Effect of Opening in Infill Wall for SESMIC Load

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Abstract— The effect of infill walls to stiffness of the structure has been known for a longtime and this effect has taken many of the earthquake regulations with empirical relationship and equation into account. However, in strength based calculation, building are taken as bare frame and infill walls are affected as vertical load to system, whereas infill walls contribute to stiffness at the beginning of the earthquake and help meet seismic loads by incurring damage during an earthquake. In this study, contribution of infill walls to stiffness of the structure will analyze in reinforced concrete framed buildings. Also, the effect of opening in the infill walls to stiffness will examin.

Key words: Shear Wall, Steel Bracing, Infill Wall, Stiffer Column, Non-Linear Time History, E-TAB 2016

I. INTRODUCTION

Earthquake is responsible for the ground motion in all directions, inducing the inertial forces on the structures. Thus the structure has to withstand lateral loads due to earthquake, wind loads along with the gravity loads.

Nowadays RC frames are the common construction practice. The gap created between the columns, beams are filled by infill materials like bricks. Due to functional requirements the openings are provided in wall for windows, doors etc., In RC buildings the gravity loads do not cause effect, but the lateral loads like wind, earthquake shaking are a matter of great concern and need special design consideration.

The presence of infill walls increases the lateral stiffness, strength and reduces the fundamental period. The presence of openings in the infill walls can reduce some amount in the increase of lateral stiffness due to infill wall.

The behavior of the infill walls subjected to the lateral loads is represented as shown in fig. When the lateral loads are applied the infill walls resists to some extent creating gaps at the corners as shown

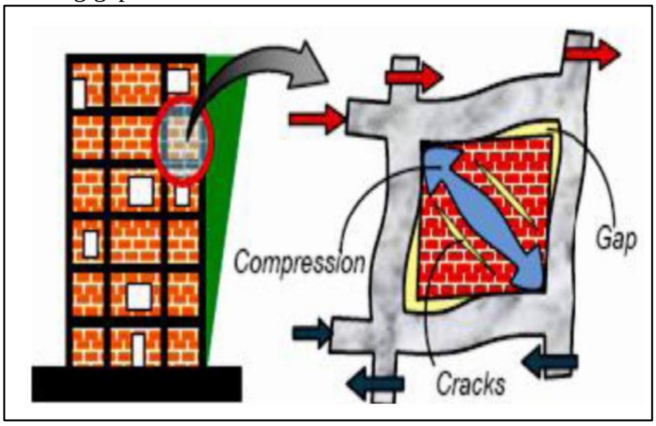

Fig. 1: Behavior of the infill wall as a strut member

II. OBJECTIVE

The main objective of this work is to carry out the effect of masonry infill walls on the seismic behavior of R.C.C. High-Rise building with response spectrum analysis.

Generally infill wall is considered as architectural purpose, but here how will infill wall contribute in strength and stiffness for lateral loading is to be study.

Also opening in wall in X, Y and both direction will affect stiffness of structure is to study.

Following results would be compared for G+10 storey building for bared frame and infilled frames. The analysis results would be compared in terms of Joint Displacement, Base shear, Storey drift, axial force and moment in columns, shear force and moment in beams.

III. PROBLEM DEFINITION

A. *Description of Structure:*

The structure selected for this project is a simple RCC building with the following description as stated below.

Number of bays in X direction and its width= 5 bays of 4.8 m each

Number of bays in Y direction and its width = 4 bays of 4.5 m each

Story height = 3 m each

- Number of storey = 11 (Excluding the plinth and substructure and including the Ground floor)
- Depth of foundation from ground level = 1.5 m\
- Column size = 400 mm x 300 mm
- Beam size = 250 mm x 350 mm
- Thickness of Slab =150 mm
- Density of concrete = 25 kN/m^3
- Live load on roof = 1.5 kN/m^2
- Live load on floors = 2.5 kN/m^2
- Brick wall on peripheral beams = 230 mm
- Brick wall on internal beams = 230 mm
- Density of brick wall 20 kN/m^3
- M35 grade concrete and Fe500 steel

IV. RESULT & DISCUSSION

The building analyzed is G+10 R.C framed building of symmetrical rectangular plan configuration. Complete analysis is carried out for dead load, live load & seismic load using ETAB 2016 software. Response spectrum Method is used. All combinations will considered as per IS 1893:2016.Total eleven models have been considered for the purpose of the study.

1) Tenstorey(G+10) RC building as bare frame.
2) Tenstorey(G+10) RC building as infill frame.

3) Tenstorey(G+10) RC building with 10% opening in infill frame along x direction.
4) Tenstorey(G+10) RC building with 10% opening in infill frame along y direction.
5) Tenstorey(G+10) RC building with 10% opening in infill frame along x and y direction.
6) Tenstorey(G+10) RC building with 20% opening in infill frame along x direction.
7) Tenstorey(G+10) RC building with 20% opening in infill frame along y direction.
8) Tenstorey(G+10) RC building with 20% opening in infill frame along x and y direction.
9) Tenstorey(G+10) RC building with 30% opening in infill frame along x direction.
10) Tenstorey(G+10) RC building with 30% opening in infill frame along y direction.
11) Tenstorey(G+10) RC building with 30% opening in infill frame along x and y direction.

A. BASE SHEAR

The response spectrum method had been adopted for seismic analysis in ETAB 2016. The figure shows maximum base shear in X and Y direction for above mentioned models.

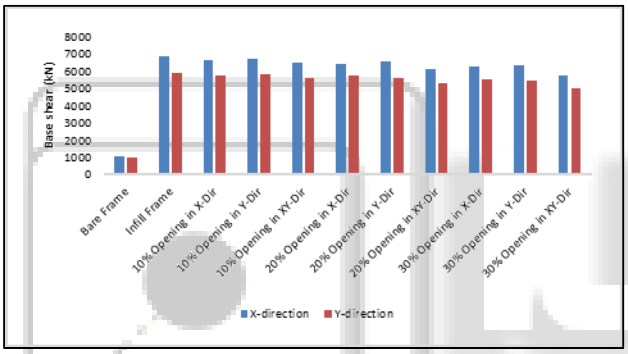

Fig. 2: Base shear (kN)

Fig shows comparison of base shear in kN for eleven models. Bare frame has a low stiffness as compared to infill frame. There for it shows that base shear is maximum for full infill frame. As % opening in infill increases, stiffness decreases and hence base shear decreases.

V. MAXIMUM LATERAL DISPLACEMENT (MM)

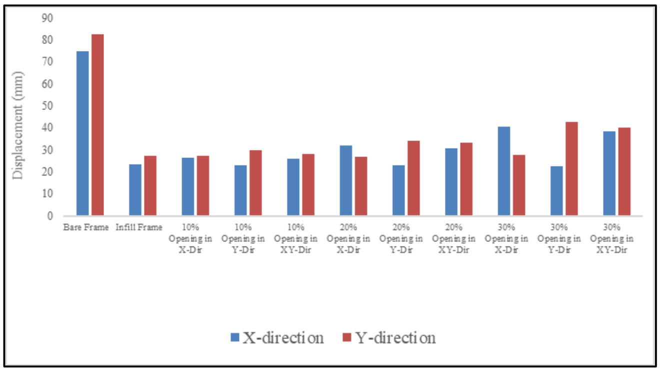

Fig. 3: Maximum Lateral Displacement (mm)

Fig. shows comparison of maximum lateral displacement in mm for eleven models. It shows that displacement is maximum for bare frame because the stiffness in low and infill frame has the minimum displacement because the stiffness is maximum. As % opening in infill increases, stiffness decreases and hence displacement increases.

VI. STOREY STIFFNESS

The response spectrum method had been adopted for seismic analysis in ETAB 2016. This shows storey stiffness in X and Y direction for above mentioned models.

A. Storey stiffness in X direction (kN/m)

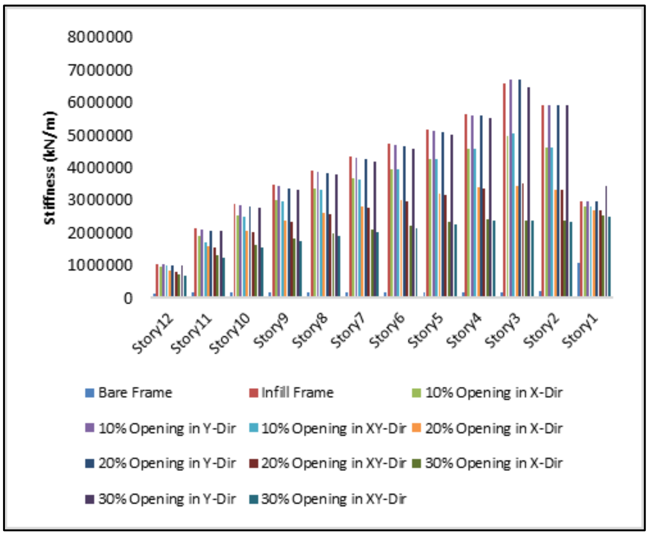

Fig. 3.1: Storey Stiffness in X direction (kN/m)

Fig shows comparison of storey stiffness in x direction in kN/m for eleven models. It shows that stiffness is maximum for bare frame. As % opening in infill increases, stiffness decreases.

B. Storey stiffness in Y direction (kN/m)

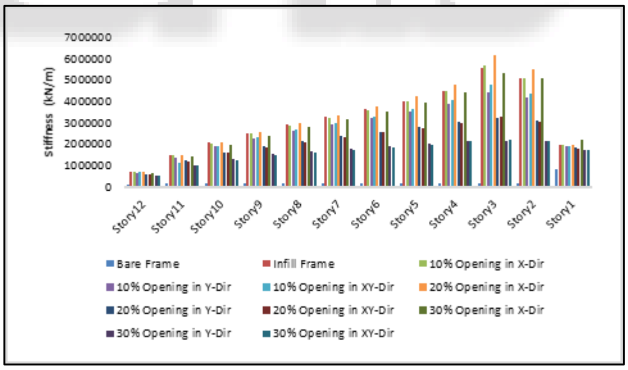

Fig. 3.2: Storey Stiffness in Y direction (kN/m)

Fig shows comparison of storey stiffness in y direction in kN/m for eleven models. It shows that stiffness is maximum for bare frame. As % opening in infill increases, stiffness decreases.

VII. COLUMN RESULTS

A. Axial Force (kN)

The response spectrum method had been adopted for seismic analysis in ETAB 2016.

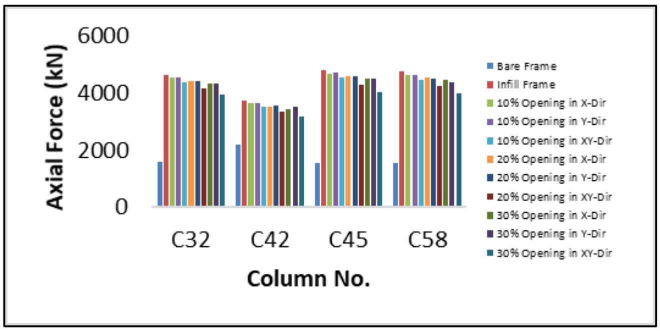

Fig. 4.1: Axial Force (kN)

Fig shows comparison of axial force in kN for eleven models. It shows that axial force is maximum for infill frame and minimum in Bare Frame. So we conclude that as % opening in infill increases, axial force decreases.

B. Moment M2 in kNm

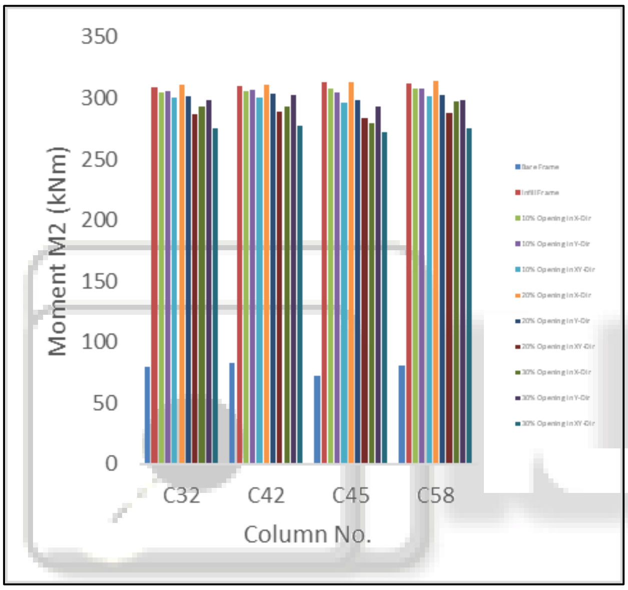

Fig. 4.2: Moment M2 (kNm)

Fig shows comparison of moment in kNm for eleven models. It shows that moment is maximum for infill frame. As % opening in infill increases, moment decreases

C. Moment M3 in kNm

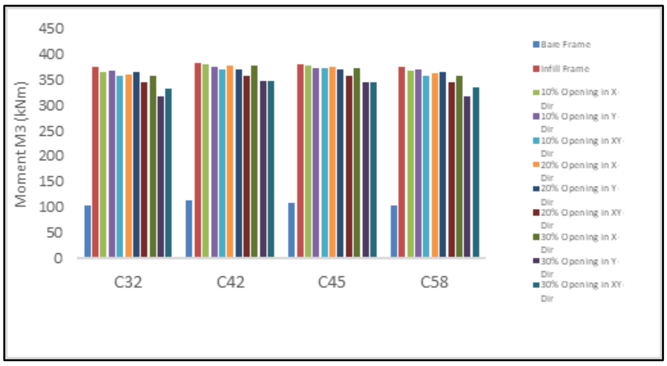

Fig. 4.3: Moment M3 (kNm)

Fig shows comparison of moment in kNm for eleven models. It shows that moment is maximum for infill frame. As % opening in infill increases, moment decreases.

VIII. BEAM RESULTS

The response spectrum method had been adopted for seismic analysis in ETAB 2016. The following fig shows hear forces, torsion and moments in beam by considering Beam B21 for above mentioned models.

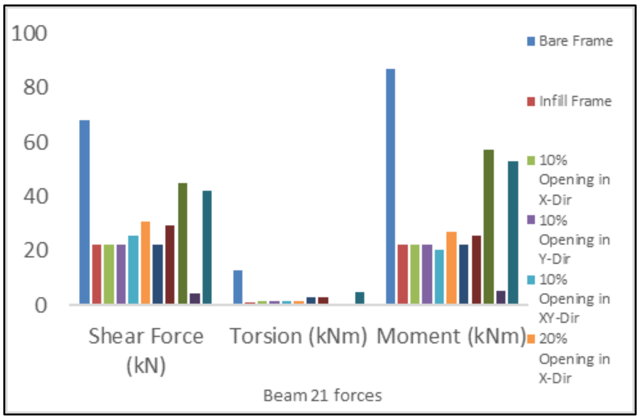

Fig. 5: Shear Force, torsion, moments in B21

IX. CONCLUSION

1) It is observed from the various research works that the infill walls contribute in enhancing the structural strength. However, the contribution of partial infill walls must be well identified so that while analyzing models for real structures, the composite action of the frame and infill would be realized.
2) RC frame with masonry infill is having highest value of base shear than bare frame
3) The presence of infill wall can affect the seismic behavior of frame structure to large extent, and the infill wallincreases the strength of stiffness of structure.
4) It is found that maximum displacement for bare frame is higher than that of with-infill case.
5) The stiffness is reducing with increase in percentage opening in infill.
6) The lateral load carrying capacity of frames is also improved by infills with openingsas compared to bare frames.
7) It has been observed that axial force and moments in column for infill wall frame are higher than in bare frame. These forces are decreases as opening size is increases in frames.
8) It has been observed that shear force and moments in beams for infill wall frame are higher than in bare frame. These forces are decreases as opening size is increases in frames.

REFERENCES

[1] C V R Murty and Sudhir K Jain,"Beneficial influence of masonry infill walls on seismic performance of RC frame buildings",12WCEE, 2000.
[2] IS: 1893(Part 1)- 2016; "Criteria for Earthquake Resistance Design of Structures- general provisions and buildings"; Bureau of Indian Standards, New Delhi.
[3] M.Pradeep Kumar, "Effect of Infill Wall with and without on RCC Frame Structure- A Review ",Imperial Journal of Interdisciplinary Research (IJIR) Vol.2,Issue-1,2016 ISSN : 2454-1362, www.onlinejournal.in

[4] J. Dorji* and D.P. Thambiratnam,” Modeling and Analysis of In filled Frame Structures Under Seismic Loads”, The Open Construction and Building Technology Journal,2009.
[5] Sachin Surendran and Hemant B. Kaushik,” Masonry Infill RC Frames with Openings: Review of In-plane Lateral Load Behaviour and Modelling Approaches”, The Open Constructions and Building Technology Journal,2012.
[6] V. V. Diware, A. C. Saoji, ”SEISMIC ASSESSMENT OF SYMMETRICAL RC STRUCTURAL WITH BRICK MASONARY INFILLS”, International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 3,May-Jun 2012.
[7] KiranTidke, ”Seismic Analysis of building with and without Infill Wall”, International Journal of Innovative Research in science, Engineering and Technology Journal of Innovational Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol.5, Issue 7,July 2016
[8] Charanchikkajavaregowada k sl,” Seismic Analysis on bare frame, in filled framed and soft RC framed buildings”, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 04 Issue:08 |Aug-2017 www.irjet.net p-ISSN: 2395-0072