COMPARATIVE ANALYSIS OF RC FRAME WITH & WITHOUT INFILL WALL SUBJECTED TO SEISMIC FORCES

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Abstract - There are so many studies about earthquakes but however it has not been possible to predict when and where earthquake will occur. In this project our objectives are to study the effect of infill strength and stiffness in the seismic analysis of multistory building, to Check the stiffness, strength and ductility of building With & Without infill for various analytical model, to study the behavior of the in filled wall frame by converting the stiffness of the masonry infill as a Diagonal Strut Method. So for satisfying these objective we design G+10 frame on E-Tab 16 with a particular specification one is said to be bare frame and another one is frame with diagonal strut which is representative of stiffness among the building frame structure. Further story drift, displacement, and axial force these parameter are analyze for zone IV, V with the help of comparative graphs.

Keywords – stiffness, infill wall, equivalent diagonal strut, seismic analysis

I. INTRODUCTION

Occurrence of recent earthquakes in India and in different parts of the world has resulted in losses, especially human lives. It has highlighted the structural inadequacy of buildings to carry seismic loads. There is an urgent need for assessment of existing buildings in terms of seismic resistance. Reinforced concrete (RC) frame buildings are increasingly becoming common in urban India. Many such buildings constructed in recent times have a special feature – Few story is left open for the purpose of parking or any other commercial purposes which result in much reduction in stiffness among the frame structure causes maximum story drift . In this paper we are going to study effect of stiffness on a frame building by analyzing structure with and without infill wall

II. STRUCTURAL MODELLING

MATERIAL PROPERTIES

A) CONCRETE

Concrete with following properties is considered for study.

- Characteristic compressive strength (fck) = 25 MPa
- Poisson Ratio = 0.3
- Density = 25 KN/m3
- Modulus of Elasticity (E) = 5000 x √ fck = 25x103 MPa *fck* is the characteristic compressive strength of concrete cube in MPa at 28-day.

B) STEEL

Steel with following properties is considered for study.

- Yield Stress (fy) = 415 MPa
- Modulus of Elasticity (E) = 2x105 MPa

C) MASONARY INFILL

Clay burnt brick, Class A, confined unreinforced masonry

Where, fm= Compressive Strength of Masonry and it has been taken from the Table E-1,Page -8 and Fig E-10 Page no 8 of SP 20)

- Compressive strength of Brick, fm = 10 MPa
- Modulus of Elasticity of masonry (Ei) = 550 x fm = 5500MPa
- Poisson Ratio = 0.15

D) BUILDING SPECIFICATION

1. Plan Dimension: 30MX27M
2. Number of Stories: G+10
3. Total Height of building: 33.45
4. Height of each story: 3M
5. Size of column: 600X600 mm

6. Size of Beam: 300X500mm
7. Thickness of Slab: 150mm
8. Thickness of wall:230mm
9. Seismic zone: IV & V
10. Soil condition: MEDIUM
11. Importance Factor: 1
12. Response Reduction: 5
13. Damping of Structure: 0.05
14. Live Load: on roof =1.5 kn/sq.m , on floor= 3 kn/sq.m
15. Floor Finish: 0.5 KN/M^2

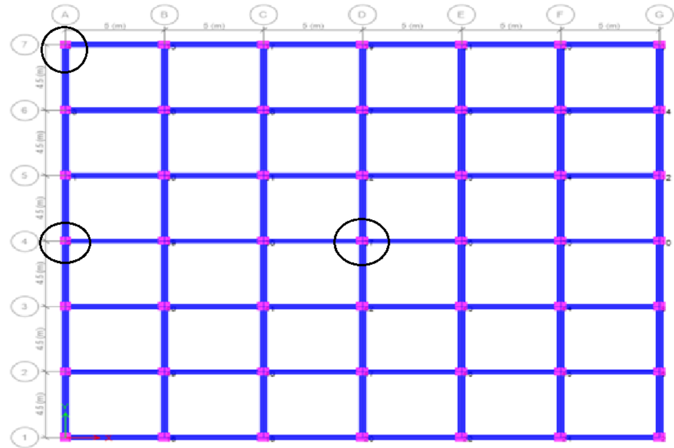
E) Earthquake parameters

Seismic zone	: IV and V
Response Reduction Factor	: 5
Importance Factor	: 1
Type of soil	: Medium
Damping of structure.	: 5%

III. ANALYATICAL MODELS

It is very important to develop a computational model on which analysis is performed. In this regard, ETBAS software has been considered as tool to perform. Hence we will discuss the parameters defining the computational models, the basic assumptions and the geometry of the selected building considered for this study. A detailed description on the modeling of RC building frames is discussed. Infill walls are modeled as equivalent diagonal strut elements.

An OGS framed building located at India (Seismic Zone IV, and V) is selected for the present study. The building is fairly symmetric in plan and in elevation.



. **Fig 1** - Typical floor plan of the selected building

In the present study different building components are modeled as described below Using Software. In this study the seven models are studied as described below

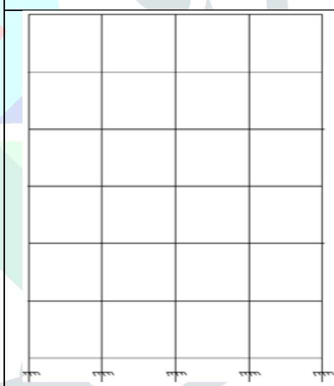
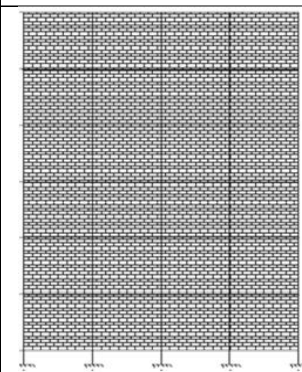
Case1- Bare Frame Building	**Case2-** Building with Uniform-Infill in All Storey
	

Fig. 2 comparative model

Modeling of Infill Walls

In present study, infill wall in stories are modeled as equivalent diagonal strut (Proposed by Hendry in 1998) and its equivalent width (W) of a strut is given as,

$$W=\frac{1}{2}\sqrt{\alpha_h^2+\alpha_l^2}$$

To determine αh and αl which depends on the relative stiffness of the frame and on the geometry of the panel.

$$\alpha_h=\frac{\pi}{2}\left[\frac{4E_f I_c h}{E_m\, t \sin 2\theta}\right]^{\frac{1}{4}} \qquad \alpha_l=\pi\left[\frac{4E_f I_b l}{E_m\, t \sin 2\theta}\right]^{\frac{1}{4}}$$

Where,

Em and Ef = Elastic modulus of the masonry wall and frame material, respectively
t, h, l = Thickness, height and length of the infill wall, respectively
Ic, Ib = Moment of inertia of the column and the beam of the frame, respectively

ϴ = tan-1(h/L)

IV. RESULT AND DISCUSSION

Later Displacement :-

The lateral displacement in columns in X-direction is considered for analysis in seismic zone IV, and V shown in graphical representation of data is shown in Graph.

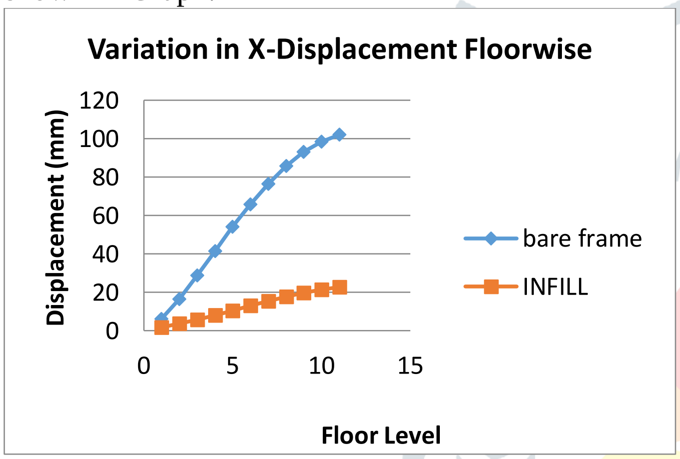


Fig.3 displacement zone IV

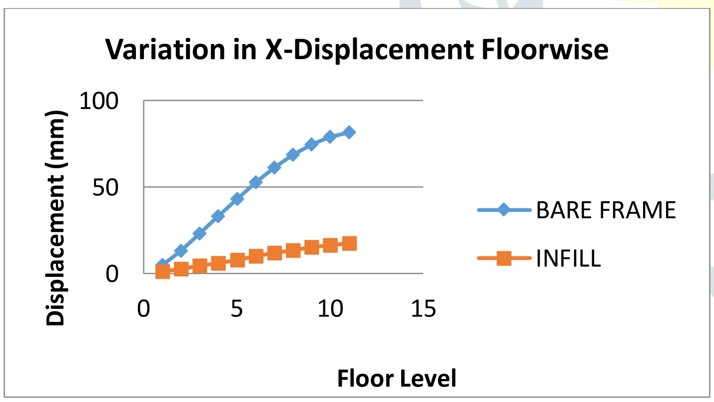


Fig.4 displacement zone V

For comparison of the later displacement of the selected building, plots of the storey level displacement in X-direction versus height are made for the two cases, imposed on the same graph. The displacement is inversely proportional to the stiffness.

From the graphs it is observed that the displacements are large occurs in case of bare frame building (case 3).

Percentage reduction in displacement with respect to bare frame is 75%

Story Drift :-

The maximum Story Drift in the all columns in longitudinal and transverse direction is considered for analysis in seismic zone IV, and V graphical representation of data is shown in Fig no.5 and 6.

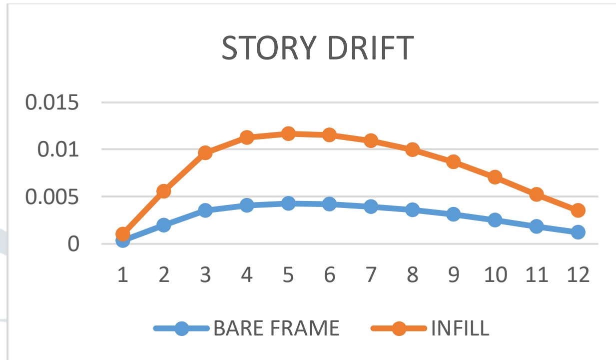


Fig. 5 story drift zone IV

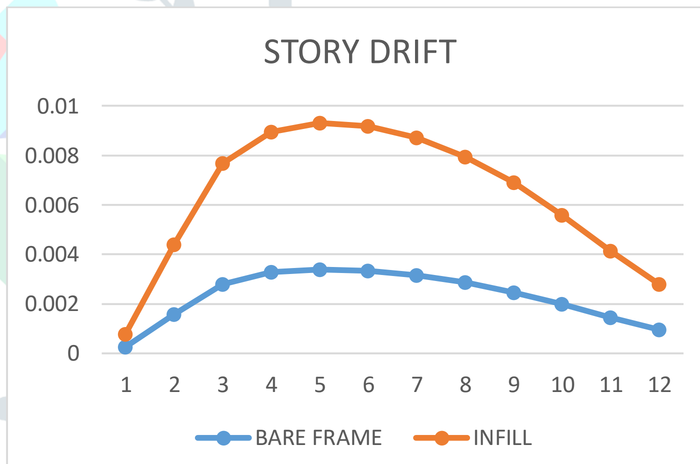


Fig.6 story drift zone v

Axial Force :- The axial force in the column 1, column 9 & column 36 is analyzed for a zone IV & V

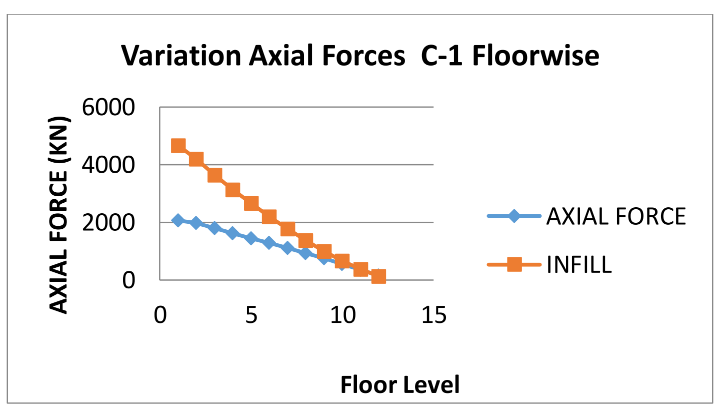


Fig. 7 Axial force c-1 zone V

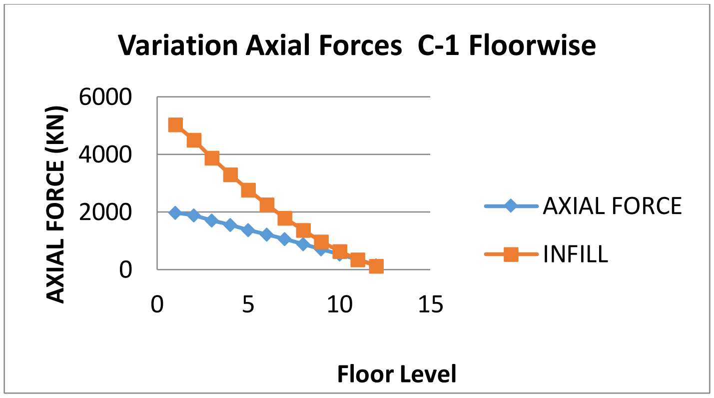


Fig.8 Axial Force c-1 zone IV

Base Shear:- The Base shear is analyzed from table given below for the zone IV & V.

TYPE	Load Case/Combo	FZ kN	MX kN-m
BARE FRAME	1.2DL+1.2LL+1.2EQX Max	195892.8843	2748542.802
INFILL WALL	1.2DL+1.2LL+1.2EQX Max	200111.0246	2948573.966

Table no 1: Base Shear zone IV

TYPE	Load Case/Combo	FZ kN	MX kN-m
BARE FRAME	1.2DL+1.2LL+1.2EQX Max	195892.8843	2727745.029
INFILL WALL	1.2DL+1.2LL+1.2EQX Max	200111.0246	2893449.803

Table no.2: Base Shear zone V

V. CONCLUDING REMARKS

1. We can analyze that stiffness in the frame building is essential which is provided with the help of infill wall.
2. The displacement is inversely proportional to the stiffness.
3. This indicate ductility demand in the first story column for this case is largest.
4. However, the story drift profile becomes smoother right for other cases indicating large stiffness and less ductility demand.
5. The base shear is directly proportional to weight of structure.
6. It is observed that the force gradually decreases from ground floor to top floor

VI. REFERENCES

Journal paper:

1. **Holmes, M.** (1961) Steel frames with brick and concrete infilling. *Proceedings of Institution of Civil Engineers*.
2. **Arlekar, J.N.; S. K. Jain** and **C.V.R Murty** (1997) Seismic response of RC frame buildings with soft first storeys. *Proceedings of CBRI golden jubilee conference on natural hazards in urban habitat.* New Delhi
3. **Riddington, J. R.** and **S. B. Smith (1977)** Analysis of infilled frames subject to racking with design recommendations. The Structural Engineer.
4. **Smith, S. B.** (1966) Behaviour of Square Infilled frames. *ASCE Journal of the Structural Division.* 92. 381-403
5. **S. B. Smith and C. Carter,** (1969) A Method of Analysis for Infilled Frames. *Proceedings of Institution of Civil Engineers*.
6. **P.B.Lamb, Dr R.S. Londhe**(2012) Seismic Behavior of Soft First Storey, Proceedings of IOSR Journal of Mechanical and Civil Engineering.
7. **Selvakoodalingam, B.; E. B. Perumal Pillai** and **P. Govindan** (1999) Strengthening of RC Infilled frame with opening. *Concrete International*.
8. Bureau of Indian Standards: IS-1893, part 1 (2002), "Criteria for Earthquake Resistant Design of Structures: Part 1 General provisions and Buildings", New Delhi, India.
9. **C.V.R Murty**, Indian Institute of Technology Kanpur, Earthquake tips, India.

Books:

P. Agrawal, M. Shrikhande(2009) earthquake resistant design of structures (PHI Learning Pvt.Ltd. New delhi,

VII. MODEL IMAGES

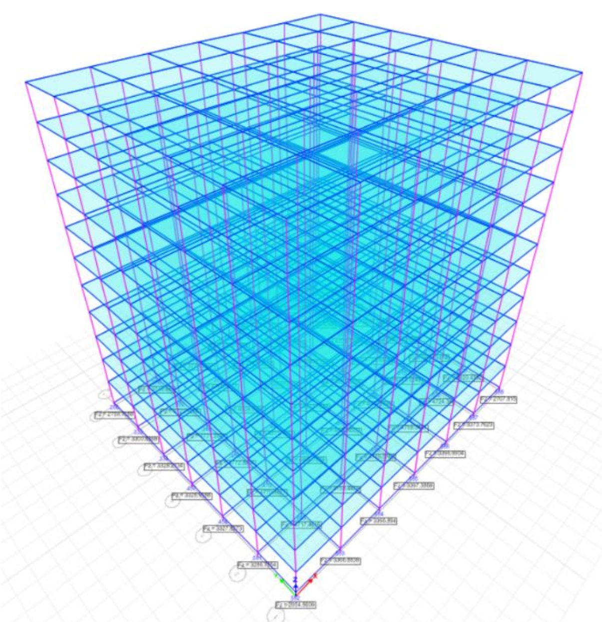


Fig. 9 Base shear result in software

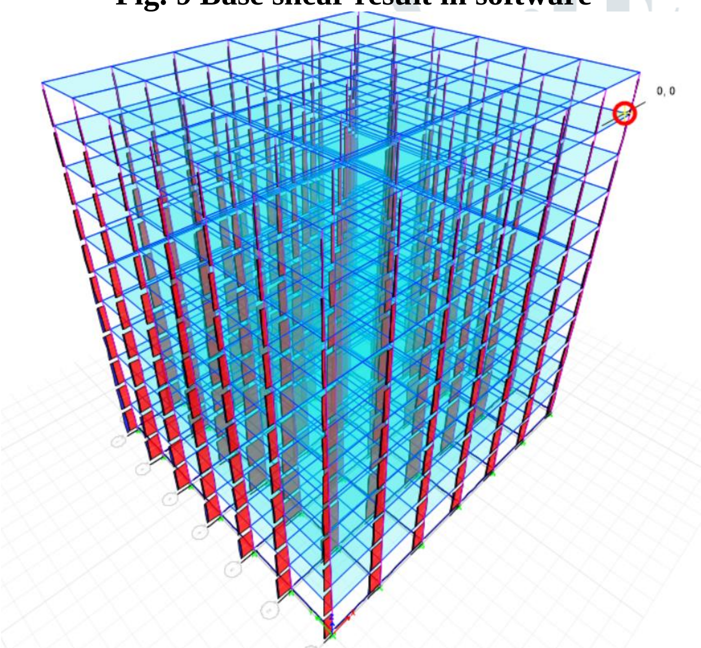


Fig.10 Axial Force

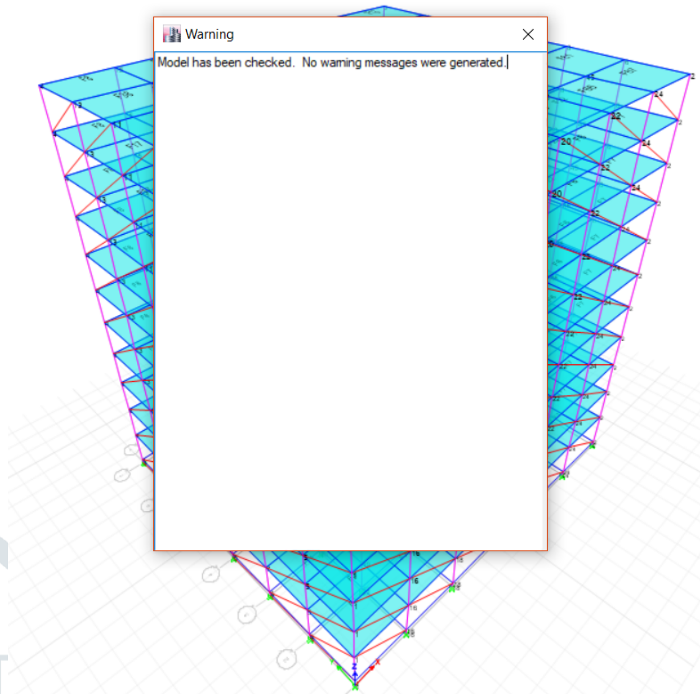


Fig. 11 Model Checking & showing equivalent strut