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Study of Masonary Infilled R.C. Frame With & Without Opening

Rahul P. Rathi [1], Dr. P.S. Pajgade [2]

ABSTRACT - Infilled frame structures are commonly used in buildings. Masonry infilled RC frames are the most common type of structures used for multistoried constructions in the developing countries, even in those located in seismically active regions. Window and door openings are inevitable parts of infill walls for functional reasons. Currently, publications like FEMA-273 and ATC-40 contain provisions for the calculation of stiffness of solid infilled frames mainly by modeling infill as a "diagonal strut." However, such provisions are not provided for infilled frames with openings Present study is an attempt to access the performance of RCC frame with infills panels. In this paper actual building such as college building (G+3) is considered by modeling of frame and Infills. Modelling of infills is done as per actual size of openings with the help of equivalent diagonal strut method for the various model such as bare frame, infill frame and infill frame with centre and corner opening.

Keywords— Masonary infill wall, equivalent diagonal strut, reinforced concrete,

1. INTRODUCTION

A large number of buildings in India are constructed with masonry infills for functional and architectural reasons. Masonry infills are normally considered as non-structural elements and their stiffness contributions are generally ignored in practice. However, infill walls tend to interact with the frame when the structure is subjected to lateral loads, and also exhibit energy-dissipation characteristics under seismic loading. Masonry walls contribute to the stiffness of the infill under the action of lateral load. The term 'infilled frame' is used to denote a composite structure formed by the combination of a moment resisting plane frame and infill walls.

The seismic design of masonry infilled RC frame buildings is handled in different ways across the world. Some of the prevalent design practices are

1) Infills are adequately separated from the RC frame such that they do not interfere with the frame under lateral deformations. The entire lateral force on the building is carried by the bare RC frame alone.

2) Infills are built integral with the RC frame, but considered as non-structural elements. The entire lateral force on the building is carried by the bare RC frame alone. This is the most common design practice in the developing countries.

In present study static analysis has been carried out for the frame and infill wall has been modeled by equivalent diagonal strut method for the centre and corner with 15% opening. Second stage analysis and design has been carried out by software STAAD- Pro then different parameters has been computed.

2. METHODOLOGY

2.1 Equivalent Diagonal strut Methods

In this method the analysis is carried out by simulating the action of infills similar to that of diagonal struts bracing the frame. The infills are replaced by an equivalent strut of length D, and width W, and the analysis of the frame-strut system is carried out using usual frame analysis methods. The relationships proposed by Mainstone Walls have to resist the shear forces that try to push the walls over.

for computing the width of the equivalent diagonal strut, is widely used in the literature and is given by.

$$W= 0.175\ (\lambda\ H)^{-0.4}\ D$$

[1] Final Year Student (M.E. Structure) , [2] Professor
Department Of Civil Engineering
Prof. Ram Meghe Institute of Technology & Research
Badnera, Amravati-444701, Maharashtra, India
Email ID: : civilenggrahul@gmail.com
Email ID: ppajgade@gmail.com

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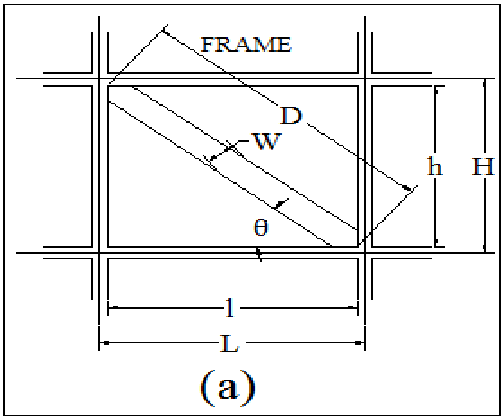

Fig 2.1 shows equivalent diagonal strut model

$$\lambda = \sqrt[4]{\frac{Ei\ \ t\,Sin(2\theta)}{4\ Ef\,Ic\,h}}$$

where

λ =Stiffness reduction factor

E_i = the modules of elasticity of the infill material, N/mm^2

E_f = the modules of elasticity of the frame material, N/mm^2

I_c = the moment of inertia of column, mm^4

t = the thickness of infill, mm

H =the centre line height of frames

h = the height of infill

L =the centre line width of frames

l = the width of infill

D = the diagonal length of infill panel

θ = the slope of infill diagonal to the horizontal.

Width of strut without opening (W)

$$W = 0.175\ (\lambda\ H)^{-0.4}\ D$$

Putting the value of stiffness reduction factor in above equation, width of strut has been calculated for estimation of width of strut without opening,

Width of strut with opening = Stiffness Reduction factor as per fig 2.3 x W without opening.

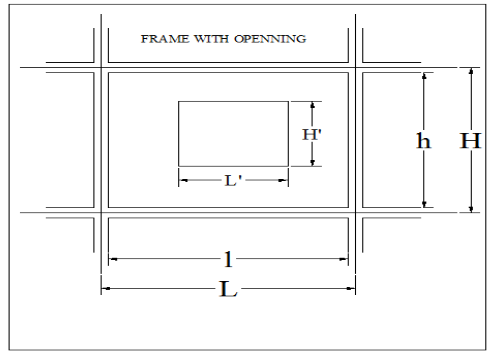

Fig 2.2 Infill frame with opening

$$\text{Opening-Area-Ratio}\ (\alpha_{co}) = \frac{\text{Area of Opening}\ (A_{op})}{\text{Area of Infill}\ (A_{\text{infill}})}$$

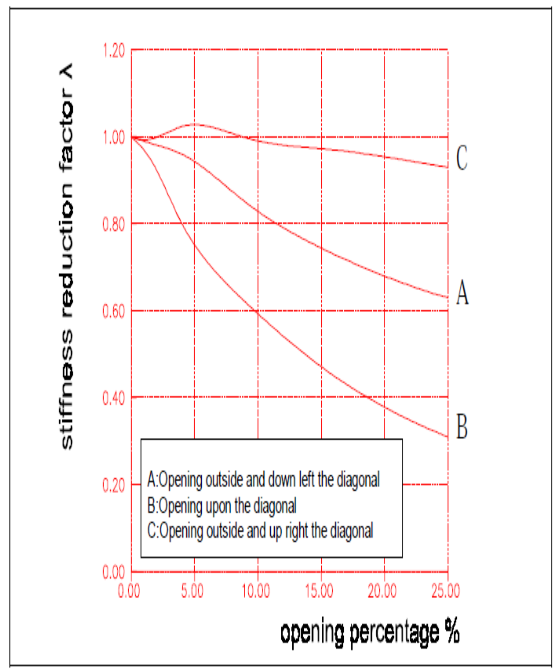

Figure 2.3 : Stiffness reduction factor for Infill

With opening at location A/B/C

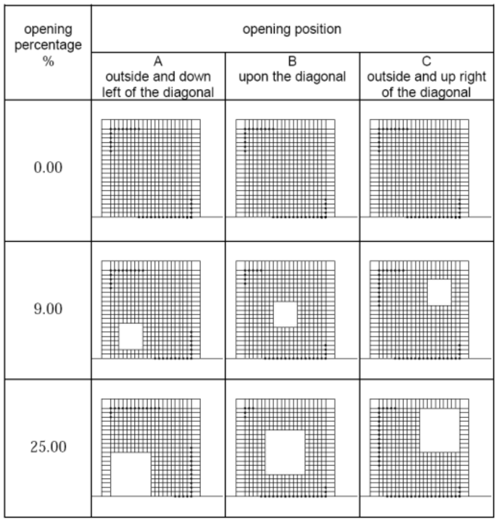

Figure 2.4: Contact/interaction areas between the infill masonry wall and the surrounding frame for different opening percentages.

The figure 2.3 shows opening influence of for three different Positions .the variation of the stiffness reduction factor λ of the infilled frame as the function of the opening percentage is depicted.

3. ANALYSIS PROBLEM

3.1 STRUCTURAL DETAILS:

Type of structure	COLLEGE BUILDING (G+3)
ZONE	III
Foundation level to Ground level	0.9M
FLOOR TO FLOOR HEIGHT	3.65M
EXTERNAL WALL	230 MM
INTERNAL WALL	230 MM
LIVE LOAD	5 KN/M^2
MATERIAL	M20 AND Fe415
SEISMIC ANALYSIS	EQUIVALENT STATIC METHOD (IS 1893-2002)
SIZE OF COLUMN	C1(NO.1 TO 7 & 10 TO 16) 350X750 C2(NO. 17 TO 23) 380X450 C3(NO. 8 & 9) 300X600
SIZE OF BEAM	B1=230X500,B2=230X300, B3=230X800
DEPTH OF SLAB	140 MM
DESIGN PHILOSOPHY	LIMIT STATE METHOD CONFORMING (IS 456-2000)
DUCTILITY DESIGN	**IS 13920-1993**

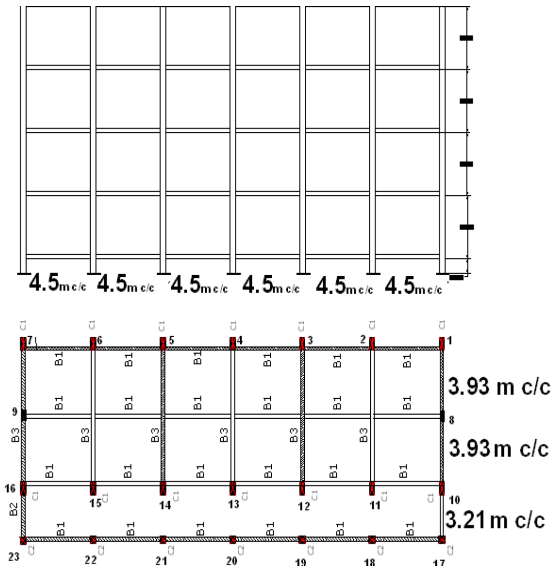

Fig 3.1: view of building

3.2 Analytical Models

For the analysis and design purpose four model has been considered namely as

1. Bare frame (S.M.R.F infill frame with masonary effect not considered)
2. Fully infilled frame (S.M.R.F infill frame with masonary effect considered)
3. Infilled frame with centre opening (15%)
4. Infilled frame with corner opening (15%)

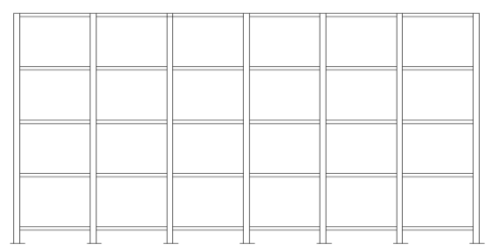

Fig 3.2: bare frame model

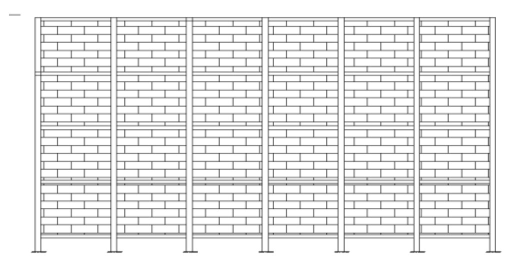

Fig 3.3: Fulley infilled frame model

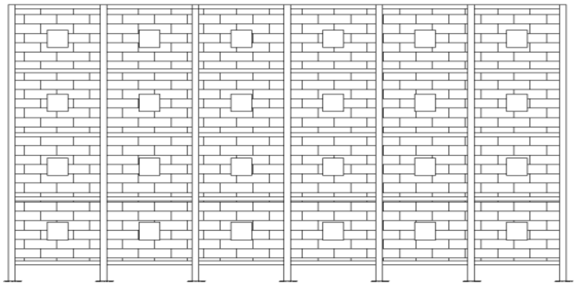

Fig 3.4: Infilled frame with centre opening

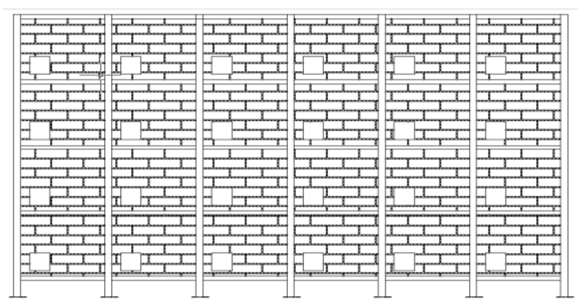

Fig 3.5: Infilled frame with corner opening

The above mentioned all frame has been designed by using STAAD-Pro software.For getting results some column has been selected for getting results and they are as column no..1,2,3. The results found to be are shown with the help of graph for the parameters

1. DEFLECTION
2. SHEAR FORCE
3. MOMENT
4. Ast

4. COMPARISON OF RESULTS

Comparison Of All Analytical Models With The Help Of Graph

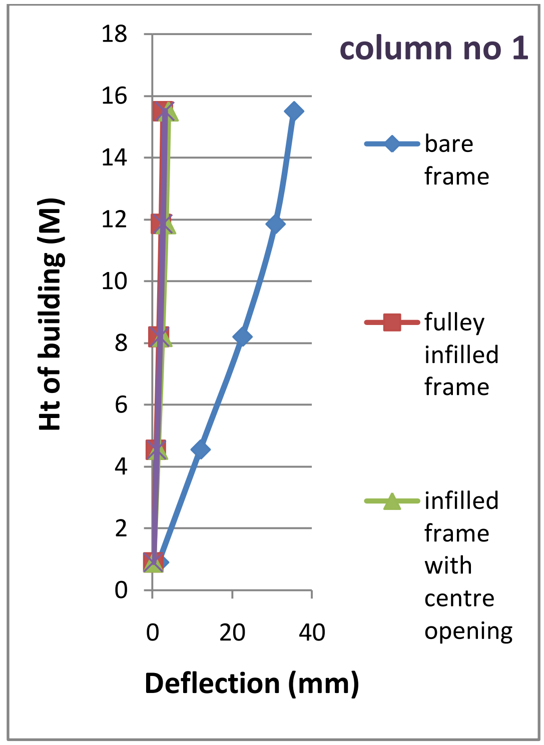

Fig 4.1:Deflection In (mm) for column no 1

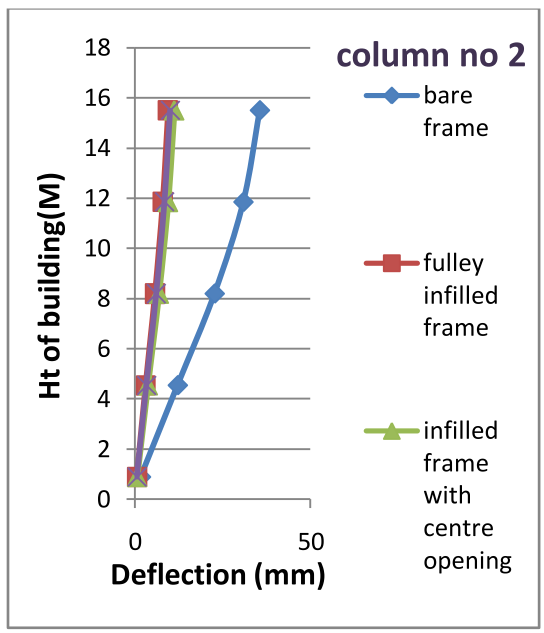

Fig 4.2: Deflection IN (mm) for column no 2

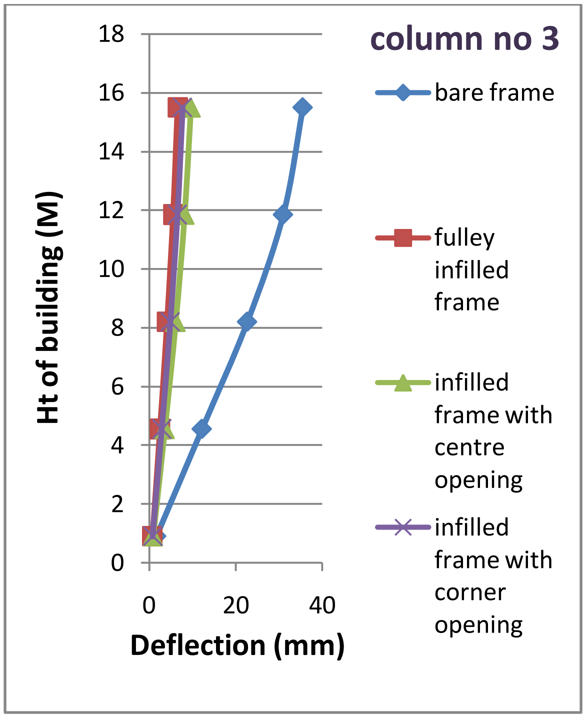

Fig 4.3 :Deflection In (mm) for column no 3

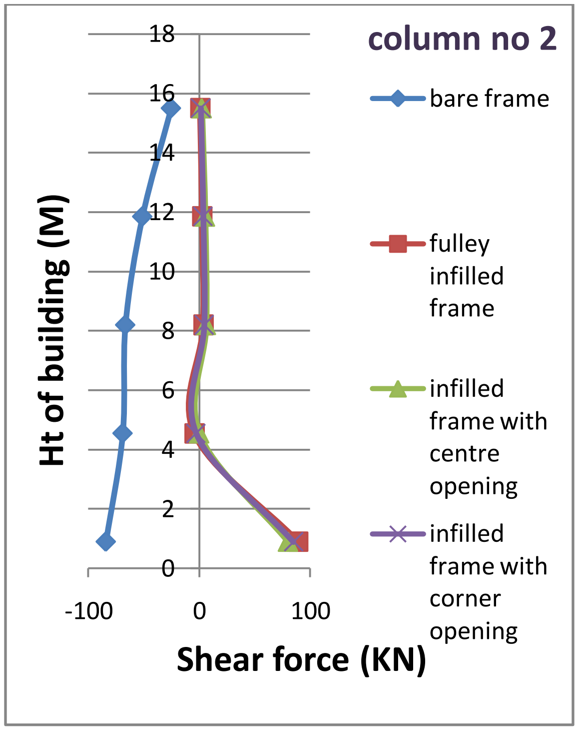

Fig 4.5: Shear force in(KN) for column no 2

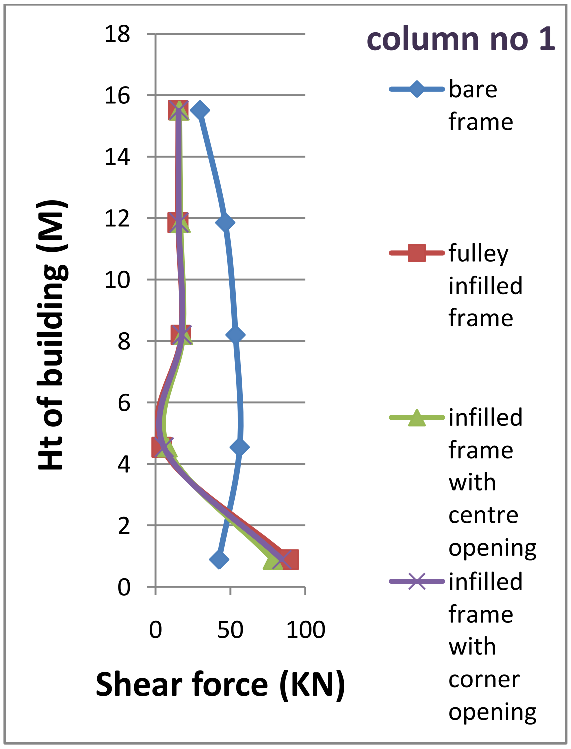

Fig 4.4: Shear force in(KN) for column no 1

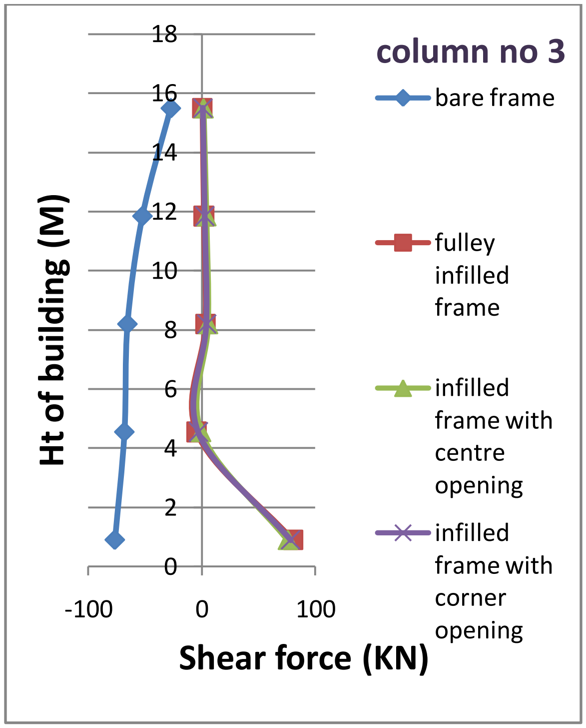

Fig 4.6: Shear force in(KN) for column no 3

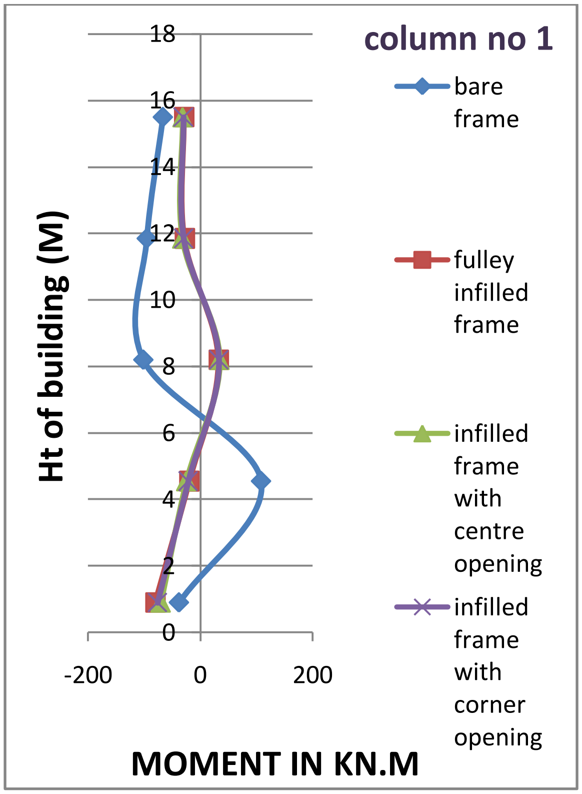

Fig 4.7: Moment in (KN.M) for column no 1

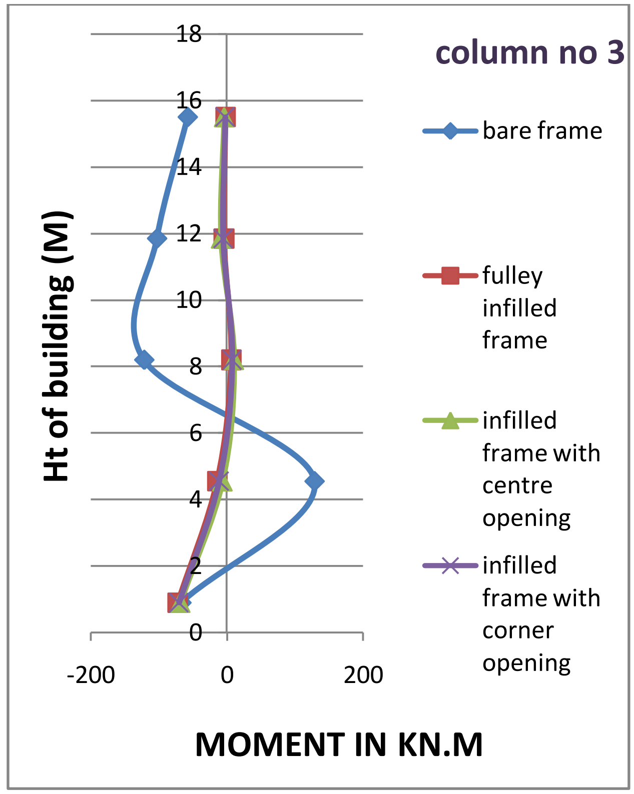

Fig 4.9: Moment in KN.M for column no 3

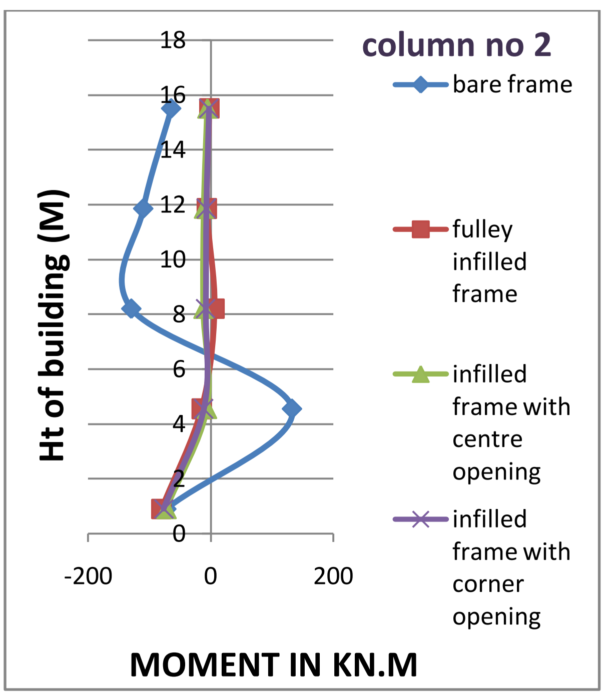

Fig 4.8: Moment in KN.M for column no 2

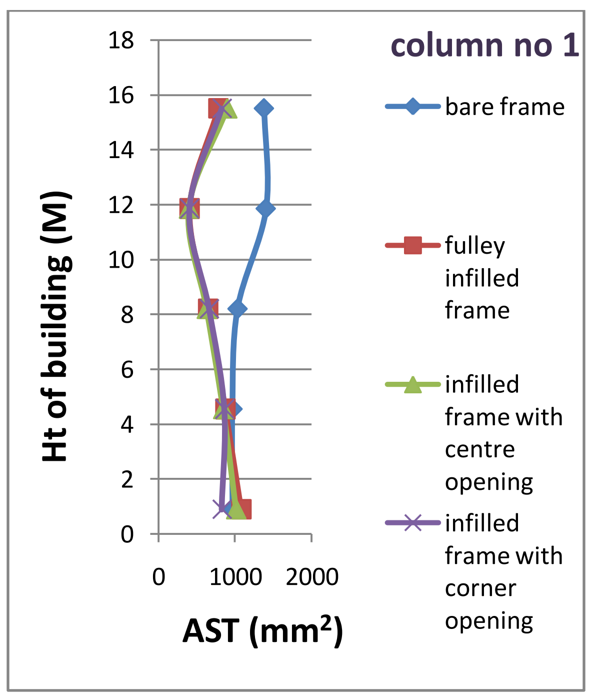

Fig 4.10: AST in mm² for column no 1

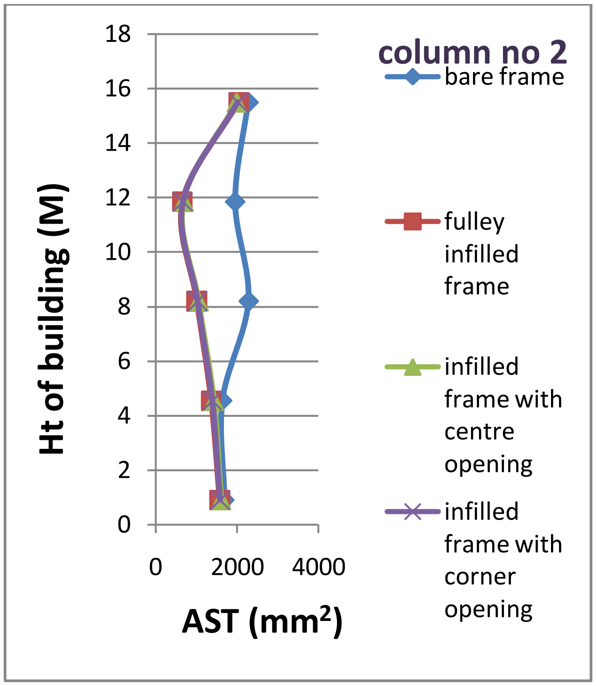

Fig 4.11: AST in mm² for column no 2

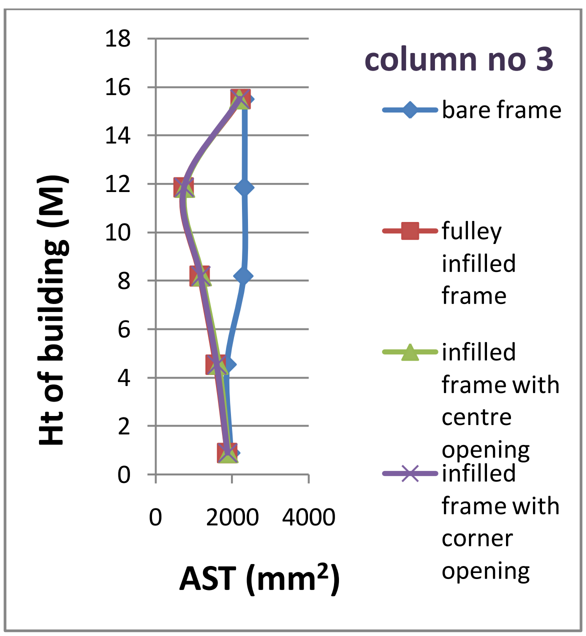

Fig 4.12: AST in mm² for column no 3

CONCLUSIONS:-

1) Results indicate that infill panels have a large effect on the behavior of frames under earthquake excitation. In general, infill panels increase stiffness of the structure.

2) The increase in the opening percentage leads to a decrease on the lateral stiffness of infilled frame.

3) Deflection in case of bare frame is very large, in case of infilled frame and infilled frame with opening deflection is less.

4) Deflection in case of centre opening is large compare to corner opening.

5) In column without considering infill wall effect the value of Shear force, Bending moment ,AST is very large compared to fully infilled frame and infilled with opening

6) Above 5 m panel dimension infill frame is less effective.

Reference:

1) P. G. Asteris, M.ASCE "Lateral Stiffness of Brick Masonry Infilled Plane Frames" JOURNAL OF STRUCTURAL ENGINEERING © ASCE / AUGUST 2003.
2) Earthquake Spectra Goutam Mondal and Sudhir K. Jain, M.EERI "Lateral Stiffness of Masonry Infilled Reinforced Concrete (RC) Frames with Central Opening", Volume 24, No. 3, pages 701–723, August 2008; © 2008, Earthquake Engineering Research Institute.
3) Giuseppina Amato, Marinella Fossetti, Liborio Cavaleri, Maurizio Papia "AN UPDATED MODEL OF EQUIVALENT DIAGONAL STRUT FOR INFILL PANELS"
4) C V R MURTY And Sudhir K JAIN "BENEFICIAL INFLUENCE OF MASONRY INFILL WALLS ON SEISMIC PERFORMANCE OF RC FRAME BUILDINGS"
5) Robin DAVIS1, Praseetha KRISHNAN1, Devdas MENON2, A. Meher PRASAD2 "EFFECT OF INFILL STIFFNESS ON SEISMIC PERFORMANCE OF MULTI-STOREY RC FRAMED BUILDINGS IN INDIA"
6) Fakhredin DANESH1, Vahid. BEHRANG2 "THE INFLUENCE OF MASONRY INFILL WALLS ON DYNAMIC BEHAVIOUR OF CONCRETE STRUCTURES."
7) Matjaz DOLSEK And Peter FAJFAR "ON SEISMIC BEHAVIOR AND MATHEMATICAL MODELLING OF INFILLED RC FRAME STRUCTURES" 12WCEE 2000, 1632
8) Liauw T.C., "An Aproximate Methods Of Analysis for infilled frames with or without opening". Building Science, vol.7, 1972, pp. 233-238
9) Maistone R.J. "Supplement Note on the stiffness and Strength of infilled frames" Current paper C.P. 1314, building Research stations , Watford, UK, Feb. 1974.
10)] IS: 1893-2002, Criteria for Earthquake Resistant Design of Structures, Part 1, Bureau of Indian Standards, New Delhi, India.
11) IS: 13920-1993 "ductile detailing of reinforced of concrete structure subjected to seismic forces code of practice."