Analysis Of A Building Considering Floating Column Under Lateral Load Condition Using ETABS

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Abstract- *Columns rest on the beam without foundation are called floating column. They are used commonly in multi-storey buildings which are purposed to hold parking at ground floor or open halls at higher floors. Discontinuation within the load transfer path is seen in this column. Thus they are designed for gravity loads. But these structures aren't designed for earthquake loads. In present scenario structures with floating column may be a common characteristic in urban India. However in tectonic areas, this type of structure is not preferred due to discontinuity of load transfer path i.e. whole earthquake load on the structure is shared by the shear walls without any loads on the floating columns.*

Keywords- Floating columns, Equivalent static analysis, Storey displacement, Storey drift , Base shear , Etabs

I. INTRODUCTION

Many urban multistory 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. Whereas the total seismic base shear as experienced by a building during an earthquake is dependent on its natural period, the seismic force distribution is dependent on the distribution of stiffness and mass along the height. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. The Response of a structure to the ground vibration is a function of the nature of foundation soil; materials, form, size and mode of construction of structure; and the duration and characteristics of ground motion. IS 1893 (part I):2002 specifies the various criteria for design of structure considering earthquake zones, type of structure, soil type, importance factor of structure, response reduction factor etc. The b asic criteria of earthquake resistant design should be based on lateral strength as well as deformability and ductility capacity of structure with limited damage, but no collapse. The floating columns or hanging columns are also vertical members similar to normal RC columns.The hanging columns are normally constructed above the ground storey, so that the ground storey can be utilized for the parking, playground, and function halls.

- **Floating Column**

Floating column is a column member that is constructed over the beam or slabs of any intermediate floors of a structure. Unlike normal columns, these columns are not attached to any footings or pedestal. The floating column construction is a new development made to serve a certain architectural purpose in the building construction.

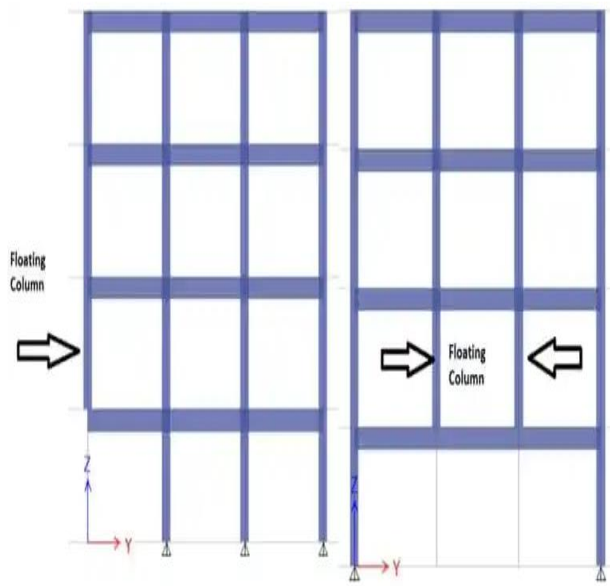

Fig 1 Building with floating column

- **General Principle of Structure Design**

The term "structure" refers to anything that is constructed or built from different interrelated parts with a fixed location on the ground. The structure is responsible for maintaining the shape and form under the influence of subjected forces. FORCE is important that the strength and stability of a structure and its individual components must be considered.

- **Seismic Analysis**

Earthquake or seismic analysis is a subset of structural analysis which involves the calculation of the response of a structure subjected to earthquake excitation. This is required for carrying out the structural design, structural assessment and retrofitting of the structures in the regions where earthquakes are prevalent.

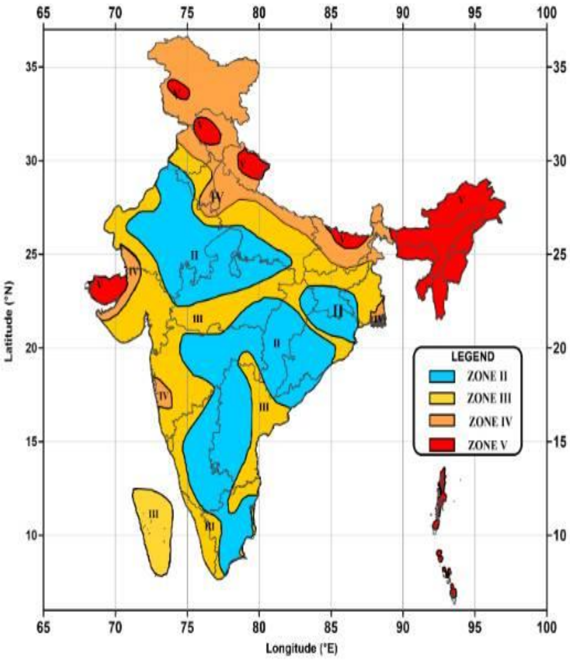

Fig 2 Seismic Map India

- **Structural Response to Earthquake**

The design of structures in earthquake regions has been based upon the assumption of a lateral load proportional to the mass of the building. For example in many areas the structure is designed to carry a “horizontal gravity” force. Such designs are based upon the assumption that the period of natural vibration of the structure is large compared with the typical period of the ground motion.

II. OBJECTIVES OF THE RESEARCH

From the earlier studies it is observed that the optimum location of floating column in a building is not studied which may not cause any harm even in highly seismic prone areas. The prime objective of this work are:

- To compare the Nodal displacement for all the models with or without floating column.
- To study the effect of Floating Column on Building Performance subjected to Lateral Load.
- To study the response of floating columns in a multi-storey building.
- To compare the maximum shear force among all the models.
- To find out the optimum location of floating column in a building frame.

III. LITERATURE REVIEW

Rawale Pradnya Balaji and K. S. Upase (2022) research paper dealt with the comparative study of seismic analysis of multi-storied building with and without floating columns. The equivalent static analysis is carried out on the entire project mathematical 3D model using the software STAAD Pro V8i and the comparison of these models was presented.

There was a correlation between the height of the building and the amount of storey displacement. Every single model displacement value goes up for the floating column structures, but most noticeably for the corner floating column building. The mass of the storey may either raise or reduce the amount of storey displacement. Storey shear will be greater for lower floors than it will be for higher levels as a result of the gradual decrease in weight from lower to higher floors.

Neha Pawar et.al (2021) objective of the research paper was to analyze the structural irregularity considering symmetrical G+8 Structure occurring due to floating columns and also to find out the optimized solution to decrease the risk due to earthquake excitation. Finite element Based Etabs software has been used for the analysis. Response spectrum analysis was done in the software. Total ten models were considered with different conditions and their results were compared in terms of storey displacement, storey drifts, base shear and overturning moments. All results were compared with the conventional building.

Results concluded that the displacement in FC building decreases as the upper story height increases but the overturning moments are increased abruptly. In modern trends, the architectural requirements are designed so as to provide more space with less obstruction. Hence Incorporating Floating columns with the combination of various irregularity can be adopted not only to fulfil Architectural requirements but also the Structural requirements. The interior placement of floating columns reduces the seismic hazard of structure as compared to outer periphery floating columns.

IV. METHODOLOGY

Steps involved in Modelling and Analysis:

Step 1: Research paper from different authors was summarized in this section who have focused towards analyzing multi storey high rise structures considering seismic loads with different zones and soil condition

Step 2: In order to initiate the modelling of the case study, firstly there's need to initialize the model on the basis of defining display units on metric SI on region India as ETABS supports

the building codes of different nations. The steel code was considered as per IS 800:2007 and concrete design code as per IS 456:2000.

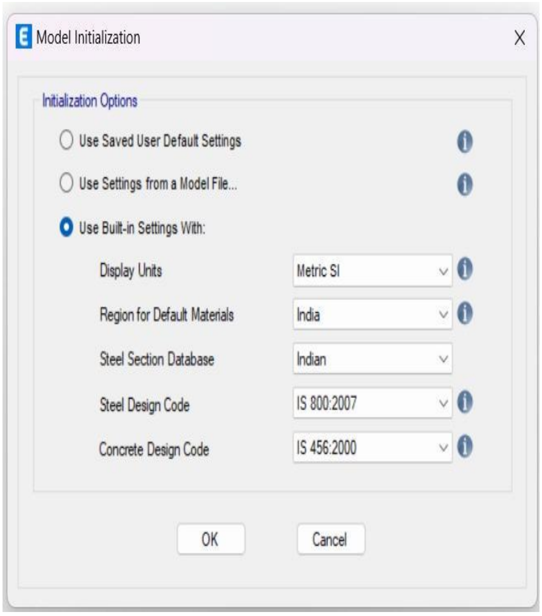

Fig 3 Model Initialization

Step 3: ETABS provides the option of modelling the structure with an easy option of Quick Template where the grids can be defined in X, Y and Z direction. Here in this case, 7 bays in X and Y direction with a constant spacing of 3.5m in both X and Y direction making the model symmetrical in nature. G+10 storey structure is considered with typical storey height of 3m and Bottom storey height of 3m.

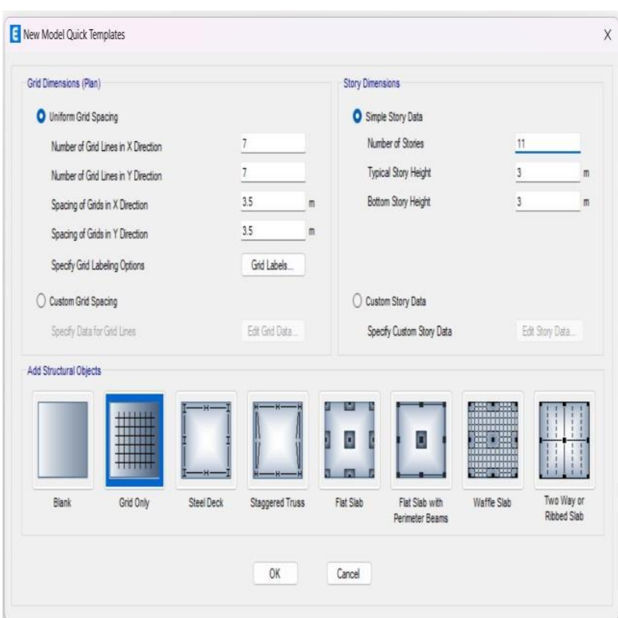

Fig 4 New Model Quick Template

Step 4: Next step is to define the material properties of concrete and steel. Here in this case study, green concrete and rebar HYSD 550 is considered and its predefined properties are available in the ETABS application.

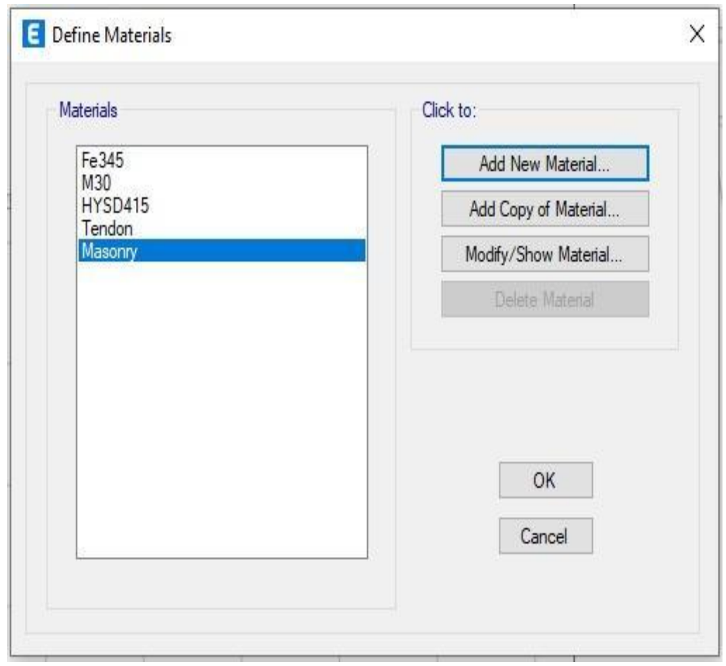

Fig 5 Defining Materials

Step 5: Defining section properties for Beam, Column. Beam size of 400x350mm, Column size of 400x400mm and Slab size of 200 mm is considered in the study.

Step 6: Assigning Fixed Support at bottom of the structure in X, Y and Z direction in both the considered cases.

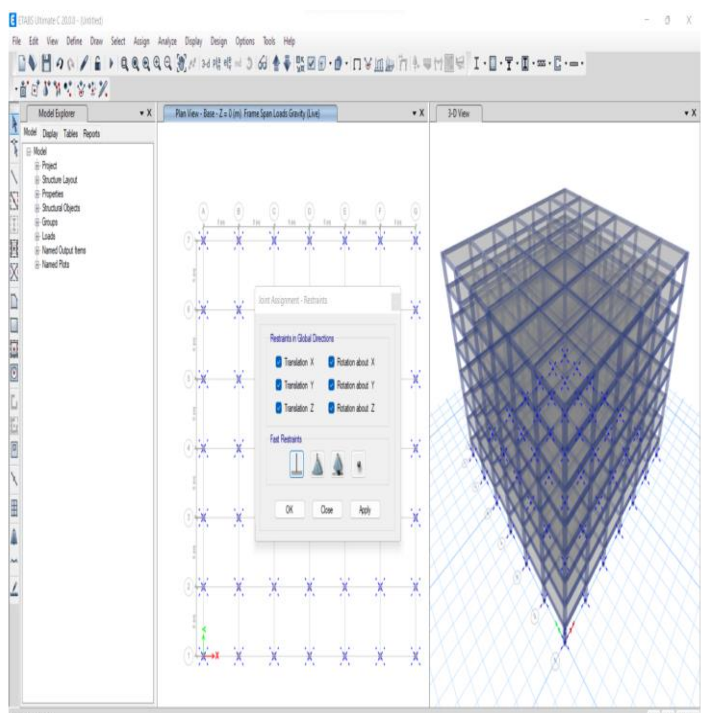

Fig 6 Assigning Fixed Support

Step 7: Defining Load cases for dead load, live load and seismic analysis for X and Y Direction.

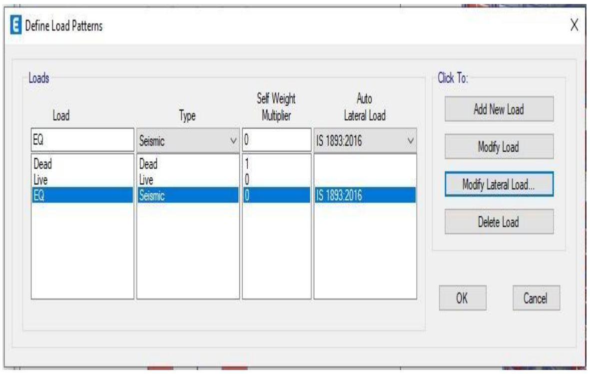

Fig 7 Defining Load Cases

Step 8 Defining Seismic Loading as per IS 1893: 2016 Part I.
Step 9: Conducting the model check for both the cases in ETABS and analyzing the structure for dead load, stress analysis and displacement.

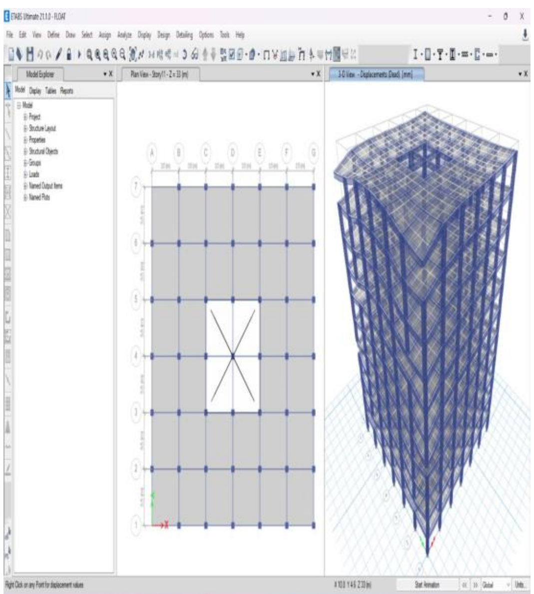

Fig 8 Model Check

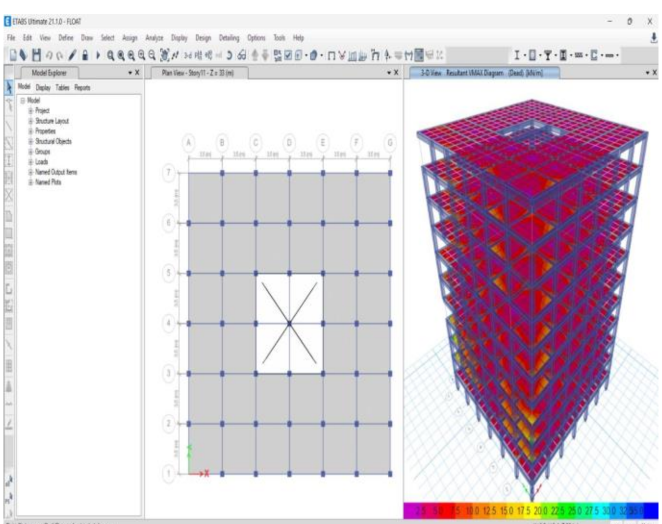

Fig 9 Stress Analysis

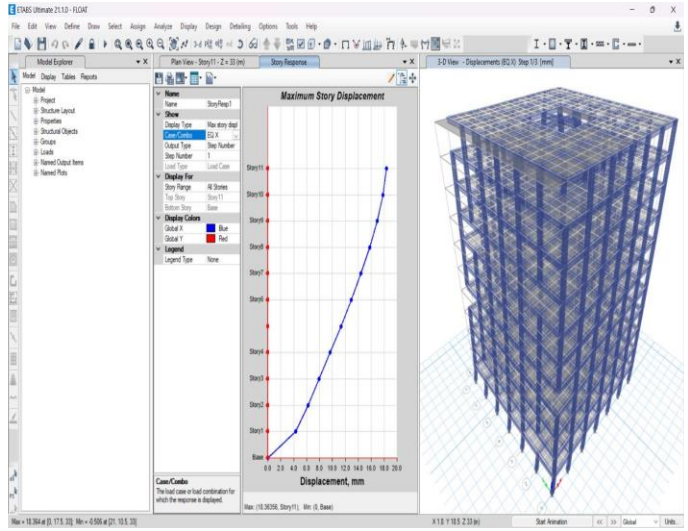

Fig 10 Storey Displacement

V. RESULTS AND DISCUSSION

- **Storey Displacement**

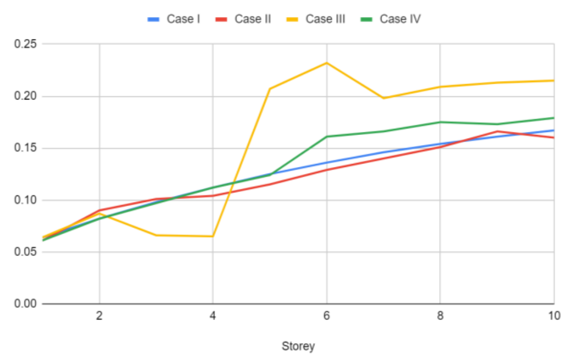

Fig 11 Storey Displacement

- **Shear Force**

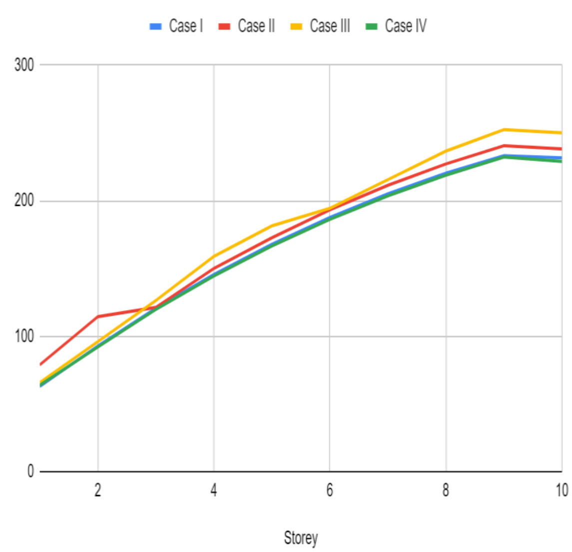

Fig 12 Shear Force in kN

- **Storey Drift**

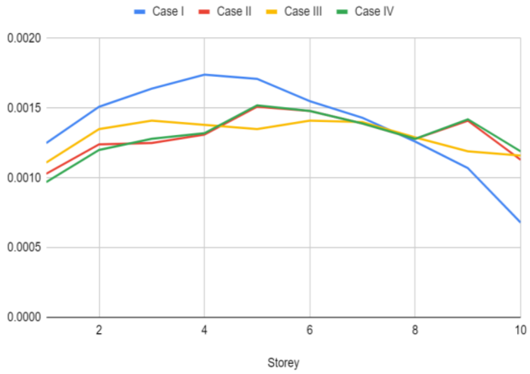

Fig 13 Storey Drift in mm

- **Base Shear**

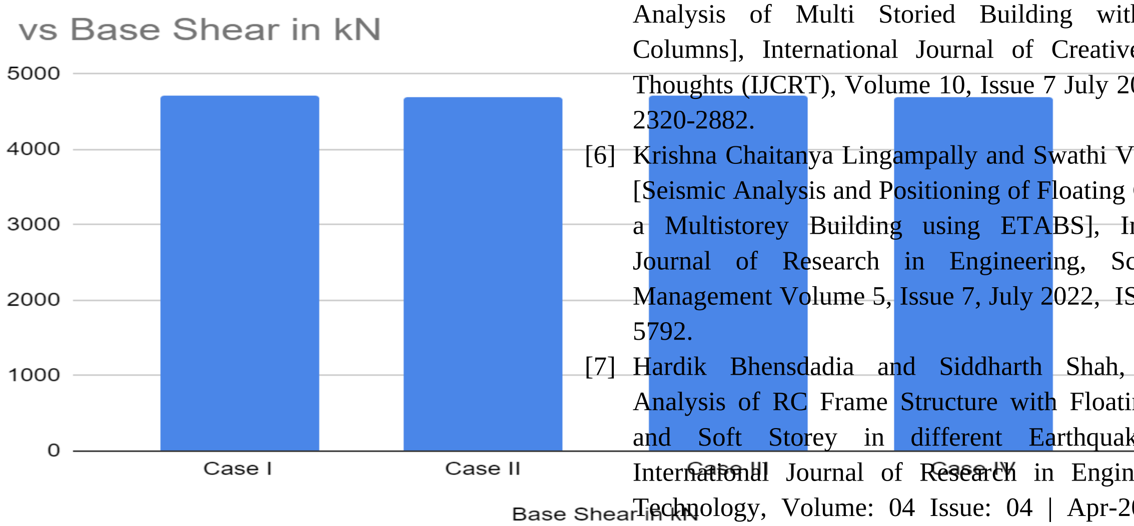

Fig 14 Base Shear in kN

VI. CONCLUSION AND FUTURE SCOPE

This specific chapter is concerned with the remarkable outcomes of the reearch. Distinct models with Floating columns and without Floating columns for reinforced concrete structure modelled using ETABS were analyzed.

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