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Behaviour of Infill Wall under Seismic Loading in RC Framed Structure

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Abstract— **The study was carried out on the condition of the structures in the past earthquakes. The study involves the design of the R.C frame or the combination of various structural stiffness elements that will be more economical in terms of cost and more efficient when subjected to seismic forces so that loss of property and loss of lives is reduced to the minimum during natural catastrophes. The study is based on the comparative studies of the frame of same plan but of different stiffness configuration. The various parameters that were studied were time period, frequency, displacement and peak storey shear.the results that were obtained indicated that the framed structure with brick infill masonry performed very well under seismic forces and the structural displacement was also reduced the only failure that was observed during the application of lateral force the stress concentration is generated at the beam column joint which leads to the failure of the structure or may generate plastic hinge at beam column joint. The combination of shear wall with brick infill and proper anchorage at the joints which may prevent the failure of structural elements and the structural may act as single unit under dynamic loading.**

Index Terms— **Time Period, Displacement, frequency, Peak Storey Shear , Shear wall, Brick Infill**

I. INTRODUCTION

Masonry in-fills in reinforced concrete buildings cause several undesirable effects under seismic loading: short-column effect, soft-storey effect, torsion, and out-of-plane collapse. Hence, seismic codes tend to discourage such constructions in high seismic regions. However, in several moderate earthquakes, such buildings have shown excellent performance even though many such buildings were not designed and detailed for earthquake forces. This paper presents some Analytical results on cycle tests of RC frames with masonry in-fills. It is seem that the masonry in-fills contribute significant lateral stiffness, strength, overall ductility and energy dissipation capacity. With suitable arrangements to provide reinforcement in the masonry that is well anchored into the frame columns, it should be possible to improve the out-of-plane response of such in-fills. Considering that such masonry in-fill RC frames are the most common type of structures used for multi storey constructions in the developing countries, there is need to develop robust seismic design procedures for such buildings. In-fills are adequately separated from the RC frame such that they do to interfere with the frame under lateral deformations. The entire lateral force on the building is carried by the bare RC frame alone. In-fills are built integral with 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-fills are built integral with the RC frame, and considered as structural elements. The in-plane stiffness offered by the in-fill walls is considered in the analysis of the building. This research work was carried with the important issues related to the identification and assessment of seismic efficiency of the various frames which do not satisfy the requirement of current seismic code and design practices. The objective of this study is to discuss the nature and extend of problem and suggest various methods and solutions that can be adopted by the builders and engineers for structurally deficient frames to transform the killing homes into safety Homes. This study will deal with the Analysis and Design of the RC Frame with and without Shear Wall, with Brick infill frame and the comparison was drawn between base shear, story displacement, time period, frequency and modal mass participation. The performance of the frame with taking in to account various parameters which can cause damage to the structure when subjected to various seismic forces were realized and the frame which performed best in the above defined parameters was suggested but the design constrain which was met during the project phase when the frames were put to seismic test the some frames performed better in few parameters while in other cases they did not perform good so the result that was concluded by clubbing the configuration of different structures like Brick infill with shear wall or else the configuration can be made as brick infill for the enhanced results.

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II. MODEL DETAILS AND ANALYSIS RESULTS

The Response Spectrum Analysis was carried out on Symmetrical Shaped Structures of the Following Dimensions

Table .1 Plan Specifications

Specifications	Dimensions	Units
Number of Stories	G+9	-
Length of Building	64.22	Meters
Breadth of Building	38.30	Meters
Height of Building including parapet wall	39	Meters
Ground floor Plan Area	1322.23	Sqm

2.1 Load Calculations

Dead loads

Water proofing of Terrace = 1.5 kN/m^2

Floor Finish = 0.5 kN/m^2

Weight of Walls = 4.6 kN/m^2

Weight of Slab = 3.75 kN/m^2

Live loads

Live load on Roof = 1.5 kN/m^2

Live load on Floor =3.5 kN/m^2

The following load combinations shall be accounted for:

- 1.5 (DL+IL)
- 1.2 (DL+IL±EL)
- 1.5 (DL±EL)
- 0.9 DL± 1.5 EL

Lumped mass on terrace

Weight of Parapet = 2 kN/m^2

Weight of Floor Finish = 0.5 kN/m^2

Weight of Water Proofing = 1.5 kN/m^2

Weight of Slab = 3.75 kN/m^2

Total Lumped Mass at = 7.75 kN/m^2

Roof Level

Lumped Mass on Floors

Weight of Slab = 3.75 kN/m^2

Weight of Walls = 4.6 kN/m^2

Weight of Floor Finish = 0.5 kN/m^2

Total Lumped Mass on = 8.85 kN/m^2

Floor

Revised loads as IS 1893 (Part 1):2002

per code

Percentage of imposed load to be considered in seismic weight calculation are mentioned in table 3

TABLE .3 Percentages of Imposed Loads

Imposed Uniformity Distribution Floor Loads (kN/m^2)	Percentage Of Imposed Load
Up to and including 3.0	25
Above 3.0	50

Live load on roof to be taken = 1.875 kN/m^2

as per code

Live Load on floors to be = 5.25 kN/m^2

taken as Per Code

2.2 Calculation of Time Period

T = 0.075 h$^{0.75}$, for RC frame building

T = 0.075 × 36$^{0.75}$ = 1.10 Sec

2.3 Computation of Spectral Acceleration Co –efficient

The spectral acceleration co-efficient is taken on the basis on time period obtained and on the type of the soil.

$$\frac{Sa}{g}=0.90$$

2.4 Design Spectrum

For the purpose of determining seismic forces, the country is classified into four seismic zones. The design horizontal seismic coefficient A for a structure shall be determined by the following expression:

$$A_h=\frac{Z\,I\,S_a}{2\,R\,g}= 0.036$$

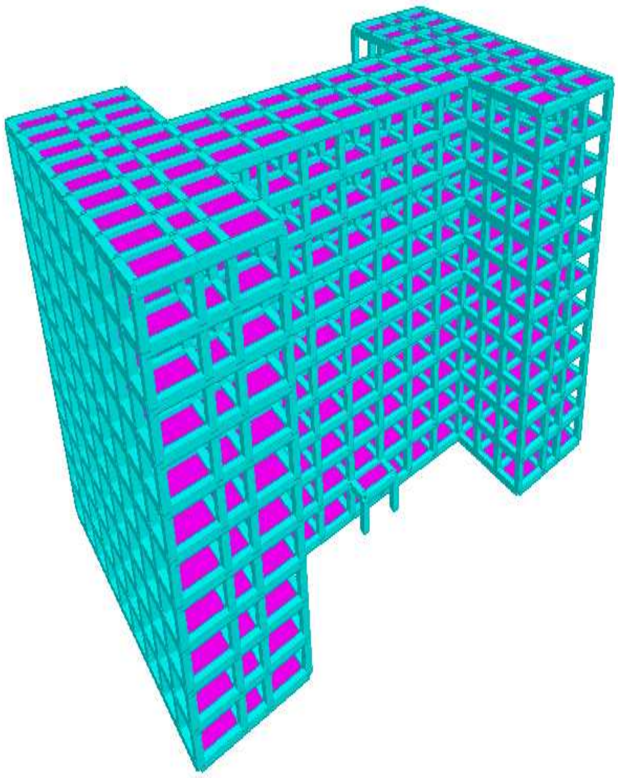

Fig .1 Bare RCC Frame

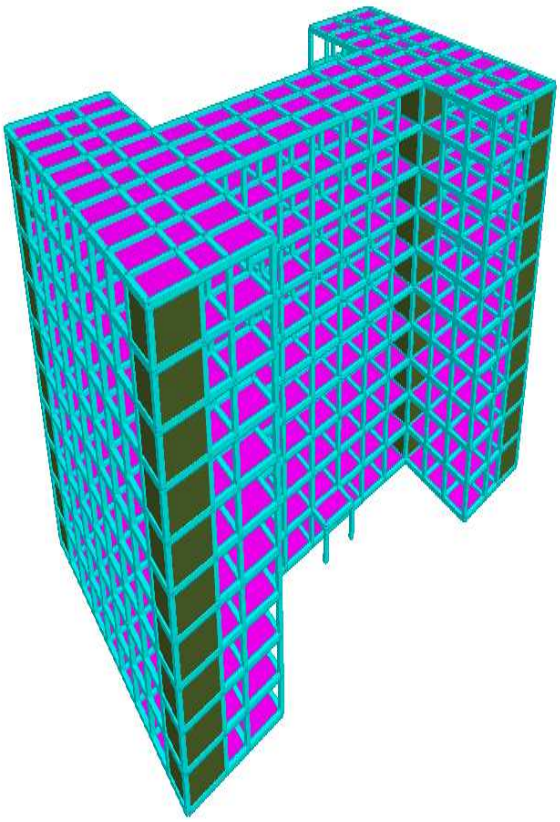

Fig .2 Frame with Shear wall

2.5 Computation of Time Period for Brick Infill

The time period of the brick infill may be calculated as

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

T_a in x directions = 0.525 sec

T_a in z directions = 0.405 sec

2.5.1 Computation of Spectral Acceleration Coefficient for Brick Infill

The spectral acceleration co-efficient is taken on the basis on time period obtained and on the type of the soil.

$$\frac{Sa}{g} = 1.90$$

2.5.2 Computation of Horizontal Seismic Coefficient for Brick Infill

The design horizontal seismic coefficient A for a structure shall be determined by the following expression:

$$A_h = \frac{Z\,I\,S}{2\,R\,g}$$

A_h= 0.076

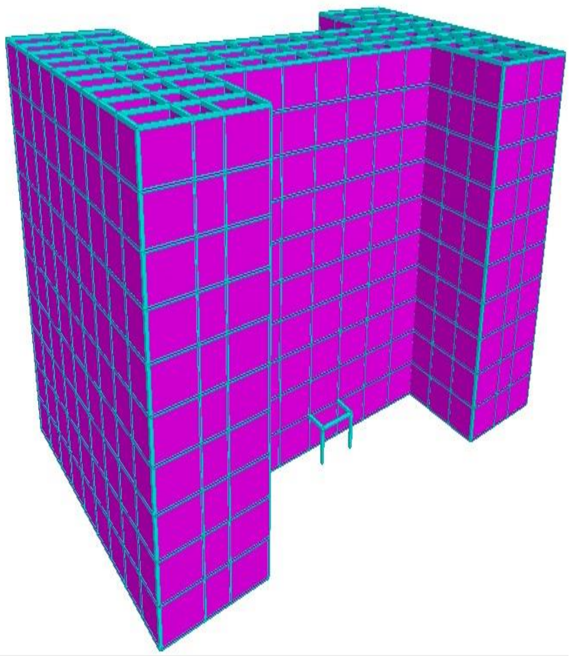

Fig .3 Frame with brick infill wall

Generally the infill frame analysis is done either by equivalent Strut method or by some other convenient method but can estimate the member forces but the exact behavior of structure cannt be examined as the infill wall acts as a panel and the behavior is way more different than that of the diagonal strut.in this case study the panel has been used as that of the same stiffness of the brick infill wall. All the parameters were considered and the panels were modified to density and stiffness of the infill wall.

III. COMPARATIVE STUDIES

The three frames of different stiffness Configuration were studied and the following results were obtained.

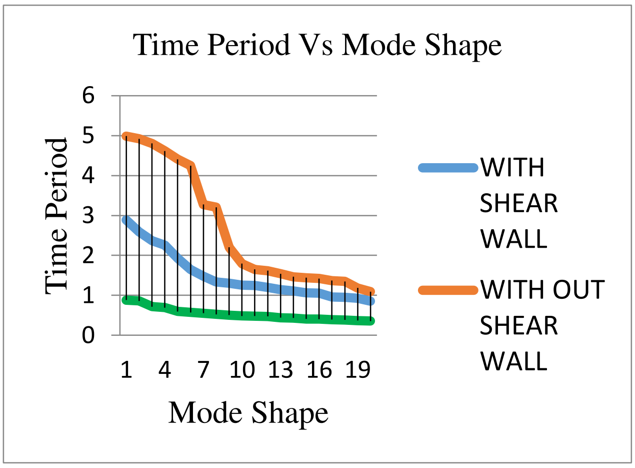

Fig .4 Time Period Vs Mode Shape.

The above graph depicts that the framed structure with brick infill indicates reduce in time period as compared to other two structural stiffness configurations. When time period is less for the structure that implies the damage caused due to earthquake will be considerably low because of the fact that the structure will undergo very less or little displacement.

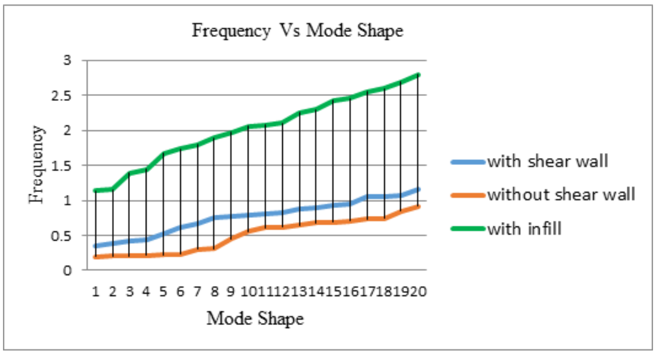

Fig .5 Frequency Vs Mode Shape

The above Graph depicts that the framed structure with brick infill indicates high in frequency as compared to other two structural stiffness configurations. If the frequency is high for the structure that implies the damage caused due to earthquake will be considerably low because of the fact that the structure will undergo very less or little displacement along with more constant vibration which may cause or lead to very minimal damage to the structure.

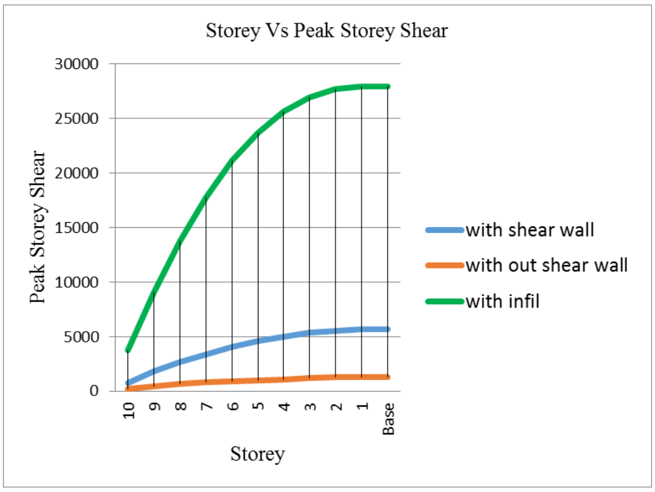

Fig .6 Number of Storey Vs Peak Storey Shear in X direction

The fig 5 depicts the variation in peak storey shear in X direction. The graph showed in the fig 5 shows the variation in the peak storey shear of the different structures with different stiffening systems. It can be noted that following graph, the frame without proper stiffening. The brick infill is having more peak storey shear. The graph depicts the peak storey shear in fig 6.

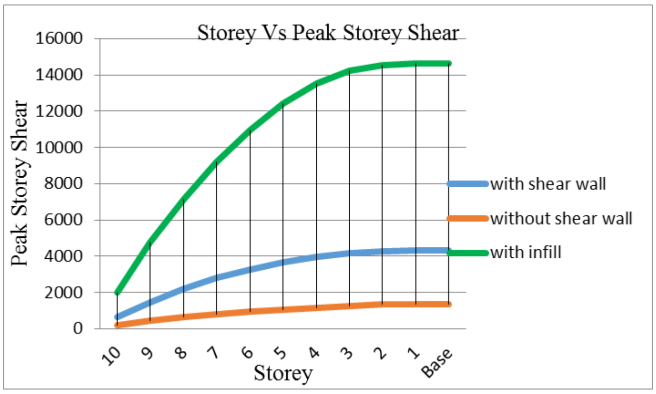

Fig .7 Number of Storey Vs Peak Storey Shear in Z direction

The graph shown below gives the resultant displacement of the various frames those were seismically analyzed. The results that were concluded showed that the maximum displacement has occurred to the structure R.C frame without shear wall while the least displacement was shown by frame with brick infill.

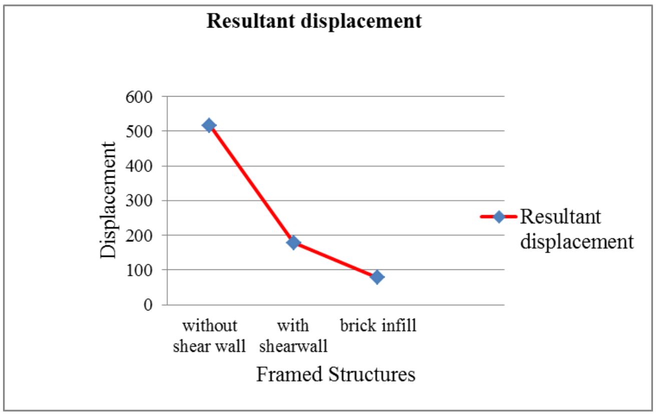

Fig .8 Comparison of Displacement

Table 3 Resultant Displacement Values

S.No	Frame	Resultant Displacement (mm)
1	Without shear wall	516.519
2	With shear wall	178.82
3	With brick infill	78.319

IV. Conclusion

The seismic studies was carried out on the following structures RC Frame without shear wall, RC Frame with shear wall ,RC frame with infill wall.

Decrease in time period

- With shear wall is 42.06 % when compared with without shear wall.
- With infill wall 84.33% when compared to without shear wall.

Increase in frequency

- With shear wall is 42.04% when compared with without shear wall..
- With infill wall 82.39% when compared to without shear wall.

Increase in peak storey in X direction

- With shear wall is 77.22% when compared with without shear wall.
- With infill wall 95.30% when compared to without shear wall.

Increase in peak storey in Z direction

- With shear wall is 69.09% when compared with without shear wall.
- With infill wall 90.86% when compared to without shear wall.

Displacement

- ➢ Reduction in lateral displacement was observed as 65.38% in Shear wall Frame when compared to Frame without Shear wall.
- ➢ Reduction in lateral displacement was observed as 84.33% in Frame with Brick infill wall when compared to bare RC frame wall.

The performance of the structure with more stiffness i.e brick infill was relatives better to the other structures which were analyzed. So the conclusion that is drawn the brick infill if clubbed with shear wall would provide better stability and resistance during earthquake.

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