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LINEAR MODAL HISTORY ANALYSIS OF MULTI- STORIED BUILDING WITH SHEAR WALL AND INFILL WALL

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Abstract: *The recent earthquakes have exposed the vulnerability of the existing reinforced concrete buildings in India. The need for evaluating the seismic adequacy of the existing structures has come into focus following the damage and collapse of numerous concrete structures during recent earthquakes. In order to carry out seismic evaluation a simplified procedure for evaluation is highly in need for a country like India which is prone to earthquakes. The time history analysis procedure is applied for the seismic evaluation of a reinforcement concrete bare frame and frame with infill along with provision of soft storey and shear wall. Shear wall systems are one of the most commonly used lateral-load resisting systems in high-rise buildings. Shear walls have very high in-plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications. Masonry infill walls are mainly used to increase initial stiffness and strength of reinforced concrete (RC) frame buildings. This study investigates soft story behavior due to increased story height, and less amount of infill at ground storey existence of both cases using time history analyses for mid-rise reinforced concrete buildings. In this paper, main focus is to determine the solution for shear wall location in multi-storey building. In order to examine the performance of building after performing the analysis parameters like natural period, base shear, displacement and storey drift is determined. Also it is concluded that the effect of infill plays very crucial role in seismic evaluation of existing RC buildings.*

Keywords: Solar Cooling, vapor absorption cycle, Ammonia-water solution.

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INTRODUCTION

Reinforced concrete framed buildings are adequate for resisting both the vertical and the horizontal load acting on them. However, when the buildings are tall, beam and column sizes workout quite heavy, so that there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these places, which fact, does not contribute to the safety of buildings. The recent earthquakes have exposed the vulnerability of the existing reinforced concrete buildings in India to come across these issues and structural retrofitting and rehabilitation is a challenging task therefore the addition of shear wall and masonry infill walls are two applicable techniques in RC building which required strength and stiffness to provide superior performance and stiffness of a building and reduces the drift demand.

The term shear wall is rather misleading as such a wall behaves like flexural members. They are usually used in tall buildings and have been found to be of immense use to avoid total collapse of buildings under seismic forces. It is always advisable to incorporate them in buildings built in region likely to experienced earthquake of large intensity or high winds. The design of these shear wall for wind are design as simple concrete walls. The design of these walls for seismic forces requires special considerations as they should be safe under repeated loads. Shear walls may become imperative from the point of view of economy and control of lateral deflection.

In reinforced concrete frame building, masonry wall are generally used in as infill and specified by architects as partitions in such a way that they do not contribute to the vertical gravity load-bearing capacity of the structure. Infill walls protect the inside of the buildings from the environment hazards and create separation insides. In addition to this infill have a considerable strength and stiffness and they have significant effect on the seismic response of the structural systems. Mostly two common structural damages observed caused by masonry infill walls in earthquakes i.e. soft stories and short columns.

BUILDING CONFIGUREURATIONS AND LOADING

For the seismic evaluation of a building the following data of building along with different components and their sizes are summarized as shown in Table 1.

Table 1: Building Details

MEMBER	SIZE
BEAM	230 X 480 mm
COLUMN	600 X 600 mm
SLAB	150 mm
SHEAR WALL	230 mm
GRADE OF CONCRETE	M20

GRADE OF STEEL	Fe 500
INFILL WALL	230 mm

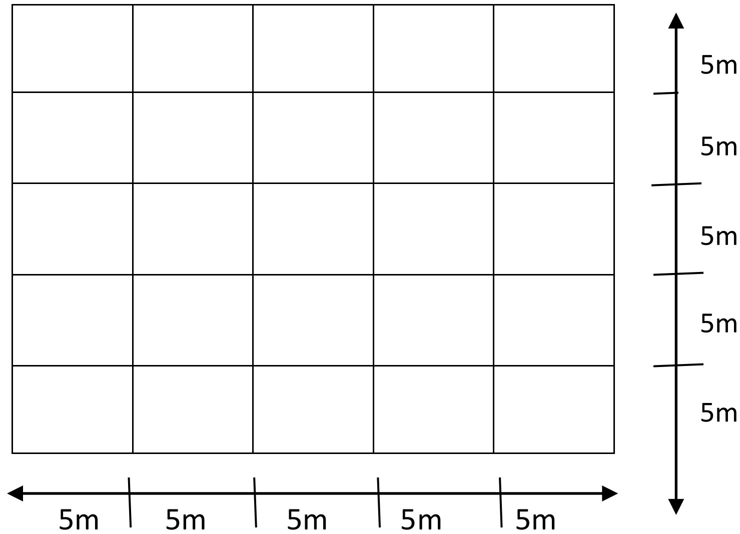
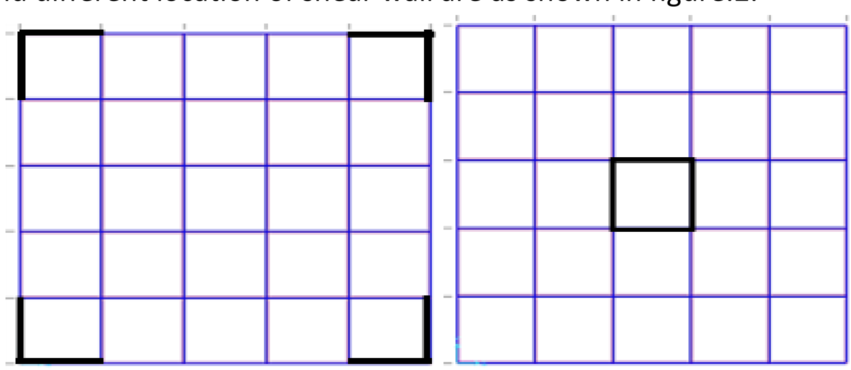


Figure 1: PLAN of G+15 and G+20 building.

II. METHODOLOGY

From the literature review it is observed that, the seismic evaluation of RC building is calculated by using different analysis method and therefore in this studies the different models of RC G+15 and G+20 building are analyzed by using time history analysis.

Shear wall is provided for the G+15and G+20 building for understanding the behaviour of provision of shear wall in multi- storied building during earthquake. Along with shear wall the buildings are provided with brick masonry infill wall for the same purpose and during provision of infill wall soft storey effect is also considered upto one and second soft storey. The different locations of shear walls which are used are as follows and along with shear wall the buildings are modeled with brick masonry infill wall with considering the effect of soft storey up to second floor.and different location of shear wall are as shown in figure.2.



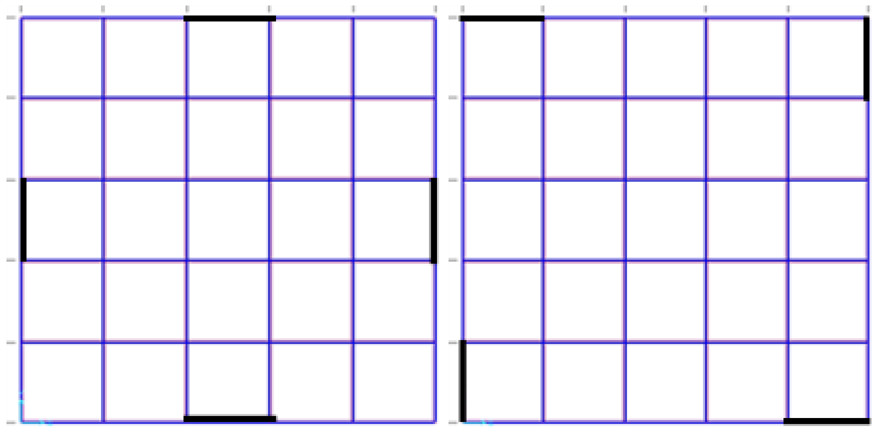


Figure 2: PLAN of G+15 and G+20 building with different location of shear wall

III. PERFORMANCE EVALUATION

The main objective of this study is to examine the behaviour of building for different location of shear wall and infill wall**.** All the above models are analyzed for earthquake records *i.e.* time history analysis. The analysis is carried out using SAP 2000 software. The comparison is made between the structural responses of different building models within the different location of shear wall and infill wall.

Free vibration analysis: Free vibration analysis is carried out to determine the frequencies and mode shape of all models. It is clearly observed that period for different models changes abruptly. The time period are shown in Table 2, and Table 3.

Table 2: Time period of G+15 and G+20 building with different location of shear wall

Building Model	Parameter	Corner Shear Wall	Periphery Shear Wall	Core Shear Wall	Central Shear Wall	Without Shear Wall
G+15	Time Period(Sec)	2.5552	2.2084	2.4498	2.5053	3.04947
G+20	Time Period(Sec	2.959	3.4137	3.266	3.3178	4.1612

Table 3: Time period of G+15 and G+20 building with infill wall at different soft storey

Building Model	Parameter	Bare Frame	Infill wall with 1 soft storey	Infill wall with 2 soft storey
G+15	Time Period(Sec)	3.0495	1.3422	1.4990
G+20	Time Period(Sec	4.1612	1.2120	1.3839

Time history analysis: It is an analysis of the dynamic response of the structures at each increment of time, when its base is subjected to a specific ground motion time history. In this method, the structure is subjected to real ground motion records. This makes this analysis method quite different from all of the other approximate analysis methods as the inertial forces are directly determined from these ground motions or in forces are calculated as function of time, considering dynamic properties of building structure. The earthquake records were used; the maximum PGA on the basis of acceleration gravity for Imperial Valley (El Centro) (1979). Acceleration component and properties of earthquake is shown in Figur3 and figure 4 and table 4 and table 5.

Table 4: Properties of Earthquake Record

Record	Imperial valley (1979)
Station	EC meloland
PGA(g)	0.348
Magnitude	6.5

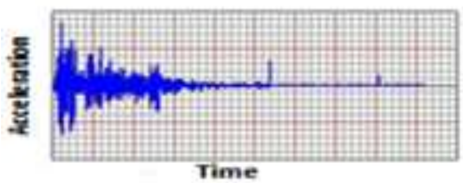


Figure 3: Acceleration component of earthquake

Table. 5 : Maximum response and its Dominant time period for diffrent time history data

Earthquake data	Maximum response	Dominant Time period
Imperial valley	9 m/s^2	0.3 – 0.8

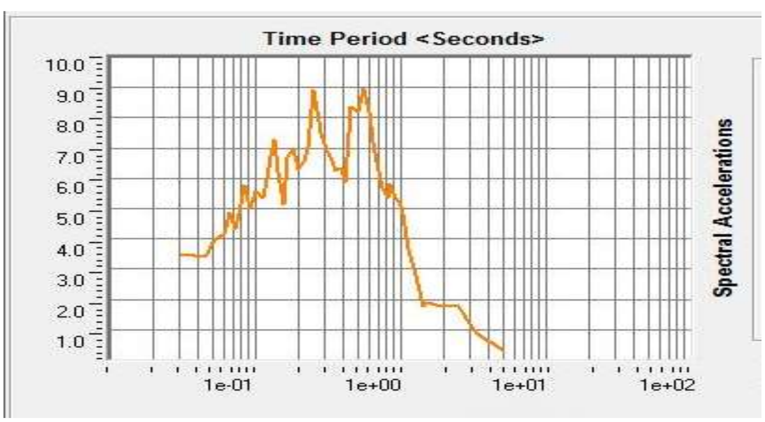


Figure 4: Response spectra for Imperial Valley earthquakes.

IV. RESULTS AND DISCUSSIONS

After modeling of all models of G+15 AND G+20 RC building with shear wall and infill wall the time history analysis is carried out for evaluating the structural seismic response using SAP 2000. The responses like displacement, storey drift and base shear are compared between the different locations of shear wall and infill wall. Figure 5 to Figure 8 shows the graphical variation of responses of G+15 AND G+20 RC building.

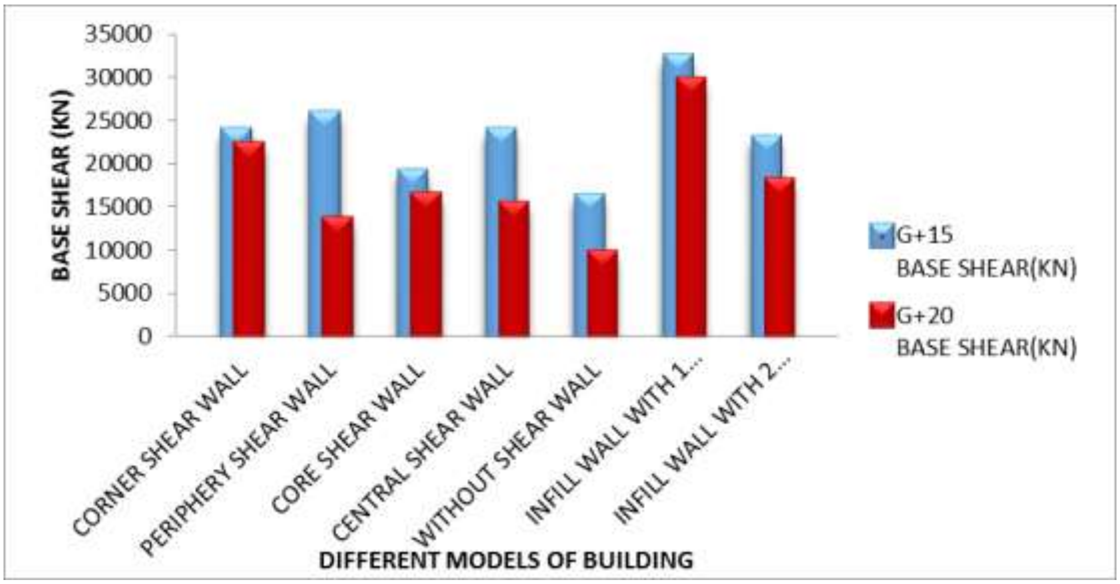


Figure 5: Base shear for different models of G+15 and G+20 RC building.

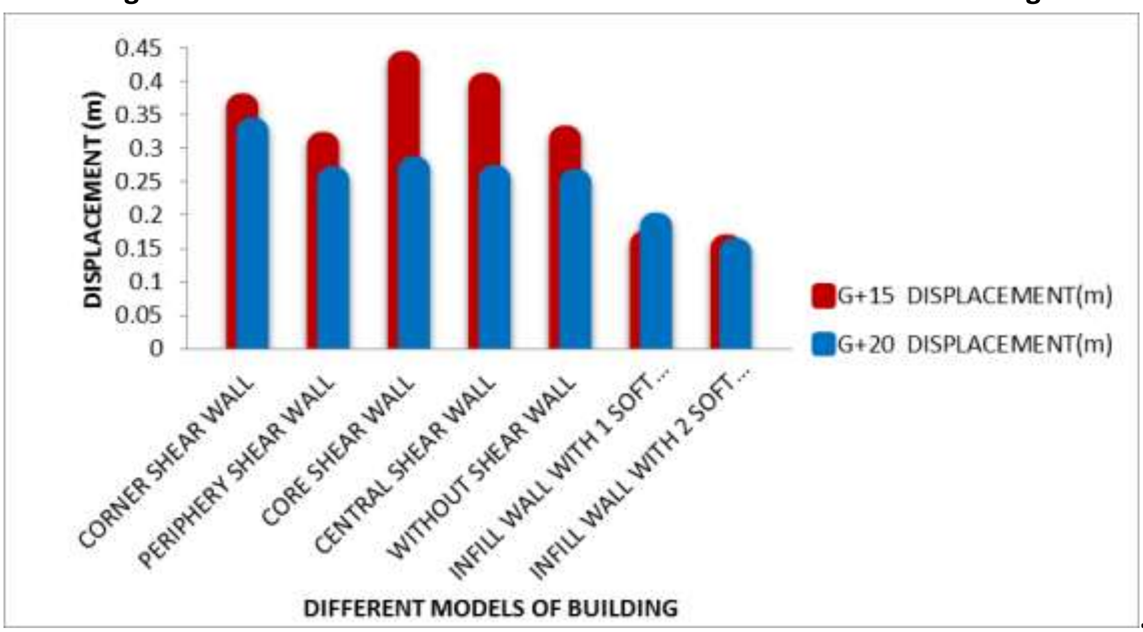


Figure 6: Displacement for different models of G+15 and G+20 RC building.

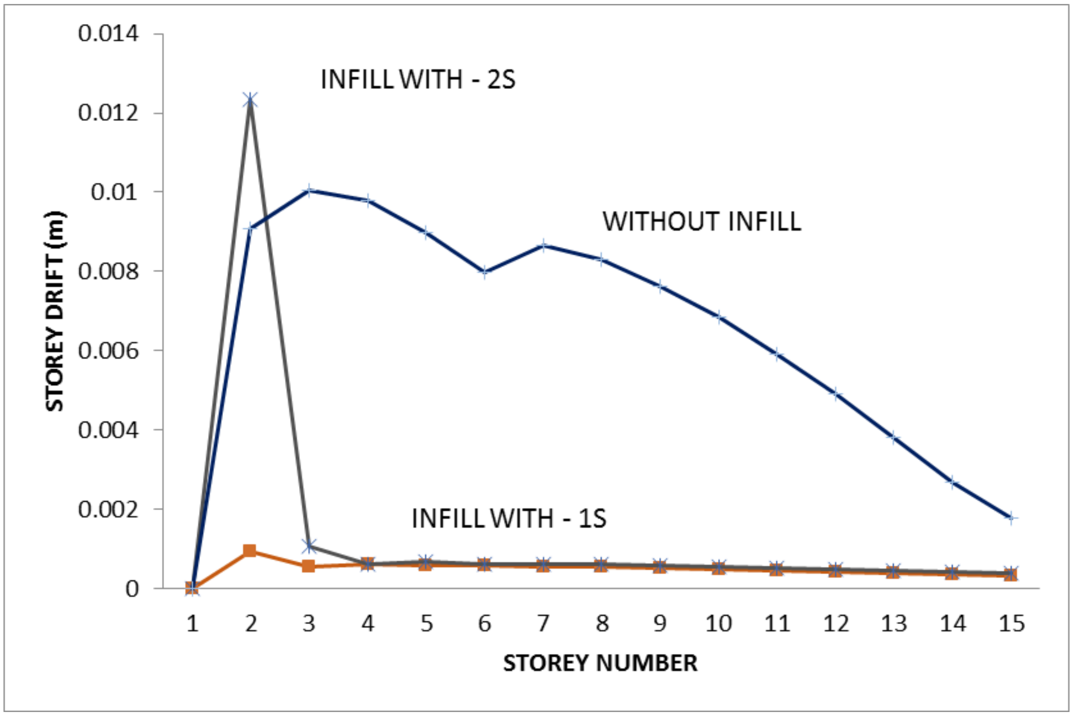


Figure.7: Storey drift for G+15 RC building for infill wall

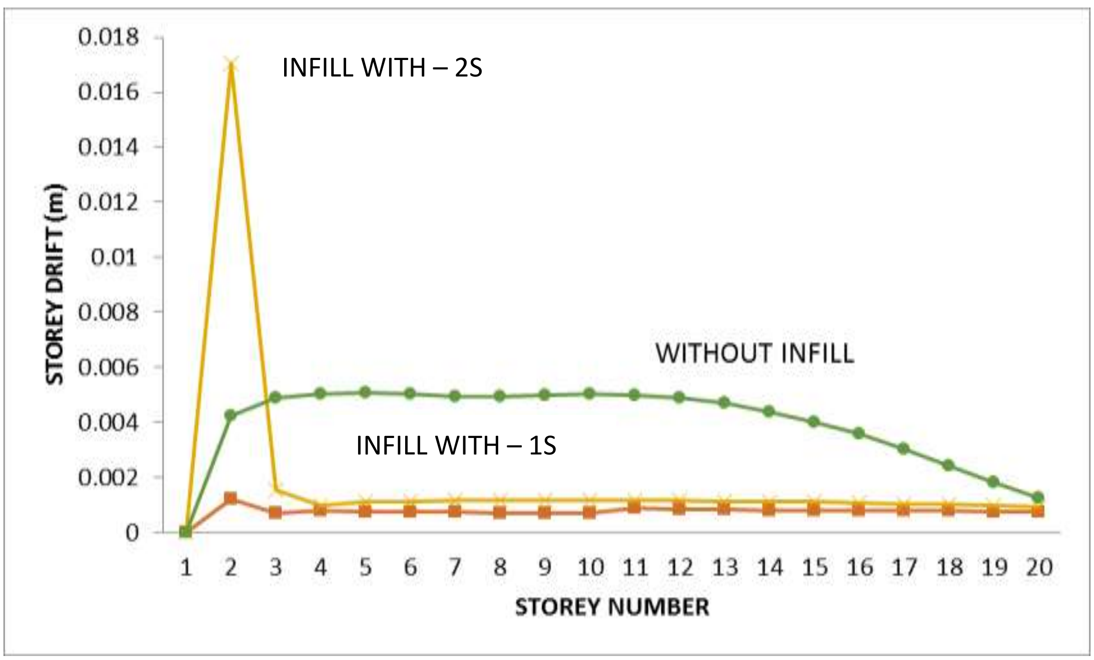


Figure 8: Storey drift for G+20 RC building for infill wall

From above graphs shown in figure (5 - 8) the variations of responses are explained in following way.In this study, RC building with and without shear wall and infill wall with soft storey provision has been considered. Seismic responses including displacements and base shear were assessed under four earthquake records. The seismic responses of RC building have been determined using time history analysis .The obtained results are summarized as follows:

1. The critical response depends on the earthquake characteristics and particularly frequency content of earthquake records.
2. The time period for bare frame of RC building is maximum than RC building with shear wall and infill wall. While comparing among the shear wall and infill wall the time period of RC building is less for building with infill with provision of one soft storey than two soft storeys and in shear wall periphery and corner shear wall gives less time period. Modal time period decreases because of increase in stiffness i.e. rigidity if building
3. Base shear for bare frame is minimum than any other provisions made in building and building with brick masonry infill wall shows maximum base shear than different provision of shear wall. While discussing among the different location of shear wall corner and core shear wall gives maximum base shear, base shear increases means stiffness of building against seismic loading increases.
4. The displacement of building is less for infill wall models with one and two soft storey than displacement in shear wall, as shear wall makes a building to behave in torsion and fails in irregular pattern.
5. The building with infill wall with one soft storey gives lesser storey drift than building with infill wall upto second soft storey and bare frame.
6. The value of storey drift suddenly increases at the level of soft storey than at other stories.

V. CONCLUSION

In this paper, various models of G+15 and G+20 RC building are analyzed to ground motion of Imperial Valley and time history analysis is carried for different location of shear wall and infill with soft storey provision. The conclusions which are obtained from this are summarized are as follows:

1. Infill panels increase stiffness of the structure.
2. From this analysis it can be concluded that infill wall will change the seismic performance of RC building.
3. Story displacement and story drift are decreased and base shear is increase with higher stiffness of infill.
4. In case of shear wall building the global stiffness increases and modal time period decreases. Due to provision of shear wall the axial forces and bending moments in the column gets reduced.

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