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INFILL WALL STIFFNESS CONSIDERATION IN EARTHQUAKE ANALYSIS

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Abstract—In this study we just compare our result with slandered solution solved in in Earthquake resistant Design of structure [4] page no 296-311 on sap 2000 so we can assure on further work result in this study we also focused on mode shapes, natural frequencies, Eigen values and base shear of structure

Keywords—Infill wall, high rise building, equivalent strut model, displacement, lump mass models, etc.

I. INTRODUCTION

In metro city there is necessity to build a high rise structure due to high population and less land availability. Also the human ambition is force to create taller structure. Large numbers of high rise reinforced concrete structure are constructing to full fill the human requirement. It is seen that stiffness and strength of reinforced concrete structure is greatly increased by considering infill masonry. In conventional analysis we just consider the frame and analysis it with the help of any computer applicable software such as STADD Pro, ETAB, and SAP etc. In such analysis wall are considered just as a load on beam of frame structure and they do not carry any load. But the infill walls are providing some stiffness and strength in case when horizontal forces act on the structure. A lot of work has been carried on consideration of infill wall stiffening effect and its construction details in which most of them are based on equivalent trut method in which method, wall panels are replaced with the help of equivalent strut. In these work lump mass models of solved problem is again solved by software and compare the results of analytical and software solved problem base on above result we create lump mass model and bare frame of actual building and its base shear is compare with each other, also lump mass and frame structure of equivalent strut models are created and their base shears are compare. For manual checking base shear of both frames are found out by static method of IS 1893-2002

II. LITERATURE REVIEW

C. Donmez & M. A. Cankaya [5] "Drift Behavior of Reinforced Concrete Frames with Infill Walls at Progressing Damage Levels" in this paper they investigate the in-plane drift behavior of the RC frames With infill walls to provide hard data about the drift capacity and its distribution about the height of the frames. for that purpose they prepared Four scaled four-story reinforced concrete frames were tested with and without infill walls. Frames were subjected to pseudo-static cyclic loading with a triangular profile. Considering that natural frequencies and the modal shapes are interrelated with the stiffness and the drift behavior of the frames under dynamic loading, these parameters are also investigated. It is observed that progressing damage and infill walls caused major changes on both stiffness and drift behavior of the tested frames. Effect of changes could be either advantageous or disadvantageous depending on the failure mode. Results show that distribution of drift that is based on mode shapes indicate higher local concentrations than distribution observed under forced static conditions

A.J.Urich & J.L. Beauperthuy [6] “Protagonism of the Infill Walls on Seismic of Venezuela Buildings Performance” in this paper they used the predominant structural system used in Venezuela the reinforced concrete frames with masonry infill. It is still common that structural engineers underestimate those masonry walls’ stiffness, strength and fragility, considering them only as a permanent weight and seismic mass. However, the assessments of buildings damaged by recent earthquakes have left in evidence that masonry walls, especially infill’s, are the protagonists of seismic performance. Masonry walls are initially much stiffer than frames; therefore, when buildings are exposed to a seismic shake, the first pulses are resisted entirely by the infill walls, with minimal contribution from the main structure, which enter to play only after walls become broken; consequently, all the drift demand is concentrated in the building’s stories or regions whose walls are the first to fail. The partially broken walls are used to cause a "soft story" and "short column" mechanisms that did not exist in the original configuration of the building.

Mr. V. P. Jamnekar & Dr. P. V. Durg [7] “SEISMIC EVALUATION OF BRICK MASONRY INFILL” The diagonal strut has been modeled by them and using SAP 2000 software and pushover analysis is performed. The example building is analysed, the effect of masonry infill in seismic evaluation of bare frame and frame with 40% infill is studied. The results obtained from the analysis are compared in terms of strength and stiffness with bare frame.

III. CONCEPT OF EQUIVALENT STRUT

Many investigators have proposed various approximations for the width of equivalent diagonal strut. Originally proposed by polyakov [1] (1956)and subsequently developed by many investigators, the width of strut depends on the length of contact between wall and column αh and between the wall and beam αL shown in fig 1. Stafford smith [2] (1966) developed the formulation for αh and αL

On the basis of beam on an elastic foundation. the following equations are proposed

$$\alpha h = \frac{\pi}{2}\sqrt[4]{\frac{4E_F h I_c}{t \sin 2\theta E_m}}$$

$$\alpha L = \pi\sqrt[4]{\frac{4E_F L I_b}{t \sin 2\theta E_m}}$$

Where

E_F and E_m= elastic modulus of the masonry wall and frame material respectively

t, h, L thickness, height and length of infill wall respectively

I_c and I_b= moment of inertia of column and beam frame respectively.

$$\theta = \tan^{-1}(h/L)$$

Hendry [3] (1998) has proposed following equation to determine equivalent strut or equivalent or effective width of strut.

$$w_{ef} = \frac{1}{2}\sqrt{\alpha h^2 + \alpha L^2}$$

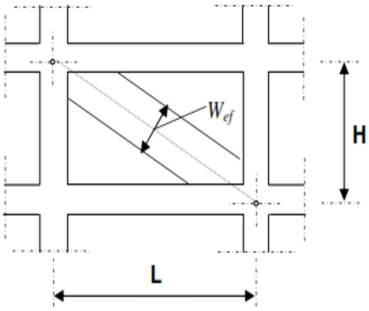

Fig1. Equivalent strut

IV. OBJECTIVE OF THE STUDY

The main objective of study is found out response of high story building with infill and without infill and compare the result of both to check the importance of infill wall on structural behavior in form of base shear, nodal displacement, etc. and make Comparative study of stiffness effect and Time period, Base, Shear etc

V. RESULT AND DISCUSSION

Problem solved in Earthquake resistant Design of structure [4] page no 296-311 are again solved with the software and the result of both analytical solution and software are as follows

- **Natural time period**
    i. Lump mass model without infill model

Table.1.

Mode no.	**Natural Time Period by analytical solution (sec)**	**Natural Time Period by software (sec)**
1	0.6977	0.69786
2	0.2450	0.245026
3	0.1636	0.163643
4	0.1383	0.138302

ii. Lump mass model with infill model
(Equivalent strut model)

Table 2.

Mode no.	**Natural Time Period by analytical solution**	**Natural Time Period by software**
1	0.1655	0.165503
2	0.0581	0.05811
3	0.0388	0.038809
4	0.0328	0.032799

- **Mode shapes**
    i. Mode shape of Lump mass model without infill as per analytical solution shown in Fig.2

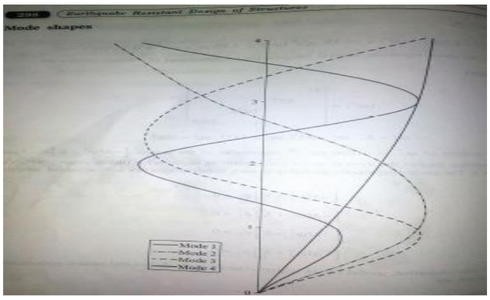

Fig.2

ii. Mode shape of Lump mass model without infill model as per software shown in fig 3.

Table3.

STOREY HEIGHT(mtr)	**MODE1**	**MODE 2**	**MODE 3**	**MODE 4**
14	0.087167	-0.08649	0.083884	-0.06956

10.5	0.079813	-0.02729	-0.04484	0.079882
7	0.060751	0.064378	-0.05396	-0.06899
3.5	0.03278	0.079456	0.080849	0.039775
0	0	0	0	0

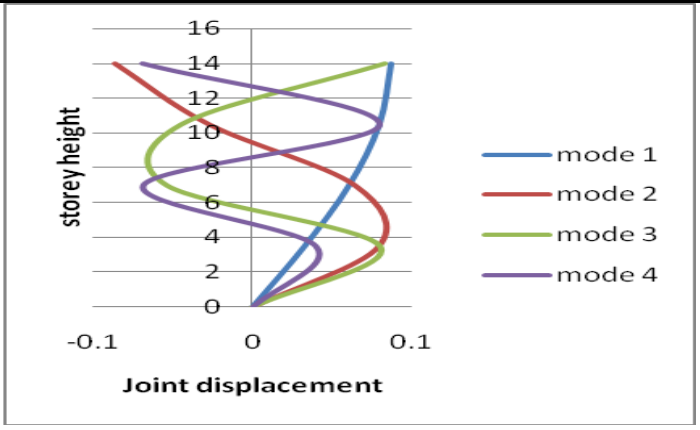

Fig.3
(Graphical representation of table 3)

iii. Mode shape Lump mass model with infill model (Equivalent strut model) as per software shown in fig 4.

Table 4.

STOREY HEIGHT (mtr)	MODE1	MODE 2	MODE 3	MODE 4
14	0.087167	-0.08649	-0.08388	0.069563
10.5	0.079813	-0.02729	0.044835	-0.07988
7	0.060751	0.064378	0.05396	0.068988
3.5	0.03278	0.079456	-0.08085	-0.03978
0	0	0	0	0

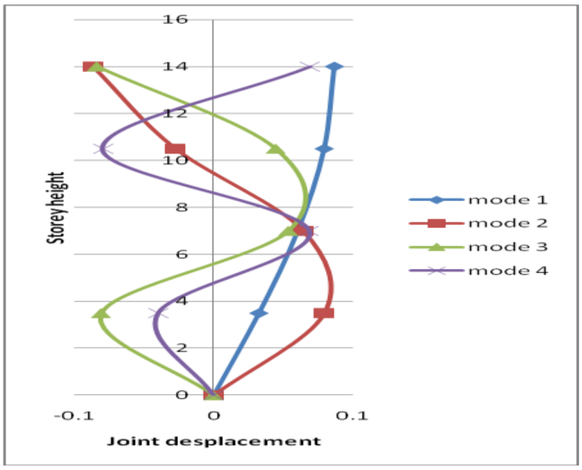

Fig.4
(Graphical representation of table 4)

- **Eigen values**

i. Lump mass model without infill model

Table5.

FROM ANALYTICAL SOLUTION	**FROM SOFTWARE**
81	81.063
657	657.56
1475	1474.2
2065	2064

ii. Lump mass model with infill model (Equivalent strut model)

Table6.

FROM ANALYTICAL SOLUTION	**FROM SOFTWARE**
1442	1441.3
11698	11691
26227	26211
36719	36697

- **Base shear**
  i. Ratio of base shear as per analytical solution With and without infill wall

  $=\frac{125.699}{80.930} = 1.5$

  ii. Ratio of base shear as per software With and without infill wall
  $= \frac{122.62}{99.856} = 1.3$

All the above results are satisfactory

VI. CONCLUSION

Results of natural frequencies are mach 100 %
Results of Eigen values are mach 100 %
So we are assured about result.

VII. REFERENCES

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