International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 02 Issue: 06| Sep-2015 www.irjet.net p-ISSN: 2395-0072

SEISMIC EVALUATION OF MULTISTOREY RC BUILDING WITH AND WITHOUT FLOATING COLUMN

Kavya N[1], Dr. K.Manjunatha[2], Sachin.P.Dyavappanavar[3]

[1] Post Graduate Student in CAD Structural Engineering, Dept of Civil Engineering, University BDT college of Engineering Davanagere, Karnataka, India

[2] Professor, Dept of Civil Engineering, University BDT college of Engineering Davanagere, Karnataka, India

[3] Post Graduate Student in CAD Structural Engineering, Dept of Civil Engineering, University BDT college of Engineering Davanagere, Karnataka, India

---***---

Abstract - ***In the present scenario, the buildings with floating columns are the typical features in the multi-storey construction. As the load path in the floating columns is not continuous, they are more vulnerable to the seismic activity. Sometimes, to meet the requirements these type of aspects cannot be avoided though these are not found to be of safe.***
Hence, an attempt is taken to study the behavior of the building during the seismic activity. In this study, the seismic behavior of the RC multistory buildings with and without floating column are considered. The analysis is carried out for the multi-storey buildings of G+3 situated at zone iv , Using ETABS Software

Key Words: *Floating column, ETABS, Equivalent static method, response spectrum analysis,*

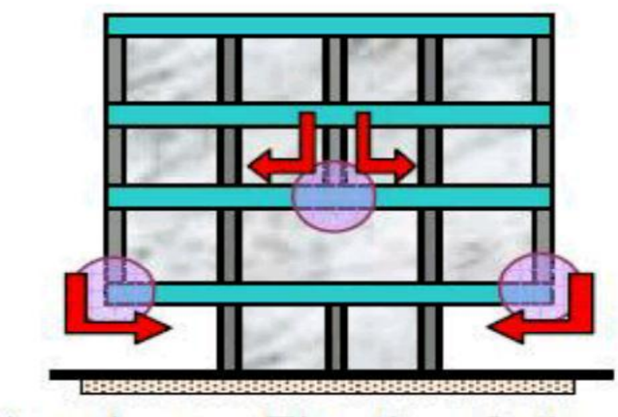
1. INTRODUCTION

1.1 General

Earthquake cause the rapid ground motions in all directions, radiating from the epicenter. These ground motions causes the structure to quiver band induces inertia forces in them. Earthquake exposes the limitation in the structures. The structures, which may emerge as strong , may disintegrate like houses of cards during seismic activity. Because of the lack of knowledge of the seismic performance of the buildings several wrong practices remained continued, till an seismic activity exposes these. There are copious examples enlisted in the design information of past earthquakes in which causes of collapse of reinforced concrete building has been imprudence in configuration loads.
A column is a vertical constituent starting from foundation level and transferring the load to the earth. The term floating column is also defined as a vertical element which rests on the beam. Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation.

1.2 FLOATING COLUMN:

Floating column is also a vertical member, The Columns Float or move in above stories such that to provide more open space is known as Floating columns. Floating columns are implemented, specially above the base floor, so that added open space is accessible for assembly hall or parking purpose.



For the study of the floating column many projects have been undertaken where the transfer of load is through the girders. Floating columns are usually adopted above the ground storey level. So that maximum space is made available in the ground floor which is essentially required in apartments, mall or other commercial buildings where parking is a major problem.

2. METHODOLOGY

To determine seismic behavior of the Buildings with and without floating columns for zone IV the basic components like inter storey drift, lateral displacement, and fundamental time period this analysis has been carried using the software ETABS V 9.7.1. for the analysis purpose Equivalent static method, and Response spectrum methods are adopted.

2.1 BUILDING MODELING

In this building model RC multi storied structures of 4 stories is considered with and without floating columns are for the analysis The typical height of the floors is considered as 3.6m and the height of the ground storey is taken as 4.8m. to avoid the tensional response under the pure lateral forces the buildings are Kept symmetric in both the orthogonal directions in plan. The plan and elevation of the building considered is as shown in the figure

2.2 Material Properties

The materials used for analysis of building models construction is reinforced concrete with M-25grade of concrete and Fe-415 grade of steel. and the stress-strain relationship is used as per IS 456:2000.
the basic material properties are in given table 1.

Material Properties	Values
Characteristic strength of concrete, f_{ck}	25 MPa
Yield stress for steel, f_y	415 MPa
Modulus of Elasticity of steel, E_s	20,0000 MPa
Modulus of Elasticity of concrete, E_c	25000 MPa

2.3 SECTION PROPERTIES:

Comprehensive information of the building models considered

Structure	SMRF
No. of storeys	G+3
Type of building	Commercial
Type of Foundation	Isolated footing
Seismic zone	IV
MATERIAL PROPERTIES9	
Grade of concrete	M20 and M30[for cantilever beam]
Grade of steel	Fe415
Youngs modulus of concrete6	ForM20, 22.32X10^{68}KN/m^2
Density of concrete	25 KN/m^2
Young's modulus of brick masonary	2100X10^3 KN/m^3
Densityof brick masonary	20 KN/m^3
MEMBER PROPERTIES5	
Thickness of slab	0.150 m
For four storey building:	0.25*0.5m (beam) 0.45*0.95m(overhanging beam) 0.25* 0.4m (small beam) 0.3* 0.5 (floating column) 0.6*0.6(peripheral column) 0.4* 0.5(core column)
Thickness of wall	0.25m
Roof finishes	2.0KN/m^2
Floor finishes	1.0 KN/m^2
Live load intensities	
Roof	1.55 KN/m^2
Earthquake Live load on slab as per clause 7.3.1 and 7.3.2 of IS 1893(part I)-2002	
floor	0.25* 3.0= 0.75 KN/m^2
Roof	5 KN/m^2

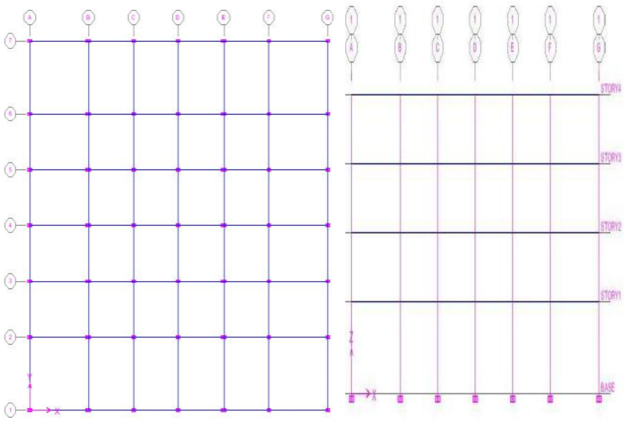
2.4 Geometry of the Considered Model:

The geometry of the building of 4 storied building model are given in table

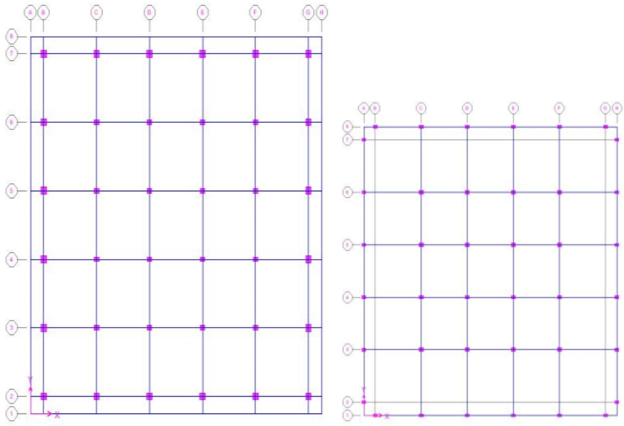
No. of Storeys	No. Bays in X direction	Bay width in X direction	No. of Bays in Y direction	Bay width in Y direction	Bottom Storey Ht	Storey Ht
4	6	5 m	5	6 m	4.8 m	3.6m

2.5 Plans and models

Plans and 3D models considered for the analysis purpose shear walls with different shape and different locations in the building



The plan and Elevation of the G+3 building model (model 1)



The plan and Elevation of the G+3 building model (model II)

2.6 LOAD COMBINATIONS CONSIDERED FOR THE BUILDING ANALYSIS

Table:- Load combinations as per IS 1893(Part1):2002

Sl. No	Load Combination	Load Factors
1	Gravity analysis	1.5(DL+LL)
2	Equivalent static analysis	a) 1.2(DL+LL± EQX) b) 1.2(DL+LL± EQY) c) 1.5 (DL ± EQX) d) 1.5 (DL± EQY) e) 0.9 (DL ± EQX) f) 0.9 (DL± EQY)
3	Response spectrum analysis	a) 1.2(DL+LL± RSX) b) 1.2(DL+LL± RSY) c) 1.5 (DL± RSX) d) 1.5 (DL± RSY) e) 0.9 (DL± RSX) f) 0.9 (DL± RSY)

Where,
DL= Dead load
LL = Live load
EQX,EQY= Earthquake load in the X and Y directions , respectively
RSX,RSY = Earthquake Spectrum in the X and Y directions, respectively.

The above shown load combinations are adopted for the design and analysis of the structure according to the code IS 1893 (part I) : 2002

3. RESULTS & DISCUSSIONS

3.1 NATURAL TIME PERIOD

The fundamental natural period of the building is calculated by the following expression as given in the code IS 1893(part I) : 2002

$T = 0.075 * h^{0.75}$ ---------- for the bare frame

$T = \frac{0.09h}{\sqrt{d}}$ ----------- for the infilled frame

Where,

h represent the overall height of the building
d represent the base dimension of the building in the direction of vibration considered. The calculation of the lateral load and its distribution along the height of the building is carried out according to the IS 1893(part I) : 2002
The earthquake load analysis is considered in both the transverse and longitudinal direction for the equivalent static method.
The natural time period obtained from seismic code IS 1893 (part1):2002 and analytical (ETABS) are shown in table

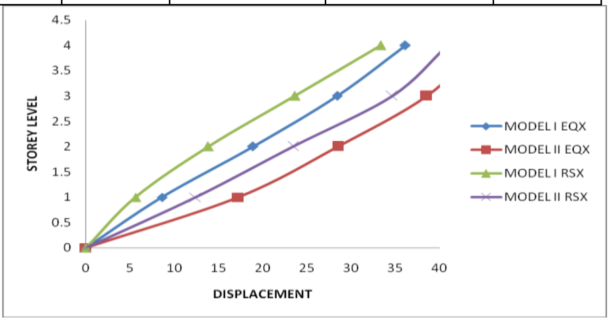
Building	Models	Gravity analysis		Seismic analysis	
				1.2 combo	
		Code	Analysis	Code	Analysis
G+3	I	0.588	1.014	0.588	1.014
	II	0.588	1.157	0.588	1.157

3.2 LATERAL DISPLACEMENTS.

Lateral displacement profile for building models obtained from the equivalent static and response spectrum methods are shown in figures

Table : Lateral displacement for the four storey building for the load combination 1.2(DL+LL± EL) in longitudinal direction.

Storey	Displacement in mm			
	Equivalent static method		Response spectrum method	
	I	II	I	II
4	36.1	44.5	33.3	40.9
3	28.4	38.5	23.6	34.6
2	18.9	28.5	13.8	23.4
1	8.6	17.2	5.6	12.4

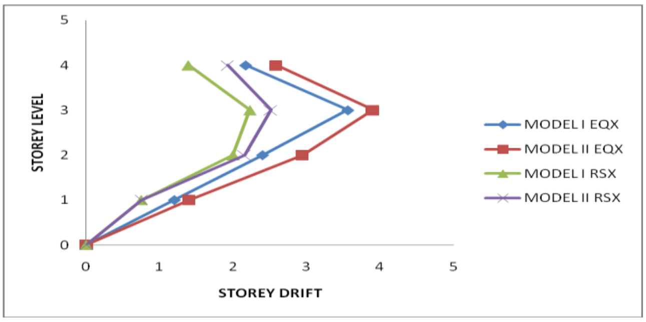


3.3 STOREY DRIFT:--

As per Clause: 7.11.1 of IS: 1893 (Part 1): 2002 (6) the storey drift for RC building is limited to 0.004 times the storey height, that is 0.4% of storey height

Table Storey drift for the four storey building for the load combination 1.2 (DL + LL ± EL) in longitudinal direction

Storey	Storey Drift in mm			
	Equivalent static method		Response spectrum method	
	I	II	I	II
4	2.17	2.58	1.39	1.92
3	3.56	3.9	2.23	2.51
2	2.4	2.94	2.00	2.15
1	1.2	1.4	0.75	0.75



3.4 CALCULATION OF BASE SHEAR

Base shear and scaling factor for four storied building model as shown in table

Model	EQX	RSX	SF	EQY	RSY	SF
I	2384.81	2110.2	1.13	2374.81	2122	1.12
II	2743.09	2213.2	1.24	2672.00	2172.3	1.23

The analysis is carried out in both equivalent static method and Response spectrum method. From the above tables it is observed that the base shear values are directly proportional to the storey of the building. The building with the floating columns shows the high base shear value.

CONCLUSIONS

In this dissertation work, the behavior of the buildings with and without floating columns are analyzed for seismic and gravity condition. The seismic parameters such as lateral displacement , base shear, fundamental time period and inter storey drift are studied and the comparison between these parameters are given between the regular building and building with floating column.

The conclusions are drawn as below:

1) The natural time periods obtained from the empirical expressions do not agree with the analytical natural periods. Hence, the dynamic analysis is to be carried out before analyzing these type of structures. And also it can be concluded from the analysis that the natural time period depends on the building configuration.
2) Lateral displacement increases along the height of the building. There is more increase in the displacement for the floating column buildings compared with the regular building.
3) The inter storey drift also increases as the increase in the number of storeys. The storey drift is more for the floating column buildings because as the columns are removed the mass gets increased hence the drift.
4) As the mass and stiffness increases the base shear also increases. Therefore, the base shear is more for the floating column buildings compared to the conventional buildings.
5) Hence, from the study it can be concluded that as far as possible, the floating columns are to be avoided especially, in the seismic prone areas.

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 02 Issue: 06| Sep-2015 www.irjet.net p-ISSN: 2395-0072

REFERENCES:

1) **Agarwal Pankaj , Shrikhande Manish (2009),** "Earthquake resistant design of structures", PHI learning private limited, New Delhi.
2) **A.P. Mundada (2014)**, "Comparative Seismic Analysis of Multi storey Building with and without Floating Column" International Journal of Current Engineering and Technology, Vol.4, No.5 (Oct 2014)
3) **Arlekar Jaswant N , Jain Sudhir K. and Murty C.V.R, (1997)**, "Seismic Response of RC Frame Buildings with Soft First Storeys". Proceedings of the CBRI Golden Jubilee Conference on Natural Hazards in Urban Habitat, 1997, New Delhi.
4) **C.V.R. Murty**, "Earthquake tip 6, IITK-BMTPC", Indian Institute of Technology, Kanpur, India
5) **Hartley Gilbert and Abdel-Akher Ahmed**, "Analysis of building frames" Journal of Structural Engineering, Vol. 119, No. 2, Page no: 468-483, 1993
6) **IS 1893 (part1) 2002,** Criteria for Earthquake Resistance Design of Structures, part 1-General provisions and buildings, fifth revision, Bureau of Indian Standard, New Delhi, India
7) **Maison and Ventura, Members of ASCE** computed dynamic properties and response behaviours OF THIRTEEN-STORY BUILDING, 1991.
8) Maison Bruce F. and Neuss Carl F, "Dynamic analysis of a forty four story building", Journal of Structural Engineering, Vol. 111, No. 7, Page No:1559- 572, July, 1985.
9) **Naga Sujani.S, Phanisha.K, Mohana Rupa, Sunita** Sarkar, P.Poluraju, "Comparison of behaviour of a multi-storey building situated in zone II and zone V, using pushover analysis by Sap 2000", International Journal of Emerging Trends In Engineering And Development, Issue 2, Vol.2(March-2012), Pp. 480-487.
10) **Pramodini, Santosh kumar, Dyavanal S.S and Annigeri S.A.(2007)** "Performance based Seismic Evaluation of Multi storied RCC Buildings" National Conference on Recent Trends in Infrastructure Development-RETID 2007, 24-25, PSG College of Technology and Association of Consulting Civil Engineers, Coimbatore.
11) **Prerana Nautiyal, Saleem Akhtar and Geeta Batham (2014)** " Seismic Response Evaluation of RC frame building with Floating Column considering different Soil Conditions" Department of Civil Engineering, University Institute of Technology, RGPV, Bhopal, Madhya Pradesh, India.vol.4,No.1.
12) **Santosh kumar, S.S Dyavanal and Satish A. Annigeri (2006)** "Performance based Seismic Evaluation of Symmetric Multi storied Buildings" 13th Symposium on Earthquake Engineering Indian Institute of Technology, Roorkee December 18-20,.

BIOGRAPHIES

Kavya N (M.Tech Scholar)
Department of studies in Civil Engineering
University BDT College of Engineering, Karnataka, India

Dr.K.Manjunath (BE.MSc.Ph.D.MIGS,MISTE,MISRMTT)
Chairman & Professor
Department of studies in civil engineering
University BDT College of Engineering, Karnataka, India

Sachin P Dyavappanavar (M.Tech Scholar)
Department of studies in Civil Engineering
University BDT College of Engineering, Karnataka, India