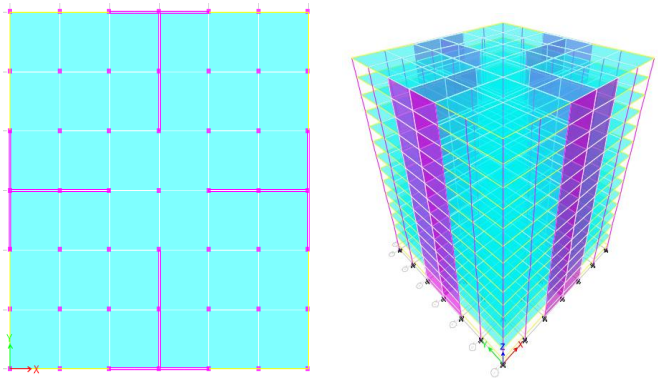


Fig.7 Plan and 3-D View of Model with T-Shaped Shear Wall

IV. Results and Discussion

A. Time Period

Time period summarization given in below table

Table 3 Time Period for Different Shear Wall

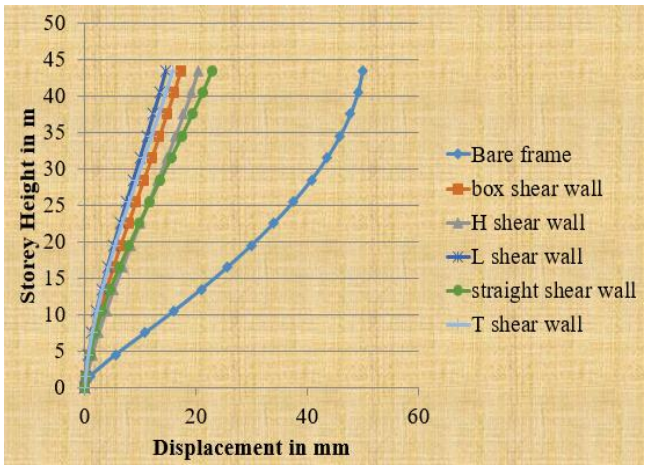
Cases	Time Period (sec)
Bare	2.832
Box	0.856
H	1.757
L	0.699
T	1.133
Straight	0.770

From this study we come to know that the time period less in L shaped shear wall.

B. Storey Displacement

Table 4 Storey Displacement for Different Shear Wall

Cases		Storey Displacement(mm)
Bare		50.020
Box		17.232
H	X	20.32
	Y	26.669
L		14.618
T		22.918
Straight		15.782



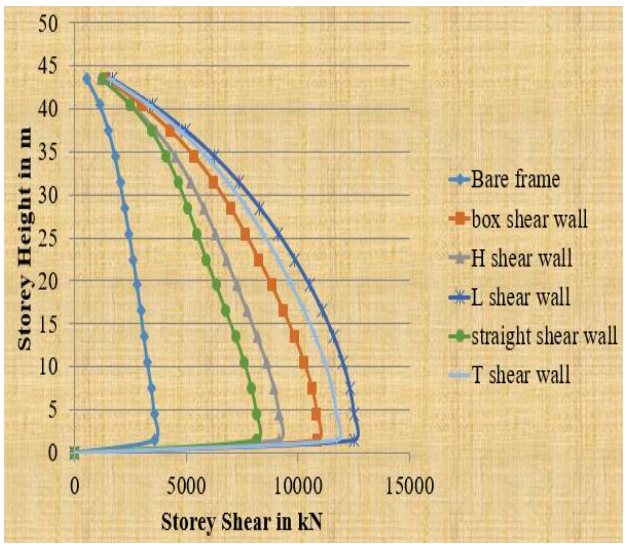
Graph 1 Storey v/s Displacement

From this study we concluded that storey displacement is less in L type shear wall. Storey shear maximum is observed for bare frame and H shaped shear wall.

C. Storey Shear

Table 5 Storey Shear for Different Shear Wall

Cases	Storey Shear(kN)
Bare	3567.60327
Box	10844
H	9155.3655
L	12512
T	11737
Straight	8145.9031

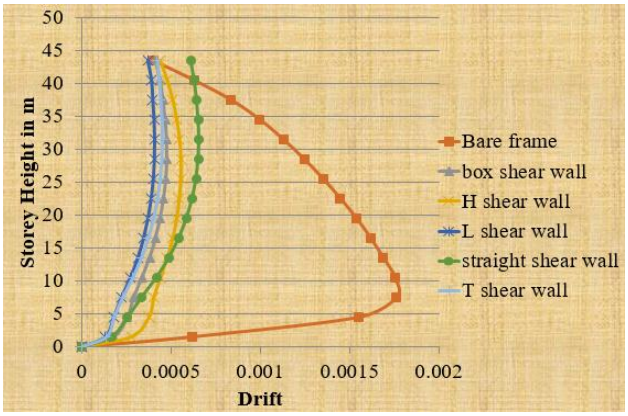


Graph 2 Storey v/s Storey Shear

D. Storey Drift

Table 6 Storey Drift for Different Shear Wall

Cases	Storey Drift
Bare	0.001763
Box	0.000478
H	0.000766
L	0.000409
T	0.000449
Straight	0.000658



Graph 3 Storey v/s Storey Drift

V. CONCLUSION

In this paper the study is carried out according to the earthquake code book IS 1893[PART I] 2002 and analysis is carried out by taking regular plan of building [G+14] on medium soil [TYPE II] and ZONE IV is done by linear dynamic with different shear walls. A comparison is carried out to determine the optimum position of shear wall.

The following are the conclusion taken in this paper.

1. The bare frame gives more displacement, time period and storey drift compared to other shapes of shear wall. Hence, the presence of shear wall is possible of controlling the damage that may occur due to earthquake force.
2. Time period comparison gives the L shaped shear wall is better shape than others.
3. From the comparison of storey displacement values L shaped shear wall indicate lesser displacement and then better one is straight shear wall.
4. Storey displacement value obtained from the analysis indicates that L shape obtained least value then better one is T shaped shear wall.
5. Storey shear maximum for L shaped and T shaped.
6. Structure with L shaped shear wall is suitable for the effect of earthquake load on the performance of building.

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