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Seismic Vulnerability of Column in Multi Story Building Without Including Soft Story and Including Soft Story at Different Levels

Mahesh Pawar[1]. Akshay Mahajan[2]. Akshay Waghmode[3]. Sagar Makwana[4]
Padmabhushan Vasantdada Patil Institute of Technology
Bavdhan Pune -411021

***Abstract*:- The increase in urbanization and increasing unbalanced of required space to availability it become imperative to provide open ground storey in commercial and residential buildings .These provision reduce the siffness of the lateral load resisting system and a progressive collapse becomes unavoidable in severe earthquake for such storey due to soft storey .Soft storey behavior exhibits higher stress at the column and the column fails as the plastic hinges are not formed on predetermine position .Thus,the vulnerability of soft story effect has rethink to structural engineer design of soft storey area in high seismicity. The present analytical study investigate the influence of some parameter of behavior of building with soft storey . The modeling of the whole building is carried out using the computer program E-TABS 2016.Parametric studies on displacement, inter storey drift and storey shear have been carried out using equivalent static analysis to investigate the influence of these parameters on the behavior of buildings with soft storey soft storey. The selected building analyzed through three on of model.**

Keywords-Multistorey buildings, sesmic analysis storey drift, storey shear, soft storey.

INTRODUCTION

Reinforced concrete structure in recent time has a special feature i.e the ground storey buildings are left open for the purpose of parking .open ground storey is adopted in many buildings in presently due to the advantages of open space meet the economical and architectural demands. But this open stories used in most sevral damaged or collapse R.C. buildings, introduced severe irregularity of sudden change in stiffness between the ground storey and upper storey since they had infilled bricks walls which increase the lateral stiffner of frame by the factor of 3 to 4 times. in such building dynamic ductility demand during probable earthquake gets concentrated in soft storey and upper storey tends to remain elastic hence building totally collapse during earthquake.

Fig.1 Collapse of a building with soft storey

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SOFT STOREY BEHAVIORS

The many building structure having parking and commercial area in their first stories , suffer structural damages and collapsing recent earthquake. a large open area with less in fill and exterior valves and higher floor level at the ground level results in soft stories and hence damage . in such building the stiffness of lateral load resisting system at those stories in quite less than the stories above and below .

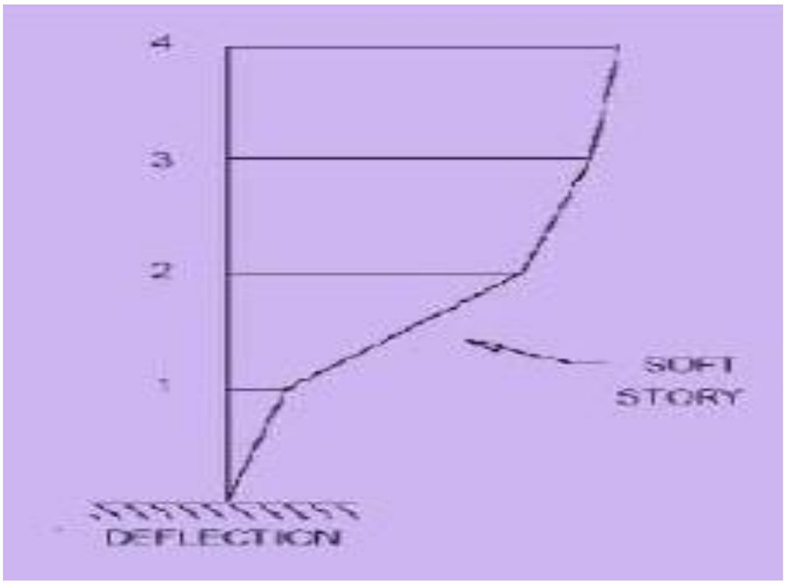

Fig.2 Soft storey behavior of a building structure under lateral loading

During an earthquake if abnormal inter stories drifts between adjacent stories occurs the lateral force can not be well disturbed along the height of structure . this situation causes the lateral force to concentrate on the stories having large displacement . in addition , if local ductility demand are not meet in design of such building structure for that stories and enter storey drifts are not limited , a local failure mechanism , even wores , a storey failure mechanism which may leads to collapse of system , may due to form higher level of load deformation effects .

A lateral displacement of stories a function of stiffness, mass and lateral force distributed on that stories . it is also known that lateral force distribution along height of building is direct related to mass and stiffness of stories . if load deformation effect is consider to be main reason for the dynamic collapse of structure during earthquake accurately determine lateral displacement calculated in elastic design process may provide very important information about the structural behaver of system . therefore dynamic analysis procedure is required in many of actual code for accurate distribution of earthquake forces along the building heights, determine modal effect of local ductility demands efficiently , although some of correct codes define of stories irregularities by stiffness comparison of adjacent floors , displacement based ctiteria for such irregularity determination is more efficient since is covers all the mass stiffness and force distribution concepts .

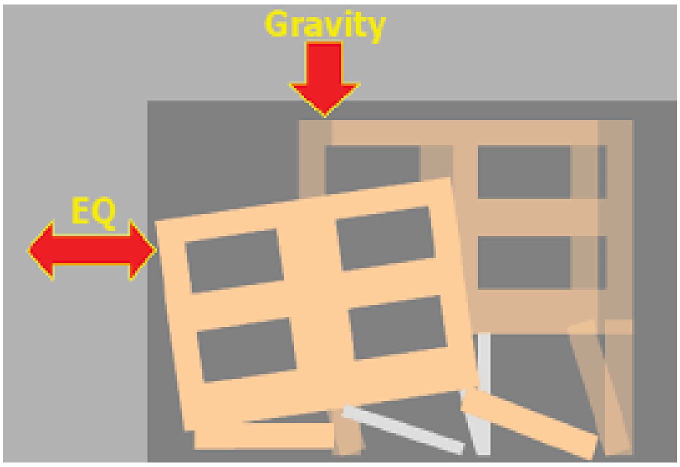

Fig.3 Collapse mechanism of a building structure having a soft storey

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METHODOLOGY

The study is carried out on reinforce concrete moment resisting frame building is modeled using computer software E-tabs 2016. Column are square to focus on soft storey effect ,without being distracted by the issues like orientation of column are assumed to be fixed. the floor slab are assumed to acts as diaphragms which insure integral action of on vertical load resisting element and modeled as four noded shell elements which six degree of freedom at each node.

Seismic loads will be considered acting horizontal direction as per IS 1893:2000.the soft storey effect by produced by providing no infill in particular storey level,where other level are proper infill effect in same model even intermediate column where curtailed as would be a functional use.

Seismic analysis is done by the response spectrum method. It has been adopted as a standard way of representation of effect of ground acceleration on structures. It reflects frequency contents, amplitude of ground motion and effect of subsequent filtering by the structure.

DISCRIPTION OF STRUCTUTAL MODELS

The open ground storey RC buildings exhibits several advantages over conventional moment resisting frame. However ,the structural effectiveness of open ground storey construction is hindered because soft storey effect exhibit higher stress at the column connection and most likely fail. In present work 11 storied RC building is being modeled using computer software E-TABS 2016 The selection of building configuration basically done as per IS:456-2000 and loading details are taken as per IS:875-1987.The static then performed using computer software E-TABS 2016 and respective observation are studied. During the development of the analytical models. several issues are taken into consideration

In this work is important to evaluate the existance of soft storey behavior in the structure. For this typical rectangular structure is taken .Having 7 bays in x- direction each have 4m span and 6 bays in y-direction have 3m span ,the z directon have 11 no of bay first bay have height 4m and oher remaining have 3m height.Three buildings are generated with this plan of building by introducing different variation and displacement ,storey drift, base shear, storey shear are various parameter discuss in this work.

In present study 11 storied "residential type" open ground RC frame building is consided which have following property.

1. Size of building : 24m x 15m
2. Grade of concrete: M25
3. Geade of steel:Fe 500
4. Height of bottom storey: 4 m
5. Height of remaining storey: 3 m
6. Slab thickness : 150 mm
7. Wall thickness:230mm
8. Size of column
9. External :300mm x 600mm Internal:300mm x1200mm (below 5 th floor) Internal:300mm x 900mm (above 5 th floor)
10. Size of beam : 300mm x 900 mm
11. Live load on floor : 5 KN/m2
12. Floor finish: 1 KN/m2
13. Sesmic zone: v
14. Soil condition :High 15.Importance factor : 1.5

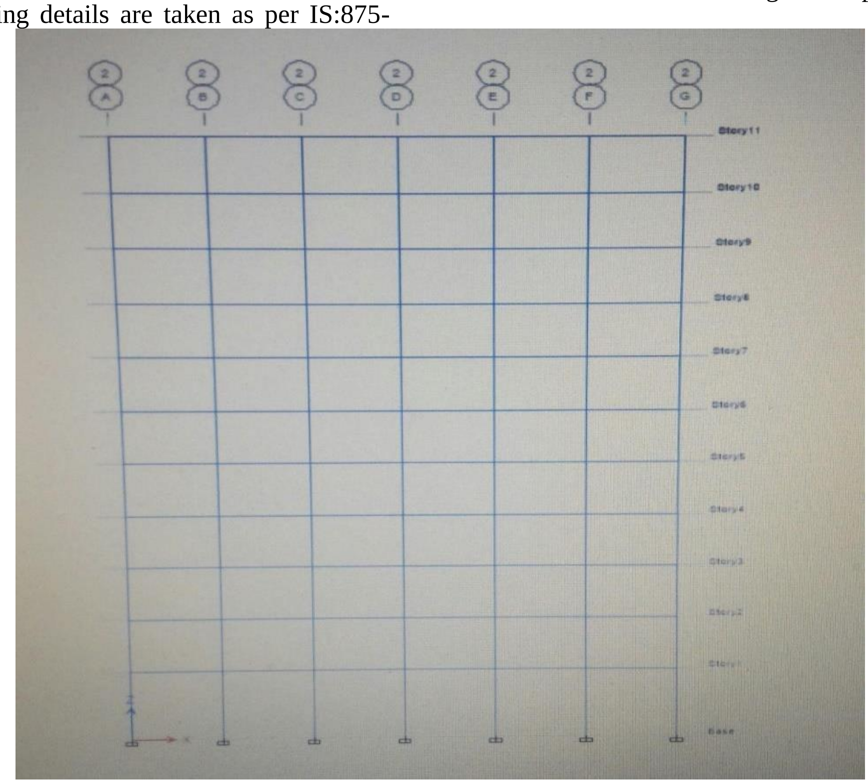

Fig 4 Plan View of RC Building

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RESULTS AND DISCUSSION

Section is deals with observations and interpretations obtained from the static analysis Equivalent static analysis is performed for Three different models by using the computer software. Model-1 is a building have without soft storey. In model-2 The soft storey provide at first storey and second storey. model-3 is similar to model-2 with only difference that the soft storey provided at sixth and eighth storey. So response of the three models is investigated in terms of displacement and storey shear.

Displacement in X-Direction

For easy comparison of the lateral displacement of the selected building, plots of the storey level displacement in X-direction versus height are made for the three models, all imposed on the graph. Fig no 5.

Each model is compared for displacement in X direction

Displacement in X-direction of Corner Column			
storey	**Model 1**	**Model 2**	**Model 3**
11	**4.937**	**4.872**	**4.975**
10	**5.717**	**5.634**	**5.765**
9	**5.146**	**5.069**	**5.185**
8	**4.585**	**4.679**	**4.493**
7	**4.459**	**4.388**	**4.492**
6	**4.256**	**4.330**	**4.183**
5	**3.034**	**3.068**	**3.019**
4	**2.969**	**2.932**	**2.990**
3	**1.823**	**1.799**	**1.838**
2	**6.202**	**6.133**	**6.241**
1	**1.776**	**1.767**	**1.7813**
G.F	**0**	**0**	**0**

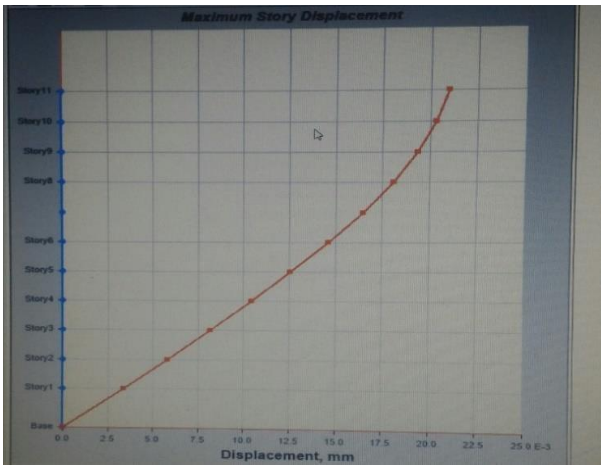

Fig.5 Displacement in X-Direction of model 1

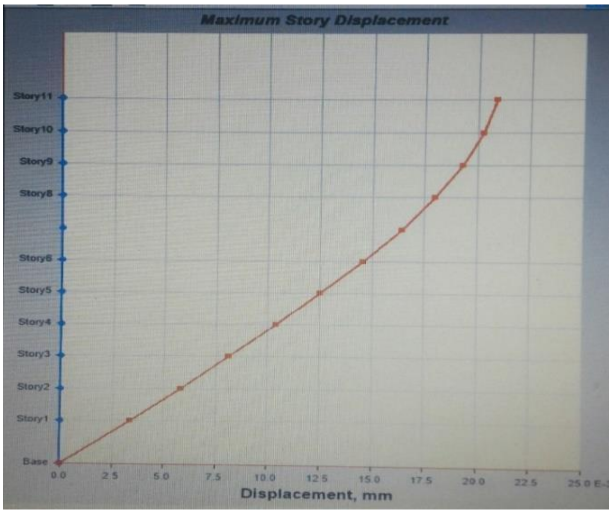

Fig.6 Displacement in X-Direction of model 2

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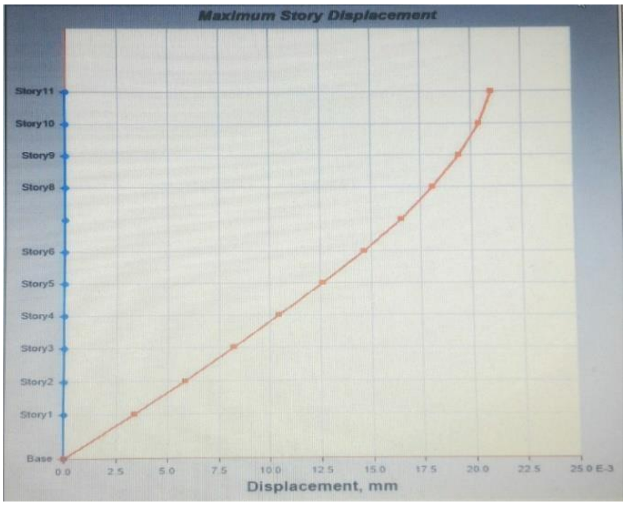

Fig.7 Displacement in X-Direction of model 3

Displacement in Y-direction of Corner Column			
Storey	**Model 1**	**Model 2**	**Model 3**
11	**0.20971**	**0.020867948**	**0.021030479**
10	**0.02033**	**0.20237243**	**0.020389674**
9	**0.01936**	**0.019281166**	**0.019416741**
8	**0.01807**	**0.018002502**	**0.018116686**
7	**0.01648**	**0.016423896**	**0.016524711**
6	**0.01463**	**0.014576921**	**0.014662898**
5	**0.01255**	**0.012503425**	**0.012581274**
4	**0.01043**	**0.010386729**	**0.010455098**
3	**0.00817**	**0.008134836**	**0.012581274**
2	**0.00580**	**0.005783966**	**0.008190631**
1	**0.00337**	**0.00357257**	**0.003381343**
G.F	**0**	**0**	**0**

Storey shear in X-Direction

Shear in X-direction of Corner Column(KN)			
Storey	**Model 1**	**Model 2**	**Model 3**
11	**4.1076**	**4.04897342**	**-4.17488131**
10	**3.6638**	**3.52429163**	**3.765310063**
9	**1.3861**	**1.476566098**	**-3.81674611**
8	**3.7783**	**-3.76237008**	**-3.81674611**
7	**1.0103**	**9.682298829**	**1.037598975**
6	**2.9595**	**2.984259134**	**2.955452694**
5	**2.7321**	**2.72455087**	**-2.756829231**
4	**2.2253**	**-2.23925861**	**-2.238213299**
3	**2.7982**	**2.78792542**	**2.112236345**
2	**2.0972**	**2.103910425**	**-2.11236335**
1	**3.1036**	**-3.09886397**	**-3.13574594**
G.F	**0**	**0**	**0**

Storey shear in Y-Direction

Shear in Y-direction of Corner Column(KN)			
Storey	**Model 1**	**Model 2**	**Model 3**
11	**4.1076**	**0.176831250**	**0.1806815**
10	**3.6638**	**0.364403040**	**0.37229036**
9	**1.3861**	**1.476566098**	**0.55032485**
8	**3.7783**	**-3.76237008**	**0.71560680**
7	**1.0103**	**9.682298829**	**0.87179879**
6	**2.9595**	**2.984259134**	**1.00247541**
5	**2.7321**	**-2.72455087**	**1.12356548**
4	**2.2253**	**-2.23925861**	**1.22646548**
3	**2.7982**	**1.29165876**	**1.30788738**
2	**2.0972**	**1.35407271**	**1.3640958**
1	**3.1036**	**1.38811274**	**1.39812722**
G.F	**0**	**0**	**0**

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CONCLUSIONS

We can say that Lateral Displacement is largest in bare frame. With soft story defect both for earthquake force in X-direction as Well as in Z-direction for Corner column as well for intermediate columns. Displacement of intermediate column is more by 0.03% and 0.05% in X and Z direction respectively w.r.t corner column.

Minimum displacement for corner column is observed in the building in which shear wall is introduced in X direction as well as in Z direction but in case of intermediate column, displacement is minimum in building having masonry infill in upper floors and with increased column stiffness of bottom story in comparison to the building with shear wall in X and Z direction.

Building having masonry infiil in upper floors and with increased column stiffness of bottom story and building with shear wall in core has a small first storey displacement of about 17% and 16.05%of respectively of that building having masonry infill in upper floors only. this implies that crucial displacement may be effectively reduce if the stiffness of first storey is made with in order of magnitude is equal to stiffness of storey above.

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