SEISMIC ANALYSIS OF RC BUILDINGS WITH AND WITHOUT SHEAR WALLS

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Abstract: A difference is made to understanding difference between brick infill wall and an shear wall. When a structure is subjected to lateral loading with ordinary brick infill it will undergoes more deformation comparatively shear wall. In this work considering two models one is RC Building with shear wall and other is RC Building brick wall, both buildings are with 21 storey's each story 3m height. The results are time periods, storey drifts and storey shears are compared with two different models by using SAAP software. To obtain the results Response spectrum and time history analysis are used.

Key Words: Shear walls, Response Spectrum analysis, and SAAP software.

I. INTRODUCTION

A fundamental economic driver for the growth of tall (particularly residential) buildings is the scarcity of land in the densely urbanized parts of the world. The competition for constructing the tallest building in a city, country, region or the world has acted as another driver for the growth of tall buildings worldwide. A building can be characterized as "tall" based on its absolute height, its relative height to the surrounding, or its slenderness. The Council on Tall Buildings and Urban Habitats designates heights of 200m, 300m and 600m as the thresholds for "tall", "super tall" and "mega tall" status (CTBUH 2010). From a structural engineering point of view, as high-rise buildings get taller and more slender, their design becomes increasingly (and differential axial shortenings of the vertical elements of tall buildings under gravity load effects. RCC tall buildings are adequate for resisting both the vertical and horizontal load. When such building is designed without shear wall, beam and column sizes are quite heavy and there is problem arises at these joint and it is congested to place and vibrate concrete at these places and displacement is quite heavy which induces heavy forces in building member. Shear wall may become essential from the point of view of economy and control of horizontal displacement. The residential medium rise building is analyzed for earthquake force by considering two type of structural system .i.e. Frame system and Dual system. Effectiveness of shear wall has been studied with the help of four different models. Model one is bare frame structural system and other four models are dual type structural system. Analysis is carried out by using standard packages SAAP

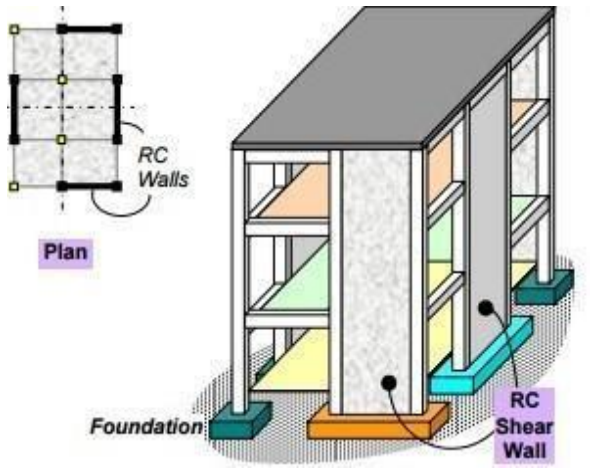


Figure:1 Shear Wall Model (Internet)

Objectives of the work

The main objective of this study is to

To analyse the response of RC building subjected to lateral loading by using SAAP software.

To study the behavior of the building by providing shear wall at different positions in the RC fram.

To design the building with shear wall and analysis of time history method and response spectrum method is done.

II. MODELINGAND ANALYSIS

The Rcc structure is consist of columns, beams and slab. The distance between the column to column is 5 m in x-direction and 5 m in y-direction. the overall dimensions of the structure is 20 m*15 m. column dimensions are 800*600 mm for (G)and(G+1) and 500*500 mm for remaining stories , beam dimensions are 500*300 mm and thickness of slab is 200 mm. plan of the RC structure without shear wall

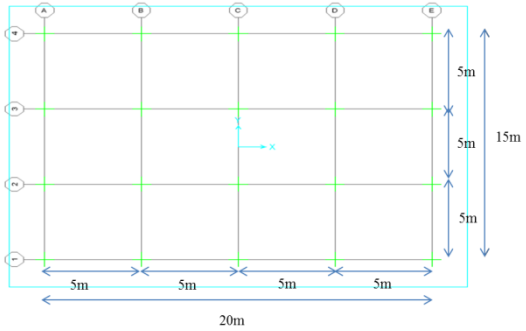


Figure: 2 Plan of the Building

Building Details

The building considered here is commercial building having G + 21 storied located in seismic zone III and I and for earthquake loading, the provisions of the IS: 1893(Part1)2002 is considered. The plan of building is shown in fig. the building is planned to facilitate the basic requirements of commercial building. The plan dimension of the building is 20 x 15 m. Height of each storey for composite and RCC is 3.3m. The floor plans were divided into three by three bays in such a bay that center to center distance between two grids is 5 meters by 5 meters respectively. The study is carried out on the same building plan for building with shear wall and without shear wall building constructions. with some basic assumptions made for deciding preliminary sections of both the structures. The basic loading on both types of structures are kept same

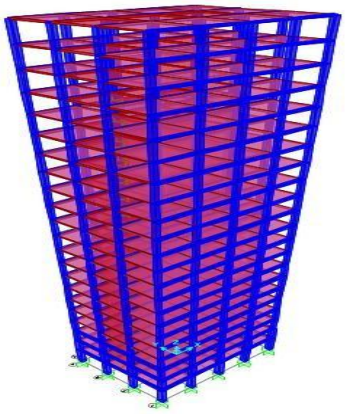
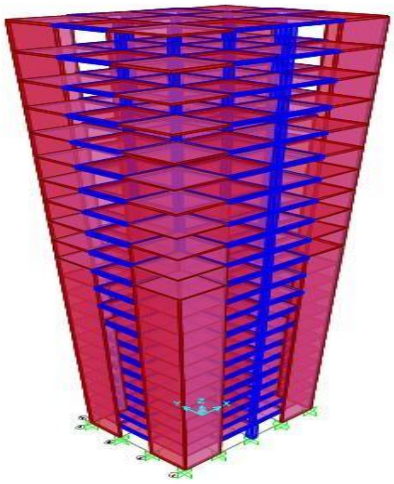


Figure:2 Building Model Without Shear Wall



Building Model With Shear walls at corners

III. RESULTS AND DISCUSSION

A detailed examination of the related literature in the form of journals and official documents was performed to study the pattern of migration and retention. Reinforced concrete building can adequately resist both horizontal and vertical load. Whenever there is requirement for a multi storey building to resist higher value of seismic forces, lateral load resisting system such as shear wall should be introduced in a building. Vertical plate like RC wall introduced in building in addition to beam, column and slab are called shear wall. Shear wall can be provided both along the length and width of the building. Properly designed building with shear wall has shown good performance in past earthquake.

Bar diagram

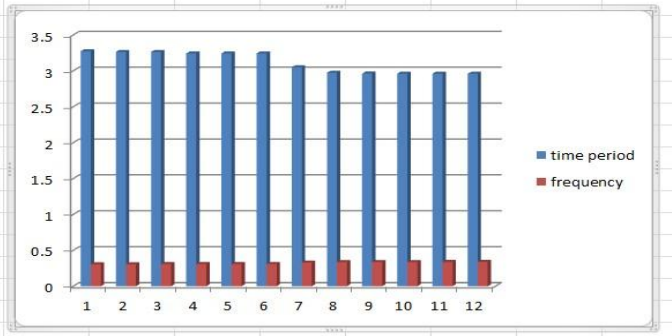


Figure 5: Bar chart of time period and frequency

This bar chart shows the different mode shapes with time period and frequencies of the building with shear walls in different position .it shows that as the time period decreases from mode shape1 to mode shape shape12 simultaneously frequency increases from mode shape 1 to mode shape 12. in other words time period is inversly proportional to frequency.

Time period results of RC building with shear wall

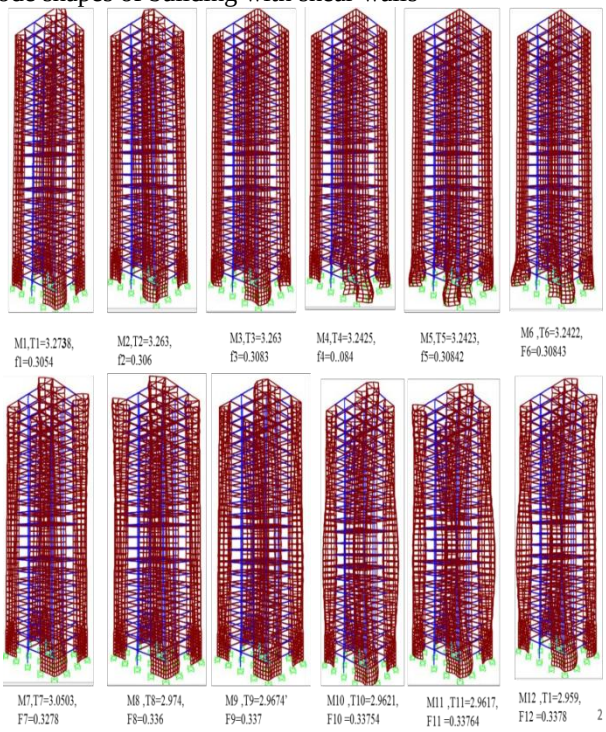
The below table shows the results of the RC building with shear wall in different position.in this table the values of the mode shapes are shown. The time period and frequency values are discussed below.

S.No	Time Period Frequency	
1	3.2738	0.3054
2	3.263	0.306
3	3.263	0.3083
4	3.2425	0.3084
5	3.2423	0.30842
6	3.2422	0.30843
7	3.0503	0.3278
8	2.974	0.336
9	2.9624	0.3375
10	2.9621	0.33754
11	2.9617	0.33764
12	2.959	0.3378

Time Period and Frequency Results

This table shows the time period and frequency of the building without shear wall in different positions. maximum time period is 3.2738sec and minimum is 0.2959sec. where as the maximum frequency is 0.3054sec and minimum is 0.3378sec.the time period of the structures dicreases from mode shape1 to mode shape12.where as the frequency increases for mode sapes1 to mode shape12.it shows time period is inversly proportional to frequency.

Mode shapes of building with shear walls



Mode Shapes of Building with Shear Wall

This mode shapes shows the maximum frequency and the time period of the building with shear walls in different positions. Fig-5.2 shows the frequency of and the time period. whereas the figure shows the different mode shapes of the structure with shear wall. They are twelve mode shapes are obtained and discussed.

Time period and frequency of rcc building without shear wall:

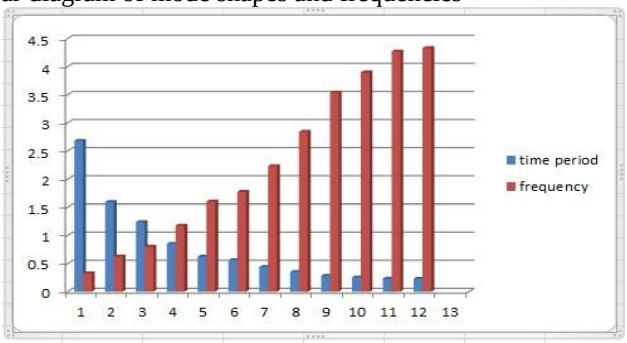
Time period and frequency results

S.No	Time Period Frequency	
1	2.683	0.327
2	1.595	0.626
3	1.24	0.801
4	0.85	1.175
5	0.6236	1.603
6	0.563	1.775
7	0.44	2.234
8	0.351	2.844
9	0.282	3.54
10	0.255	3.9
11	0.2329	4.27
12	0.23	4.33

Time period and frequency results

This table shows the time period and frequency of the building with shear wall in different positions.maximum time period is 2.683sec and minimum is 0.23sec. where as the maximum frequency is 4.33sec and minimum is 0.327sec

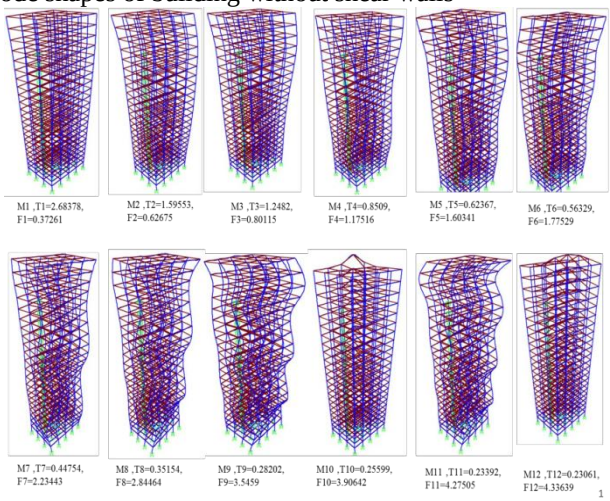
Bar diagram of mode shapes and frequencies



Bar chart of time period and frequency

This bar chart shows the different mode shapes with time period and frequencies of the building without shear walls.it shows that as the time period decreases simultaneously frequency increases. in other words time period is inversly proportional to frequency

Mode shapes of building without shear walls

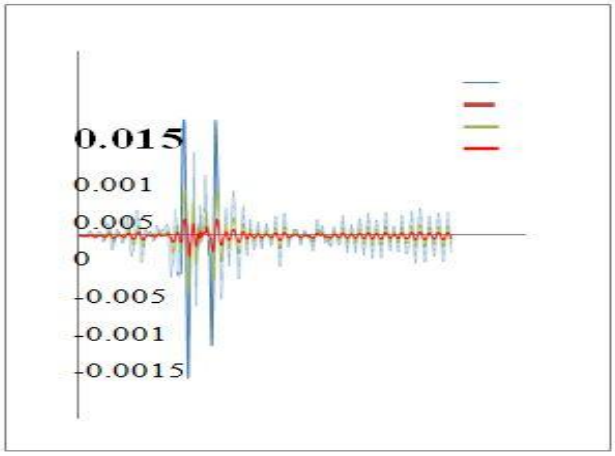


mode shapes of building without shear wall

This mode shapes shows the maximum frequency and the time period of the building with shear walls in different positions. Fig.5.4 shows the frequency of and the time period. Whereas the figure shows the different mode shapes of the structure with shear wall. They are twelve mode shapes are obtained and discussed.

Time history analysis

Time history analysis of rc frame building with shear wall in x-direction



Time history on x-direction

shows the displacements along with time of the building with shear walls in different positions. This graph shows the maximum displacements and minimum displacements in y-direction and time on x-direction. This joints which are explained below are selected for every five floors of the building. Joint 825 has the maximum displacement of0.00947 at 38 sec and minimum displacement of -0.095 at 38sec .Joint 725 has the maximum displacement of 0.00661 at 38sec and minimum displacement of -0.06 at 38sec.Joint 62 5 has the maximum displacement of 0.00379 at 50sec and minimum displace ment of -0.004 at
40sec. and Joint 525 has the maximum displacement of 0.00138 at 40sec and minimum displacement of -0.002 at 40sec.

2. Time history analysis of RC frame building with shear wall in y-direction:

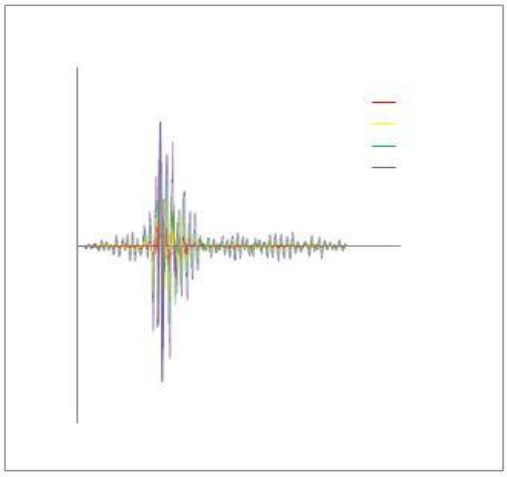


Figure -5.6: Time history on y-direction

Above fig-5.6 shows the displacements along with time of the building with shear walls in different positions. This graph shows the maximum displacements and minimum displacements in y-direction and time on x-direction. This joints which are explained below are selected for every five floors of the building. Joint 825 has the maximum displacement of 0.00774 at 40 sec and minimum displacement of -0.065 at 38sec .Joint 725 has the maximum displacement of 0.00661 at 38sec and minimum displacement of -0.0081 at 40sec.Joint 625 has the maximum displacement of 0.00378 at 40sec and minimum displace ment of -0.004 at 40sec. and Joint 525 has the maximum displacement of 0.00178 at 40sec and minimum displacement of -0.00178 at 40sec.

3. Time history analysis of RC frame building without shear wall in x-direction:-

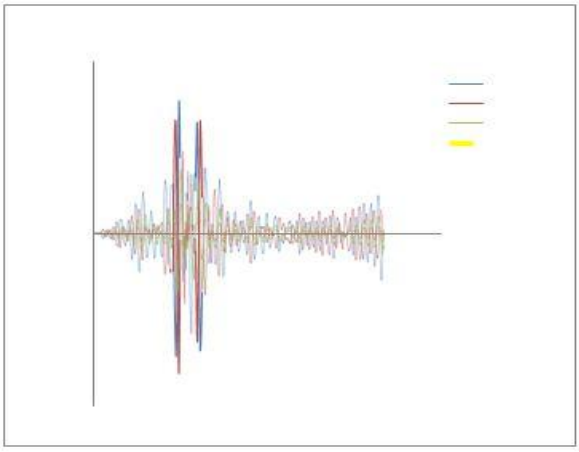
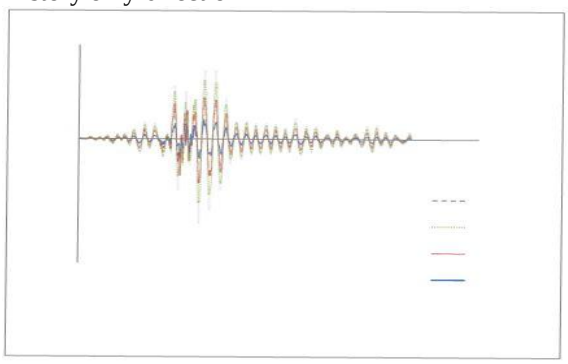


Figure -5.7: Time history on x-direction

Above fig -5.7shows the displacements along with time of the building without shear walls in different positions. This graph shows the maximum displacements and minimum displacements in y-direction and time on x-direction. This joints which are explained below are selected for every five floors of the building. Joint 133 has the maximum displacement of0.00709 at 42 sec and minimum displacement of -0.075 at 43sec .Joint 238 has the maximum displacement of 0.01191 at 40sec and minimum displacement of -0.0091 at 42sec.Joint 343 has the maximum displacement of 0.01926 at 40sec and minimum displace ment of -0.004 at
50sec. and Joint 448 has the maximum displacement of 0.02798 at 40sec and minimum displacement of -0.031 at 41sec.

Time history of model without shear wall in y-direction:

time history on y-direction

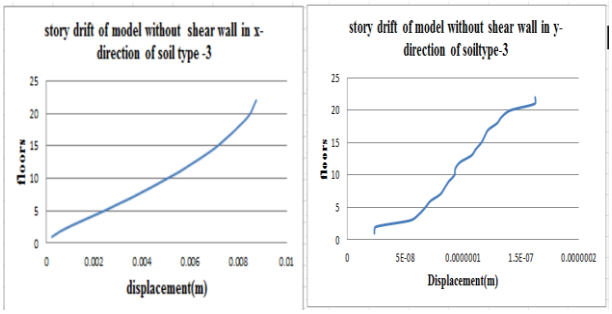


Above fig-5.8 shows the displacements along with time of the building without shear walls in different positions.This graph shows the maximum displacements and minimum displacements in y-direction and time on x-direction. This joints which are explained below are selected for every five floors of the building.Joint 133 has the

maximum displacement of0.00056 at 0.5sec and minimum displacement of -0.0075 at 0.45sec .Joint 238 has the maximum displacement of 0.000712 at 0.47sec and minimum displacement of -0.0091 at 42sec.Joint 343 has the maximum displacement of 0.000939 at 40sec and minimum displace ment of -0.001 at 0.4 sec. and Joint 448 has the maximum displacement of 0.00612 at 40sec and minimum displacement of -0.0075 at 0.4sec.

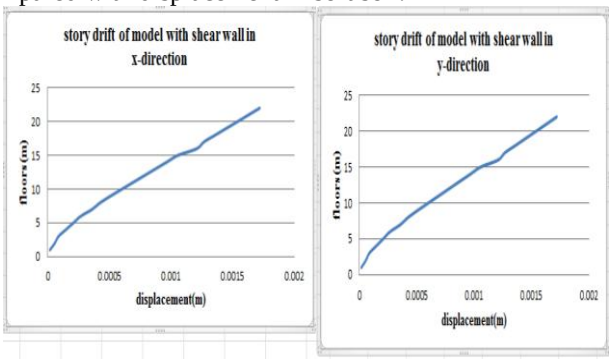
Response spectrum analysis

Story drifts of the models with and without shearwalls in x-direction and y-direction for soft and hard soils.the graphs are shown below and disscused by comparing the two structures.they are the structure with shear wall and with out shear wall story drift in x, y directions

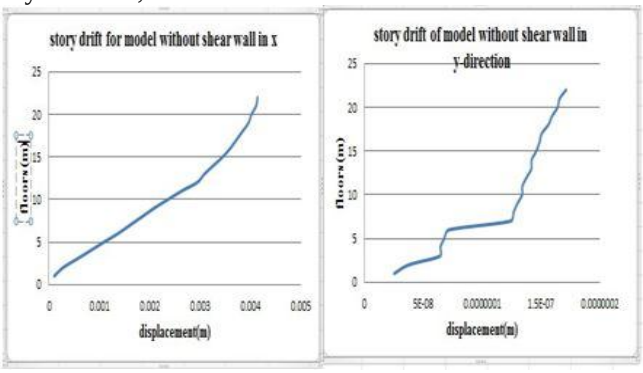


story drift in x, Y directions

From the above figures we can observe that the storey drift in case of bottom storey at the first storey of building is going on increasing up to top top storey.the displacement for soft soil is more in x-dirction when compared with displacement in y-direction.the displacement for hard soil is more when compared with displacement in soft soil.



story drift in x, Y direction



story drift in x, Y direction

From the above figures we can observe that the storey drift in case of bottom storey at the first storey of building is going on increasing up to top top storey.the displacement for soft soil is more in x-dirction when compared with displacement in y-direction.the displacement for hard soil is more when compared with displacement in soft soil

IV. CONCLUSION

This project deals with the seismic Analysis of RC frame buildings with and without shear walls. Two models are considered they are building with shear wall and building without shear wall. These models are analyzed by two methods, they are time history method and response spectrum method.In response spectrum method only two types of soil are considered. Previous Earthquake data is taken.i.e.,Bhuj earthquake. The displacements in shear wall building are more when compared with displacements in without shear wall building

Frome above comparative studies it is absorbed that the Building with shear wall shows better performance when compared with building without shear wall.

- Story drift is highly influenced by the presence of shear wall in the Building.
- In Response spectrum analysis displacement is high in building with shear wall and low in building without shear wall.
- In time history analysis it is observed that the top floor of the building has maximum displacement whereas minimum at bottom floor of the building in both the models.
- Providing shear walls at adequate positions substantially reduces the displacement due to earthquake.
- Proper positioning of shear wall results in effective and efficient performance of building during earthquakes.

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