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Study of Behavior of the Soft Stories at Different Locations in the Multi-Story Building

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***Abstract* – Present situation growth of Multi-story building is very high because of rapid urbanization all over the world. Open first story is generally provided for parking, reception lobbies, communication halls or any purpose in multi-story building. But in case of earthquake multi-story building with soft story gives poor performance. There are various factors effects on the behavior of multi-story building i.e. irregularity in plan and elevations, uneven distribution of mass etc. Infill wall in frame building provides stiffness and improves the behavior of building under lateral loads. In the present work, study on different location of soft stories are considered for the analysis. To study of different location on the seismic behavior of multi-story building, linear dynamic analysis (Response spectrum analysis) in ETABs software is carried out. Different seismic parameters like time period, story shear, story displacement and story drift are checked out. The seismic behavior of multi-story building with soft stories is carried out. For that, G+14 (Reinforced cement concrete) RCC model is selected.**

Index Terms*— *Displacement, Story Drift, Story Shear, ETABS, soft story.

I. INTRODUCTION

Vast growth in the population in India is one of the main reasons for the construction of tall buildings in major cities. It is also the reason for the development of the country. Soft story is provided in the multi-story buildings depending on the needs of the occupants in the building. For Ex: providing car parking at the basement or the stories used for commercial purpose.

A soft story is defined as "If the story is lesser than 70% stiff than that of the story exactly above or lesser than 80% stiff as the average three story above it, is known as soft story". Due to the lesser stiffness in this story the lateral forces due to earthquake must be resisted by columns and if these columns are weak then this will lead to the severe damage or collapse of the building.

The basic fundamental earthquake resistant design concept is the strong columns-weak beams criteria, so as to ensure safety of the occupants, i.e. during earthquake the beams yield before the columns get collapsed. The behaviour of the structure and degree of damages of the multi storeyed buildings depends on the capacity of structural members undergoing the process of deformations in elasticity during seismological ground motions. The collapse or the damage of the high rise building due to soft story is very often, the ground floor soft story during earth quake fail to resist the lateral earthquake forces. Since the distribution of the lateral forces in the high rise buildings is depend on the mass and the stiffness of the building. The soft story which has less stiffness depends upon the column to resist the lateral forces. Infill walls provide stiffness to the structures. And infill wall improves the seismic behaviour of structures. The opening provided in the masonry infill wall reduces the lateral strength of the structures. Because of infill materials building improves resistance of lateral load.

II. AIM AND SCOPE OF THE STUDY

A. Objectives of the present study

The objectives of the project are as listed below:

1. To study the optimum location of soft storey over the height of the building.
2. To study the optimum location of multi soft storey over the height of the building.
3. To obtain Displacement, Storey drift, Storey shear by Response spectrum method.

B. Present Study

Present study involves to find the optimum location of a single and a multi-soft story in a G+14 RCC tall building. The project is been carried out using the software ETABS 15.2.2. In total 6 models are created namely T1 to T6, out of which, T1, T2 & T3 are the models with single soft story at different locations in the building. T4, T5 & T6 are the models with multi soft story at different locations in the building. Analysis of each of the models were done and the results were compared with each other and the respective graphs were been obtained.

C. Scope of the study

The purpose of this hypothetical study is to evaluate the seismic properties and characteristics for multi storey residential building structures. The main aspect of this analysis is to obtain the sustainability of the building regarding the performance of the buildings by using the aid of capacity and the demand of the structure for a designed strong motion earthquake characteristics using the response spectrum method.

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III. TYPES OF MODELS

T1: Model with single soft story at Ground floor of the building.
T2: Model with single soft story at 8th floor of the building.
T3: Model with single soft story at 15th floor of the building.
T4: Model with multi soft story at Ground floor and 8th floor of the building.
T5: Model with multi soft story at 8th floor and top of the building.
T6: Model with multi soft story at ground floor and top of the building

IV. MODELLING

A. Model Definition

In this study we take a 15-storey RC building the geometrical parameters of the multi-story frame are as follows:

Type of building	- SMRF
Number of stories	- 15 stories
Floor height of each story	- 3m
Base supports	- Fixed
Structural type	- RCC Framed structure
Grade of concrete	- M30
Grade of steel	- Fe500
Size of columns	- 600mm x 600mm, 750mm x 750mm
Size of beams	- 230mm x 600mm
Depth of slab	- 175mm
Wall thickness	- 230 mm
Live load	- 2 kN/m^2 and 3 kN/m^2
Floor finish	- 1 kN/m^2
Seismic zone	- Zone V
Importance factor	- 1
Reduction factor	- 5
Soil type	- II

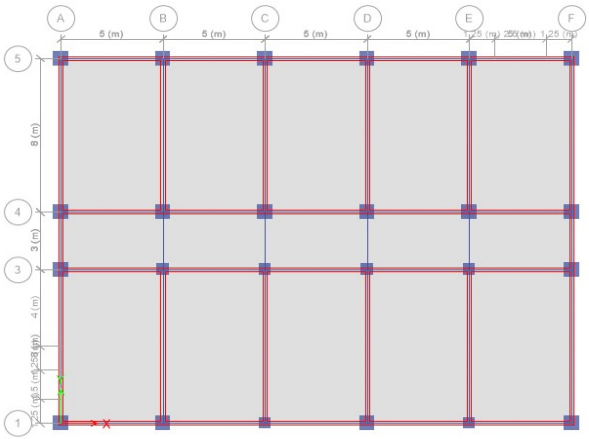

Fig. 1 Building Plan

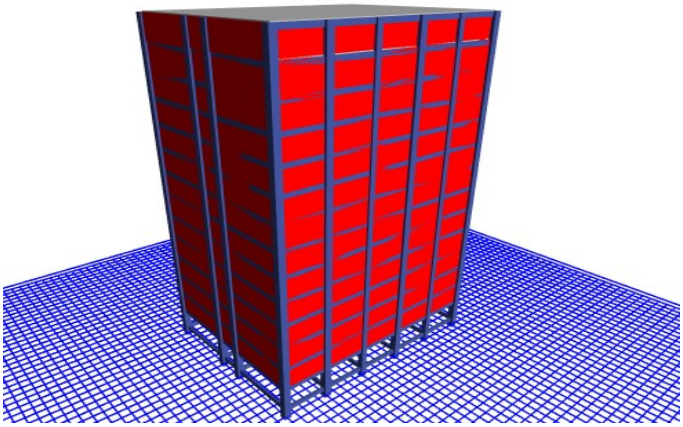

Fig. 2 3D rendered view

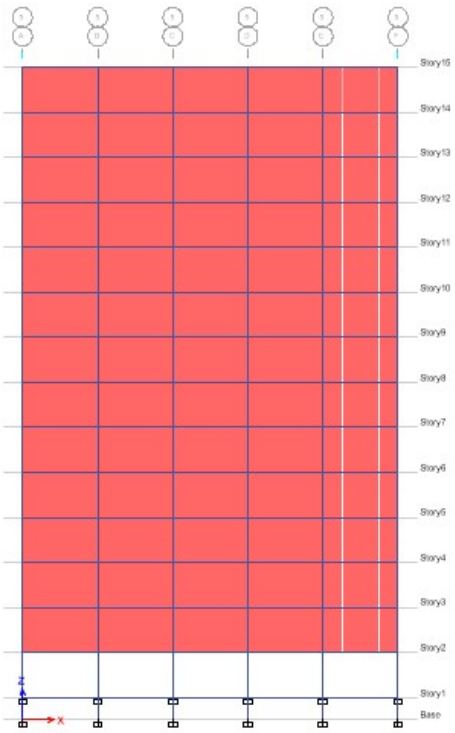

Fig. 3 Elevation of single soft storey at ground floor

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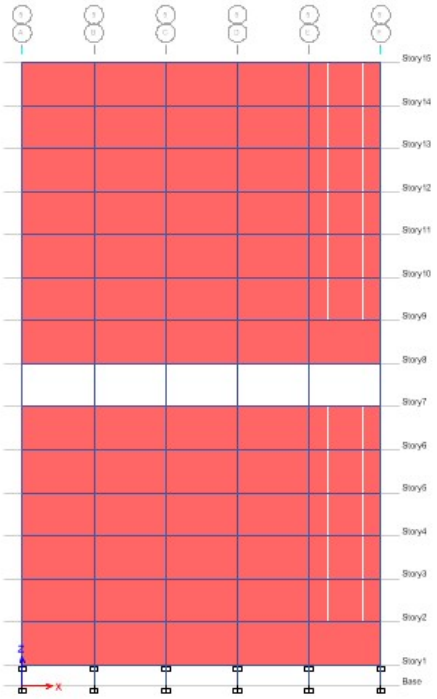

Fig. 4 Elevation of single soft storey at middle

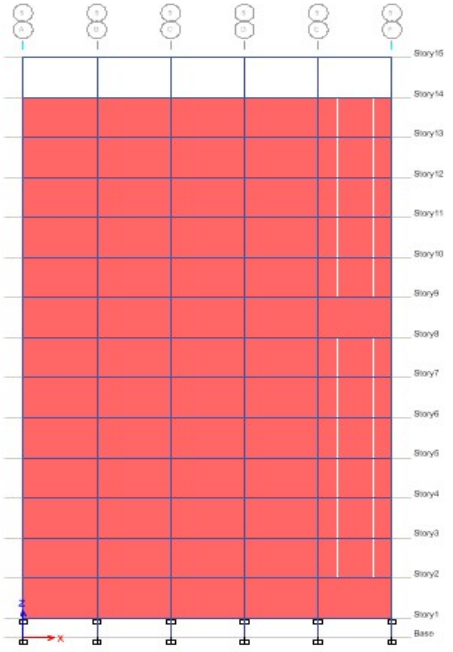

Fig. 5 Elevation of single soft storey at top

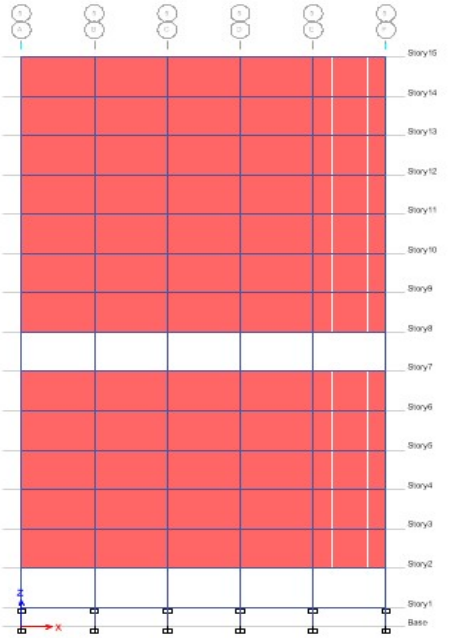

Fig. 6 Elevation of multi soft storey at ground and 8th floor

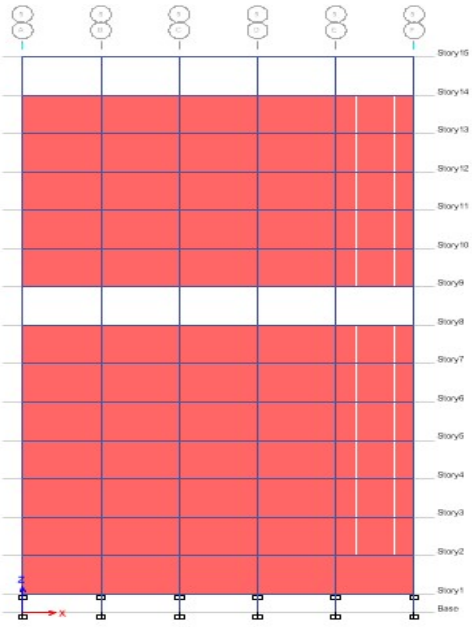

Fig. 7 Elevation of multi soft storey at 8th and top floor

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V. RESULTS

A study is done on the behavior of soft story at different locations of a multistory building by response spectrum analysis. The response is calculated in term of displacement, story drift and story shear.

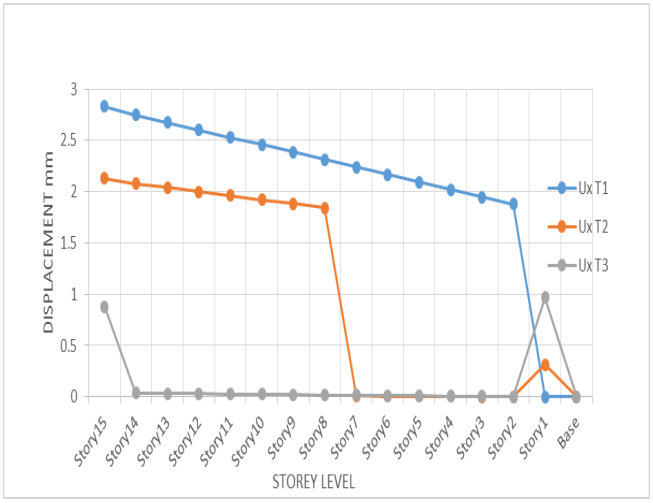

Fig. 8 Single soft storey displacement in X-direction

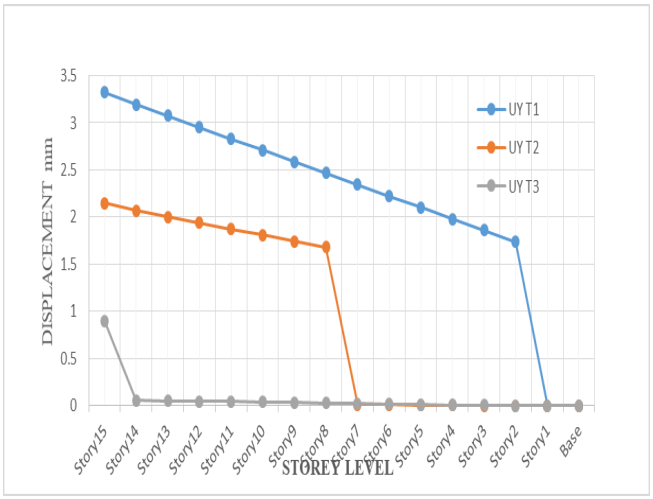

Fig. 9 Single soft storey displacement in Y-direction

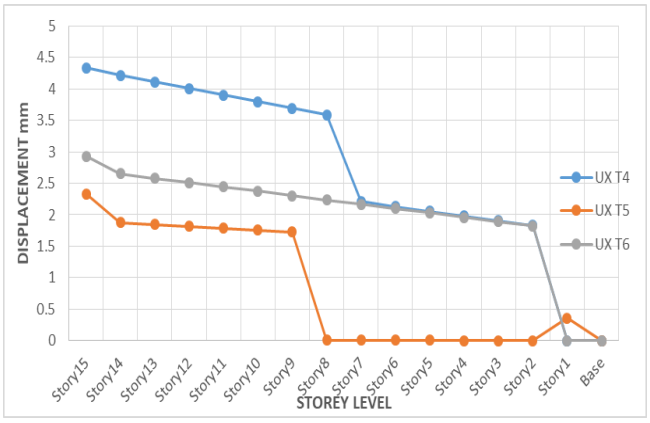

Fig. 10 Multi soft storey displacement in X-direction

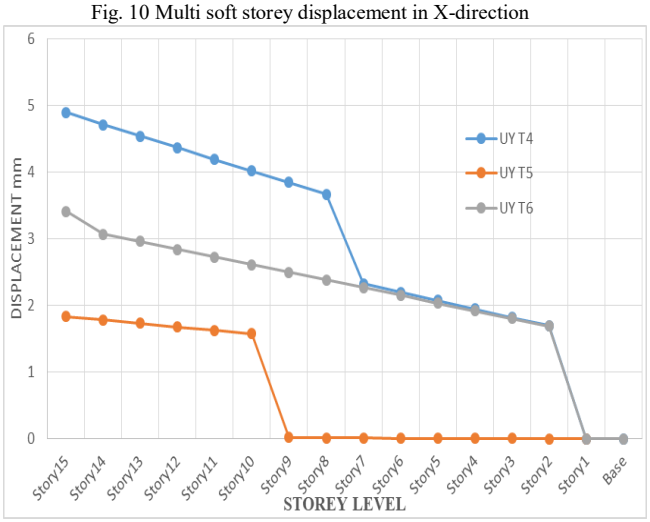

Fig. 11 Multi soft storey displacement in Y-direction

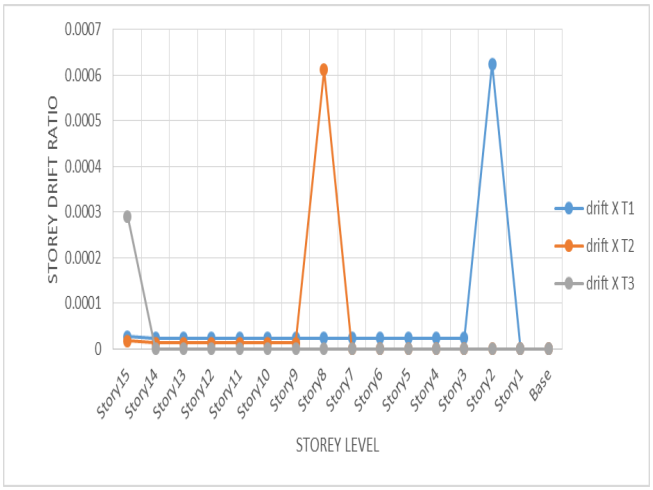

Fig. 12 Single soft storey drift in X-direction

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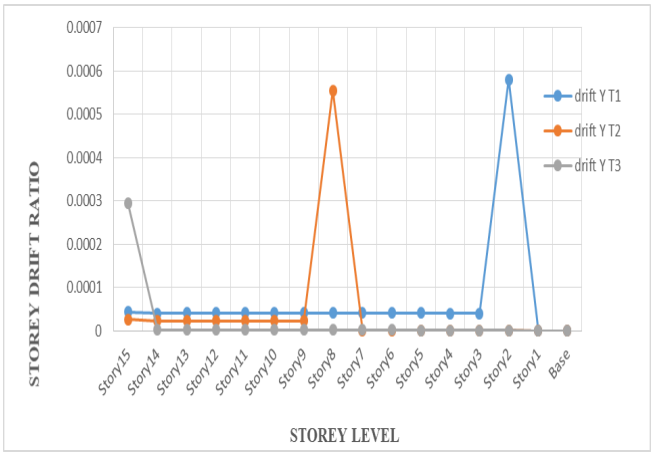

Fig. 13 Single soft storey drift in Y-direction

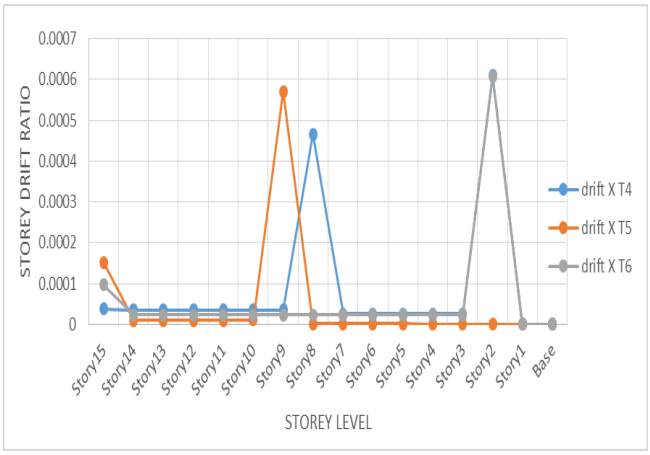

Fig. 14 Multi soft storey drift in X-direction

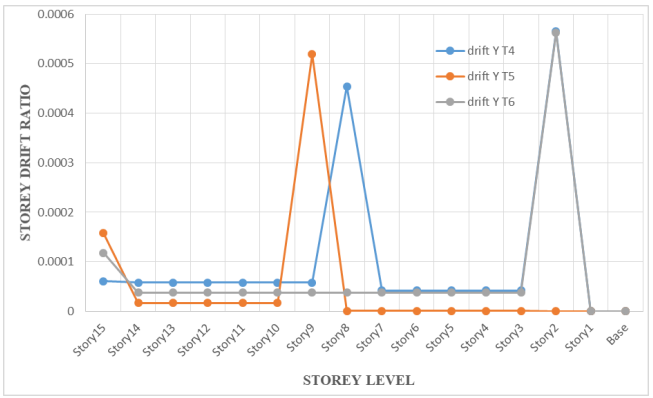

Fig. 15 Multi soft storey drift in Y-direction

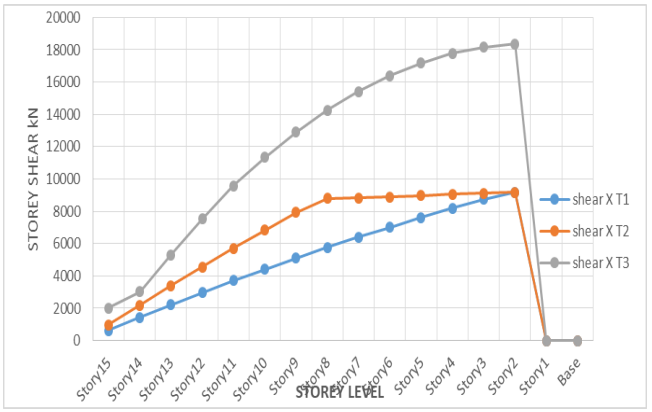

Fig. 16 Single soft storey shear in X-direction

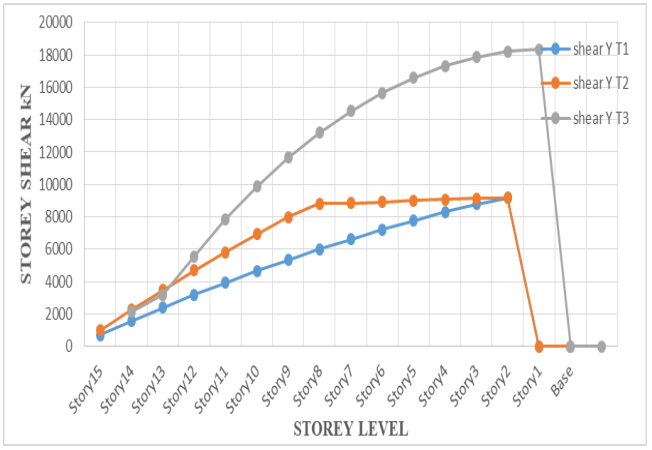

Fig. 17 Single soft storey shear in Y-direction

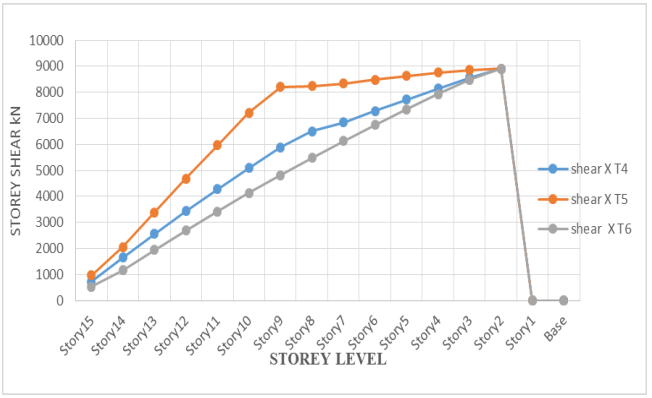

Fig. 18 Multi soft storey shear in X-direction

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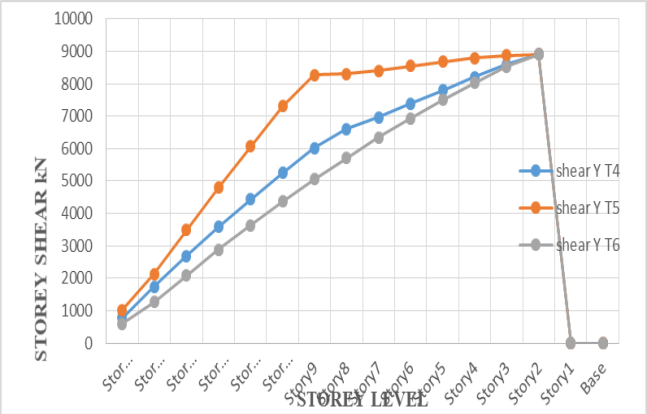

Fig. 19 Multi soft storey shear in Y-direction

VI. CONCLUSION

[1] Comparison of single soft storey at different locations in the building is developed and it is found that the earthquake response is maximum in the model with soft storey at ground floor and minimum in the model with soft storey at the top floor. From this one can say that the top soft storey will absorb more energy which results in the reduction of Earthquake response of the building.

[2] As the location of soft storey shifts to upper floors the maximum lateral drift value decreases. In case of unavoidable conditions, soft storey should be provided in upper floor levels above middle floor heights to decrease the impact of soft-story**.**

[3] From the above it is seen that, when the effect of soft storey is considered then the deflection has increase at that particular floor.

[4] RC frame buildings with open first storeys are known to perform poorly during in strong earthquake shaking

[5] The value of storey drift for all stories for all cases are found to be within permissible limit i.e. As per IS 1893:2002 they should not be more than 0.004 times to storey height of the structure

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