Effect of Shear wall Geometry on Ten Storey Building with Raft and Fixed base foundation

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Abstract::Raft foundation is widely used for high-rise buildings where presence of shear wall is very common. Shear Wall resists a major portion of the lateral load of high-rise buildings. So, presence of shear wall on mat foundation causes significant change in pattern and intensity of loading on mat foundation. The present work involved an investigation of effect of shear wall geometry in different seismic zones with and without the presence of raft foundation. Multi storey building with ten storey is analysed for the storey drift, storey displacement and base shear. The analysis of building is done by response spectrum analysis. The different shapes of shear walls C,L,F,I with same plan area is considered. The effect of shear wall geometry is studied in zone II, zone III, zone IV, zone V. Loads and load combinations selected based on IS 456-2000 and IS 875-1987 code. Three types of soil conditions are considered type I, type II, type III. Raft foundation is designed by meshing the slab into equal quadrilaterals. Assigning of the area springs to the each quadrilateral. Meshing is done inorder to convert the infinite solution into finite solution. The different shapes of the shear wall is analysed in zone V with the raft foundation in type I. The results are compared with and without the raft foundation, conclusions are drawn that the best shape of the shear wall suits in different seismic zones.

Index Terms: Shear walls, Response spectrum analysis, Raft foundation.

I. INTRODUCTION

In building construction a rigid vertical diaphragm capable of transferring lateral forces from exterior walls, floors and roofs to the ground foundation in a direction parallel to their planes. Examples are the reinforced concrete wall. Lateral forces caused by wind, earthquake and uneven settlement loads, in addition to the weight of the structure and occupants create powerful twisting forces. This lead to the failure of structure by shear. Shear walls are especially important in the high-rise buildings subjected to the lateral wind and seismic forces. Generally shear walls are either plane or flanged in section while core walls consists of channel sections. They also provide adequate strength and stiffness to control lateral displacements. The shape and plan position of shear wall influences the behaviour of the structure considerably. Structurally, the best positions for the shear walls is in the centre of each half of the building. This is rarely practical, since it also utilizes the space a lot, so they are positioned at the ends it is better to use wall with no openings in them. So, usually the walls around the lift shafts and stair wells are used.

Also walls on the sides of buildings, that have no windows can be used. Different types of shear walls are used C,L,F,I.

II. OBJECTIVES

1. To compare the different types of the zones with the different shapes of the shear walls of zone II, zone III, zone IV, zone V
2. Response spectrum analysis is performed for the above parameters and comparing the storey shear, story displacement, story drift.
3. Introduction of raft foundation in zone V on type 3 soil
4. To carry out the graphs storey displacement, storey drift storey shear.

III. MODELLING AND ANALYSIS

| Parameter                | Value     |
|--------------------------|-----------|
| Height of the building   | 30m       |
| No. of stories           | 10        |
| Height of each storey    | 3m        |
| Grade of concrete        | FE415     |
| Grade of steel           | M30       |
| Depth of slab            | 300 mm    |
| Size of the beams        | 400x400 mm|
| Size of the column       | 700x800 mm|
| Shear wall thickness     | 300 mm    |
| Plan area                | 576 m²    |

Building details

ANALYSIS IN ZONE III

Table 2.1 building dBuilding models

| Model 1 | model 2 |
|---------|---------|
| ![Model 1](image1.png) | ![model 2](image2.png) |
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Model 3 and 4

Figure 2.1 plan models of different shapes of shear walls

Design of raft foundation in ETABS
1. Meshing of thick slab into 20X20 cm quadrilaterals
2. Thickness of slab 450mm

Figure 2.2 raft foundation
Figure 2.3 meshing

IV. RESULTS AND DISCUSSION ANALYSIS IN ZONE II

Figure 3.1 that L shape shear wall has maximum storey drift in both X and Y directions than other type of shear walls. I and F shape shear wall shows more drift in Y direction compared to X direction. C shape shear wall shows min difference in the x and y directions.

Figure 3.2 F shape shear wall shows maximum displacement and C shape shows minimum displacement. L and I shape shows similar results.

Figure 3.3 max storey shear is shown by C shape and min storey shear is shown by both F and I shape shear wall

Figure 3.4 F shape shear wall shows max storey drift and L shape shows minimum drift

Figure 3.5 F shape shear wall shows max displacement and L and I shape shear wall has more displacement in y direction compared to x direction. C shape shear wall has more displacement in x direction compared to L and I shape

Figure 3.6 that in x direction C shape has max displacement and I shape has minimum displacement. In the terms of y direction C shape has max displacement and I shape has minimum displacement.
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Figure 3.7 shows that in x direction F and I shape shows max drift and in the y direction C, F, I shows max displacement. L shape shear minimum displacement both in terms of x and y directions.

Figure 3.8 shows that in x direction F shape shows max displacement and L shape shows minimum displacement. In the y direction F and C shows max displacement and L shape shows minimum displacement.

Figure 3.9 shows that in x direction I and L show max storey shear and in the y direction I shape shows max storey shear and F shape has minimum storey shear.

Figure 3.10 shows that in x direction I shape shows max drift, in the y direction max drift shown by F shape and minimum drift shown by C and L shape shear walls.

Figure 3.11 shows that in x direction F shape shows max storey displacement and I shape shows minimum displacement.

Figure 3.12 shows that in x direction I shape shows max storey shear and C shape has min storey shear. F, L does not show much difference in both x and y direction.

Figure 3.13 shows that in x direction I and F shape max displacement and minimum displacement is shown by L shape. In y direction I shape shear wall shows max displacement and minimum displacement is shown by shape shear wall. C shape shear wall good results in x and y.
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Figure 3.14 that in x direction I and F shape has max storey drift and L shape shear wall has minimum storey drift. In the y direction I shape has max storey drift and L shape shows minimum storey drift. C shape shows max storey drift in y direction and minimum drift in x direction.

Figure 3.15 in I and f shows max shear and l shape shear shows min storey shear. In the y direction f shape has max shear and l shows min storey shear. C shape also shows min in x and max in y direction.

V. CONCLUSIONS

1. L shape shear shows better results in all the 3 cases in storey drift, storey displacement, storey shear.
2. From the storey displacement point of view, L shape shows that the displacement is prevented on an average of 50 to 60% using the raft foundation compared to without using the raft foundation.
3. Using the raft foundation the storey shear with L shape shear wall is reduced by 40 to 45% compared to the foundation with no raft foundation.
4. Finally L shape shear wall is preferred in high risk earth quake zones.

REFERENCE

1. Anand N. and Mightraj C. “Seismic behavior of RCC shear wall under different soil conditions” GEO trendz, Indian Geotechnical Conference, IGC2010, IIT Bombay, December 16-18, 2010.
2. A. Boominathan, G. R. Dodagoudar, A. Suganthi and R. Uma Maheswari “Seismic Hazard Assessment Considering Local Site Effects for Microzonation Studies of Chennai City” A Workshop on Microzonation ©Interline Publishing, Bangalore.
3. A.D. Pandey, Prabhat Kumar and Sharad Sharma “Seismic soilstructure interaction of buildings on hill slopes” Journal of Civil and Structural Engineering, 2011.
4. A.D. Shirhatti and Dr. S.S. Quadri “Seismic response analysis of RC frames considering soil structure interaction” Proceedings of Indian Geotechnical Conference December 22-24, 2013, Roorkee.
5. Bhattacharya, K., Dutta, S.C., and Dasgupta, S. (2004). “Effect of soil flexibility on dynamic behaviour of building frames on raft foundation” Journal of Sound and Vibration, 274, pp. 111–135.
6. Dutta, S.C., Maiti, A., Moitra, D. (1999). “Effect of soil-structure interaction on column moment of building frames” Journal of Institution of Engineers (India).