International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 7, November-December 2022 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Sesimic Analysis of Multistorey Building Having a Floating Column and Shear Wall with an Introduction to Flat Slab

Mridul Shukla[1], Prof. Afzal Khan[2]

[1]Student, [2]Assistant Professor,
[1,2]Department of Civil Engineering, Millennium Institute of Technology, Bhopal, Madhya Pradesh, India

ABSTRACT

Seismic behavior of multistoried building or high-rise structures having various types of structural elements which make structure more vulnerable is peculiar for mankind and disturbing because of erratic nature of volcanic activity. This underground eruption does not only destroy properties which induce economical loss but also affect human life due to immersive loss of individual soul. As per today's situation more open space and additional clear space in stature is attaining importance. More open space is gaining importance to serve parking area in basement, for marriage hall or exhibition hall, shopping complex and much more. Similarly appealing architecture is also in demand for ever in architectural history so increasing headroom by removing beam is a way to accomplish the objective. These necessities is accomplished by adding various structural elements as stated in the introduction viz floating column for open space and flat slab for increasing headroom. With the addition of these elements structure is more prone to volcanic eruptions so it is needed to add some structural element that can adhere the resulting lateral forces i.e., shear wall to resist lateral load resisting system. After analyzing it had been concluded that extensive research is performed on these types of situations with numerous structural practices and methodologies adopted so far to neutralize the seismic effect as much as possible. To analyze the aforesaid problem statement various configuration are modeled and analyzed which is amalgamation of all three structural elements in different combination. To accomplish the objective a G+10 storied multistory building is framed and analyzed against various seismic and non-seismic parameters. Various 11 storied models are framed with a combination of three structural elements in which all models have one common element i.e., floating column. So, the models configured in various amalgamations are simple RCC building, building with only floating column, building with floating column and flat slab, building with floating column and shear wall and a combination of all comprising RCC building with floating column, shear wall and flat slab. It has been concluded from investigation that Case D is found most optimum which makes it possible to add structural element viz floating column for more space, flat slab to increasing headroom with the help lateral load resisting system i.e., shear wall to a particular extent within safer limits.

***How to cite this paper**:* Mridul Shukla | Prof. Afzal Khan "Sesimic Analysis of Multistorey Building Having a Floating Column and Shear Wall with an Introduction to Flat Slab" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-7, December 2022, pp.129-158, URL: www.ijtsrd.com/papers/ijtsrd52286.pdf

IJTSRD52286

KEYWORDS: *Shear Wall, Flat Slab, Floating Column, Seismic Behavior, Multistoried Building*

INTRODUCTION

Seismic activities are natural menaces or oftenly told a disaster in which cataclysms are shown in terms of destruction or collapse of habitat which results in loss of humankind. To overawe these kinds of circumstances seismic analysis is performed prior to every construction whose objective states that the structure should be able to bear without sustaining any damage minor shaking intensity so that even after seismic activity structure is serviceable. Seismic forces generate lateral forces which induces critical stresses in a structure which in turns induce lateral sway in the structure. Now a day's concept of building on stilts or open ground story building is in trend because of requirement of more open space in ground story for parking, reception multipurpose hall, supermarkets etc. The strength demand on the column in the first storey for these building is large, upper stories move almost together as a single block and most of the horizontal displacement of the building occurs in the soft ground storey.

Generally reinforced concrete buildings are self-suffice to carry both lateral and longitudinal force. But if we talk about multistorey high rise building or specific shaped building to carry seismic loads for higher seismic zones certain lateral load resisting system is required. There are various structural arrangements have been developed so far to resist seismic action, some of them are shear wall, bracings, outrigger also known as shear wall belt system, framed tube, diagrid system etc. These structural arrangements will help in construction of complex structures, skyscrapers and different complex arrangements to facilitate a variety of architectural concept. These, lateral load resisting system will help in making structures safer against all odds which is our prime concern along with maintaining the economy of the project.

Along with structural feasibility, strength, economy and space management another thing comes into existence is aesthetics of the structure. This will add another challenge to make the structure more striking which is somehow made possible by introducing flat slab. These structural elements will help in removing beams from our framed structure. As beam cause hindrance in space management in terms of interior and they do does not seems enhanced and so diminishing the aesthetics of structure.

METHODOLOGY

Research methodology is an approaching technique of practical implementation in which research study is to be carried out along with different sorting technique and requisite procedure that is to be required for investigative study. Technically methodology is the scientific method that is used to justify any subject taken for research with the help of various techniques which encompasses identification, selection, process used and analyzing information about selected subject. The investigation performed in any research work is always accompanied by the fact that the comparative analysis of previous circumstances in any research and so by getting the novel outcomes changes it accordingly.

Modeling approach suggest the models framed as per decided by the methodologies adopted in such a way when certain models changes in input parameter the so cause results are also altered and so different method is adopted to overcome the situation and for this new method new models are framed. Theoretically a model should encompass following key point:

1. Main theories that are adopted in research,
2. Concepts needed to be explored in research,
3. Interaction between concepts and adopted theories.

Seismic behaviour of multistoried building or high-rise structures having various types of structural elements which make structure more vulnerable is peculiar for mankind and disturbing because of erratic nature of volcanic activity. This underground eruption does not only destroy properties which induce economical loss but also affect human life due to immersive loss of individual soul. As per today's situation more open space and additional clear space in stature is attaining importance. More open space is gaining importance to serve parking area in basement, for marriage hall or exhibition hall, shopping complex and much more. Similarly appealing architecture is also in demand for ever in architectural history so increasing headroom by removing beam is a way to accomplish the objective.

These necessities is accomplished by adding various structural elements as stated in the introduction viz floating column for open space and flat slab for increasing headroom. With the addition of these elements structure is more prone to volcanic eruptions so it is needed to add some structural element that can adhere the resulting lateral forces i.e. shear wall to resist lateral load resisting system. Above necessities is achieved by studying and analyzing various research paper related to aforementioned necessities in which some technical and theoretical references. After analyzing it had been concluded that an extensive research is performed on these types of situations with numerous structural practices and methodologies adopted so far to neutralize the seismic effect as much as possible. Although the combined analysis was not performed so far for high rise building having floating column, flat slab and shear wall all at a time. As a final point it was concluded that the behaviour of high rise structure is to be explored due to seismic action induced by adding floating column, flat slab and to reduce seismic action shear wall is added in the analysis. Next to identifying the problem statement in the concept, counterbalance the problem to eradicate the seismic excitation and stabilize their effect.

Modeling Approach

Modeling approach in structure design and modeling is an analysis model and technique to investigate and evaluate the association between various seismic and non-seismic parameters used in the investigation. This theory represents the relationship between various models and construct. Modeling approach implemented in the methodology form the basis of structural analysis to obtain obligatory outcomes. In this arena precise modeling is the first initiative in structural analysis, examination, comparison and design of all the models in which selection of modeling approach and analysis tool depends on certain factors. These factors comprise of purpose and objective of structural analysis, feasibility and significance of structure and preciseness level required and obtained in the study.

There are various seismic method of analysis suggested by IS code in order to determine the behaviour of building against seismic excitation and also for retrofitting of structure. These earthquake forces are dynamic in nature and these forces are analyzed several parameters viz. load carrying capacity, ductility, dampness, stiffness and mass. Following are the types of seismic method of analysis:

1. Equivalent Static Analysis
2. Response Spectrum method of Analysis
3. Linear Dynamic Analysis
4. Non-Linear Static Analysis
5. Non-Linear Dynamic Analysis

For structures lying in lower earthquake zones and with low stature, 'seismic coefficient method' is suggested on the contrary for higher seismic zones with greater height time history method of analysis or response spectrum method of analysis is suggested. Also the revisions made by Indian Code which mandate time history method and response spectrum method of analysis accordingly.

1. CALCULATIONS AND RESULTS

1.1. Result Parameters

All the four modelled configurations are analyzed and examined on software and the outcomes so obtained is presented in charts and tabular form to provide a justified support for each case against various seismic and non-seismic parameters by dynamic method of analysis.

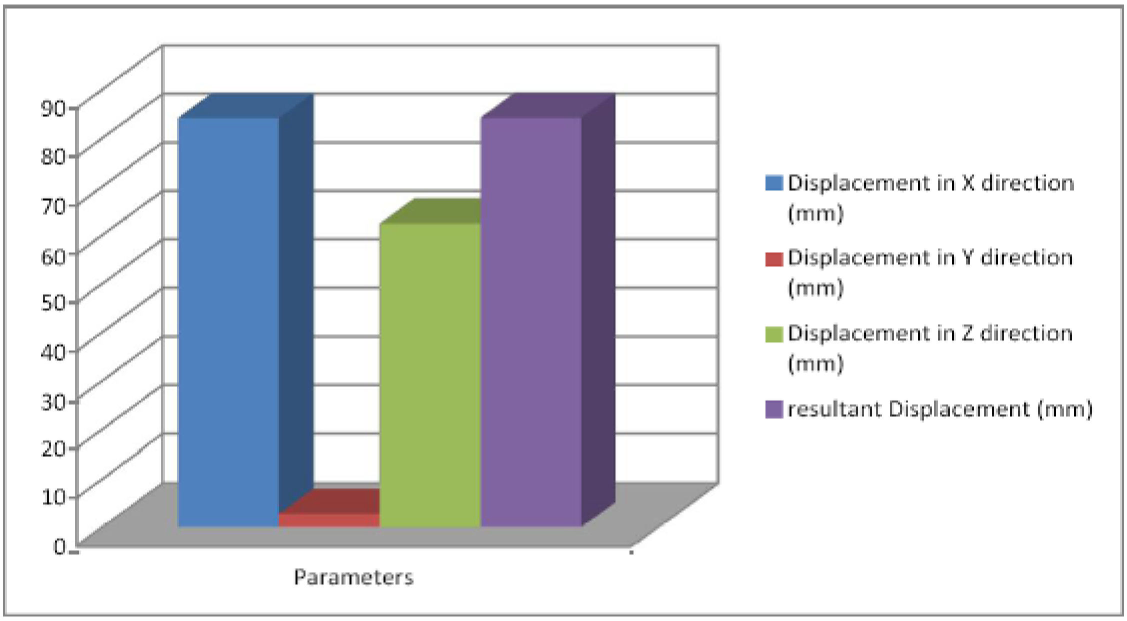
Various cases are modelled, studied, examined and compared for numerous parameters considered for investigation of the study. For comparative investigation result for parameters like shear force and bending moment are presented in all the three mutually perpendicular directions. Similarly nodal displacement, axial force, and torsional moments are shown in tabular as well as graphical form for a maximum value in each direction. Another variable is story drift whose values are recorded at each story and the best is found from those values. The seismic parameters modal participation factor, direct stress, bending stress, membrane stress frequency and time period for various modes for each case are observed and compared for best possible results.

1.1.1. Result Parameters for case 1

1.1.1.1. Displacement:

Table 1.1 Displacement graph for case 1

Maximum Nodal Displacement values				
Case1	In X direction (mm)	In Y direction (mm)	In Z direction (mm)	Resultant value (mm)
	84.117	2.829	62.362	84.165



Graph 1.1 Displacement graph for case 1

1.1.1.2. Axial force:

Table 1.2 Axial force for case 1

Beam no	Load combination	Axial force (kN)
1388	1.5DL + 1.5LL	7049.379

1.1.1.3. Torsional Moment:

Table 1.3 Torsional moment for case 1

Load combination	Torsional Moment (kNm)
1.5DL + 1.5LL	4.507

1.1.1.4. Shear force:

Table 1.4 Shear force for X-directional beams in case 1

Shear force values

	Fy (kN)	Fz (kN)
For X direction beam	205.333	0.847

Graph 1.2 Shear force graph in X-direction beams in case 1

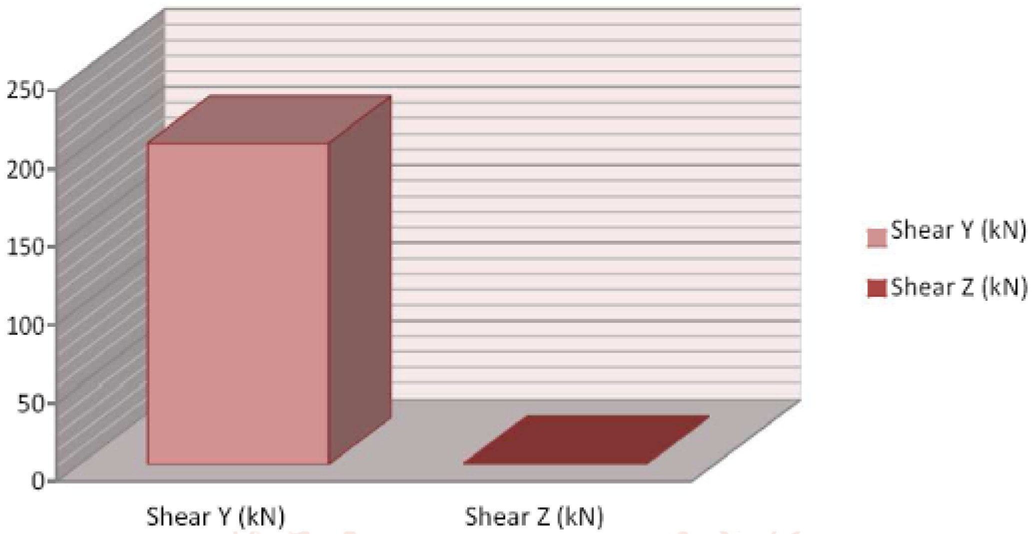
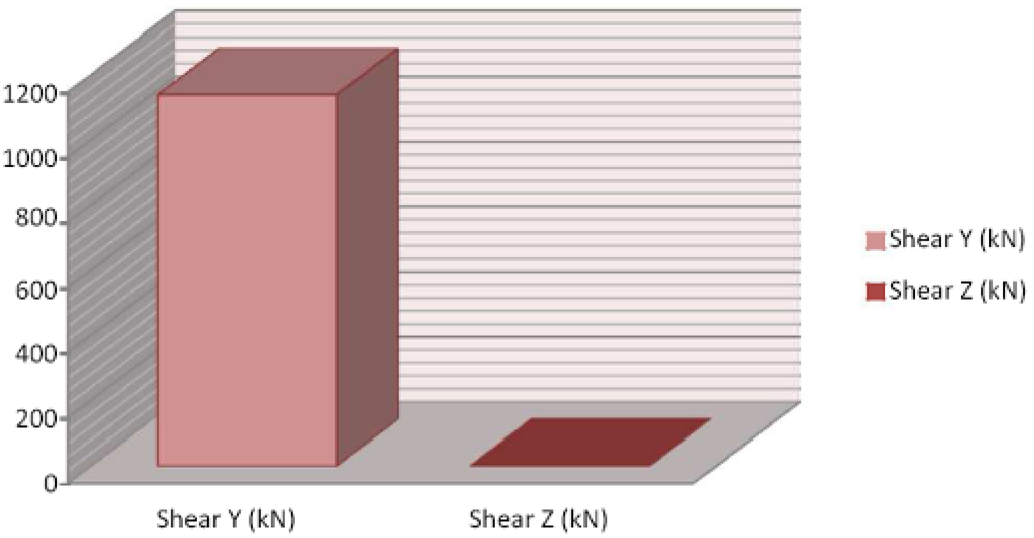


Table 1.5 Shear force in Z-direction beams in case 1

Shear force values

	Fy (kN)	Fz (kN)
For Z direction beam	195.878	1.19

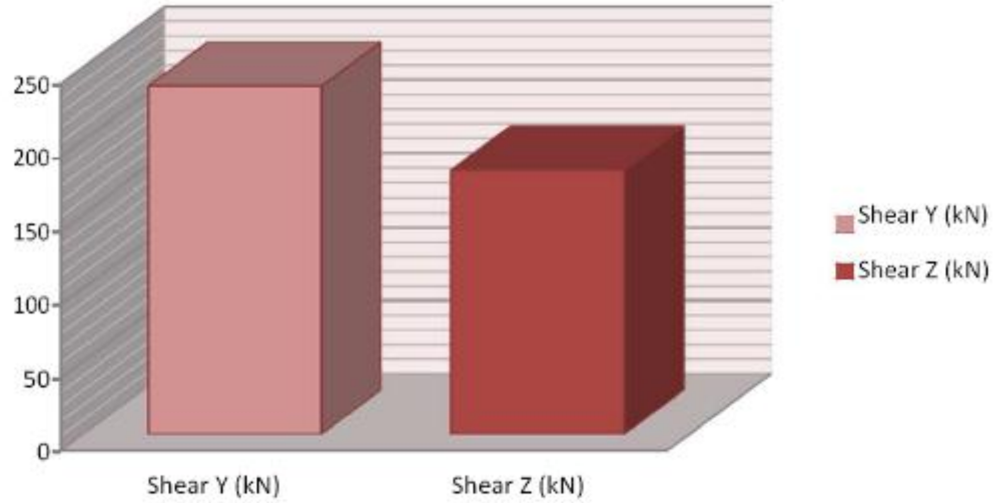


Graph 1.3 Shear force graph in Z-direction beams in case 1

Table 1.6 Shear force in column in case 1

Shear force values

	Fy (kN)	Fz (kN)
For column	236.781	179.53



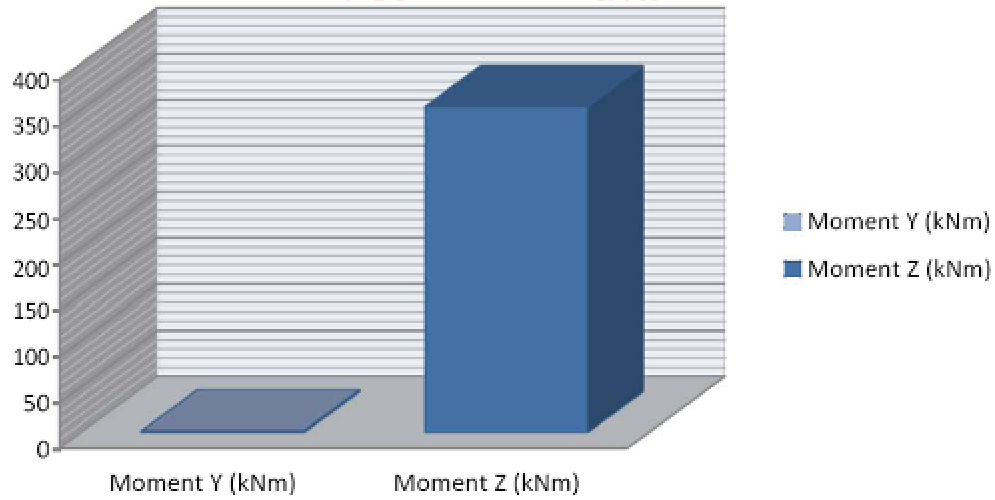
Graph 1.4 Shear force graph for column in case 1

1.1.1.5. Bending moment:

Table 1.7 Bending moment in X-direction beams in case 1

Bending moment values

	My (kNm)	Mz (kNm)
For X direction beam	2.118	353.767

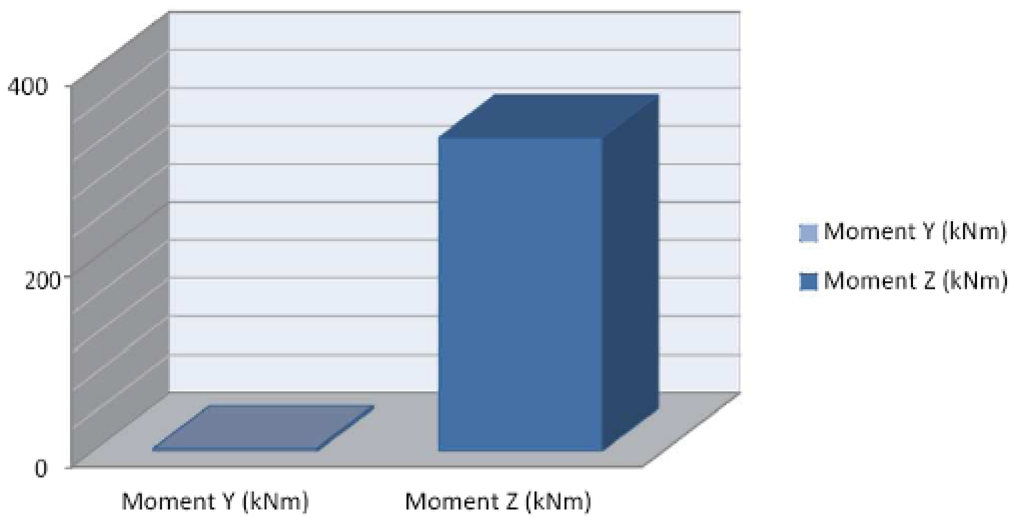


Graph 1.5 Bending moment graph in X-direction beams in case 1

Table 1.8 Bending moment in Z-direction beams in case 1

Bending moment values

	My (kNm)	Mz (kNm)
For Z direction beam	3.000	329.030

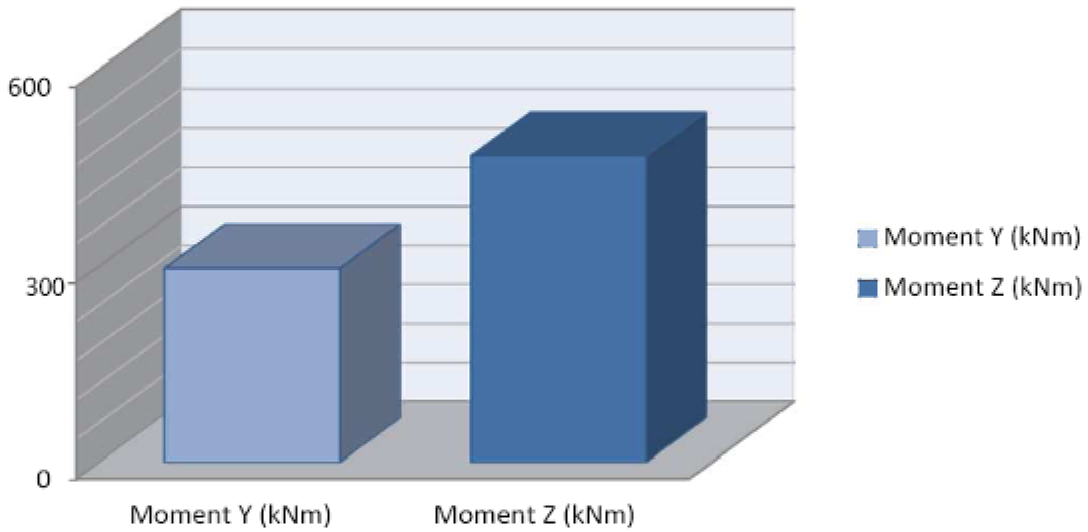


Graph 1.6 Bending moment graph in Z-direction beams in case 1

Table 1.9 Bending moment in column in case 1

Bending moment values

	My (kNm)	Mz (kNm)	
For column	297.064	469.277	

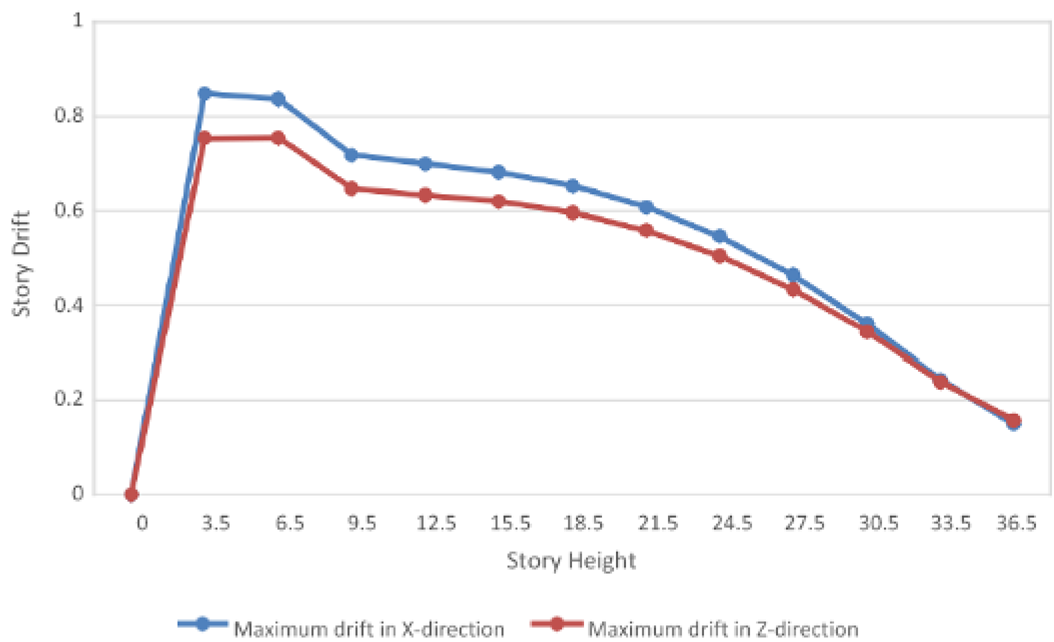


Graph 1.7 Bending moment graph for column in case 1

1.1.1.6. Story Drift:

Table 1.10 Story drift in X and Z-direction for case 1

Height of building	Story drift values(cms)	
	Maximum drift in X- direction	Maximum drift in Z- direction
0	0	0
3.5	0.8479	0.7534
6.5	0.8365	0.7541
9.5	0.7171	0.6463
12.5	0.6989	0.6325
15.5	0.6812	0.6194
18.5	0.6517	0.5954
21.5	0.6071	0.5577
27.5	0.4632	0.4324
30.5	0.3601	0.3417
33.5	0.2420	0.2378
36.5	0.1500	0.1567

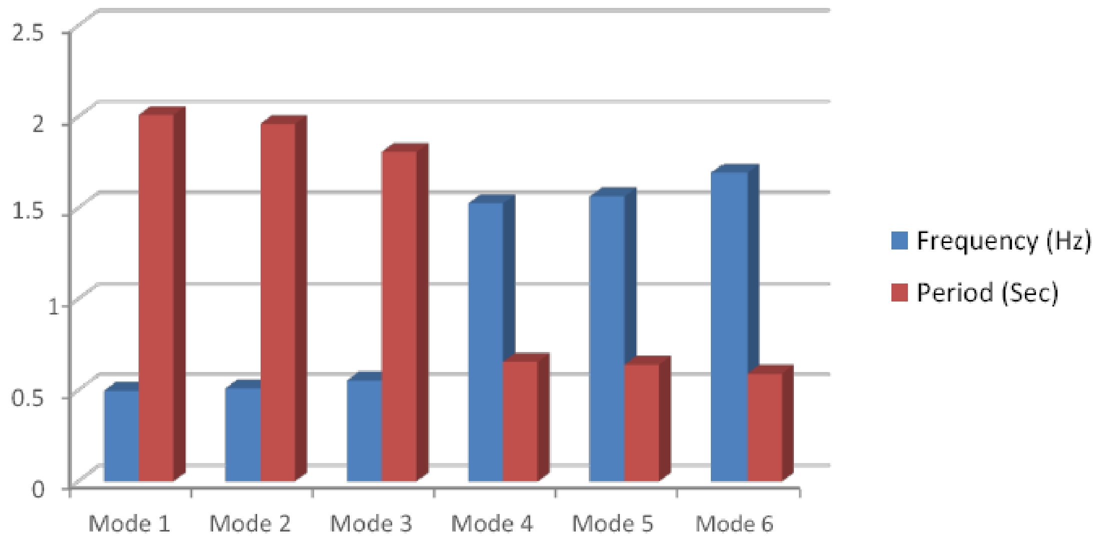


Graph 1.8 Story drift in X and Z-direction for case 1

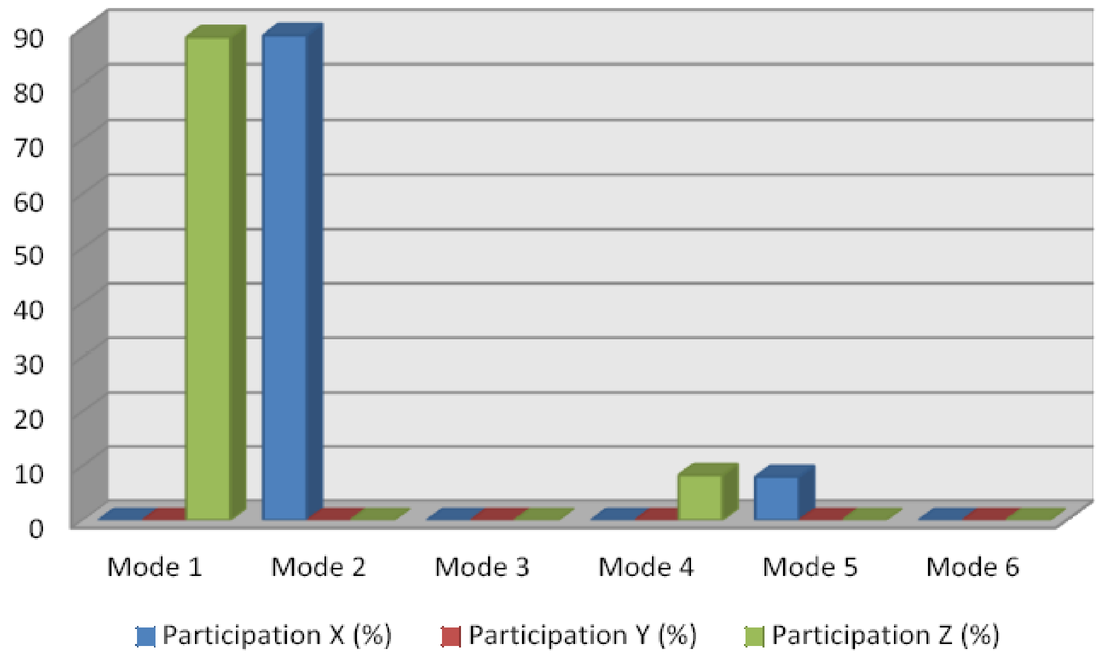
1.1.1.7. Modal Participation Factor, Frequency and Time Period:

Table 1.11 Mode participation factor, frequency and period for various modes for case 1

Mode	Frequency (Hz)	Time Period (seconds)	Participation X (%)	Participation Y (%)	Participation Z (%)
1	0.497	2.01008	0	0	88.51
2	0.510	1.95907	88.86	0	0
3	0.553	1.80673	0	0	0
4	1.525	0.65562	0	0	8.32
5	1.564	0.63958	7.98	0	0
6	1.693	0.59065	0	0	0



Graph 1.9 Graph showing frequency & period for various modes for case 1



Graph 1.10 Graph showing mode participation factor for various modes for case 1

1.1.1.8. Shear Stress:

Table 1.12 Shear stress values for case 1

Case	SQX (N/mm2)	SQY (N/mm2)
A	0.096	0.07

1.1.1.9. Membrane Stress:

Table 1.13 Membrane stress values for case 1

Case	SX (N/mm2)	SY (N/mm2)	SXY (N/mm2)
A	0.203	0.2	0.029

Table 1.14 Bending stress values for case 1

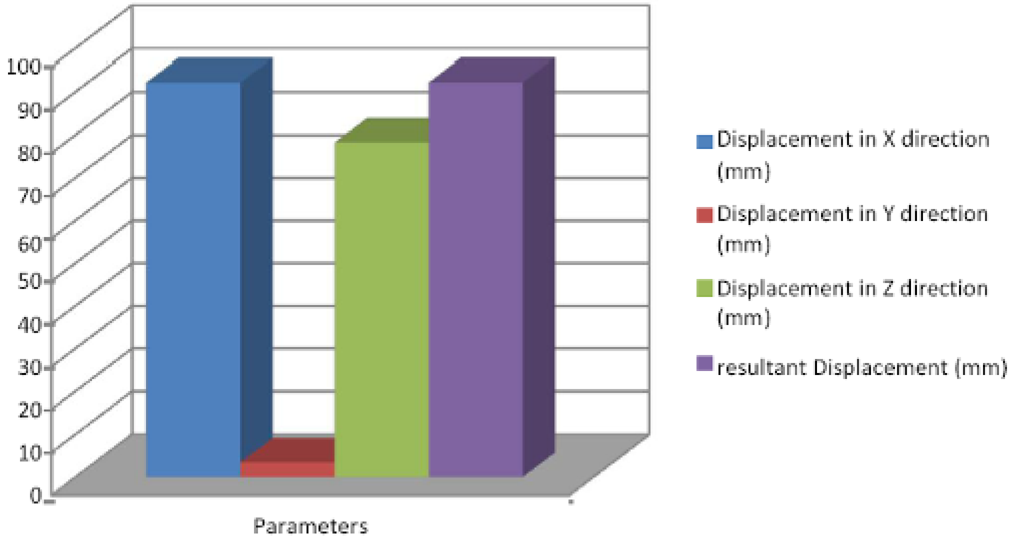
Case	MX (kN-m/m)	MY (kN-m/m)	MXY (kN-m/m)
A	2.414	2.4	2.032

1.1.2. Result Parameters for case 2

1.1.2.1. Displacement:

Table 1.15 Displacement graph for case 2

	Maximum Nodal Displacement values			
	In X direction (mm)	In Y direction (mm)	In Z direction (mm)	Resultant value (mm)
Case 2	92.104	3.449	78.204	92.14



Graph 1.11 Displacement graph for case 2

1.1.2.2. Axial force:

Table 1.16 Axial force for case 2

Beam no	Load combination	Axial force (kN)
35	1.5DL + 1.5LL	13227.794

1.1.2.3. Torsional Moment:

Table 1.17 Torsional moment for case 2

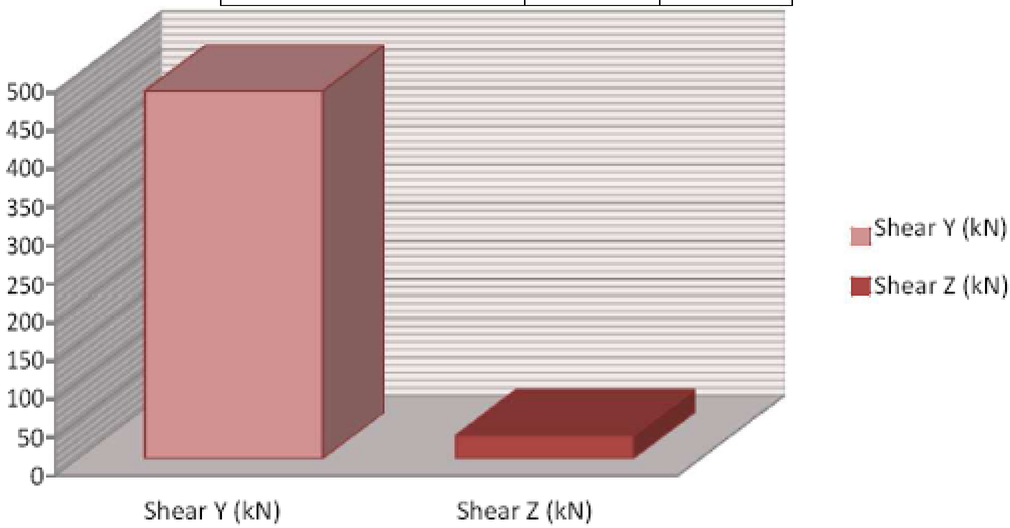
Load combination	Torsional Moment (kNm)
1.5 DL + 1.5 EQ(+Z)	67.12

1.1.2.4. Shear force:

Table 1.18 Shear force for X-directional beams in case 2

Shear force values

	Fy (kN)	Fz (kN)
For X direction beam	478.012	30.345

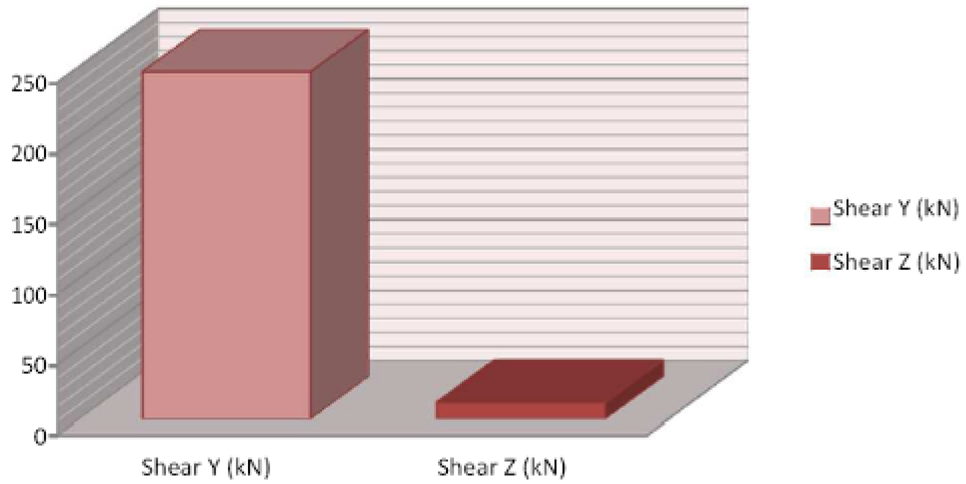


Graph 1.12 Shear force graph in X-direction beams in case 2

Table 1.19 Shear force in Z-direction beams in case 2

Shear force values

	Fy (kN)	Fz (kN)
For Z direction beam	246.264	11.678

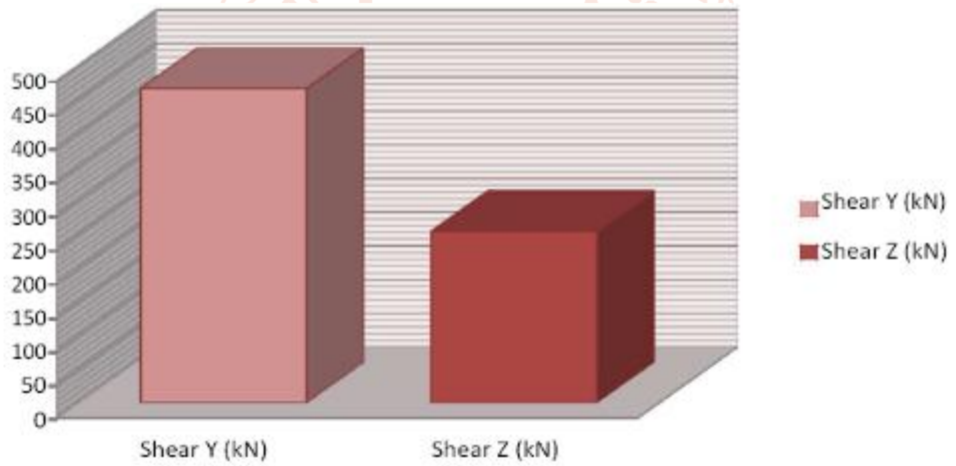


Graph 1.13 Shear force graph in Z-direction beams in case 2

Table 1.20 Shear force in column in case 2

Shear force values

	Fy (kN)	Fz (kN)
For column	465.646	253.809



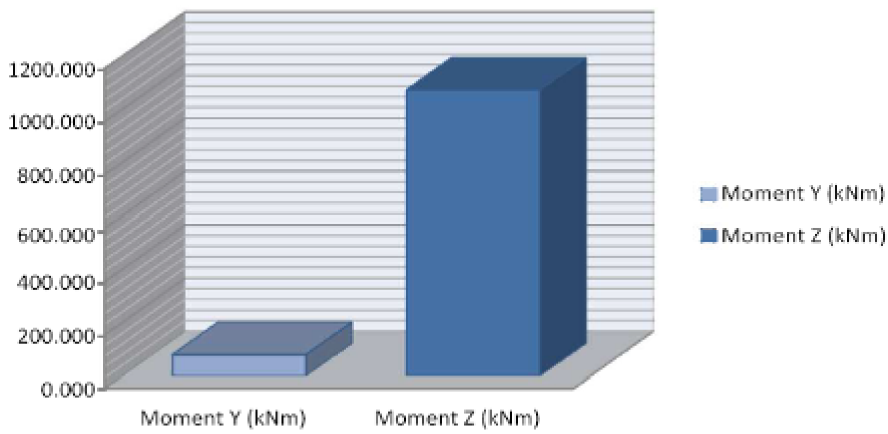
Graph 1.14 Shear force graph for column in case 2

1.1.2.5. Bending moment:

Table 1.21 Bending moment in X-direction beams in case 2

Bending moment values

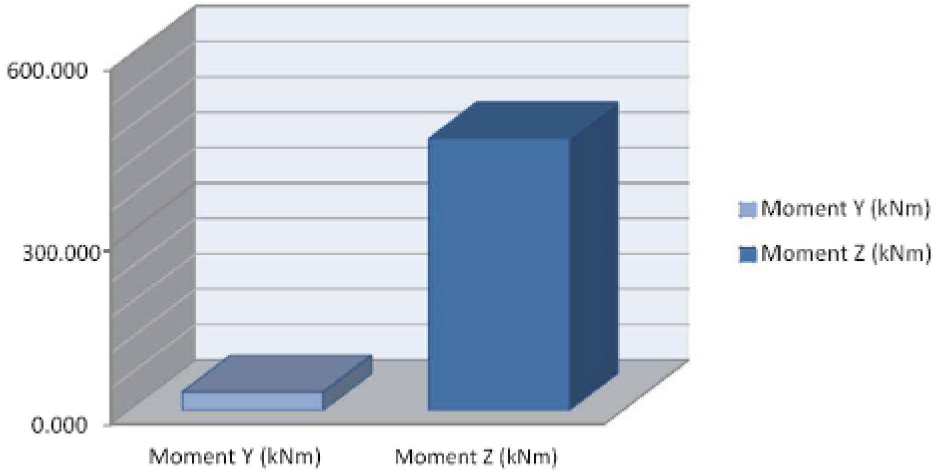
	My (kNm)	Mz (kNm)
For X direction beam	79.000	1073.615



Graph 1.15 Bending moment graph in X-direction beams in case 2

Table 1.22 Bending moment in Z-direction beams in case 2

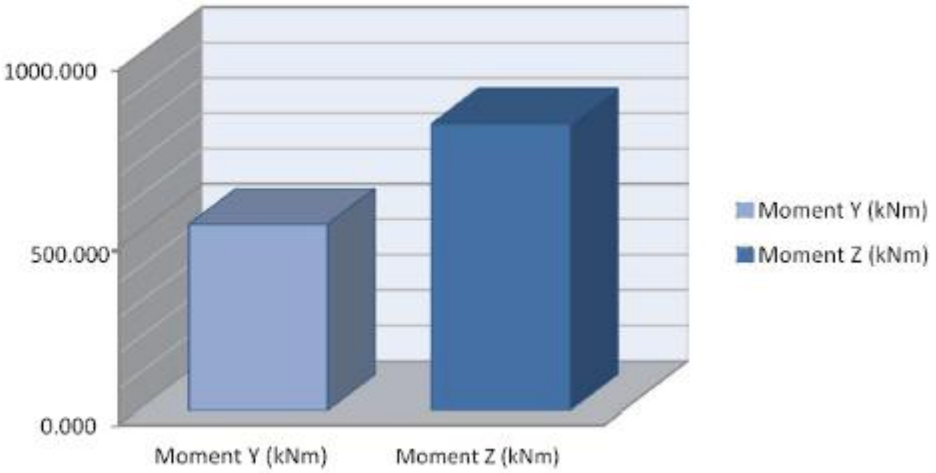
	Bending moment values	
	My (kNm)	Mz (kNm)
For Z direction beam	30.942	460.859



Graph 1.16 Bending moment graph in Z-direction beams in case 2

Table 1.23 Bending moment in column in case 2

	Bending moment values	
	My (kNm)	Mz (kNm)
For column	525.039	809.007

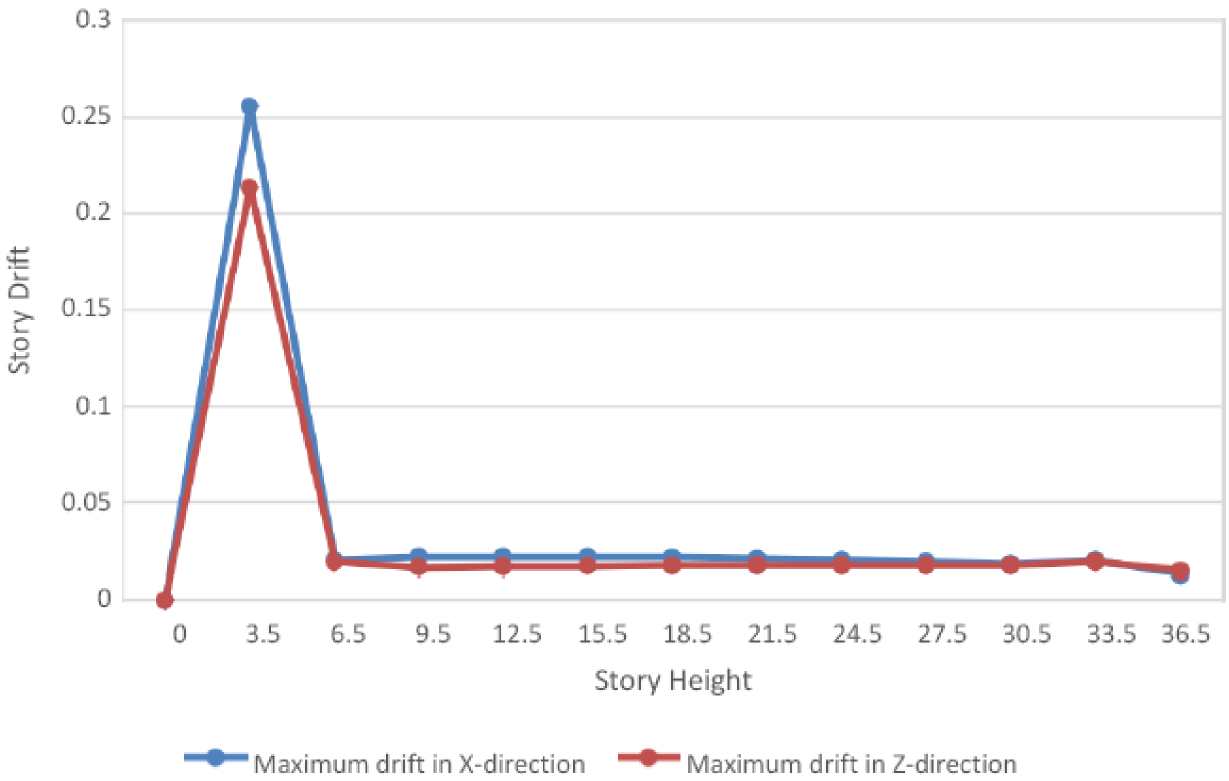


Graph 1.17 Bending moment graph for column in case 2

1.1.2.6. Story Drift:

Table 1.24 Story drift in X and Z-direction for case 2

Height of building	Story drift values(cms)	
	Maximum drift in X- direction	Maximum drift in Z- direction
0	0	0
3.5	1.6474	1.3406
6.5	1.3440	1.0998
9.5	0.7354	0.7203
12.5	0.6955	0.6986
15.5	0.6782	0.6845
18.5	0.6487	0.6597
21.5	0.6046	0.6214
24.5	0.5430	0.5673
27.5	0.4617	0.4956
30.5	0.3591	0.4050
33.5	0.2417	0.3013
36.5	0.1500	0.2209

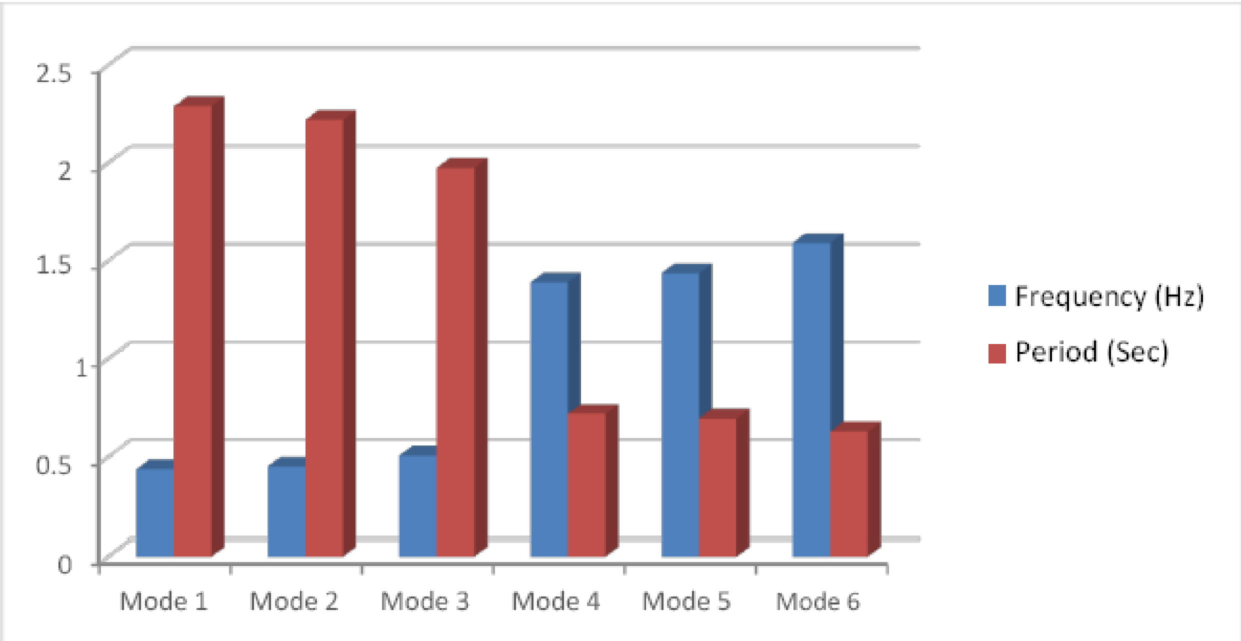


Graph 1.18 Story drift in X and Z-direction for case 2

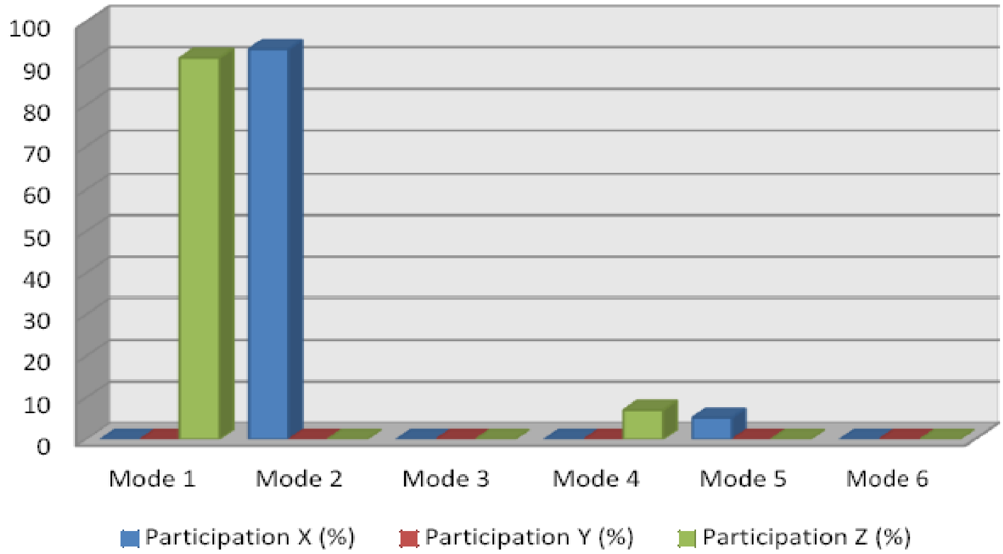
1.1.2.7. Modal Participation Factor, Frequency and Time Period:

Table 1.25 Mode participation factor, frequency and period for various modes for case 2

Mode	Frequency (Hz)	Time Period (seconds)	Participation X (%)	Participation Y (%)	Participation Z (%)
1	0.437	2.29038	0	0	91.34
2	0.451	2.21932	93.40	0	0
3	0.506	1.97457	0	0	0
4	1.390	0.71925	0	0	7.02
5	1.437	0.69573	5.17	0	0
6	1.593	0.62785	0	0	0



Graph 1.19 Graph showing frequency & period for various modes for case 2



Graph 1.20 Graph showing mode participation factor for various modes for case 2

1.1.2.8. Shear Stress:

Table 1.26 Shear stress values for case 2

Shear stress values		
Case	SQX (N/mm2)	SQY (N/mm2)
B	0.306	0.079

1.1.2.9. Membrane Stress:

Table 1.27 Membrane stress values for case 2

Membrane stress values			
Case	SX (N/mm2)	SY (N/mm2)	SXY (N/mm2)
B	0.426	0.261	0.164

1.1.2.10. Bending Stress:

Table 1.28 Bending stress values for case 2

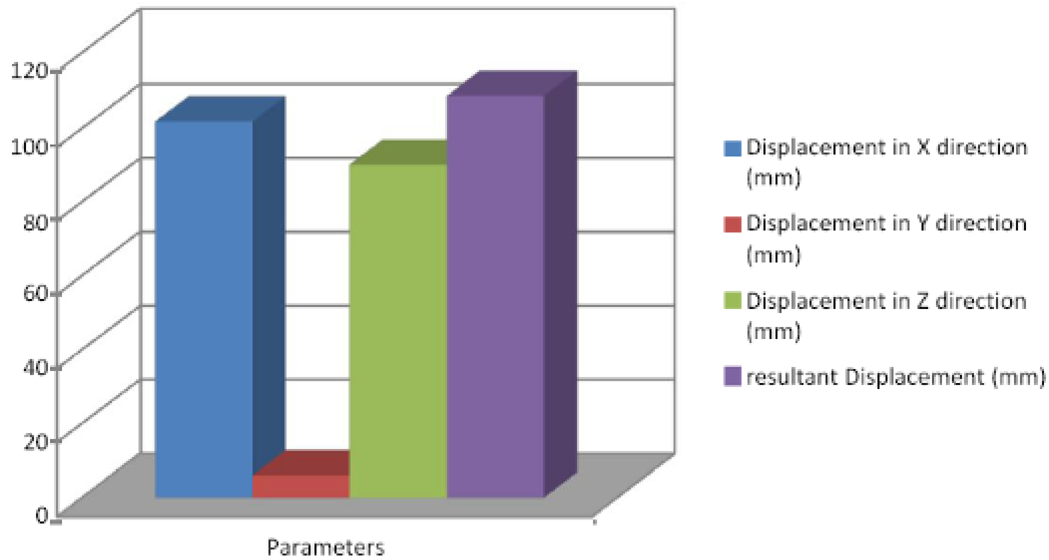
Bending stress values			
Case	MX (kN-m/m)	MY (kN-m/m)	MXY (kN-m/m)
B	13.207	3.189	1.584

1.1.3. Result Parameters for case 3

1.1.3.1. Displacement:

Table 1.29 Displacement graph for case 3

	Maximum Nodal Displacement values			
	In X direction(mm)	In Y direction(mm)	In Z direction(mm)	Resultant value(mm)
Case3	101.876	5.994	90.124	108.77



Graph 1.21 Displacement graph for case 3

1.1.3.2. Axial force:

Table 1.30 Axial force for case 3

Beam no	Load combination	Axial force (kN)
2279	Seismic Load Case	4357.953

1.1.3.3. Torsional Moment:

Table 1.31 Torsional moment for case 3

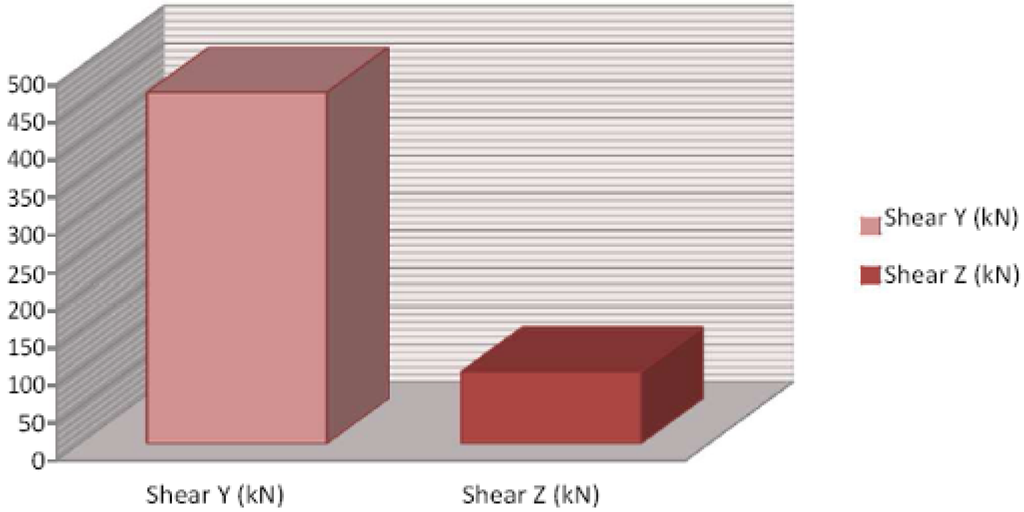
Load combination	Torsional Moment (kNm)
Response Spectrum	602.592

1.1.3.4. Shear force:

Table 1.32 Shear force for X-directional beams in case 3

Shear force values

	Fy (kN)	Fz (kN)
For X direction beam	466.844	96.063

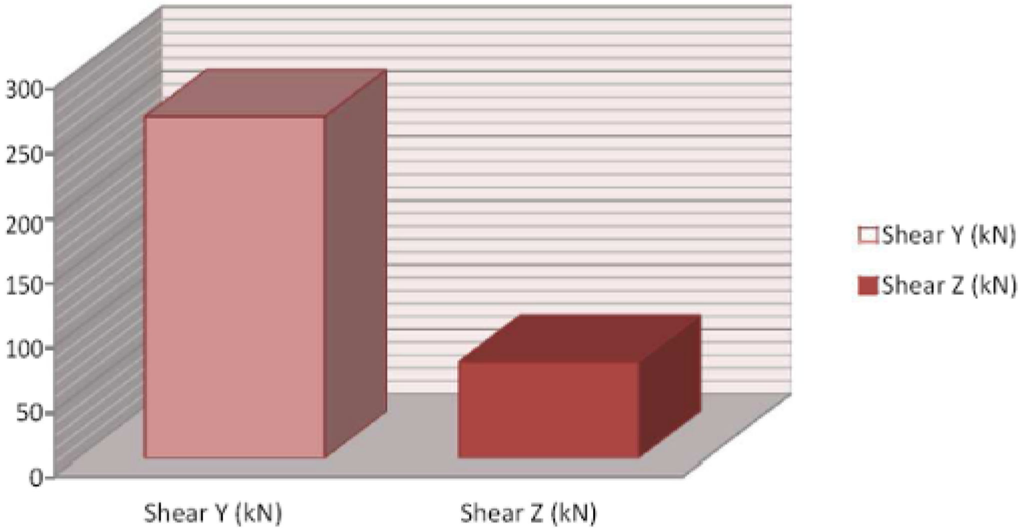


Graph 1.22 Shear force graph in X-direction beams in case 3

Table 1.33 Shear force in Z-direction beams in case 3

Shear force values

	Fy (kN)	Fz (kN)
For Z direction beam	264.367	74.432

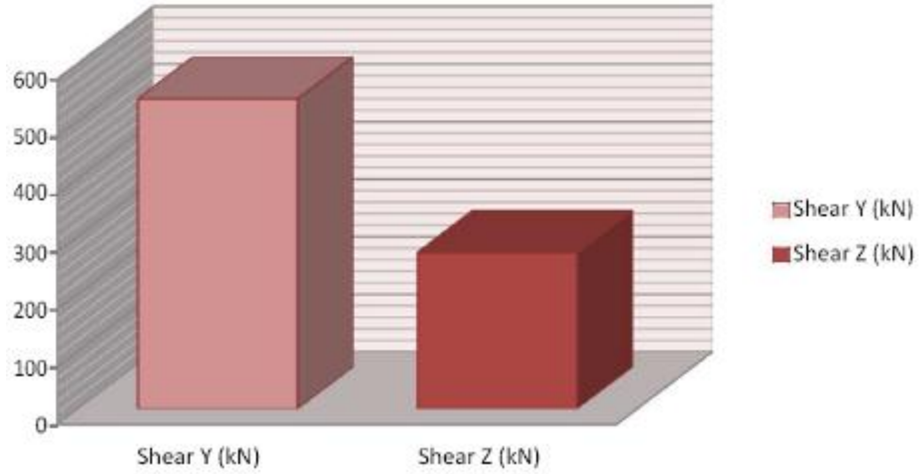


Graph 1.23 Shear force graph in Z-direction beams in case 3

Table 1.34 Shear force in column in case 3

Shear force values

	Fy (kN)	Fz (kN)
For column	538.506	271.447



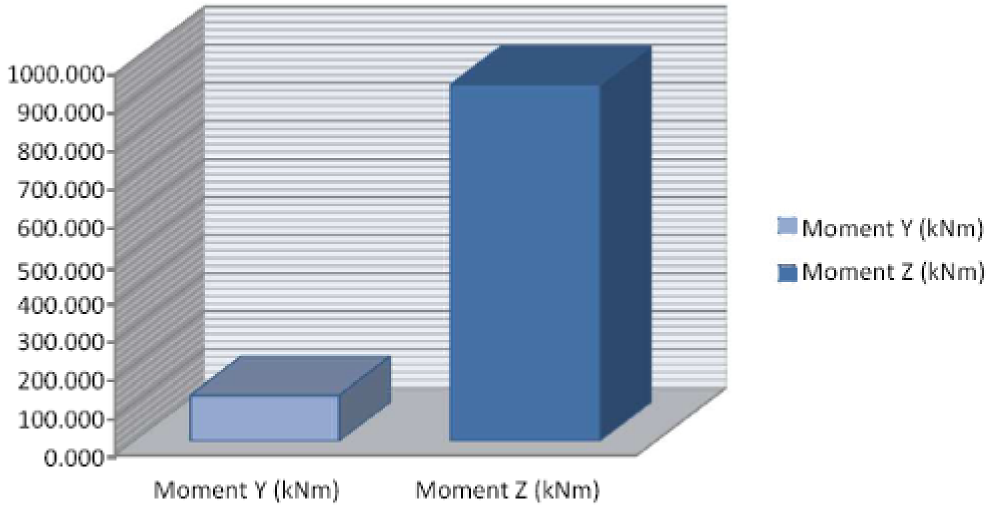
Graph 1.24 Shear force graph for column in case 3

1.1.3.5. Bending moment:

Table 1.35 Bending moment in X-direction beams in case 3

Bending moment values

	My (kNm)	Mz (kNm)
For X direction beam	119.235	934.418

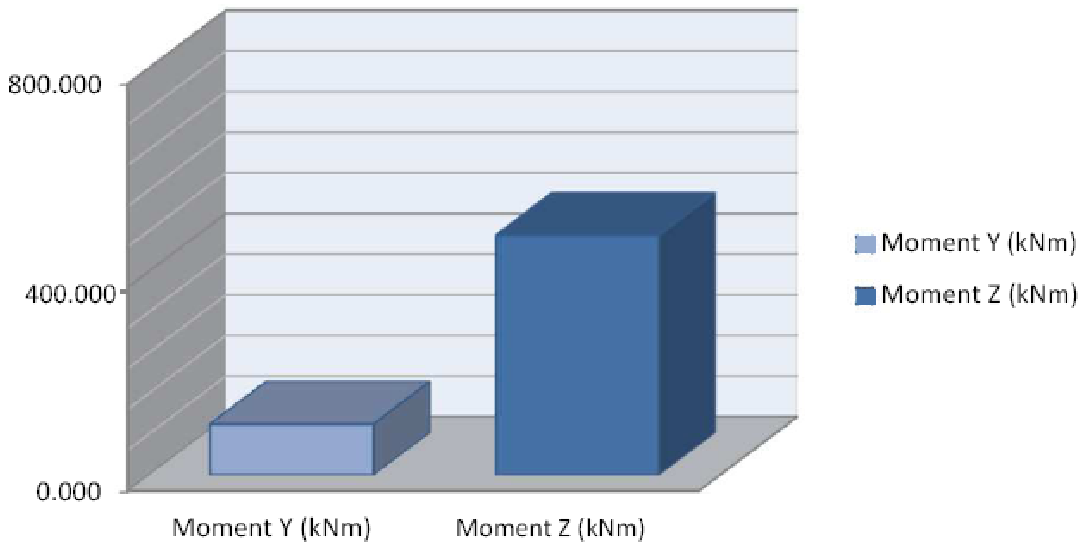


Graph 1.25 Bending moment graph in X-direction beams in case 3

Table 1.36 Bending moment in Z-direction beams in case 3

Bending moment values

	My (kNm)	Mz (kNm)
For Z direction beam	99.969	471.728

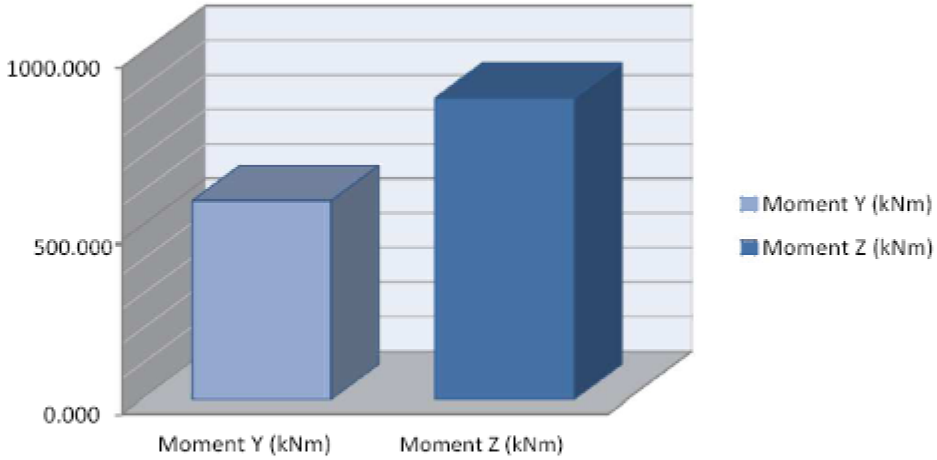


Graph 1.26 Bending moment graph in Z-direction beams in case 3

Table 1.37 Bending moment in column in case 3

Bending moment values

	My (kNm)	Mz (kNm)
For column	575.178	872.655

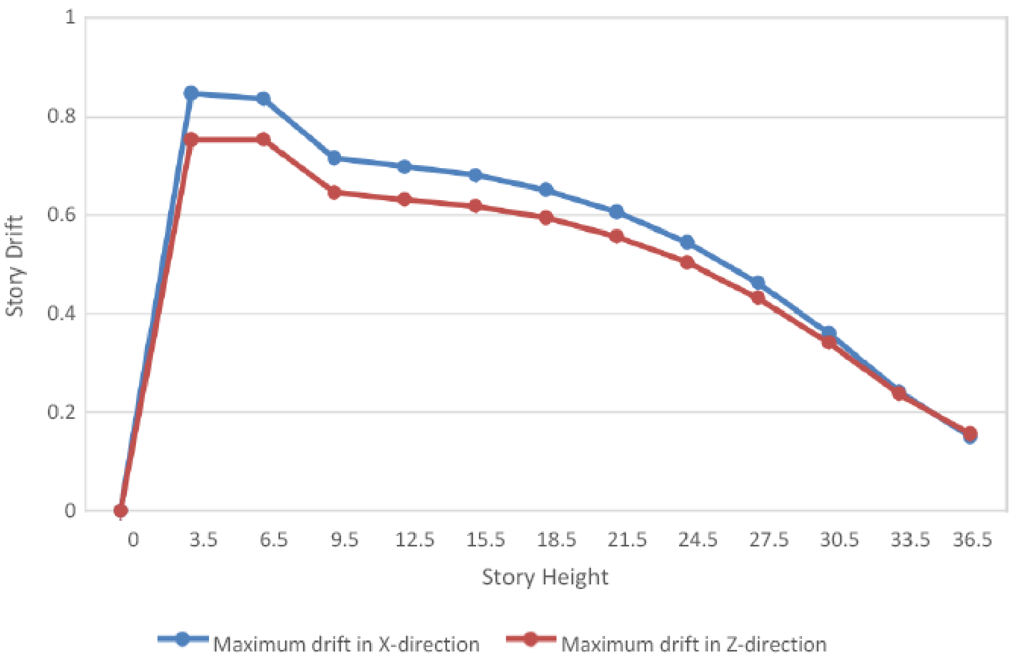


Graph 1.27 Bending moment graph for column in case 3

1.1.3.6. Story Drift:

Table 1.38 Story drift in X and Z-direction for case 3

Height of building	Story drift values(cms)	
	Maximum drift in X- direction	Maximum drift in Z- direction
0	0	0
1.7161	1.441	1.7161
1.3564	1.2647	1.3564
0.6674	0.8563	0.6674
0.6241	0.8103	0.6241
0.6112	0.7939	0.6112
0.5862	0.7655	0.5862
0.5481	0.7221	0.5481
0.4944	0.6612	0.4944
0.4231	0.5805	0.4231
0.3327	0.4788	0.3327
0.2273	0.3628	0.2273
0.1451	0.2708	0.1451

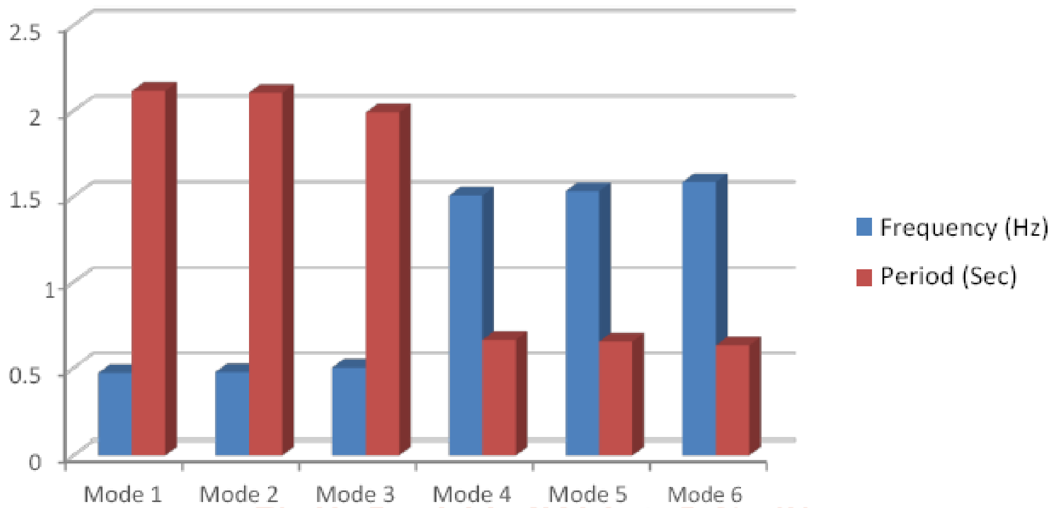


Graph 1.28 Story drift in X and Z-direction for case 3

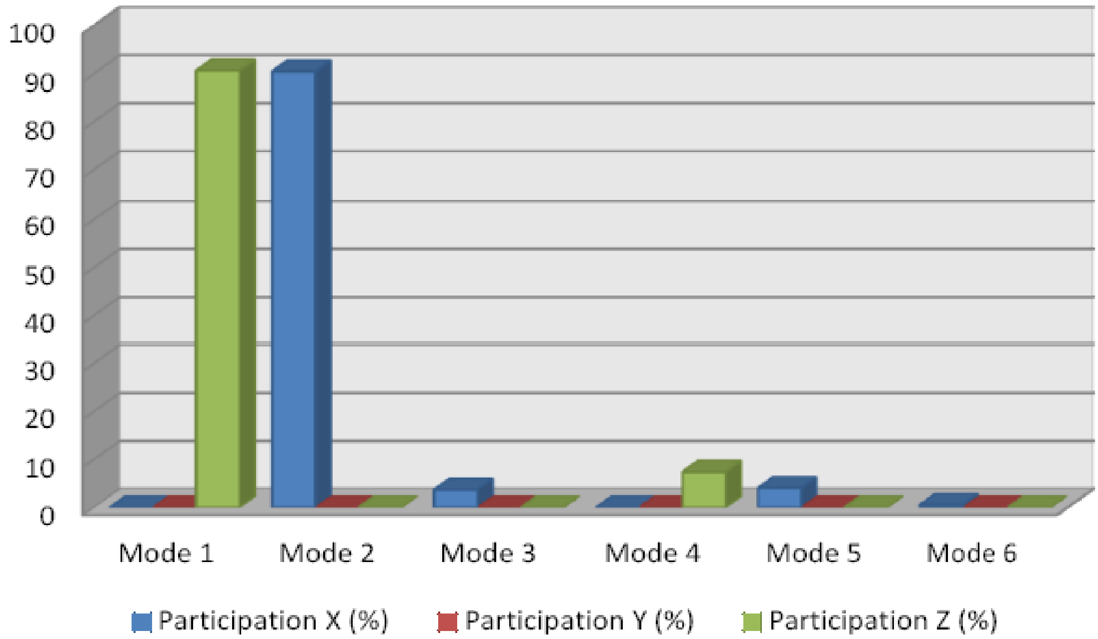
1.1.3.7. Modal Participation Factor:

Table 1.39 Mode participation factor, frequency and period for various modes for case 3

Mode	Frequency (Hz)	Time Period(seconds)	Participation X (%)	Participation Y (%)	Participation Z (%)
1	0.472	2.11741	0	0	90.69
2	0.475	2.10603	90.48	0	0
3	0.503	1.98976	3.72	0	0
4	1.506	0.66402	0	0	7.42
5	1.531	0.65314	4.04	0	0
6	1.585	0.6309	0.55	0	0



Graph 1.29 Graph showing frequency & period for various modes for case 3



Graph 1.30 Graph showing mode participation factor for various modes for case 3

1.1.3.8. Shear Stress:

Table 1.40 Shear stress values for case 3

Shear stress values

Case	SQX (N/mm2)	SQY (N/mm2)
C	0.744	0.892

1.1.3.9. Membrane Stress:

Table 1.41 Membrane stress values for case 3

Membrane stress values

Case	SX (N/mm2)	SY (N/mm2)	SXY (N/mm2)
C	1.021	1.212	0.483

1.1.3.10.Bending stress values

Table 1.42 Bending stress values for case 3

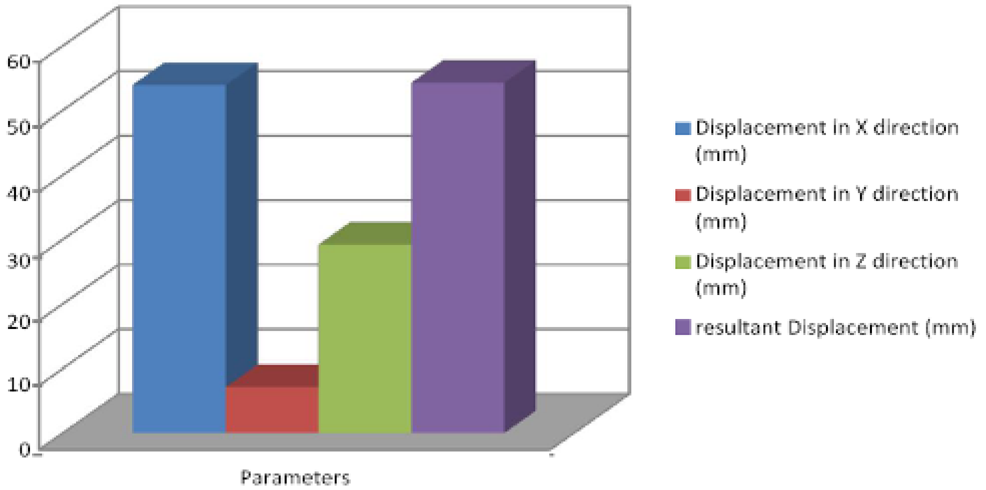
Case	MX (kN-m/m)	MY (kN-m/m)	MXY (kN-m/m)
C	58.412	74.249	31.572

1.1.4. Result Parameters for case 4

1.1.4.1. Displacement:

Table 1.43 Displacement graph for case 4

	Maximum Nodal Displacement values			
	In X direction (mm)	In Y direction (mm)	In Z direction (mm)	Resultant value (mm)
Case 4	53.915	7.133	29.196	54.246



Graph 5.31 Displacement graph for case 4

1.1.4.2. Axial force:

Table 1.44 Axial force for case 4

Beam no	Load combination	Axial force (kN)
2265	Response Spectrum	4388.098

1.1.4.3. Torsional Moment:

Table 1.45 Torsional moment for case 4

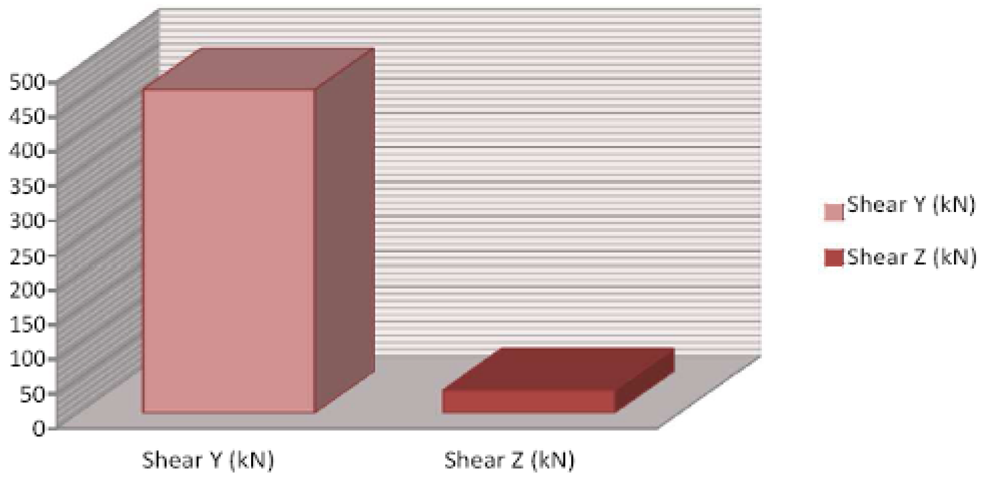
Load combination	Torsional Moment (kNm)
Response Spectrum	277.016

1.1.4.4. Shear force:

Table 1.46 Shear force for X-directional beams in case 4

Shear force values

	Fy (kN)	Fz (kN)
For X direction beam	466.154	33.43

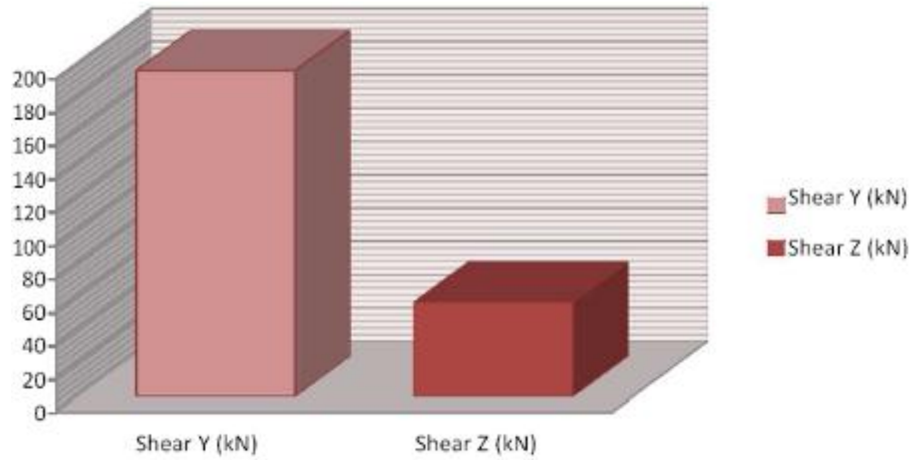


Graph 1.32 Shear force graph in X-direction beams in case 4

Table 1.47 Shear force in Z-direction beams in case 4

Shear force values

	Fy (kN)	Fz (kN)
For Z direction beam	195.471	56.441

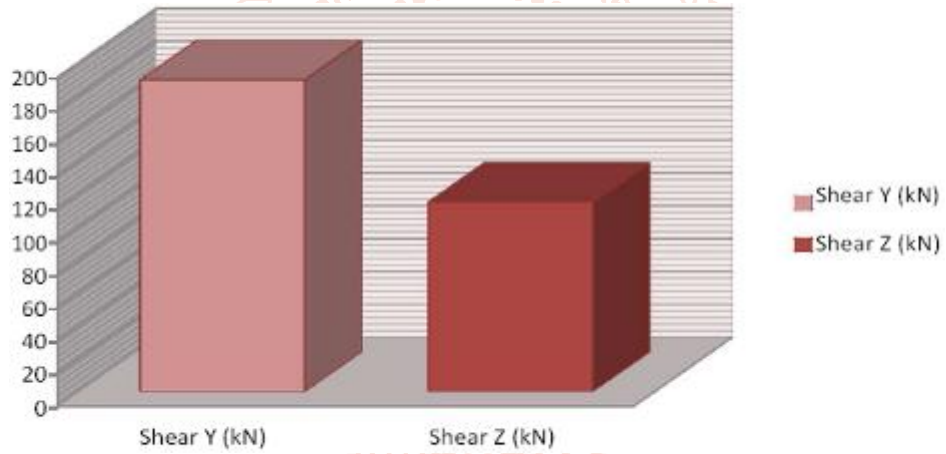


Graph 1.33 Shear force graph in Z-direction beams in case 4

Table 1.48 Shear force in column in case 4

Shear force values

	Fy (kN)	Fz (kN)
For column	189.455	115.098



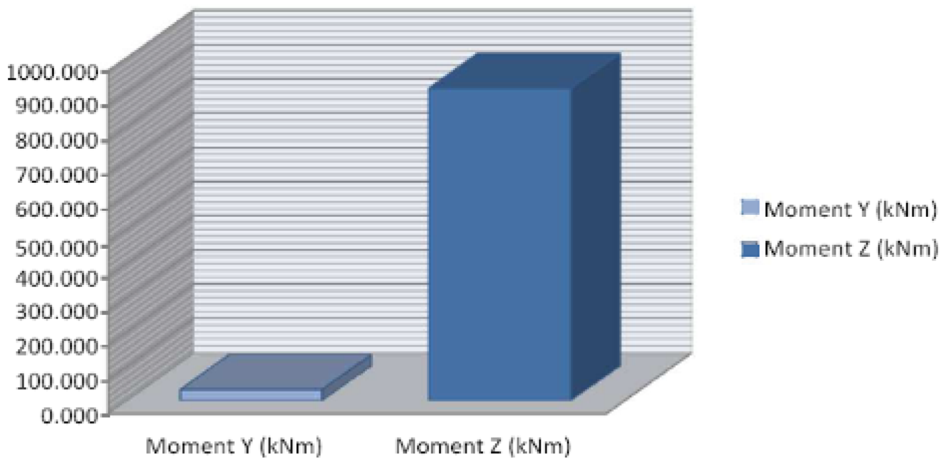
Graph 1.34 Shear force graph for column in case 4

1.1.4.5. Bending moment:

Table 1.49 Bending moment in X-direction beams in case 4

Bending moment values

	My (kNm)	Mz (kNm)
For X direction beam	31.819	910.657

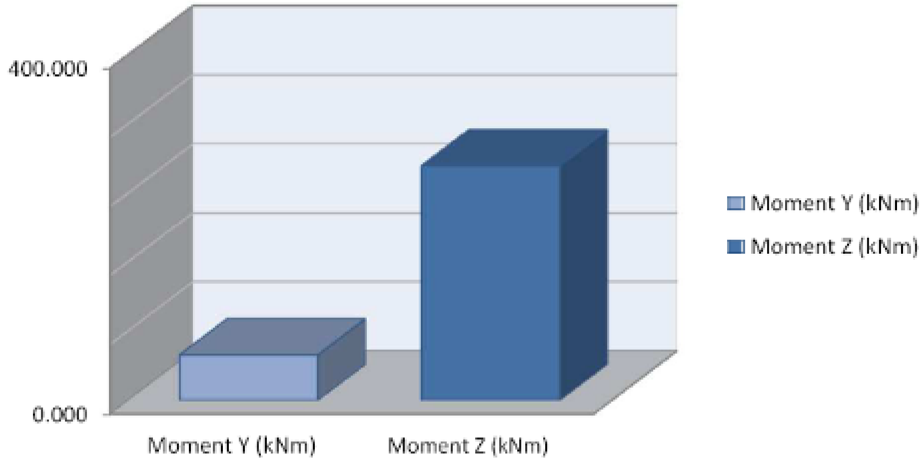


Graph 1.35 Bending moment graph in X-direction beams in case 4

Table 1.50 Bending moment in Z-direction beams in case 4

Bending moment values

	My (kNm)	Mz (kNm)
For Z direction beam	52.404	271.767

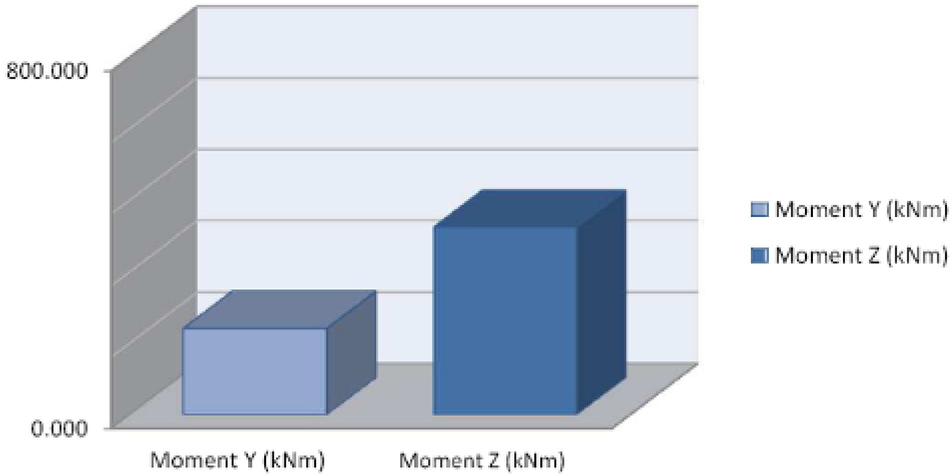


Graph 1.36 Bending moment graph in Z-direction beams in case 4

Table 1.51 Bending moment in column in case 4

Bending moment values

	My (kNm)	Mz (kNm)
For column	192.870	419.398

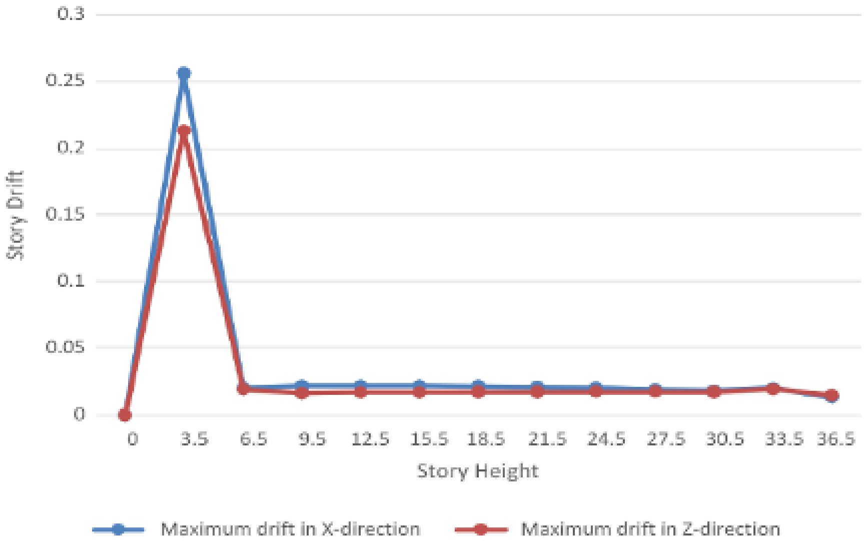


Graph 1.37 Bending moment graph for column in case 4

1.1.4.6. Story Drift:

Table 1.52 Story drift in X and Z-direction for case 4

Height of building	Story drift values(cms)	
	Maximum drift in X- direction	Maximum drift in Z- direction
0	0	0
3.5	0.2556	0.2133
6.5	0.0201	0.0190
9.5	0.0216	0.0162
12.5	0.0217	0.0166
15.5	0.0216	0.0168
18.5	0.0213	0.0170
21.5	0.0208	0.0171
24.5	0.0201	0.0172
27.5	0.0191	0.0172
30.5	0.0180	0.0171
33.5	0.0198	0.0192
36.5	0.0129	0.0147

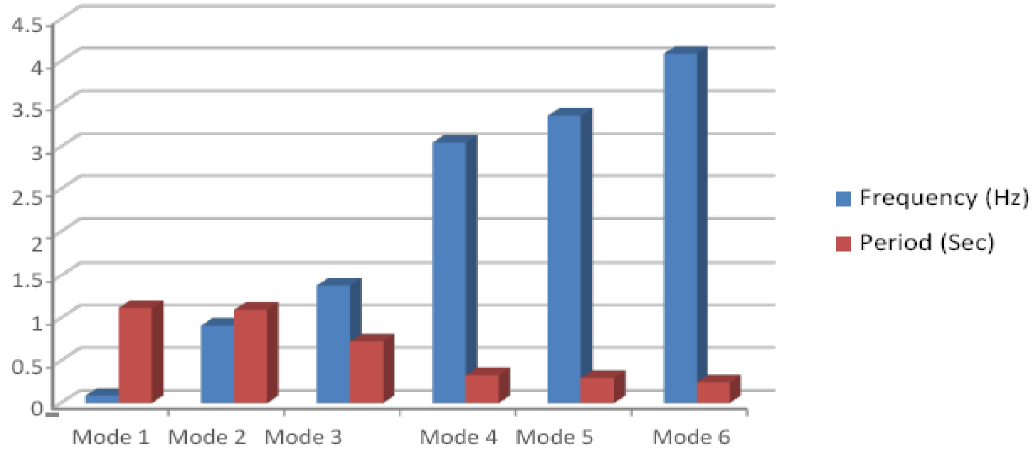


Graph 1.38 Story drift in X and Z-direction for case 4

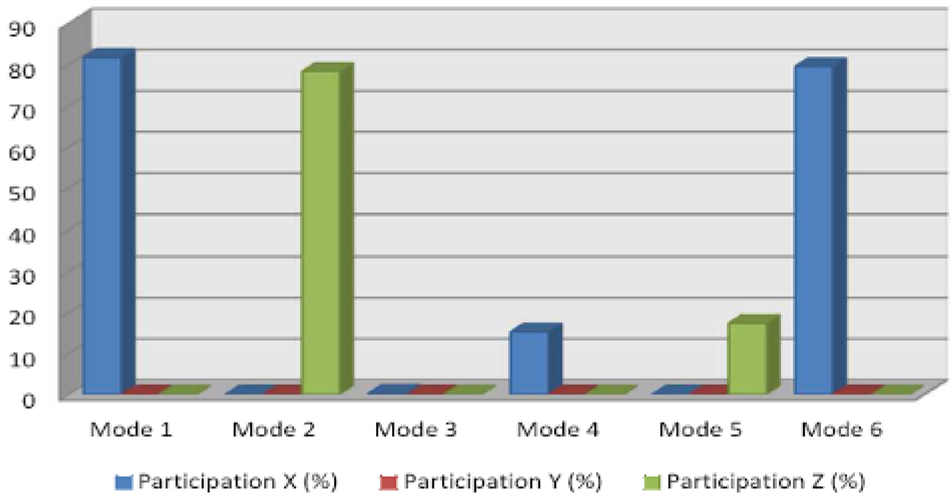
1.1.4.7. Modal Participation Factor:

Table 1.53 Mode participation factor, frequency and period for various modes for case 4

Mode	Frequency (Hz)	Time Period (seconds)	Participation X (%)	Participation Y (%)	Participation Z (%)
1	0.089	1.11877	81.68	0	0
2	0.910	1.09866	0	0	78.26
3	1.381	0.7241	0.2	0	0
4	3.048	0.32806	15.18	0	0
5	3.364	0.2973	0	0	17.32
6	4.088	0.24463	79.47	0	0



Graph 1.39 Graph showing frequency & period for various modes for case 4



Graph 1.40 Graph showing mode participation factor for various modes for case 4

1.1.4.8. Shear Stress:

Table 1.54 Shear stress values for case 4

Shear stress values

Case	SQX (N/mm2)	SQY (N/mm2)
D	0.403	0.501

1.1.4.9. Membrane Stress:

Table 1.55 Membrane stress values for case 4

Membrane stress values

Case	SX (N/mm2)	SY (N/mm2)	SXY (N/mm2)
D	0.921	0.849	0.549

1.1.4.10.1.1.1.10 Bending Stress:

Table 1.56 Bending stress values for case 4

Bending stress values

Case	MX (kN-m/m)	MY (kN-m/m)	MXY (kN-m/m)
D	40.89	42.597	18.533

1.2. ANALYSIS OF VARIOUS CASES

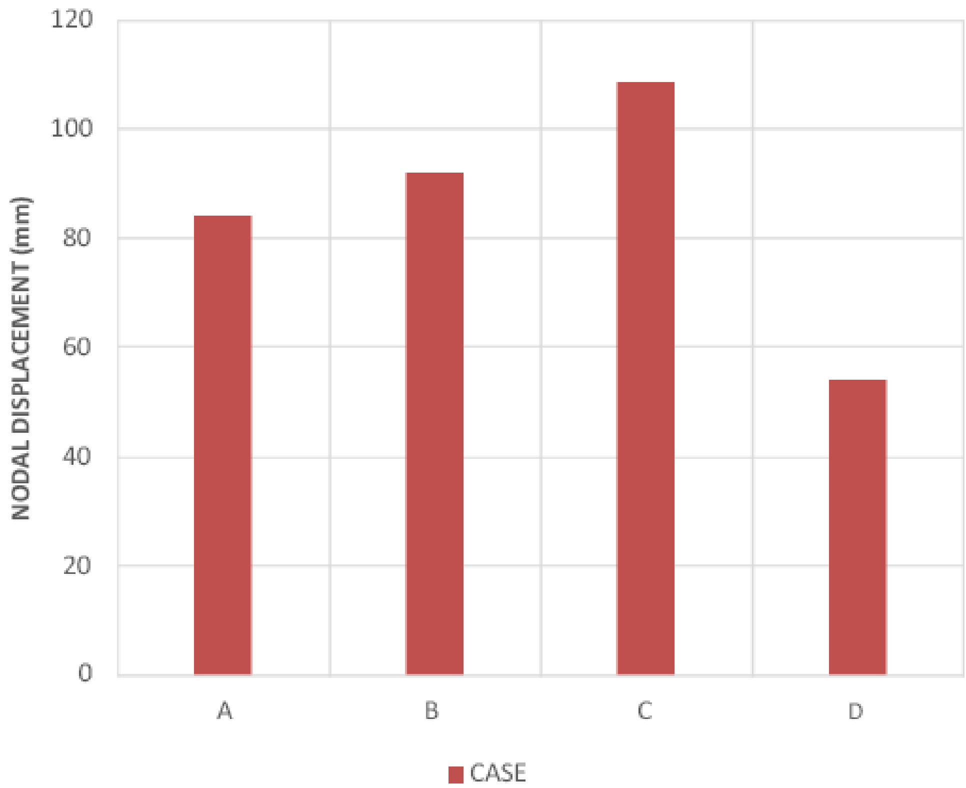
Dynamic analysis of various cases is carried out against numerous seismic parameters is performed as per IS 1893:2002(Part-1) by response spectrum method of analysis. Subsequent results are computed and compared for various cases listed below:

1.2.1. Nodal displacement

Out of all the cases taken for analysis the maximum nodal displacement is found for case III.

Table 1.57: Maximum Nodal displacement for various cases

CASE	NODE	DISPLACEMENT (mm)
A	435	84.165
B	435	92.14
C	1600	108.77
D	1603	54.246



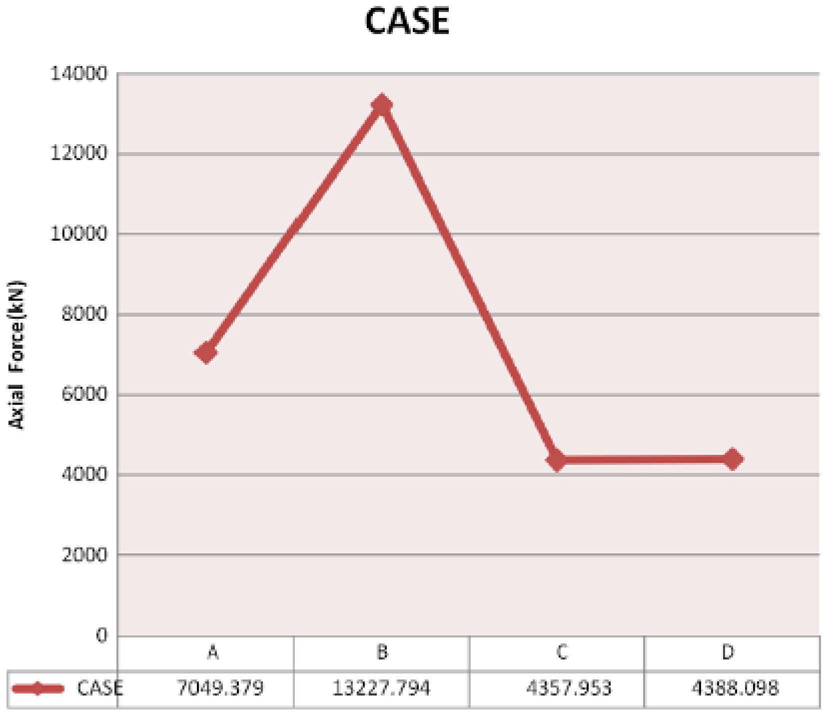
Graph 1.41 Graphical representation of Nodal Displacement for all cases

1.2.2. Axial force

Out of all the cases taken for analysis the minimum axial force is found for case II.

Table 1.58: Maximum Axial forces for various cases

CASE	AXIAL FORCE(kN)
A	7049.379
B	13227.794
C	4357.953
D	4388.098



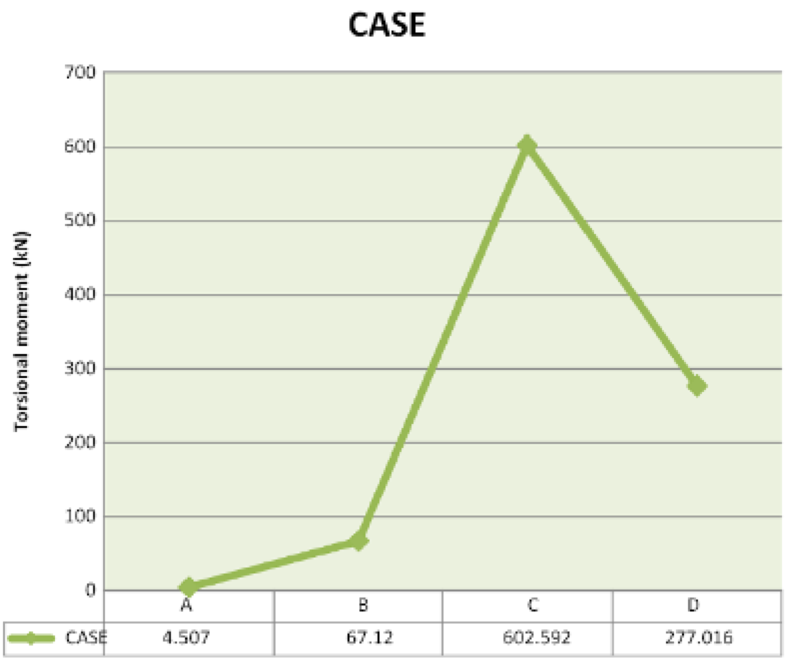
Graph 1.42 Graphical representation of Axial Force for all cases

1.2.3. Torsional Moment

For all the cases considered for study the torsional moment is found minimum for cases A, B and D.

Table 1.59: Maximum Torsional moment for various cases

CASE	TORSIONAL MOMENT(kNm)
A	4.507
B	67.12
C	602.592
D	277.016



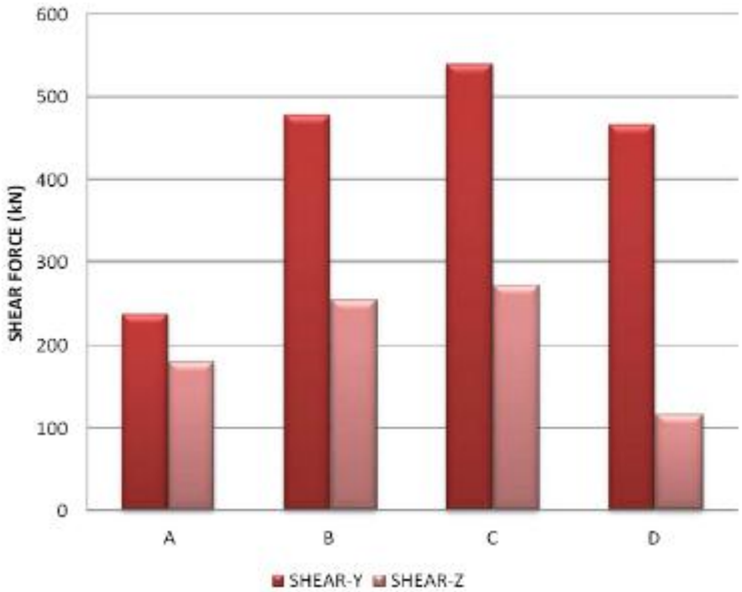
Graph 1.43 Graphical representation of Torsional moment for all cases

1.2.4. Shear force

In all the cases the shear force is found minimum for cases A, C & D for shear component in y direction and found minimum for case A, B & D for shear component in Z direction.

Table 1.60: Maximum Shear Force in Y & Z direction for various cases

CASE	SHEAR Y (kN)	SHEAR Z (kN)
A	236.781	179.53
B	478.012	253.809
C	538.506	271.447
D	466.154	115.098



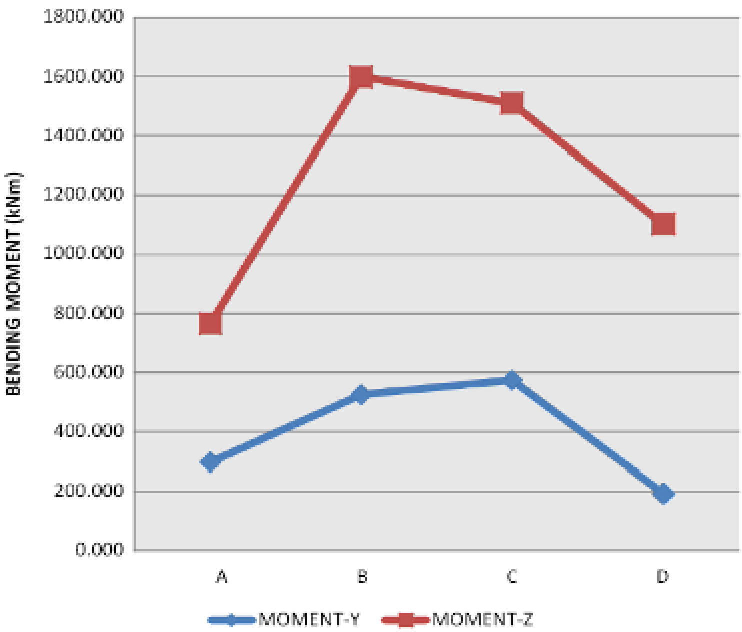
Graph 1.44 Graphical representation of Shear Force in Y & Z direction

1.2.5. Bending moment

In all the cases the bending moment is found minimum for cases A, B & D for moment component in Y direction and found minimum for cases A, C & D for moment component in Z direction

Table 1.61: Maximum Moment in Y & Z direction for various cases

CASE	MOMENT Y (kNm)	MOMENT Z (kNm)
A	297.064	469.277
B	525.039	1073.615
C	575.178	934.418
D	192.870	910.657



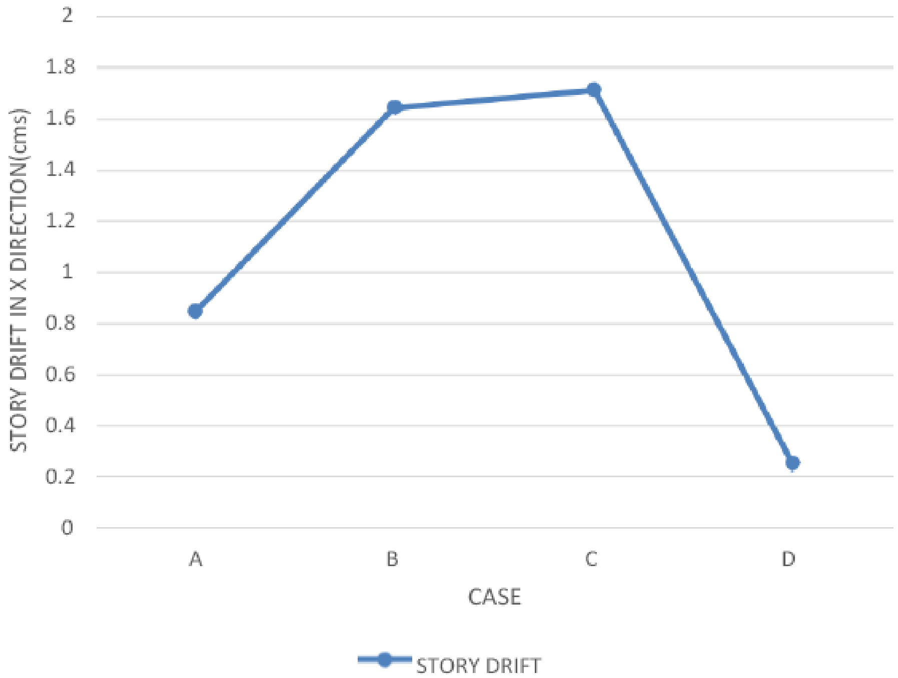
Graph 1.45 Graphical representation of Moment in Y & Z direction

1.2.6. Story drift

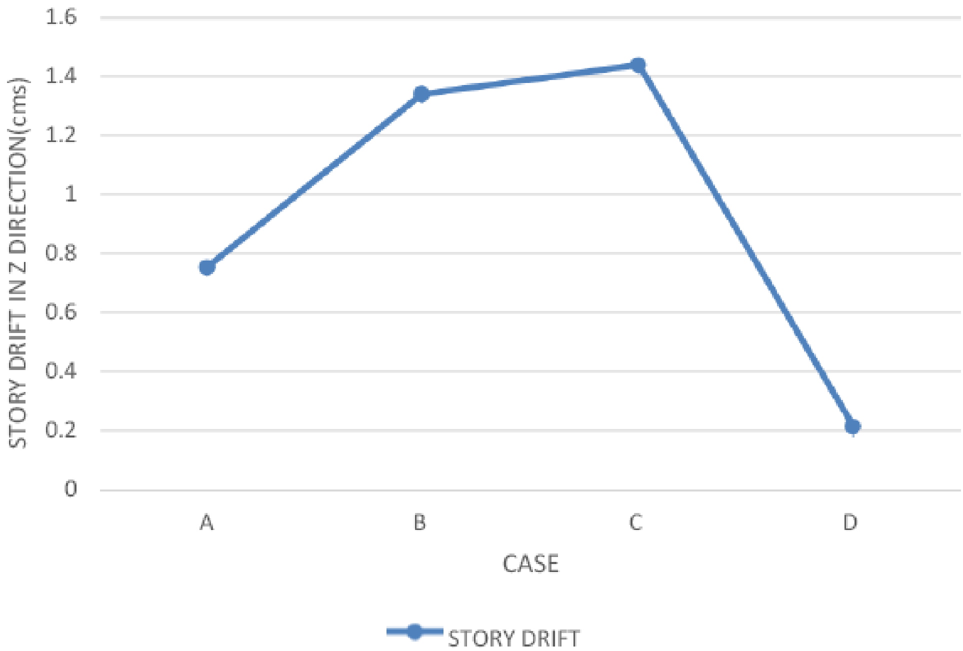
Out of all the cases taken for analysis the minimum Story drift is found for case D.

Table 1.62: Maximum Story Drift in X & Z direction for various cases

CASE	FLOOR	HEIGHT(m)	MAXIMUM STORY DRIFT(cms)	
			X DIRECTION	Z DIRECTION
A	Ground	3.5	0.8479	
	Ground	3.5		0.7534
B	Ground	3.5	1.6474	
	Ground	3.5		1.3406
C	Ground	3.5	1.7161	
	Ground	3.5		1.441
D	Ground	3.5	0.2556	
	Ground	3.5		0.2133



Graph 1.46 Graphical representation of Story Drift in X direction for all cases



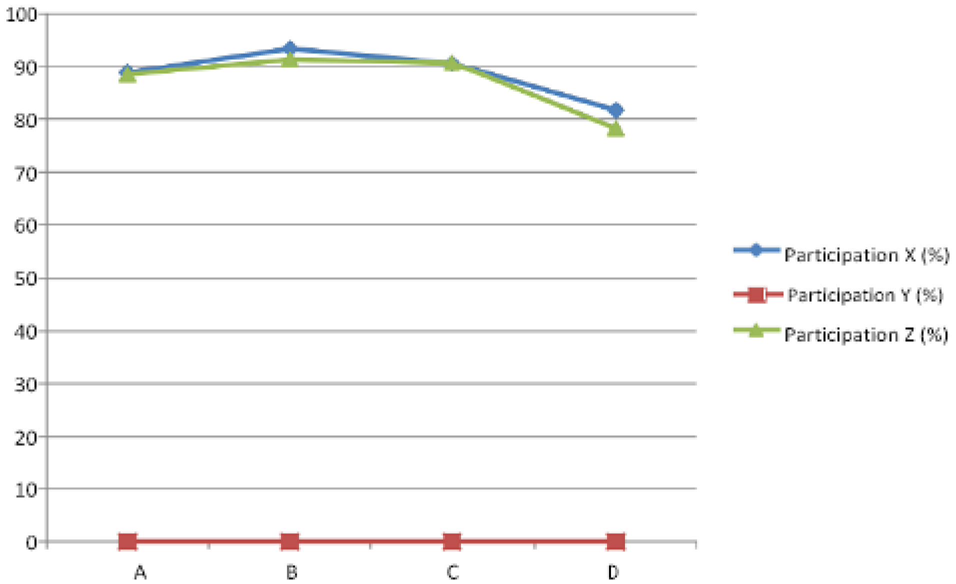
Graph 1.47 Graphical representation of Story Drift in Z direction for all cases

1.2.7. Modal participation factor

Out of all the cases the modal participation factor is found maximum for cases A,B&C

Table 1.63: Maximum modal participation factor in X, Y & Z direction for various cases

CASE	Mode	MODAL PARTICIPATION FACTOR		
		Participation X (%)	Participation Y (%)	Participation Z (%)
A	2	88.86	0	0
	1	0	0	88.51
B	2	93.40	0	0
	1	0	0	91.34
C	2	90.48	0	0
	1	0	0	90.69
D	1	81.68	0	0
	2	0	0	78.26



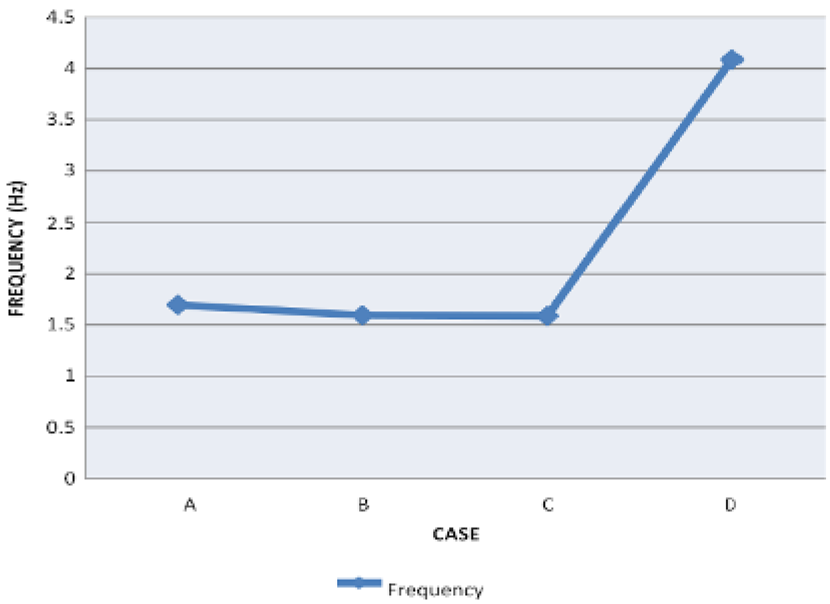
Graph 1.48 Graphical representation of modal participation factor in X,Y & Z direction for all cases

1.2.8. Frequency

Out of all the cases taken for analysis the maximum frequency is found for case IV.

Table 1.64: Maximum frequency in Y & Z direction for various cases

CASE	Mode	Frequency (Hz)
A	1	1.693
B	1	1.593
C	1	1.585
D	1	4.088

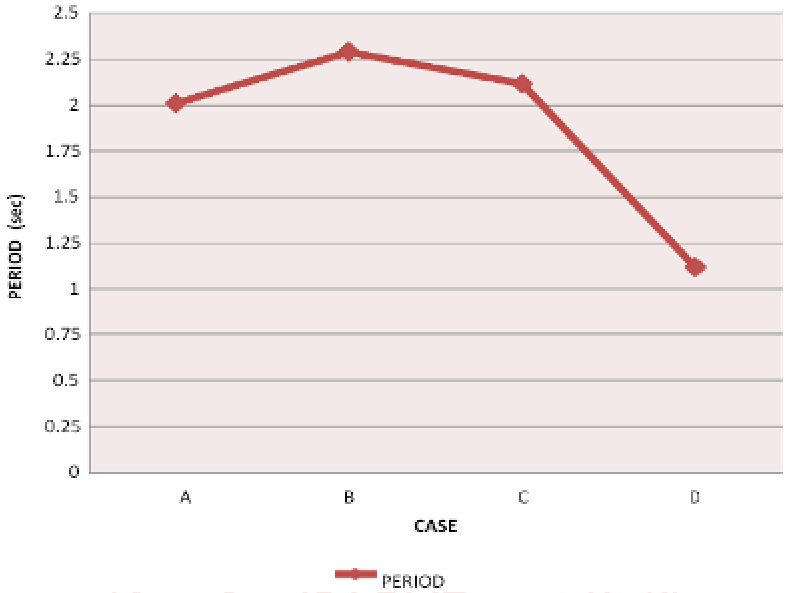


Graph 1.49 Graphical representation of frequency for all cases

1.2.9. Time Period
Out of all the cases taken for analysis the maximum time period is found for case II.

Table 1.65: Maximum frequency in Y & Z direction for various cases

CASE	Mode	Period (sec)
A	1	2.01008
B	1	2.29038
C	1	2.11741
D	1	1.11877



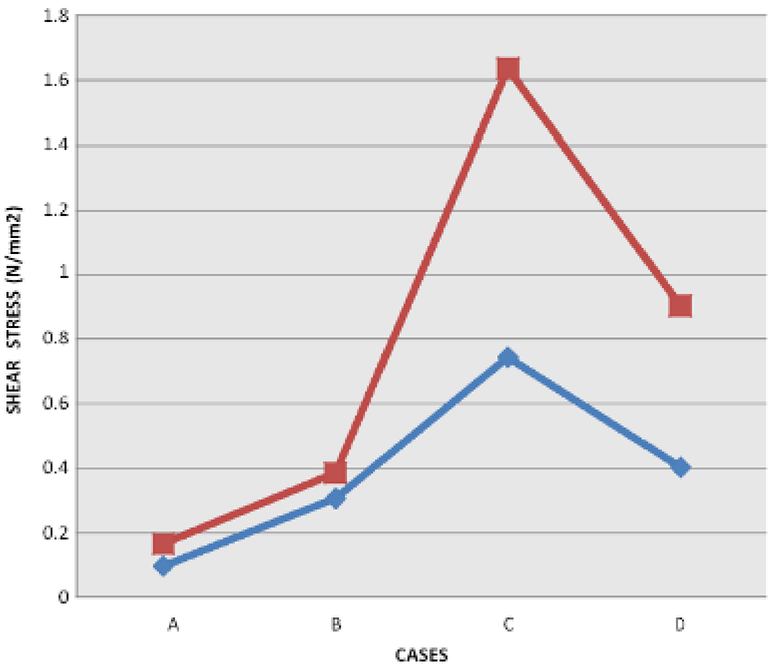
Graph 1.50 Graphical representation of period for all cases

1.2.10. Shear Stress
In all the cases the shear stress is found minimum for cases A, B & D

Table 1.66: Maximum Shear Stress in Y & Z direction for various cases

Shear stress values

Case	SQX (N/mm2)	SQY (N/mm2)
A	0.096	0.07
B	0.306	0.079
C	0.744	0.892
D	0.403	0.501



Graph 1.51 Graphical representation of Shear Stress in Y & Z direction

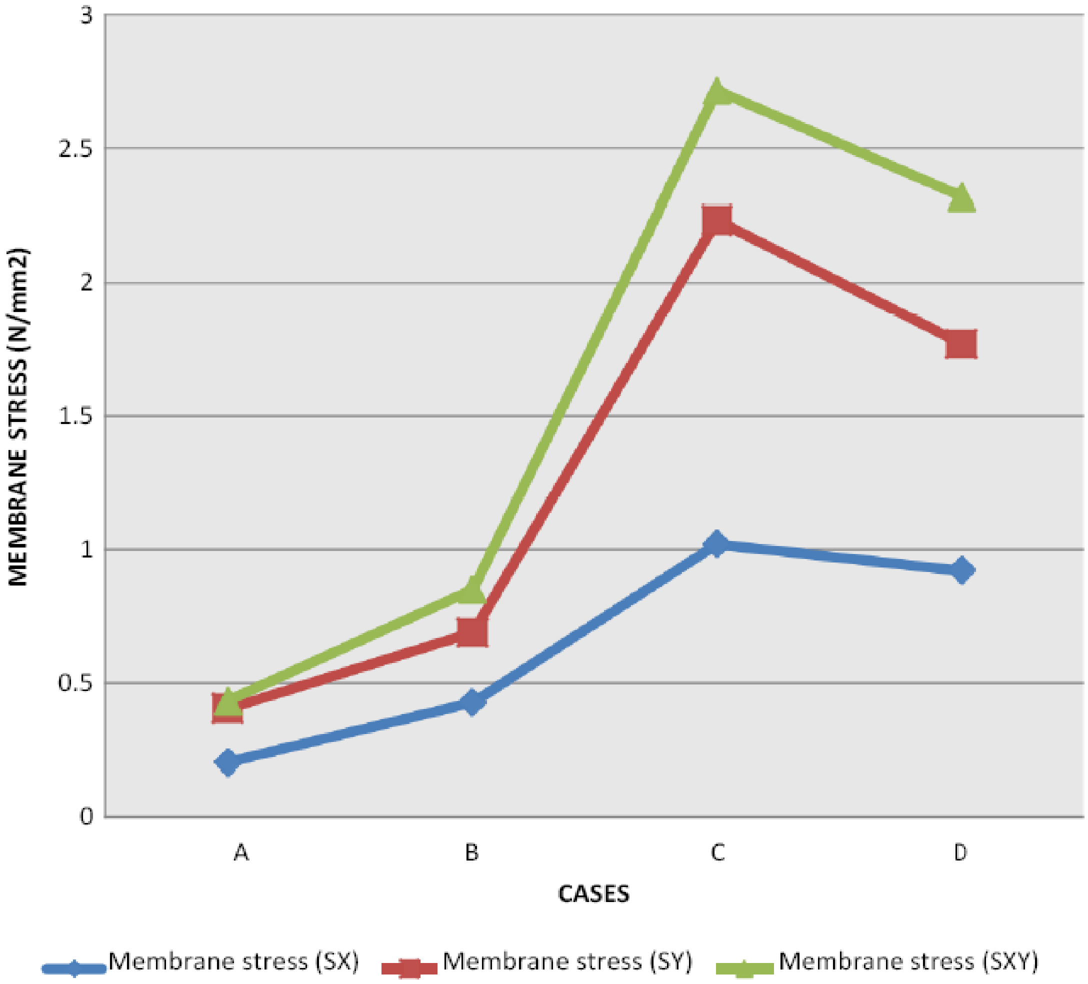
1.2.11. Membrane Stress

In all the cases membrane stress is found minimum for cases A, B & D

Table 1.67: Maximum Membrane Stress in Y & Z direction for various cases

Membrane stress values

Case	Membrane stress (SX) (N/mm2)	Membrane stress (SY) (N/mm2)	Membrane stress (SXY) (N/mm2)
A	0.203	0.2	0.029
B	0.426	0.261	0.164
C	1.021	1.212	0.483
D	0.921	0.849	0.549



Graph 1.52 Graphical representation of Membrane Stress in Y & Z direction

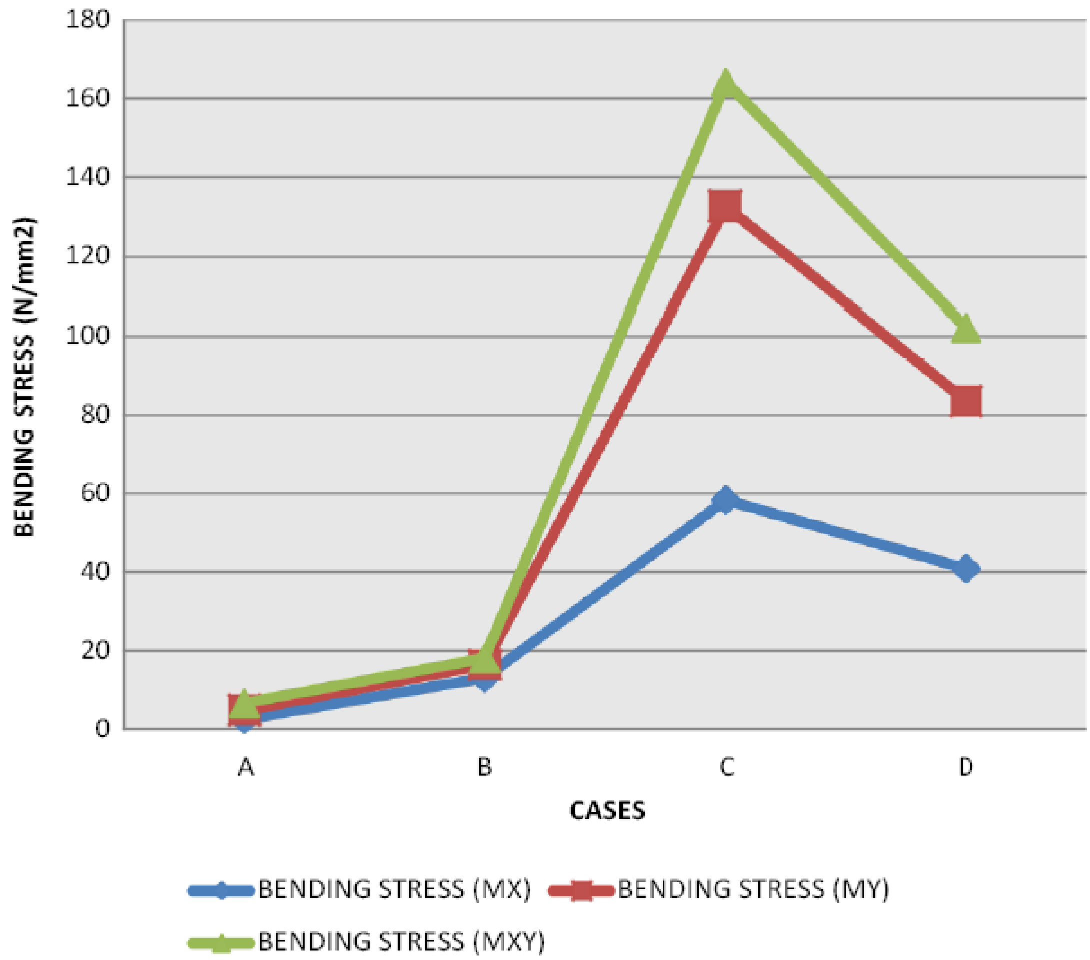
1.2.12. Bending stress

In all the cases the bending stress is found minimum for cases A, B & D

Table 1.68: Maximum Bending stress in Y & Z direction for various cases

Bending stress values

Case	BENDING STRESS (MX) (kN-m/m)	BENDING STRESS (MY) (kN-m/m)	BENDING STRESS (MXY) (kN-m/m)
A	2.414	2.4	2.032
B	13.207	3.189	1.584
C	58.412	74.249	31.572
D	40.89	42.597	18.533



Graph 1.53 Graphical representation of Bending stress in Y & Z direction

2. CONCLUSION AND FUTURE SCOPE

2.1. Conclusion

Insofar as apprehension about construction skill there are various approaches developed and incorporated to enhance the living style along with all the facilities is still an opportunity to fix in term of headroom, more space along with security of structure. In this study all these problems are taken in consideration in the same structure to provide better living experience within the limits of structural safety guidelines. From investigation following conclusions are made subsequently computing, analyzing and comparing various cases:

1. On computing and comparing it was found that the nodal displacement is found least for case IV with a value of 54.246mm. It clearly depicts from the evaluation that displacement is very nominal at node 1603which is located at the top floor of the building when compared with height.
2. After comparing and analyzing all the cases axial force for case C & D is found optimum.
3. Subsequently analyzing and comparing shear force it was found that out of all the cases A & D are most optimum cases. As case A is regular building without any deformity but case D is RCC building with floating column, flat slab and shear wall i.e., with a lot of deformities but shear force in this case is found optimum after case A.
4. After analyzing it was found that the most optimum case for bending moment is case A & D. Although the values are lower in both the cases but in different directions but case A is simple RCC building so Case D is most optimum case comprising a lot of deformities.
5. On comparing story drift for all the cases at each story it was concluded that the cases D is most efficient in both directions longitudinal as well as transverse respectively. It was seen clearly that case D is better that that of case A because ibn case slenderness of building is also an issue but in case D after adding different structural element shear will help in keeping structure safer both in terms of seismic component and also slenderness of building.
6. After evaluating various cases it has been found that the torsional moment is least for case A, B & D.
7. Comparing the frequency for all cases in both longitudinal and transverse direction, case B & C is observed as most efficient. Correspondingly, the optimum time period is found for case B, C & A.

8. On comparing all the cases modal participation factors in both longitudinal and transverse direction, Case D is observed as most efficient.
9. Out of all the cases it was observed that shear stress is found least in case of case B & D for both the components. After analyzing and comparing for membrane stress it was found that the most optimum cases are A & B. Similarly for the aforesaid cases i.e., A & B the values are found least.
10. When analyzing all the cases for stress factor it was found that cases A & B are comprising least value but evaluating all cases it also visible that these values are only provides result when deformities or irregularities are lesser but when the structural element are added which cause distortions so with the addition of shear wall it was managed for some extent with a ratio of 1/3 when comparing case C & D.
11. Finally, it has been concluded from investigation that Case D is found most optimum which makes it possible to add structural element viz floating column for more space, flat slab to increasing headroom with the help lateral load resisting system i.e., shear wall to a particular extent within safer limits.

2.2. Future scope

1. For future evaluation and investigation this study is extended for seismic analysis with plan irregularities along with variation of terrain system as per design requirements.
2. Likewise, this study is extended for all type of irregularities like vertical irregularities, stiffness irregularities and mass irregularities etc.
3. This investigation is also prolonged for examination of multistory building along with various structural elements resting on variable terrain against different soil conditions with different seismic zones.
4. This study is also extended for effect of adding different lateral load resisting measures like bracings, diagrids, etc.
5. Generally the study is limited for specific height but it is also extended for skyscraper not only for seismic effect but also for wind effect with variable soil conditions like for desert also.

REFERENCES

[1] 2015, Kavya N., Dr. K. Manjunatha, Sachin P. Dyavappanavar, “Seismic evaluation of multistory RC building with and without floating columns”.

[2] 2014, A. P. Mundada, S. G. Sawdatkar, “Comparative seismic analysis of multistory building with and without floating column”.

[3] 2015, Isha Rohilla, S. M. Gupta, Babita Saini, “Seismic response of multistory irregular building with floating column”.

[4] 2014, Keerthigowda B. S., Syed Tajoddeen, “Seismic analysis of multistory building with floating column”.

[5] 2014, Pratyush Malaviya, Saurav, “Comparative study of effect of floating columns on the cost analysis of a structure designed on Staad Pro v8i”.

[6] 2014, Prerna Nautiyal, Saleem Akhtar, Geeta Batham, “Seismic response evaluation of RC frame building with floating column considering different soil conditions”.

[7] 2014, Sabari S, Praveen J. V., “Seismic analysis of multistory building with floating column”.

[8] 2014, T. Raja Sekhar, P. V. Prasad, “Study of behaviour of seismic analysis of multistoried building with and without floating column”.

[9] 2018, shivani tyagi, prof B. S tyagi “Seismic analysis of multistory building with floating column”

[10] 2018 , Kishalay Maitra, N. H. M. Kamrujjaman Serker “evaluation of seismic performance of building floating column”

[11] 2017, Zozwala Mohammed Mustafa, Dr. K. B. Parikh “Seismic Analysis of a Multistorey Building with Floating Column: A Review”

[12] 2016, Gangadari Vishal Kumar, Dr. S Sunil Pratap Reddy “ seismic analysis of multistory building with floating column”

[13] Srikanth. M. K, Yogeendri. R. Holebagilu, (2014), “Seismic Response of Complex Buildings with Floating Column for Zone II and Zone V”, International journal of Engineering Research-Online, Vol. 2. Issue. 4, ISSN: 2321-7758.

[14] Mr. Nikhil Bandwal, Prof. Anand Pande, Prof. Vaishali Mendhe, Prof. Amruta Yadav (2014) “To Study Seismic Behaviour of RC Building with Floating Columns”, International Journal of Scientific Engineering and Technology Research, Vol. 03, Issue 08, Pg. No. 1593-1596. (ISSN 2319-8885)

[15] Ms. Priyanka D. Motghare, (2016) “Numerical Studies Of Rcc Frame With Different Position

Of Floating Column", Technical Research Organization India. Vol. 2, Issue-1, 2016, (ISSN 2395- 7786)

[16] Sharma R. K, Dr. Shelke N. L. (2016) "Dynamic Analysis of RCC Frame Structure with floating Column", International Journal of Advanced Research in Science, Engineering and Technology., Vol. 03, Issue 06, (ISSN 2350-0328)

[17] Ms. Waykule. S. B, Dr. C. P. Pise, Mr. C. M. Deshmukh, Mr. Y. P. Pawar, Mr S. S Kadam, Mr. D. D. Mohite, Ms. S. V. Lale, (2017), "Comparative Study of floating column of multi storey building by using software", International Journal of Engineering Research and Application, Vol. 07, Issue 1, Pg. No. 3138, (ISSN 2248-9622)

[18] Prof. Sarita Singla, Er. Ashlie Rahman, (2015), "Effect of Floating Columns on Seismic Response of Multi-Storeyed RC Framed Buildings", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 4 Issue 06.

[19] SukumarBehera, (2012), "Seismic Analysis of Multistory Building with Floating Column" A Thesis of National Institute Of Technology Rourkela, Pp. 21-93.

[20] IS. 456. Indian Standards (plain and reinforced concrete code of practice), (Fourth Revision), 2000.

[21] IS: Indian Standards Criteria For Earthquake Design of Structures, 1893-2002.

[22] IS 875:1987 part 1 for Dead load.

[23] IS 875:1987 part 2 for Live load.

[24] IS 875:1987 part 3 for Wind load.

[25] IS 875:1987 part 5 for Load combinations.