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Comparative Study on the Shear Wall Location of Multistoried Building

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Abstract – *An Building are designed as per the Indian standard code meeting all specific requirements of code. Eleven storey reinforced concrete structure without shear wall and with shear wall at different locations are considered under the response spectrum method. Total nine numbers of models are created at different locations including without shear wall model. Storey drift, Storey displacement, Storey shear etc. parameters are considered for this study. This study presents the behavior of shear wall at different location.*

Key Words: **Shear wall, Location, ETABS, Dynamic analysis, Response spectrum**

1. INTRODUCTION

India has had a greatest earthquake in the last century. Earthquake can be minor, moderate & strong. On an average annually about 700 earthquakes of magnitude 5.0 – 6.0 occur in the world. The 7.9 magnitude Kutch earthquake (2001) occurred on India's annual republic day. Nearly 20800 people died and 1.66 lakh people were injured. Conventionally, buildings are designed to resist earthquakes which may come only once in 500 years. Design of buildings wherein there is no damage during the strong but rare earthquake shaking is called "Earthquake proof design". Practically no building can be made earthquake proof. Engineers are try to make earthquake resistant buildings. Buildings resists the effect of ground shaking. They may get damaged but not collapse during strong earthquake. The main objective is to resist minor earthquake without damage, to resist moderate earthquake with some non-structural damage and to resist major earthquake without collapse.

The aim of the earthquake resistant design is to have structures that will behave elastically. During major earthquake to avoid collapse structural members must be ductile to absorb energy by elastic deformation. RC buildings have vertical plate like RC walls called shear walls in addition to slabs, beams and columns as per the Figure 1.1. Shear walls are vertical elements of the horizontal force resisting system. These walls generally start at foundation level & are continues throughout the building height. Because reinforcement detailing of walls is relatively straight and easily implemented at site, shear walls are easy to construct. When shear walls are situated with proper opening in the building, they can form an efficient lateral force resisting system by reducing lateral displacements under earthquake.

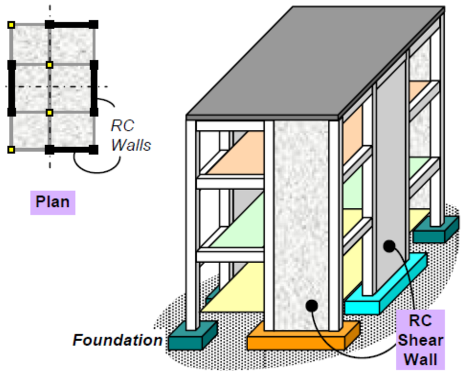

Fig:1 Reinforced concrete shear wall in the building

2. OBJECTIVES

(i) To find optimum location of shear wall by using different parameters like storey displacement, storey drift, storey shear.

(ii) To compare the performance of the building without shear wall to the building having shear wall.

(iii) To study the behavior of building under linear dynamic analysis method.

(iv) Comparative study of individual parameters like storey displacement, storey drift, storey shear for without shear wall building to the building having a shear wall at different locations.

3. LITREATURE VIEW

Kumbhare, Saoji (2012) [1] investigated the effectiveness of changing reinforced concrete shear wall location on multi storied building using five numbers of model. Model one was without shear wall, model two was dual type structural system with shape of shear wall, third and fourth model was L type of shear wall and rectangular shape of shear wall respectively and model six was box type of shear wall using different parameters like displacement and storey drift, storey shear, shear force and bending moment. They have concluded that, constructing without shear wall is more economical compared to dual type structural system in building.

Chandurkar, Pajgade (2013) [2] investigated the seismic analysis of RC building with and without shear wall using four numbers of model. Model one was without shear wall, model two was shear wall on each side, third and fourth model was at corner with different length which is 4.5m and 2m respectively. Using rectangular shear wall using different parameters like displacement and storey drift. They have concluded that, constructing shear wall in shorter span at corner is more economical in building. Storey drift is maximum for model one then other models.

Baral, Yajdani (2015) [3] analysed RC framed building for different position of shear wall. They have prepared five models. Model one was without shear wall, model two was shear wall on each side on middle, model third was at corner with 3m length on each side, model four was in the center and model five was at corner extending 1.5m length on each side using different parameters like displacement and storey drift, shear force and bending moment etc. for static and dynamic analysis method. They have concluded that, Story drift of model three was lower than other models. Displacement was higher than other models for model one for both static and dynamic analysis.

Magendra, Titiksh, Qureshi (2016) [4] investigated optimum positioning of shear walls in multi-storey buildings using five numbers of models using different parameters like stroey displacement, storey drift, storey shear, storey overtuning moment. Model one was without shear wall, model two was shear wall at periphary at corners, model three was shear wall at periphary at centres, model four was box type shear wall at centre of the geometry. They have concluded that model four gave better performance than other models in terms of storey drift and storey displacement and storey shear parameters.

Patwari, Kalurkar (2016) [5] investigated the shear wall locations with flat slab and its effect on structure subjected to seismic effect for multistorey building using six numbers of models using time history method including displacement, base shear, acceleartion, time period parameters. Model one was without shear wall, model two was structure with flat slab, model three was with core shear walls, model four was with shear wall at outer periphery, model five was with shear wall right angled and model six was with core shear wall torsion mode. For model four story displacement is minimum. It is 29.13 % and 10.06 % less than L type shear wall model in terms of displacement.

Mishra, Singh (2018) [6] discovered the optimization of shear wall in irregular multistoried buildings. They have prepared five models for the analysis. They have taken H shape for analysis using different parameters like displacement, storey drift. They have concluded that model five shows better performance in terms of displacement and storey drift.

Nayel, Abdulridha, Kadhum, (2018) [7] investigated the effect of shear wall locations in RC multistoried building using four numbers of model. Model one was without shear wall and other models were at corner, at side and in the middle respectively using rectangular shear wall using different parameters like displacement and base shear. They have concluded that, in terms of displacement without shear wall (model one) was given better performance and in terms of base shear. Shear wall in the middle (model two) was given better performance than other models.

4. METHEDOLOGY

4.1 MODELLING OF BUILDING

Here the study is carried out for the behavior of G+10 storied reinforced concrete building with shear wall in regular plans. Floor height provided 3m. And also the properties are defined for the structure.

4.2 BUILDING PLAN AND DIMENSION DETAILS

The Following are the specification of G+ 10 storied reinforced concrete building located in seismic zone IV resting on medium soil type. Table no. 1 shows the different shear wall location model number and their notations. Table no. 2 shows considered parameters for building. Buildings modelled using ETABS are shown in Fig: 2 to Fig:10.

Table -1: Model number and their notations

Model No	Notations
1	WSW
2	SWIV 5m
3	SWOH 6m
4	SWIV 5m and 4m
5	SWIH 5m and 4m
6	SWI 4m H and V
7	SWV 5m and 4m I and O
8	SW H and V 5m I and O
9	SWI 5m and 4m H and V

Table -2: Considered Parameters

Parameter	Values
Concrete grade	M25
Steel grade	Fe 500
Thickness of slab	125mm
Dimension of beam	230mm X 425mm
Dimension of column	600mm X 600mm, 300mm X 600mm 300mm X 750mm 300mm X 900mm
Floor height	3000 mm
Shear wall thickness	230 mm

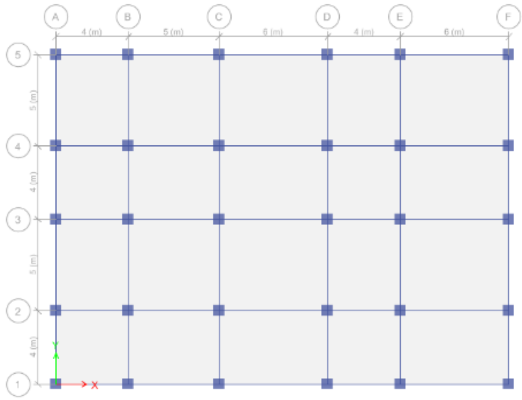

Fig 2: WSW model

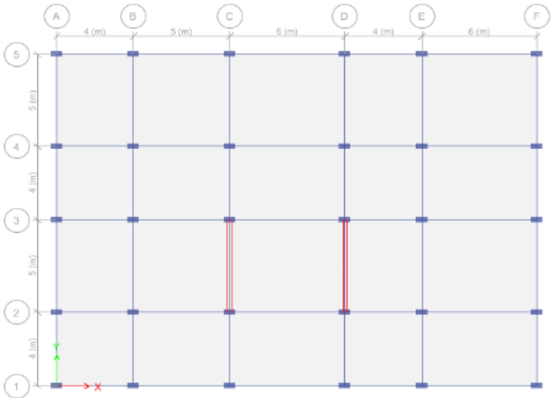

Fig 3: SWIV 5m model

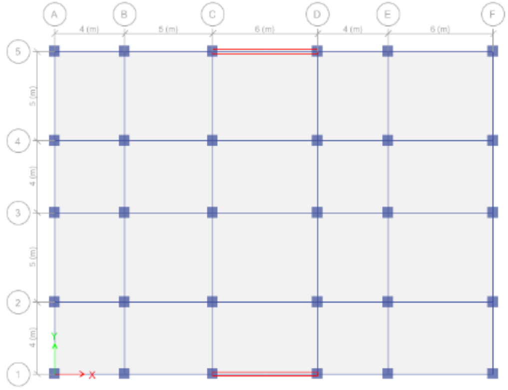

Fig 4: SWOH 6m model

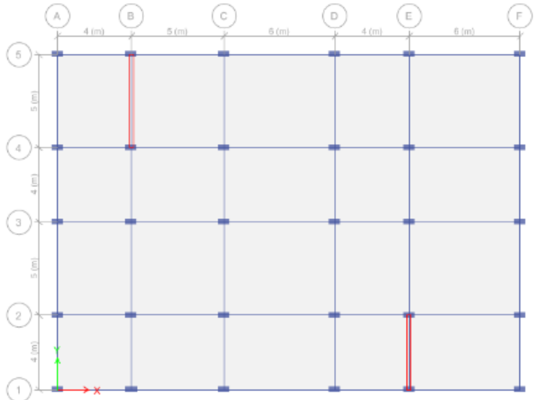

Fig 5: SWIV 5m and 4m model

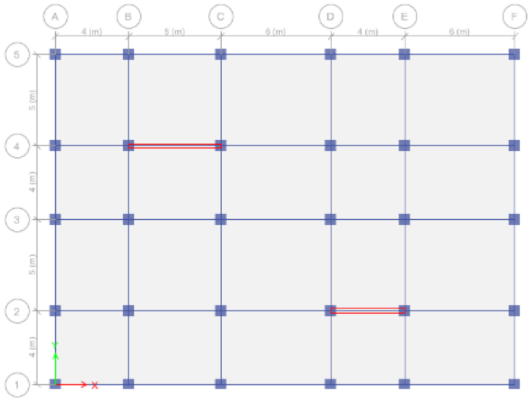

Fig 6: SWIH 5m and 4m model

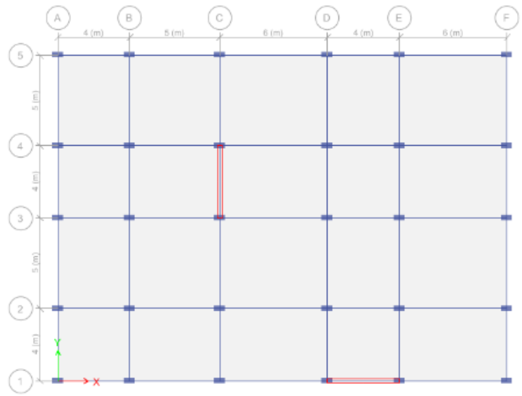

Fig 7: SWI 4m H and V model

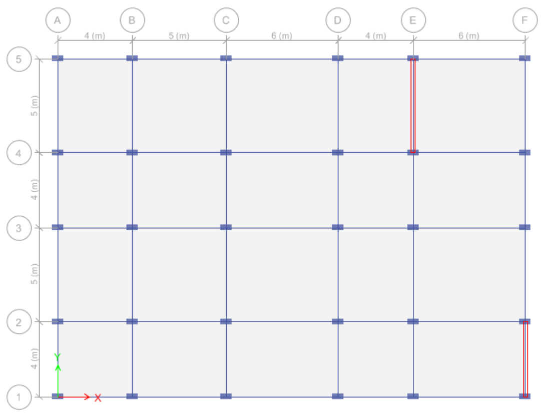

Fig 8: SWV 5m and 4m I and O

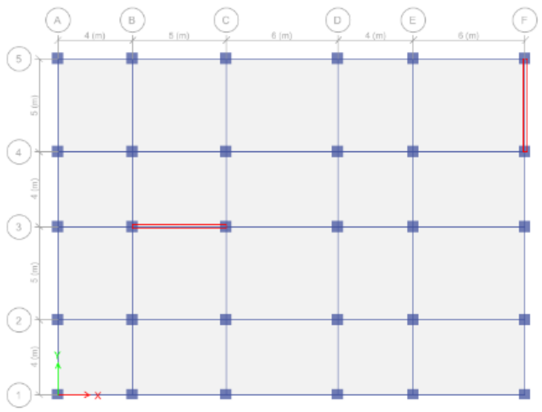

Fig 9: SW H and V 5m I and O

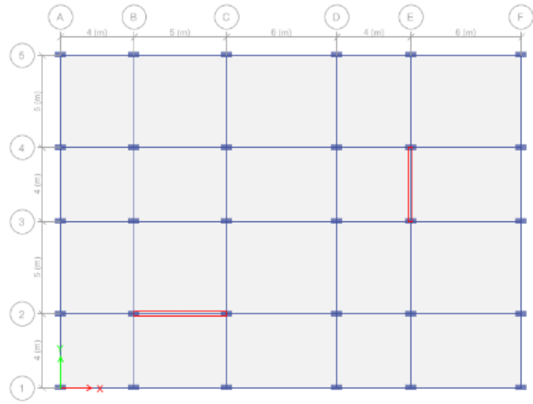

Fig 10: SWI 5m and 4m H and V

4.3 ASSIGNING LOADS

- Floor finish
  Floor finish intensity = 2 kN/m^2
- Live load
  Live load intensity= 3 kN/m^2

5. SEISMIC ANALYSIS OF BUILDING

Seismic parameters are considered as per IS 1893(Part 1):2016as per Table no. 3

Table -3: Seismic properties

Seismic Properties	As per IS 1893:2016
Seismic Zone	0.24 (IV)
Response Reduction Factor	5 (SMRF)
Importance Factor	1.2
Time period	1.032

6. RESULTS

6.1 STOREY DISPLACEMENT

Graphical representation of displacement values for all models as shown in Chart 1 and Chart 2.

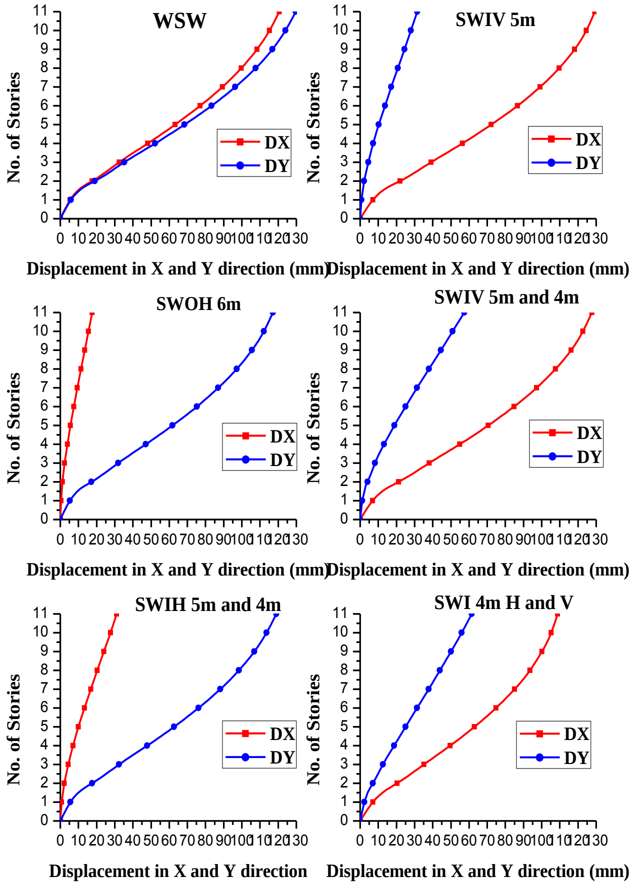

Chart1: Displacement graph of Model 1 to model 6

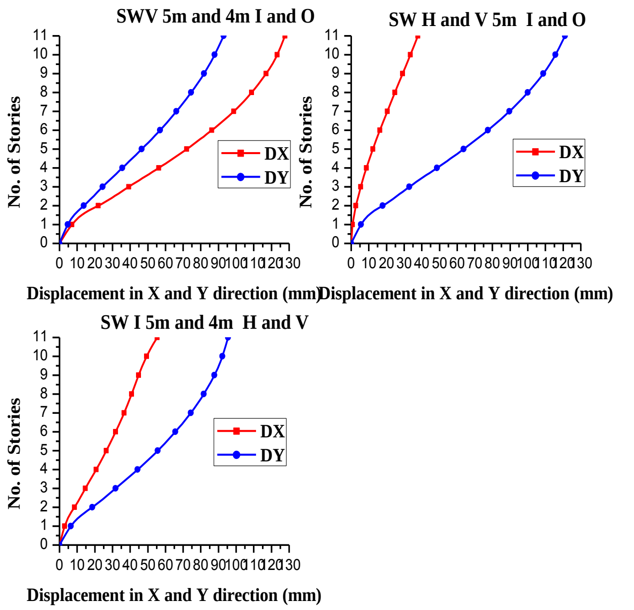

Chart:2 Displacement graph of Model 7 to model 9

6.2 STOREY SHEAR

Graphical representation of storey shear values for all models as shown in Chart 3.

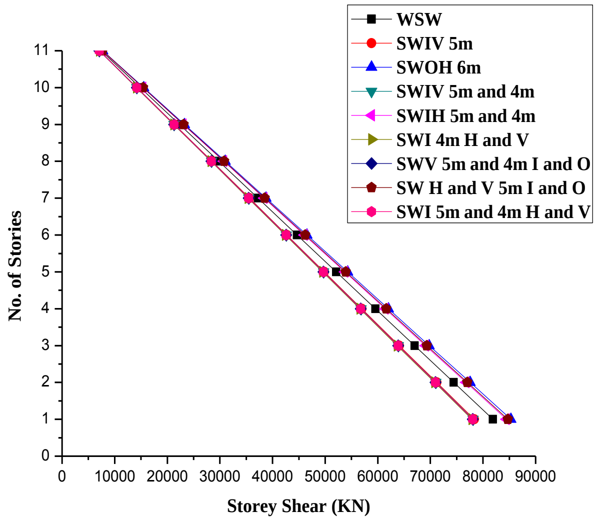

Chart 3: Storey shear for all model

6.3 STOREY DRIFT

Graphical representation of storey drift values for all models as shown in Chart 4 and Chart 5.

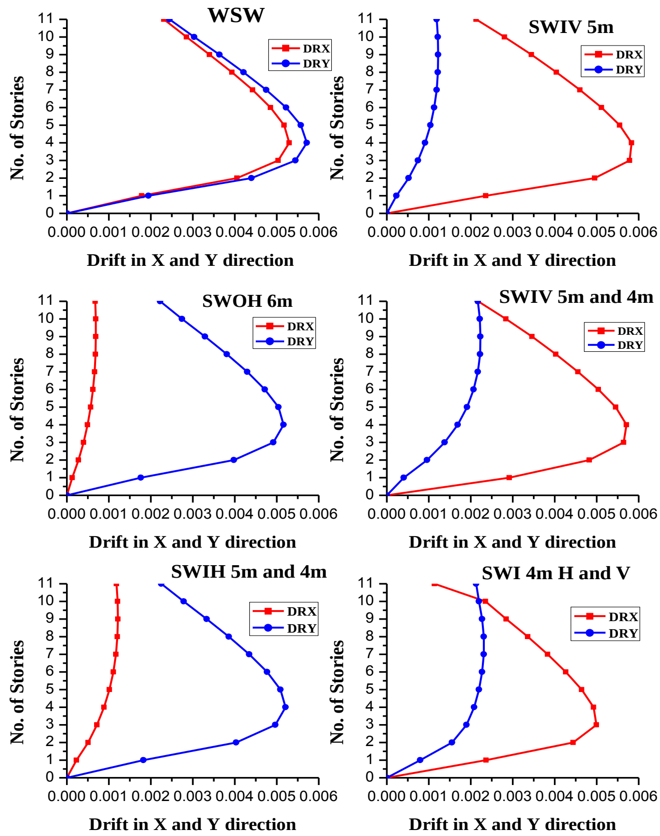

Chart 4: Drift graph of Model 1 to model 6

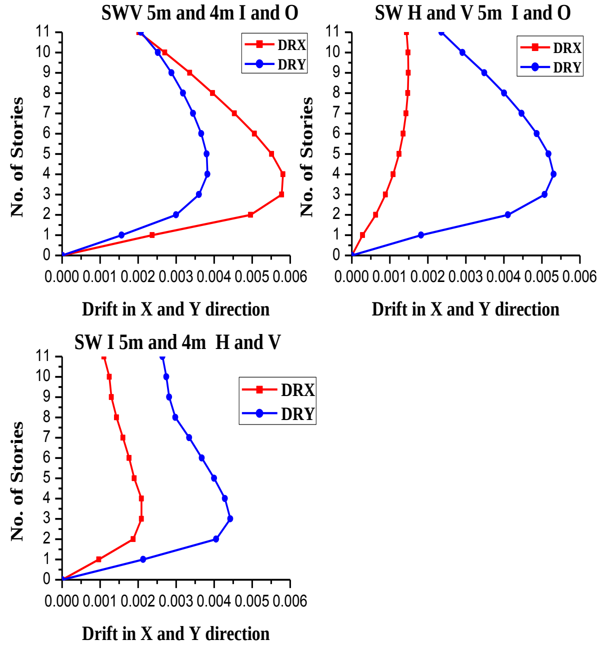

Chart 5: Drift graph of Model 7 to model 9

7. CONCLUSIONS

The present study focuses to determine effectiveness of shear wall location under earthquake loads with the help of finite element software, ETABS. From the above study, following conclusions were drawn.

- It is observed that shear wall in the inner core of the system of 5m length in the vertical direction (SWIV 5m) (Model 2) have 83% less displacement, when compared with without shear wall (WSW) (Model 1) in Y direction in terms of displacement parameter.
- It is observed that shear wall in the outer core of the system of 6m length in the horizontal direction (SWOH 6m) (Model 3) have 87% less drift, when compared with without shear wall (WSW) (Model 1) in X direction in terms of drift parameter.
- It is observed that shear wall in the inner core of the system of 5m length in the vertical direction (SWIV 5m) (Model 2) have 79% less drift, when compared with without shear wall (WSW) (Model 1) in Y direction in terms of drift parameter.
- Location of shear walls in outer core is more suitable while providing in X direction and for Y direction location of shear walls in inner core is more suitable.
- It is observed that shear wall in the inner core of the system of 5m length in the vertical direction (SWIV 5m) (Model 2) showed better performance than other models in terms of storey shear

Hence we can conclude that shear wall in the inner core location is more suitable for Y direction and for X direction outer core location is more suitable.

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