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Seismic Response Control of Multi-Storey Using Shear Wall.

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Abstract:- Shear walls are the most commonly used component in high rise building. This is one of the most important and appropriate members used in the building situated in high seismicity areas. Shear walls provide high strength and stiffness to the building and increase the stability of the structure. It is basically designed to resist the lateral forces acting on a building. Shear walls are very helpful for resisting lateral loads in the structure. In this project, G+8 storied structure is taken and the shear wall is provided. In this study 4 models are taken among which 1 model, no shared wall is provided or we can say it is a bare frame structure, while in other model shear walls are provided at different locations of the structure likely at corners, at the core, at side bays. The structure is considered as situated in zone-V. In this study, the modelling and result comparisons are done by using STAAD PRO V8i Software. One comparison is done between the structure without shear wall and with shear wall and another comparison is done among the structure with the shear wall at different locations of the building. Different parameters like shear force, lateral displacement and bending moment are compared according to the positions of the shear wall in the structure.

Keywords- Shear wall, Lateral forces, Shear force, Lateral displacement, bending moment.

1) Introduction:

An open ground storey building which is also known as soft storey building is most commonly used in urban areas where people used to provide parking space at ground floor and the upper floors of the building are used for residential and commercial purpose. Due to no infills between the columns on the ground floor, this building shows a higher possibility to collapse during the period of the earthquake. Nowadays, the high rise building is majorly in demand, but the lateral forces acting on the high rise building increases the possibility of collapsing. The major portion can be resisted by using the shear wall in the building. Shear walls are one of the most economical and prominent structural systems to resist the seismic forces in the reinforced concrete building. In high seismic zones, the RC shear wall is widely in use because it provides high lateral stiffness and resists up to large extent against the seismic effect. India has a wide history of major earthquakes. According to geographical statics, around 54% of the land in India is vulnerable to the earthquake. Basically, India is categorized into 4 seismic zones on the basis of the seismicity level of the area. The 4 zones are: zone-2, zone-3, zone-4, and zone-5. In which zone-2 is the lowest level seismicity and zone-5 is the highest level seismicity.

2) Numerical Study:

This study is done to understand the behaviour of the structure only with a bare frame and with the infilled frame using the shear wall at different locations. In this project, the shear wall is being modelled by surface meshing.

In the current project, the shear wall is provided at three different locations and then the best location of shear for the structural stability is determined on the basis of axial force and lateral displacement in columns. The comparison has also done between bare frame without shear wall and with the bare frame with the best location of the shear wall. The wind loads and earthquake loads assigned to the structures are determined with respect to provisions given in IS 875 (Part-3) and are 1893 (Part-1) respectively.

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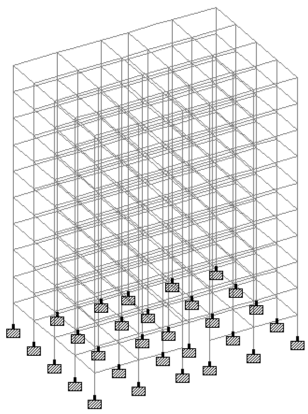
2.1) Description of the Building

In this study, a Reinforced Concrete Structure is selected. The model is designed by own for the study purpose. The symmetrical layout is considered with G+8 stories has the symmetrical layout and consists of nine stories with each storey height of 3 m.in Y-direction. Floor plan of all models is rectangular with a length of 25m. in X-direction and width of the model is 15m. In Z-direction. In the models, the X-axis has 5 bays of 5m each. And the Z-axis has 3 bays of 5m each. The height of the structure is 18m with 9 bays of 3m each.

a) The building is located in Seismic Zone V.
b) The number of bays in x and Z-directions is 5 and 3 respectively.
c) The spacing between bays x and Z-directions is 5m.
d) The spacing between bays in the y-direction is 3m.
e) The grade of concrete used is M 25 and the grade of steel used is Fe 415
f) Floor to floor height is 3 m
g) Slab depth is 125 mm.
h) Size of columns is 230 mm × 600 mm.
i) Size of beams is 230 mm × 450 mm. , 150mm × 300mm.
j) The external wall is 230 mm and the thickness of the internal wall is 115 mm.
k) Live roof load is 1.5 KN/m2.
l) Live load on floors is 3 KN/m2.
m) Roof finish load is 1.5 KN/m2.
n) Floor finish load is 1 KN/m2.
o) Importance factor is taken as 1.
p) Unit weight of RCC is 25 KN/m3.
q) The thickness of the Shear walls is 230 mm.
r) The elastic modulus of a brick masonry wall is 22360 MPa
s) Modulus of concrete is 25000 MPa.
t) Damping of the structure is taken as 5%.
u) Spectra are taken as per IS 1893 (Part-1): 2016.
v) The building is resting on medium soil.

2.2) Four models have considered for the study:



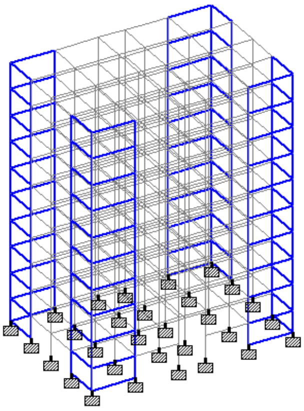
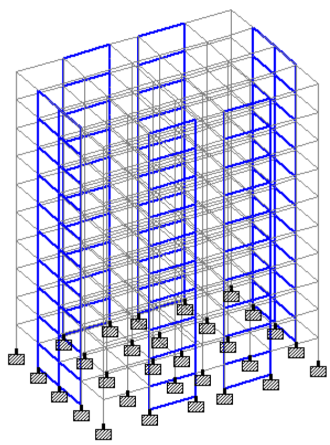


Fig.1.1.BareFrame. Fig.1.2.ShearWall at Corner.



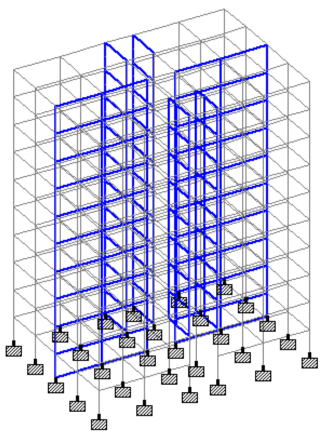


Fig.1.3.Shear Wall at Middle. Fig.1.4.Shear Wall at Periphery.

Comparisons were done between bare framed Structure i.e. the model without a Shear wall, a model with the shear wall at the corner, a model with the shear wall at outer and model with the shear wall at the core (4 MODELS).

3)Result Analysis of G+8 storey building

3.1) For the Comparison in Model 1, Model 2, Model 3 and Model 4 Corner and Middle Column are selected as shown in fig. below.

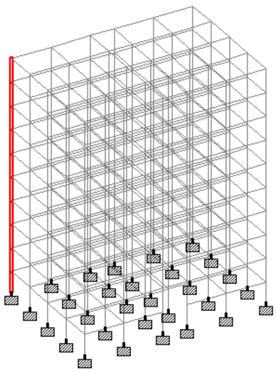


Fig.2.1 Corner Column Position

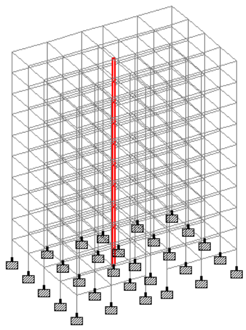
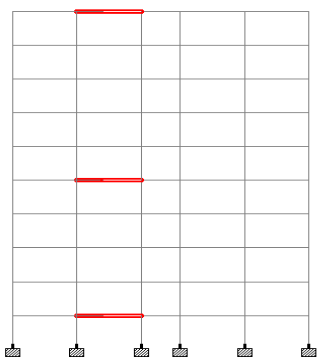


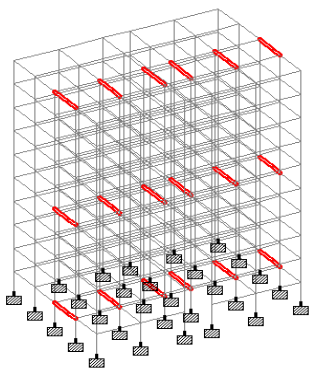
Fig.2.2 Middle Column Position

Table – 1: Comparison Of Bending Moment, Shear Force And Deflection For Corner And Middle Columns Of The Structure

COLUMNS	BENDING MOMENT (KN-m)			
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
CORNER	58.12	**0.514**	38.94	55.23
MIDDLE	55.39	53.23	36.88	**14.62**
COLUMNS	SHEAR FORCE (KN)			
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
CORNER	-31.82	**0.18**	-22.01	-30.41
MIDDLE	33.03	31.81	22.83	**8.164**
COLUMNS	DEFLECTION (mm)			
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
CORNER	6.24	**2.106**	4.31	5.466
MIDDLE	12.03	11.181	10.698	**3.937**

3.2) For the Comparison in Model 1, Model 2, Model 3 and Model 4 Top, Middle and Bottom Beam are selected as shown in fig. below.





This is the positions of the top, middle and bottom beams.

Table – 2: Comparison Of Bending Moment, Shear Force And Deflection For Top, Middle And Bottom Beams Of The Structure.

BEAM	BENDING MOMENT (KN-m)			
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
TOP FLOOR	95.89	82.52	**48.825**	120.78
MIDDLE FLOOR	78.13	66.05	**62.92**	91.566
BOTTOM FLOOR	13.12	10.213	**9.77**	14.737
BEAM	SHEAR FORCE (KN)			
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
TOP FLOOR	-81.36	-76.93	**-43.89**	-107.21
MIDDLE FLOOR	-65.57	-61.07	**-59.69**	-71.558
BOTTOM FLOOR	-11.26	-10.06	**-9.92**	-11.913
BEAM	DEFLECTION (mm)			
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
TOP FLOOR	12.83	10.81	**9.072**	10.07
MIDDLE FLOOR	8.804	7.39	**6.82**	7.387
BOTTOM FLOOR	1.78	1.43	**1.31**	1.566

4) Conclusions:

Dynamic analysis of RC frame is performed using a seismic coefficient method as per IS code 1893:2016 for G+8 storied RC framed structure with and without the shear wall at different locations. Some of the main observations and conclusion are as follows:

I. Base Shear value of the structure with the shear wall is higher as compared to the bare frame.

II. The other parameters like Bending Moment, Deflection and Shear Force of thee structure with Shear Wall have less value as compare to Bare frame.

III. In corner column, the Bending Moment, Deflection and Shear Force value are least with the structure having Shear Wall at Corner.

IV. In the Middle column, the Bending Moment, Deflection and Shear Force value are least with the structure having Shear Wall at Core.

V. The least value of the Bending Moment, Deflection and Shear Force in the Beams at all floors with the structure having Shear Wall at Periphery.

This study shows that the shear walls in the seismic analysis of the structure significantly increases the strength of the overall frame and decreases the probability of collapse of the structure. The presence of the shear wall majorly affects the behavior of the structure by increasing its strength and stiffness.

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