

# Analysis of Soft Storey Building in Different Seismic Zones by Staad.Pro V8i Software

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**ABSTRACT:** Now a days with the increase of population in cities, the area available for residence as well as commercial purpose is very congested and people face's problem for parking, So for parking we left ground story openly called the soft storey (Fig.1) which doesn't consist in-filled masonry walls to resist lateral forces which is induced on building due to earthquake. In our paper , we analyzed these kinds of buildings for seismic zones III and V of the India for same load conditions. We have done comparative study of collapse conditions (i.e. Bending moment, Shear force, Lateral displacement and Support reactions), with the help of Staad. Pro V8i software.

**KEYWORDS:** Masonry wall, Earth-quake zones, Soft storey.

## I. INTRODUCTION

Soft story is an open storey, which is not that much capable to resist lateral forces as compared to above non soft storey floors. In our paper we have taken G+5 storey building in which ground floor is left open for parking purposes and other 5 floors are kept for residence purpose (Fig.1). These all above 5 stories are infilled by masonry walls. This type of building is called soft first storey or open ground story building. These types of buildings may collapse under seismic loads which induce in lateral direction (i.e. X-X or Z-Z directions). So, we give importance to design a such buildings as a seismic resistance structures as per IS 1893-2002, as per code soft storey having lateral stiffness less than 70% than other floors of the building.

## II. RELATED WORK

Some of the literatures on the topic are as follows:-

[1]. Abhishek Arora (2015), carried out analytical study for finding out some provisions to soft storey, which can reduce the damages during an earthquake. The modelling of the whole was carried out using the computer program ETABS. In the seismic analysis, they have given RCC for provision of soft storey in two ways, firstly by providing stiff column, which increase the stiffness of the load carrying member or by providing adjacent infill-wall paneling building frame, which also increases the load carrying strength. [2]. Devendra Dohare, Dr. Savita Maru (2014), carried out study on the seismic behavior of soft storey building with the different arrangements in soft storey building when it is subjected to static and dynamic seismic loading. They observed that by providing infill, it improved the resistant behavior of the structure than the soft storey provided. [3]. Dr. Saraswati Setia, Vineet Sharma (2012), carried out analytical study on the investigation of some parameters on behavior of building with soft storey. The modelling of the whole building was carried out using the computer program STAAD. pro 2006. They have done parametric studies on displacement, inter-storey drift and storey shear using equivalent static analysis for investigating the influence of these parameters on behavior of buildings with soft storey. They analyzed the building by five numerical models. [4]. S. Arun Kumar, Dr. G. Nandini Devi (2016), carried out study with various building models such as soft storey structure with shear wall and soft storey with steel bracings at the first storey building through ETABS software by pushover analysis method and also results & conclusions of the analysis were also shown.[5]. Suchita Hirde, Ganga Tegugade

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(2014), carried out study on the performance of a building with soft storey at different level along with a G.L. and also they have done non-linear static pushover analysis. The hinges formed in the basic models were seen at the performance point and for increasing the performance; it is retrofitted with shear walls. The results obtained for basic models and retrofitted models were compared in the form of performance point and hinge formation pattern at performance point.[6]. Vipin V. Halde, Aditi H. Deshmukh (2015), carried out study on the investigation of the effect of a storey in the behavior of a structure and also effect of masonry infill on the structure.

### III. MODELLING AND LOADING DETAILS

For this study we have taken two cases (i.e. zone III and zone V of India) of soft storey building for seismic loading. Soft storey consider in a building is of 10.5m\*10.5m and height is 20m. Plan and elevation of building with soft storey are as shown below:

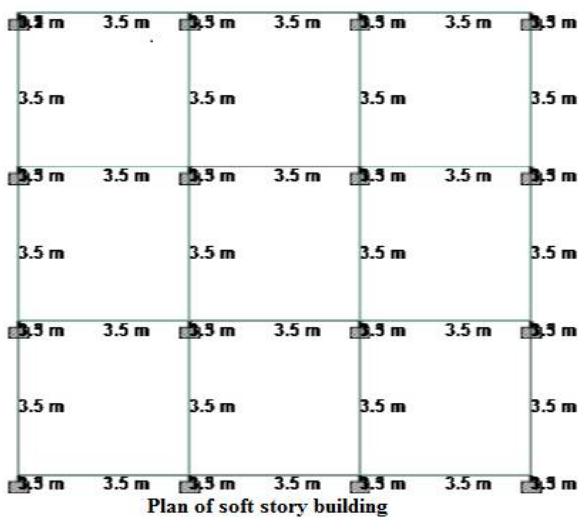


Fig.1: Plan of soft storey building.

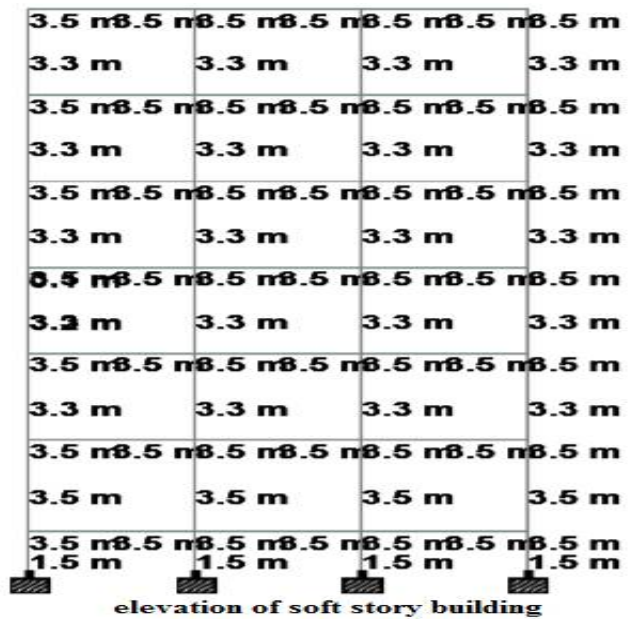


Fig.2: storey building Elevation of soft

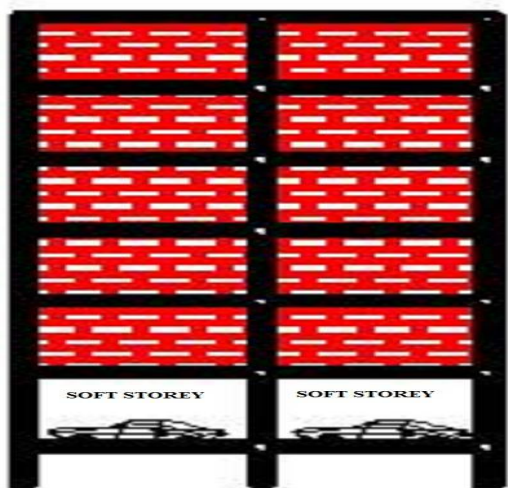


Fig.3: Building frame structure with soft storey

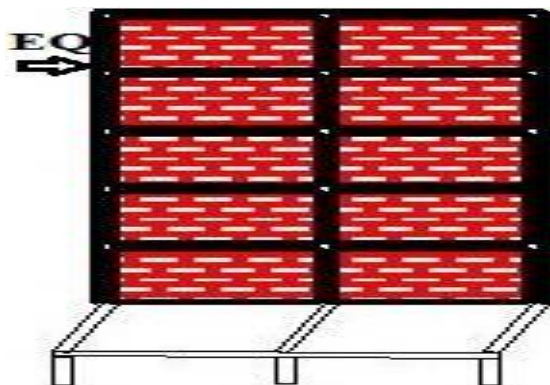


Fig.4: Failure model of soft storey during earthquake

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Table 1: Table for dead

S.No.	Type of load	intensity	Unit
1	Member load	11.88	kN/m
2	Member load	5.94	kN/m
3	Member load	5.5	kN/m
4	Floor load	3.75	kN/m <sup>2</sup>

Table 2: Table for live loads

S.No.	Type of load	Intensity	Unit
1	Floor load	4	kN/m <sup>2</sup>
2	Floor load	1	kN/m <sup>2</sup>

Table 3: Seismic zone with zone factor

S.No.	Seismic zone as per IS 1893:2002(part-1)	Zone factor
1	II	0.1
2	III	0.16
3	IV	0.24
4	V	0.36

Table 4: Load case details for seismic forces

Load case no.	Load case detail
1.	E.Q. IN X DIRECTION
2.	E.Q. IN Z DIRECTION
3.	DEAD LOAD
4.	LIVE LOAD
5.	1.5(DL+LL)
6.	1.5(DL+EQX)
7.	1.5(DL-EQX)
8.	1.5(DL+EQZ)
9.	1.2(DL+LL+EQX)
10.	1.2(DL+LL-EQX)
11.	1.2(DL+LL+EQZ)
12.	1.2(DL+LL-EQZ)
13.	1.5(DL+LL+EQX)
14.	1.5(DL+LL-EQX)
15.	1.5(DL+LL+EQZ)
16.	1.5(DL+LL-EQZ)

Length of each beam = 3.5m  
 Base dimension = 10.5x10.5m  
 Depth of foundation = 1.5m  
 Height of soft story = 3.5m  
 Height of 2<sup>nd</sup> to 6<sup>th</sup> story = 3.3m  
 Size of each column = 350x350m  
 Structure type - RC frame building  
 Ordinary moment resisting frame - 5  
 All general building - 1.0  
 Soil type - Medium  
 Period in X direction - 0.555sec  
 Period in Z direction - 0.555sec

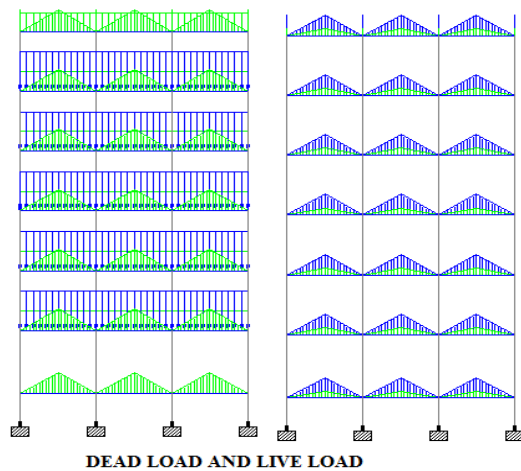


Fig.5: Dead and live load acting on the structure

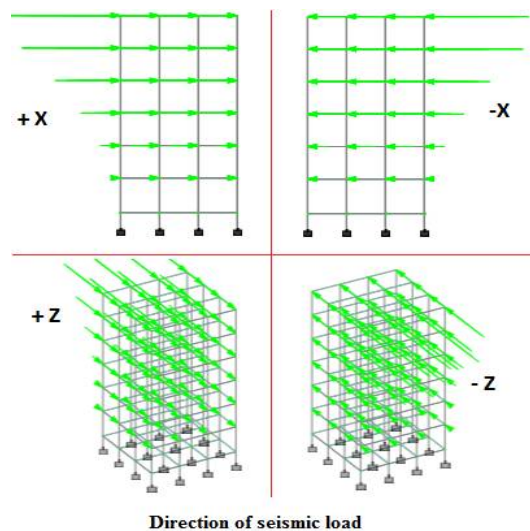


Fig.6: Earth quake forces acting on the structure.

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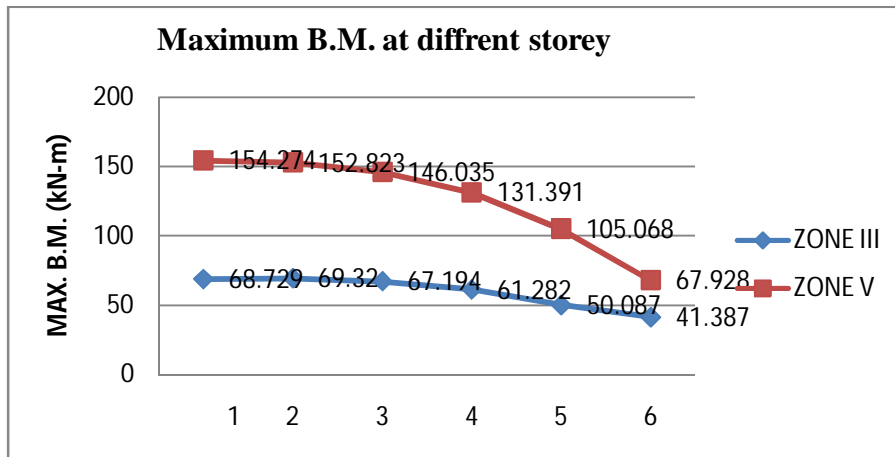
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## IV. EXPERIMENTAL RESULTS

The behaviour of soft storey building under deferent loading condition has been analysed for two seismic zones with different parameters. The tables, graphs and the dissection with respect to variations of the particular zones are given as follows.

Table 5: Maximum bending moment (kNm) at diff. Storey

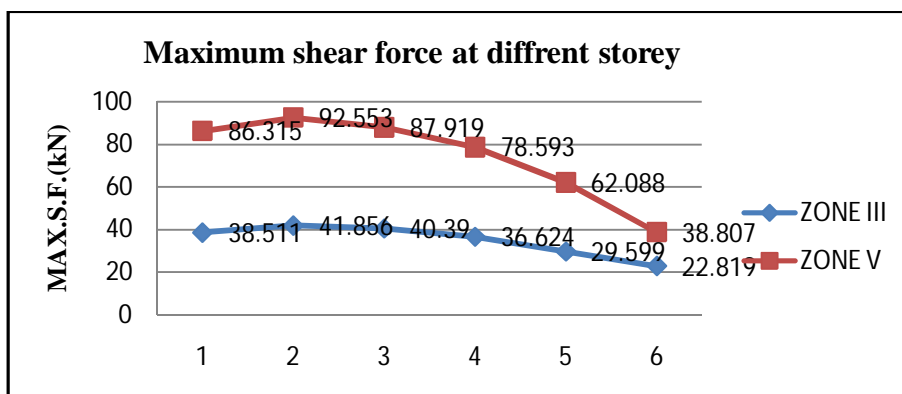
Zone	1	2	3	4	5	6
III	68.72	69.32	67.19	61.28	50.08	41.38
V	154.3	152.8	146.1	131.4	105.1	67.92



Graph.1: shows the maximum bending moment values at a deferent storey for zone III and zone V.

Table 6: Maximum shear force (kN) at different storey

ZONE	1	2	3	4	5	6
III	38.51	41.85	40.39	36.62	29.59	22.81
V	86.31	92.55	87.91	78.59	62.08	38.80



Graph.2: shows the maximum shear force values at a deferent storey for zone III and zone V.

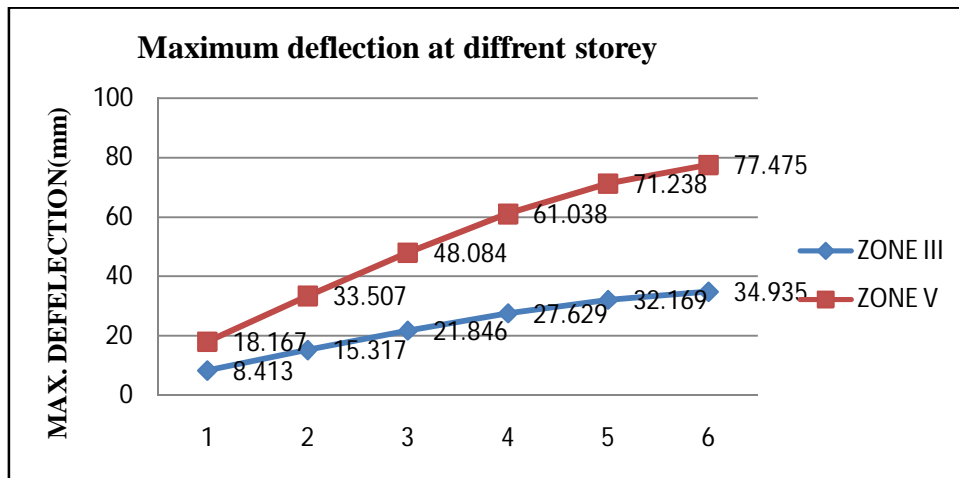
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Table 7: Maximum deflection (mm) at different storey

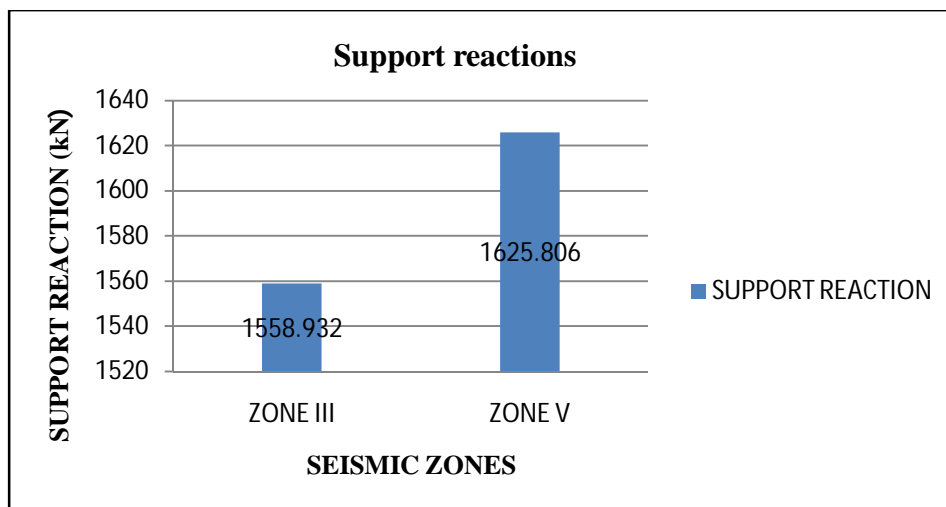
ZONE	1	2	3	4	5	6
III	8.413	15.317	21.846	27.629	32.17	34.94
V	18.167	33.507	48.084	61.038	71.238	77.475



Graph.3: shows the maximum deflection values at a different storey for zone III and zone V.

Table 8: Maximum support reaction (kN)

ZONE	SUPPORT REACTION
ZONE III	1558.932
ZONE V	1625.806



Graph.4: shows the maximum support reaction values for zone III and zone V.

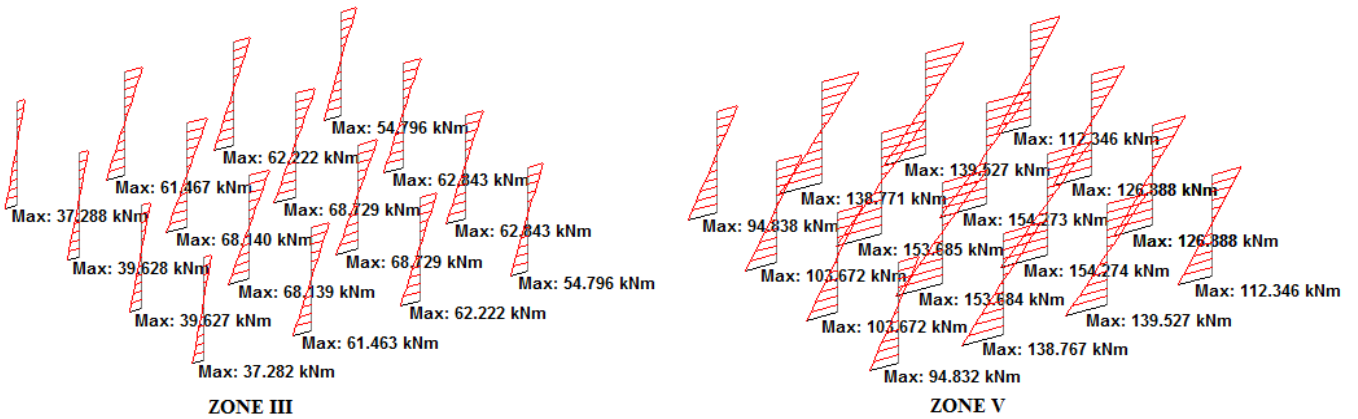


Fig.7: B.M. at soft storey for zone III and zone V.

Here, Fig.7 shows maximum bending moment diagram of soft storey for zone III and zone V, central columns are taking maximum moment but in zone V, moment developed as compare to zone III is higher.

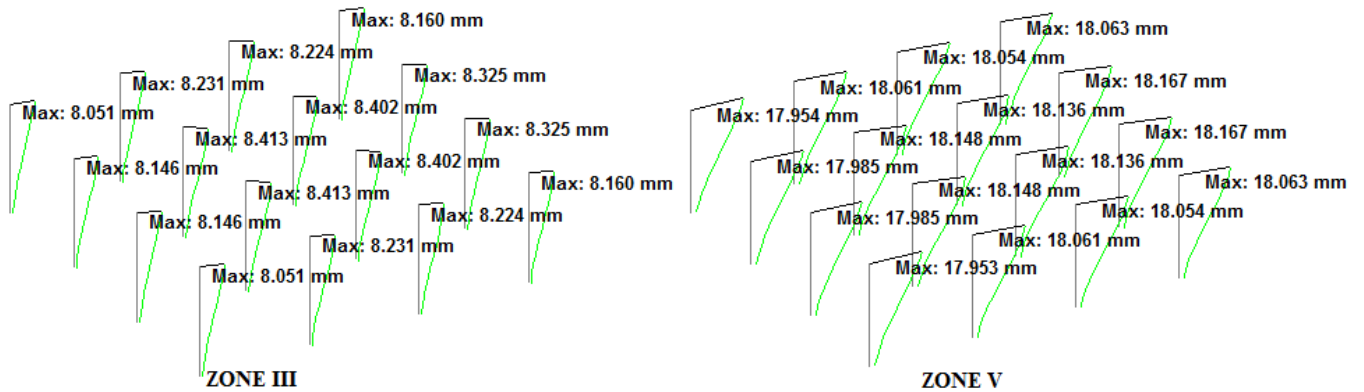


Fig.8: Deflection at soft storey for zone III and zone V.

Here, Fig.8 shows that the deflections are induced on soft storey for zone III and zone V in which deflection of zone V is maximum than zone III for a soft storey.

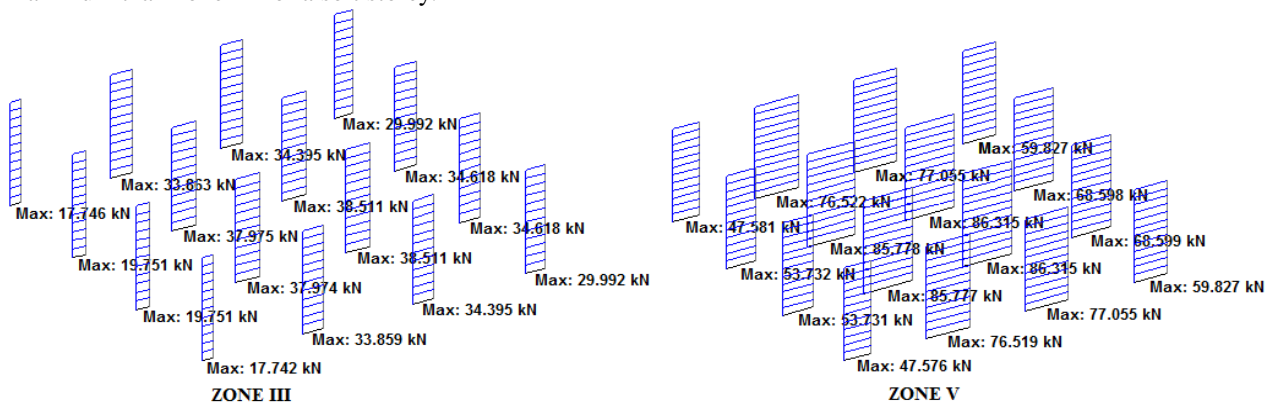


Fig.9: S.F. at soft storey for zone III and zone V.

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Here, Fig.9 shows that zone V is carrying maximum shear than zone III for a soft storey building in which central columns are taking maximum shear force for both the zones.

## IV. CONCLUSION

### A. Deflection

Maximum deflection on building at the top for zone III and V is 34.935mm and 77.475mm respectively, but maximum deflection on soft storey is 8.413mm and 18.167mm respectively. So it was observed that the maximum deflection of zone III was 54.9% less than zone V at the top of building and on soft storey it was 53.69% less.

### B. Bending moment

Maximum bending moment on the soft storey building at zone III and zone V are 68.729kN-m and 154.274kN-m respectively, So it was observed that B.M. for zone III is 55.447% less than zone V.

### C. Shear force

Shear force for zone III and zone V for soft storey is 38.511kN and 86.315kN respectively, but S.F. for second floor is 41.856kN on zone III and 92.553kN for zone V, so it was observed that shear force is critical at the junction of soft storey and also for second floor and the value of shear force for zone III is 54.5% less than zone V.

### D. Support reaction

Maximum support reaction for zone III and zone V is 1558.932kN and 1625.806kN respectively and support reaction for zone V is higher than zone III.

As per study data of seismic zone III and zone V we analysed zone III is around 2 times safer in Deflection, shear force and bending moment than zone V.

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