RESEARCH ARTICLE OPEN ACCESS

Comparison Between Structural Analysis of Residential Building (Flat Scheme) Subjected to Gravity With Respect to Seismic Forces (In zone II and zone III) For Different Storey Heights

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ABSTRACT
The recent development in methods to analyze the RC frame structure brings us to this study. This paper is approach to introduce the comparison between structural analysis of Residential building (Flat Scheme) subjected to gravity with respect to seismic forces (in zone II and zone III) for different storey heights.

For structural engineers, seismic load should be considered as important aspect that needs to be included in the building design. However majority of buildings constructed in India are designed for gravity loading only and poorly detailed to accommodate lateral loads. The purpose of this paper is to investigate the comparison between structural analysis of residential building subjected to gravity with respect to seismic forces in zone II and zone III for different storey heights.

The analysis for residential building (G+3) is carried out by using software SAP by seismic coefficient method. Columns, beams and footing has been drawn. Microsoft office Excel 2007 programs were used for drafting , and analysis of columns, beams and footing.

This analysis gives better understanding the seismic performance of buildings. The results show that the building which is designed only for gravity load is found inadequate to resist seismic load in zone II and zone III.
Keywords – Linear static analysis, earthquake, displacement.

I. INTRODUCTION

Vibrations which disturb the earth's surface caused by waves generated inside the earth are termed as earthquakes. It is said that earthquakes will not kill the life of human but structures which are not constructed in considering the earthquake forces do. At present a major importance has given to earthquake resistant structures in India for human safety. India is a sub-continent which is having more than 60% area in earthquake prone zone. A majority of buildings constructed in India even in seismic zones are designed based on consideration of only gravity load. But earthquake is an occasional load which leads to loss of human life but also disturbs social conditions of India. The earthquake forces in a structure depend on a number of factors such as,

- Characteristics of the earthquake (Magnitude, intensity, duration, frequency, etc.)
- Distance from the fault.
- Site geology.
- Type of structure and its lateral load resisting system.

Generally, a three phase approach is followed to describe a structure under earthquake loading, i.e. (i) the structure must have adequate lateral stiffness to control the inter-story drifts such that no damage would occur to non-structural elements during minor but frequently occurring earthquakes, (ii) during moderate earthquakes, some damage to non-structural elements is permitted, but the structural element must have adequate strength to remain elastic so that no damage would occur, and (iii) during rare and strong earthquakes, the structure must be ductile enough to prevent collapse by aiming for repairable damage which would ascertain economic feasibility.

II. DESCRIPTION OF STRUCTURAL MODELS

Size of Beam,	Width	= 0.3m
	Depth	= 0.45m
Size of column,	Width	= 0.3m
	Depth	= 0.6m
Thickness of external wall		= 0.23m
Thickness of internal wall		= 0.15m
Density of concrete		= 25KN/m^3
Density of brickwork		= 20KN/m^3
Thickness of slab		= 0.12m
Live load on floors		= 3KN/m^2
Live load on stairs		= 3KN/m^2
Type of soil		= Medium
Height of storey		=3m,4m,5m

Zone factor, Z (For zone II) =0.1
Zone factor, Z (For zone III) =0.16
Importance factor, I =1
Response reduction factor, R =3
Method: Seismic Coefficient Method

III. ANALYTICAL MODEL CONSIDERED FOR ANALYSIS

The correct analysis will depend upon the proper modeling the behavior of materials, elements and connectivity. Therefore, it is important to select an appropriate and simple model to match the purpose of analysis. For the proposed work, three-dimensional model is selected. Fig shows three-dimensional model of a frame considered for analysis.

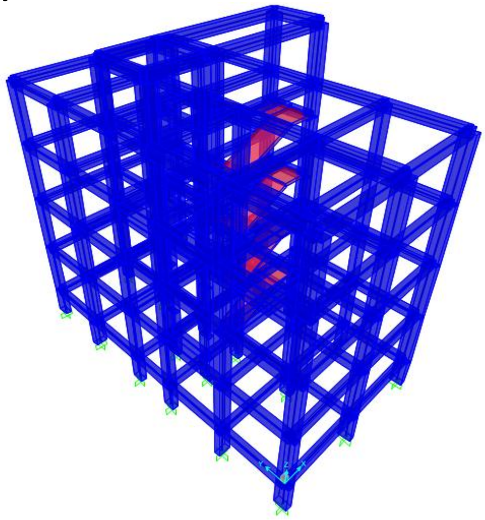


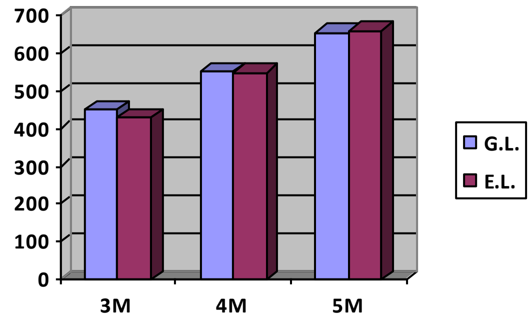
Fig 1: Three-Dimensional Model of Frame

IV. RESULTS AND DISCUSSION

In this paper the results of the selected building models studies are presented. Analysis were carried out using SAP 2000-15 software and different parameters studied such as axial force, bending moment, displacement and torsion for different storey heights. The tables and figures are shown below.

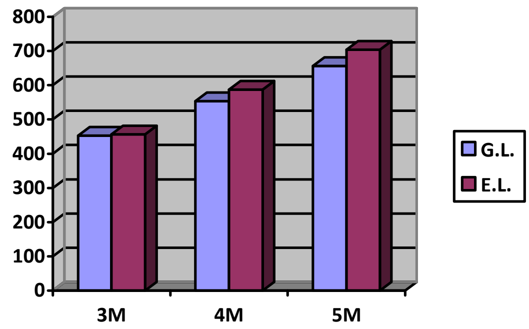
Axial force in column in zone II

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	452.40	553.05	655.67
7 1.5(DL+EQY)	430.59	548.73	660.64



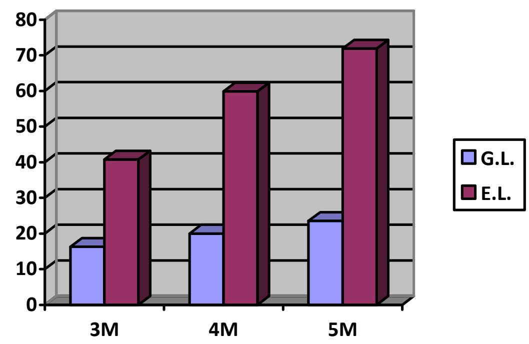
Axial force in column in zone III

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	452.40	553.05	655.67
7 1.5(DL+EQY)	456.77	586.99	703.48



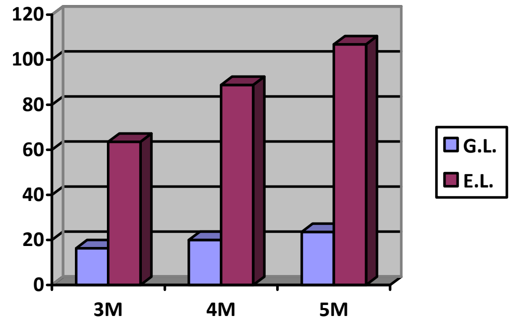
Bending moment Mx in column in zone II

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	16.303	20.030	23.570
7 1.5(DL+EQY)	40.778	59.86	71.861



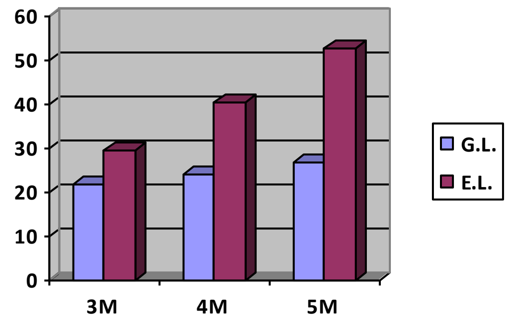
Bending moment Mx in column in zone III

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	16.303	20.030	23.570
7 1.5(DL+EQY)	63.552	88.776	106.861



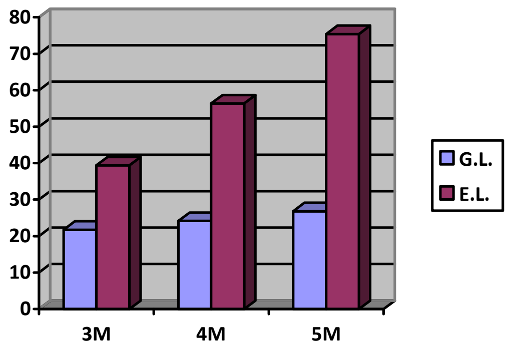
Bending moment My in column in zone II

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	21.734	24.133	26.830
6 1.5(DL+EQX)	29.547	40.416	52.893



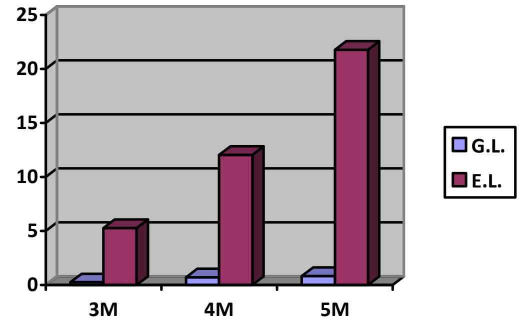
Bending moment My in column in zone III

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	21.734	24.133	26.830
6 1.5(DL+EQX)	39.394	56.384	75.426



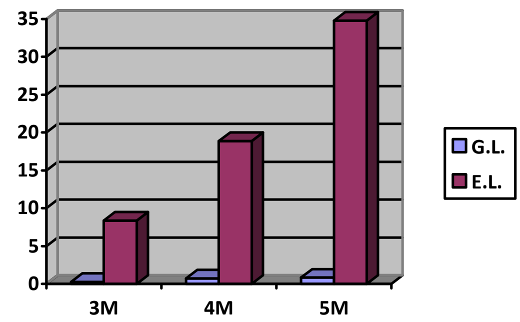
Displacement in column joint in zone II

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	0.2515	0.7199	0.8361
6 1.5(DL+EQX)	5.2614	12.0457	21.7643



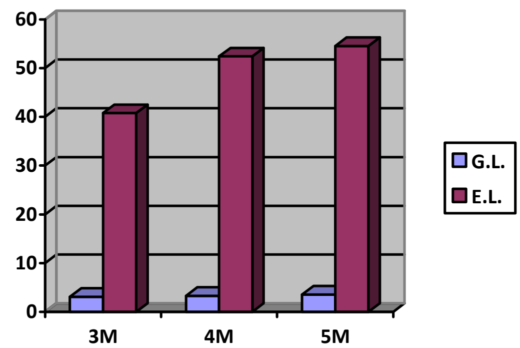
Displacement in column joint in zone III

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	0.2515	0.7199	0.8361
6 1.5(DL+EQX)	8.3563	18.8802	34.7882



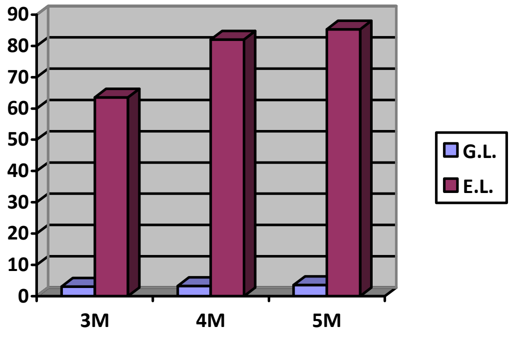
Bending moment Mx in footing in zone II

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	3.0776	3.2875	3.5589
7 1.5(DL+EQY)	40.7784	52.4059	54.563



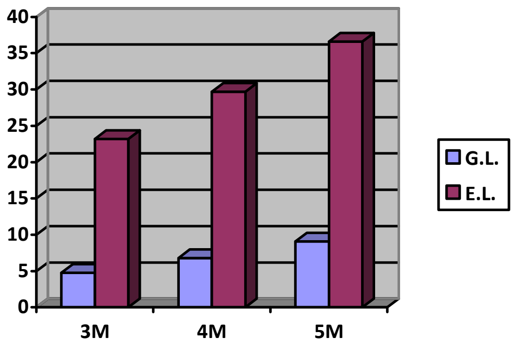
Bending moment Mx in footing in zone III

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	3.0776	3.2875	3.5589
7 1.5(DL+EQY)	63.5524	81.9991	85.2694



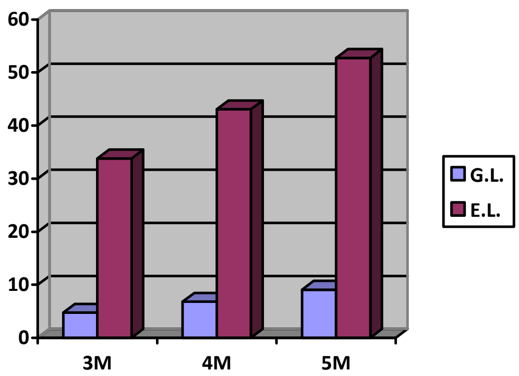
Bending moment My in footing in zone II

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	4.7537	6.7883	9.066
6 1.5(DL+EQX)	23.1714	29.6788	36.5938



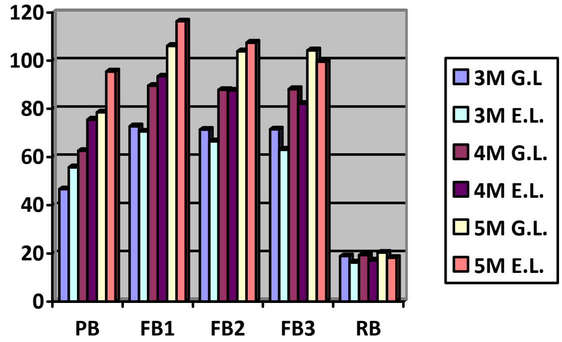
Bending moment My in footing in zone III

COMBINATION	STOREY HEIGHT		
	3M	4M	5M
1 1.5(DL+LL)	4.7537	6.7883	9.066
6 1.5(DL+EQX)	33.7903	43.0502	52.7462



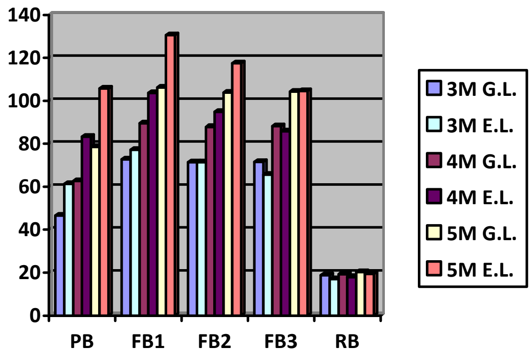
Axial force in beam in zone II

BEAM	COMBINATION	STOREY HEIGHT		
		3M	4M	5M
PB	1 1.5(DL+LL)	46.615	62.613	78.565
	8 1.5(DL-EQX)	55.757	75.557	95.552
FB1	1 1.5(DL+LL)	72.78	89.579	106.175
	8 1.5(DL-EQX)	70.555	93.449	116.326
FB2	1 1.5(DL+LL)	71.364	87.843	103.873
	8 1.5(DL-EQX)	66.527	87.591	107.47
FB3	1 1.5(DL+LL)	71.506	88.164	104.275
	7 1.5(DL+EQY)	63.02	82.151	99.644
RB	1 1.5(DL+LL)	18.818	19.313	20.302
	2 1.2(DL+LL+EQX)	16.29	17.025	18.172



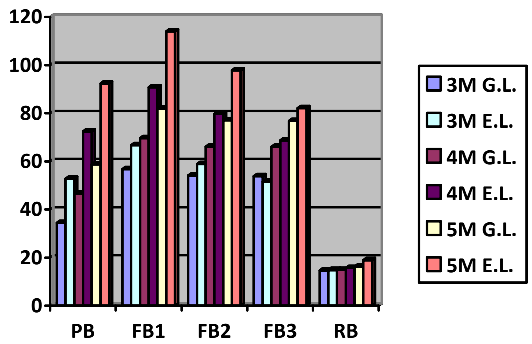
Axial force in beam in zone III

BEAM	COMBINATION	STOREY HEIGHT		
		3M	4M	5M
PB	1 1.5(DL+LL)	46.615	62.613	78.565
	8 1.5(DL-EQX)	61.27	83.322	105.767
FB1	1 1.5(DL+LL)	72.78	89.579	106.175
	8 1.5(DL-EQX)	77.244	103.67	130.612
FB2	1 1.5(DL+LL)	71.364	87.843	103.873
	8 1.5(DL-EQX)	71.385	94.858	117.471
FB3	1 1.5(DL+LL)	71.506	88.164	104.275
	8 1.5(DL-EQX)	65.64	85.887	104.622
RB	1 1.5(DL+LL)	18.818	19.313	20.302
	2 1.2(DL+LL+EQX)	17.031	17.969	19.33



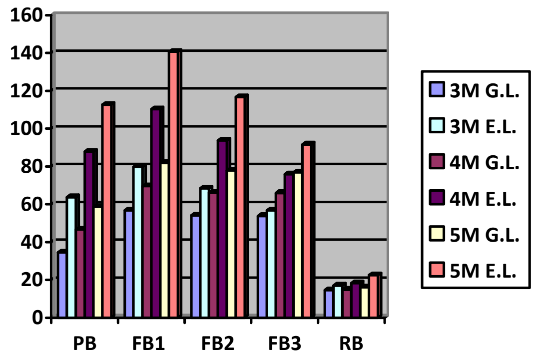
Bending moment in beam in zone II

BEAM	COMBINATION	STOREY HEIGHT		
		3M	4M	5M
PB	1 1.5(DL+LL)	34.46	46.64	58.70
	8 1.5(DL-EQX)	52.73	72.41	92.40
FB1	1 1.5(DL+LL)	56.80	69.61	81.85
	8 1.5(DL-EQX)	66.66	90.73	114.0
FB2	1 1.5(DL+LL)	54.04	66.10	77.07
	8 1.5(DL-EQX)	58.89	79.73	97.76
FB3	1 1.5(DL+LL)	53.83	66.00	76.86
	8 1.5(DL-EQX)	51.59	68.65	82.15
RB	1 1.5(DL+LL)	14.59	14.84	16.17
	6 1.5(DL+EQX)	14.81	15.69	18.94



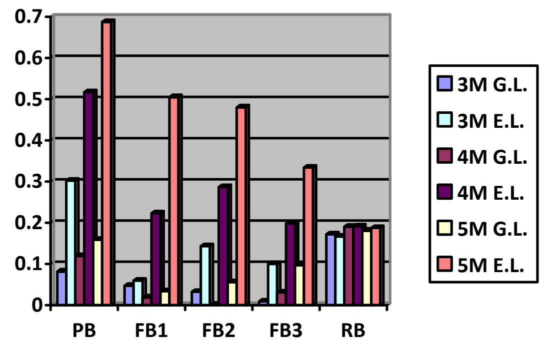
Bending moment in beam in zone III

BEAM	COMBINATION	STOREY HEIGHT		
		3M	4M	5M
PB1	1 1.5(DL+LL)	34.465	46.647	58.704
	8 1.5(DL-EQX)	63.779	87.896	112.68
FB1	1 1.5(DL+LL)	56.805	69.618	81.854
	8 1.5(DL-EQX)	79.760	110.24	140.64
FB2	1 1.5(DL+LL)	54.042	66.108	77.072
	8 1.5(DL-EQX)	68.498	93.803	116.75
FB3	1 1.5(DL+LL)	53.833	66.006	76.868
	8 1.5(DL-EQX)	56.801	75.923	91.65
RB1	1 1.5(DL+LL)	14.593	14.842	16.174
	6 1.5(DL+EQX)	17.037	18.246	22.504



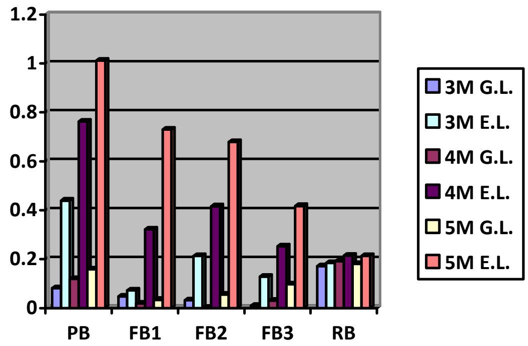
Torsion in beam in zone II

BEAM	COMBINATION	STOREY HEIGHT		
		3M	4M	5M
PB1	1 1.5(DL+LL)	0.0818	0.1192	0.1586
	9 1.5(DL-EQY)	0.3024	0.5171	0.6878
FB1	1 1.5(DL+LL)	0.0475	0.019	0.0338
	9 1.5(DL-EQY)	0.0595	0.223	0.505
FB2	1 1.5(DL+LL)	0.0322	0.0013	0.0559
	9 1.5(DL-EQY)	0.1434	0.2869	0.4803
FB3	1 1.5(DL+LL)	0.0093	0.0307	0.0971
	9 1.5(DL-EQY)	0.1	0.1986	0.3344
RB1	1 1.5(DL+LL)	0.1719	0.1907	0.181
	3 1.2(DL+LL+EQY)	0.1666	0.1912	0.1876



Torsion in beam in zone III

BEAM	COMBINATION	STOREY HEIGHT		
		3M	4M	5M
PB1	1 1.5(DL+LL)	0.0818	0.1192	0.1586
	9 1.5(DL-EQY)	0.4395	0.7621	1.0117
FB1	1 1.5(DL+LL)	0.0475	0.019	0.0338
	9 1.5(DL-EQY)	0.0724	0.3213	0.7298
FB2	1 1.5(DL+LL)	0.0322	0.0013	0.0559
	9 1.5(DL-EQY)	0.2136	0.416	0.6792
FB3	1 1.5(DL+LL)	0.0093	0.0307	0.0971
	9 1.5(DL-EQY)	0.1289	0.2524	0.4174
RB1	1 1.5(DL+LL)	0.1719	0.1907	0.181
	3 1.2(DL+LL+EQY)	0.184	0.2144	0.2132



V. CONCLUSION

- In column there is very little change in axial force due to gravity load in comparison with earthquake load for 3M, 4M and 5M storey height. The axial force is linearly varries along with the storey height.
- The bending moment due to earthquake load in column and in footing is highly increasing with the storey height. So, if earthquake load is not considered for the analysis, there will be possibilities of overturning.
- The earthquake force produces the lateral displacement in the structure, so the displacement due to earthquake load is very severe.
- In beam, there is also a little change in axial force due to gravity load in comparison with earthquake load.
- In beam, the bending moment due to earthquake load is more as compared to gravity load. As the floor height is increases, the bending moment in beam decreases.
- The effect of torsion in beam due to earthquake load is more as compared to gravity load. As the floor height is increases, the torsion in beam decreases.
- As the effect of earthquake is more in bending moment in column, footing and beam, displacement in column joint, and torsion in beam, if the structure is designed only for gravity load it will not sustain the earthquake load. So we have to consider the earthquake load for the analysis and design of building structures.

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