BEHAVIOUR OF 3D RC FRAMES WITH MASONRY INFILL UNDER EARTHQUAKE LOADS- AN ANALYTICAL STUDY USING E-TABS

Arulmozhi. N[1], Srinivasan. R[2], Suresh Babu. S[3], Jegidha.K.J[4]

[1]PG Scholor, Department of Civil Engineering, Adhiyamaan College of Engineering, Hosur
[2]Assistant Professor, Department of Civil Engineering, Adhiyamaan College of Engineering, Hosur
[3]HOD, Department of Civil Engineering, Adhiyamaan College of Engineering, Hosur
[4]Assistant Professor, Department of Civil Engineering, Adhiyamaan College of Engineering, Hosur

Abstract

Moderate and astringent earthquakes have struck different places in the world, causing rigorous damage to reinforced concrete structures. The bond between the structural elements and masonry in-fills of the building is habitually effected by Earthquake. The voids between horizontal and vertical resisting elements of the building frame is filled by Masonry in-fills. An infill wall enhances considerably the strength and rigidity of the structure. It has apperceived that frames with in-fills have more vigor and rigidity compared to the bare frames Hence this study is about the demeanor of 3D-RC frames with and without masonry in-fills utilizing E-TABS. parameters were studied like displacement, lateral load distribution, stiffness and overturning moment of the frames and it is concluded that, the in-fill walls are needed to be considered while designing phase of the structures.

***Keywords**: Earthquake load, 3D RC Frame, Masonry In-Fill*

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1. INTRODUCTION

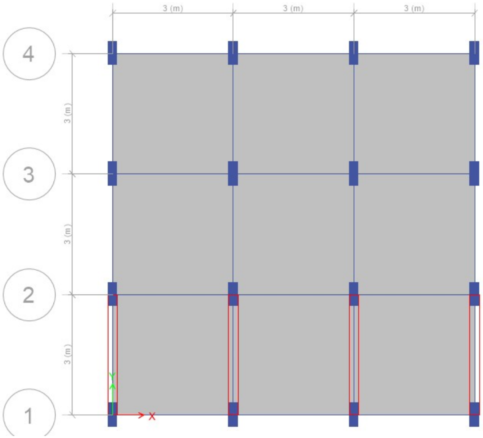
The earthquake is a phenomenon that releases high amount of energy in a short time through the earth. Structures designed to resist moderate and frequently occurring earthquakes must have ample stiffness and strength, to control deflection and avert any possible collapse. In other words, a structure not only should dissipate a considerable amount of imported energy by ductile demeanor, but additionally it should be able to control the deformations and transfer the force to substratum through enough lateral stiffness in ground kineticism From the observations of damages of the past earthquakes, it is hard to digest the loss of greater number of human lives and to the properties. So this is due to the lack of proper design and understanding construction technique among both public and engineering domain. The buildings, which had already been constructed is susceptible to face more seismic risk, due to the increased seismic vulnerability, hence proper evaluation of the building against seismic hazards is absolutely necessary.

The rapid industrialization and increase in population have called for optimum use of scarce land due to which multi-storey building have become inevitable. Apart from dead and live loads, the structures have to withstand lateral forces. Under the action of natural wind and earthquake a tall building will be continually buffeted by gusts and other dynamic forces. Masonry infill walls are frequently utilized as interior partitions and exterior walls in low or middle elevate RC buildings. The infill walls are conventionally treated as non-structural elements and they are ignored in analytical models In the design and assessment of buildings because they are surmised to be propitious to the structural replications. Ergo their influences on the structural replication are generally ignored. When the boundary frame of the structure when it is subjected to ground forms of kineticism their stiffness and strength are not tiny .This interaction may or may not be salutary to the performance of the structure.

In developing countries ,Most of the reinforced concrete (RC) frame buildings are in-filled with masonry walls. Experience during the past earthquakes has demonstrated the benign effects as well as the ill-effects of the presence of infill masonry walls. In least two moderate earth quake (enormity 6.0 to 6.5 and maximum intensity 7 on MM scale). In India, RC frame building with brick masonry in-fills have shown excellent performance even though most such buildings were not designed and detailed for seismic replication. From the extensive review of literature carried out, it has been found that no analytical study on three-bay, multi-storey R.C.C frame subjected to lateral loading has been done so far. In this research analytical study was carried out on a three bay, multi storey R.C frame with different locations and percentage of masonry in-fills. The load points were located at first storey level.

1.2 Analytical Model:

A typical multi-storey residential building, with three bays in longitudinal as well as in transverse direction is considered for study as shown in fig 1. The grade of concrete used is M20 and steel is fe415. As per IS 456:200,. The thickness of slab and masonry in-fill is 150mm and 230mm respectively. The live load on roof and floor finish are taken to be $3kN/m^2$ and $1kN/m^2$. The size of beam is 230x450mm and size of column is 230x600mm. The building is considered to be sited in IV zone with medium soil setting.



Fig(1). Plan of frame

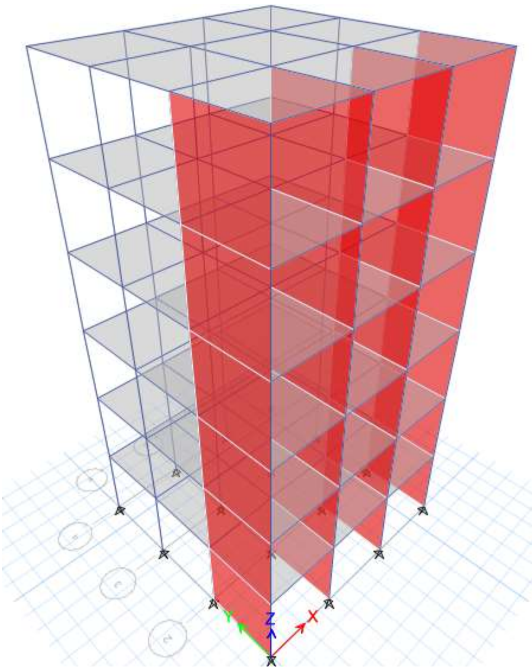


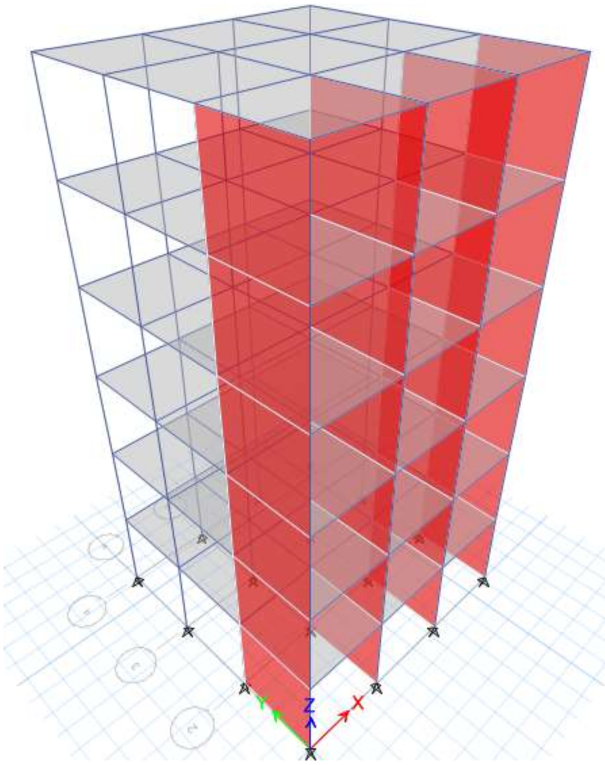
Fig (2). Elevation of frame

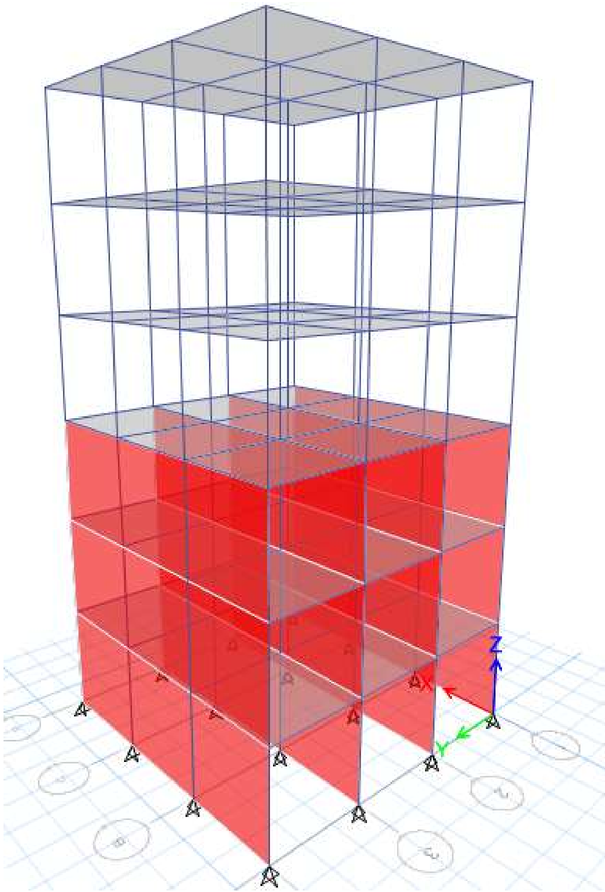
2. METHODOLOGY OF THE PRESENT WORK:

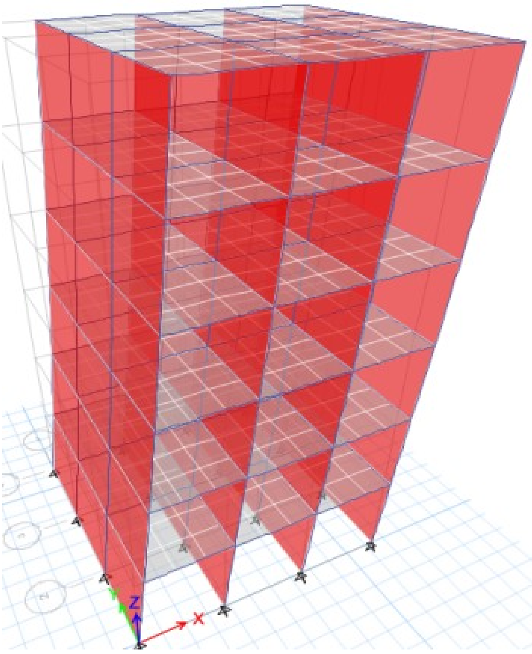
In this study, response spectrum analysis is used to determine earthquake response of the structure using E-tabs software. The analysis is performed on three cases: G+5, G+10, G+20 with different in-fill wall configurations. The frame is premeditated as per prevailing practice in India. Seismic loads are predictable as per IS 1893 (2002).The dead and live loads are calculated using IS 875 Part 1 (1987) and lateral loads are calculated as per IS 1893(2002). . The seismic parameters such storey displacement, lateral load distribution was calculated for the below models.

Three cases were considered for the analysis of frames with various infill wall configurations at various percentages.

Case (1).G+5

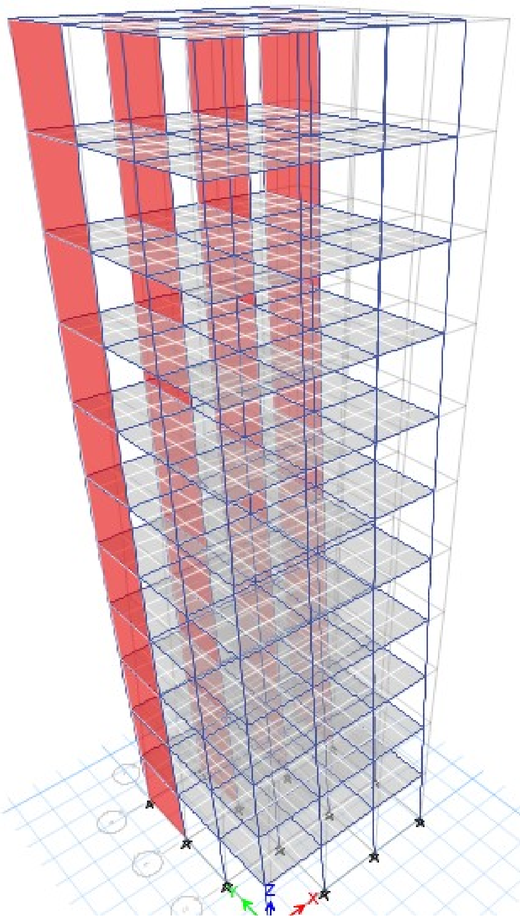

Model (1). Frame vertically in-filled with masonry walls in a single bay


Model (2). 50% of Frame in-filled with masonry walls in all three bays.

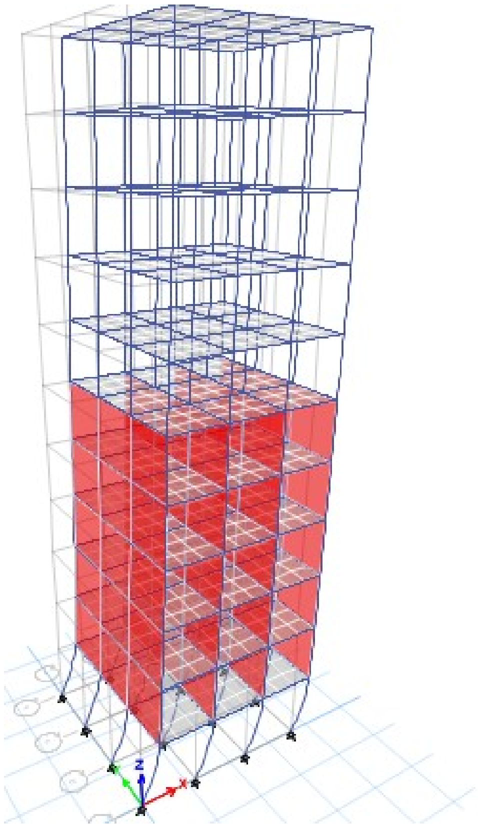


Model (3). 100% of frame in-filled with masonry walls in all three bays.

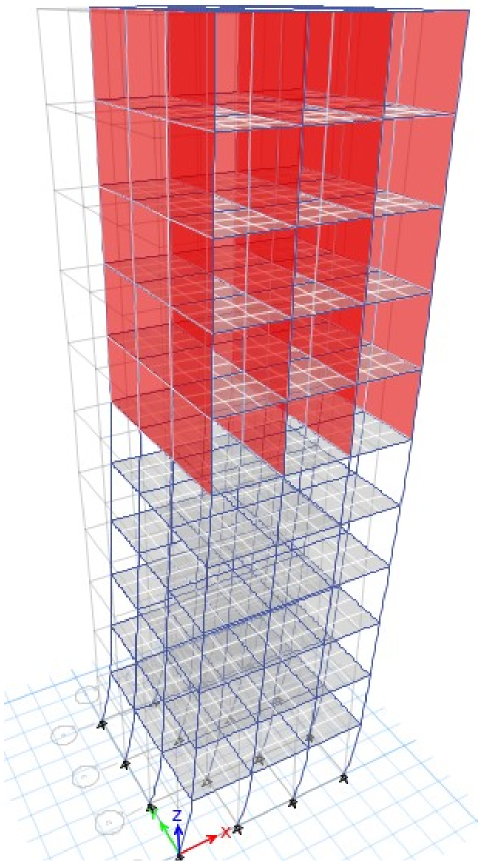
Case (2).G+10



Model(1). Frame vertically in-filled with masonry walls in a single bay along a X direction.

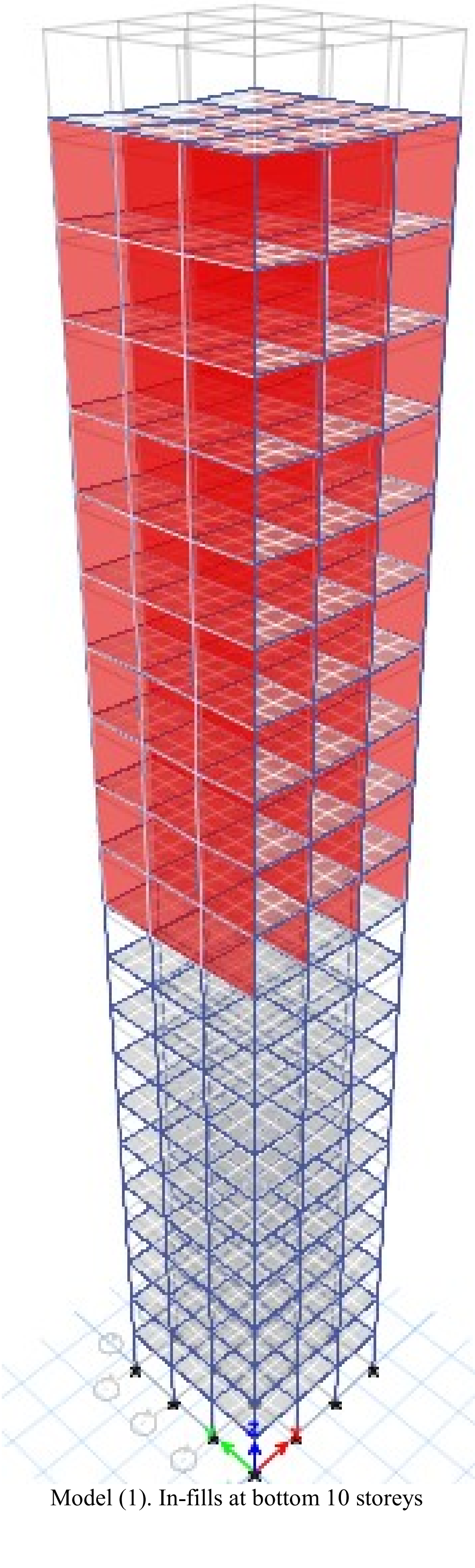


Model (2). 50% of Frame in-filled with masonry walls in all three bays at bottom stories

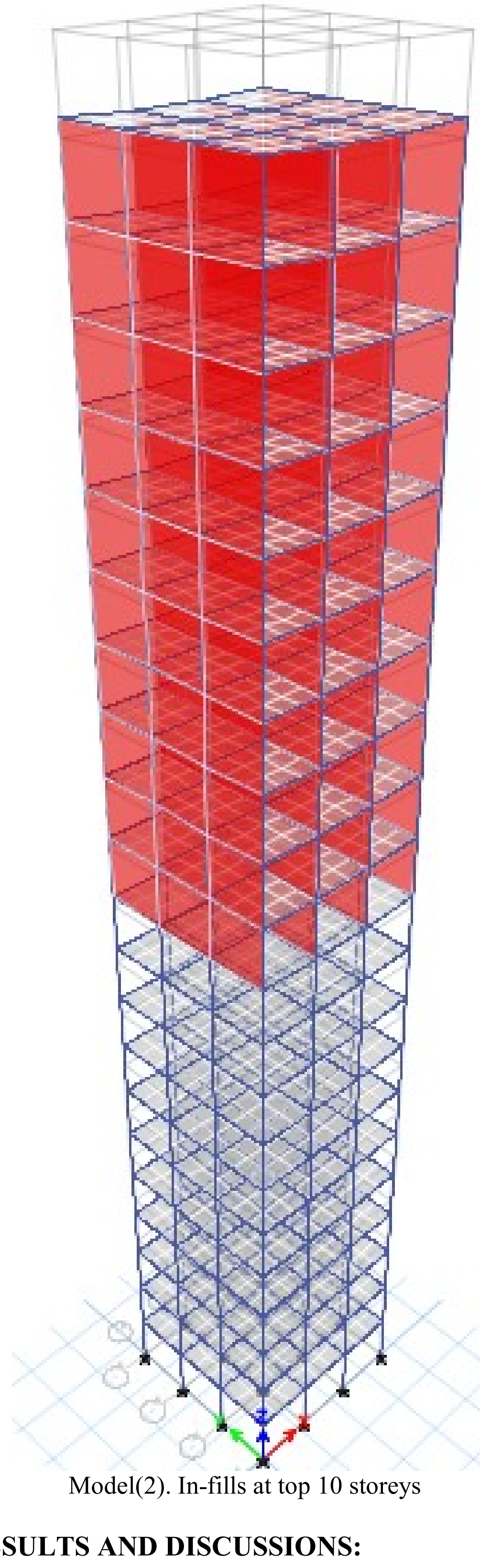


Model(3). Frames in-filled with masonry walls in all three bays at top stories

Case (3). G+20



Model (1). In-fills at bottom 10 storeys



Model(2). In-fills at top 10 storeys

3. RESULTS AND DISCUSSIONS:

The performance of fames with various percentage of masonry infills for the specified models are alalysed using E-tabs software. Those results have been compared based on the parameters like, displacement, lateral load distribution, overturning moment and stiffness. The graphs obtained from software analysis are shown in fig 3 to fig 14.

Case(i): G+5

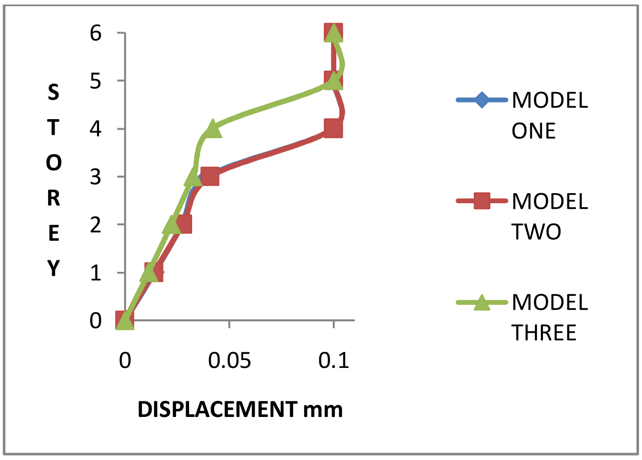


Fig (3)

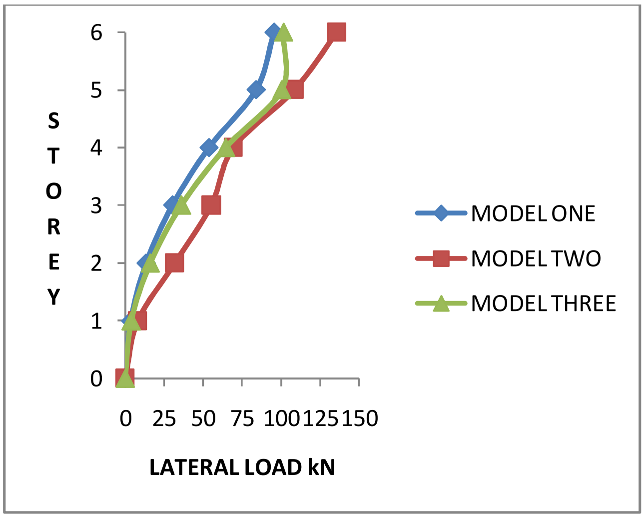


Fig (4)

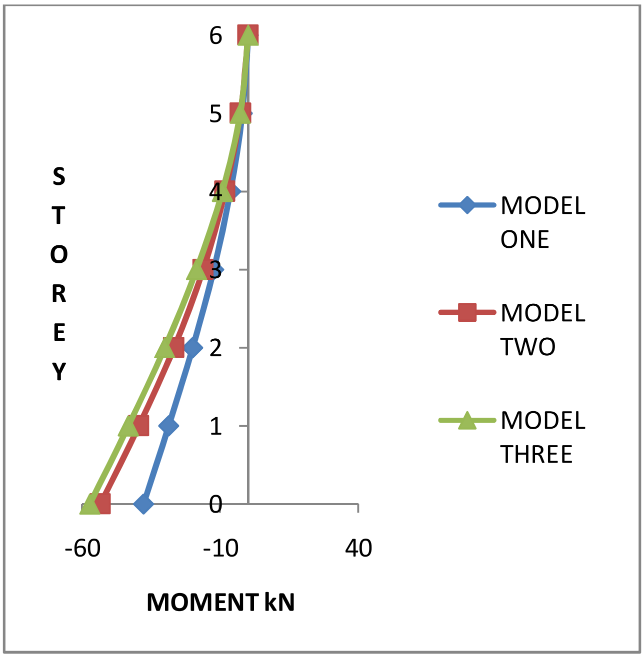


Fig (5)

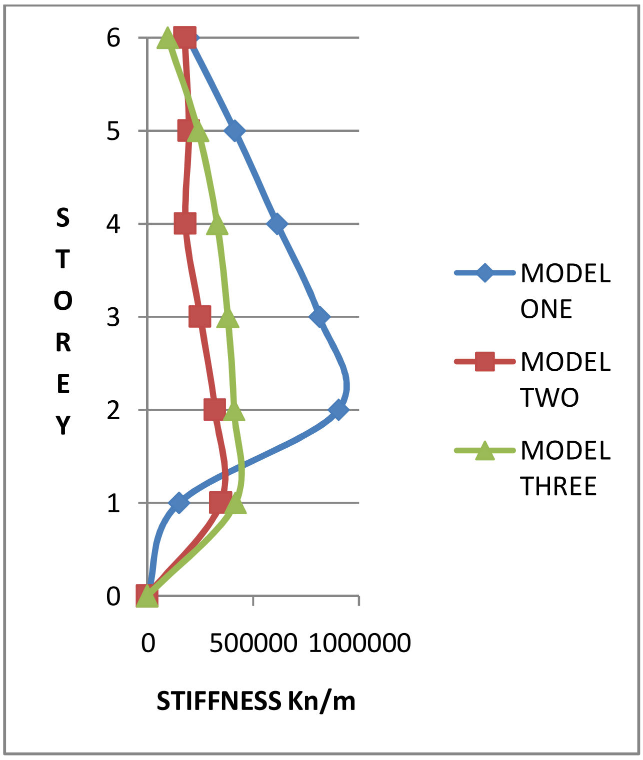


Fig (6)

Case (ii: G+10

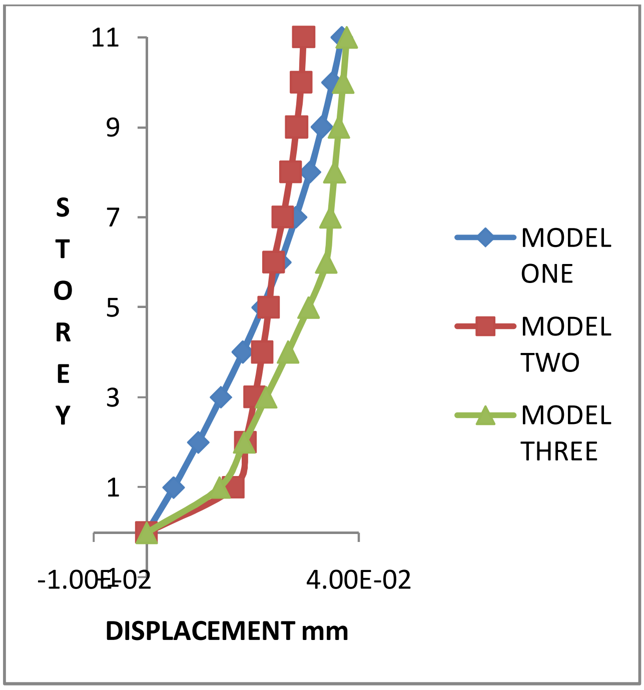


Fig (7)

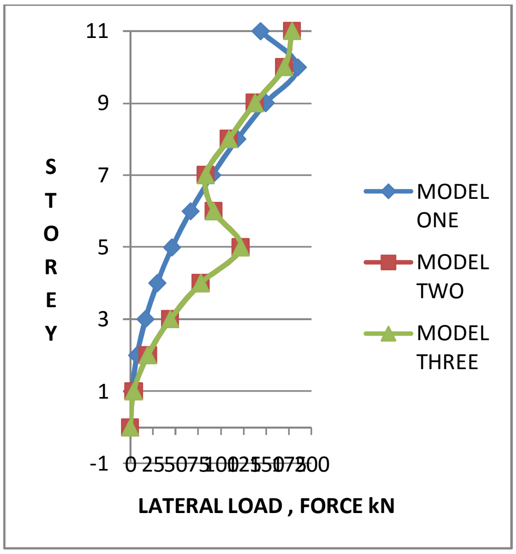


Fig (8)

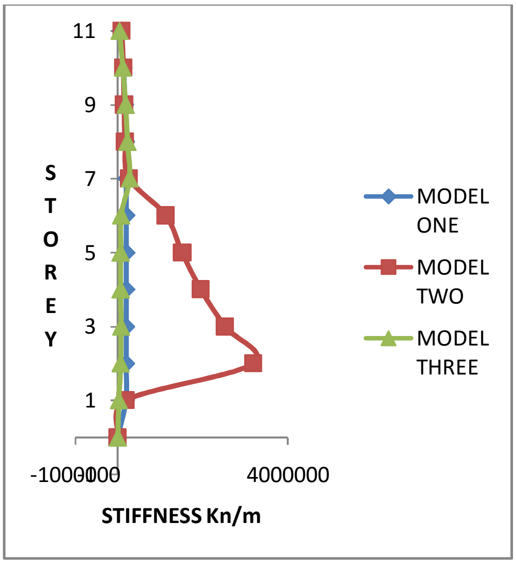


Fig (9)

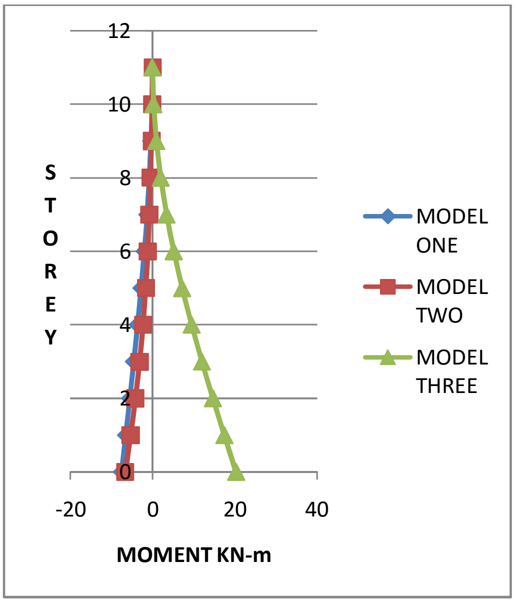


Fig (10)

Case (iii): G+20

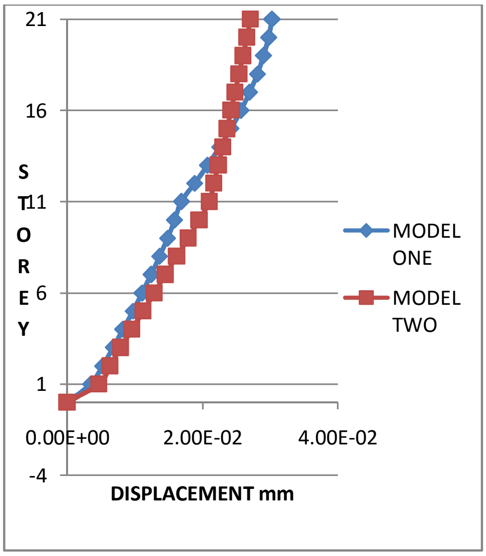


Fig (11)

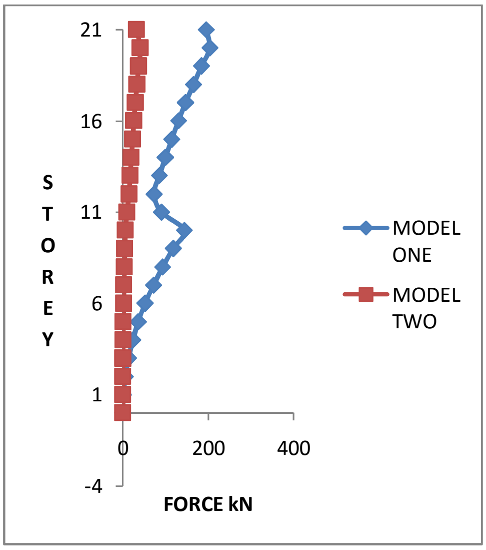


Fig (12)

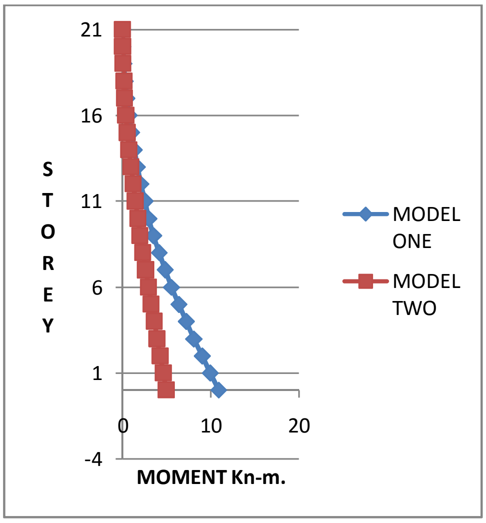


Fig (13)

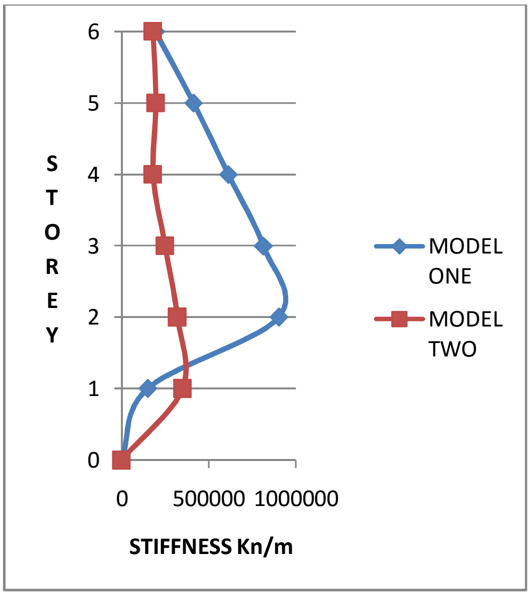


Fig (14)

Fig (3 to 14). shows the displacement, lateral load, stiffness and overturning moment of the frame

Table (1) and (2). Comparative analysis of all 3 cases

Cases	Model	Displacement mm	Over turning moment kN-m	Storey shear, kN
Case (i) G+5	Model one	70	18.5	0.30
	Model two	73	41	0.81
	Model three	48	32	0.58
Case (ii) G+10	Model one	37	20.2	0.96
	Model two	16	6.40	4.40
	Model three	13	7.20	3.40
Case (iii) G+20	Model one	30	11	3.20
	Model two	27	5	1.20

Table (2)

Cases	Model	Lateral load, kN	Eigen value, Rad^2/sec^2
Case (i) G+5	Model one	340	83720.21
	Model two	162	166957.11
	Model three	225	337617.12
Case (ii) G+10	Model one	182	53868.93
	Model two	180	2096.237
	Model three	120	4884.3185
Case (iii) G+20	Model one	200	540.1131
	Model two	45	1030.7868

4. CONCLUSIONS

- The lateral stiffness of the framed structures is enhanced by the infill wall , conversely the presence of apertures within the infill wall would reduce the lateral stiffness
- When considering the infill wall the root displacement of the structure reduces and stiffness of the structure increases. The masonry infill wall is more significant in small structures, but, when the height of the structure increases, the effect of masonry infill wall reduces.
- The displacement is found to be more in the structure where the in-fills are not present. The maximum displacement is found to be 73mm.
- The lateral load displacement of the framed structures is found to be not regular, it varies because of absence of infill.

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BIOGRAPHIES

Arulmozhi.N, PG scholar, Deptartment of Civil Engineering, Adhiyamaan College of Engineering, Hosur.
arul.theshark4@gmail.com
+91 9003965069

Srinivasan.R , Assistant Professor,
Dept. Of Civil Engineering
Adhiyamaan college of Engineering,
Hosur. bksrinivasan8@gmail.com
+91 9952664755

Dr. Suresh Babu .S Dean (Research and development), Head of the Department (Civil Engineering) Adhiyamaan college of Engineering, Hosur. **Sunisurp@gmail.com**

Jegidha .K.J, Assistant professor
Department of Civil Engineering
Adhiyamaan College of Engineering,
Hosur. jegirkj@gmail.com
+ 91 9444714847