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Research Article

Behavior Study of Industrial Building under Dynamic Load

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Abstract

Every loom machinery is going to produce vibrations during its operation. We can neither reduce these vibrations nor can we stop their use. Vibrations are transmitted to structure and so we need to design such structure so that the effect of vibration on structure can be minimized and the structure can offer permissible stress and strain. This will result in increasing the sustainability of the structure. The purpose of this research project work is to study and understand the behavior of composite structural system (i.e. combination of load bearing and framed structural system) subjected to vibration of reciprocating type machines like looms.

Keywords: *Looms Industry, Vibration, Dead Load, Time History, Displacement, Modes, Frequency.*

1. Introduction

The looms machines which are used for the production of the woven clothes are becoming very popular and useful in the textile industries. These looms machinery are very efficient and are much better as compared to the conventional loom or say handloom. Modern loom machinery takes less time and gives more production. The only drawback is the vibrations caused by these machines are not good for the structural health of the industry in which they are been operated. These vibrations are born because of the speedy motion of slay in the loom. These vibrations may cause damage to various structural elements like the walls, columns, beam, etc. If the resonance condition occurs then it becomes more harmful to the structure as it could not resist the effect of these vibrations in this condition. Thus, the structure should be so designed so that the vibrations of the looms machinery could not affect the structure. The structure should be sustainable and strong enough to bear the effects of the vibrations. Here, an attempt is made to study the behavior of the composite structure which is been subjected to the vibrations caused by these loom machinery.Anil K. Chopra has explained in detail the understanding and analysis of single-degree-of-freedom systems and its applications. He has also commented on dynamic behaviour of structures subjected to harmonic loads (Anil K. Chopra, *et al*, 1995).Dr. Jatin Desai and Dr. Bharat Mistry have given a detail description of the theory along with the systematic applications of laws of mechanics to engineering problems. They have explained the mechanical vibrations in detail (Dr. Jatin Desai and Dr. Bharat Mistry, *et al*, 2001). Anil K. Chopra aimed at deeper understanding of structural dynamics, design of structures and earthquake analysis. He explained in the degree of freedom of structures under effect of vibrations in depth (Anil K. Chopra, *et al*, 1980). Cyril M. Harris has mentioned the characteristics of Harmonic motion. In this book he has also described in depth about analysis and behaviour of the forced undamped vibrations having single degree of freedom (Cyril M. Harris, *et al*, 2002). Hasmukhrai B. has explained in detail the fundamental operations of weaving – Primary motion, Secondary motion & Auxiliary motion. He has also explained the construction and mechanism of Beating-up Motion (Hasmukhrai B., *et al*, 1996).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. He has also suggested various remedial measures to minimize these vibrations (Victor Wowk, *et al*, 2008). Jigar Sevalia, Sunil Kukadiya, Yogesh Rathod, Sarthi Bhavsar and Gaurang Parmar carried out parametric study on the dynamic behaviour of a structure for looms industry subjected to vibrations due to looms machinery (Jigar Sevalia, Sunil Kukadiya, Yogesh Rathod, Sarthi Bhavsar and Gaurang Parmar, *et al*, 2012).Jigar Sevalia, Sunil Kukadiya, Yogesh Rathod, Sarthi Bhavsar and Gaurang Parmar made 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 (Jigar Sevalia, Sunil Kukadiya, Yogesh Rathod, Sarthi Bhavsar and Gaurang Parmar, *et al*, 2013)**.**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

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working, noise, loom developments (P. R. Lord and M. H. Mohamed, *et al*, 1973). Dr. M. K. Talukdar, Prof. P. K. Sriramulu and Prof. D. B. Ajgaonkar discussed in detail about weaving, machines used in weaving, various mechanisms involved in it, the effect of the machinery, their management, various mathematical terms and figures useful in the machine operation and finding the speed of the slay, etc. (Dr. M. K. Talukdar, Prof. P. K. Sriramulu and Prof. D. B. Ajgaonkar, *et al*, 2004).Varanasi Rama Rao explained in depth the design criteria for machine foundations and their Codal requirements as per IS Codes (Varanasi Rama Rao, *et al*, 2011).

2. Methodology

Preparation of drawing of typical industrial floor plan showing layout of machine position on the industrial floors of existing building, section and elevation using CAD software.

Modelling of building frame structure using structural engineering software – STAAD.Pro. Its pre-analysis includes modelling, labelling, assigning geometric properties and loads to various structural components, as well as to assign support conditions and to assign suitable analysis commands. The post-analysis includes studying of various modes shapes and their respective frequencies and amplitude, plotting of the graphs of various results of mode shapes, frequency and displacements with respect to various sizes of beams and columns.

The dynamic analysis of the structure for looms industry is done by the following approach.

Reconnaissance survey which includes visit to the various looms industry and interaction with the industrial people for getting a better practical picture of the looms industry, study of structural system of the looms industry and understanding the working of the looms machine.

Collection of necessary machine data such as the dimension of the machine components, its operating speed, weight of cloth roll, etc.Also the data regarding the building which includes various dimensions of the building and size of its various structural components like beam, column, slab, etc.

3. Looms Machine Data

Table 1 Looms Machine Data

Particular	Details
Size of Machine	1.15 m x 1.89 m
Operating Speed	60 rpm
Dimension of Slay	213.36 cm x 6 cm x 7.62 cm
Mass of Slay	25 kg
Operating Frequency	2.67 Hz

4. Analysis Method and Geometric Configuration

The plan of the loom industry is shown in Fig 1. by using the STAAD.Pro. Software, the dynamic analysis of the loom industry is carried out. An attempt of parametric study is made in this paper.

To study the dynamic behavior of the structure subjected to harmonic loading due to machine operation, sixty four different models have been developed in this parametric study. These models are made by varying the beam size, column size, storey height and wall thickness. Various sizes of these components are listed in Table 2.

Table 2 Different Sizes of Components considered for study

Various Parameters	Sizes
Beam Size (mm x mm)	230x460, 230x525, 230x600, 230x675
Column Size (mm x mm)	230x460, 230x525, 230x600, 230x675
Storey Height (m)	3.2 , 3.6 , 4 and 4.4
Wall Thickness (m)	0.23, 0.39, 0.45 and 0.61
Slab Thickness (mm)	125mm

The structure has a 12 bays having plan dimension of standard size 4.83 m x 38.64 m. 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.

Wall thickness = 23 cm, 39 cm, 45 cm, 61 cm

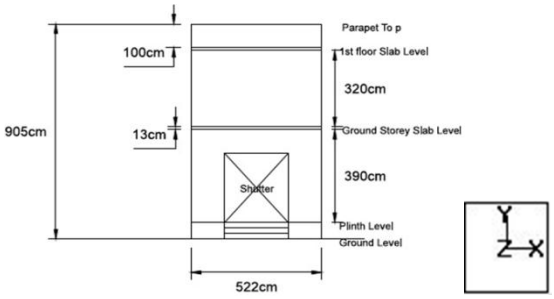
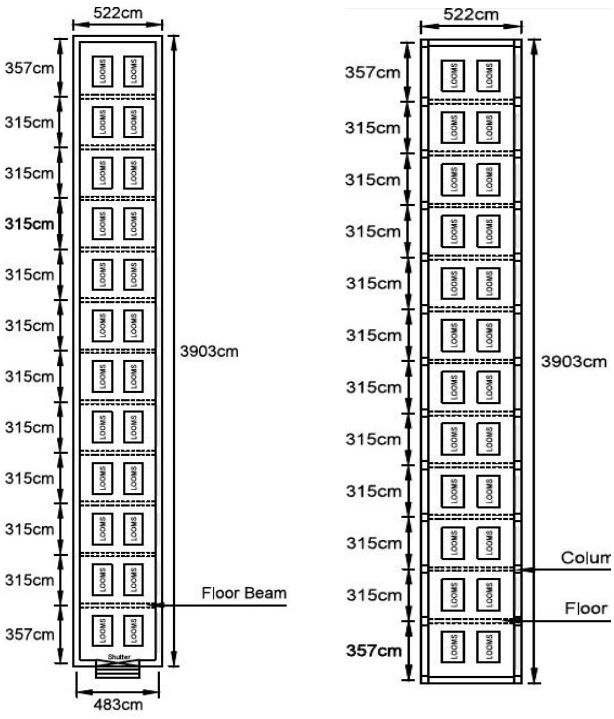


Fig.1 Front Elevation of Loom Industry



Typical Ground Floor Plan Typical First Floor Plan

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

Table 3 Effect of Column Size and Storey Height on horizontal frequency in X-Direction (For Beam Size 230 mm x 460 mm and Wall Thickness 0.23 m)

Column Size (mm x mm)	Height of Storey (m)	Frequency in X-Direction (Hz)					
		Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6
230x460	3.2	1.766	3.339	5.390	6.460	6.462	7.076
	3.6	1.594	3.061	4.679	5.563	5.765	6.646
	4.0	1.923	3.802	6.385	8.109	8.635	8.918
	4.4	1.349	2.630	3.586	4.328	4.666	6.243
230x525	3.2	1.771	3.365	5.549	6.698	6.803	7.119
	3.6	1.599	3.087	4.828	5.753	6.100	6.661
	4.0	1.925	3.802	6.386	8.111	8.637	8.945
	4.4	1.353	2.664	3.722	4.483	5.025	6.247
230x600	3.2	1.776	3.387	5.700	6.941	7.080	7.170
	3.6	1.604	3.113	4.998	5.981	6.428	6.680
	4.0	1.928	3.804	6.387	8.112	8.638	8.974
	4.4	1.357	2.693	3.859	4.684	5.347	6.251
230x675	3.2	1.781	3.405	5.824	7.155	7.221	7.269
	3.6	1.608	3.131	5.126	6.159	6.630	6.697
	4.0	1.930	3.804	6.389	8.114	8.639	9
	4.4	1.361	2.716	3.979	4.799	5.589	6.255

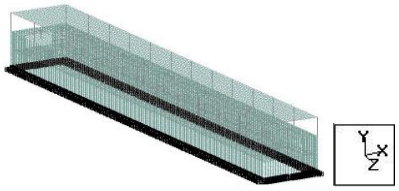


Fig.3 3D View of a Building Structure Model for Looms Industry in STAAD.Pro

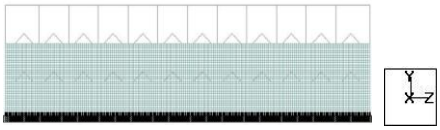


Fig.4 2D View of a Building Structure Model for Looms Industry in Y-Z Plane in STAAD.Pro

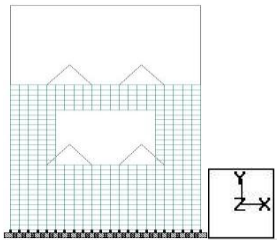
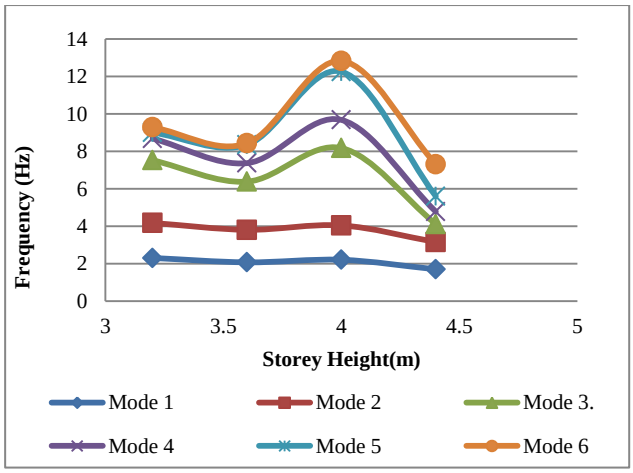


Fig.5 2D View of a Building Structure Model in X-Y Plane in STAAD.Pro

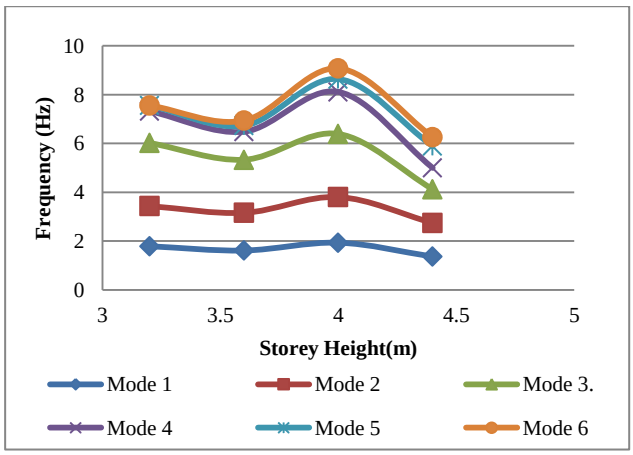
5. Results

Table 4 Effect of Column Size and Storey Height on horizontal Displacement in X-Direction (For Beam Size 230 mm x 460 mm and Wall Thickness 0.23 m)

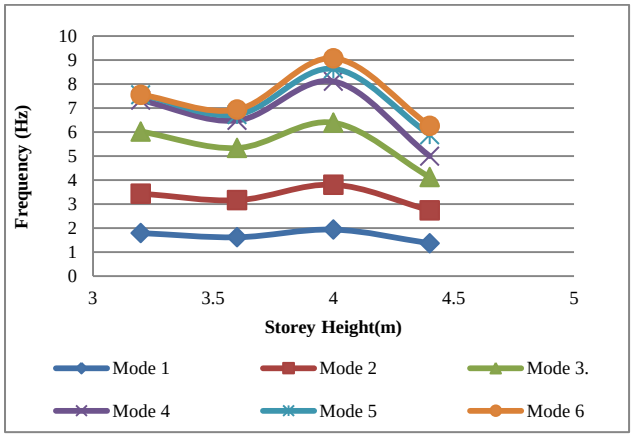
Storey Height (m)	Column Size (mm x mm)			
	230x460	230x525	230x600	230x675
3.2	2.053	1.995	1.941	1.899
3.6	2.522	2.445	2.370	2.315
4.0	3.033	2.927	2.830	2.754
4.4	3.597	3.459	3.334	3.233



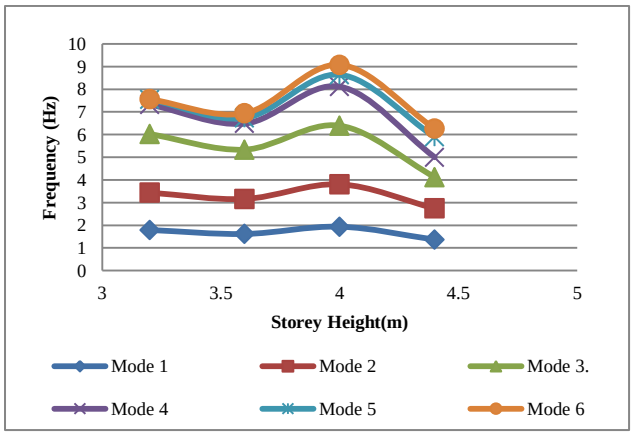
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx460mm and Wall Thickness 0.23m)



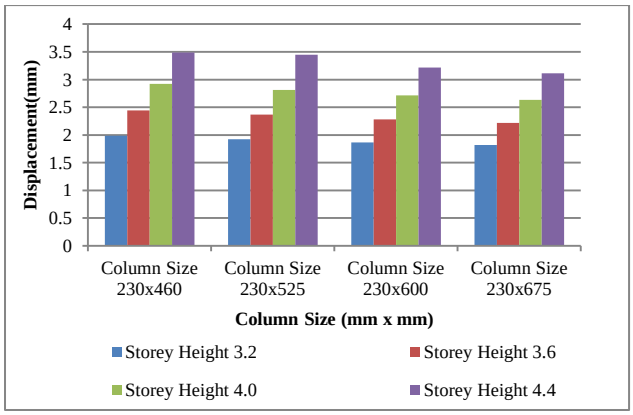
(B) Effect of Column Size and Storey Height on Horizontal, Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx525mm and Wall Thickness 0.23m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx460mm and Wall Thickness 0.23m)



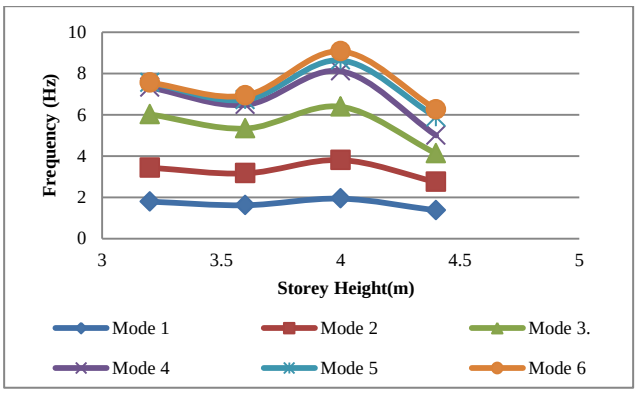
(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx525mm and Wall Thickness 0.23m)



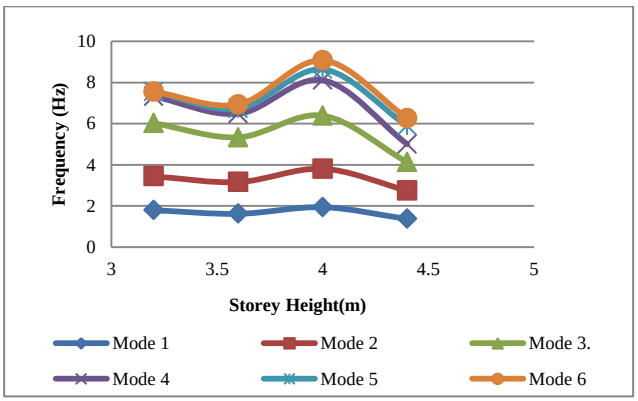
(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

Fig.6 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 460 mm and Wall Thickness 0.23 m)

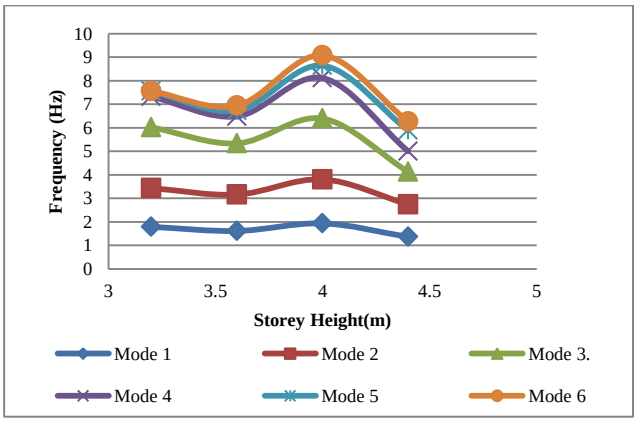
Similarly, the results are obtained for various parameters like the different beam size, column size, storey height and wall thickness. The graphs obtained from these results are given below:



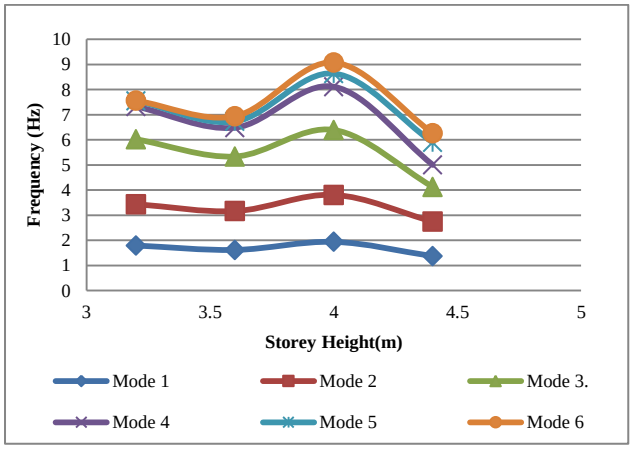
(A)Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx460mm and Wall Thickness 0.23m)



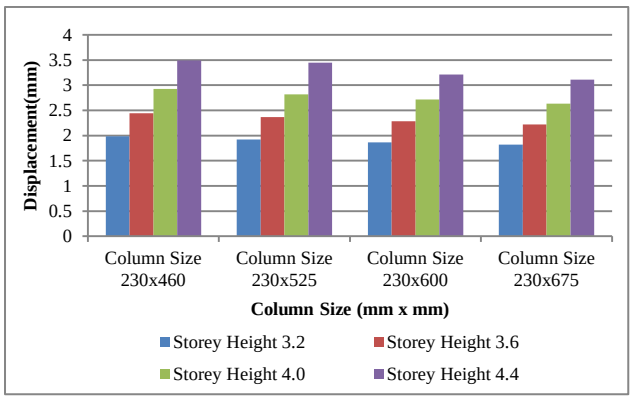
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx525mm and Wall Thickness 0.23m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx600mm and Wall Thickness 0.23m)

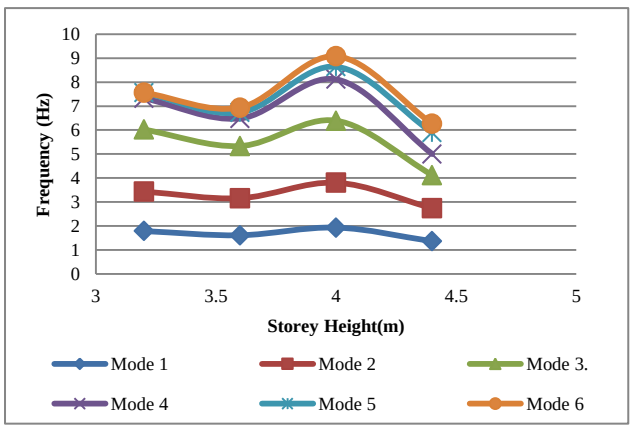


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx675mm and Wall Thickness 0.23m)

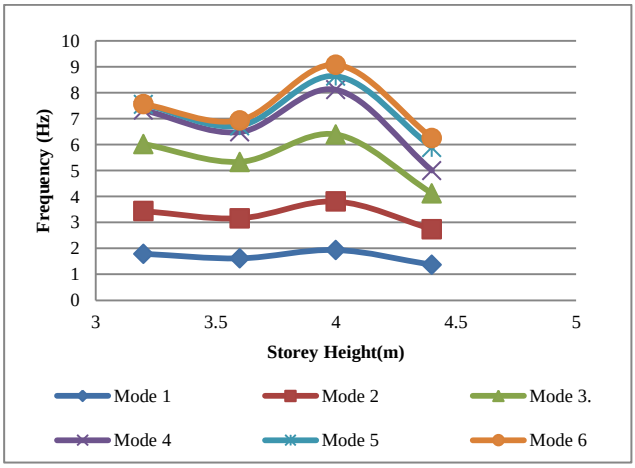


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

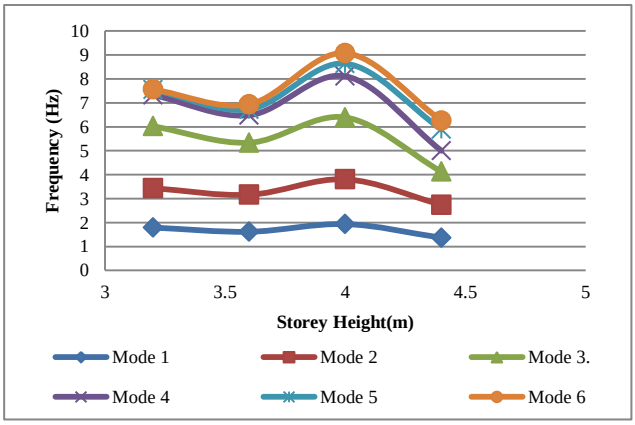
Fig.7 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 460 mm and Wall Thickness 0.23 m)



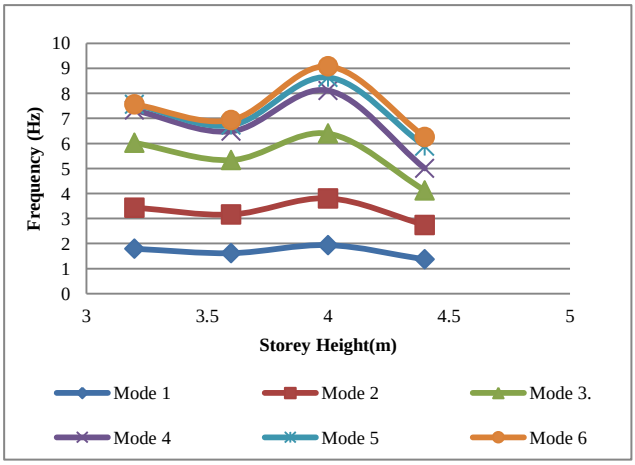
(A)Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx460mm and Wall Thickness 0.23m)



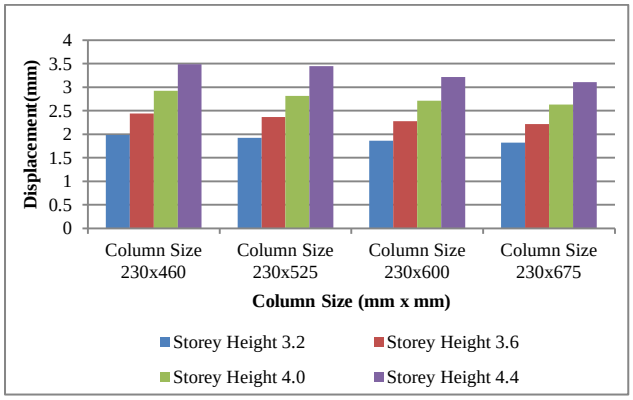
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx525mm and Wall Thickness 0.23m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx600mm and Wall Thickness 0.23m)

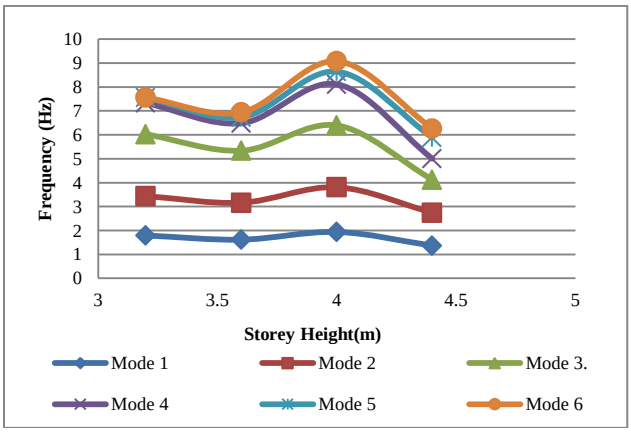


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx675mm and Wall Thickness 0.23m)

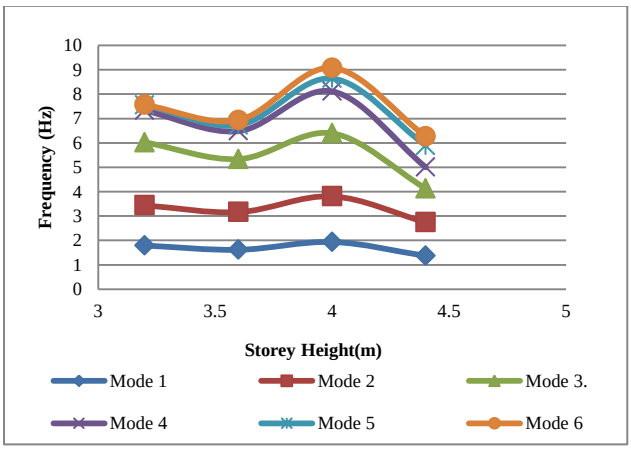


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

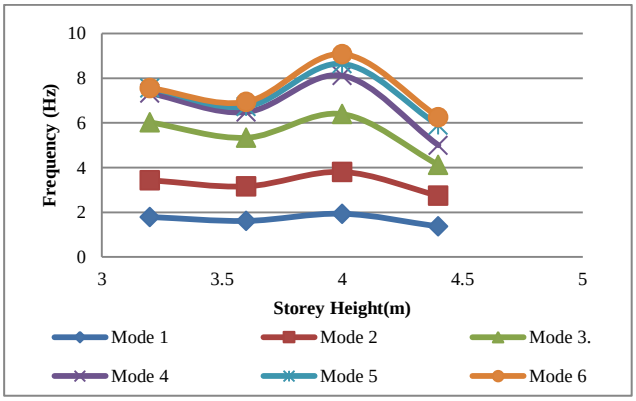
Fig.8 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 600 mm and Wall Thickness 0.23 m)



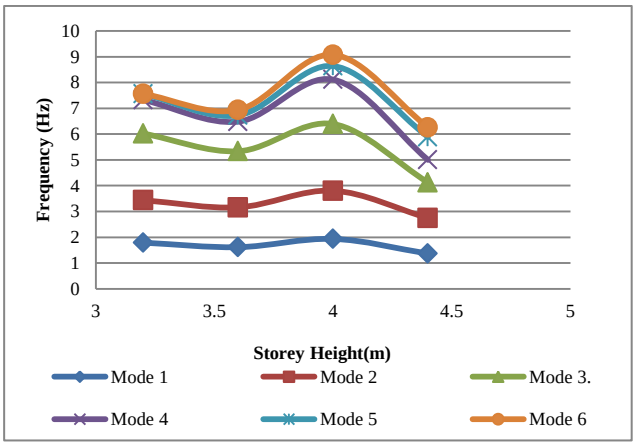
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx460mm and Wall Thickness 0.23m)



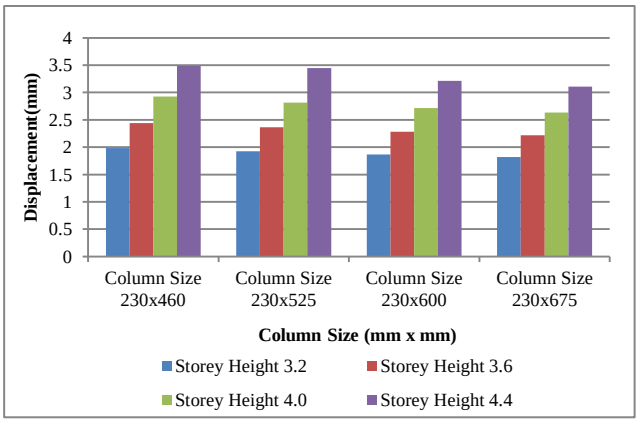
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx525mm and Wall Thickness 0.23m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx600mm and Wall Thickness 0.23m)

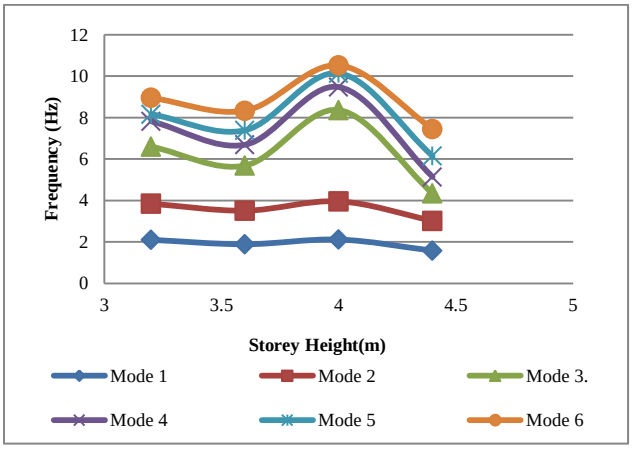


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx675mm and Wall Thickness 0.23m)

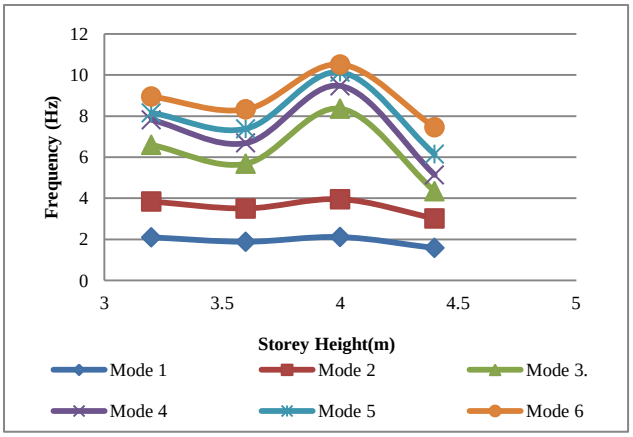


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

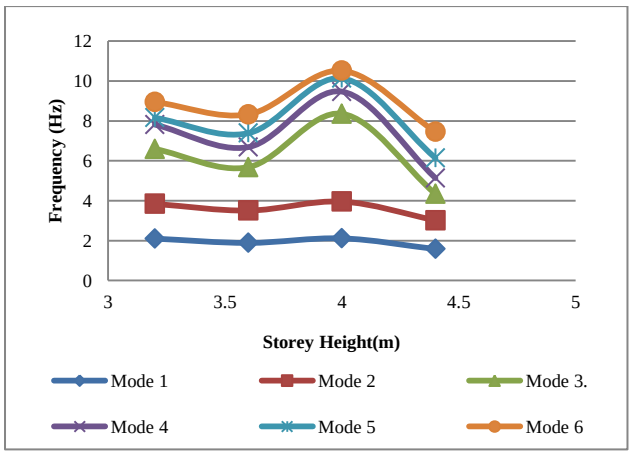
Fig.9 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 675 mm and Wall Thickness 0.23 m)



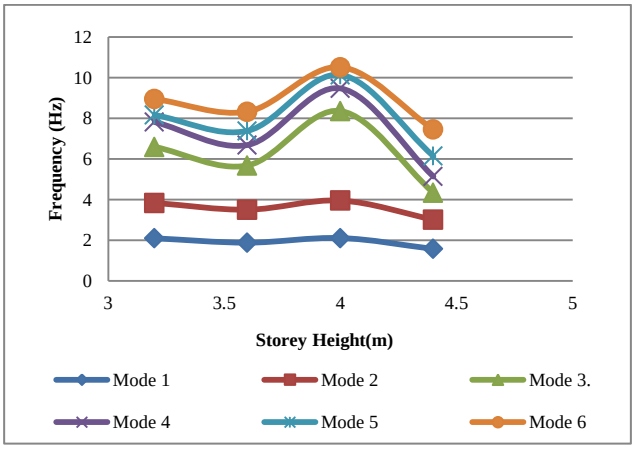
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx460mm and Wall Thickness 0.39m)



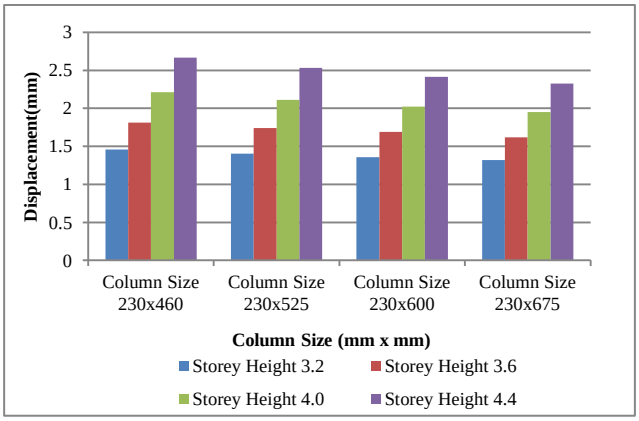
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx525mm and Wall Thickness 0.39m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx600mm and Wall Thickness 0.39m)

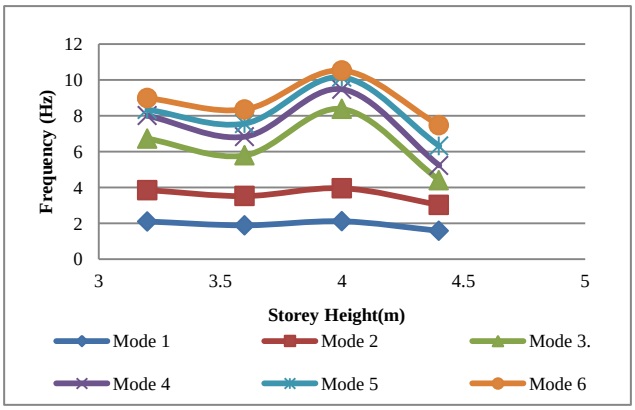


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx675mm and Wall Thickness 0.39m)

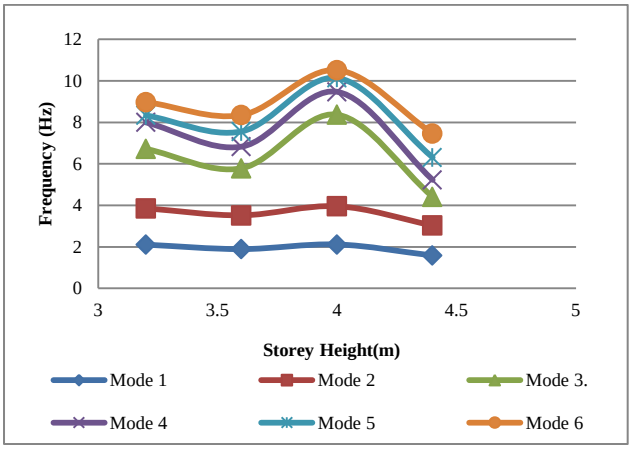


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

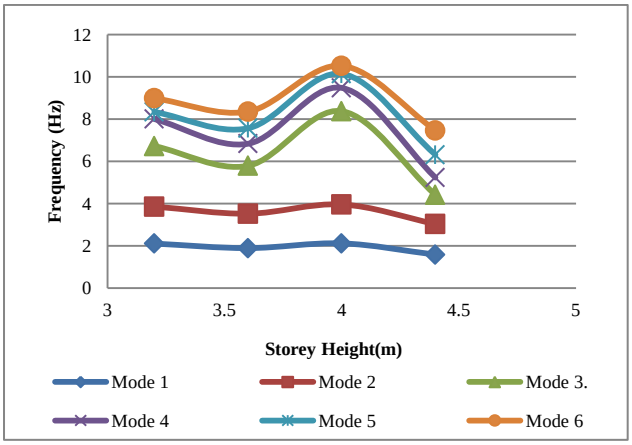
Fig.10 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 460 mm and Wall Thickness 0.39 m)



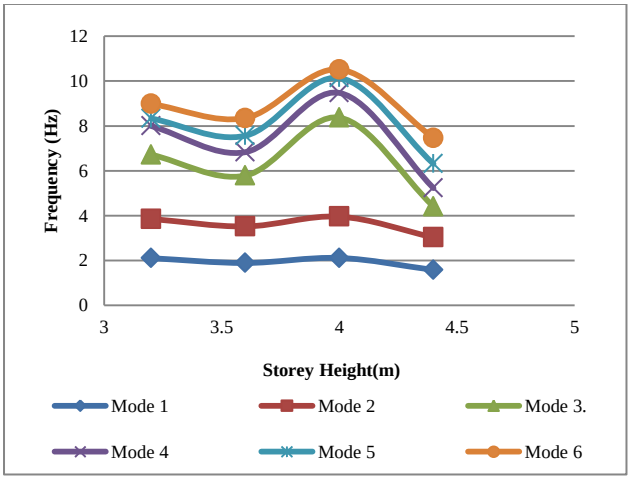
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx460mm and Wall Thickness 0.39m)



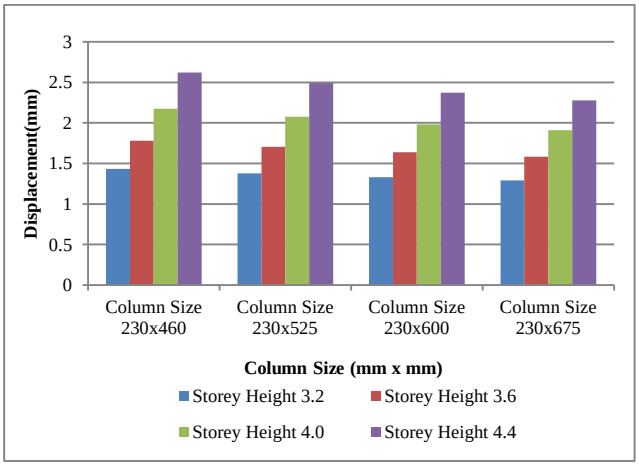
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx525mm and Wall Thickness 0.39m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx600mm and Wall Thickness 0.39m)

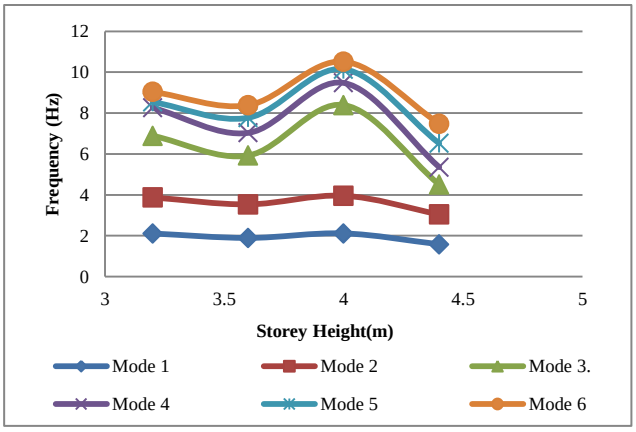


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx675mm and Wall Thickness 0.39m)

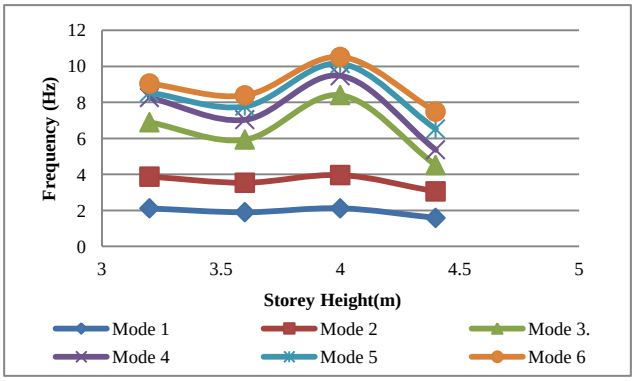


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

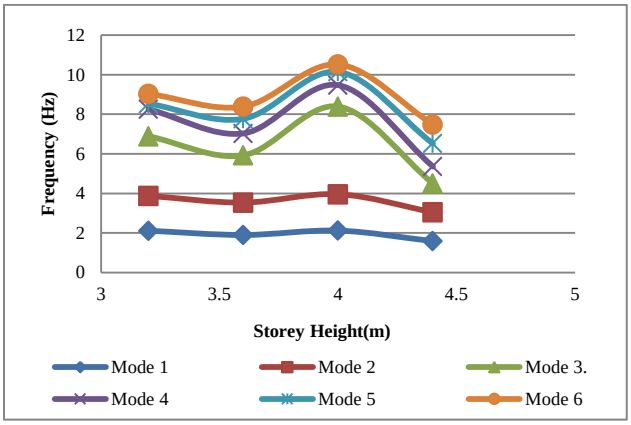
Fig.11 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 525 mm and Wall Thickness 0.39 m)



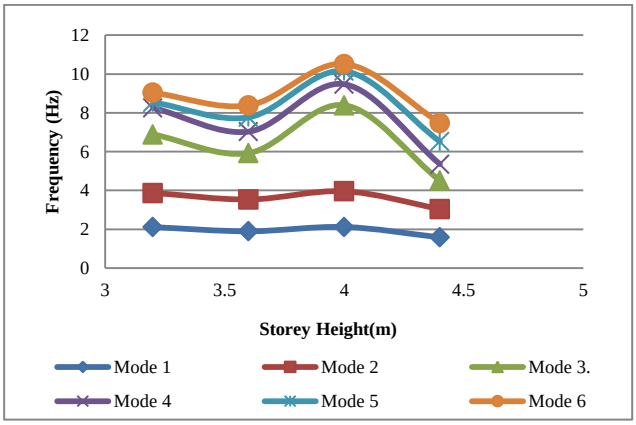
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx460mm and Wall Thickness 0.39m)



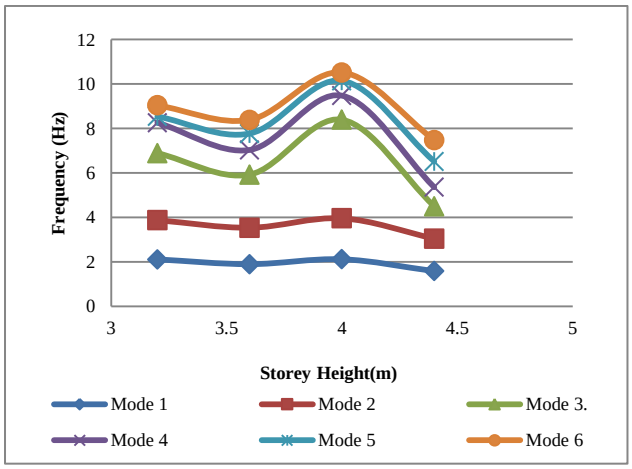
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx525mm and Wall Thickness 0.39m)



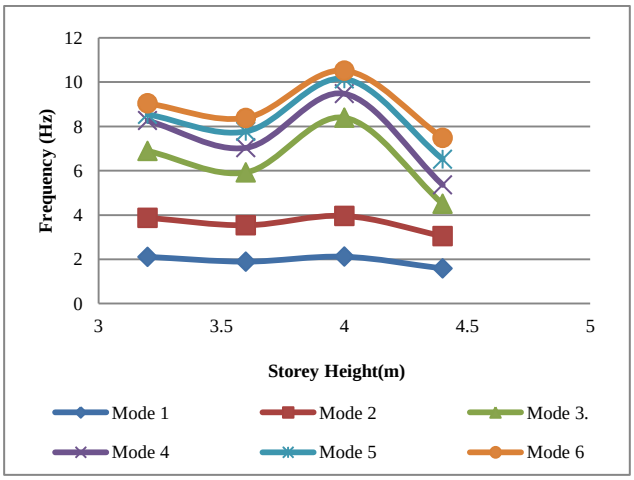
(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx600mm and Wall Thickness 0.39m)



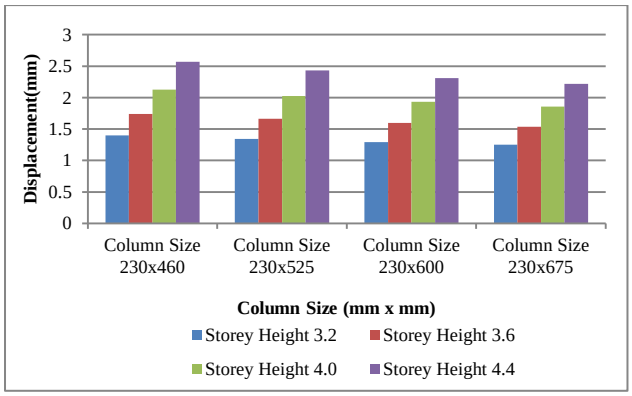
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx460mm and Wall Thickness 0.39m)



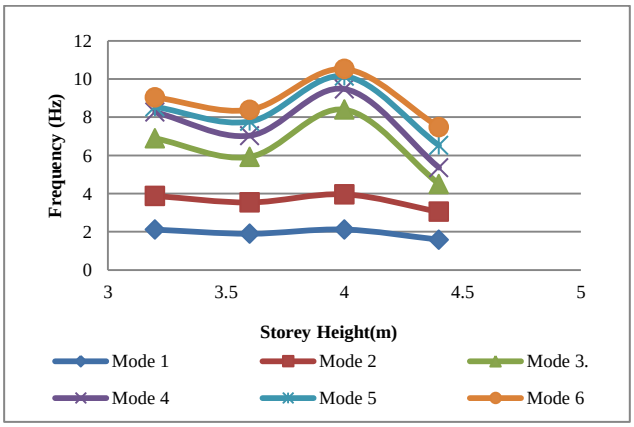
(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx675mm and Wall Thickness 0.39m)



(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx525mm and Wall Thickness 0.39m)

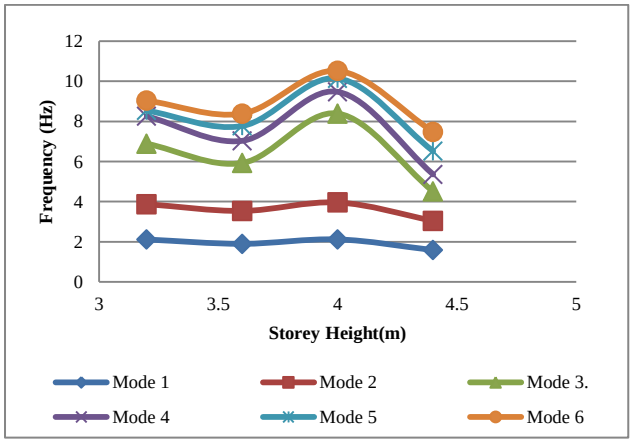


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

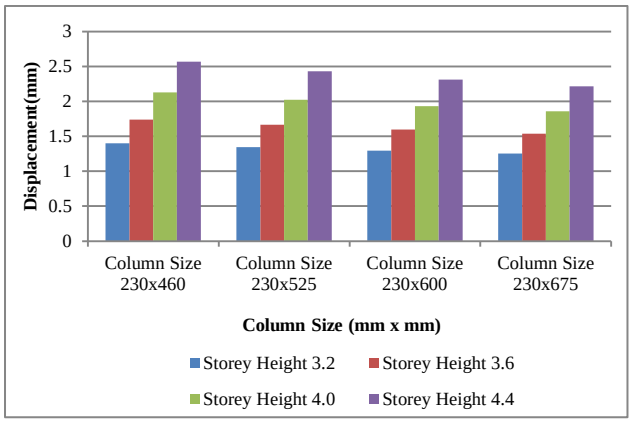


(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx600mm and Wall Thickness 0.39m)

Fig.12 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 600 mm and Wall Thickness 0.39 m)

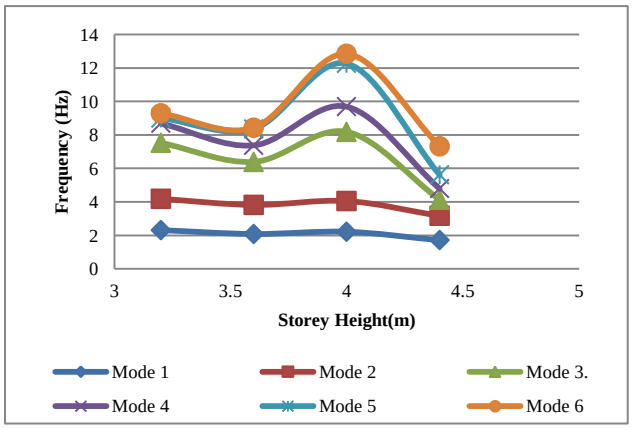


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx675mm and Wall Thickness 0.39m)

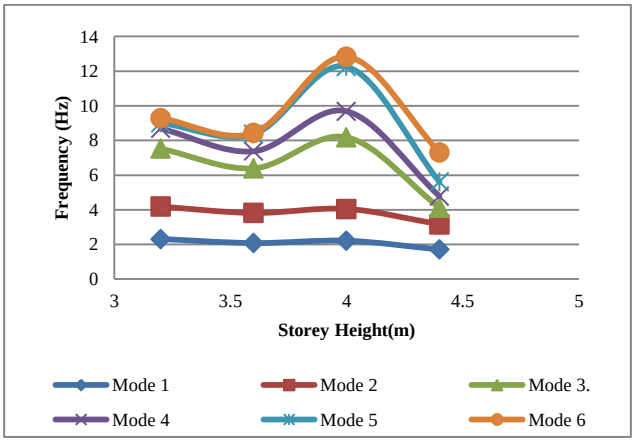


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

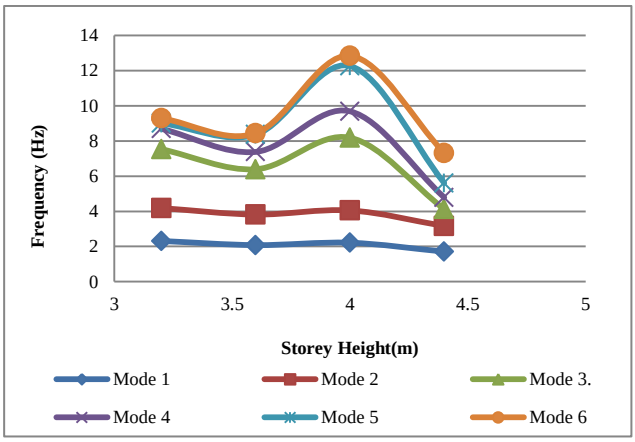
Fig.13 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 675 mm and Wall Thickness 0.39 m)



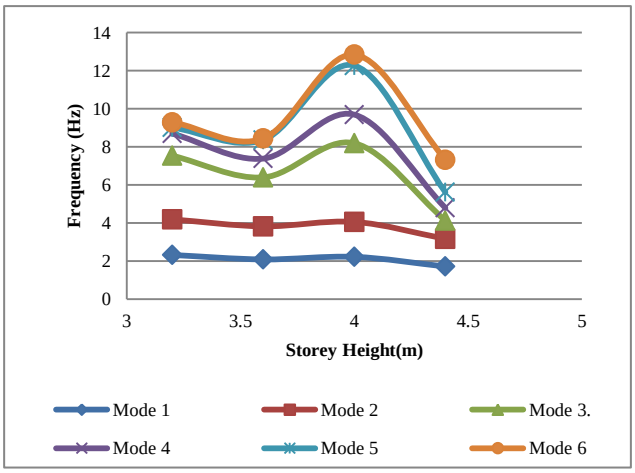
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx460mm and Wall Thickness 0.45m)



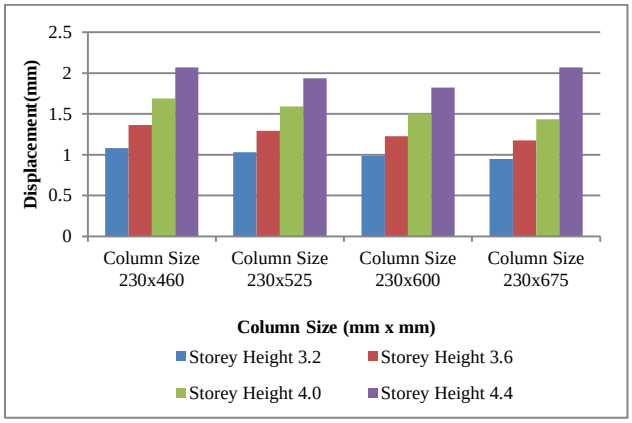
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx525mm and Wall Thickness 0.45m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx600mm and Wall Thickness 0.45m)

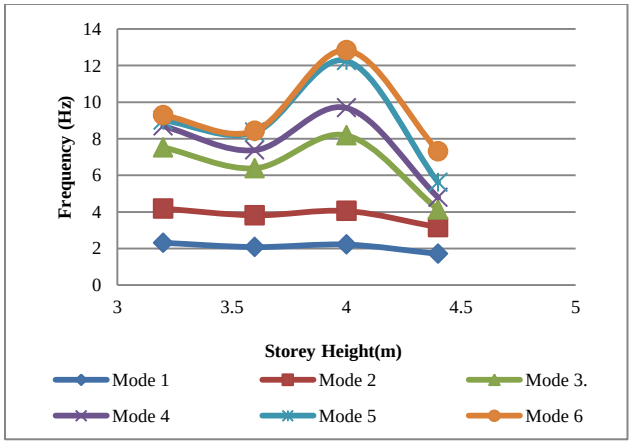


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx675mm and Wall Thickness 0.45m)

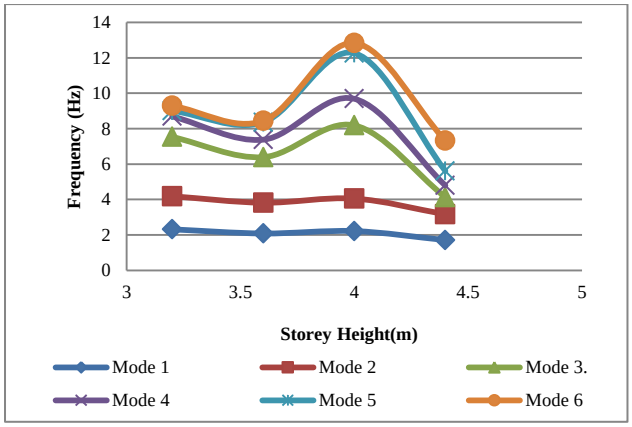


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

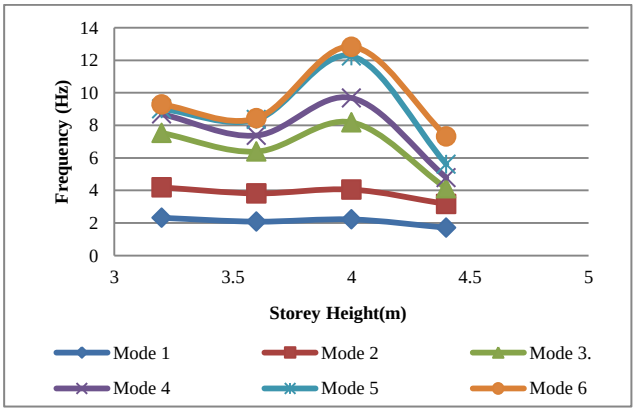
Fig.14 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 460 mm and Wall Thickness 0.45 m)



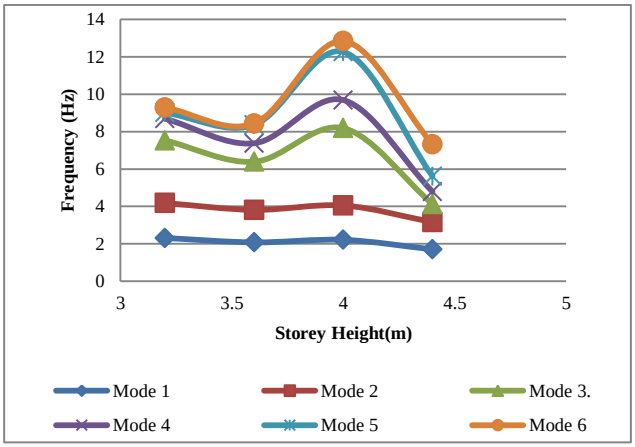
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx460mm and Wall Thickness 0.45m)



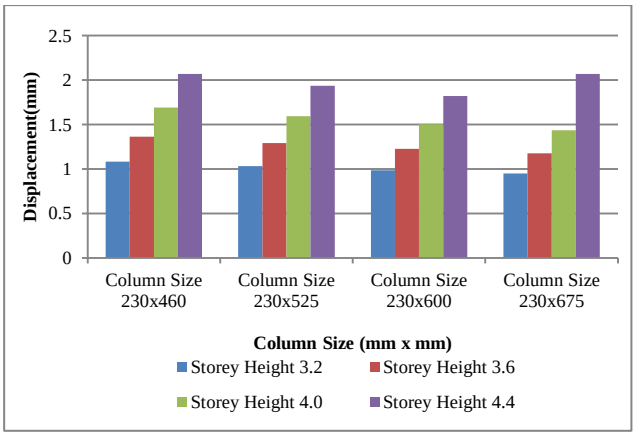
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx525mm and Wall Thickness 0.45m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx600mm and Wall Thickness 0.45m)

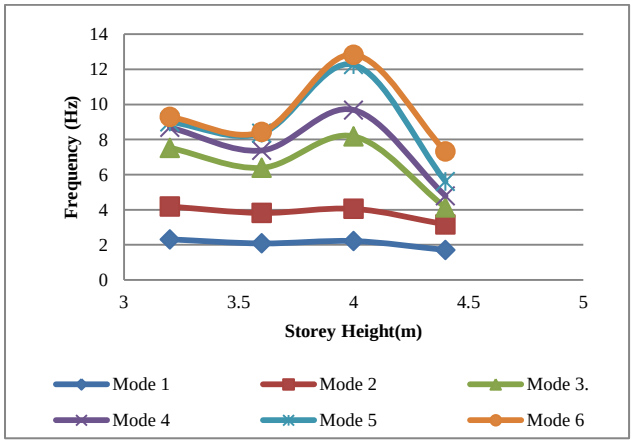


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx675mm and Wall Thickness 0.45m)

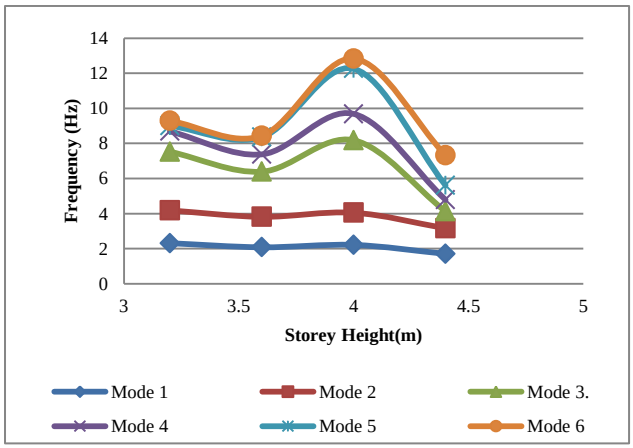


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

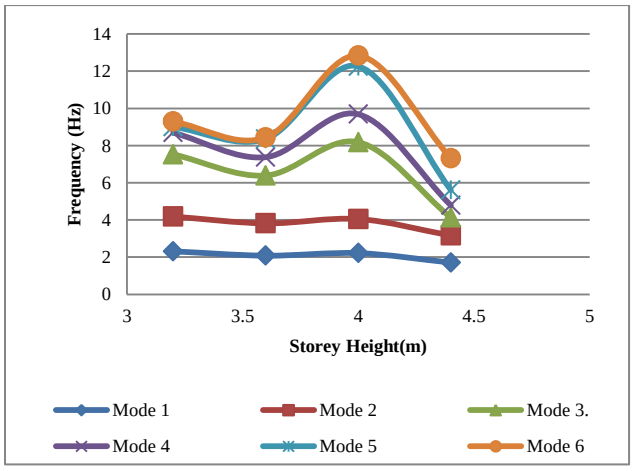
Fig.15 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 525 mm and Wall Thickness 0.45 m)



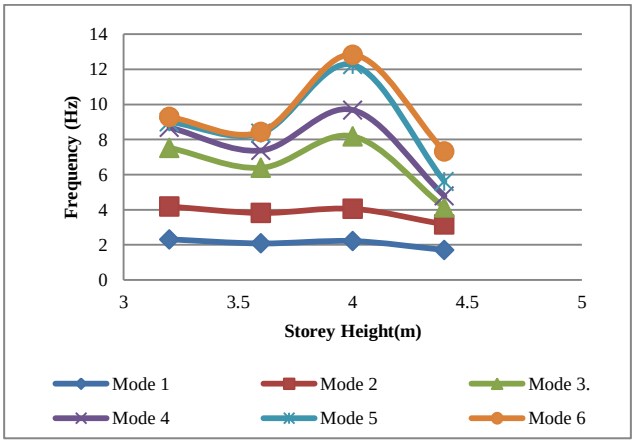
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx460mm and Wall Thickness 0.45m)



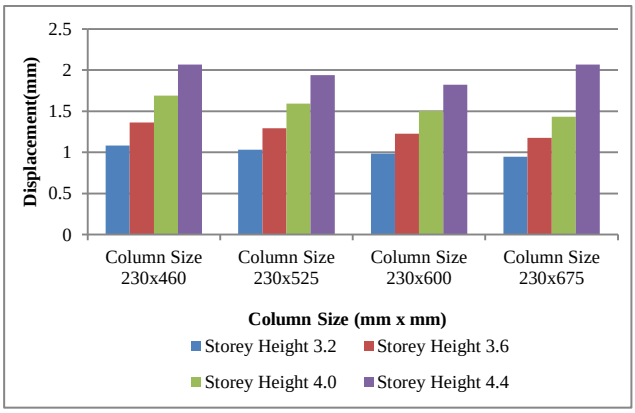
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx525mm and Wall Thickness 0.45m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx600mm and Wall Thickness 0.45m)

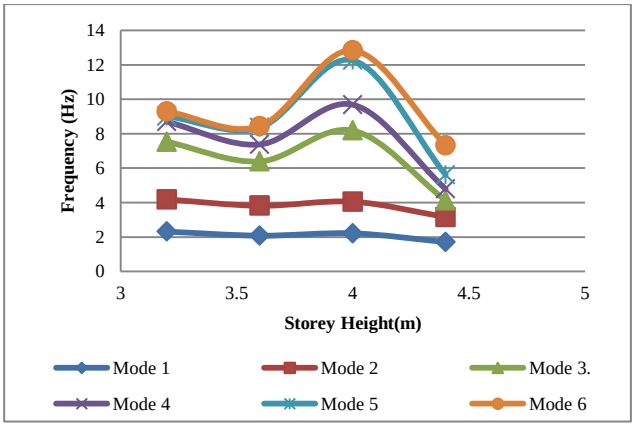


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx675mm and Wall Thickness 0.45m)

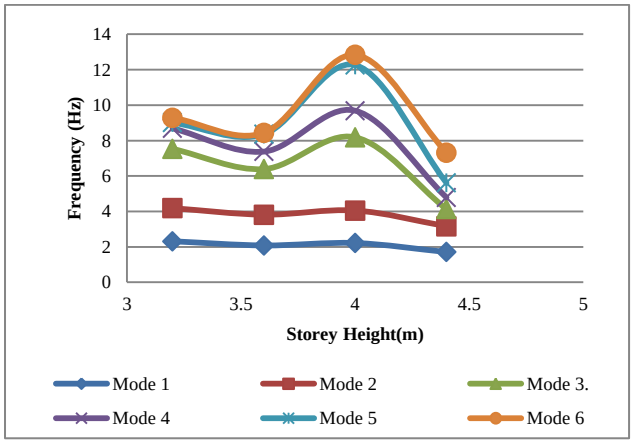


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

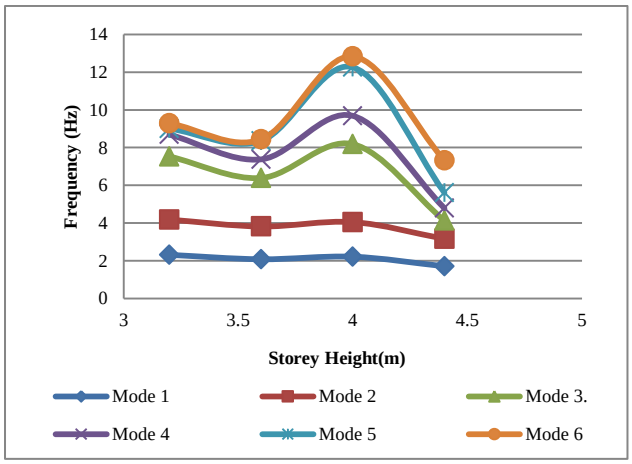
Fig.16 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 600 mm and Wall Thickness 0.45 m)



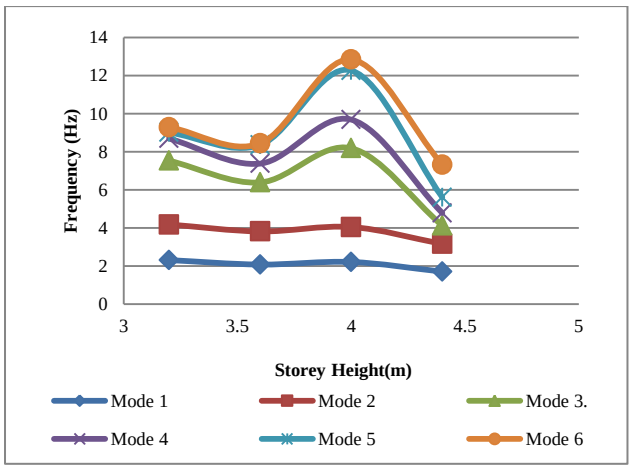
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx460mm and Wall Thickness 0.45m)



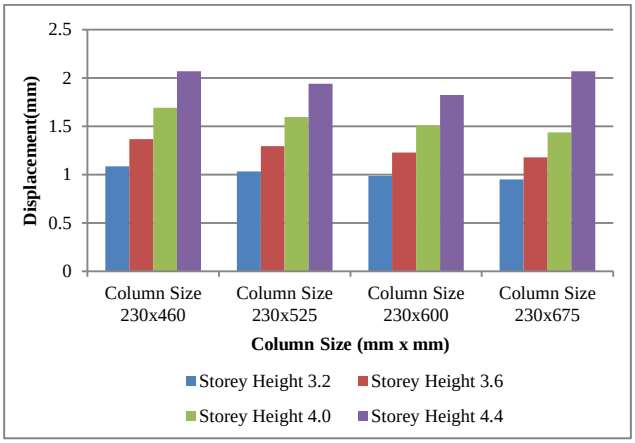
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx525mm and Wall Thickness 0.45m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx600mm and Wall Thickness 0.45m)

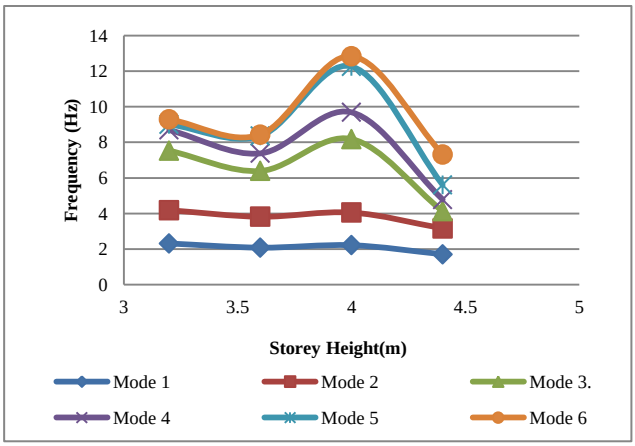


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx675mm and Wall Thickness 0.45m)

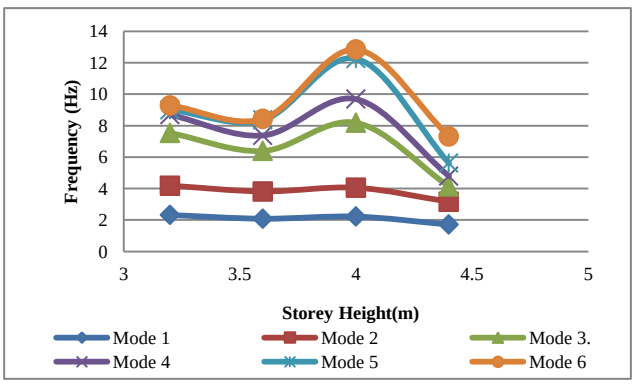


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

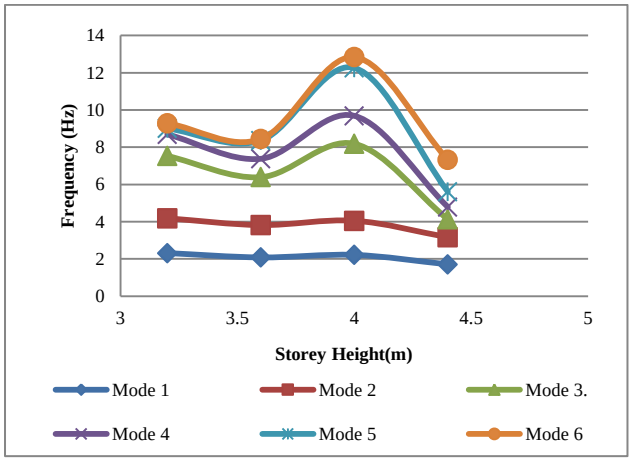
Fig.17 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 675 mm and Wall Thickness 0.45 m)



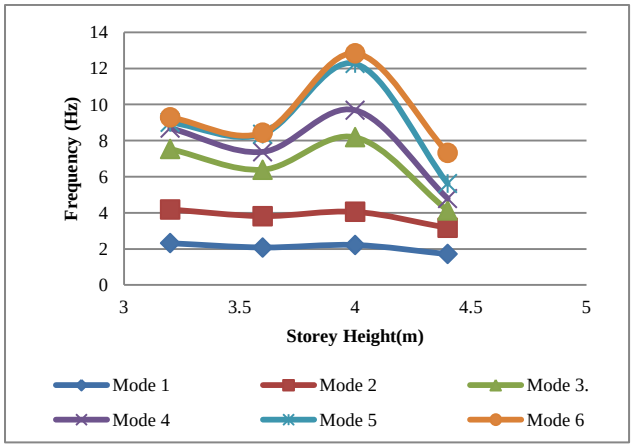
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx460mm and Wall Thickness 0.61m)



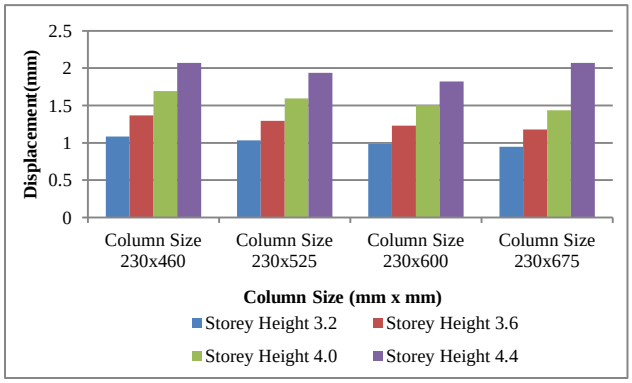
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx525mm and Wall Thickness 0.61m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx600mm and Wall Thickness 0.61m)

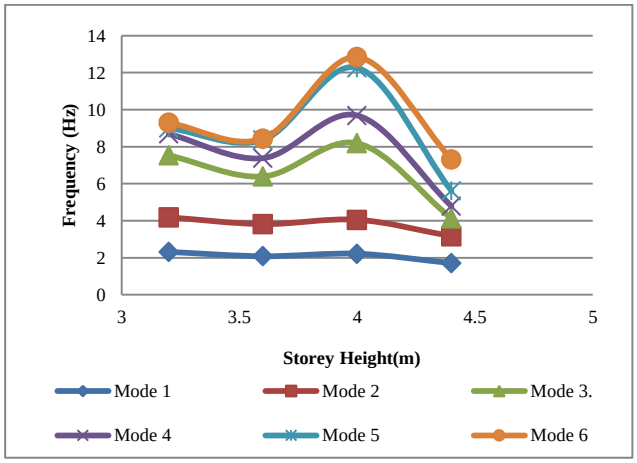


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx460mm, Column Size 230mmx675mm and Wall Thickness 0.61m)

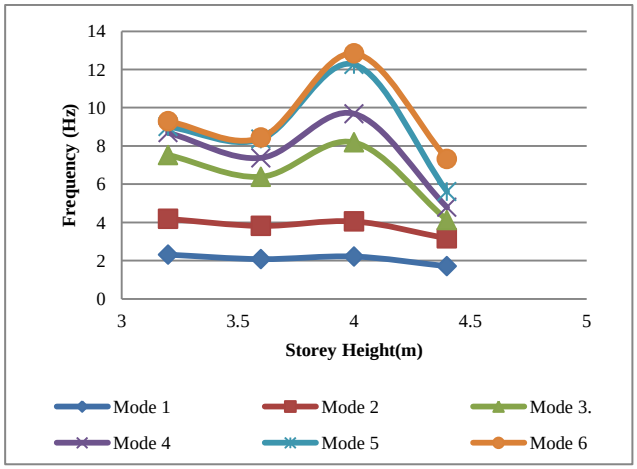


E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

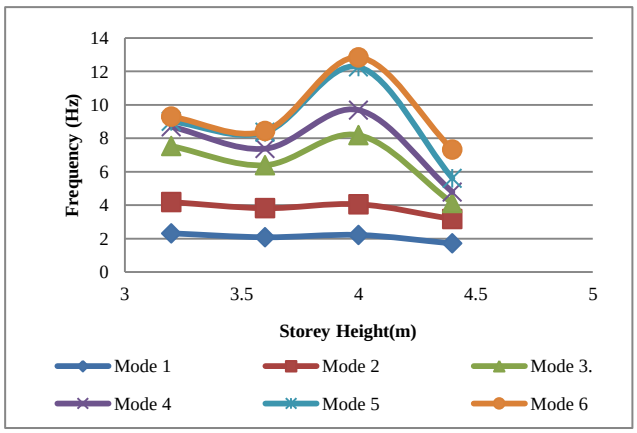
Fig.18 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 460 mm and Wall Thickness 0.61 m)



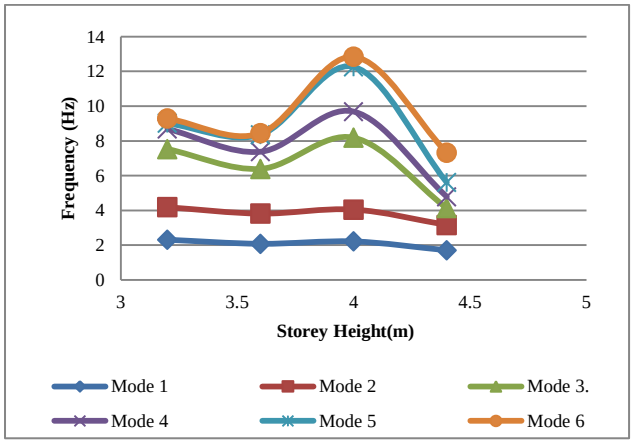
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx460mm and Wall Thickness 0.61m)



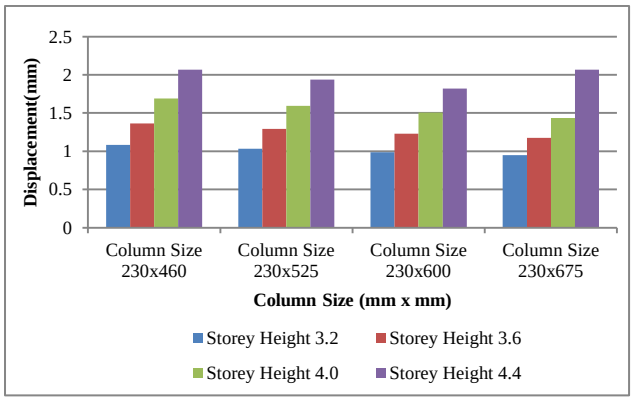
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx525mm and Wall Thickness 0.61m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx600mm and Wall Thickness 0.61m)

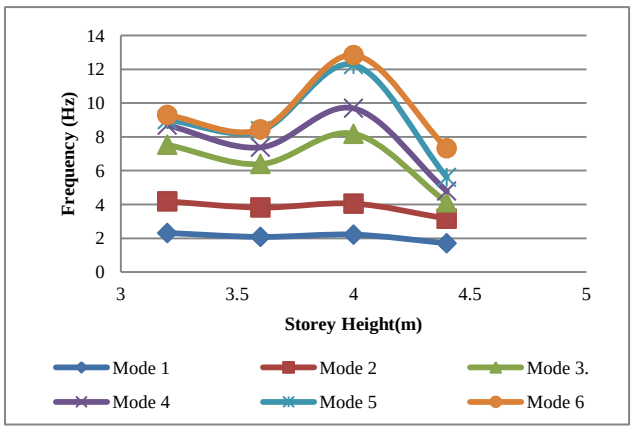


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx525mm, Column Size 230mmx675mm and Wall Thickness 0.61m)

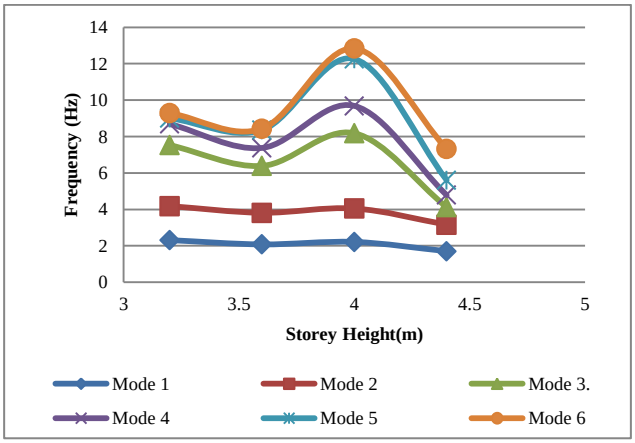


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

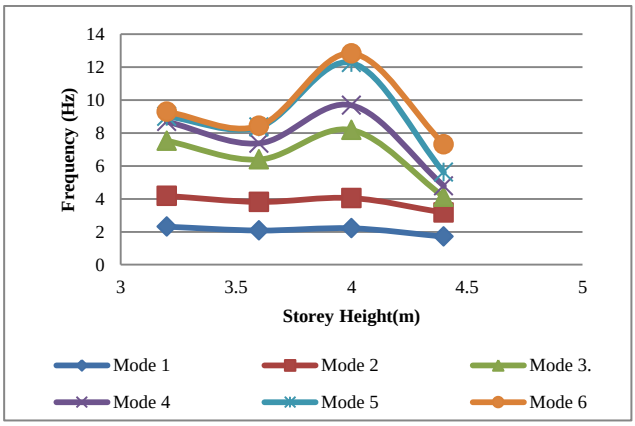
Fig.19 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 525 mm and Wall Thickness 0.61 m)



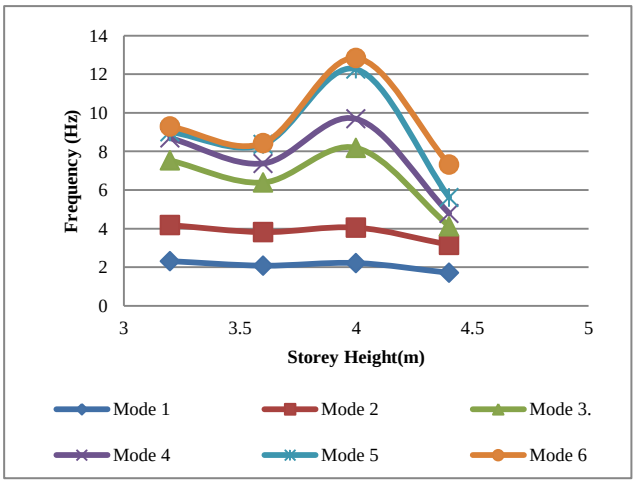
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx460mm and Wall Thickness 0.61m)



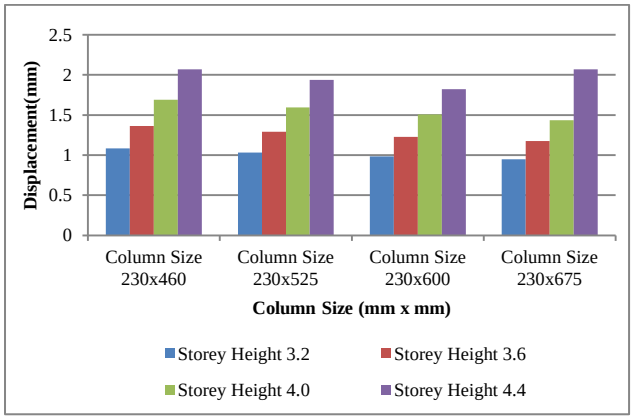
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx525mm and Wall Thickness 0.61m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx600mm and Wall Thickness 0.61m)

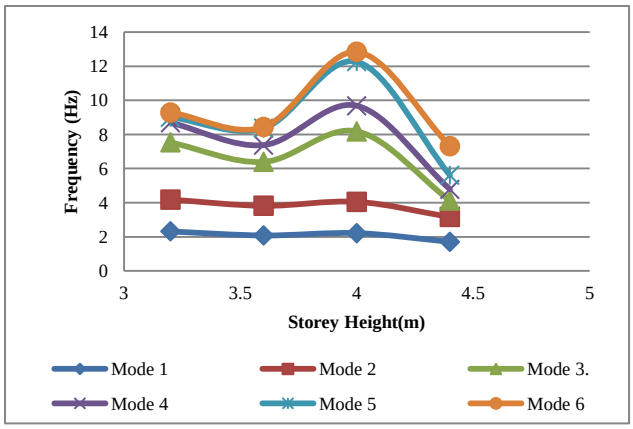


(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx600mm, Column Size 230mmx675mm and Wall Thickness 0.61m)

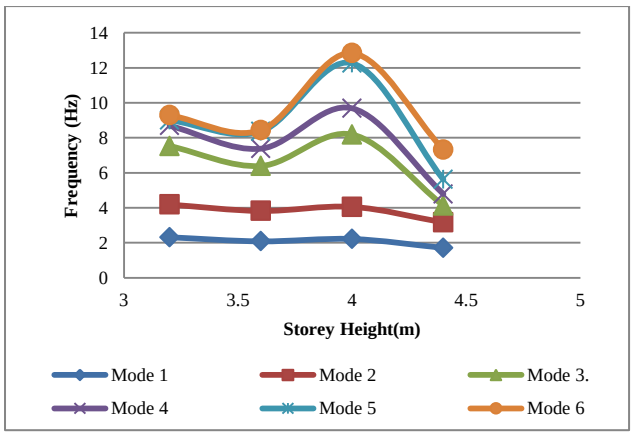


(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

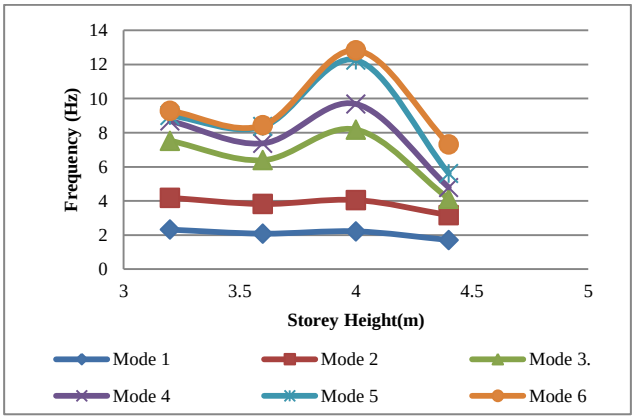
Fig.20 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 600 mm and Wall Thickness 0.61 m)



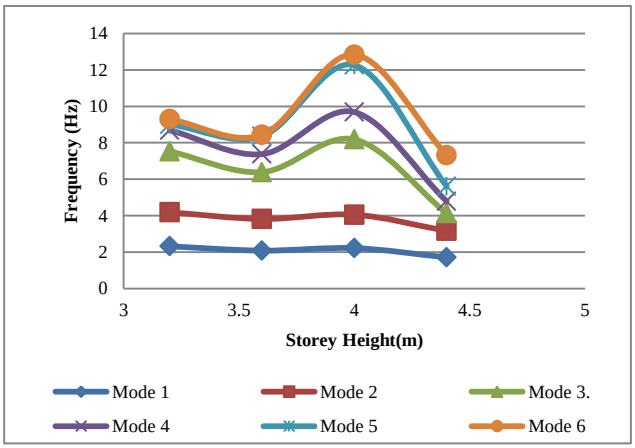
(A) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx460mm and Wall Thickness 0.61m)



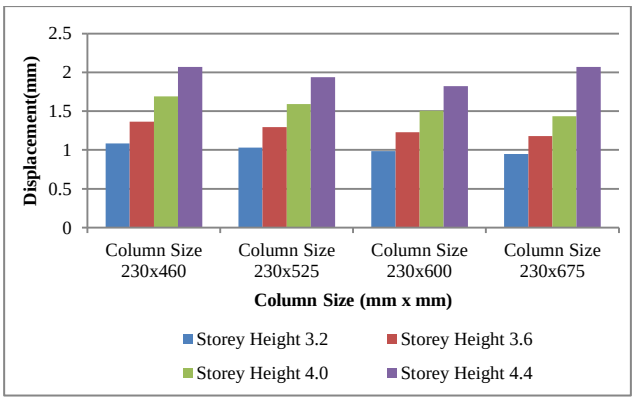
(B) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx525mm and Wall Thickness 0.61m)



(C) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx600mm and Wall Thickness 0.61m)



(D) Effect of Column Size and Storey Height on Horizontal Frequency in X-Direction (For Beam Size 230mmx675mm, Column Size 230mmx675mm and Wall Thickness 0.61m)



(E) Effect of Column Size and Storey Height on Horizontal Displacement in X-Direction

Fig.21 Effect of Column Size and Storey Height on Horizontal Frequency and Displacement in X-Direction (For Beam Size 230 mm x 675 mm and Wall Thickness 0.61 m)

6. Conclusions

The conclusion of the thesis includes Study on Performance Evaluation of Structure subjected to Dynamic Loading and Study of Dynamic Performance of the Industrial Building. This section includes the effect of horizontal frequency and displacement on the looms factory building for varying Beam Size, Column Size and Storey Heights. The study is carried out for Ground+ One Storey and conclusions are extracted from the graphical results.

For a particular beam size, column size and floor height frequency of the structure increases with the increase in wall thickness. For example, from Tables 3, for beam and column size both 230 mmx460 mm 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 0.23 m to 0.61 m. The reason behind this behavior 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.

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 m are not suitable for floor heights other than 3.6 m and 4.4 m.

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 from the fig 6 to fig 21.

From the Table 3 and Table 4, it is also 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.

It can be seen from the table 3, the column size is not making much difference. This is because the structure considered in our study is a composite structure. Therefore, change in column size will have negligible effect whereas the change in wall thickness will affect the structure more.

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.

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.

With the increasing wall thickness, the displacement of the structure is reducing in X- direction for any size of beam, column and floor height. Due to increase in thickness of the wall, it increases the stiffness of the structure and hence, displacement is reducing.

The graphs corresponding to various tables clearly help to visualize the results.

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