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Earthquake Analysis of RC Building With and Without Infill Wall

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Abstract - *The effect of masonry infill panel on the response of RC frame subjected to seismic action is widely recognized and has been subject of numerous experimental investigations, while several attempts to model it analytically have been reported. In analytically analysis infill walls are modelled as equivalent static approach there are various formulae derived by research scholars and scientist for width of modelling. Infill behaves like compression between column and beam and compression forces are transferred from one node to another. In this study the effect of masonry walls on high rise building is studied. Static analysis on high rise building with different arrangement is carried out. For the analysis G+10R.C.C framed building is modelled. The width is calculated by using equivalent static method. Various cases of analysis are taken. All analysis is carried out by software STAAD-PRO. Storey drift, Nodal displacement, mass participation ,base shear is calculated and compared for all models. The results show that infill walls reduce displacement, time period and increase base shear. So it is essential to consider the effect of masonry infill for the seismic evaluation of moment resisting reinforced concrete frame*

Key Words: *RCC Framed Buildings, Infill Wall &Without Infill , High-Rise Building, Displacement, Base Shear, Storey Drift.*

1. INTRODUCTION

Reinforced concrete (RC) frame buildings with masonry infill walls have been widely constructed for commercial, industrial and multi storey residential uses in seismic regions. Masonry infill typically consists of bricks or concrete blocks constructed between beams and columns of a reinforced concrete frame. The masonry infill panels are generally not considered in the design process and treated as architectural (non-structural) components. Nevertheless, the presence of masonry infill walls has a significant impact on the seismic response of a reinforced concrete frame building, increasing structural strength and stiffness (relative to a bare frame). Properly designed infills can increase the overall strength, lateral resistance and energy dissipation of the structure. An infill wall reduces the lateral deflections and bending moments in the frame, thereby decreasing the probability of collapse. Hence, accounting for the infills in the analysis and design leads to slender frame members, reducing the overall cost of the structural system. The total base shear experienced by a building during an earthquake is dependent on its time period.

The seismic force distribution is dependent on the stiffness and mass of the building along the height. The structural contribution of infill wall results into stiffer structure thereby reducing the storey drifts (lateral displacement at floor level). This improved performance makes the structural design more realistic to consider infill walls as a structural element in the earthquake resistant design of structures

2. OBJECTIVES

1. Perform Seismic Analysis Of Multi Storey Building.
2. Dynamic Analysis Of Multi- Storey RCC Building with and Without Infill Wall By Using STAAD -PRO.
3. To Compare Base Shear, Joint Displacement, Storey Drift, Mass Participation.

3. METHODOLOGY

Time History Analysis- In order to examine the exact non-linear behaviour of building structures, nonlinear time history analysis has to be carried out. In this method, the structure is subjected to real ground motion records. This makes this Analysis of Masonry Infill in a Multi-Storied Building analysis method quite different from all of the other approximate analysis methods as the inertial forces are directly determined from these ground motions and the responses of the building

Response Spectrum Method- In order to perform the seismic analysis and design of a structure to be built at a particular location, the actual time history record is required. However, it is not possible to have such records at each and every location. Further, the seismic analysis of structures cannot be carried out simply based on the peak value of the ground acceleration as the response of the structure depend upon the frequency content of ground motion and its own dynamic properties. To overcome the above difficulties, earthquake response spectrum is the most popular tool in the seismic analysis of structures.

4. REVIEW OF MACRO MODELS

4.1 EQUIVALENT DIAGONAL STRUT MODEL

The existence of infill influences the distribution of lateral loads on the framed structures due to the increase in stiffness. The investigation of interaction of infill with frames has been endeavored by utilizing many analyses like theory of elasticity or finite element analysis. Because of complexity and uncertainty in defining the interaction between infills and the frames, several approximate methods are being developed. A prominent among the most prevalent and known approaches is by replacing masonry infill by equivalent diagonal struts, the thickness of which is equal to the thickness of masonry infills. The primary issue with this approach is to find the effective width. Numerous Scientists have proposed different techniques for determining the width of equivalent diagonal strut. Strut width leans on the length of contact between the columns and the wall (αh) and between the beam and wall (αL).

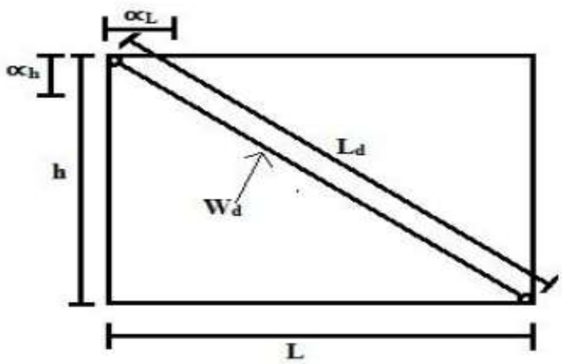


Fig -1: Equivalent diagonal strut model

4.2 CRITERIA FOR SELECTION OF SUITABLE BRICK BRACING SECTION:-

1) Calculation of width of brick bracing-
Size of external concrete column -500x500mm
Size of internal concrete column-750x750mm

Slenderness ratio $\lambda = \frac{l}{rmin}$
Live load =5 KN
Pressure=0.175x25+2.5=6.875
Calculation of diagonal width of strut-
equivalent digoanal strut_

Em=13800 MPA=13800X10^3 KN
t= 0.23M
h= 4.0-0.75=3.25
L=5-0.5=4.5

Q= $\tan^{-1}\left(\frac{h}{l}\right) = 35.83$

Ic=25.20X 10^9 mm4

Ib=1.05X 10^{10} mm4
Poission ratio(u)=0.17

Shear Modulus(G)=0.04

Frame properties(Ef)=5000X $\sqrt{30} = 27386$ mpa

$$\alpha l = \pi \sqrt[4]{\frac{4EfIbL}{Emtsin2\theta}}$$

$$\alpha l = \pi \sqrt[4]{\frac{4X27386x1.05X10^{10}X4.5}{13800x0.23xsin(2x35.83)}}$$

=3596.71
Width(w) Of brick infill wall-

w=($\sqrt{\alpha h^2 + \alpha l^2}$)X$\frac{1}{2}$

w=($\sqrt{1390.74^2 + 3596.71^2}$)X$\frac{1}{2}$
=1928.11 mm
=1900mm
B=230mm

4.3 BUILDING PROPERTIES:

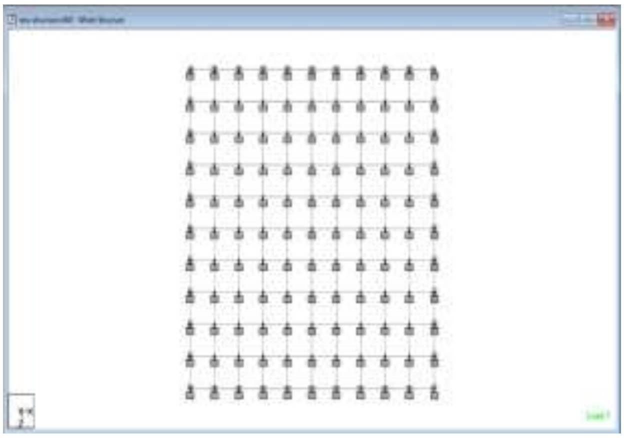
Site Properties:

Type of frame	= SMRF
No. of storeys	= G+9
Importance factor(I)	= 1
Slab thickness	= 175mm
Live load	= 5kN/m2
Dead load	= 4.375kN/m2
Height of floor	= 4m
Type of building	= Commercial
Soil strata	= Hard
Density of concrete	= 25kN/m2
Grade of steel	= Fe500
Beam width(b)	= 300mm
Beam depth(d)	= 750mm
Seismic zone	= III
Zone factor	=0.16
Importance factor	=1.0
Response Reduction factor R	=5

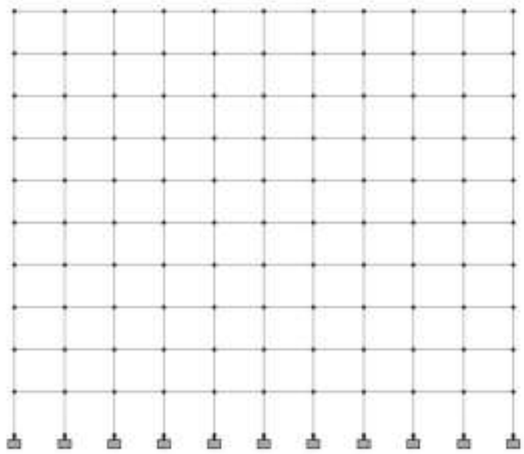
5. LOAD COMBINATIONS:

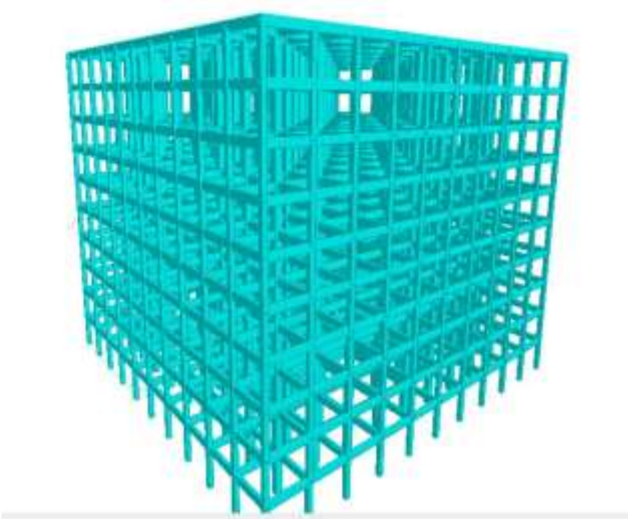
Load combinations that are to be used for Limit state Design of reinforced concrete structure are listed below. 1. 1.5(DL+LL)
2. 1.2(DL+LL±EQ-X)
3. 1.2(DL+LL±EQ-Y)

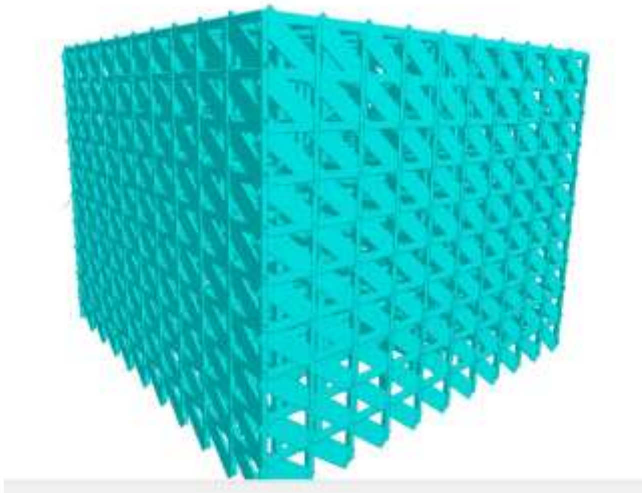
6. MODELLING OF INFILL AND WITHOUT INFILL WALL



PLAN





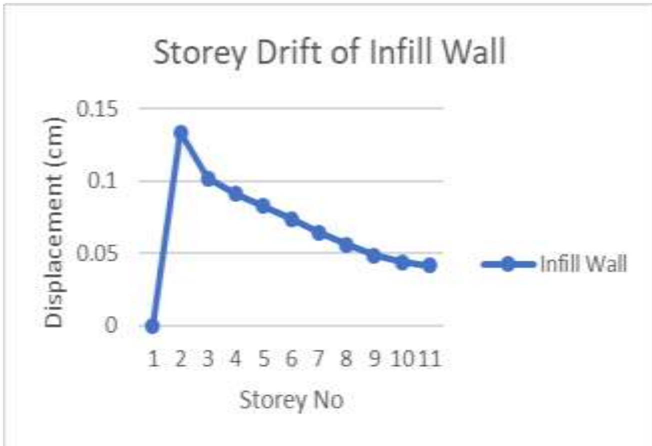


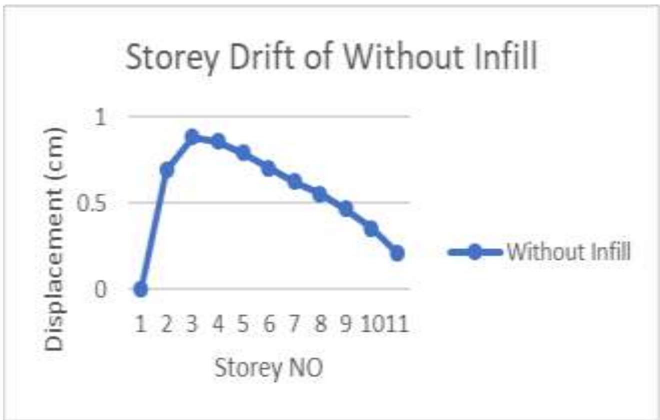
7. RESULT:

Compare Storey Drift

Storey Height(m)	Infill Wall(cm)	Without Infill Wall(cm)
40	0	0
36	0.1335	0.69
32	0.102	0.8819
28	0.0911	0.8563
24	0.0826	0.7903
20	0.0737	0.7055
16	0.0646	0.6227
12	0.0558	0.5526
8	0.0486	0.4668
4	0.0438	0.3534
0	0.0417	0.2116

Table no 01:



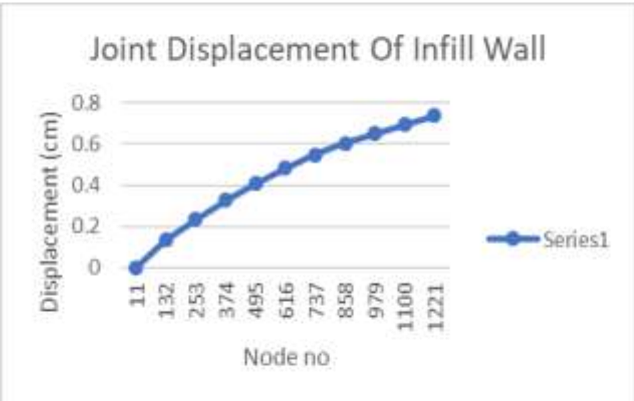


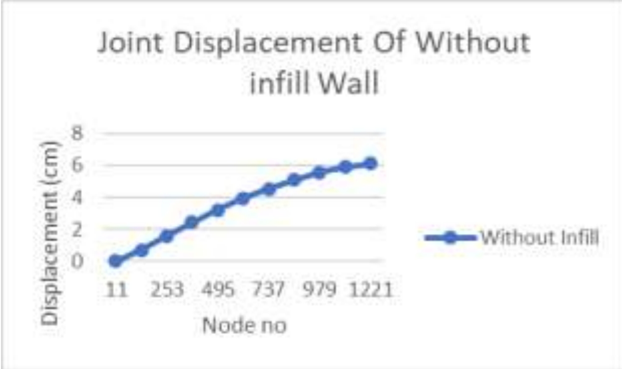
BASE SHEAR :

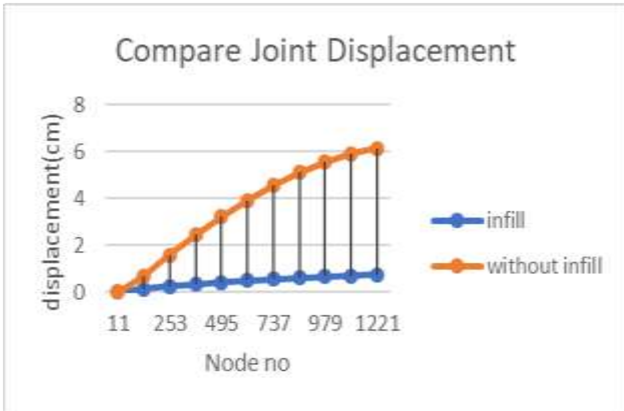
Type	Base Shear	Time(sec)
Infill wall	-1.98E+04	10.5125
Without infill wall	2.29E+04	15.45139

7.1. GRAPH :

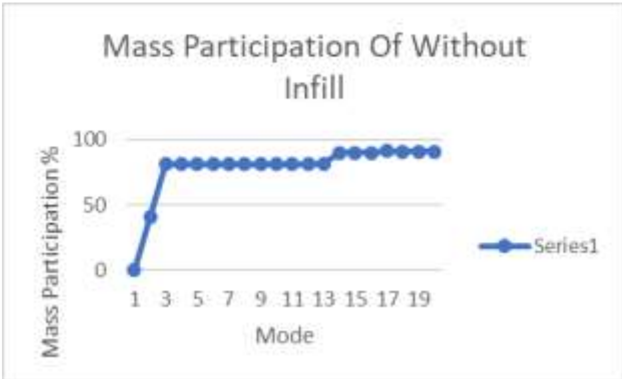
JOINT DISPLACEMENT OF INFILL AND WITHOUT INFILL STRUCTURE:

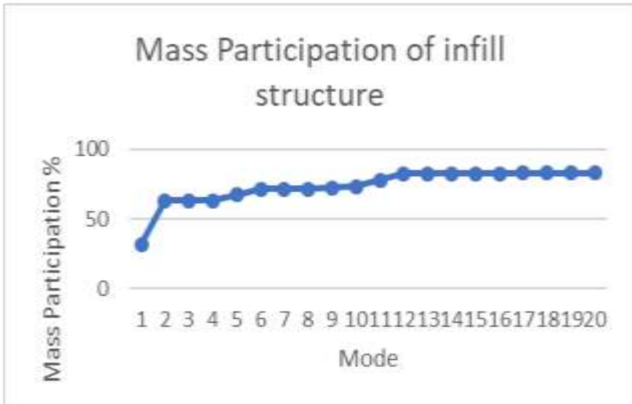


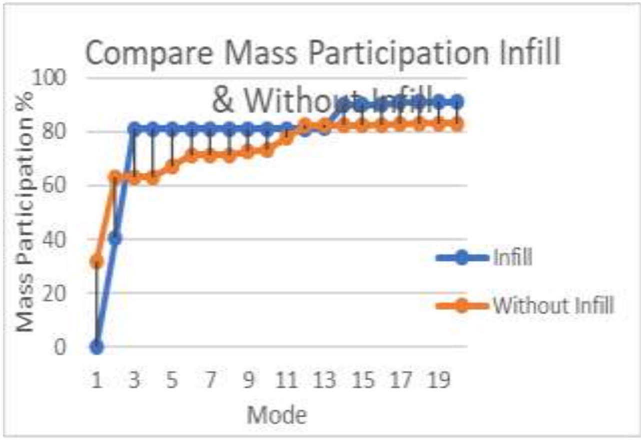




MASS PARTICIPATION OF INFILL AND WITHOUT INFILL STRUCTURE







8. CONCLUSIONS:

1. The results as obtained using **STAAD.Pro V8i (SELECTseries 4)** for with and without infill walls are compared for different categories of a beams shows a difference between with and without infill walls where without infill walls show the maximum values.

2. In Table no 1 The storey drift shows a difference between with and without infill walls where without infill walls shows the maximum drift. The difference in storey drift is 50% higher for without infill than with infill walls.

3. In the Nodal displacement shows a difference between with and without infill walls where without infill walls show the maximum displacement. The difference in nodal displacement is **2** times higher for without infill than with infill walls.

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