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A Study on Seismic Performance of Multi-Story Buildings with Floating Columns Using ETABS Software

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ABSTRACT

Many urban multi-storey buildings in India today have open first storey as an unavoidable feature. This is primarily being adopted to accommodate parking or reception lobbies in the first storey. Floating columns are adopted to increase the built up area on the floor. Floating column is one of the structural irregularities in buildings and it is highly undesirable in building built in seismically active areas. In this paper present study about analysis of G+7 Building with and without floating column in seismic zone II is considered. Two models are made to Analysis the Behaviour of Building based on acting of Earth Quake forces on the structure the analysis is done by using ETABS software by equivalent static method and various parameter of building in seismic area i.e. base shear, lateral story displacement and story drift in seismic zone II are carried out.

Keywords: *Coconut shells, Coir fiber, Compressive strength, Flexural strength, Fine aggregates, coarse aggregates.*

I. INTRODUCTION

Multi-storey buildings constructed for the purpose of residential, commercial, industrial with an open ground storey is becoming a common feature. For the purpose of parking, usually the ground storey is kept free without any constructions, except the columns which transfer the building weight to the ground. For a hotel or commercial building, where the lower floors contain banquet halls, conference rooms, lobbies, show rooms or parking areas, large interrupted space is required for the movement of people or vehicles. Closely spaced columns based on the layout of upper floors are not desirable in the lower floors of such buildings.

Floating Column:
The floating column is a vertical member which rest on a beam and doesn't have a foundation. The floating column act as a point load on the beam and this beam transfers the load to the columns below it. But such column cannot be implemented easily to construct practically since the true columns below the termination level are not constructed with care and hence finally cause to failure.

Transfer Beam:
In Frame as load carrying system when column is not allowed to continue downward due to some restriction, problem is resolved by using transfer beam. A transfer beam carries the load of an especially heavy load, typically a column. It is used to transfer the load of a column above to two separate columns below. This is often needed in cases where you need different or larger column spacing. One example where we often see transfer beams is in high rise buildings. These buildings often have retail spaces and parking garages at the lower levels and residential or office units on the upper levels.

Objectives of the work
The objective of the present work is to study the behaviour of multi-storey buildings with floating columns under earthquake excitations. Finite element method is used to solve the dynamic governing equation. Linear time history analysis is carried out for the multi-storey buildings under different earthquake loading of varying frequency content. The base of the building frame is assumed to be fixed.

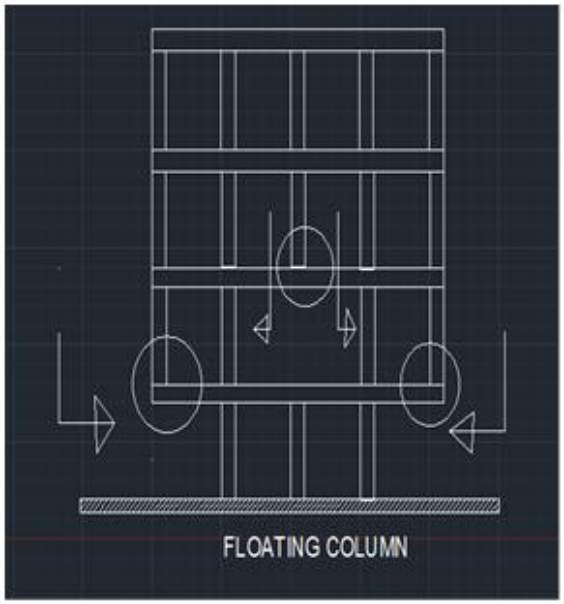

Fig.1 Floating column in building

II. METHOD OF SEISMIC ANALYSIS

Seismic analysis is a subset of structural analysis and the calculation of the response of a building structure to earthquake .It is a part of the process of structural design ,earthquake engineering or structural assessment in region where earthquake is are prevalent.

A building has the potential to 'wave back and forth during an earthquake (or even a severe wind storm). This is 'fundamental mode' and is the lowest frequency of building response .most building, however higher modes of response which are uniquely activated during earthquake.

Equivalent static method

This method defines a series of forces acting on a building to represent the effect of earthquake ground motion, typically defined by a seismic design response spectrum .It assumes that the building responds in its fundamental mode. For this to be true, the building must be low-rise and must not twist significantly when ground moves. The response is read from a design response, given the natural frequency of building. The applicability of this method is extended in many building codes by applying factors to account for higher buildings with some higher modes, and for low levels of twisting. To account for effects due to "yielding" of structure, many codes apply modification factors that reduce the design forces (example force reduction factors).

III. MODELLING

A G+7 storied building with floating column and building without floating column located in zone II and v of India as per code IS 1893(Part1):2002 were taken for the investigation. In this study first a normal building without floating column is modeled as model1. In model 2 floating column is located at 1st floor, Modeling and analysis was carried out using E-Tabs Software.

Table 1 Building Data

Parameters	Without floating column building Model1	Floating column at 1st floor building Model2

Soil type	Soft soil	Soft soil
Seismic zone	III	III
Response reduction factor	5	5
Importance factor	1	1
Height of building	19M	19M
Floor to floor height	3M	3M
Plinth Level From Bottom	2M	2M
Thickness of slab	125mm	125mm
Beam sizes	300×400mm	300×400mm
Column sizes	300×450mm	300×450mm
Material properties	M_{30}	M_{30}

For analysis purpose two models considered namely as:
MODEL1- Building without floating column
MODEL2-Building in which floating column located at 1st floor to top floor

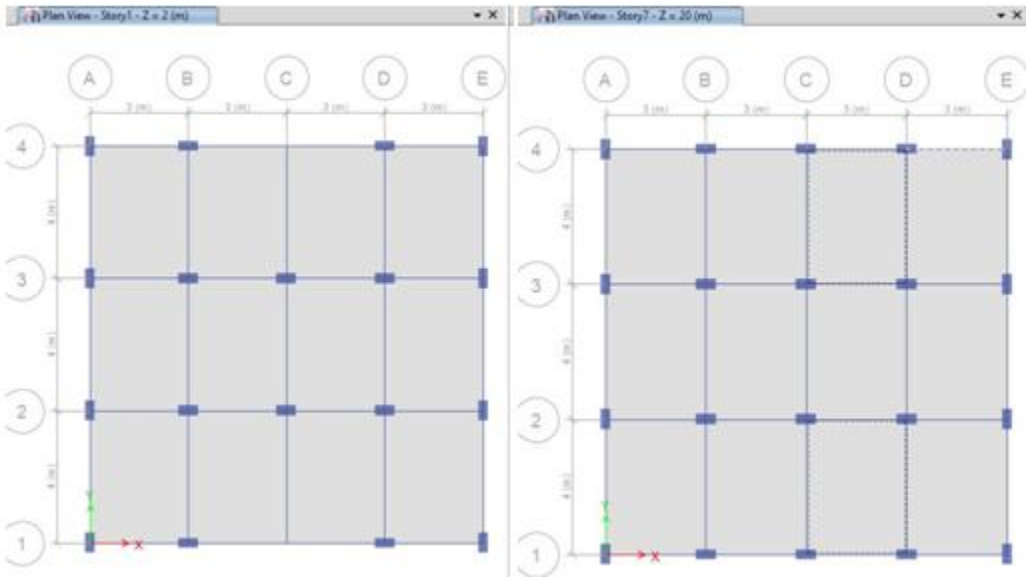

Fig 2. Plan of the Building Models

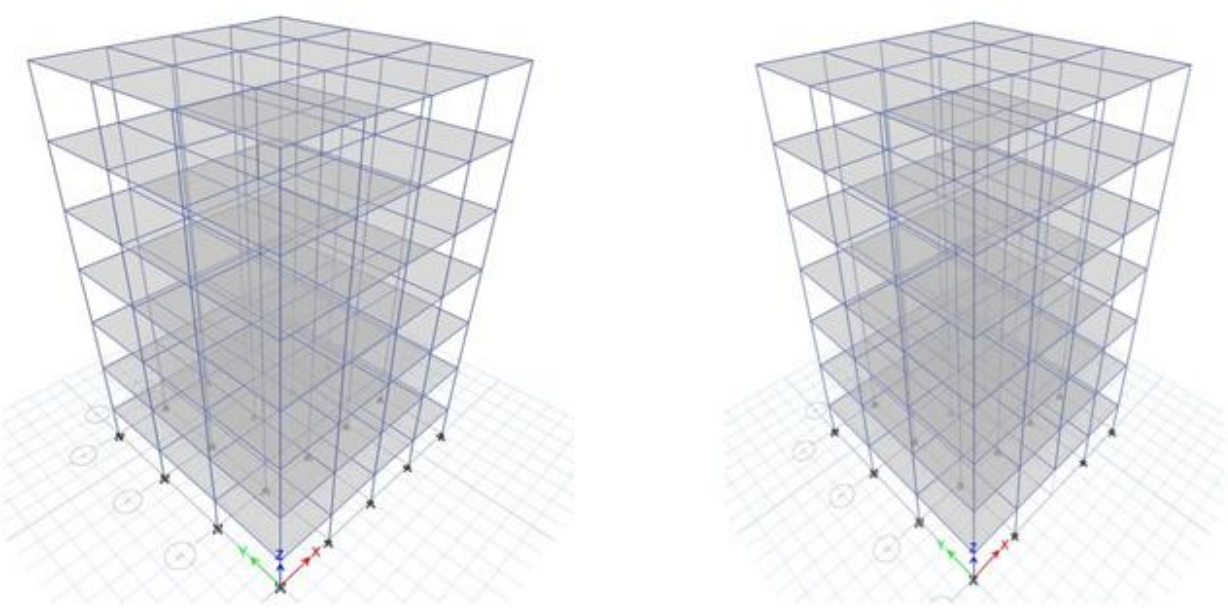

Fig 3. 3D Elevation of the Building Models with and without floating column

IV. RESULTS AND DISCUSSIONS

In present study, comparison of Building Model with and Without Floating Column carried out and the parameter such as shear, storey displacement, storey drift and dynamic response are done by varying the location of floating column floor wise by using linear static method analysis. Result are compared in tabular and graphically for the analysis of building with and without floating column.

4.1 Storey shear of building

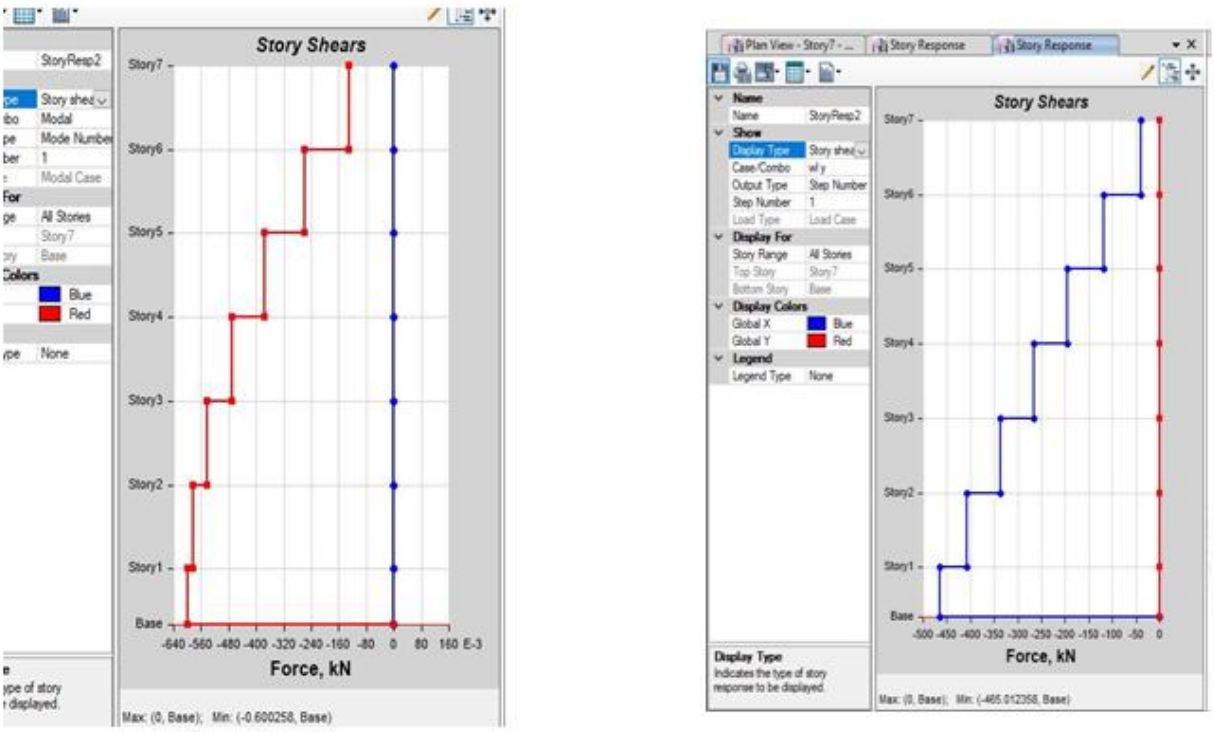

Fig 4. Storey shear of building with and without floating column

4.2 Maximum storey displacement of building

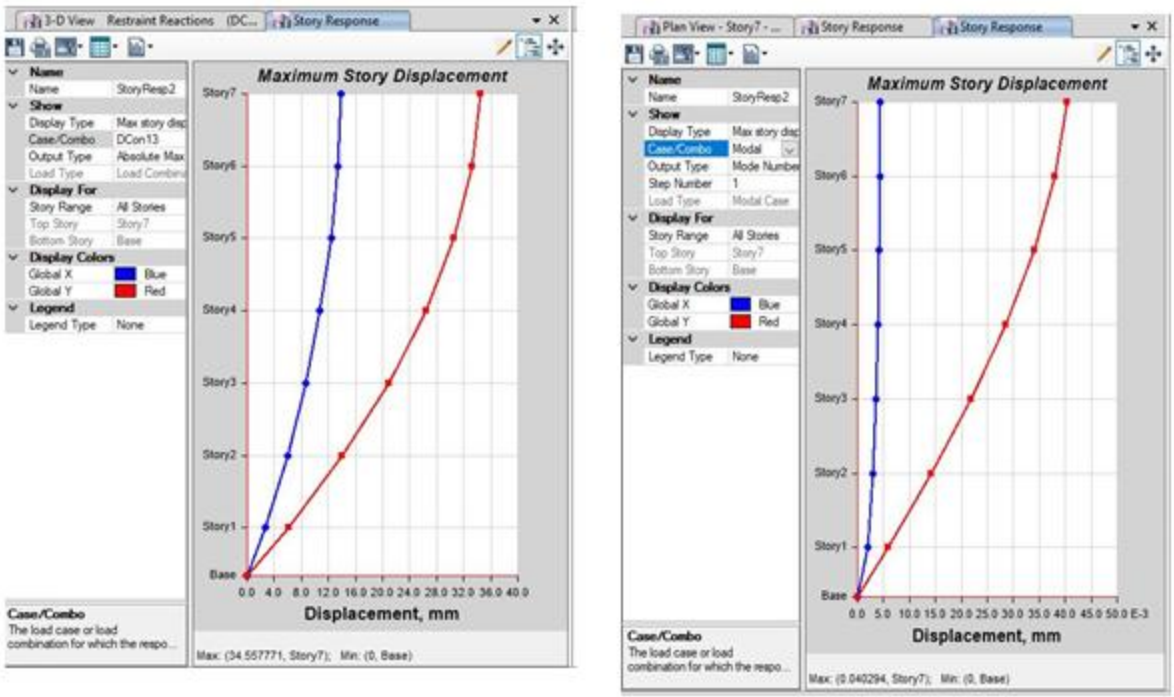

Fig 5. Maximum storey displacement of building with floating and without floating column

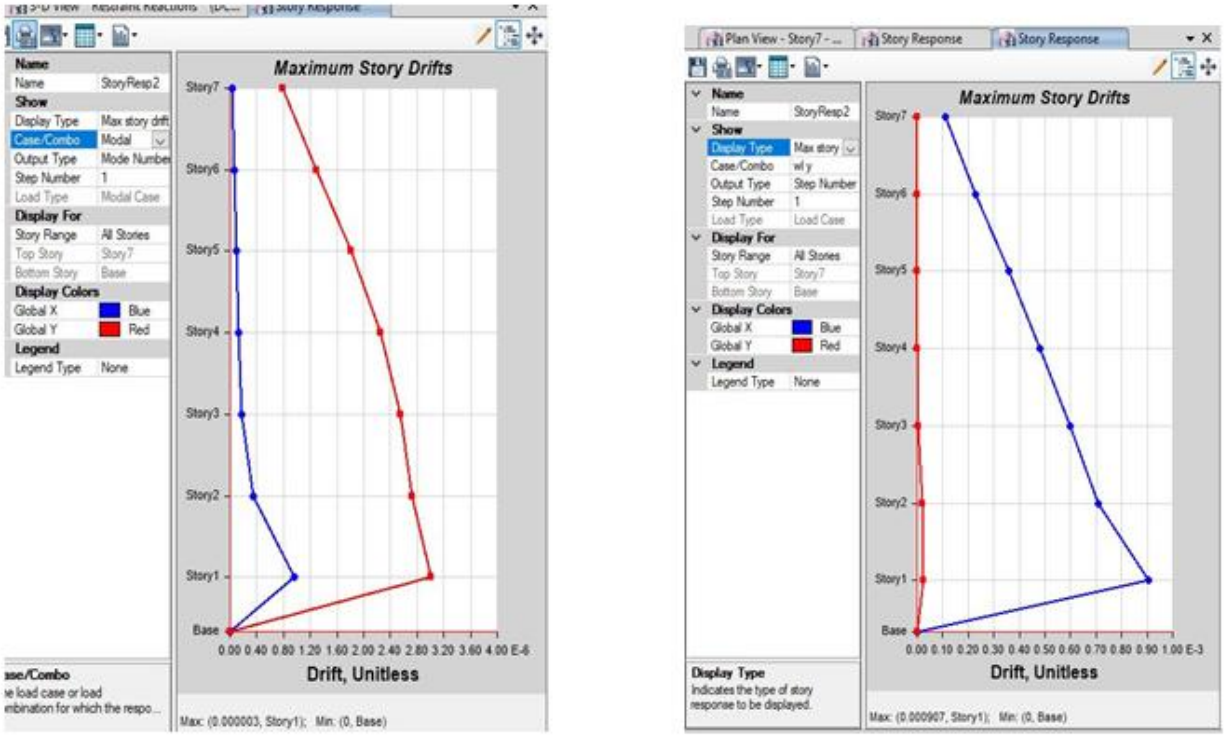

Fig 6. Maximum storey drift of building with floating and without floating column

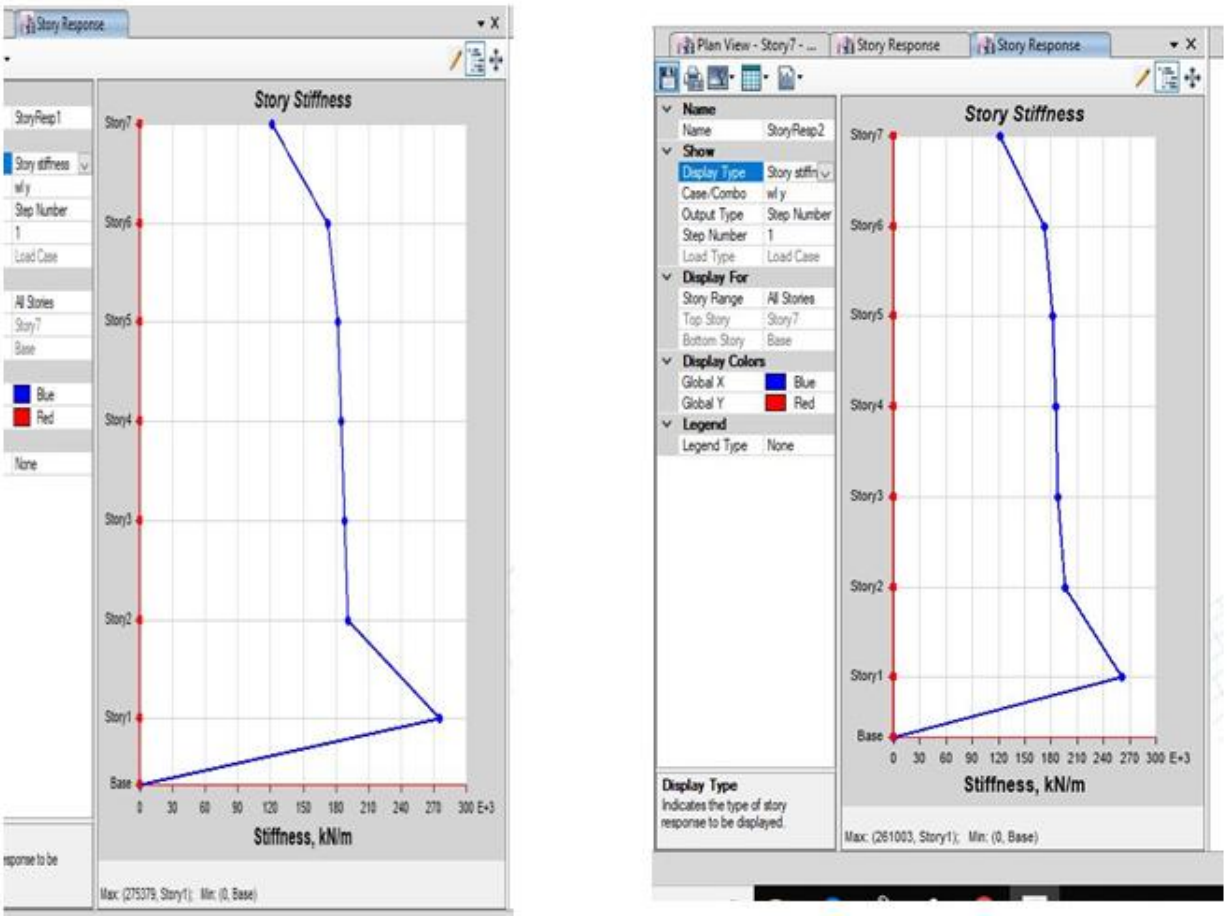

Fig 7. Maximum storey stiffness of building with floating and without floating column

V. CONCLUSION

Following are some of the conclusions which are drawn on the basis of Thesis

1. It was observed that in building with floating column has less base shear as compared to building without floating column.
2. It was observed that displacement in floating column building is more as compared to without floating Column building.
3. It was observed that building with floating column has more storey drift as compared to building without floating column.
4. Steel required percentage at bottom of column below which Floating column rest has more steel due to acting of floating column load and the Beam steel is as increased on which Floating column rest.
5. In some bottom columns the steel percentage is greater than 4% for floating column model.

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