



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 9, September 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569



9940 572 462



6381 907 438



ijirset@gmail.com



www.ijirset.com



# A Study on Effect of Shear Walls and Bracing System in a Multi-storey Building Having Soft Storey at Various Levels

Guruprasad H M<sup>1</sup>, Arpitha D J<sup>2</sup>

P.G. (Structural Engineering) Student, Bapuji Institute of Engineering and Technology, Davangere, India<sup>1</sup>

Assistant Professor, Department of Civil Engineering, Bapuji Institute of Engineering and Technology,  
Davangere, India<sup>2</sup>

**ABSTRACT:** Many urban cities witnessing construction of high rise building day by day. Structural Engineers are challenged to give effective and economic design of structures considering effect of lateral loads. Due to the demand of land and aesthetic views architects have subjected to go semi residential projects like a building with both residential units and commercial units in the same structure due to this structure are built with vertical irregularities and stiffness irregularities. This paper investigates the behavior of tall structures with soft stories at various levels and also effect of position and orientation of shear walls and bracing in the structure. These soft stories are induced due to variation of stiffness along the vertical height of stories, this intern is cause due to change in story heights. A comparative study is carried out to provide an insight for the guiding response parameters such as story shear, story displacement, storey drift, stiffness variation and time period have been carried out using dynamic analysis to investigate the influence of these parameters on the behavior of shear walls and bracing system in a multi-story building having story at a various level.

**KEYWORDS:** ETABS, Seismic zone II, Shear walls, Bracing system, Response spectrum method

## I. INTRODUCTION

Many metropolitan cities are seeing the construction of tall buildings day in and day out. Structural engineers are challenged to provide an efficient and economical design of structures taking into account the influence of lateral loads. Due to the need for the land and the aesthetic point of view, the architects came up with the project to sell the house as a building with two dwelling units. And business units in the same structure since these structures are constructed with longitudinal irregularities and stiffness irregularities. In this study we carefully studied the behaviour of high rise structures with flexible floors at different levels, as well as the influence of the position and direction of the supporting walls and supporting structure. Soft floor is one or two floors in a multi storey building and its lateral rigidity is less than that of upper storeys. The building behaves as an inverted pendulum during earthquake and puts a lot of pressure on the structural components.

To solve this problem, we need to improve the structure. The bracing system is a structural system designed to withstand the forces of wind and earthquakes, the bracing members must not swing horizontally. Bracing wall is a structural element used to hold lateral forces, i.e. parallel to the plane of the wall, bracing walls are vertical elements of the transverse force system providing bracing walls or bracing systems for buildings is one of the best methods to overcome problems associated with earthquake effects, while also providing bracing walls with bracing and directional bracing Plays an important role and also while applying a bracing system for the building structure, the type of bracing system, the size of the bracing system plays an important role. And by applying shear and bracing walls system for building structure, it improves the strength and rigidity of buildings. In this study, a study comparing the effects of wall bracing and bracing in multi-storey buildings with flexible floors at different levels is considered.

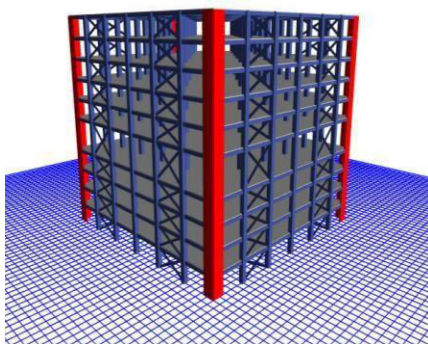
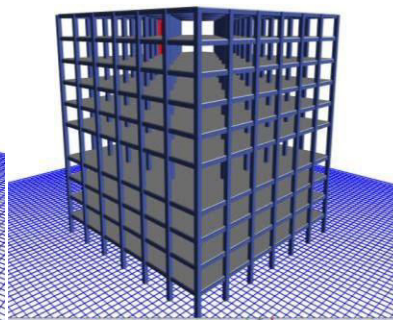
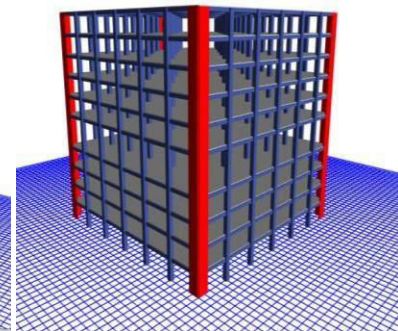
## II. MODELING AND BUILDING DESCRIPTION

The modeling and analysis of the structure is done by using ETABS 2017 software. Table 3.1 shows the description of the buildings. The building has 10 number of stories that includes conventional and soft storey. The buildings are

conventional, shear wall and bracings systems having soft storey at first and fifth storey. The buildings are considered to be seismic zone II. Shear wall provided are of 200 mm thickness.

**Table 1 : Building description**

No of floors	G+10
Structure height	3m and 5m
Seismic zone	II
Type of soil	Medium
Importance factor	1.2
Reduction factor	5
Zone factor	0.10
Live load Floor finish	4
Grade of steel	HYSD 500
Grade of concrete	M40
Shear wall thickness	200
Bracings size	200X450mm

**Fig. 1. Building with soft storey at 5<sup>th</sup> storey****Fig. 2. Shear wall with soft storey at 5<sup>th</sup> storey****Fig. 3. Bracings system with soft storey at 5<sup>th</sup> storey****Load combinations:**

Load combinations used in the analysis of the buildings as per IS codes are as follows.

- 1.5DL.
- 1.5DL+1.5LL.
- 1.2DL±1.2LL±1.2EQX.
- 1.2DL±1.2LL±1.2EQY.
- 0.9DL±1.5EQX.
- 0.9DL±1.5EQY.
- 1.5DL±1.5EQX.
- 1.5DL±1.5EQY.
- 1.5DL±1.5EQY.
- 1.2DL±1.2LL±1.2SPECX.
- 1.2DL±1.2LL±1.2SPECY.
- 1.5DL±1.5SPECX.
- 1.5DL±1.5SPECY.
- 0.9DL±1.5SPECX.



- 0.9DL±1.5SPECY

### III. RESULTS AND DISCUSSION

**Table 1: Storey displacement values of model 1    Table 2: Storey Drift ratio values of model 1**

Storey Number	X-direction	Y-direction
10	17.798	11.412
9	17.343	10.849
8	16.591	10.082
7	15.482	9.13
6	13.989	8.013
5	12.032	6.724
4	7.555	4.096
3	5.161	2.719
2	2.926	1.482
1	0.99	0.481
0	0	0

Storey Number	X-direction	Y-direction
10	0.000189	0.000223
9	0.000261	0.000262
8	0.00038	0.000322
7	0.000506	0.000377
6	0.000661	0.000433
5	0.000901	0.000528
4	0.000801	0.00046
3	0.000746	0.000413
2	0.000647	0.000334
1	0.00033	0.00016
0	0	0

**Table 3: Storey stiffness values of model 1**

Storey Number	X-direction	Y-direction
10	317506.2	312657.2
9	546784.8	572242.7
8	618608.9	704112
7	641617.2	769682.3
6	628786	804467.5
5	339744.2	473387.8
4	689209.3	955443.5
3	800545.4	1148682
2	999075.5	1561382
1	1982290	3130945
0	0	0

**Table 4: Storey displacement values of model 2**

Storey Number	X-direction	Y-direction
10	14.679	11.089
9	14.044	10.477
8	13.194	9.696
7	12.083	8.75
6	10.695	7.638
5	9.026	6.363
4	5.627	3.905
3	3.706	2.545
2	1.997	1.353
1	0.638	0.426
0	0	0

**Table 5: Storey Drift ratio values of model 2**

Storey Number	X-direction	Y-direction
10	0.000223	0.00022
9	0.00029	0.000264
8	0.000377	0.00032
7	0.000469	0.000375
6	0.000575	0.000435
5	0.000689	0.000497
4	0.000649	0.000458
3	0.000574	0.000399
2	0.000455	0.00031
1	0.000213	0.000142
0	0	0

**Table 6: Storey stiffness values of model 2**

Storey Number	X-direction	Y-direction
10	9.006	8.28
9	8.57	7.823
8	7.995	7.236
7	7.281	6.533
6	6.435	5.72
5	5.475	4.812
4	4.424	3.834
3	3.315	2.821
2	2.193	1.826
1	1.138	0.924
0	0	0

Table 7: Storey displacement values of model 3

Storey Number	X-direction	Y-direction
10	336817.2	338743.9
9	620869.2	639916.8
8	748457.6	787703.3
7	807076.8	869141.4
6	814371.7	905218.4
5	481344.4	546550.8
4	932374.6	1071337
3	1115239	1297237
2	1483944	1808195
1	3200528	3860807
0	0	0

Table 8: Storey Drift ratio values of model 3

Storey Number	X-direction	Y-direction
10	9.006	8.28
9	8.57	7.823
8	7.995	7.236
7	7.281	6.533
6	6.435	5.72
5	5.475	4.812
4	4.424	3.834
3	3.315	2.821
2	2.193	1.826
1	1.138	0.924
0	0	0

Table 9: Storey stiffness values of model 3

Storey Number	X-direction	Y-direction
10	526618.7	479603.9
9	974201.2	907452.2
8	1200593	1138338
7	1326744	1270953
6	1375209	1349525
5	827249.3	825882
4	1591906	1605148
3	1850372	1908678
2	2364575	2555491
1	4600883	5008997
0	0	0

Table 10: Storey stiffness values of model 3

Storey Number	X-direction	Y-direction
10	526618.7	479603.9
9	974201.2	907452.2
8	1200593	1138338
7	1326744	1270953
6	1375209	1349525
5	827249.3	825882
4	1591906	1605148
3	1850372	1908678
2	2364575	2555491
1	4600883	5008997
0	0	0

#### IV. CONCLUSIONS

1. It has been observed that storey displacement values of model 1 is maximum at top storeys and low at bottom storeys. There is sudden decreases after 5<sup>th</sup> storey because of soft storey at fifth storey. It is observed that Maximum storey displacement increases with increase in the seismic zone in both X and Y direction. Here Maximum storey in X direction is more than maximum storey in Y direction as shown in table 1.
2. In case of model 2 building with shear wall the storey displacement values will sudden decreases after 5<sup>th</sup> storey
3. Displacement values is maximum at top and low at bottom storeys as shown in table 4. But in case of model 3 building with bracings system the displacement values is linearly varying from top to bottom. However, there is no sudden decreases in at soft storey as shown in the table 7.
4. It is observed that model 1,2 and 3 Storey drift ratio will also increase with increase in number of storeys. Drift is more in the intermediate storey of the building. According to IS codes, Storey drift must not exceed  $0.004 \times h$  whereas  $h$ =Storey height as shown in the table 2, 5 and 8.
5. Storey stiffness has been observed that in model 1,2 and 3 stiffness gradually increases roof to 6<sup>th</sup> storey but sudden decreasing will come at 5<sup>th</sup> storey level and again increasing from 5<sup>th</sup> storey to plinth level. Hence in model 1,2 and 3 stiffness is less than 70% in both X and Y direction because soft storey at 5<sup>th</sup> storey as shown in the table 3,6 and



## REFERENCES

1. IS 1893 (Part 1):2016 Criteria for earthquake resistant design of structures.
2. IS: 456-2000 plain and reinforced concrete code of practice.
3. IS: 875 (Part 1) Code of Practice for Design Loads (other than Earthquake) for Buildings and Structures, Part 1 Dead Loads - Unit Weights of Building Materials and Stored Materials.
4. IS: 875 (Part 2) Code of Practice for Design Loads (other than Earthquake) for Buildings and Structures, Part 2- Imposed Loads.
5. IS: 875 (Part 5) Code of Practice for Design Loads (other than Earthquake) for Buildings and Structures, Part 5- Special Loads and Combinations.
6. IS 800:2007 General Construction in Steel — Code of Practice.
7. Beigi S M H A et.al. (2014), “Gapped-Inclined Braces for Seismic Retrofit of Soft-Story Buildings”, Journal of Structural Engineering.
8. Maria I and Todorovska (2014), “Base Isolation by a Soft First Storey with inclined Columns”, Journal of Engineering Mechanics.
9. Misir I S (2014), “Potential Use of Locked Brick Infill Walls to Decrease Soft- Story Formation in Frame Buildings”, Journal of Performance of Constructed Facilities, Volume 9.
10. D khan and Rawat A (2016), “Nonlinear Seismic Analysis of Masonry Infill RC Buildings with Eccentric Bracings at Soft Storey Level”, World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium, Vol 161, pp. 9-17.+
11. Ashok k jain (2015), “Seismic Response of RC Frames with Steel Braces”, Journal of Structural Engineering.



**Impact Factor:  
7.569**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details