Seismic Analysis of A Multi-Storeyed Building With Floating Columns using ETABS

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***Abstract*—Floating columns are a type of column constructed over beams or slabs of any intermediate floors of a multistoreyed building.They are not attached to any footings or pedestal and is also called hanging column.The present study investigates the effect of floating column upon the storey shear,displacement and storey drift using ETABS software.Static analysis and dynamic analysis using response spectrum method is done for multi storeyed building with and without floating columns.**

Keywords—Floating columns,static analysis,dynamic analysis,response spectrum analysis.

1.INTRODUCTION

Today many multistoreyed buildings have floating column.This is provided generally to provide more space in ground floor for accomodation of parking and for aesthetic beauty.Floating column in a building may may result in concentration of forces,or deflection in the undesirable load path in vertical laretal force resisting system.Building with hanging column at an intermediate storey have discontinuities in the load transfer path.This paper presents the results of investigation of structural response quantities of a multi storeyed building with floating column provided at outer corners and inner corners.

II. OBJECTIVES

The primary objectives of this study are –

1. To ensure safety against earthquake forces of tall structures
2. To reduce irregularity introduced by floating columns
3. To produce good structural work for performing analysisand design for a building.
4. To predict the responses of different structural componentsdue to effect of loads.
5. To design and analyse multi-storeyed building in asystematic process
6. To study the structural responseof the building models withrespect to
   - Base shear
   - Storey displacement
   - Storey drift
   - Fundamental time period of the building

III. MODEL STUDIES

A 24 m x 24 m multi storeyed building (G+6) is selected forstudy.The details of bare frame is given in Table.1.

TABLE1. BUILDING DATA

Building Type	G+6 RC building
Plan	24 mx 24m
No. of bays	5
Bay width	4.8m
Total building height	24 m
Each storey height	3 m
Beam	300mm x 400mm
Column	400mm x 500mm
Slab Thickness	150 mm
Exterior wall thickness	230 mm
Interior Wall Thickness	155 mm
Materials used	Fe415 rebars M25 grade concrete
Load combinations	Based on IS 875-1987,IS 456-2000
Earthquake load	based on IS 1893-2002
Live Load	2 kN/m^2
Floor Finish load	1 kN/m^2
Wall load	13.66 kN/m

The modelling of a bare frame is done as the first step.The model details and their details are shown in the figures given below.The plan,elevation,3D view are shown below.

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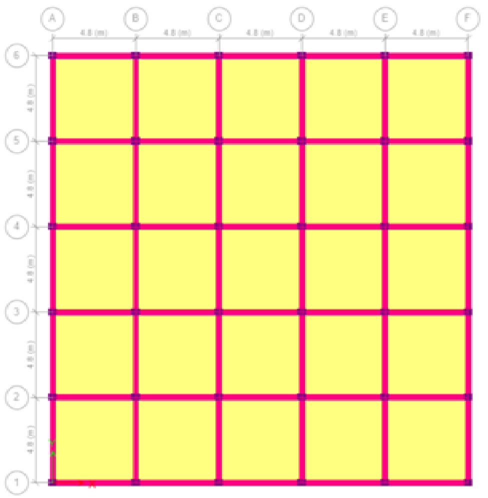


Fig.1 Plan view

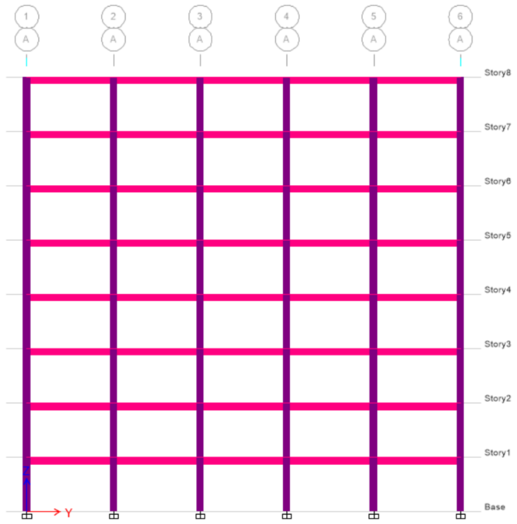


Fig.2.Elevation view

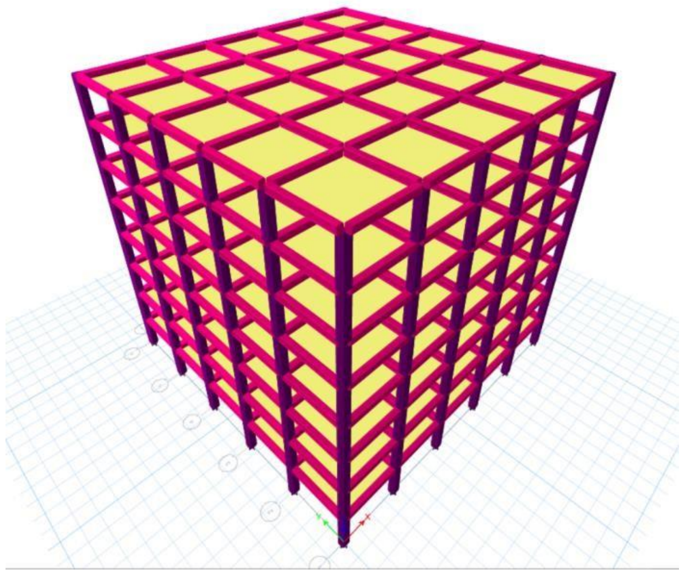


Fig.3 3D view of building

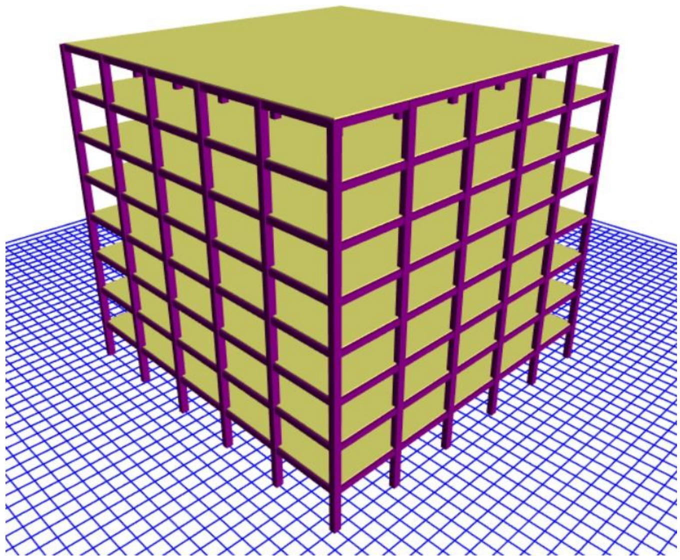


Fig.4 Rendered 3D View

After modelling completed,analysis of this bare frame is carried out.When the loads are applied,we get the mode shapes during a particular time interval.The first mode shape obtained is shown below.It shows the deformation of the building due to the loading.

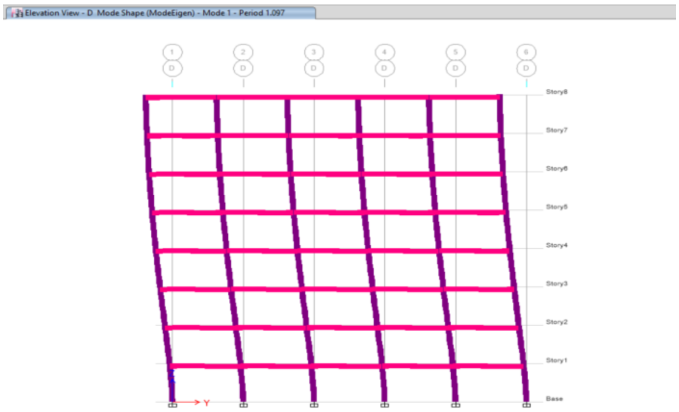


Fig.5 First mode shape

FLOATING COLUMN

The same building is modelled with floating columns provided at the inner and outer corners of the building.The variation in the behaviour and the displacements are necessary to analyse the effect of floating column in buildings,especially in earthquake prone areas like seismic zones IV and V.

The model of the building with floating column at inner corners is shown below.

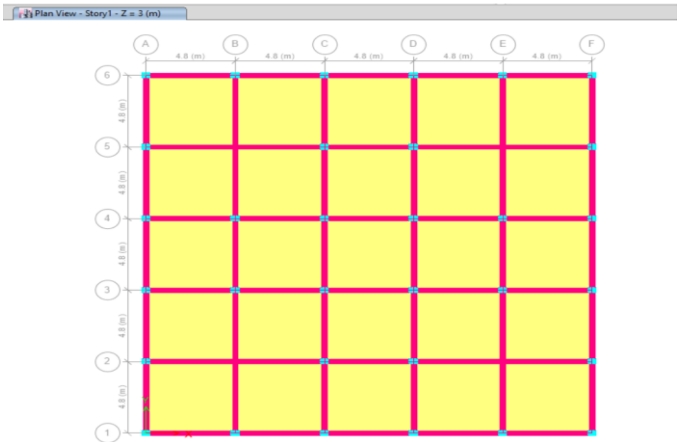


Fig.6 a)Plan of the building with infill wall at inner corners

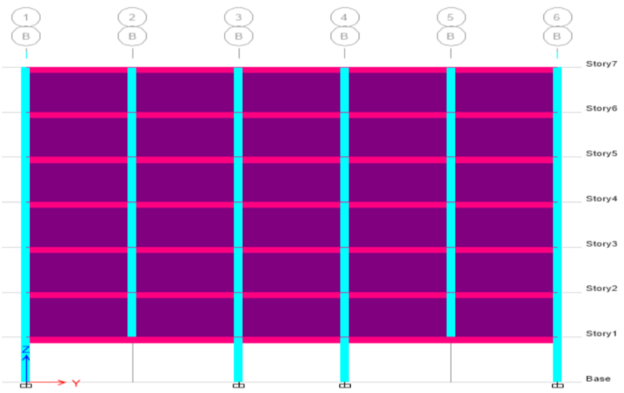
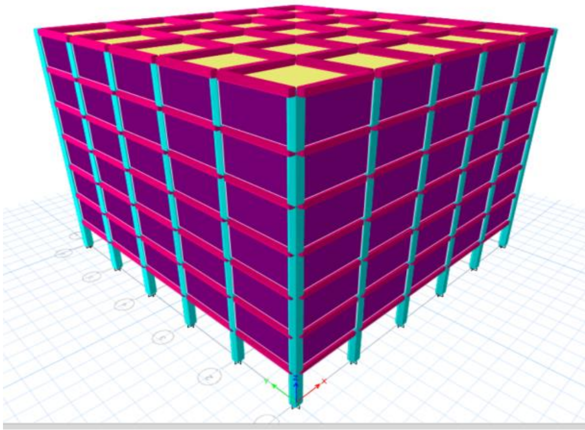


Fig6 b) Elevation of building



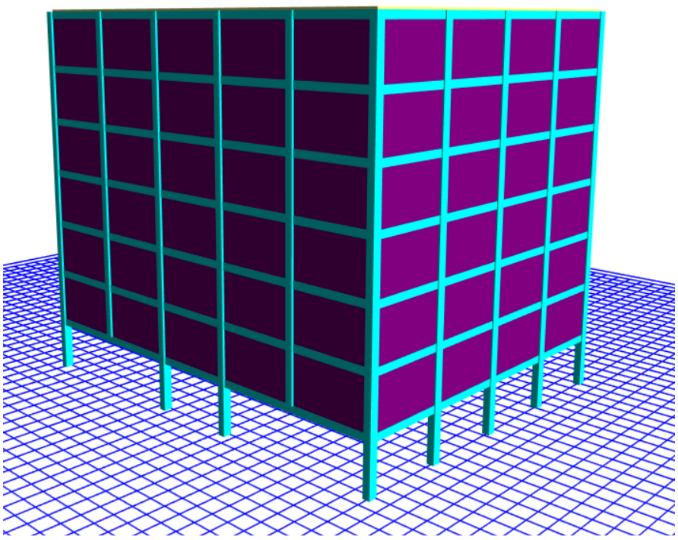


Fig 6 c) 3D view

Similiarly,the ground soft storey building with floating columns are provided at the outer corners of the building.The model details are shown in Fig.7

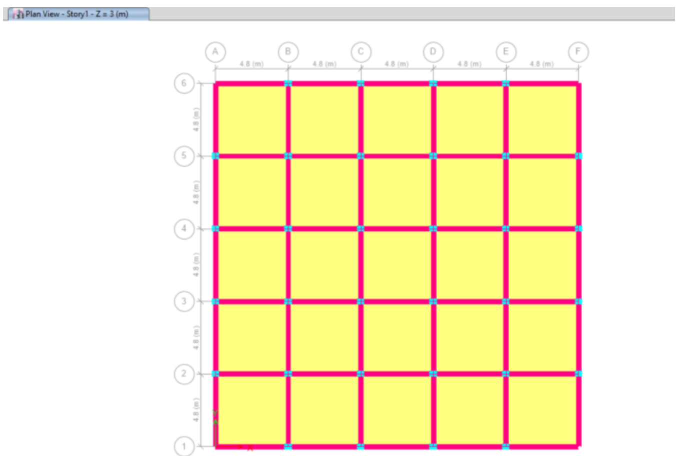


Fig..7a) Plan of the building with infill wall at outer corners

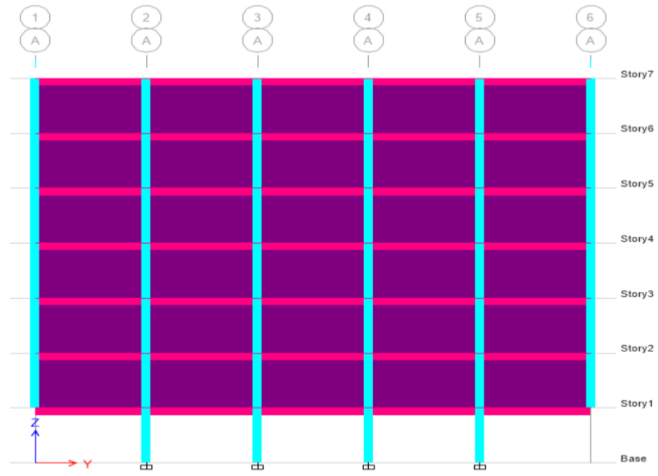


Fig7 b) Elevation of building

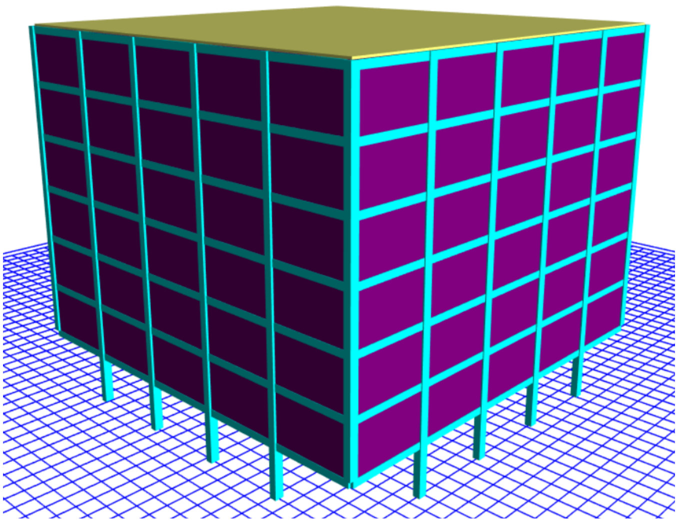


Fig 7 c) 3D view

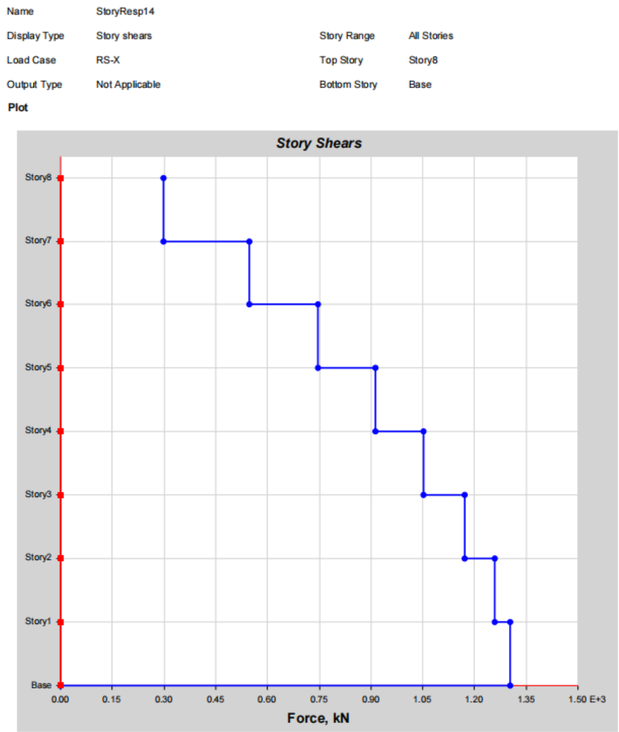
IV. METHOD OF ANALYSIS

Seismic analysis is an important tool in earthquake engineering which is used to invvestigate the response of buildings in a simpler manner due to seismic forces.It is a part of structural design where earthquake is prevalant.

Response Spectrum Analysis (RSM) permits a multiple modes of response of a building to be taken into account.Computer analysis can be done to determine these modes of structure.For each mode,a response is obtained from the design spectrum ,corresponding to modal frequency and modal mass,and they are combined to estimate the total response of the structure.In this,the magnitude of forces in all directions are calculated and then effects on the building are observed.

V. RESULTS AND DISCUSSIONS

In the present study,the effect of varying the location of floating columns is studied.The results are compared in graphical form for analysis of building with floating column at inner,outer corners and without floating column.



Story7	21	Top	546.7804	1.633E-06
		Bottom	546.7804	1.633E-06
Story6	18	Top	746.8681	1.567E-06
		Bottom	746.8681	1.567E-06
Story5	15	Top	912.4469	1.365E-06
		Bottom	912.4469	1.365E-06
Story4	12	Top	1053.0104	1.423E-06
		Bottom	1053.0104	1.423E-06
Story3	9	Top	1170.6475	1.006E-06
		Bottom	1170.6475	1.006E-06
Story2	6	Top	1259.258	6.676E-07
		Bottom	1259.258	6.676E-07
Story1	3	Top	1302.9443	5.623E-07
		Bottom	1302.9443	5.623E-07
Base	0	Top	0	0
		Bottom	0	0

Fig.8a)Base shear for bare frame

Story	Elevation m	Location	X-Dir mm	Y-Dir mm
Story8	24	Top	17.476	0.002
Story7	21	Top	16.614	0.002
Story6	18	Top	15.199	0.002
Story5	15	Top	13.23	0.002
Story4	12	Top	10.768	0.002
Story3	9	Top	7.899	0.002
Story2	6	Top	4.771	0.002
Story1	3	Top	1.745	0.002
Base	0	Top	0	0

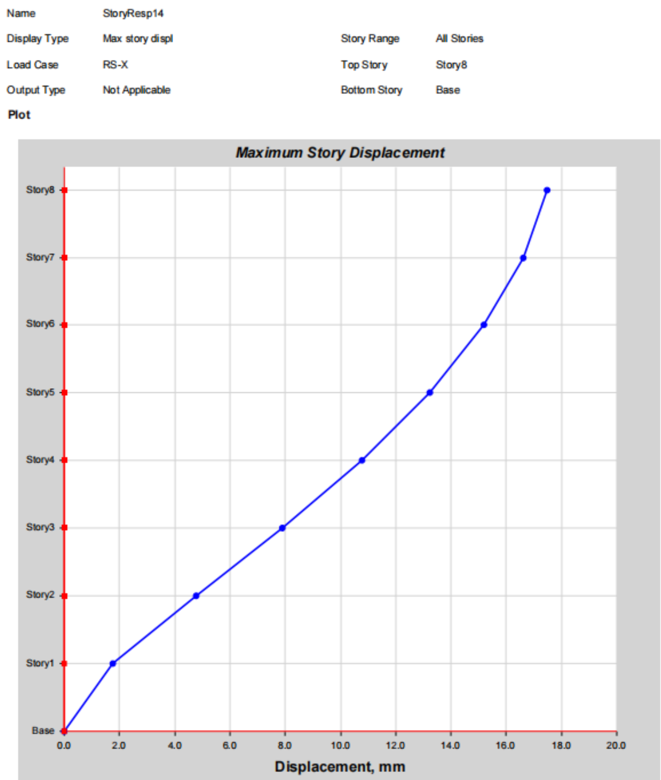


Fig.8b) storey displacement for bare frame

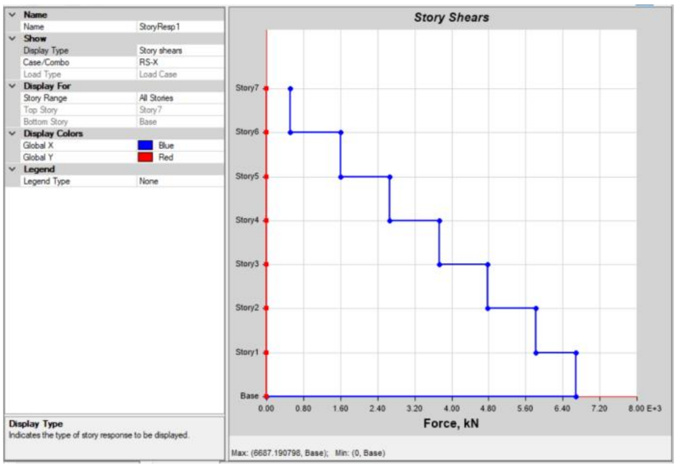


Fig.9a) Base shear for building with floating column at inner corners

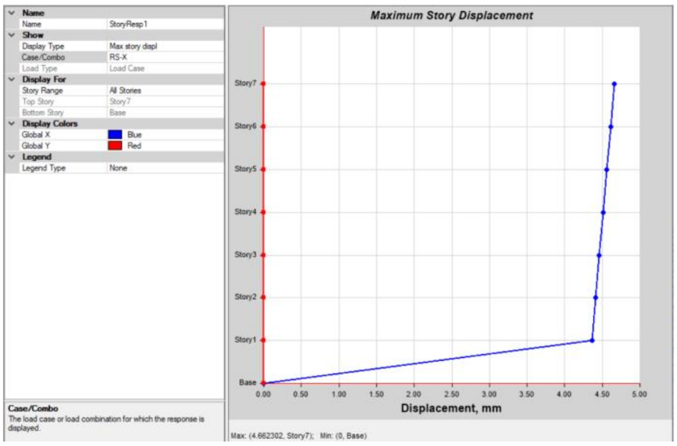


Fig9b)storey displacement for building with floating column at inner corners

Story	Elevation m	Location	X-Dir	Y-Dir
Story8	24	Top	0.000323	4.134E-07
Story7	21	Top	0.000515	4.249E-07
Story6	18	Top	0.000694	3.628E-07
Story5	15	Top	0.000847	3.445E-07
Story4	12	Top	0.00097	3.354E-07
Story3	9	Top	0.001048	3.164E-07
Story2	6	Top	0.00101	2.236E-07
Story1	3	Top	0.000582	0.000001
Base	0	Top	0	0

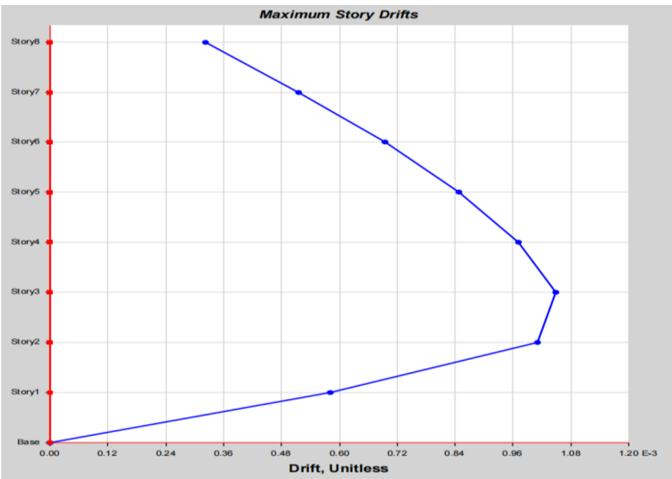


Fig.8c) storey drift for bare frame

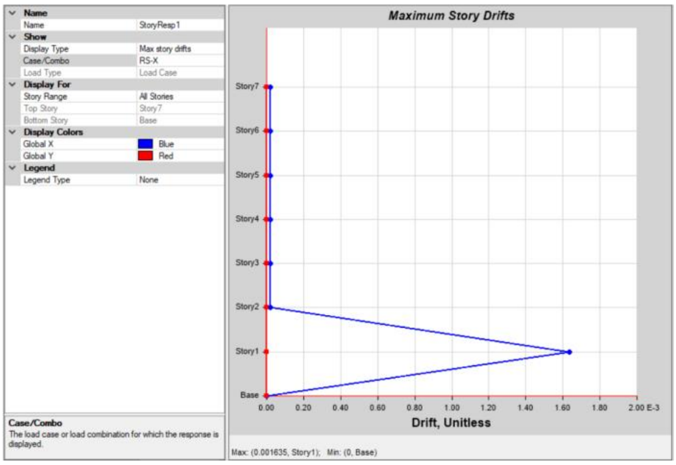


Fig.9c) storey drift for building with floating column at innercorners

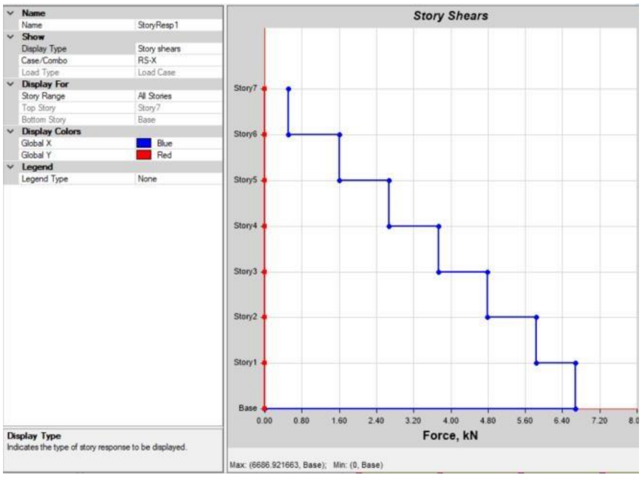


Fig.10a) Base shear for building with floating column at outercorners

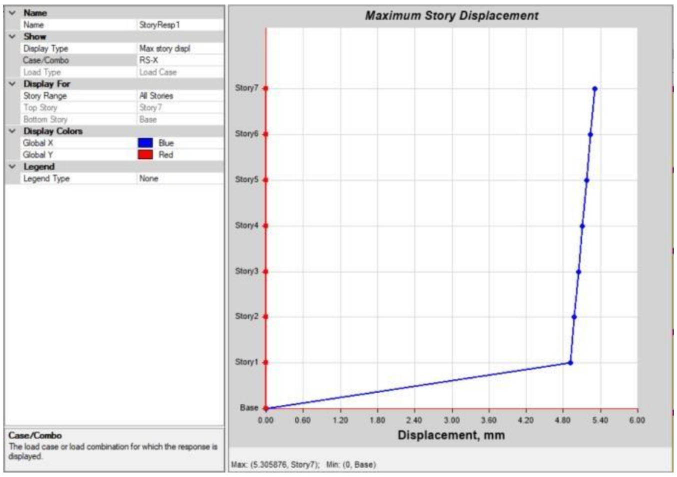


Fig.10b) storey dislacement for building with floating column atouter corners

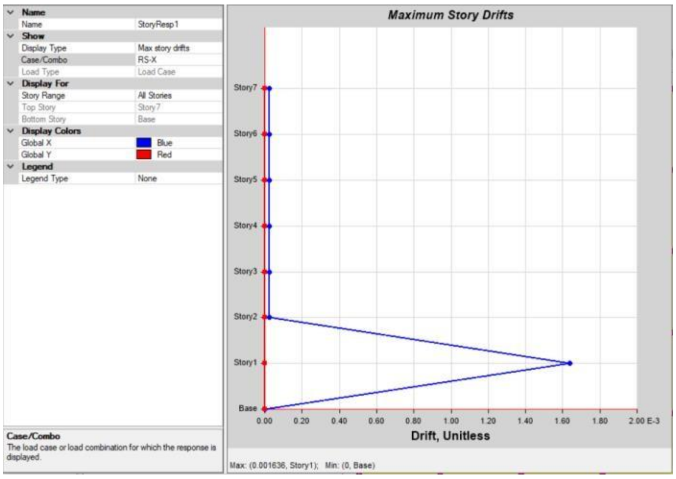


Fig.10c) storey drift for building with floating column at outercorners

VI. CONCLUSIONS

The present studt investigated the effect og structural response quantities of building due to presence of floating columns.Analytical study was carried out on a building by comparing the cases when floating column absent,provided at inner corner and outer respectively.Following are the conclusion that are drawn on the basis of study.

- By introduction of floating columns, the base shear decreases about 51.38% that of building with infill walls at all stories. Thus it has technical and functional advantage over conventional construction
- Storey displacements increase about 12.5 % when floating columns are introduced in the building
- Buildings with floating column can be adopted for getting more space for parking or entrancecorridors.
- Floating column buildings are safe under gravity loads and designed only for those loads.

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