

COMPARATIVE STUDY OF MULTI STOREY BUILDING WITH AND WITHOUT FLOATING COLUMNS AND SHEAR WALLS

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Abstract - Study the behavior of structure when obtaining floating columns, obtaining shear wall, and both shear wall and floating columns structure with comparing the normal structure. Also comparing the parameters like storey displacements, storey drift, storey shear, time period. Considering G+20 storey building, four models. First model will consider the normal building, second model will consider floating columns structure, third model will consider shear wall structure, fourth model will consider both shear walls and floating columns structure. The seismic analysis of G+20 storey structure is analysed by both equivalent static and response spectrum method. Using Indian Standard code IS 1893(Part-1) 2002 and ETABS-2016 software. Obtained storey displacements, storey shear, storey drift, time period for seismic zone V. Consider the both equivalent static method and response spectrum method. 1.2(DL+LL+RSY) load combination is critical and increased displacements model II is 6%, decreased 45% in model III, 40% in model IV. The storey drift compared normal structure increased drifts in model II is 9%, decreased 40% in model III, and 31% in model IV. The storey shear compared normal structure decreased shears in model II is 4.5%, increased 24% in model III, and 23% in model IV. Comparing all four models the time period of floating column building model II is greater than all three building. Model III is better performances lesser displacements, more strength comparing all models.

Key Words: Floating column, Shear wall, Storey displacements, Storey drift, Storey shear, Equivalent static method, Response spectrum method.

1. INTRODUCTION

In our country many urban multi story buildings first storey will be open as an unavoidable future. This is being adopted for accommodate majorly vehicle parking, reception lobbies, or halls etc. in the first storey. During earthquake the total seismic base shear of the building is dependent on its natural period, the seismic force distribution is dependent on the distribution of stiffness and mass along the height. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path, any deviation or discontinuity in this load transfer path results in poor performance of the building. Buildings with vertical setbacks like the hotel buildings with a few storey wider than the rest cause a

sudden jump in earthquake forces at the level of discontinuity. Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey.

The 60% of India lies in earthquake prone zone, hence it increases the need of understanding the behavior of earthquake, also constructing and developing earthquake resistant structures. Thus, shear walls are introduced to resist the lateral forces produced during earthquake. They are known as the vertical elements of the horizontal force resisting system. Shear walls in the structure counters the effect of lateral loads acting on structure. Especially, important for high rise buildings, shear walls thus act against lateral forces caused by wind, earthquake and uneven settlement loads.

Commonly the shear wall building will be strong. But the floating column structure, how behavior with the shear wall will be studied in this study.

1.1 Floating column

A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which of the column ends due to structural design or site condition, rests on the beam that is in horizontal member. These beams turns the load transfer to the below columns. These columns load was considered as the point load. Where indicating the floating columns, in that floor and below floors beams and columns should be in heavy in size and heavy material will used. Because floating columns load transfer the load horizontal beam and act on concentrated load so beams and columns sizes should be increased.

1.2 Shear wall

A shear wall is a wall used to resist the shear, produced due to earthquake loads or lateral forces. Shear wall commonly provided in high rise building. It will introduced from foundation level up to extended to the building height. Shear wall thickness may vary from 150mm to 400mm. shear wall oriented in vertical direction like wide beams to resist the lateral forces to downwards to the foundation.

Providing the shear wall commonly by width and length of the structures. When the centre of gravity of building and load carried by building it differs more than 30%, in that case shear wall will be provided. So concrete shear wall will provided the structures to bring centre of gravity and centre

of rigidity in range of 30% because lateral force will not increase more. Fig.2 shows the shear wall structure.

2. LITERATURE REVIEW

Isha Rohilla, S. M. Gupta, Babita Saini. (2015) [1]

In this paper studied the seismic response of the multistorey irregular building with floating column. The building model will be considered as G+5 and G+7 with zone II and zone V. To evaluate the results of the building as storey response, storey shear, storey displacements will be obtained by the using of ETABS software. The floating column should be avoided in high rise building in zone V. Storey displacements increases with increase in load on floating column. Storey shear will be decreases when presence of floating column because of reduction mass of column in structures. Increase the size of the beams and columns to improve the performance of building with floating column to reduce the storey displacements and storey drift.

Kandukuri Sunitha, Mr. Kirankumar Reddy. (2017) [2]

In this paper studied on the analysis of normal building with five storey, ten storey, and fifteen storey. And different positions and different conditions like floating columns, shear wall, bracings are taken as same models. Two methods to be considered for the analysis of structure as linear static method and time history method. Analysis done for using ETAB software compare the displacements, storey drift and the time history values of the different models. In static analysis concluded that the maximum displacements and storey drift values are increasing for floating column. by observing the drift ratio the deflection and storey drift will be drastically changed when the height of the building will be increased.

P. P. Chandurkar, Dr. P. S. Pajgade. (2013) [3]

In this paper studied the seismic analysis of the RCC building with and without shear wall for 10 storey building. The main focus of this paper will be solution the shear wall location in multi storey building. Four different model should be considered in zone II zone III zone IV zone V. These four seismic zones and four models should be calculated the parameters like storey displacement, storey drift. Also calculate the total cost for the ground floor with the both cases replacing column with shear wall. The whole analysis is carried out by using ETAB v.9.5.0 software. For ten storey or below ten storey building the shear wall will not effective. But in high rise building it is effective and also economical. Providing of shear wall at adequate locations substantially reduces the displacements due to earthquake

Sachin. P. Dyavappanavar, Dr. K. Manjunatha, Kavya N. (2015) [4]

In this paper focused the seismic behavior of multistorey building with shear wall at different locations. Considered five different models twenty storey building, zone IV, and different locations of shear wall and analysis is done by using

of ETABS v 9.7.1 software. Equivalent static method, response spectrum method and time history method adopted. To determine the displacements and base shear of different structures. The shear wall increase the strength and stiffness of the structure. For both static and response spectrum analysis exterior corner shear wall model will show the lesser displacements in longitudinal and transverse direction.

3. OBJECTIVES OF THE STUDY

- 1) The main objective of this study is to study the behavior of the combination of floating column structure and shear wall structure.
- 2) Modeling the four different models as G+20 storey structures as, Normal bared frame building, with shear wall structure, with floating column structure and combination of floating column and shear wall structures.
- 3) Seismic analysis is done by equivalent static method and dynamic analysis by response spectrum method with seismic zone V
- 4) Obtaining the parameters storey displacements, storey shear, storey drift, time period for modeled structures.
- 5) Comparing the results of normal building with shear wall building.
- 6) Comparing the results of normal building with floating column building.
- 7) Comparing the results of normal building with combination of floating column building and shear wall building.

4. METHODOLOGY

Consider the G+20 storey, four different structure and analysing structures by using as per Indian standard code IS 1893 (Part-1) 2002 and ETABS-2016 software. To determine the parameters like storey displacements, storey shear, storey drift, time period, the following method will be adopted for the analysis purpose.

- Equivalent static method
- Response spectrum method

Table -1: Parameters of all Models

PARAMETERS	MODEL-I	MODEL-II	MODEL-III	MODEL-IV
Plan	35mX30m	35mX30m	35mX30m	35mX30m
Number of bay in X-dir	7	7	7	7
Number of bay in Y-dir	6	6	6	6
Spacing of each bay	5m	5m	5m	5m
Height of building	64m	64m	64m	64m
Each floor height	3m	3m	3m	3m
Number of storey	G+20	G+20	G+20	G+20
Grade of concrete	M25	M25	M25	M25
Column size	600X600 mm	600X600 mm	600X600 mm	600X600 mm
Beam size	300X450 mm	300X450 mm	300X450 mm	300X450 mm
Slab thickness	150mm	150mm	150mm	150mm
Live load	3kN/m ²	3kN/m ²	3kN/m ²	3kN/m ²
Floor finish	1.5kN/m ²	1.5kN/m ²	1.5kN/m ²	1.5kN/m ²
Terrace load	2.0kN/m ²	2.0kN/m ²	2.0kN/m ²	2.0kN/m ²
Seismic zone	V	V	V	V
Soil type	II (Medium)	II (Medium)	II (Medium)	II (Medium)
Response reduction factor	5	5	5	5
Importance factor	1	1	1	1
Floating column	-----	In 1st floor	-----	In 1st floor
Shear wall	-----	-----	At corners	At corners

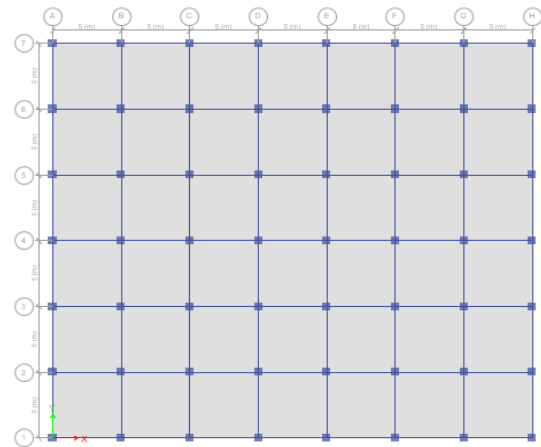


Fig -1: Plan of Normal structure Model I

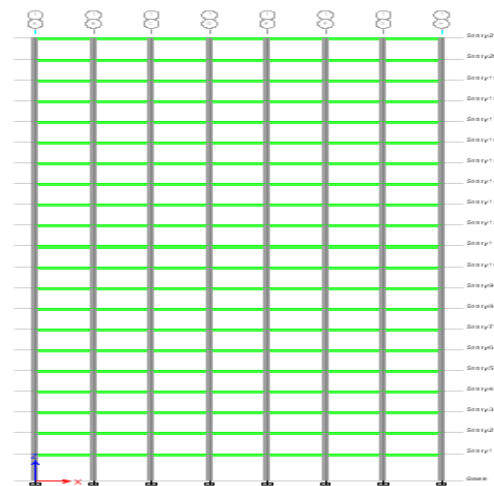


Fig -2: Elevation of Model I

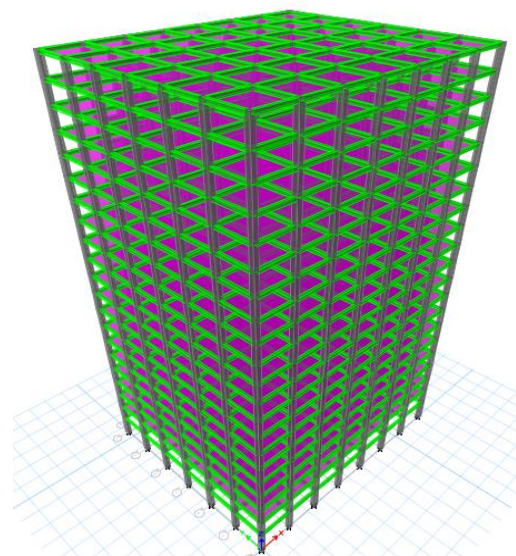


Fig -3: Elevation of Model I

Model I: This model or RC structure is consider as normal building or bared frame structure.

Model II: This model consider floating column structure. (floating columns in ground floor)

Model III: This model consider shear wall structure. (shear walls at all corners of the building)

Model IV: Structure is consider both shear walls and floating columns structure.

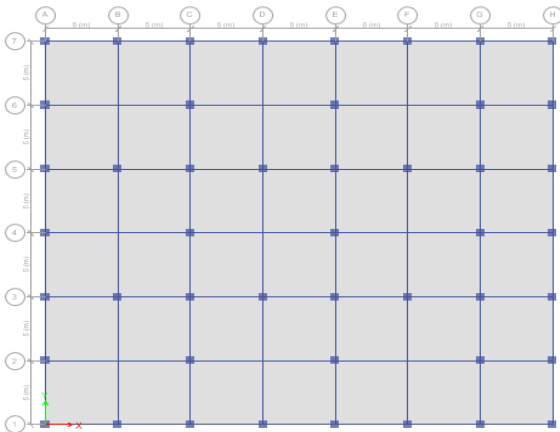


Fig -4: Plan of floating column structure Model II

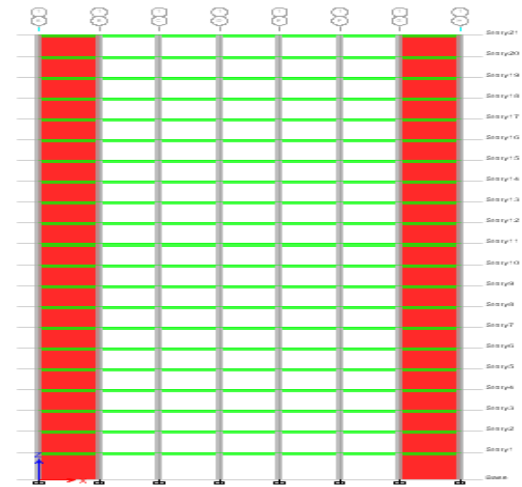


Fig -7: Elevation of Model III

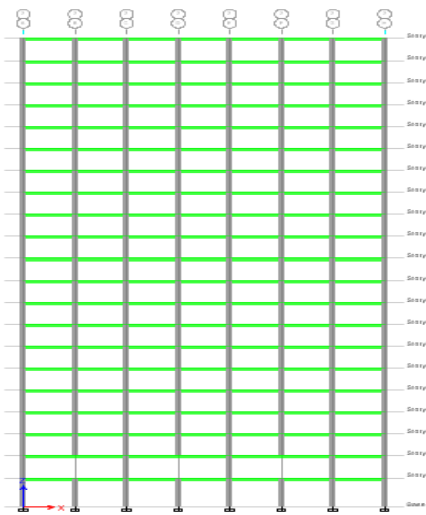


Fig -5: Elevation of Model II

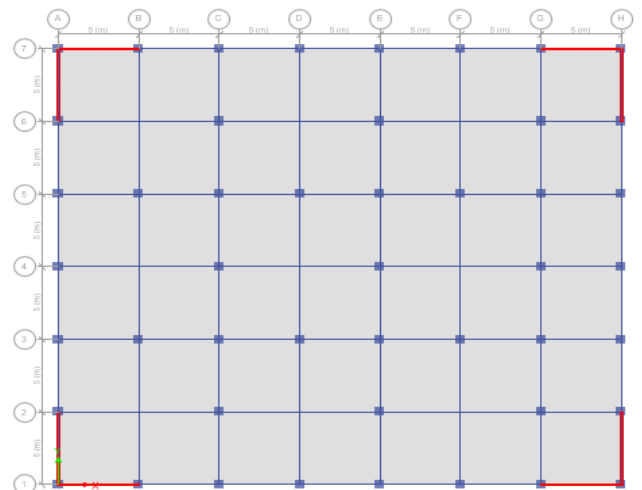


Fig -8: Plan of both shear walls and floating columns structure Model IV

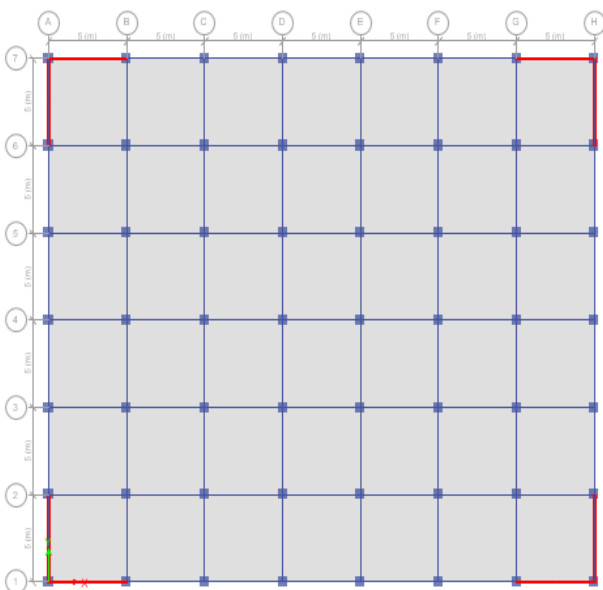


Fig -6: Plan of shear wall structure Model III

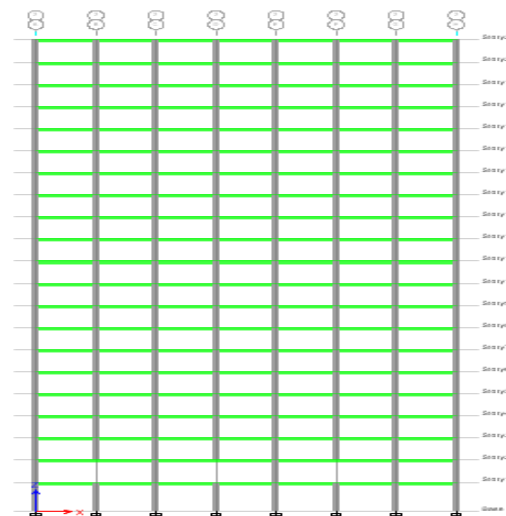


Fig -9: Elevation of Model IV

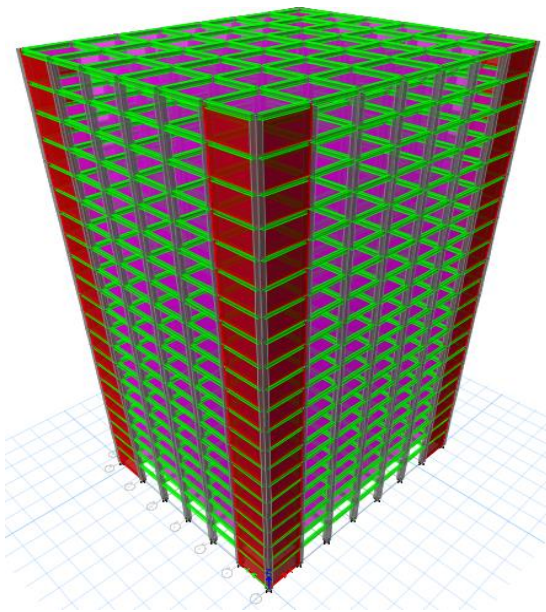


Fig -10: Elevation of Model IV

5. RESULTS AND DISCUSSIONS

5.1 Storey displacements

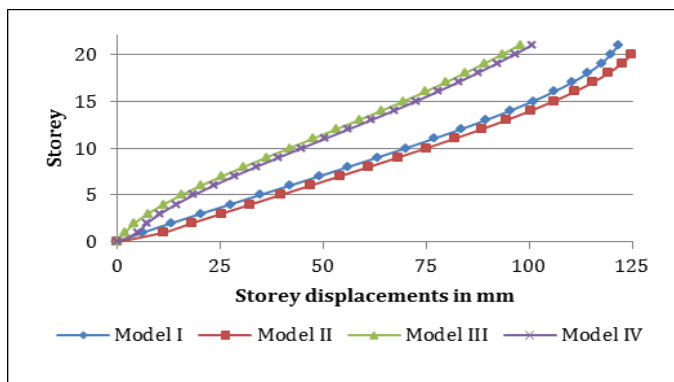


Chart -1: Displacements v/s storey for 1.2(DL+LL+EQY) load combination.

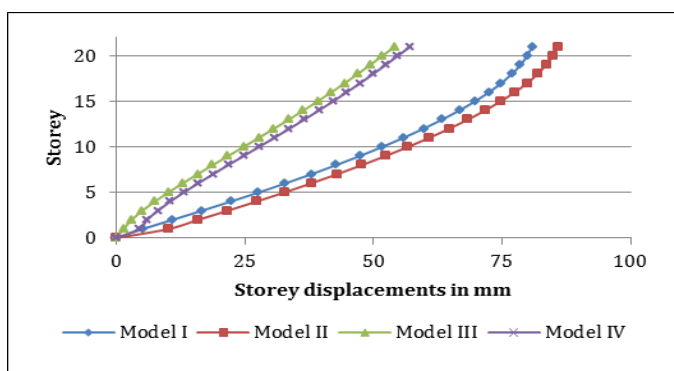


Chart -2: Displacements v/s storey for 1.2(DL+LL+RSY) load combination.

Chart 1 represents the storey displacements v/s storey in Y direction, zone V for the combination of 1.2(DL+LL+EQY). Results will be critical and obtained from equivalent static method. Observing the results and chart comparing to normal building (model-I), the storey displacements is increased 4% in model II, decreased 24% in model III, decreased 21% in model IV.

Chart 2 represents the storey displacements v/s storey in Y direction, zone V for the combination of 1.2(DL+LL+RSY). Results will be critical and obtained from response spectrum method. Observing the results and chart comparing to normal building (model-I), the storey displacements is increased 6% in model II, decreased 48% in model III, decreased 40% in model IV.

5.2 Storey drift

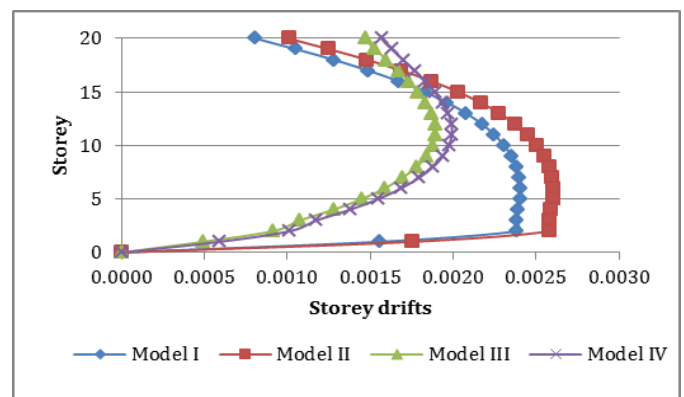


Chart -3: Drifts v/s storey for 1.2(DL+LL+EQY) load combination.

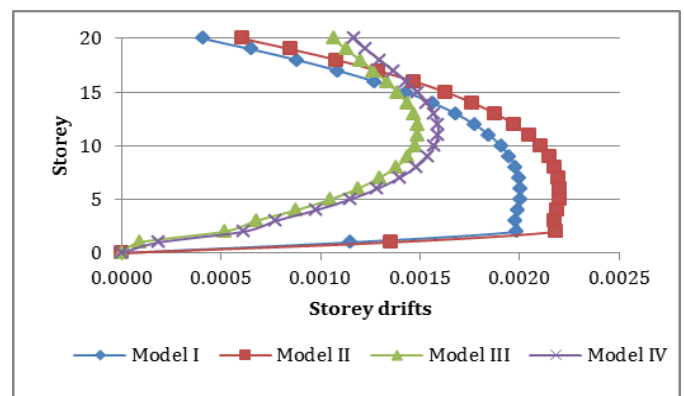


Chart -4: Drifts v/s storey for 1.2(DL+LL+RSY) load combination.

Chart 3 represents the storey drifts v/s storey in Y direction, zone V for the combination of 1.2(DL+LL+EQY). Results will be critical and obtained from equivalent static method. Observing the results and chart comparing to normal building (model-I), the storey drifts is increased 8% in model II, decreased 26% in model III, decreased 20% in model IV.

Chart 4 represents the storey drifts v/s storey in Y direction, zone V for the combination of 1.2(DL+LL+RSY). Results will be critical obtained from response spectrum method. Observing the results and chart comparing to normal building (model-I), the storey drifts is increased 9% in model II, decreased 40% in model III, and decreased 31% in model IV.

5.3 Storey shear

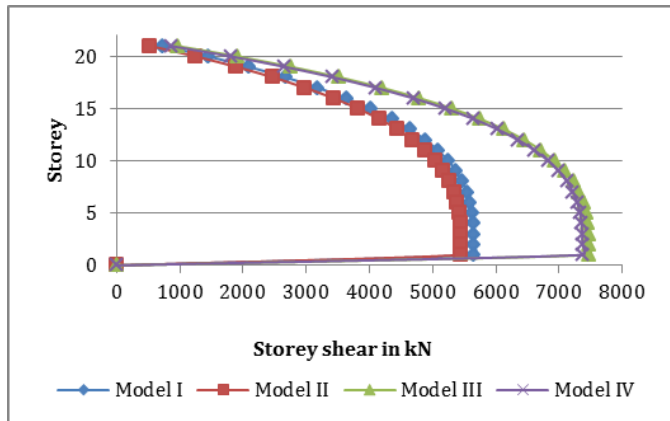


Chart -5: Storey shear v/s storey for 1.2(DL+LL+EQY) load combination.

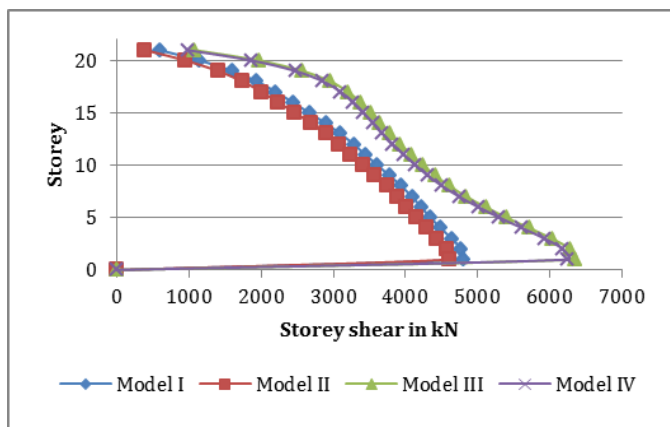


Chart -6: Storey shear v/s storey for 1.2(DL+LL+RSY) load combination.

Chart 5 represents the storey shears v/s storey in Y direction, zone V for the combination of 1.2(DL+LL+EQY). Results will be critical and obtained from equivalent static method. Observing the results and chart comparing to normal building (model-I), the storey shears is decreased 4% in model II, increased 24% in model III, increased 23% in model IV.

Chart 6 represents the storey shears v/s storey in Y direction, zone V for the combination of 1.2(DL+LL+RSY). Results will be critical and obtained from response spectrum method.

Observing the results and chart comparing to normal building (model-I), the storey shears is decreased 4.5% in model II, increased 24% in model III, and increased 23% in model IV.

5.4 Time period

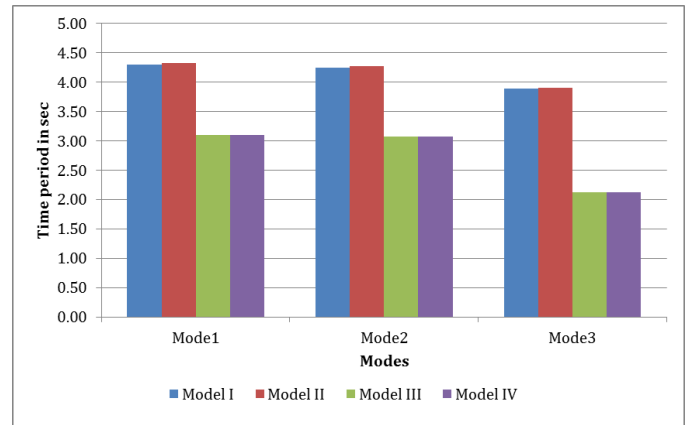


Chart -7: Time period v/s first three modes

Chart 7 represents the time period v/s first three modes of the models. The time period is obtained from the modal participation factor. Comparing all four models the time period of floating column building model II is greater than all four buildings.

6. CONCLUSIONS

- 1) Seismic analysis of G+20 storey structure is done by both equivalent static and response spectrum method to obtain the parameters storey displacements, storey shear, storey drift, time period for seismic zone V.
- 2) Considered the storey displacements comparing to model-I, increased 6% in model-II, decreased 45% in model III, 40% in model IV.
- 3) Storey drift obtained from equivalent static method and response spectrum method, increased the storey drift 9% in model II, decreased 40% in model III, 31% in model IV.
- 4) Storey shear obtained from equivalent static method and response spectrum method, decreased the storey shear 4.5% in model II, increased 25% in model III, 24% in model IV.
- 5) Compared all four structures the time period of floating column building model II is greater than all four buildings.
- 6) Model III shear wall structure is better performance lesser displacements, more strength comparing all models.

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Codes

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- [9] IS 875 (Part-2) 1987. "Code of practice for Design imposed loads for buildings and structures."

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