# Finite Element Analysis of In-Fill Panels In Rcc Frame For Seismic Zone Iii Using Staad

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***Abstract-*** *The presence of infill wall in the building gives better behavior under lateral loads. For multistoried structures, the consideration of effect of bottom storey under seismic forces would be an important parameter. As per IS 1893 (Part-I) :2002the columns and beams of the softstorey are to be designed for 2.5 times the storey shear and moments calculated under the seismic load of a bare frame ( i.e. without considering infill effect). In this paper, model is studied to investigate the magnification factor for variousload combinations considering peripheral masonry infill wall only for zone III, peripheral masonry infill wall along with tie beams and RCC X braings underseismiceffect.TheR.C.C. Building model (P+5) has been preparedusing STAAD-Prosoftware. The Seismic Coefficient Method has been performed for the analysis of various models. The results of investigations and their conclusions are discussed below*

***Keywords*****-** In fill Walls, RCC frames, IS 1893:2002, Equivalent Strut Method, STAAD-Pro,Zone III

## I. INTRODUCTION

In RC frame brick walls is just architectural point of view and to make partition and other aspect. In multistory buildings, the ordinarily occurring vertical loads i.e. dead or alive, do not cause much of a effects, but the lateral loads due to wind or earthquake tremors are a matter of great concern and need special consideration in the design of buildings. These lateral forces can produce the critical stress in a structure, set up undesirable vibrations, and in addition, cause lateral sway of the structure which can reach a stage of discomfort to the occupants. In many countries situated in seismic regions, reinforced concrete frames are infilled fully or partially by brick masonry panels with or without openings. Although the infill panels significantly enhance both the stiffness and strength of the frame, their contribution is often not taken into account because of the lack of knowledge of the composite behavior of the frame and the infill. During the elastic response phase, the presence of brick infill walls increases in plane lateral stiffness of the structure and reduced its fundamental period , and as a result leads to larger shear forces.n residential building RC frame structure are infill by brick panels on all four sides and resisting the lateral earthquake loads on building. By experimentally it has been shown that brick walls have high initial lateral stiffness (Moghaddam and Dowling 1987, Drysdale et al. 1999, Paulay and Priestley 1992,). Hence masonry infills in RC frames different lateral load transfer mechanism of the structure from predominant frame action to predominant truss action (Murty and Jain 2000). Shown in Figure 1 below. Thus it is responsible for increase in axial forces in the RC frame.

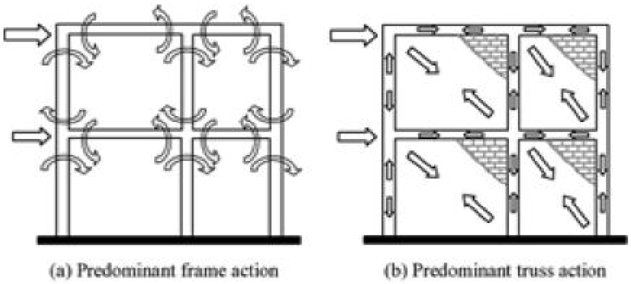


Fig.1 Schematic Representation of Infill Walls

## II. CODAL PROVISION (IS 1893:2002 Part-I)

Seismic Analysis using IS 1893 (Part1):2002In this approach the earthquake force is applied on the structure using seismic coefficient method. In this method the design horizontal seismic coefficient Ah for the structure is given as

$$Ah=(Z/2)*(Sa/g)*(I/R)$$

Where, Z= zone factor as per different zones. IS 1893 (Part1):2002 has classified India in to four zones II to V. In zone II seismic intensity is low and very severe for zone v, I= importance factor, depending upon the functional use of the structures, R= Response reduction factor, depending on the perceived seismic damage performance of the structure, characterized by ductile or brittle deformations. However, the ratio I/R shall not be greater than 1.0 and Sa/g = Average response acceleration coefficient for rock or soil sites. This ratio depends upon the time period and site condition. For the calculation of the earthquake force soils are grouped into three groups as shows in table 3.2 below.

Figure 2 of IS 1893-2002(I) shows the proposed 5 percent spectra for rocky and soils sites and Table 3 of IS 1893-2002(I) gives the multiplying factors for obtaining spectral values for various other damping.

And the approximate fundamental natural period of vibration in seconds for other types of buildings including moment resisting building with infill can be estimated as-
For other buildings

$$T_a = 0.09h/\sqrt{d}$$

Where, h = Height of building in meters. This excludes the basement storeys where basement walls are connected with ground floor deck or fitted with building columns, however, it includes the basement when they are not connected.

d = base dimension of the building at the plinth level in meters along considered direction of the lateral force.
The total design lateral force (design seismic base shear) along any principal direction shall be calculated by using following expression

$$V_B = A_h \times W$$

Where,
VB = design seismic base shear
Ah = design horizontal seismic coefficient for structures as explained in section 3.10.1 of IS 1893-2002.
W = seismic weight of building as full dead load and appropriate amount of imposed load.

### 2.1 Equivalent Diagonal Strut Method

The frames with unreinforced masonry can be modeled as equivalent braced frames by replacing infills with equivalent diagonal strut. Many investigators proposed various approximations for the width of equivalent diagonal strut. The width of diagonal strut depends on length of contact between the wall & the columns (αh) and between wall & beams (αL). The formulation for αh & αLon the basis of beam on an elastic foundation was given by Stafford Smith (1966). Hendry (1998) proposed the following equation to determine effective strut width w, where the strut is assumed to be subjected to uniform compressive stress.

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

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

$$w = \sqrt{\alpha_h^2 + \alpha_L^2}$$

Where, Em is Elastic Modulus of masonry wall, Ef is Elastic Modulus of masonry of frame material, t is Thickness of the in-fill wall, h is Height of the in-fill wall, L is Length of the in-fill wall, Ic is Moment of Inertia of the column of the frame, Ib is Moment of Inertia of the beam of the frame, θ is tan-1 (h/L) and w is Width of the Equivalent Strut

## III. PROBLEM STATEMENT

Consider a four-storey reinforced concrete office building shown in Fig. 1.2. The building is located in Pune(seismic zone III). The soil conditions are medium stiff and the entire building is supported on a raft foundation. The R. C. frames are infilled with brick-masonry. The lumped weight due to dead loads is 12 kN/m2on floors and 10 kN/m2on the roof. The floors are to cater for a live load of 4 kN/m2on floors and 1.5 kN/m2on the roof.Beam Size 230 x450.Column Size 230 x600.Slab thickness 120 mm.Grade of concrete M20 and Grade of steel Fe415

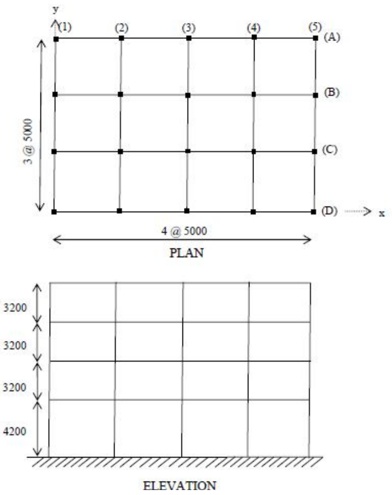


Fig.2 Plan and Elevation of RCC Frame

**Seismic Weights:**

The floor area is 15×20=300 sq. m. Since the liveload class is 4kN/sq.m, only 50% of the live loadis lumped at the floors. At roof, no live load is tobe lumped. Hence, the total seismic weight on the floors and the roof is:

Floors:

W1=W2 =W3 =300× (12+0.5×4)
= 4,200 KN
Roof:
W4 = 300×10
= 3,000 KN
(clause7.3.1, Table 8 of IS: 1893 Part 1)
Total Seismic weight of the structure,
W = ΣWi = 3×4,200 + 3,000

= 15,600 KN

Fundamental Period:

Lateral load resistance is provided by momentresisting frames infilled with brick masonrypanels. Hence, approximate fundamental naturalperiod:
(Clause 7.6.2. of IS: 1893 Part 1)
EL in X-Direction:
T = 0.09h / d
= 0.09(13.8) / 20
= 0.28 sec
The building is located on Type II (medium soil).
From Fig. 2 of IS: 1893, for T=0.28 sec,
Sa /g=2.5
Ah= 0.09(Clause 6.4.2 of IS: 1893 Part 1)

**Design base shear**

Vb=Ah X W
= 0.09×15,600
= 1,440 kN
(Clause 7.5.3 of IS: 1893 Part 1)

Force Distribution with Building Height:

The design base shear is to be distributed withheight as per clause 7.7.1. Table 1.1 gives thecalculations. Fig. 1.2(a) shows the design seismicforce in X-direction for the entire building.
EL in Y-Direction:
T = 0.09h d
= 0.09(13.8) / 15
= 0.32 sec
Sa/g = 2.5;
Ah = 0.09
Therefore, for this building the design seismic force in Y-direction is same as that in the Xdirection.

## III. FEM MODELS IN STAAD-PRO

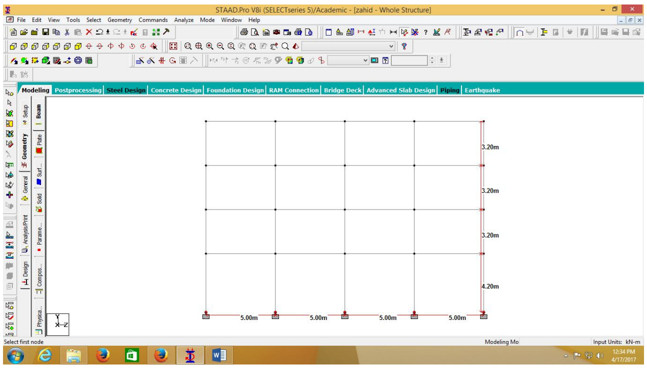


Fig.4FEM model in STAAD-Pro

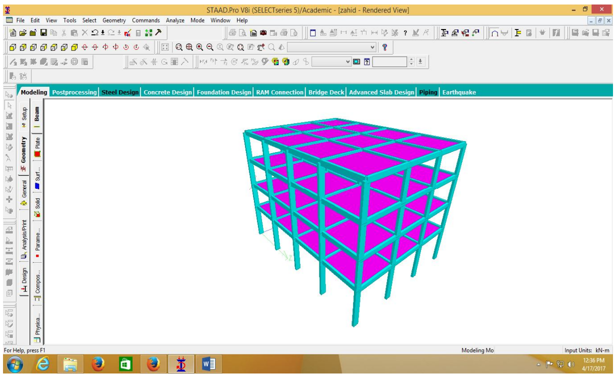
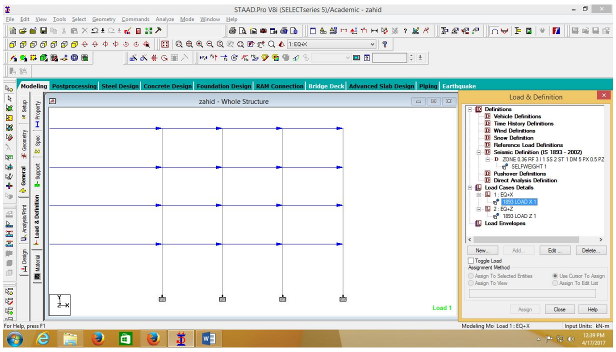


Fig.5 RENDERED VIEW STAAD-Pro



Definitions
Vehicle Definitions
Time History Definitions
Wind Definitions
Snow Definition
Reference Load Definitions
Seismic Definition (IS 1893 - 2002)
ZONE 0.36 RF 3 I 1 SS 2 ST 1 DM 5 PX 0.5 PZ
SELFWEIGHT 1
Pushover Definitions
Direct Analysis Definition
Load Cases Details
1 : EQ+X
1893 LOAD X 1
2 : EQ+Z
1893 LOAD Z 1
Load Envelopes

☐ Toggle Load
Assignment Method
○ Assign To Selected Entities
● Use Cursor To Assign
○ Assign To View
○ Assign To Edit List

Modeling Mo Load 1 : EQ+X
Input Units: kN-m

Fig.3 Base Shear Aloang X direction

The frame is modeled as per the parameters as given in Table 1. Two types of models are considered for the analysis as given below:
Model 1: Bare frame model, however masses of the infill walls are included in the model.
Model 2: Full infill masonry model. Building has one full brick masonry infill wall in all storeys except the ground floor.

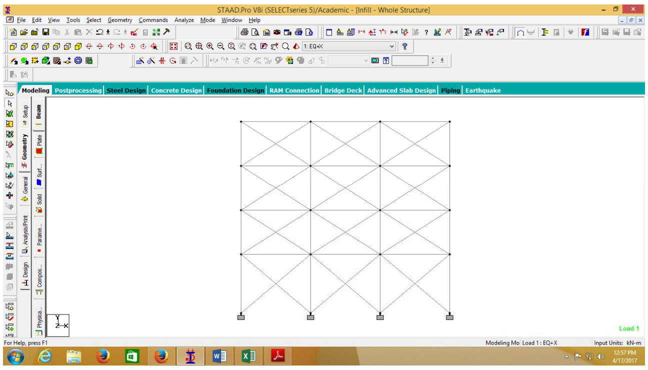


Fig.6 FEM model in STAAD-Pro of Infill Walls

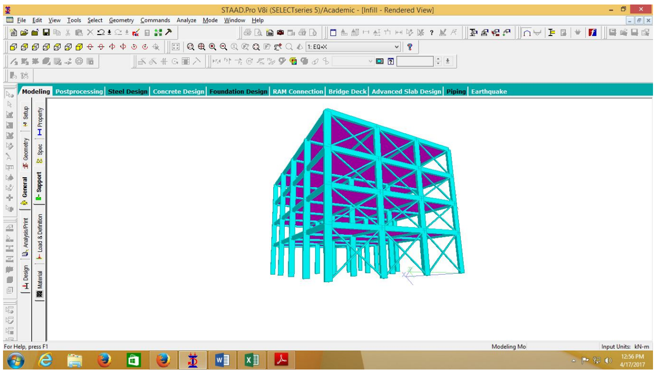
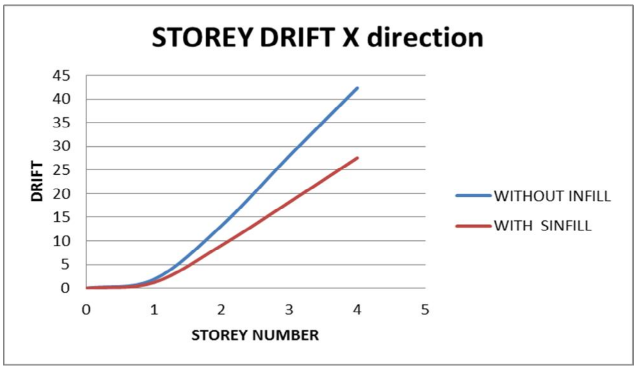
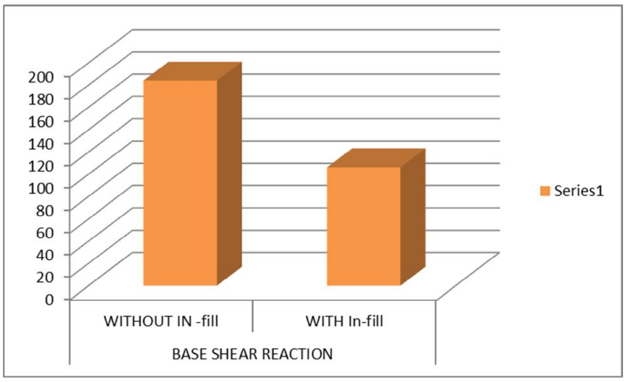


Fig.7 FEM model in STAAD-Proof Infill Walls

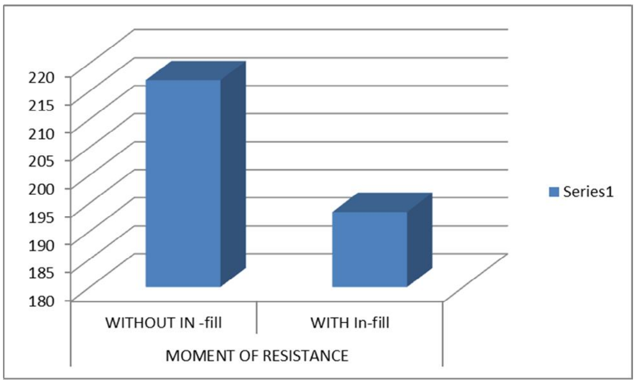
## IV. RESULT AND DISCUSSION



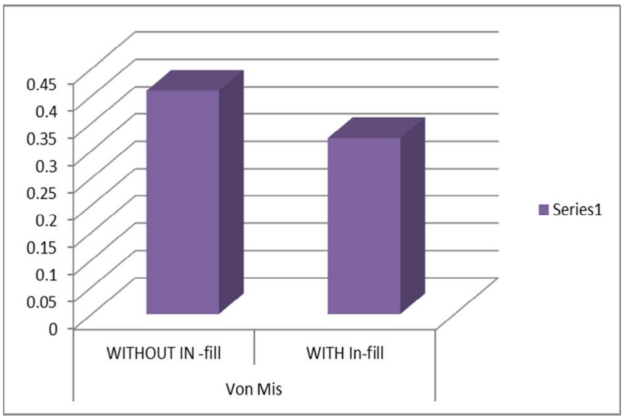
Graph 6.1 Storey Drift-X



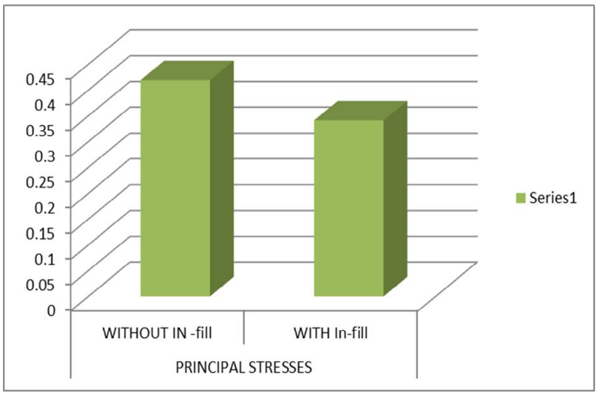
Graph 6.2 Base Reaction



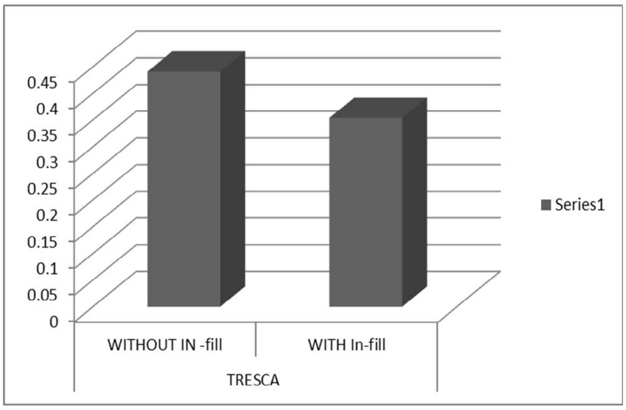
Graph 6.3 Moment of resistance



Graph 6.4 von mises



Graph 6.5 Principal Stress



Graph 6.6 Tresca Stress

## VI. CONCLUSION

In this paper G+4 model with in fill wall and without in fill wall is studied for seismeic loads.The infill wall is designed as per equivalent strut method.The following conclusion can be made from staad-pro models;

- The story drift along X direction is reduced to 24% for in-fill panel walls
- Von-mises stresses,tresca stress are considerably reduced in In-fill wall panels due to increase in stiffness

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