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RESEARCH ARTICLE

PUSHOVER ANALYSIS OF A MULTISTORIED BUILDING WITH AND WITHOUT SHEAR WALL UNDER SEISMIC LOAD

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ABSTRACT

This paper discuss a comparative study of G+9 building with and without shear wall is carried out so as to understand lateral displacement, storey drift and base shear of the building. The main objective of this paper is to reduce the storey drift of the multistoried building by introducing different configurations of shear wall. In the beginning seismic analysis is done by using static linear response spectrum method and based on the results obtained the dimensions of beams and columns are optimized to bring the storey drift within the limit specified as per IS 1893(Part 1):2002. Non linear static Pushover analysis of building is performed and storey responses for the structure is determined. From the obtained results it is concluded that the building with certain configurations of shear wall provides more resistance to lateral loads compared to the building without shear wall and the best configuration of shear wall is identified. The analysis of building is done using software ETABS.

INTRODUCTION

Earthquake is nature's one of the greatest hazards to human lives and properties. Special structural systems should be developed so as to resist the effect of earthquakes on the buildings. These structural systems should be capable of resisting lateral loads acting on a tall building. Shear wall is a structural element which is capable of resisting lateral loads along with vertical and gravity loads. As these lateral loads develops high stress which may cause sway movement in high rise building. Seismic response of a building can be improved by providing a shear wall. Shear wall should be placed symmetrically in plan so as to reduce the damage caused due to earthquake. When they are placed along the exterior perimeter they acts effectively. Shear wall can act as a partition wall as well as load bearing wall, thereby eliminating several column. A study was conducted on fifteen storied building situated in Zone IV to determine the location of shear wall using elastic and elastoplastic analysis (Anshumn *et al*., 2011). From the study it is concluded that the top deflection reduces and reaches the permissible limit when shear wall is provided in shorter direction of top storey. A comparative study of five types of building configuration with shear wall at different position where analyzed (Anuj Chandiwala, 2002).

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From the obtained result it is found that shear wall at the end of L section is best suited because it provided stiffness at the end portion of the building. A study was conducted about shear wall frame interactions (IS 1893(Part 1)-2002). It is found that they are very much effective in resisting load due to earthquake and are found to be economical for medium rise residential building. The seismic response for a 45 storey building was analyzed where optimization technique was used for analysis (Kumbhare and Saoji, 2012). By raising the existing dimension the structure was found to be more stable. A study on the effects of reinforced concrete shear wall on the building was done for identifying different modes of failure of the structure. A new method of calculating flexural strength was introduced in this study by analyzing a slender rectangular shear wall.

MATERIALS AND METHODS

In this paper a comparative study is done between a building without shear wall and with shear wall. The analysis is done using the software ETABS. Non linear push over analysis was done to compare the seismic response of the building with and without shear wall. The storey drift, storey displacement, storey stiffness and base shear were obtained for building with and without shear wall. The analysis is done with the help of IS1893-2002(Part 1) and FEMA 356 and FEMA 440.

A. ETABS Software

ETABS is an integrated software which is used for the structural analysis and design of a building. This special program is introduced about 40 years ago. It was developed by computers and structures, Berkeley, USA. General structures including towers, bridges, stadiums, building, dams, industrial plant, silos etc. It helps in model creation, modification, execution of analysis, design optimization. It having many tools that helps in quick and accurate construction of the models. It is provided with different techniques that helps in doing complex projects.

B. Push over analysis

It is an inelastic static analysis of a structure. If a specified load pattern is followed which varies from zero load to a particular displacement. Here the structure is subjected to incremental lateral load. In push over analysis a preferred lateral load is applied along the building height. These lateral loads are then increased so as to cause the yielding of some members. Then corresponding to this yielding some modifications are made in the structural members. So that stiffness of yielded member can be reduced, then again load is increased till the displacement reduces a particular value as a result of this structure becomes unstable.

C. Analysis of the building

The various parameters which are considered for the analysis of the building by using ETABS are mentioned in Table 1 as shown below. These parameters are assumed as per the convenience. The seismic zone considered is zone V because zone V is the most earthquake prone area as per Indian Standards (IS 1893(Part 1)-2002).

Table 1. Data considered for analysis

Seismic zone	V
Type of Building	Commercial
Seismic zone factor	0.36
Response reduction factor	5
Importance factor	1
Height of the building	40m
Plan dimension	14 x18 m
No. of stories	TEN (G+9)
Floor to Floor Height	3.6 m
Number of bays	4 x 6
Length of Bay	3.5 in X & 3m in Y Direction
Live Load	On floor 1KN/m2
Floor finish load	1 KN/m2
Wall Thickness	230 mm
Grade of Concrete	M25
Grade of Steel	Fe415
Beam Size	350mm X 500mm
Column Size	450mm X 600mm
Thickness of shear wall	100 mm

RESULTS AND DISCUSSION

The various results obtained from the analysis of the G+9 storied structure by using ETABs is as follows

A. Storey drift

As per IS 1893(Part 1): 2002 storey drift is defined as 'The displacement of one level relative to the other level above or below. In IS 1893(Part 1): 2002 its given that 'the storey drift shall not exceed 0.004 times the storey height'.

Height of the building = 4m

Therefore maximum storey drift

= .004 x 4
=.016m

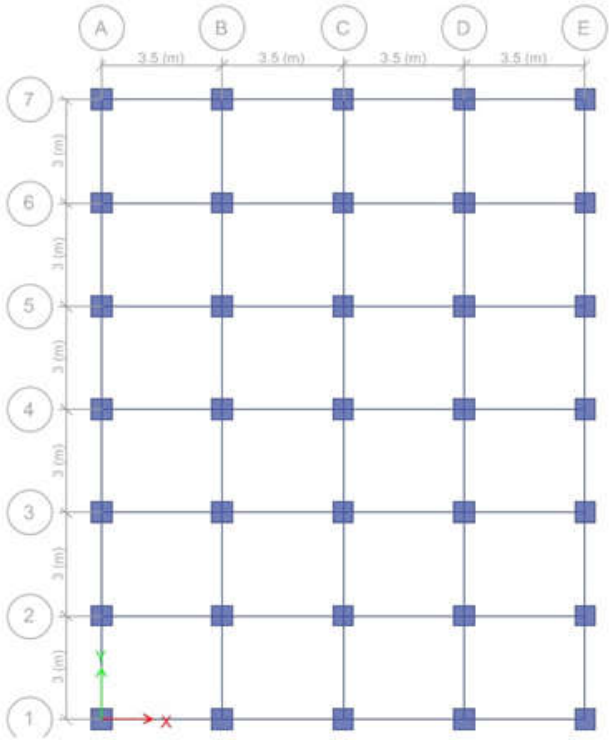

Fig. 1. Plan of the building

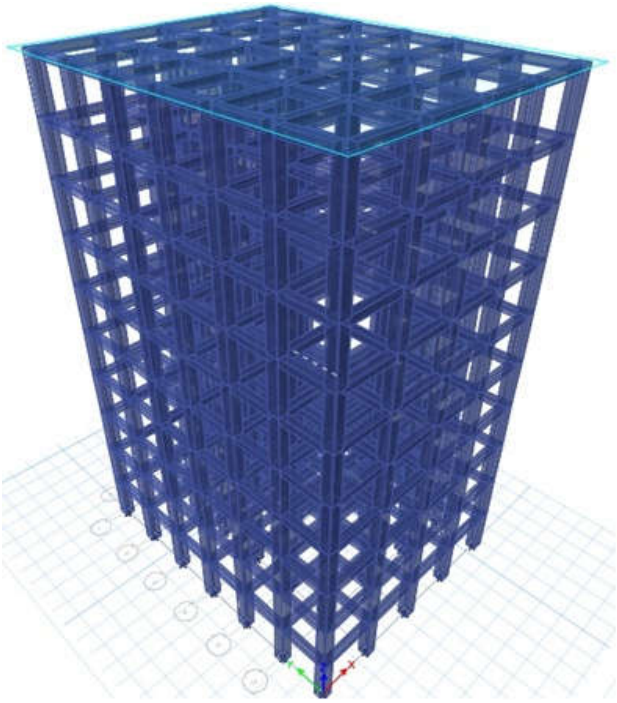

Fig. 2. Three dimensional view of the building

Different building configurations of shear wall considered for analysis are given below:-

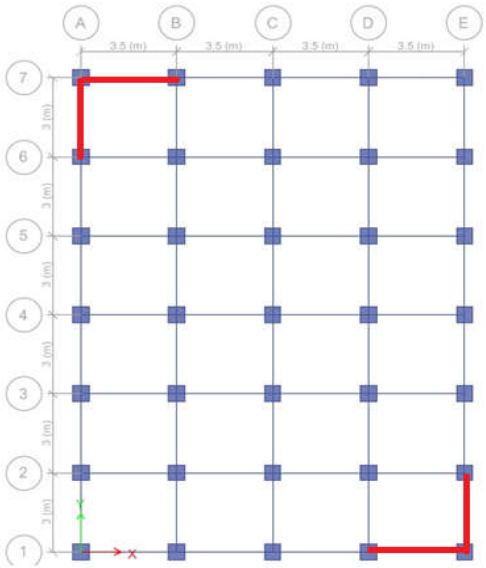

Fig. 3. Type 1 configuration

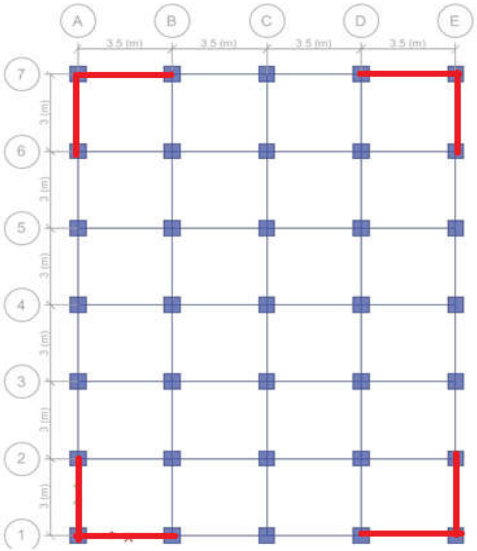

Fig. 4. Type 2 configuration

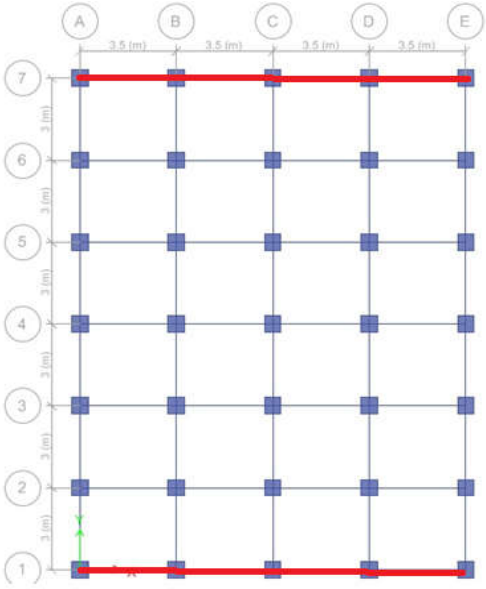

Fig. 5. Type 3 configuration

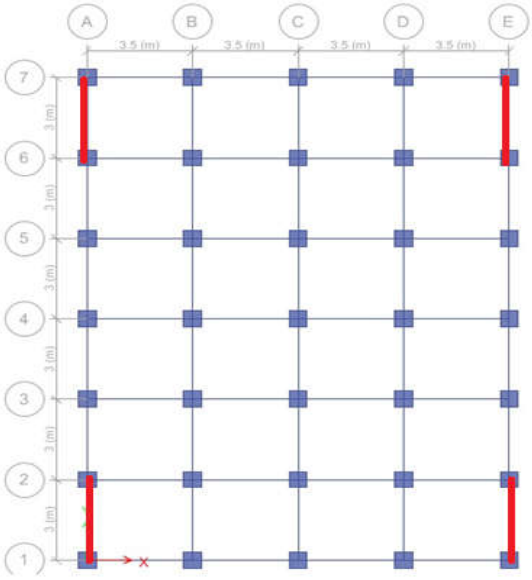

Fig. 5. Type 4 Configuration

It is observed from the graph that maximum storey drift is obtained for storey 3 the value is .015915.Therefore to reduce the storey drift so as to make the structure safe the size of beams and columns are optimized.

The building is analyzed using linear response spectrum analysis and the graph obtained is given below:-

Fig. 6. Storey drift of building without shear wall by linear response spectrum analysis

The optimized size of beam = 350mm X 500mm

The optimized size of column = 450mm X 600mm

The graph below shows the storey drift corresponding to the building without shear wall, type 1, type 2, type 3 and type 4 configuration of building obtained by using push over analysis

From the graph it is clear that building without shear wall has crossed the maximum storey drift value whereas the building with different configuration of shear wall is observed to have a storey drift value within the maximum storey drift limit. Thus the building with shear wall is found to be more safe compared to the building without shear wall.

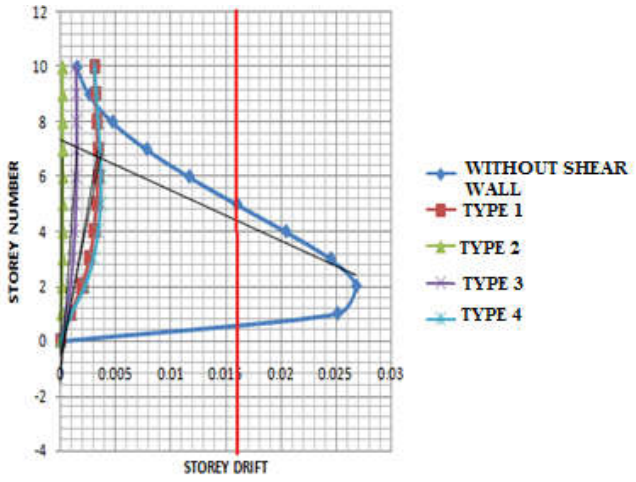

Fig. 7. Storey drift of building with and without shear wall by push over analysis

Table 2. Maximum storey Drift

Building Type	Maximum storey Drift(mm)
Without shear wall	0.02684
Type 1	0.00339
Type 2	0.000194
Type 3	0.001432
Type 4	0.003628

B. Storey displacement

The lateral forces acting on different storey of the building causes a displacement. This displacement is called lateral displacement. It is observed to be maximum at the top storey. The storey displacement of the G+9 building obtained with the help of push over analysis is graphically shown below:-

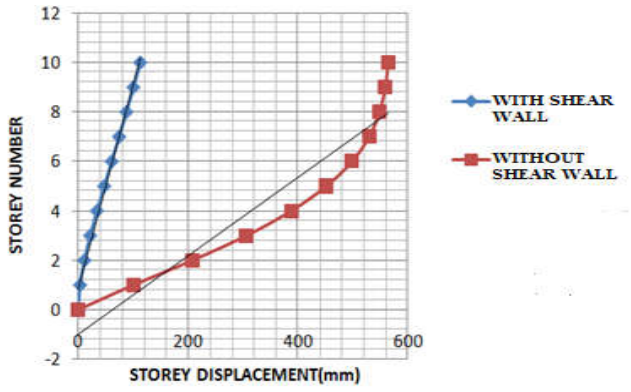

Fig. 7. Storey displacement of building with and without shear wall by using push over analysis

It is observed from the graph that building provided with shear wall is having less lateral displacement compared to the building without shear wall.

C. Base shear

As per IS 1893(Part1) : 2002 base shear is a defined as ‘ an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure”.

The base shear corresponding to different building configurations when the push is applied in the X-direction is given in the graph:-

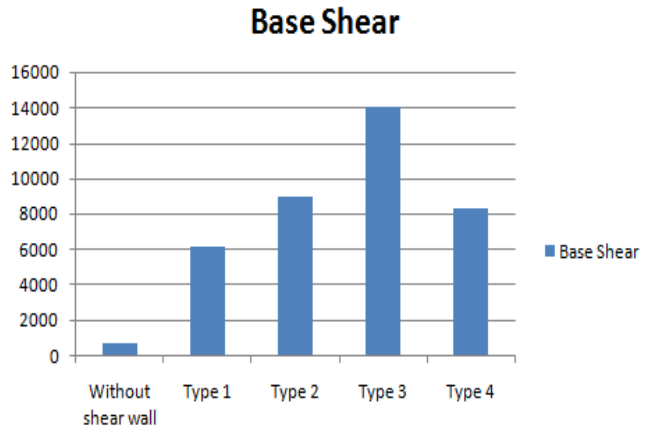

Fig. 8. Maximum Base shear

Table 3. Maximum base shear

Building Type	Maximum Base Shear(KN)
Without shear wall	662
Type 1	6115
Type 2	8976
Type 3	14007
Type 4	8297

Conclusion

From the obtained results it is concluded that building with shear wall helps in resisting lateral force compared to the building without shear wall. It is observed that type 2 building configuration is having the least storey drift value (0.00194) compared to other building configurations. Therefore building with type2 helps in resisting more lateral loads compared to the other building configurations.

REFERENCES

Anshumn. S, Dipedu Bhuia, Bhavin Ramjiyani, 2011. “Shear wall location in Multi-Storey Building.” *International Journal of Civil Engineering*, Vol. 9, No. 2 Pages 493-506.

Anuj Chandiwala, 2002. “Earthquake analysis with different position of shear wall” *International Journal of Emerging Technology and Advance Engineering*. (Dec), volume no.2 ISSN(2250-2459)

IS 1893(Part 1)-2002, “Criteria For Design of Earthquake Resistant Structures” – Part 1 General Provisions And Building”, 5th Revision, 2002, Bureau of Indian standards, New Delhi, India.

Kumbhare, P .S. and A.C. Saoji, 2012. “Effectiveness of reinforced shear wall on multistoried structures” International Journal of Engineering Research and Technology (IJERT) (June), Vol. no-1, ISSN (2278-0181).

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