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SEISMIC EVALUATION OF SOFT STOREY BUILDING CONSIDERING ONE BY ONE FLOOR AS A SOFT STOREY

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ABSTRACT
With the advancement in field of high rise construction, various types of frame arrangements have been emerged. Le Corbuiser popularly known as LC was one of the pioneers of, what is now called five points of modern architecture. Hence, he deviced the concept of soft storey, in which stiffness is altered, along with storey height to achieve an asthetic view. The present study is an attempt to analyse soft storey considering one by one floor as a soft storey. The total cases studied are 7. Seismic zone II is considered in the analysis. To analyse soft storey building STAAD.Pro software used. Results are analysed in terms of bending moments, shear forces and nodal displacements. Graphical outputs are also generated

KEYWORDS: soft, storey, seismic, staad.pro, high rise

I. INTRODUCTION
Since the presence of a soft storey which has less rigidity than other storeys and if this fact was not taken into consideration it causes the construction to be affected by the earthquake. Because the columns in this part are forced by the earthquake more than the ones in the other parts of the building. Studies conducted suggest that walls increase the rigidity at a certain degree in the construction .

A construction is divided into two parts from the point where there is a soft storey of the constructions with equal rigidity between the storeys; the displacement of the peak points at the moment of a earthquake causes the other building with a soft storey to get damaged because the construction with a soft storey cannot show the same rigidity. Reinforced concrete frame buildings have become common form of construction with masonry infills in urban and semi urban areas in the world. The term infilled frame denotes a composite structure formed by the combination of a moment resisting plane frame and infill walls. The infill masonry may be of brick, concrete blocks, or stones. Ideally in present time the reinforced concrete frame is filled with bricks as non-structural wall for partition of rooms because of its advantages such as, thermal insulation, durability, cost and simple construction technique.

Many such buildings constructed in recent times have a special feature - the ground storey is remains open, which means the columns in the ground storey do not have any partition walls between them. This types of structures having no infill masonry walls in ground storey, but having infill masonry walls in all the upper storeys, are called as Open Ground Storey (OGS) Buildings. This open ground storey structure is also termed as structure with 'Soft Storey at Ground Floor'. They are also known as open first storey building (when the storey numbering starts with one from the ground storey itself), pilotis, or stilted buildings. Open first storey is now a day's unavoidable feature for the most of the urban multi-storey buildings because social and functional needs for parking, restaurant, commercial use etc. are compelling to provide an open first storey in high rise structure. Parking has become a necessary feature for the most of urban multi-storeyed buildings as the population is increasing at a very fast rate in urban areas leading to crisis of vehicle parking space. Hence the trend has been to utilize the ground storey of the building itself for parking purpose.

Shobha. L et. al. (2016) Since long Masonry Infills (MI) are being used to fill the voids between the horizontal and the vertical structural elements such as beams and columns. They are treated as non-structural elements and they are not considered during the analysis and design of the structure. But, when Laterally loaded, the MI tends to interact with the RC frame, changing the structural behavior. Here, in this study, an attempt is being made to

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incorporate the MI in the form an Equivalent Diagonal Strut (EDS), whose width is calculated using the various relations proposed by the researchers. A general review of the relations proposed by the Researchers in calculating the width of the EDS is being made and compared. The paper also focuses to study the variation in the Deflection and the Stiffness in the frame by modeling the MI as EDS and performing the linear analysis. The software being used for the analysis is ANSYS.

Vikunj K. Tilva at. al. (2016) In the present era we are spotting that the load bearing structures are substituted by the RC frame structures because of its sustainability against the earthquake, durability, long life span and also high strength. In past history, it has been observed that some of the greatest earthquakes on the earth have caused tremendous effect on human life and property. Most earthquake-induced casualties are the direct result of structural collapses. Structural collapse implies that the structural system is unable to withstand its own gravity loads. In this paper, symmetrical frame of commercial building (G+5) located in different seismic zones and different soil condition is considered by modeling of initial frame. Which contain the provisions of calculation of stiffness of infill masonry wall frames by modeling infill as a "Equivalent diagonal strut method" and IS 1893-2002. This linear static analysis is to be carried out on the models such as strut frame which is performed by using computer software STAAD-Pro from which different parameters are computed. In which it shows that infill panels increase the stiffness of the structure. Different parameters like displacement, storey drift, and base shear are calculated for the different storey height.

Ho CHOI et. al. (2014) In this study, RC frames with URM wall for typical school buildings in Korea are experimentally investigated to evaluate their seismic capacity. One-bay, one-fourth scale specimens with concrete block walls having different boundary condition due to beam rigidity are tested under in-plain loading. In this paper, the diagonal strut mechanism of concrete block wall is discussed using principal compressive strains on concrete block wall. The lateral strength carried by concrete block wall and RC frame are also explained based on the compressive stress acting on concrete block wall and the curvature distribution along both columns during the test.

Nikhil Agrawal et. al. (2013) Infilled frame structures are commonly used in buildings. Masonry infilled RC frames are the most common type of structures used for multi-storeyed constructions in the developing countries, even in those which are located in seismically active regions also. Masonry infill walls are mainly used to increase initial stiffness and strength of reinforced concrete (RC) frame buildings. In the present study, it is attempt to highlights the performance of masonry infilled reinforced concrete (RC) frames including open first storey of with and without opening. This opening is express in terms of various percentages here, in this paper, symmetrical frame of college building (G+5) located in seismic zone-III is considered by modelling of initial frame.According to FEMA-273, & ATC-40 which contain the provisions of calculation of stiffness of infilled frames by modelling infill as"Equivalent diagonal strut method". This analysis is to be carried out on the models such as bare frame, strut frame, strut frame with 15% centre &corner opening, which is performed by using computer software STAAD-Pro from which different parameters are computed. In which it shows that infill panels increase the stiffness of the structure.

II. GEOMATRY DETAIL & MODELLING

This thesis deals with comparative study of behaviour of soft storey building frames considering geometrical configurations under earthquake forces. This problem is associated with the soft story buildings considering geometrical and seismic parameters.

The framed buildings are subjected to vibrations because of earthquake and therefore seismic analysis is essential for these building frames. The fixed base systems are analyzed by employing different building frames in seismic zones by means of STAAD.Pro software. The responses of the same building frames are studied and the evaluation of the best geometry which satisfy one of the seismic zones is carried out

Following cases has taken in to consideration for the study:-
CASE- 1 Bare frame without equivalent diagonal struts
CASE-2 Equivalent diagonal struts at centre of structure

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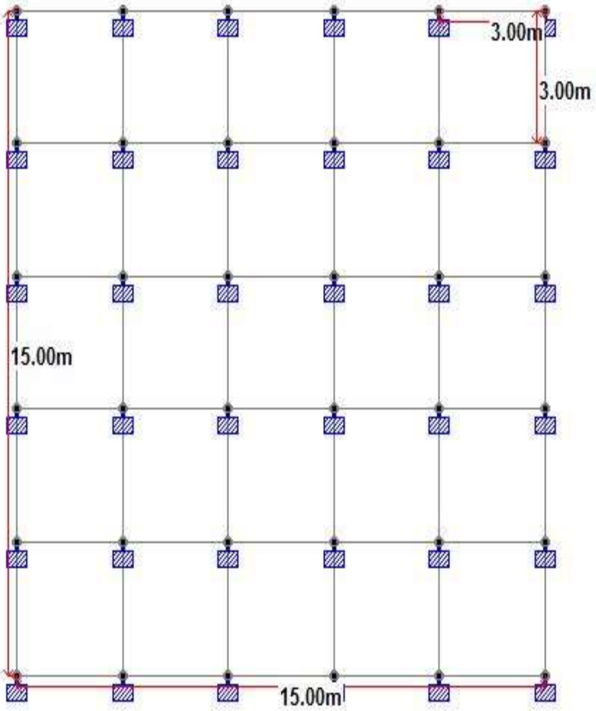

Fig. 3.1: Structure plan of geometry

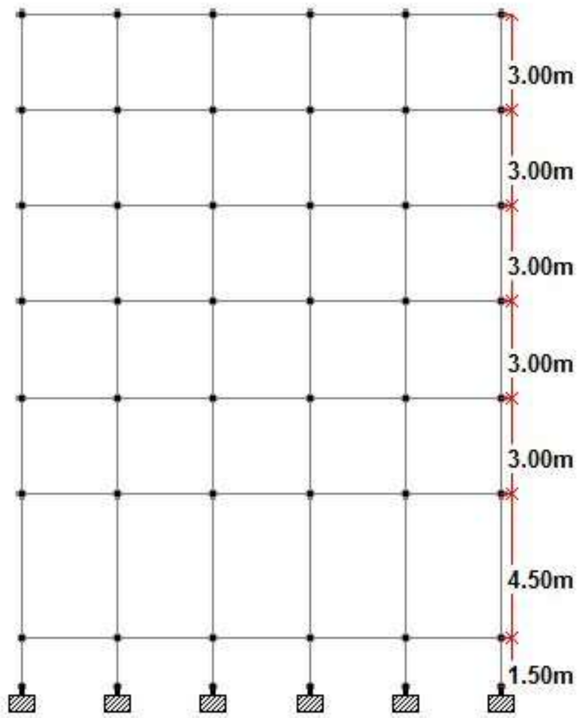

Fig 3.2 Soft storey at first storey of 4.5 m

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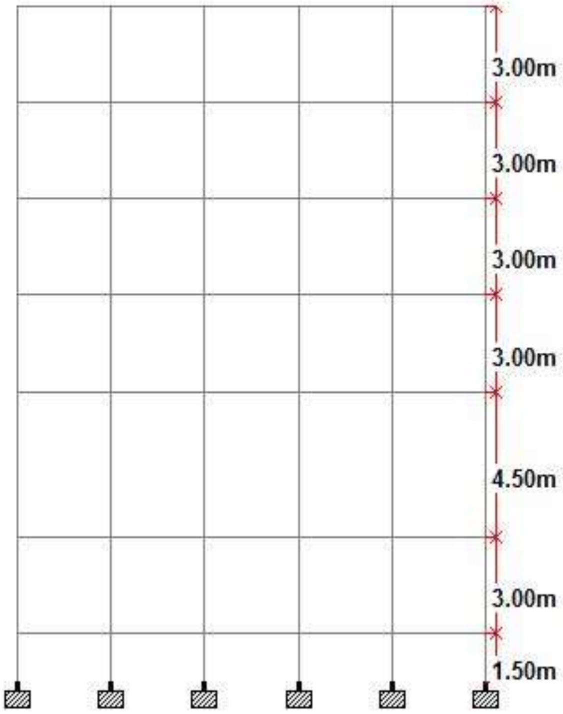

Fig 3.3: Soft storey at second storey of 4.5 m

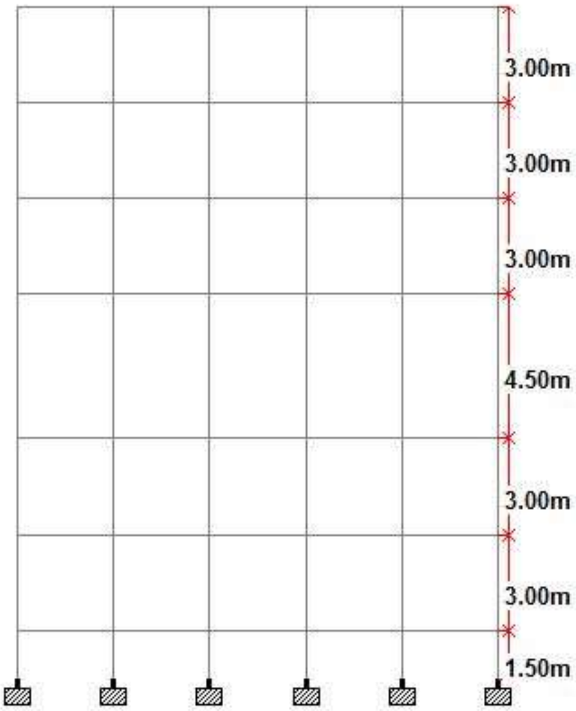

Fig 3.4: Soft storey at third storey of 4.5 m

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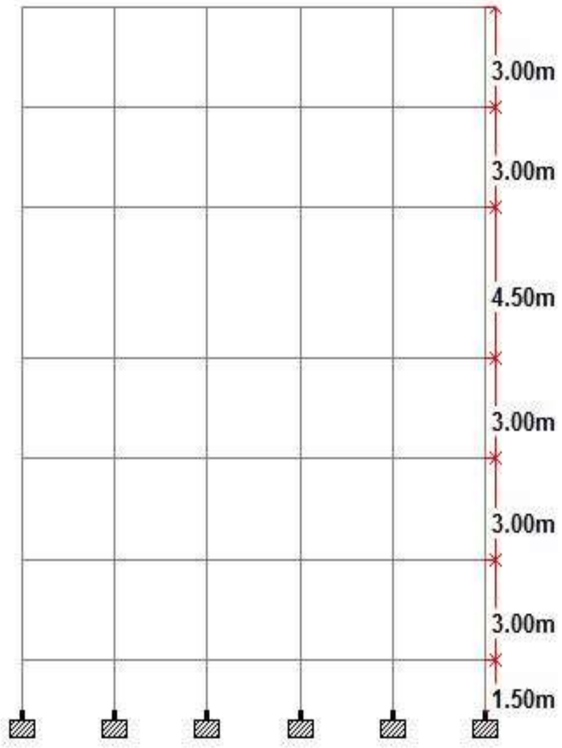

Fig 3.5: Soft storey at second storey of 4.5 m

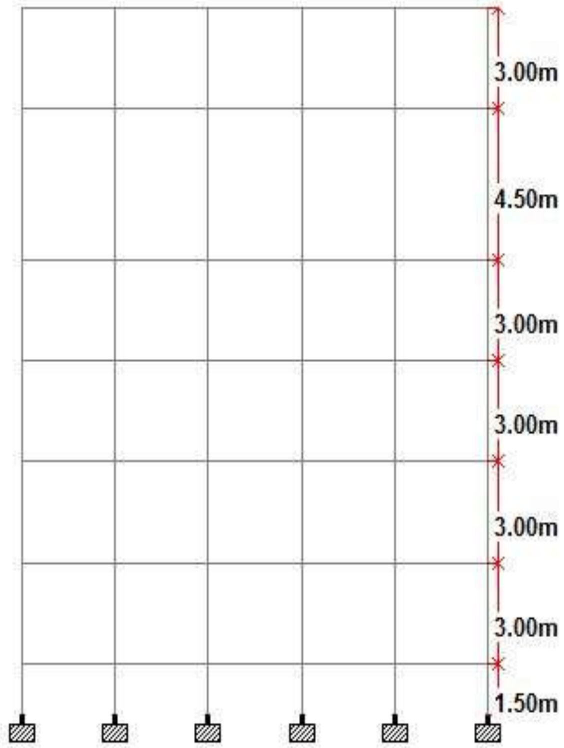

Fig 3.6: Soft storey at third storey of 4.5 m

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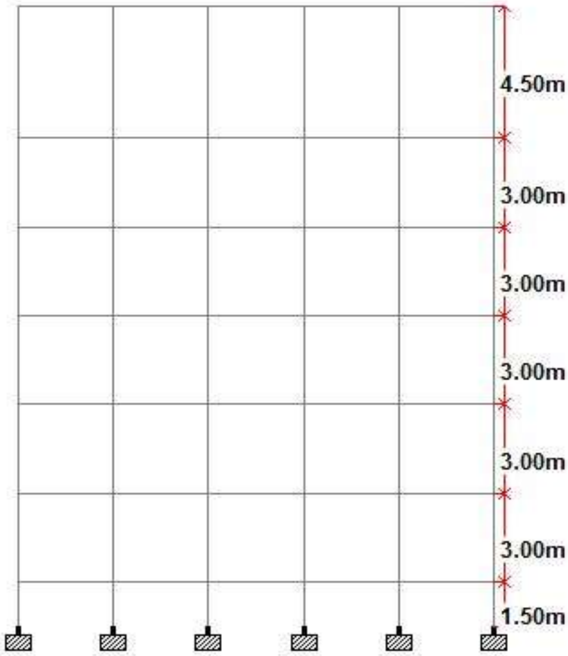

Fig 3.7: Soft storey at sixth storey of 4.5 m

III. RESULTS & DISCUSSION

Bending Moment

Bending moment is shown in Table 4.1 and Fig. 4.1:

Table 4.1: Bending Moment (kNm)

Bending moment (kNm)	
Soft storey	**without struts**
No soft	138.321
1st storey	178.319
2nd storey	179.089
3rd storey	173.252
4th storey	165.886
5th storey	144.338
6th storey	144.41

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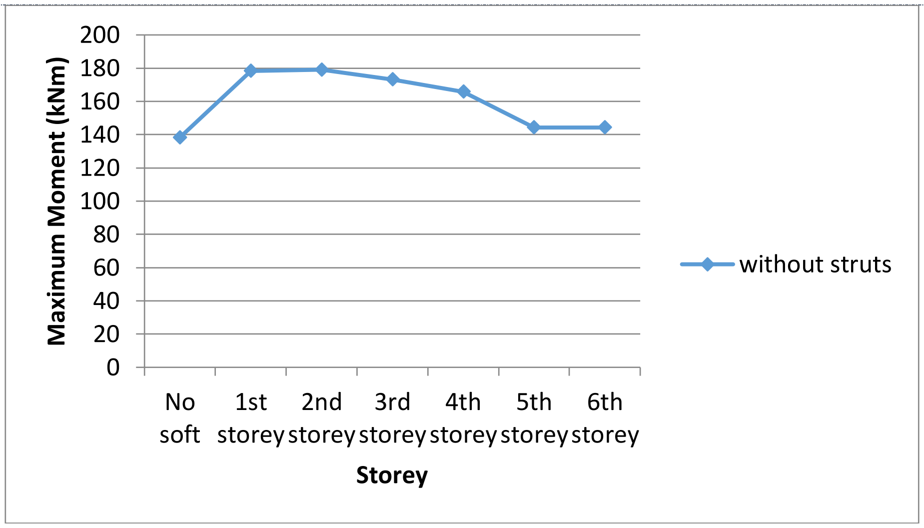

Fig. 4.1: Bending Moment (kNm)

Shear Force

Shear force is shown in Table 4.2 and Fig. 4.2:

Table 4.2: Shear Force (kN)

Shear Force (kN)	
Soft storey	**without struts**
No soft	123.121
1st storey	150.413
2nd storey	165.772
3rd storey	156.162
4th storey	175.701
5th storey	133.788
6th storey	125.846

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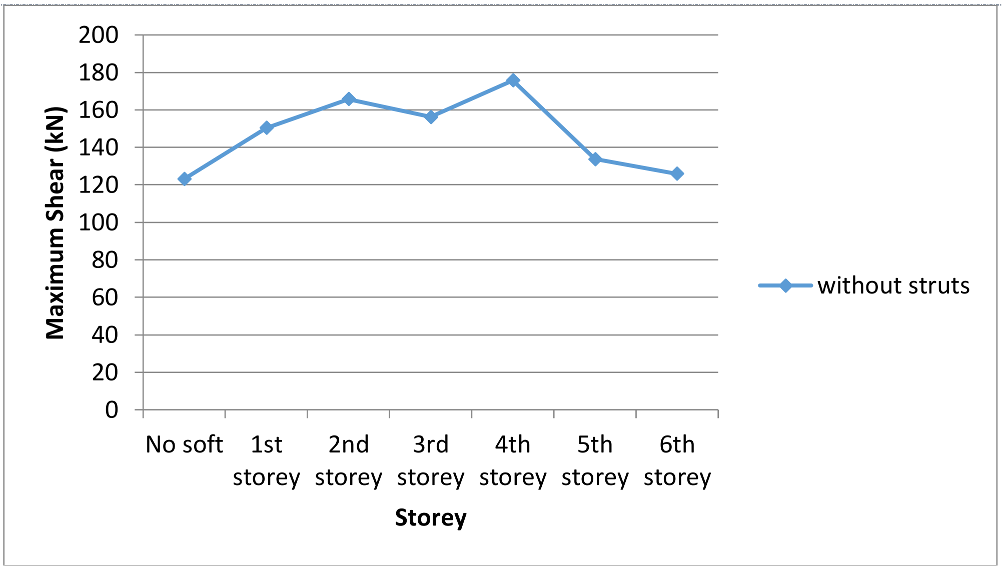

Fig. 4.2: Shear Force (kN)

Maximum Nodal Displacement

Maximum Nodal Displacement in X direction are shown in Table 4.3 and Fig. 4.3:

Table 4.3: Maximum Nodal Displacement (mm) in X direction

Maximum Nodal Displacement (mm) in X direction	
Soft storey	**without struts**
No soft	23.975
1st storey	33.713
2nd storey	34.045
3rd storey	33.692
4th storey	32.796
5th storey	31.156
6th storey	28.538

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Fig. 4.3: Maximum Nodal Displacement (mm) in X direction

Maximum Nodal Displacement in Z direction are shown in Table 4.4 and Fig. 4.4:

Table 4.4: Maximum Nodal Displacement (mm) in Z direction

Maximum Nodal Displacement (mm) in Z direction	
Soft storey	**without struts**
No soft	52.376
1st storey	77.775
2nd storey	77.937
3rd storey	76.872
4th storey	74.426
5th storey	70.068
6th storey	63.175

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Fig. 4.4: Maximum Nodal Displacement (mm) in Z direction

IV. CONCLUSION

1. Bending Moments

a. It was observed that maximum bending moment in 2nd storey and minimum is in no soft storey building.

b. While observing nature of graph, soft storey at 6th storey is minimum hence at top floor soft storey is recommended.

2. Shear Forces

a. It was observed that maximum shear force in 4th storey and minimum is in with no soft storey building.

b. While observing nature of graph, soft storey at 6th storey is minimum hence at top floor soft storey is recommended.

3. Maximum Nodal Displacements

a. Maximum displacement is Z direction is more than X direction.

b. It was observed that maximum displacement in 2nd storey and minimum is in no soft storey building.

a. While observing nature of graph, soft storey at 6th storey is minimum hence at top floor soft storey is recommended.

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