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Seismic Study of Multistoried Horizontal Irregular RCC Buildings

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ABSTRACT

The goal of this research work is to investigate the various seismic responses static as well as dynamic of horizontal irregular multistoried building is carried out. Comparison is made between horizontal irregular building on the basis of shear force, bending moment storey drift , modal displacement and base shear in different seismic zones and found that membrane ,shear along different axis increases from 10,20 and 30 multistoried building in zone 2 and zone 5 statically and dynamically and bending moment along different axis increases from 10,20 storey and decreases to 30 multistoried building in zone 2 and zone 5 statically and dynamically using staad software and also Propose the best suitable building configuration on existing conditions In this paper the comparative study of membrane stresses, shear stresses, bending moment is carried out statically of C shape multistoried horizontal irregular building at different seismic zones and storey shear at base of building and top of building and CQC stresses are analyzed at x and z direction is carried out and the following conclusions should be made: Membrane Stresses along x and y direction increases from 10 to 20 storey and 30 storey statically in zone 2. Shear Stresses along x and y direction SX and SY increase from 10 to 20 storey and 30 storey statically zone 2.Bending Moment along x and y direction MX in crease from 10 to 20 storey to 30 storey statically zone 2. MY increase from 10 to 20 storey and 30 storey statically zone 2. MX Y increase from 10 to 20 storey and decreases to 30 storey statically zone 2

Key Words: shear force, bending moment ,storey drift , modal displacement, membrane ,shear along , Membrane Stresses ,Shear Stresses

1. INTRODUCTION

Earthquakes is the most devastating and unpredictable of all natural disasters, from which it is very difficult to save life and concrete structures against it. Hence to overcome these issues of earthquake we need study the seismic performance of the built up structures in environment through the various analytical procedures, which ensure that the structures withstand during the minor earthquakes and

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Volume 06 Issue 02
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produce caution whenever major earthquake events occurs So that we can save as many lives and structures as possible. The behavior of a building depends on several factors during earthquake occurrence as stiffness, and adequate lateral strength, simple and regular configurations and ductility. The buildings with the regular geometry and uniformly distributed mass and stiffness in plan as well as in elevation suffer much less damage compared to irregular configurations during earthquake. But nowadays need and demand of the latest generation and growing population has made the architects or engineers inevitable towards planning of irregular configurations. Hence earthquake engineering has developed the key issues in understanding the role of building configurations.

3. PROBLEM FORMULATION AND METHODOLOGY

3.1 Objective:

The goal of this research work is to investigate the various seismic responses static as well as dynamic of horizontal irregular multi-storeyed building is carried out

1To perform a comparative study of the various seismic parameters of multi-storeyed building structures.

2 Comparison between horizontal irregular building on the basis of shear force, bending moment storey drift, modal displacement and base shear in different seismic zones.

3 To propose the best suitable building configuration on existing conditions.

3.2 Methodology:

For this purpose the different cases are studied

Case1: Static Analysis of 10 storey multi-storeyed building for seismic zone II

Case 2: Static Analysis of 20 storey multi-storeyed building for seismic zone II

Case 3: Static Analysis of 30 storey multi-storeyed building for seismic zone II

Case 4: Static Analysis of 10 storey multi-storeyed building for seismic zone V

Case 5: Static Analysis of 20 storey multi-storeyed building for seismic zone V

Case 6: Static Analysis of 30 storey multi-storeyed building for seismic zone V

Case7: Dynamic Analysis of 10 storey multi-storeyed building for seismic zone II

Case 8: Dynamic Analysis of 20 storey multi-storeyed building for seismic zone II

Case 9: Dynamic Analysis of 30 storey multi-storeyed building for seismic zone II

Case 10: Dynamic Analysis of 10 storey multi-storeyed building for seismic zone V

Case11: Dynamic Analysis of 20 storey multi-storeyed building for seismic zone V

Case12: Dynamic Analysis of 30 storey multi-storeyed building for seismic zone V

3.3 General dimensions of Buildings

FOR 10 STOREY BUILDING

Case I: Plan Area is 50m x 35m

FOR 20 STOREY BUILDING

Case I: Plan Area is 50m x 35m

FOR 30 STOREY BUILDING

Case I: Plan Area is 50m x 35m

3.4 Loads Considered:

3.4.1 Dead Load:

The loads considered are as follows:

The self-weight of slab =0.2 x 1 x 1 x 25 = **5** kN/m^2

Load considered due to floor finish= **1** kN/m^2

3.4.2Live Load:

Live load adopted for floor slab and roof according to IS 875 part-II: **5** kN/m^2.

3.4.3 Earthquake Load:

Response Reduction Factor: was taken fromtable-7(clause 6.4.2) IS1893 Part-1:2002. **Importance Factor**: Depends on the functional use of building characterised by hazardous consequences of its failure, it is taken from table-6(clause 6.4.2) of IS1893 **Part**-1:2002.

Time Period of undammed free vibration.

In the present work, parameters of earthquake load were considered as:

Earthquake Load and seismic parameters	
Earthquake Parameters Zone (Z)	II
Response Reduction factor (RF)	3
Importance factor (I)	1
Rock and soil factor (SS)	2
Type of structures	1
Damping ratio (DM)	0.05
Time Period	Ta=0.09H/√D

3.4.5 Load Combinations as considered for static analysis:

The load combinations were adopted according to IS 1893 Part-1: 2002 & IS 456:2000:

1. 1.5 (DL + LL)
2. 1.2 (DL + LL + EQX)
3. 1.2 (DL + LL - EQX)
4. 1.2 (DL + LL + EQZ)
5. 1.2 (DL + LL – EQZ)
6. 1.5 (DL + EQX)
7. 1.5 (DL – EQX)
8. 1.5 (DL + EQZ)
9. 1.5 (DL – EQZ)
10. 0.9 DL + 1.5 EQX
11. 0.9 DL - 1.5 EQX
12. 0.9 DL + 1.5 EQZ
13. 0.9 DL – 1.5 EQZ

Here X &Z are the directions of earthquake loads considered in the analysis.

3.5 Preliminary Sections and materials considered:

The plan area for the proposed work is 50m x 35m in which size of panels is 5x5 m. The properties of material adopted are:

3.5.1 The Young's modulus of elasticity of concrete adopted was 25,000 MPa while the Poisson's ratio was 0.2.

3.5.2 The preliminary sections of columns and beams were fixed on the basis of deflection criteria [i.e. span to depth ratio].

S.No	Description	No of stories	Column		Slab	Beam	
			Width (mm)	Length (m)	Thickness (mm)	Width (mm)	Depth (mm)
1	IRREGULAR BUILDING	10	0.75	3	175	0.5	0.75
		20	0.75	3	175	0.5	0.75
		30	0.75	3	175	0.5	0.75

3.7 Generation of model using STAAD. Pro:

1 Create a new file and input the properties of member's i.e column, flat slab and shear wall.

2 Apply different loads on the structure and design the elements and then run analysis.

3 Go to post processing mode and get the results of members and elements.

4 View the output file to get the design results of all the members and elements

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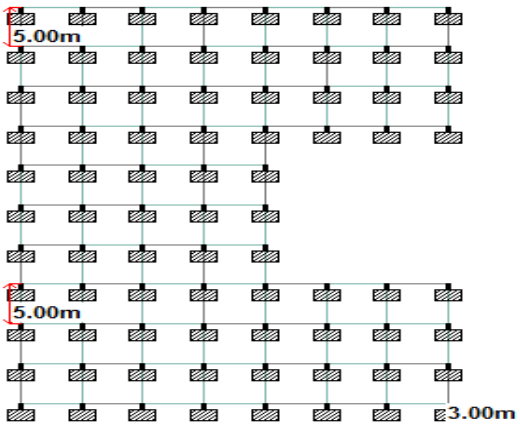

Fig No. 1:Plan of 10,20,30 storey multi-storeyed building

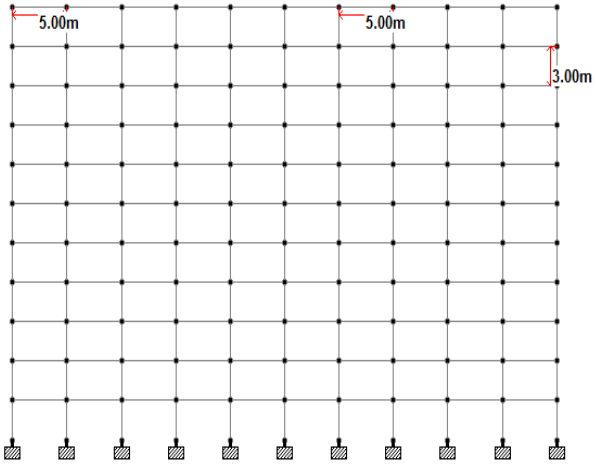

Fig no. 2:Elevation of 10 storey multi-storeyed building

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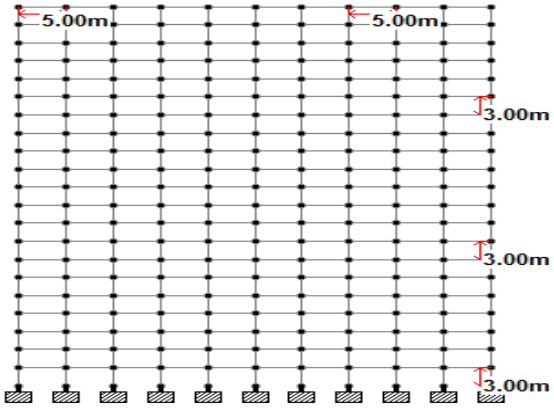

Fig No. 3:Elevation of 20 storey multi-storeyed building

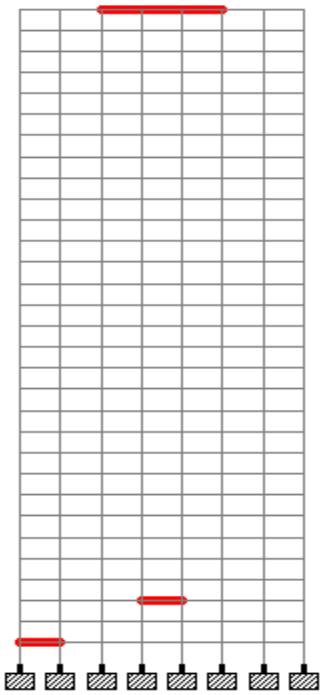

Fig no. 4:Elevation of 30 storey multi-storeyed building

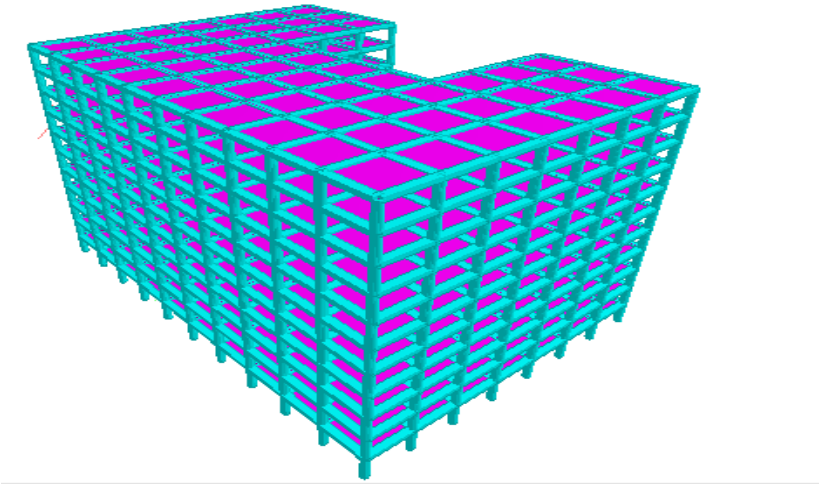

Fig No. 5:3-D View of 10 storey multi-storeyed building

CHAPTER-4
RESULTS AND DISCUSSIONS

Table No. – 1: Static Analysis of 10 storey multi-storeyed building for seismic zone II

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local) N/mm2	SQY (local) N/mm2	SX (local) N/mm2	SY (local) N/mm2	SXY (local) N/mm2	Mx kN m/m	My kN m/m	Mxy kN m/m
Max Qx	3356	13 GENERATED INDIAN CODE	0.02	-0.00	0.003	0.01	-0.00	0.001	-0.01	0.002

		GENRAL_STRUCTURES 9								
Min Qx	3309	12 GENERATED INDIAN CODE GENRAL_STRUCTURES 8	-0.02	-0.01	0.002	0.002	0.000	-0.002	-0.07	0.027
Max Qy	3361	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	0.001	0.022	0.004	0.003	0.000	-0.036	-0.01	0.002
Min Qy	3378	14 GENERATED INDIAN CODE GENRAL_STRUCTURES 10	-0.00	-0.02	0.005	0.003	0.000	0.001	0.003	0.000
Max Sx	3642	5 GENERATED INDIAN CODE GENRAL_STRUCTURES 1	-0.00	0.000	0.036	0.025	0.014	-0.157	-0.04	-0.02
Min Sx	3700	5 GENERATED INDIAN CODE	0.000	-0.00	-0.144	-0.14	-0.01	-0.363	-0.08	-0.04

		GENRAL_STRUCTURES 1								
Max Sy	3655	5 GENERATED INDIAN CODE GENRAL_STRUCTURES 1	0.017	0.000	0.029	0.045	0.004	0.078	0.149	0.001
Min Sy	3688	5 GENERATED INDIAN CODE GENRAL_STRUCTURES 1	-0.01	0.000	-0.129	-0.15	0.009	-0.062	-0.10	0.033
Max Sxy	3702	13 GENERATED INDIAN CODE GENRAL_STRUCTURES 9	-0.01	0.004	-0.085	-0.11	0.021	-0.183	0.005	0.116
Min Sxy	3701	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	0.006	0.004	-0.085	-0.11	-0.02	-0.183	0.005	-0.12
Max Mx	3133	14 GENERATED INDIAN CODE	-0.01	-0.00	0.019	0.015	0.000	0.337	0.100	0.000

		GENRAL_STRUCTURES 10								
Min Mx	3700	5 GENERATED INDIAN CODE GENRAL_STRUCTURES 1	0.000	-0.00	-0.144	-0.14	-0.01	-0.363	-0.08	-0.04
Max My	3714	5 GENERATED INDIAN CODE GENRAL_STRUCTURES 1	0.000	0.000	-0.141	-0.14	-0.01	0.259	0.431	0.012
Min My	3125	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	0.000	0.010	0.014	0.017	-0.01	-0.078	-0.34	-0.01
Max Mxy	3693	5 GENERATED INDIAN CODE GENRAL_STRUCTURES 1	-0.01	-0.01	-0.125	-0.15	-0.02	0.135	0.124	0.125
Min Mxy	3698	5 GENERATED INDIAN CODE	0.004	-0.00	-0.125	-0.15	0.017	0.135	0.124	-0.13

		GENRAL_ STRUCTU RES 1								

Table No. – 2: Static Analysis of 20 storey multi-storeyed building for seismic zone II

			Shear		Membrane			Bending Moment		
	Pl ate	L/C	SQ X (loc al) N/m m2	SQ Y (loc al) N/m m2	SX (loc al) N/m m2	SY (loc al) N/m m2	SX Y (loc al) N/m m2	Mxk Nm/ m	My kN m/ m	Mx ykN m/m
M ax Qx	34 01	13 GENERAT ED INDIAN CODE GENRAL_ STRUCTU RES 9	0.05 4	0.00 2	0.00 2	0.00 9	0.00 1	- 0.20 3	- 0.03	0.00 4
Mi n Qx	34 62	15 GENERAT ED INDIAN CODE GENRAL_ STRUCTU RES 11	- 0.05	- 0.01	0.00 9	0.00 7	- 0.00	- 0.02 4	0.02 7	0.03 6
M ax Qy	34 70	12 GENERAT ED INDIAN CODE GENRAL_ STRUCTU RES 8	- 0.01	0.05 4	0.00 5	0.00 7	0.00 2	- 0.04 2	0.02 1	0.03 7
Mi	33	14		-			-			-

n Qy	80	GENERATED INDIAN CODE GENRAL_STRUCTURES 10	0.001	0.05	0.006	0.002	0.00	0.020	0.210	0.00
Max Sx	3171	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	-0.05	-0.00	0.056	0.050	-0.01	0.030	0.010	0.014
Min Sx	6423	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	-0.01	-0.01	-0.206	-0.18	0.013	0.313	0.096	0.105
Max Sy	3180	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	-0.05	0.001	0.038	0.055	0.040	0.109	0.018	-0.05
Min Sy	6432	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	-0.01	0.002	-0.155	-0.19	-0.09	-0.252	-0.07	-0.02
M	64	13			-	-		-	-	

ax Sx y	31	GENERATED INDIAN CODE GENRAL_ STRUCTURES 9	0.012	0.002	0.155	0.19	0.093	0.252	0.07	0.023
Mi n Sx y	64 32	15 GENERATED INDIAN CODE GENRAL_ STRUCTURES 11	-0.01	0.002	-0.155	-0.19	-0.09	-0.252	-0.07	-0.02
M ax M x	31 33	14 GENERATED INDIAN CODE GENRAL_ STRUCTURES 10	-0.04	-0.00	0.034	0.014	0.000	0.690	0.169	0.001
Mi n M x	64 30	13 GENERATED INDIAN CODE GENRAL_ STRUCTURES 9	0.004	0.001	-0.164	-0.15	0.056	-0.735	-0.22	-0.02
M ax M y	64 44	5 GENERATED INDIAN CODE GENRAL_ STRUCTURES 1	0.003	-0.00	-0.144	-0.12	-0.01	0.452	0.788	0.042
Mi	31	15					-	-	-	-

n My	25	GENERATED INDIAN CODE GENRAL_STRUCTURES 11	0.001	0.036	0.012	0.030	0.01	0.141	0.68	0.01
Max Mxy	6432	13 GENERATED INDIAN CODE GENRAL_STRUCTURES 9	-0.01	0.010	-0.059	-0.13	0.076	-0.230	-0.06	0.325
Min Mxy	6431	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	0.007	0.010	-0.059	-0.13	-0.08	-0.230	-0.06	-0.33

Table No. – 3: Static Analysis of 30 storey multi-storeyed building for seismic zone II

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local) N/mm2	SQY (local) N/mm2	SX (local) N/mm2	SY (local) N/mm2	SXY (local) N/mm2	Mxk Nm/m	My kNm/m	Mxy kNm/m
Max Qx	7979	14 GENERATED INDIAN CODE GENRAL_STRUCTURES 10	0.055	-0.022	-0.003	0	0.001	0.12	0.034	-0.06

Min Qx	7973	12 GENERATED INDIAN CODE GENRAL_STRUCTURES 8	-0.053	-0.019	-0.003	-0.001	-0.002	0.105	-0.074	0.054
Max Qy	8018	12 GENERATED INDIAN CODE GENRAL_STRUCTURES 8	-0.011	0.053	0.002	-0.001	0	-0.09	0.02	0.053
Min Qy	7982	14 GENERATED INDIAN CODE GENRAL_STRUCTURES 10	-0.002	-0.055	0.01	0.002	0	-0.02	0.143	0.002
Max Sx	8383	12 GENERATED INDIAN CODE GENRAL_STRUCTURES 8	-0.007	-0.025	0.041	0.018	-0.002	-0.033	0.059	0.01
Min Sx	8448	5 GENERATED INDIAN CODE GENRAL_STRUCTURES 1	0	-0.031	-0.23	-0.04	-0.001	-0.052	0.057	0
Max Sy	3180	15 GENERATED INDIAN CODE GENRAL_S	-0.02	0.002	0.029	0.041	0.015	-0.017	0.005	0.009

		TRUCTURES 11								
Min Sy	8482	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	-0.011	0.013	-0.151	-0.16	-0.059	-0.305	-0.068	0.062
Max Sxy	8481	13 GENERATED INDIAN CODE GENRAL_STRUCTURES 9	0.011	0.013	-0.151	-0.16	0.059	-0.305	-0.068	-0.062
Min Sxy	8482	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	-0.011	0.013	-0.151	-0.16	-0.059	-0.305	-0.068	0.062
Max Mx	8479	13 GENERATED INDIAN CODE GENRAL_STRUCTURES 9	-0.004	-0.004	-0.179	-0.109	0	0.639	0.198	-0.083
Min Mx	8480	13 GENERATED INDIAN CODE GENRAL_STRUCTURES 9	-0.001	0.006	-0.156	-0.105	0.029	-0.764	-0.195	-0.082
Max	84	5 GENERATE	0.01	0	-0.10	-0.12	-0.00	0.31	0.84	0.04

My	94	D INDIAN CODE GENRAL_STRUCTURES 1			1	7	2	6	7	3
Min My	6416	14 GENERATED INDIAN CODE GENRAL_STRUCTURES 10	0	-0.011	-0.007	-0.047	0	-0.051	-0.416	0.026
Max Mxy	8482	13 GENERATED INDIAN CODE GENRAL_STRUCTURES 9	-0.01	0.022	-0.079	-0.08	0.026	-0.233	-0.046	0.198
Min Mxy	8481	15 GENERATED INDIAN CODE GENRAL_STRUCTURES 11	0.01	0.022	-0.079	-0.08	-0.026	-0.233	-0.046	-0.198

Membrane Stresses of irregular C shape building along 10, 20, 30 multi-storeyed building for czone

Shear Stresses of irregular C shape building along 10, 20, 30 multi-storeyedbuilding for zone II

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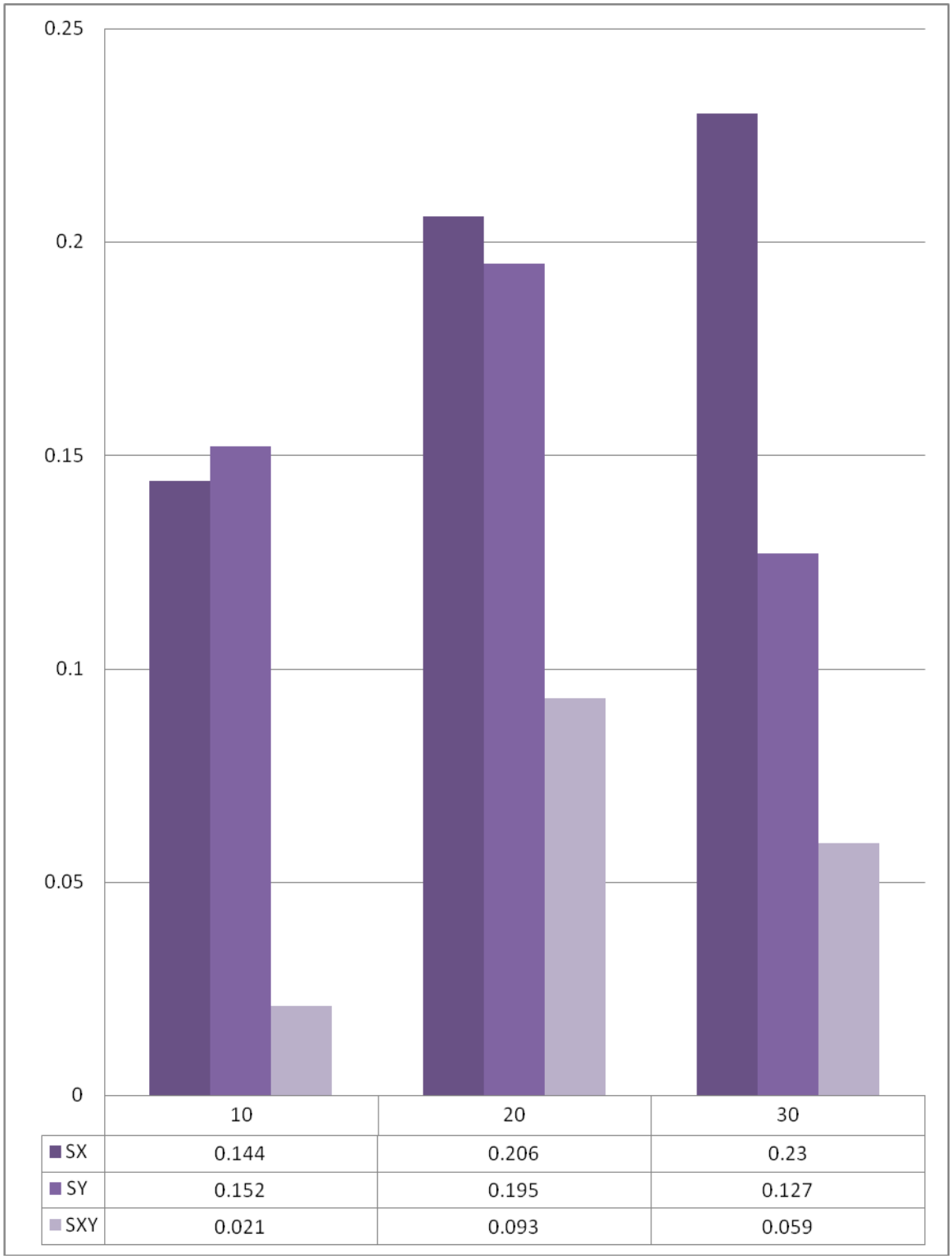

	10	20	30
SX	0.144	0.206	0.23
SY	0.152	0.195	0.127
SXY	0.021	0.093	0.059

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Volume 06 Issue 02
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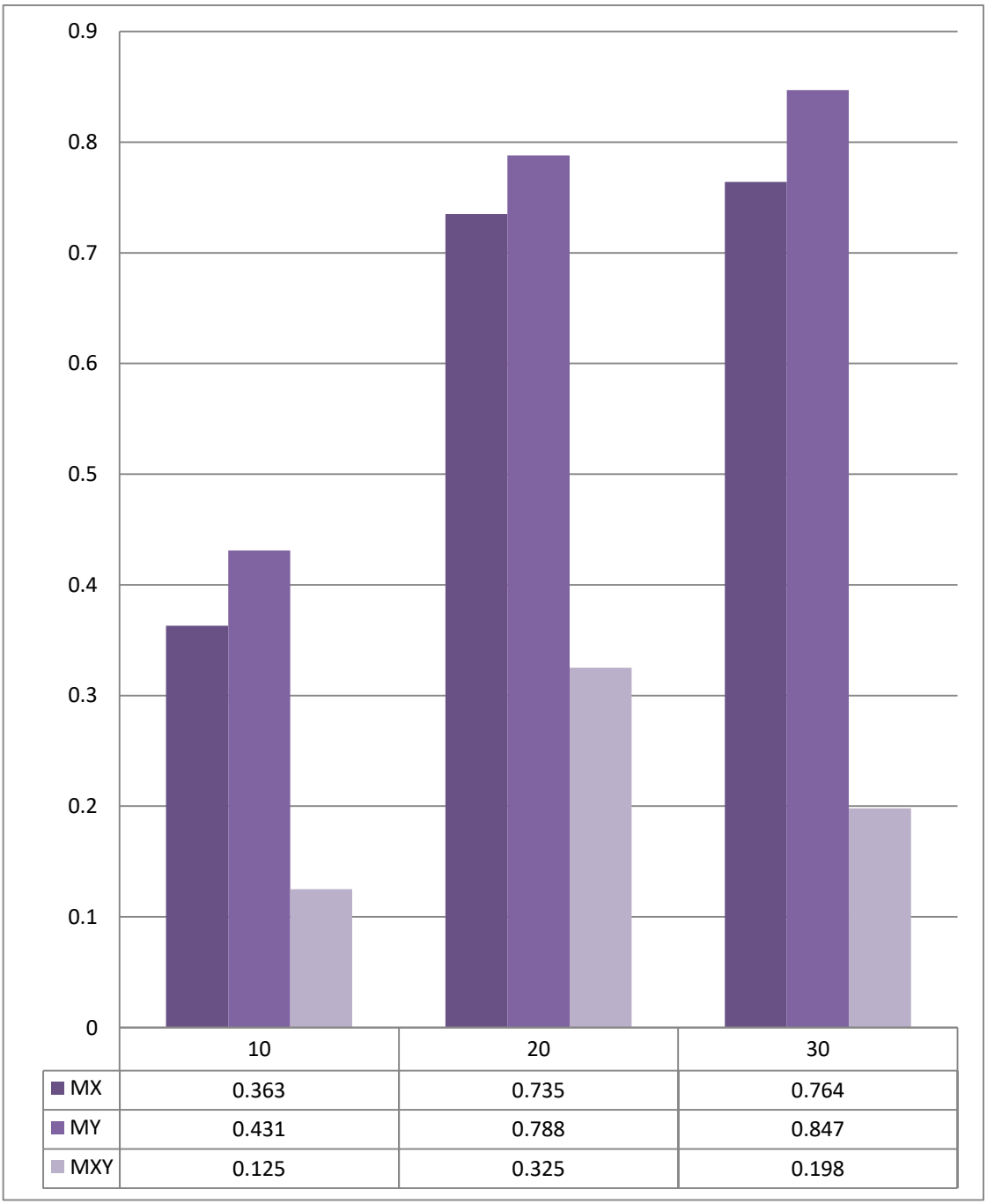
Bending Moment of irregular C shape building along 10, 20, 30 multi-storeyed building for zone II



	10	20	30
MX	0.363	0.735	0.764
MY	0.431	0.788	0.847
MXY	0.125	0.325	0.198

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Volume 06 Issue 02
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2. CONCLUSION

The goal of this research work is to investigate the various seismic responses static as well as dynamic of horizontal irregular multi-storeyed building is carried out. Comparison is made between horizontal irregular building on the basis of shear force, bending moment storey drift, modal displacement and base shear in different seismic zones and found that membrane shear along different axis increases from 10,20 and 30 multi-storeyed building in zone 2 and zone 5 statically and dynamically and bending moment along different axis increases from 10,20 storey and decreases to 30 multi-storeyed building in zone 2 and zone 5 statically and dynamically using staad.pro software and also Propose the best suitable building configuration on existing conditions.

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Volume 06 Issue 02
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