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Dynamic Analysis of Composite Structural System for Looms Industry

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ABSTRACT
All the structures subjected to any kind of loads or displacement tends to behave dynamically. Thus the structures are always under continuous loading. The industrial buildings have to support the machineries in motion which are under high degree of vibrations. And so the design of base and the foundations of such structures under vibrations are very important and need to be stable. Problems of dynamics of bases and foundations are to be studied carefully, so as to understand the response characteristics of the power loom industry structure. This is very important from the economic point of view as well as to secure the stability and safety of the structure; dynamic analysis was carried out for Ground + One storey industry load bearing structure using STAAD.Pro software. In this paper, an attempt has been made to study the dynamic analysis of the structure under vibrations caused by reciprocating type machines. This paper makes attempt to study the effects of various structural parameters like Beam Size, Column Size and Storey Height and Wall Thickness variation on Frequency and Displacement of the industrial building which in future will serve as guidelines to the structural engineers and the industry people.

KEYWORDS: Looms Industry, Vibrations, Frequency, Displacement, Modes, Storey Height, Time History.

I. INTRODUCTION

With the increase in the industrialization, there is tremendous increase in the usage of machines. Looms Machines are one of the vital part of the Textile Industry. The industrial machines are needed to be accommodated such as they provide best serviceability. The structural buildings accommodating the machines are to be thus properly designed such that there is no hindrance in the rate of production. The Textile Industry is the biggest industry in India and thus accommodation of more machines are to be made. As we know, the Looms machine in motions produces sinusoidal vibrations which affect the stability of the structure carrying them. The structures are thus to be designed carefully so as to avoid the resonance condition. The high operating speed of machines imparts vibration on the building structure which leads to the development of new branch of mechanics as industrial seismology.

K.G. Bhatia in his ISET journal, 2008 provided guidelines regarding the foundations of industrial achiness and earthquake effects. Dr. B. C. Punmia briefly explained elementary properties, soil hydraulics, elasticity applied to soils, compressibility, strength and stability, foundation engineering, pavement design. Barkan D. D. has commented on the behaviour of reciprocating machines and the type of load it imparts to the foundation. Shamsher Prakesh and Vijay K. Puri in their SERC journal have given guidelines for foundation of machines regarding the response of foundations subjected to vibratory loads and also the classification of different types of machines namely Rotary Machines, Reciprocating Machines and Impact Machines. Victor Wowk has presented his ideas on deciding the strategy in analysing the vibrations produced by machines. His strategy of analysis includes: identifying source of vibration, calculating its frequency and amplitude, analyse the severity of this amplitude, adopt suitable corrective option. Booth J E has given an introduction to physical methods of testing textile fibres, yarns, and fabrics. Himanshu Chaudhary and Subir Kumar Saha, dept of mechanical engineering, IIT Delhi, in 2006 suggested that the optimization of the design of carpet weaving metallic loom can be carried out resulting in relative light weight material thereby reducing stress and strain on the beams and columns and also reducing the cost. Jigar Sevalia, Sunil Kukadiya, Yogesh Rathod, Sarthi Bhavsar and Gaurang Parmar, in their international Journal of engineering research and applications (IJERA) published paper making an attempt to study the effects of various structural parameters like Beam Size, Column Size and Storey

Height variation on Frequency and Displacement of the industry building which will fill the lacunae by serving as guidelines to structural engineers and industry people. P. R. Lord and M. H. Mohamed has provided guidelines for important aspects regarding conversion of yarn to fabric, including of weaving, winding and preparation, loom design and its working, noise, loom developments. Varanasi Rama Rao explained in depth the design criteria for machine foundations and their Codal requirements as per IS Codes. Fiona Cobb provides guidelines for professional and student s of structural engineering with combination of tables, data, facts, codes, formulae and rules of thumb make. IS:2974 (Part I) – 1982 (Reaffirmed 1998) covers the design and construction of foundations for machines of the reciprocating type which normally generate steady state vibration and is of a size for which a rigid block type foundation is normally used. It also aids in the guidelines that are necessary for the design and analysis of foundations for reciprocating machines.

II. METHODOLOGY

The methodology of this paper includes reconnaissance survey, collection of necessary machine data, preparation of drawing of industrial floor plan showing machine position of existing building using CAD Software, modelling of R.C.C Composite structure of Ground + One Storey, using STAAD.Pro, graphical presentation of results for various mode shapes, frequency and displacement with respect to various Beam sizes, Column sizes and Storey height and wall thickness.

The structure has a 12 bays having plan dimension of standard size 4.83 m x 38.64 m as shown in the fig. 1 and 2. The foundation is assumed to be resting at 3.0 m depth below Ground Level and plinth level is assumed to be 2.6 m above ground level. The floor heights considered in this course of study are varying as it is described in the Table 1. The dynamic analysis is done for Ground floor + First floor with 12 bays.

Table 1 A Building Unit having various Parameters and their Sizes

Various Parameters	Sizes
Beam Size (mm x mm)	230x460, 230x525, 230x600, 230x675
Column Size (mm x mm)	230x460, 230x525, 230x600, 230x675
Wall thickness (m)	0.23 , 0.39, 0.45, 0.61
Storey Height (m)	3.2, 3.6, 4, 4.2
Slab Thickness (mm)	125

2.1 Shuttle Loom Machine Data

- Size of Machine = 1.15 m x 1.89 m
- Operating Speed = 60 rpm
- Dimensions of Slay = 213.36 cm x 6 cm x 7.62 cm
- Mass of Slay = 25kg
- Operating Frequency = 2.67 Hz

2.2 Loads acting on the Structure

- Self-Weight considering density of R.C.C. as 25 kN/m^3
- Water-proofing Load = 1.5 kN/m^2
- Weight of Floor-Finishing Load = 0.8 kN/m^2
- Live Load = 2 kN/m^2
- Weight of Machine = 9.8 kN
- Time History Load as a function of sine wave having amplitude of 1.67 kN and frequency of 2.67Hz

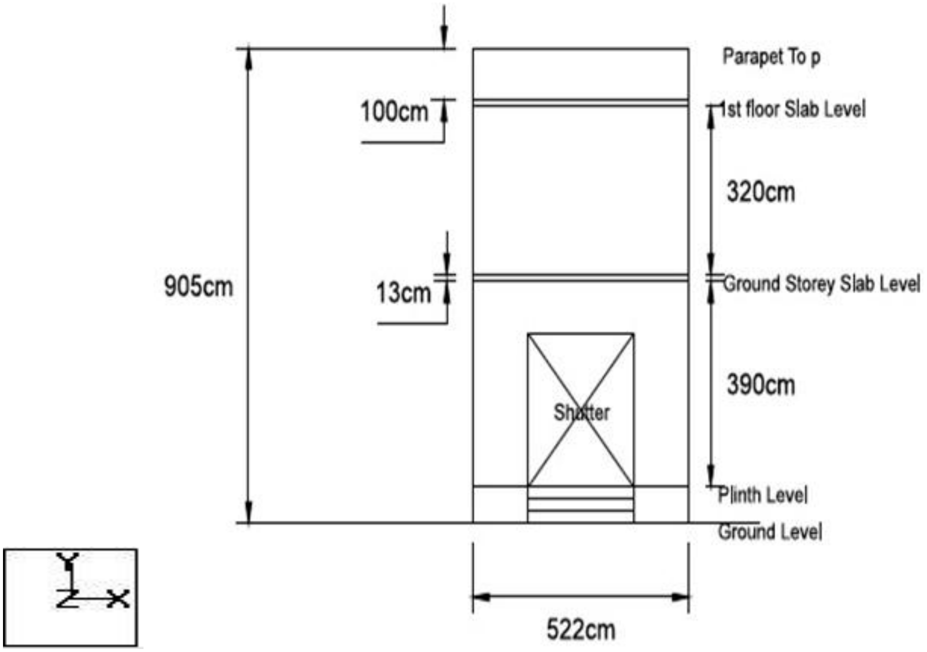
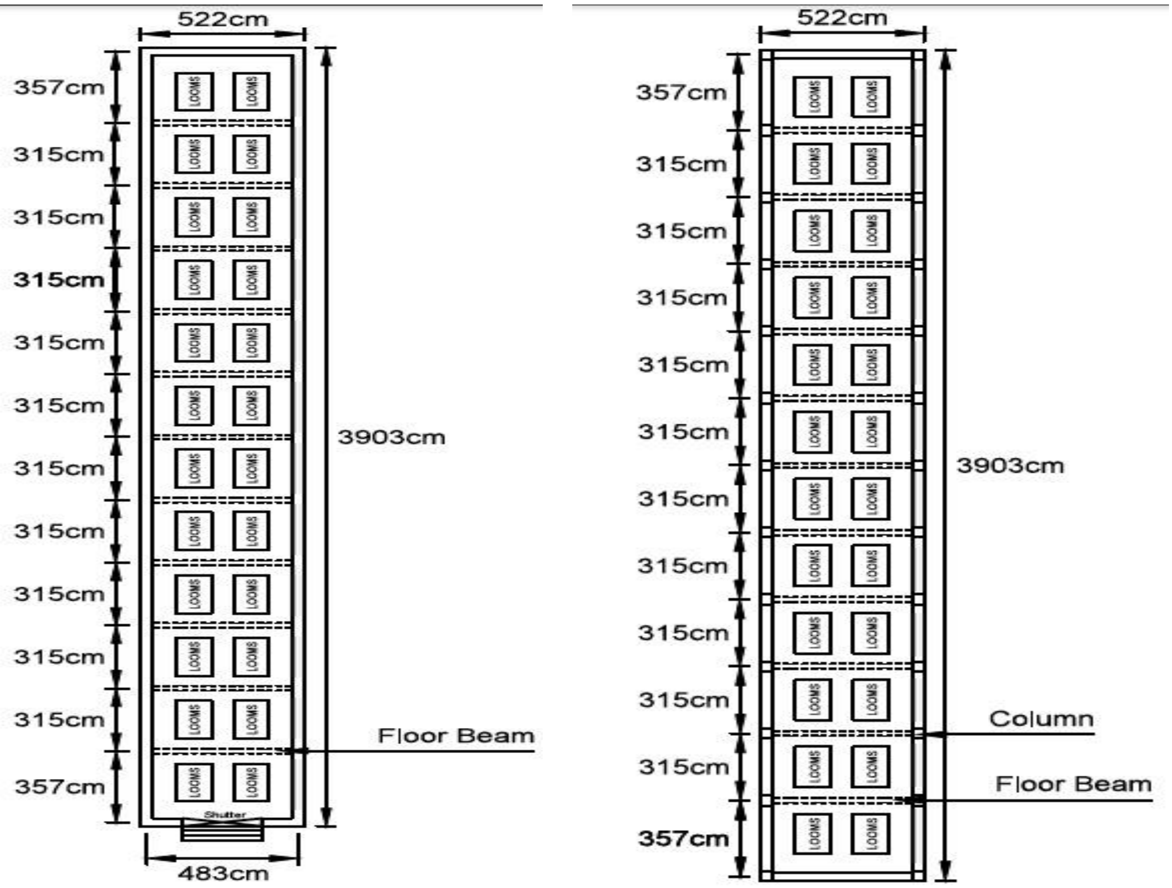


Fig. 1 Front Elevation of Loom Industry



TYPICAL GROUND FLOOR PLAN **TYPICAL FIRST FLOOR PLAN**

Fig.2 Typical Floor Plan of Looms Industry of Ground Floor and First Floor

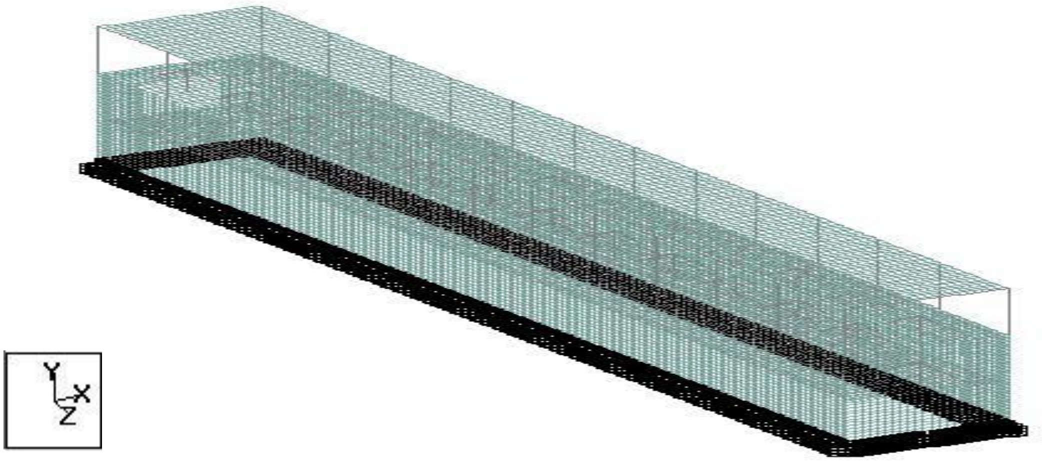


Fig. 3 3D View of a Building Structure Model for Looms Industry in STAAD.Pro

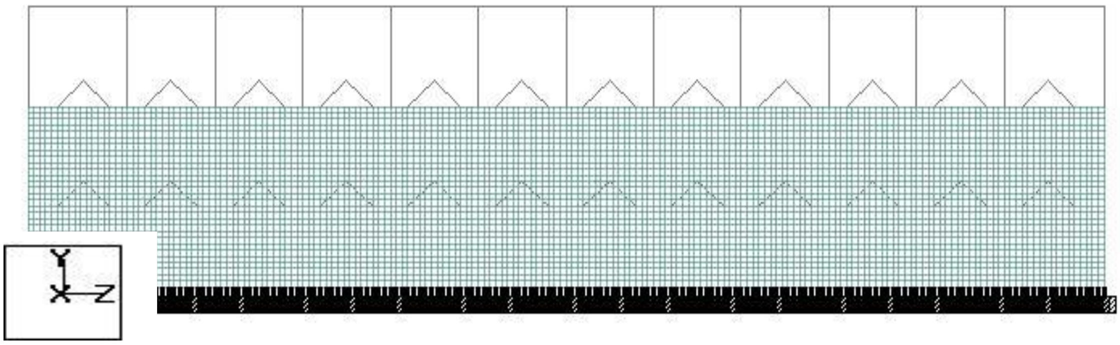


Fig. 4 2D View of a Building Structure Model for Looms Industry in Y-Z Plane in STAAD.Pro

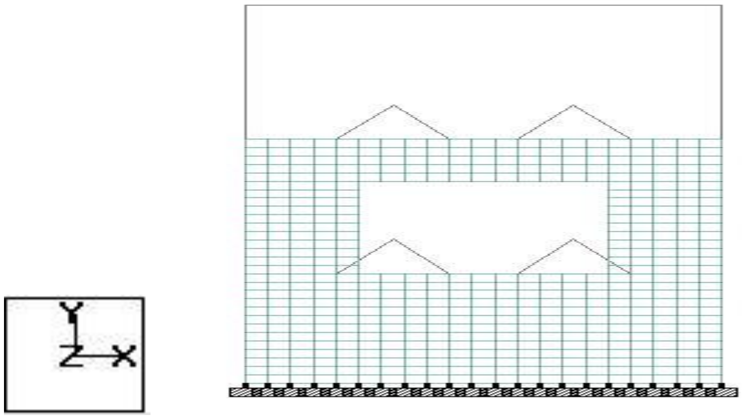


Fig. 5 2D View of a Building Structure Model in X-Y Plane in STAAD.Pro

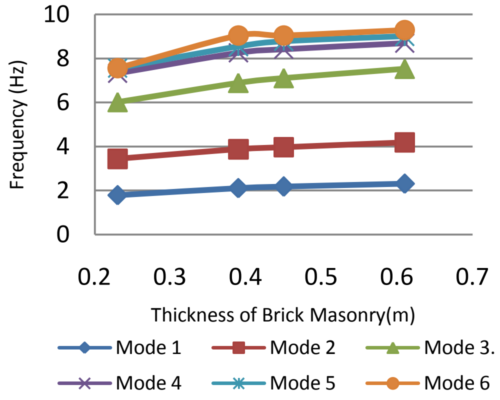
III. RESULTS

Beam Size (mm x mm)	Wall Thickness (m)	Frequency in X-Direction (Hz)					
		Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6
230x460	0.23	1.766	3.339	5.390	6.460	6.462	7.076
	0.39	2.076	3.764	5.952	6.958	7.136	8.872
	0.45	2.137	3.860	6.083	7.048	7.314	8.888
	0.61	2.274	4.069	6.320	7.185	7.687	8.878
230x525	0.23	1.768	3.350	5.459	6.555	6.559	7.092
	0.39	2.080	3.776	6.038	7.062	7.263	8.890
	0.45	2.141	3.873	6.174	7.155	7.446	8.905
	0.61	2.278	4.082	6.419	7.298	7.834	8.893
230x600	0.23	1.771	3.358	5.514	6.630	6.633	7.106
	0.39	2.083	3.786	6.107	7.145	7.359	8.908
	0.45	2.144	3.882	6.246	7.241	7.548	8.922
	0.61	2.281	4.091	6.499	7.389	7.947	8.908
230x675	0.23	1.772	3.363	5.550	6.680	6.682	7.116
	0.39	2.085	3.792	6.154	7.202	7.422	8.922
	0.45	2.147	3.888	6.296	7.300	7.615	8.936
	0.61	2.284	4.098	6.553	7.451	8.023	8.920

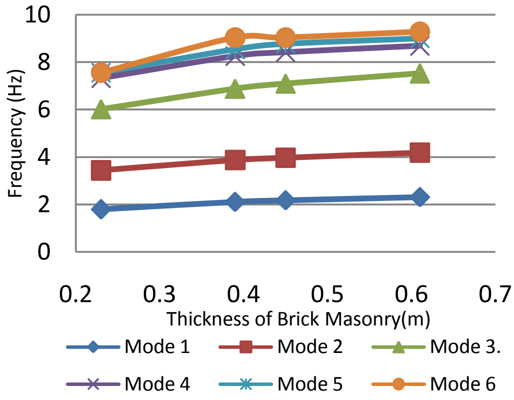
Table 2 Effect of Beam Size and Wall thickness on horizontal frequency in X-Direction (For Column size 230mm x 460mm and floor height 3.2m)

Table 3 Effect of Beam Size and Wall Thickness on horizontal Displacement in X-Direction (For Column Size 230mm x 460mm and Floor Height 3.2m)

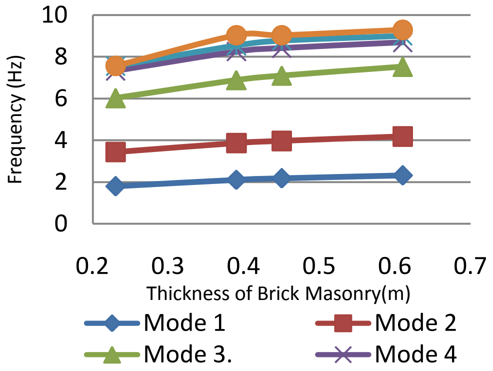
Wall Thickness (m)	Beam Size (mmxmm)			
	230x460	230x525	230x600	230x675
0.23	2.053	2.023	2.001	1.985
0.39	1.460	1.434	1.413	1.399
0.45	1.347	1.322	1.302	1.289
0.61	1.137	1.114	1.096	1.083



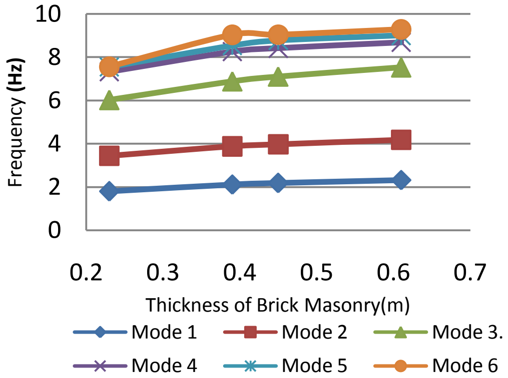
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 460mm and Floor Height 3.2m)



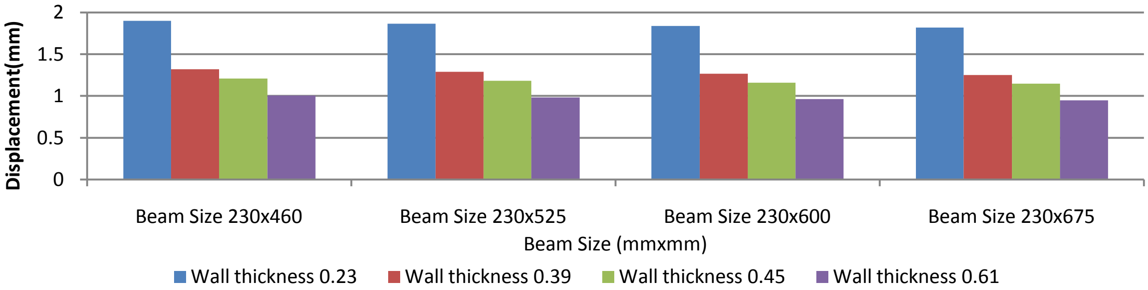
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 525mm and Floor Height 3.2m)



(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 600mm and Floor Height 3.2mm)



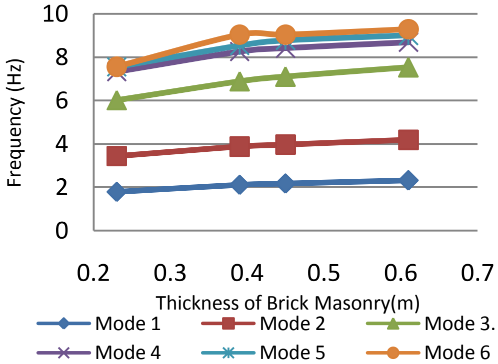
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 675mm and Floor Height 3.2mm)



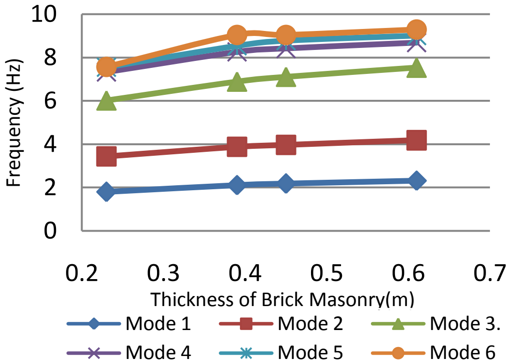
(E) Effect of Beam Size and Wall Thickness on horizontal Displacement in X-Direction

Fig. 6 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 460mm and Floor Height 3.2m)

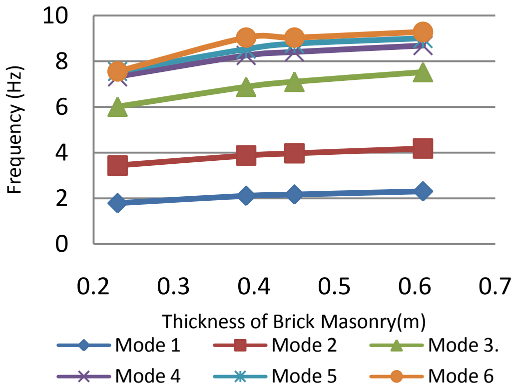
Similarly we derived graphical results for various Beam size, Column size, and Storey height and wall thickness.



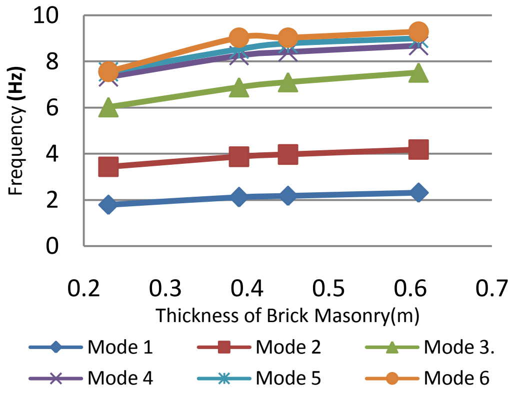
(A) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 460mm and Floor Height 3.2m)



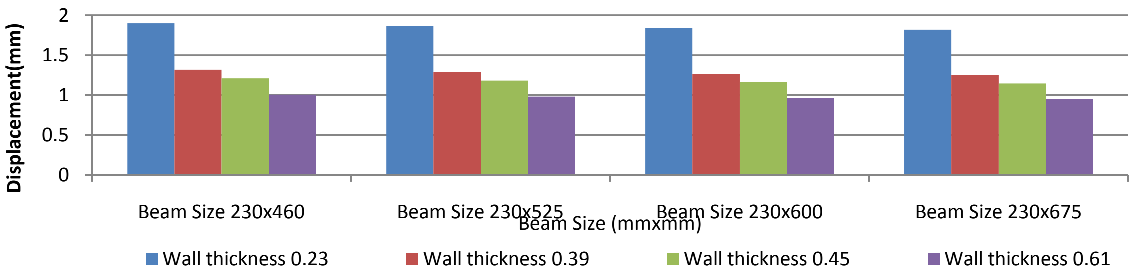
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 5525mm, Beam Size 230mm x 525mm and Floor Height 3.2m)



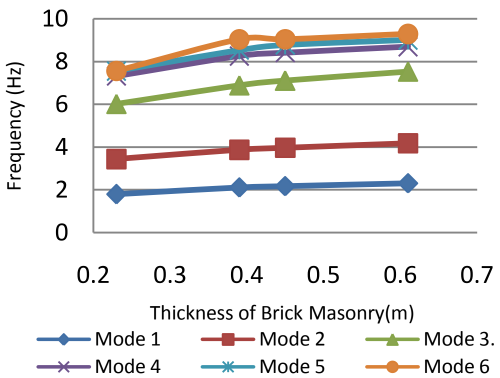
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 600mm and Floor Height 3.2mm)



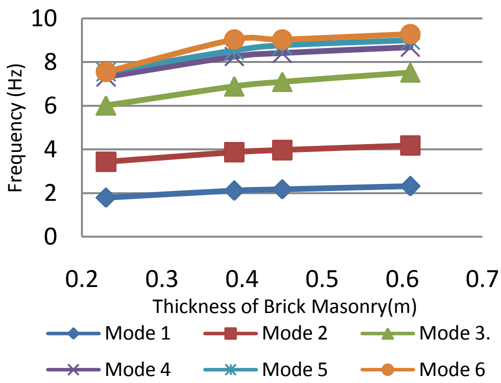
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 675mm and Floor Height 3.2mm)



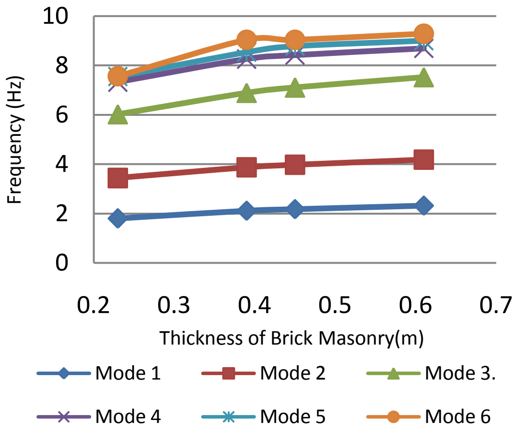
(E)Effect of Beam Size and Wall Thickness on horizontal Displacement in X-Direction
Fig. 7 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction



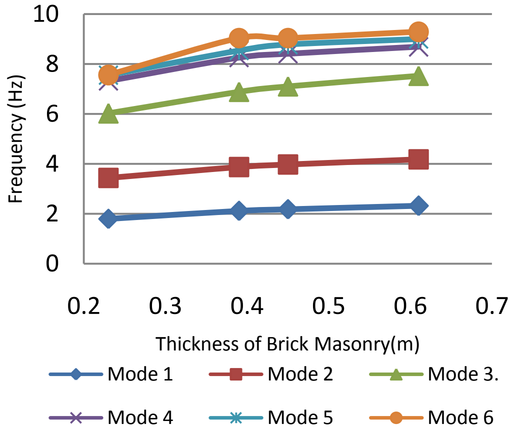
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 6000mm, Beam Size 230mm x 460mm and Floor Height 3.2m)



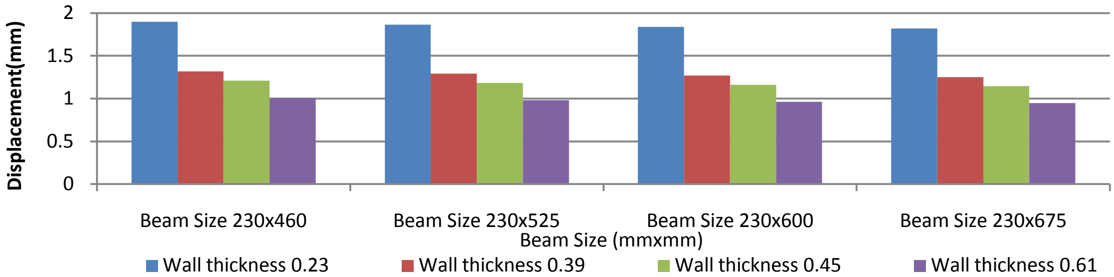
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 525mm and Floor Height 3.2m)



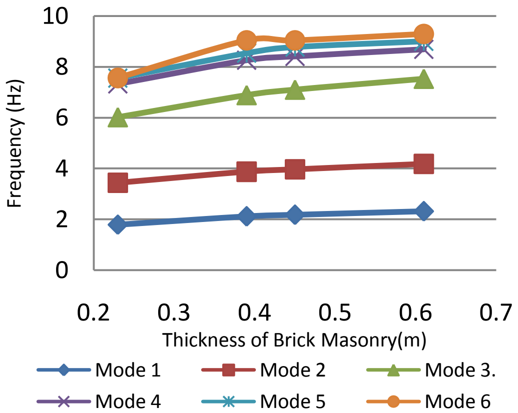
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 600mm and Floor Height 3.2m)



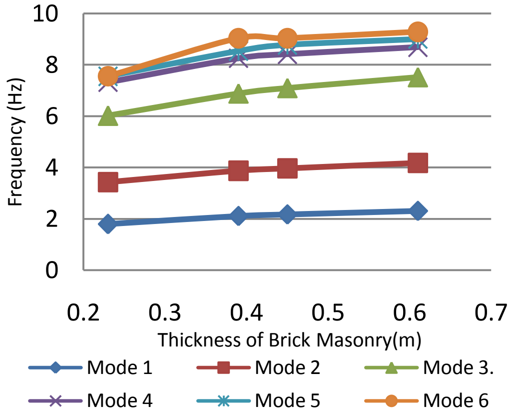
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 675mm and Floor Height 3.2m)



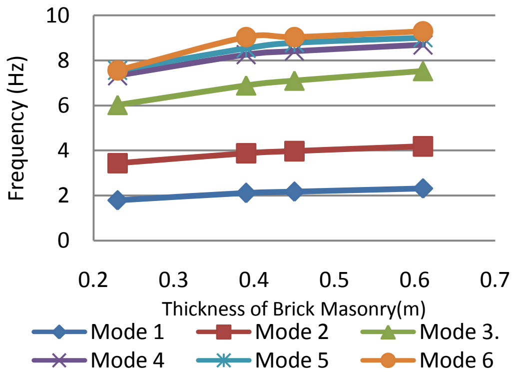
(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.8 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 600mm and Floor Height 3.2m)



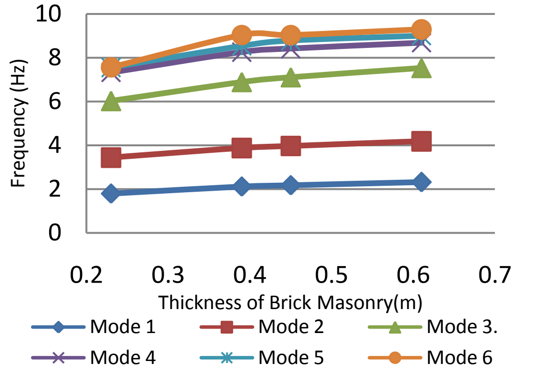
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x675mm, Beam Size 230mm x 460mm and Floor Height 3.2m)



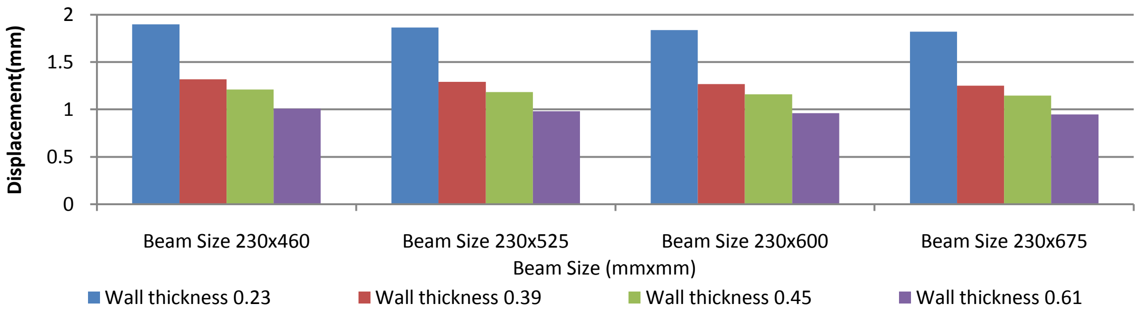
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 525mm and Floor Height 3.2m)



(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 600mm and Floor Height 3.2mm)

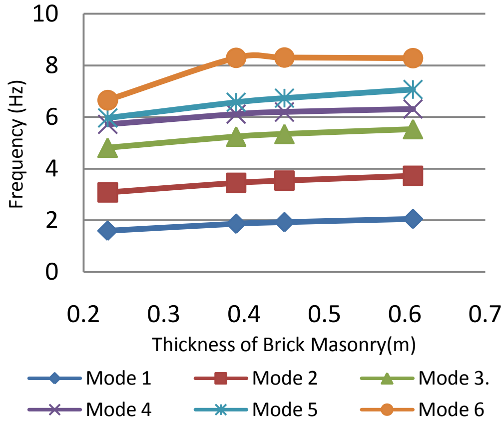


(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 675mm and Floor Height 3.2mm)

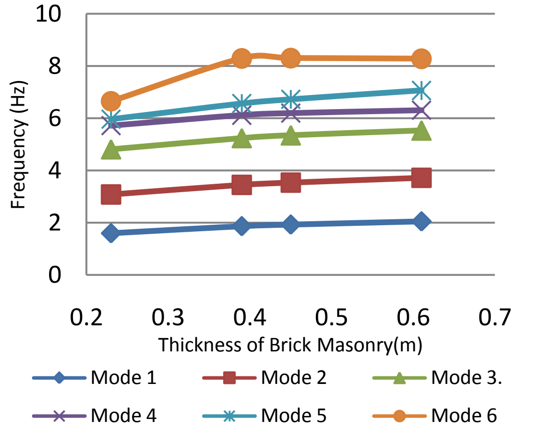


(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction

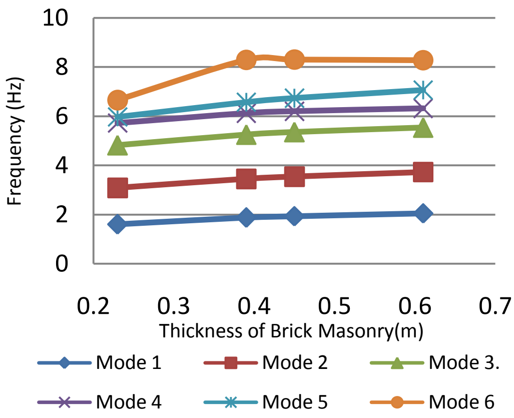
Fig.9 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 675mm and Floor Height 3.2m)



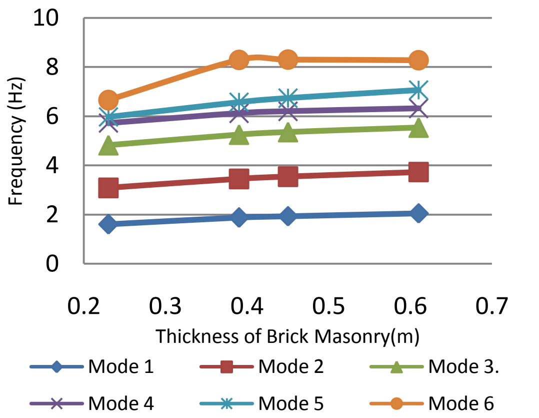
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 460mm and Floor Height 3.6m)



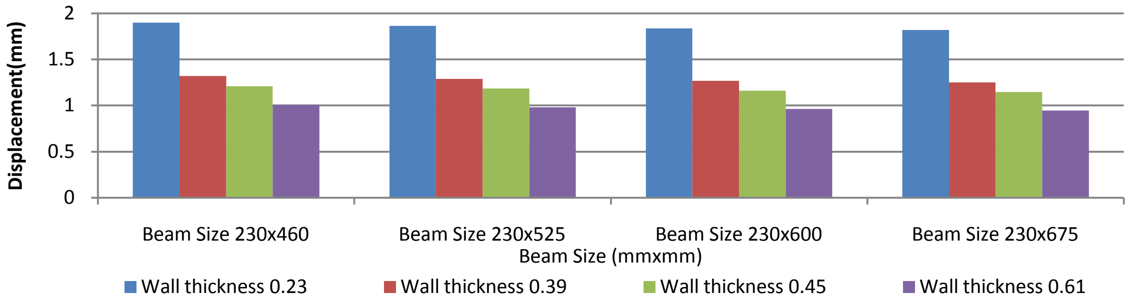
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 525mm and Floor Height 3.6m)



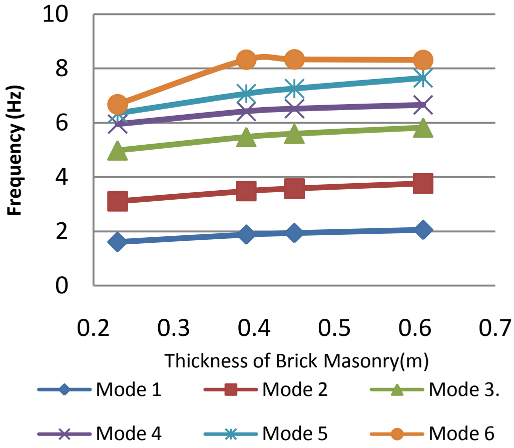
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 600mm and Floor Height 3.6mm)



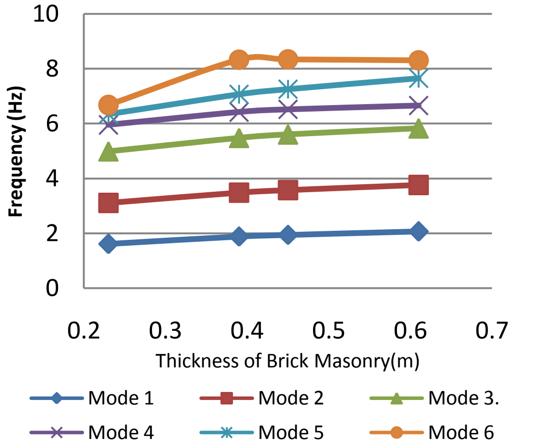
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 675mm and Floor Height 3.6mm)



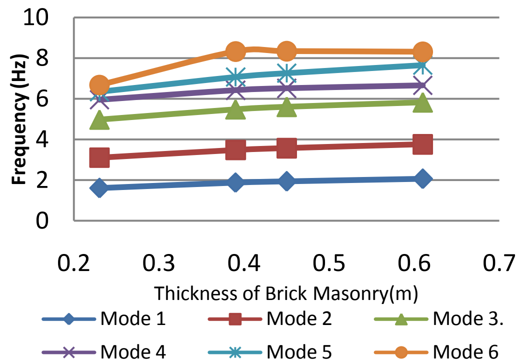
(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.10 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 460mm and Floor Height 3.6m)



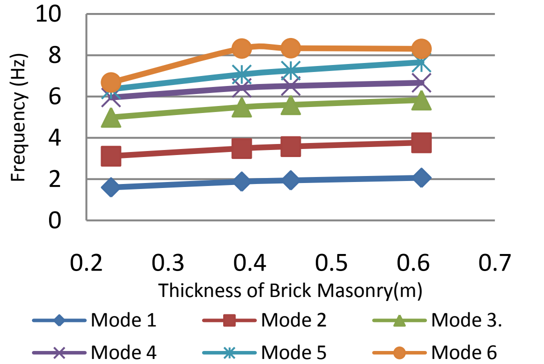
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 460mm and Floor Height 3.6m)



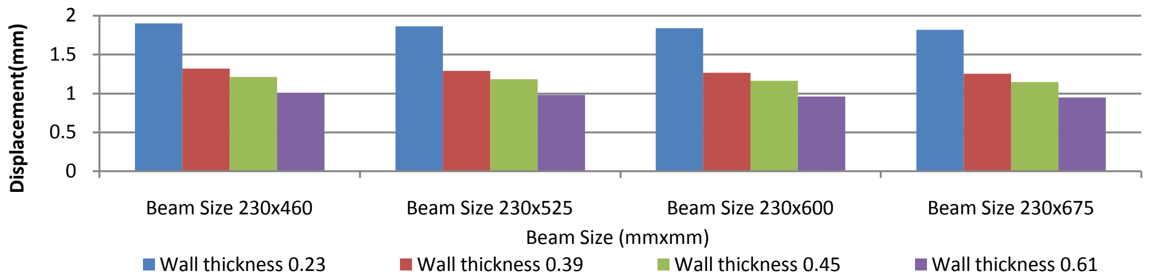
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 525mm and Floor Height 3.6m)



(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 600mm and Floor Height 3.6m)

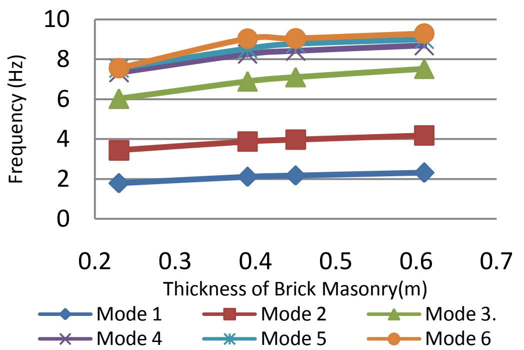


(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 675mm and Floor Height 3.6m)

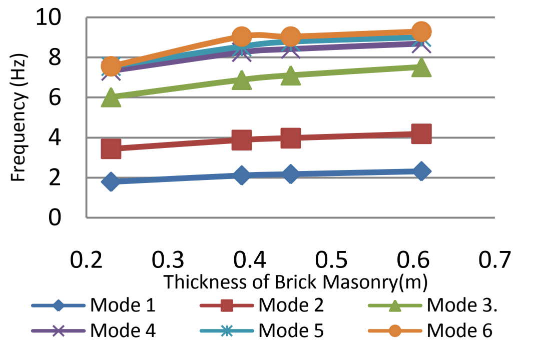


(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction

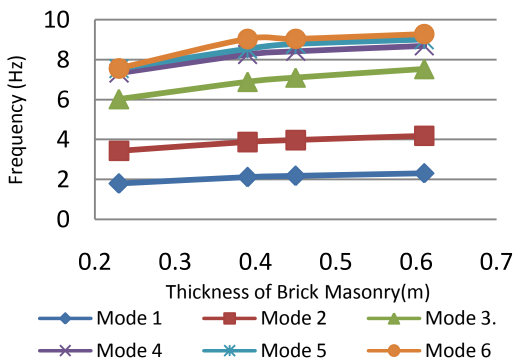
Fig.11 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 525mm and Floor Height 3.6m)



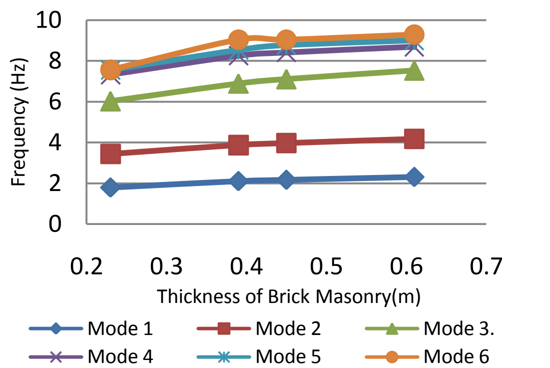
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 460mm and Floor Height 3.6m)



(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 525mm and Floor Height 3.6m)

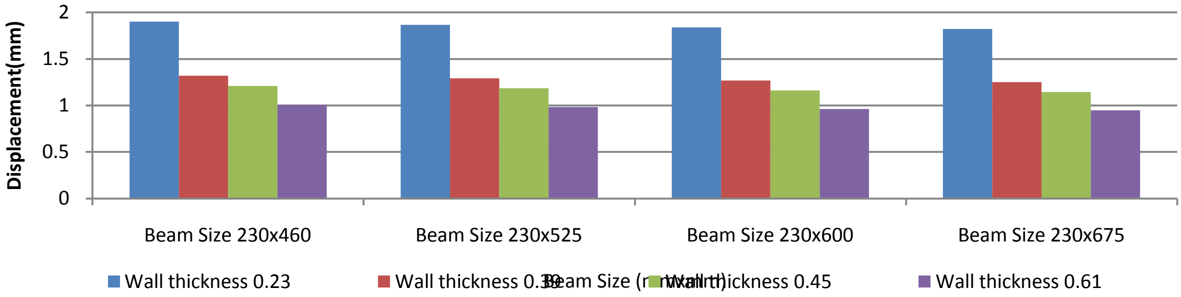


(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm,

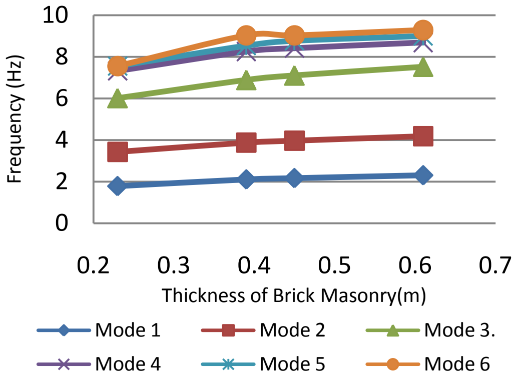


(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm,

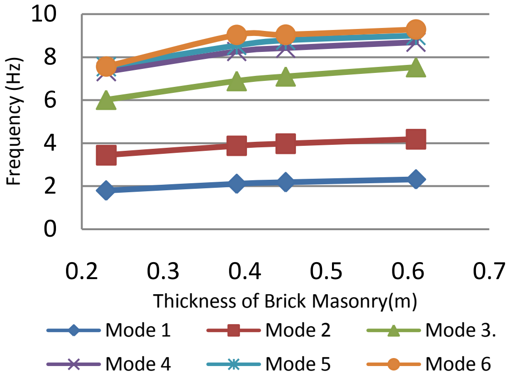
Beam Size 230mm x 600mm and Floor Height 3.6m) **Beam Size 230mm x 675mm and Floor Height 3.6m)**



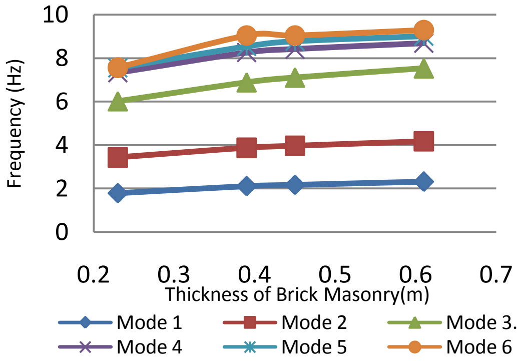
(E)Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.12 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 600mm and Floor Height 3.6m)



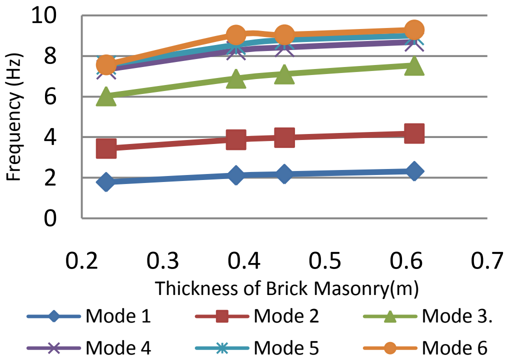
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 460mm and Floor Height 3.6m)



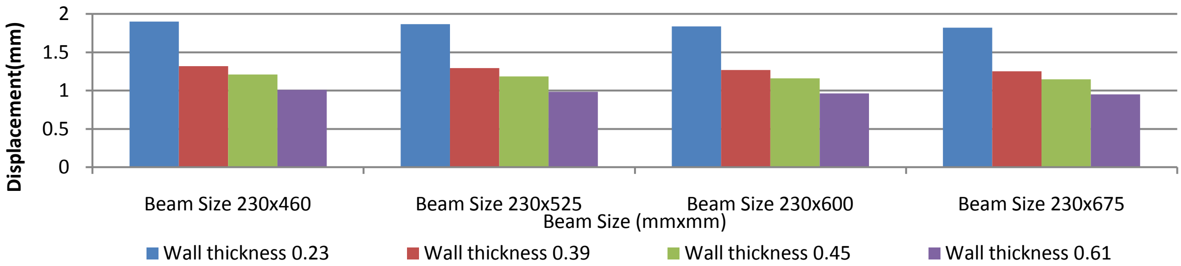
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 525mm and Floor Height 3.6m)



(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 600mm and Floor Height 3.6m)

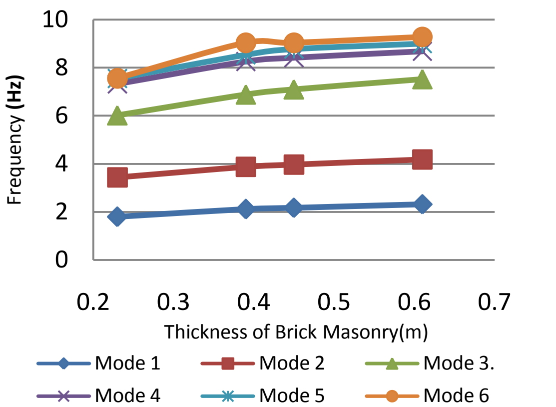


(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 675mm and Floor Height 3.6m)

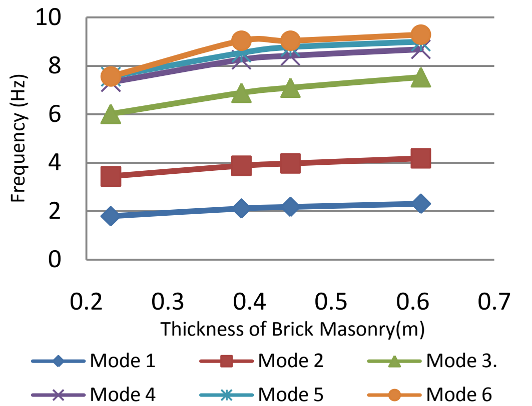


(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.13 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction

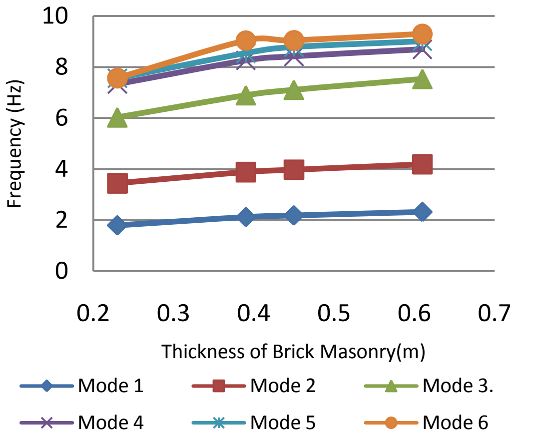
(For Column Size 230mm x 675mm and Floor Height 3.6m)



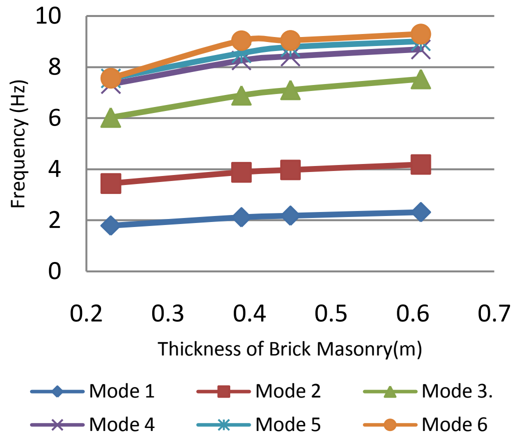
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 460mm and Floor Height 4.0m)



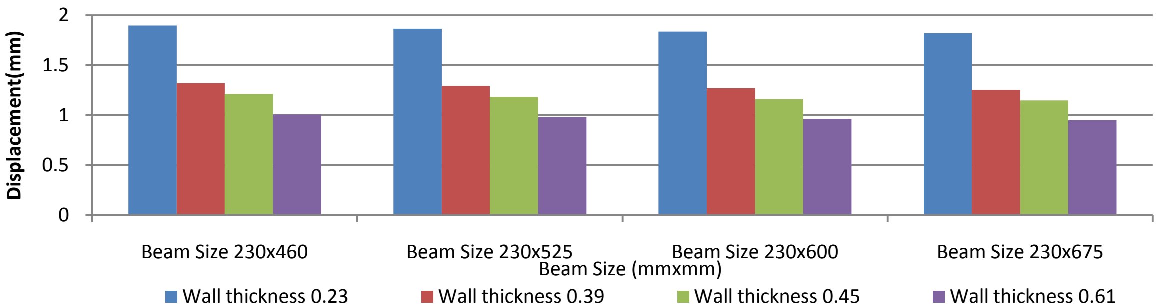
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 525mm and Floor Height 4.0m)



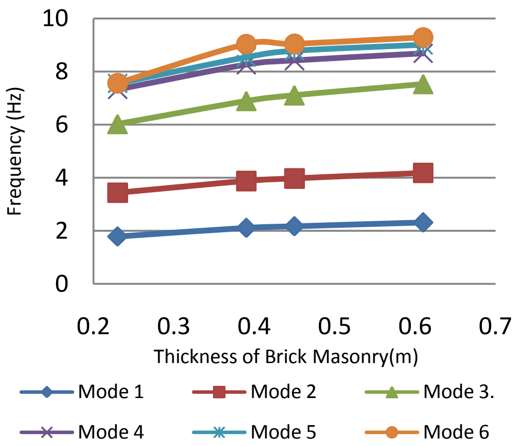
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 600mm and Floor Height 4.0m)



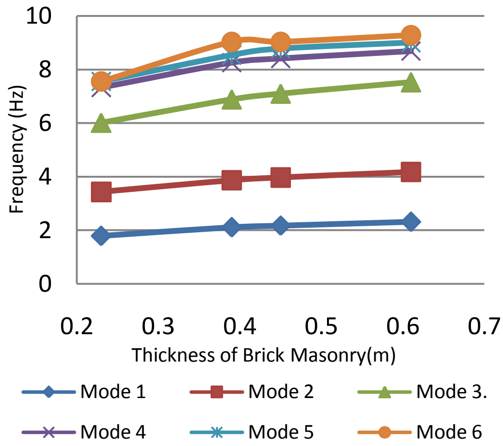
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 675mm and Floor Height 4.0m)



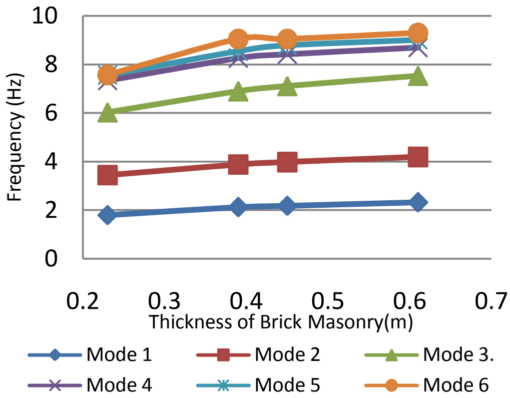
(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.14 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 460mm and Floor Height 4.0m)



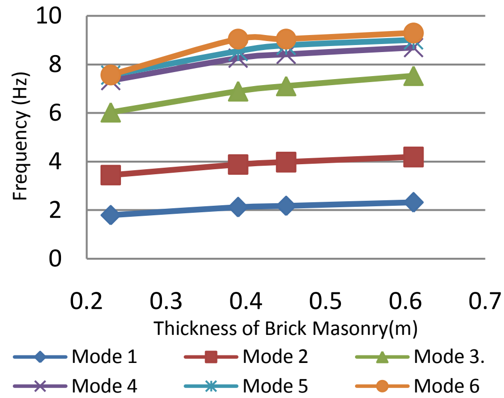
(A) **Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 460mm and Floor Height 4.0m)**



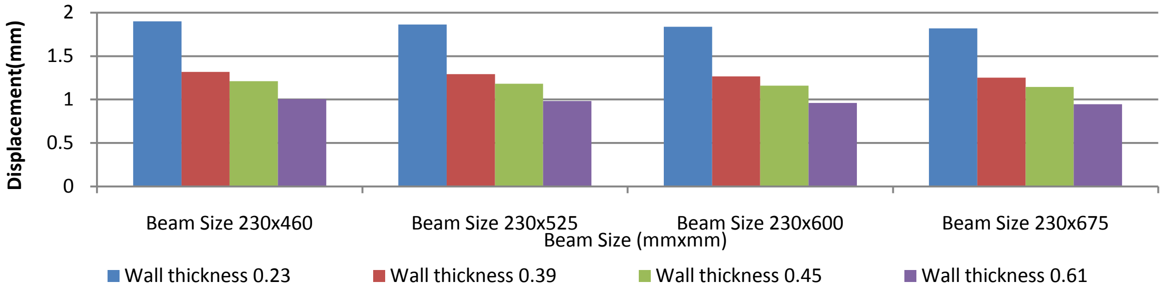
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 525mm and Floor Height 4.0m)



(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 600mm and Floor Height 4.0m)

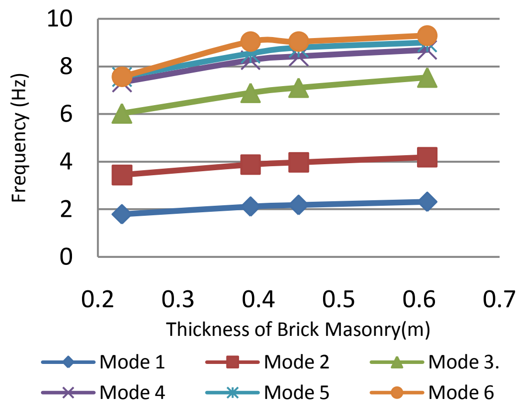


(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 675mm and Floor Height 4.

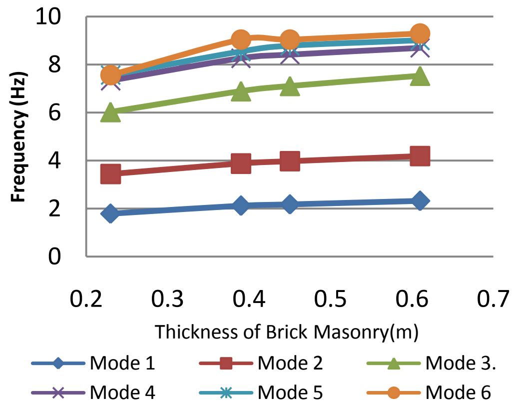


(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction

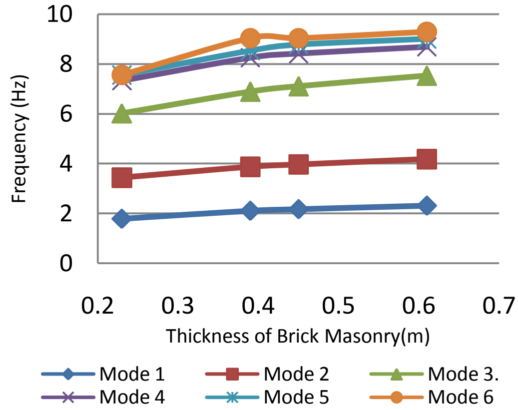
Fig.15 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 525mm and Floor Height 4.0m)



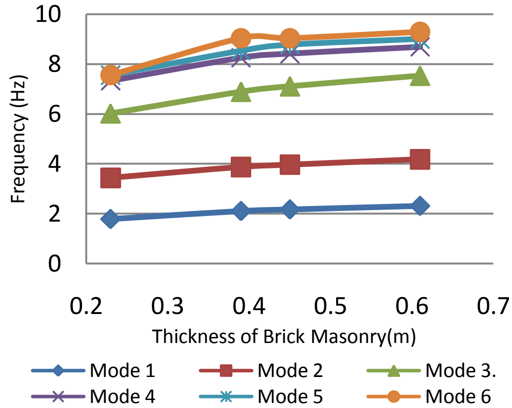
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 460mm and Floor Height 4.0m)



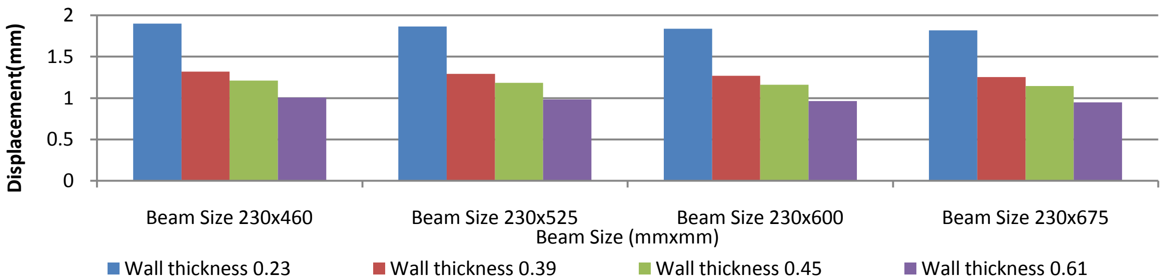
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 525mm and Floor Height 4.0m)



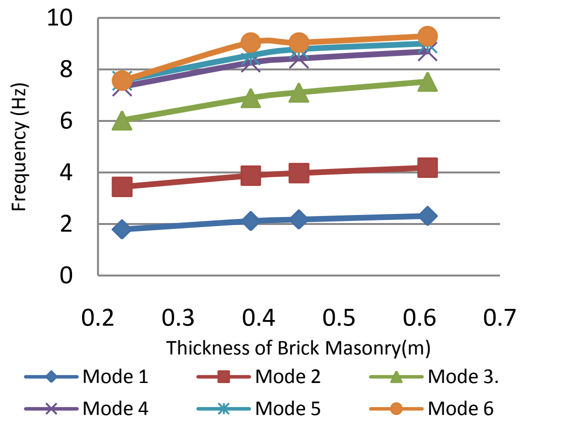
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 600mm and Floor Height 4.0m)



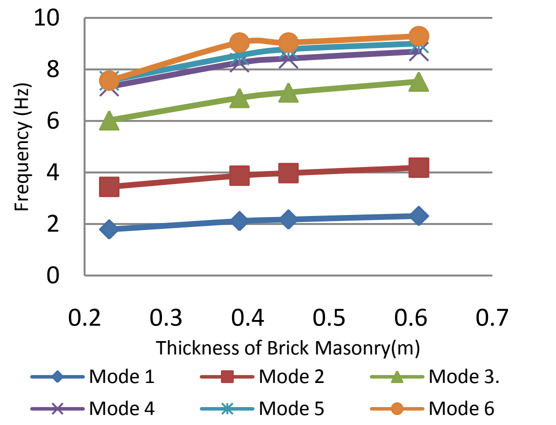
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 675mm and Floor Height 4.0m)



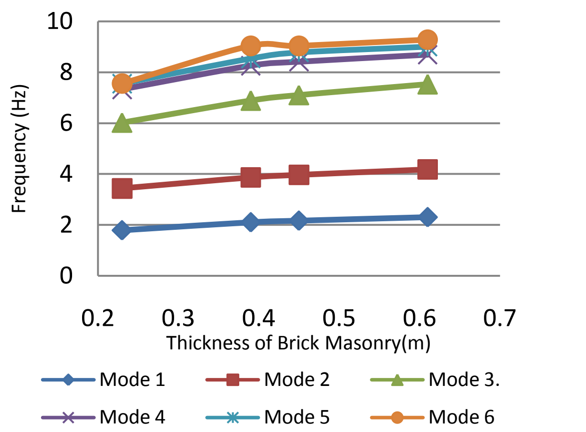
(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.16 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 600mm and Floor Height 4.0m)



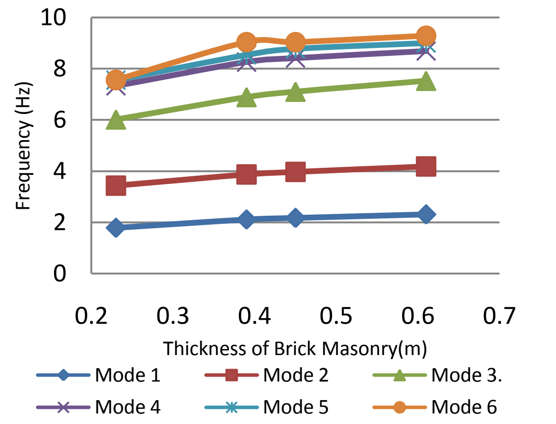
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 460mm and Floor Height 4.0m)



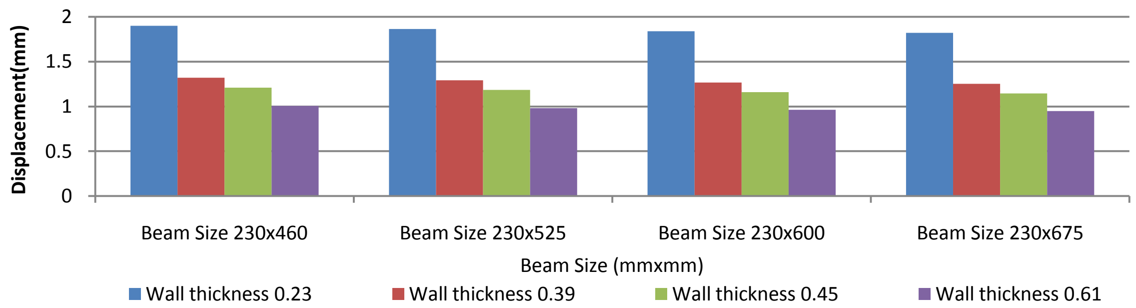
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 525mm and Floor Height 4.0m)



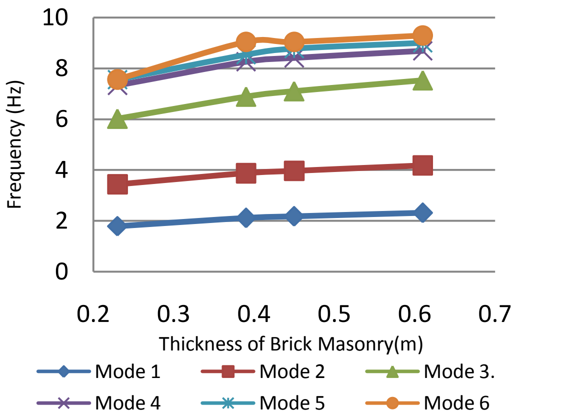
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 600mm and Floor Height 4.0m)



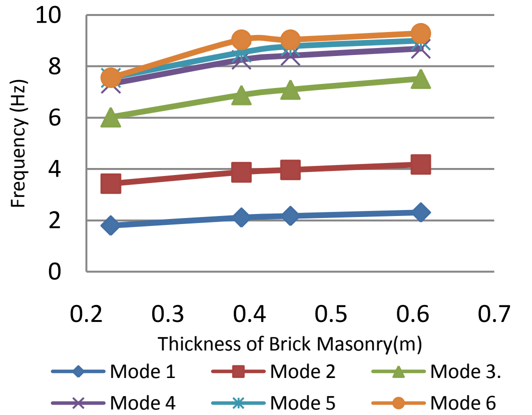
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 675mm and Floor Height 4.0m)



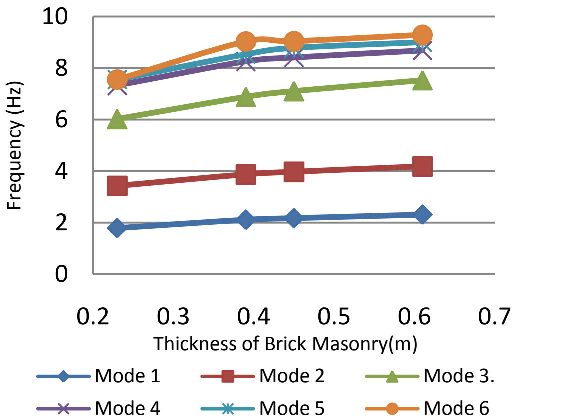
(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.17 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 675mm and Floor Height 4.0m)



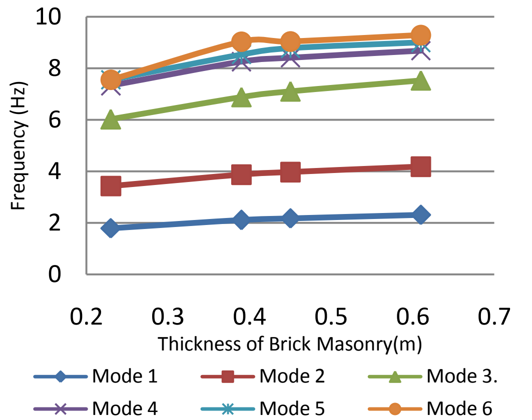
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 460mm and Floor Height 4.4m)



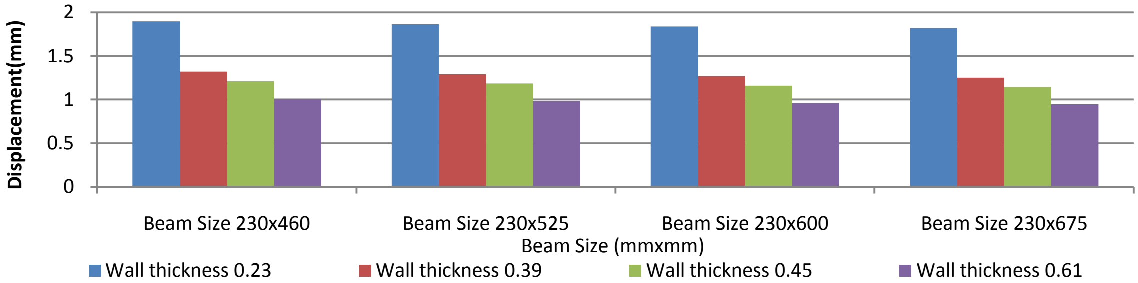
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 525mm and Floor Height 4.4m)



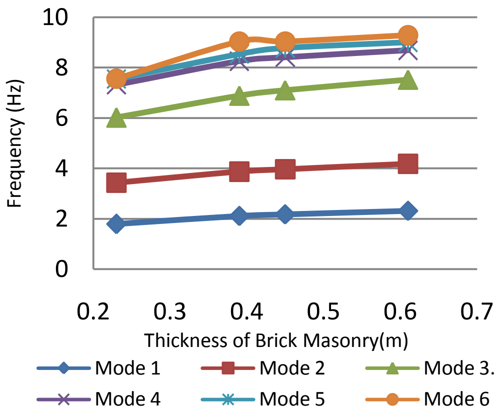
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 600mm and Floor Height 4.4m)



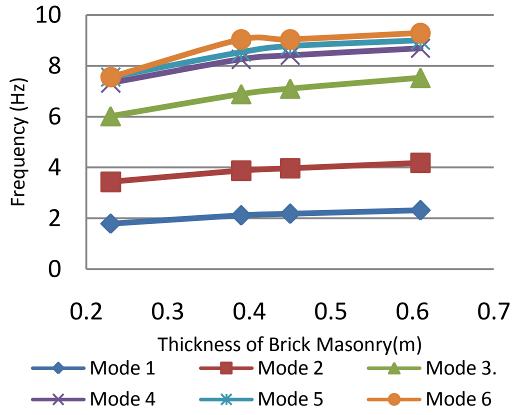
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 460mm, Beam Size 230mm x 675mm and Floor Height 4.4m)



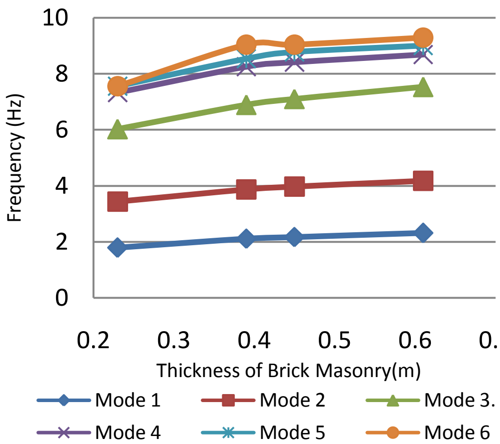
(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.18 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 460mm and Floor Height 4.4m)



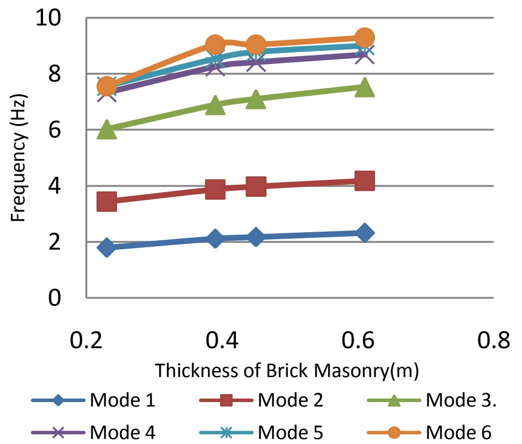
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 460mm and Floor Height 4.4m)



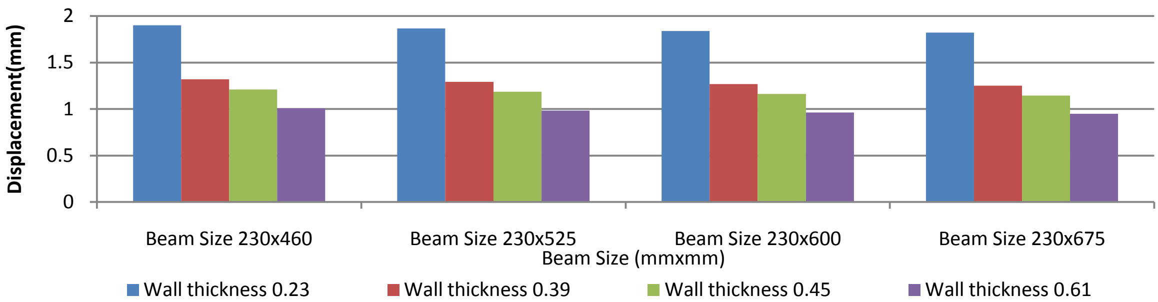
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 525mm and Floor Height 4.4m)



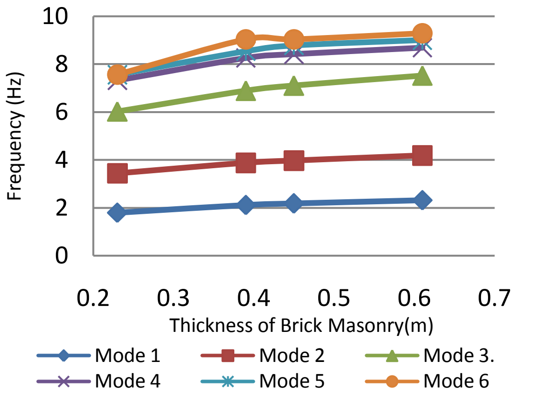
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 600mm and Floor Height 4.4m)



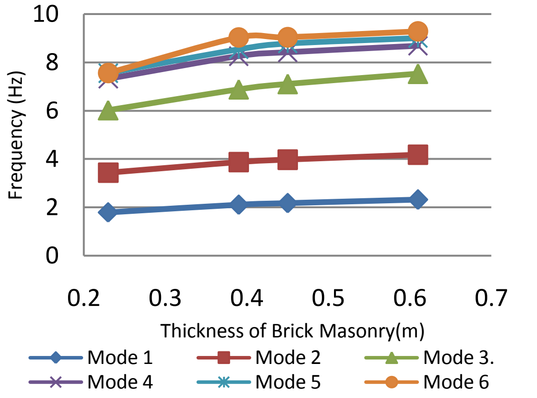
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 525mm, Beam Size 230mm x 675mm and Floor Height 4.4m)



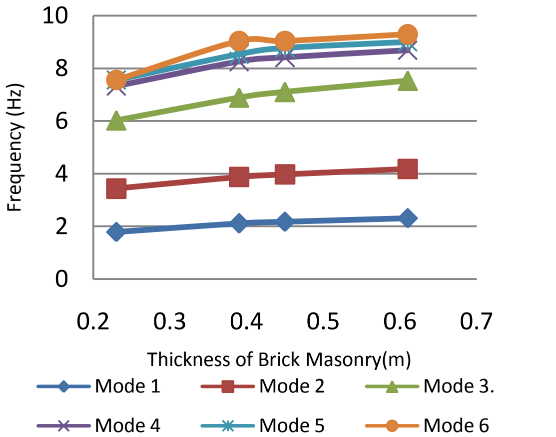
(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.19 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 525mm and Floor Height 4.4m)



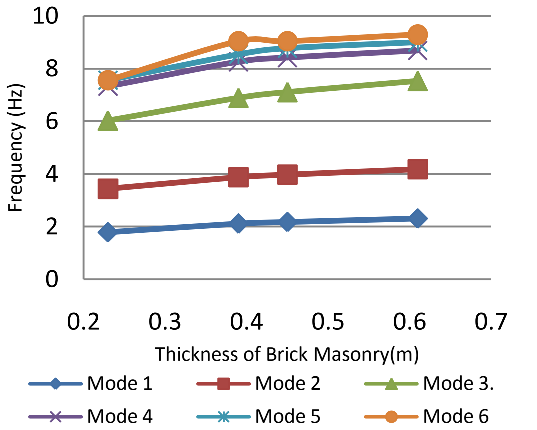
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 460mm and Floor Height 4.4m)



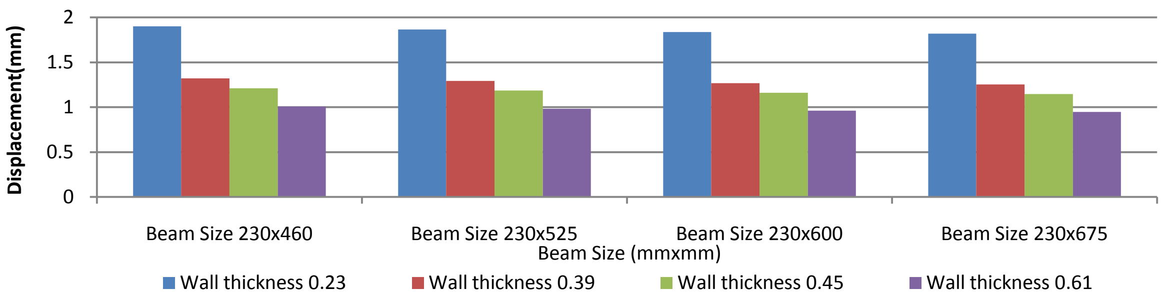
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 525mm and Floor Height 4.4m)



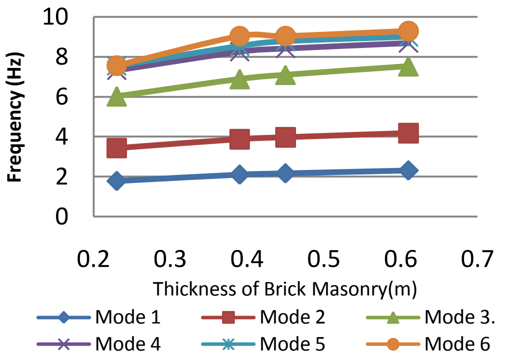
(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 600mm and Floor Height 4.4m)



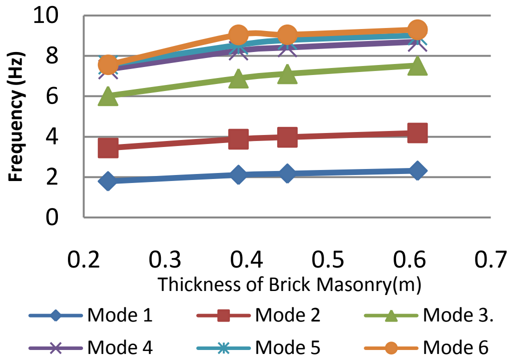
(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 600mm, Beam Size 230mm x 675mm and Floor Height 4.4m)



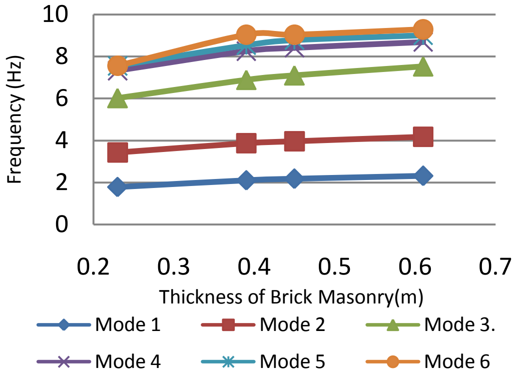
(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.20 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 600mm and Floor Height 4.4m)



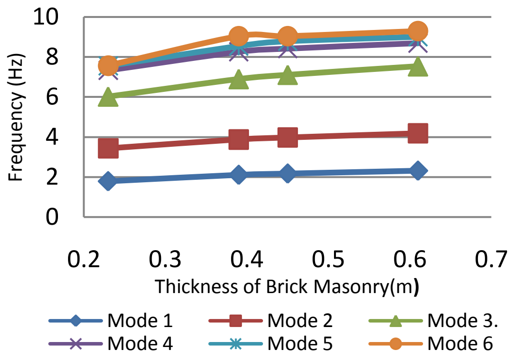
(A) Effect Of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 460mm and Floor Height 4.4m)



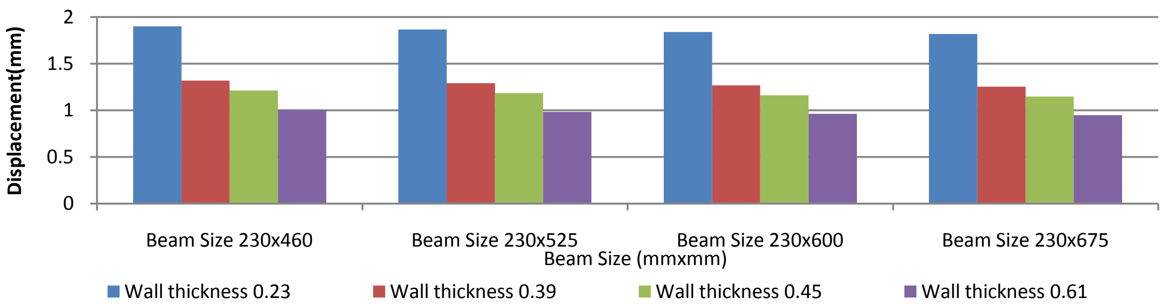
(B) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 525mm and Floor Height 4.4m)



(C) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 600mm and Floor Height 4.4m)



(D) Effect of Beam Size and Wall Thickness on Horizontal Frequency in X-Direction (For Column Size 230mm x 675mm, Beam Size 230mm x 675mm and Floor Height 4.4m)



(E) Effect of Beam Size and Wall Thickness on Horizontal Displacement in X-Direction
Fig.21 Effects of Beam Size and Wall Thickness on Horizontal Frequency and Displacement in X-Direction (For Column Size 230mm x 675mm and Floor Height 4.4m)

IV. CONCLUSIONS

1. For a particular beam size, column size and floor height frequency of the structure increases with the increase in wall thickness. For example, in Table 2, for beam and column size both 230mmx460mm,and floor height 3.2 m, frequency in Mode 1 changes from 1.766 Hz to 2.274 Hz for the change in wall thickness from 0.23m to 0.61 m. The reason behind this behaviour can be explained as the increase in the wall thickness makes the structure laterally stiffer and hence frequency of vibration increases while the displacement reduces.
2. For wall thickness 0.45 m and 0.61 m, the floor height should be 3.6 m or 4.4 m; so that resonance condition could be avoided. Wall thickness 0.45 m and 0.61 are not suitable for floor heights other than 3.6 m and 4.4 m.
3. It has been found that in case of composite structural system, mode 1 is critical from resonance point of view i.e. fundamental mode. All other modes of vibration are in over-tuned condition as it can be seen in all tables.

4. From the Tables 2 to 33, it is evident that for a particular column size, storey height and wall thickness, increase in beam size leads to very insignificant increase in frequency and decrease in displacement. Hence, varying beam size brings insignificant changes in frequency and displacement. The reason behind this phenomenon is that in composite structural system, the frequency of the structure is largely dependent on load bearing structural element i.e. wall; and hence any change in the dimension of beam is contributing very less to the frequency of the structure.
5. From table 2, it can be seen that for column size 230 mm x 460 mm, and floor height 3.2 m, the resonance condition is occurring when wall thickness is 0.45 m and 0.61 m for any beam size. Hence, it can be concluded that the wall thickness 0.45 m and 0.61 m is not good for the structural health of the building when the height is 3.2 m. To avoid resonance condition, the only one key parameter is helpful and that is floor height. By providing height of 3.6 m instead of 3.2 m, the resonance condition can be avoided.
6. When column size is kept constant and beam sizes are varying and vice-versa, a stage comes when column size is equal to the beam sizes and any further increasing of beam size or column sizes, there is not much change over the dynamic behaviour of the building.
7. In case of the floor height 4.4 m, resonance condition is occurring in mode 2 for any size of beam size, column size and wall thickness. It indicates that due to increase in height, the structure has become flexible and resonance condition gets transferred from mode 1 to mode 2.
8. For any size of beam and column, as well as wall thickness; with the increase in storey height, the frequency of structure in any mode is reducing. It clearly indicates that the increase in storey height makes the structure flexible and hence, frequency of vibration of structure reduces.
9. With the increase in storey height, the displacement in X- direction is increasing gradually for any size of beam, column and wall thickness. For example it can be seen tables 2, 6, 10 and 14. It is very true that increase in height of the structure makes it flexible and hence displacement increases.
10. With the increasing wall thickness, the displacement of the structure is reducing in X-direction for any size of beam, column and floor height. For example, it can be seen from table 3. Due to increase in thickness of the wall, it increases the stiffness of the structure and hence, displacement is reducing.
11. For a particular storey height, the frequency of a structure increases by increasing the beam size or column size, which in turn, reduces the magnitude of displacement as seen from fig 7 to fig 16. When the column sizes is increasing the displacement trend is decreasing in nature. The reason behind it is that the increase in column sizes increases the lateral stiffness of the building which reduces the displacement of the building.
12. From fig.6-(A),(B),(C),(D), it can be seen that with the increase in wall thickness frequency increases. From fig.6-(E) it can be seen that for a particular beam size displacements decreases with the increase in wall thickness. Due to increase in thickness of the wall, it increases the stiffness of the structure and hence, displacement is reducing.
13. The percentage increase in frequency is less for change in column size as compared to percentage increase in frequency for change in wall thickness. This is because the structure referred in this project is a composite structure and hence, change in wall thickness will have more effect on displacement and frequency as compared to change of column size. Referring Tables 2 and 4 and also graphs in Fig. 6 and 7 makes the results more clear.

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