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SEISMIC ANALYSIS OF RCC BUILDING WITH & WITHOUT FLOATING COLUMNS

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ABSTRACT

The columns which are supported on a beam instead of rigid foundation are called as floating columns. Many of the buildings in India are constructed with floating columns. This is primarily beam adopted to accommodate parking or reception lobbies in the first story. The earthquake force generated at different floor level of the building need to be carried out to the foundation by the shortest possible way which may not be the case when floating columns are provided. Providing floating columns may satisfy some of the functional requirements but structural behavior changes abruptly due provisions of floating columns. The flexural and shear demand of the beams which supports floating columns are much higher than surrounding beams, this leads to stiffness irregularities at a particular joint. Columns are main lateral load resisting elements in moment resisting frame and play a vital role in seismic performance of building. The stiffness of the storey below the floating column is usually lower than the storey above and below it.

In this thesis the seismic performance of building with and without floating columns are presented in terms of various parameters such as displacement, storey drift, maximum column forces, time period of vibration etc. The building having various locations of floating columns ie floating columns starting from different stories are considered for the study. The building is modeled by using finite element software ETABS. The beams and columns are modeled as two nodded element with six degrees of freedom at each node. The slab is modeled as membrane element with three degrees of freedom at each node. Equivalent static analysis and response spectra dynamic analysis are performed on the various buildings and their seismic performance is evaluated. The main aim is to evaluate the seismic response of building with floating columns and compare it with the normal building.

Keywords: Etabs, Floating Column, RCC, Seismic Forces,

I. INTRODUCTION

Nowadays multistorey buildings constructed for the purpose of residential, commercial, industrial etc., with an open ground storey is becoming a common feature. For the purpose of parking all, usually the ground storey is kept free without any constructions, except the columns which transfer the building weight to the ground. 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 earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path; any deviation or discontinuity in this load transfer path results in poor performance of the building. Buildings with vertical setbacks (like the hotel buildings with a few storey wider than the rest) cause a sudden jump in earthquake forces at the level of discontinuity. Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey. Many buildings with an open ground storey intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake. Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path.

II. LITERATURE REVIEW

1 A.P. Mundada and S.G. Sawdatkar: This paper deals with the study of architectural drawing and the framing drawing of the building having floating columns. Existing residential building comprising of G+ 7 structures has been selected for carrying out the project work. The load distribution on the floating columns and the various effects due to it is also been studied in the paper. The importance and effects due to line of action of force is also studied. In this paper we are dealing with the comparative study of seismic analysis of multi-storied building with and without floating columns

2 Ashwin Sanjay Balwaik: This paper represents a comparative analysis of G+1 structure with and without floating columns. The maximum bending moment of the structures are compared in this paper. The maximum moment that is obtained is more in case of structure with floating column and lesser in case of structure with normal column. The sections required by the structure with floating column is more. As the bending moment is maximum in case of structure with floating column we can conclude that the structure will required more material so nomal column structure is more economical.

3 Isha Rohilla1, S.M. Gupta and Babita Saini: In this paper, the critical position of floating column in vertically irregular buildings has been discussed for G+5 and G+7 RC buildings for zone II and zone V. Also the effect of size of beams and columns carrying the load of floating column has been assessed. The response of building such as storey drift, storey displacement and storey shear has been used to evaluate the results obtained using ETABS software. Floating columns should be avoided in high rise building in zone v because of its poor performance.

4 SreekanthGandlaNanabala, Pradeep Kumar Ramancharla and Arunakanthi: This paper studies the analysis of a G+5 storey normal building and a G+5 storey floating column building for external lateral forces. The analysis is done by the use of SAP 2000, also study is to find whether the structure is safe or unsafe with floating column when built in seismically active areas and also to find floating column building is economical or uneconomical.

III. WHAT IS 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. 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. 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. The floating column is used for the purpose of architectural view and site situations. possible area on a plot within the available bylaws. Since balconies are not counted in floor space index (FSI), buildings have balconies overhanging in the upper stories beyond the column foot print areas at the ground storey, overhangs up to 1.2 m to 1.5 m in plan are usually provided on each side of the building. In such cases, floating columns are provided along the overhanging perimeter of the building. Most of the time, architect demands for the aesthetic view of the building, in such cases also many of the columns are terminated at certain floors and floating columns are introduced. But Provision of floating columns resting at the tip of overhanging beams increases the vulnerability of the lateral load resisting system due to vertical discontinuity. This type of construction does not create any problem under vertical loading conditions. But during an earthquake a clear load path is not available for transferring the lateral forces to the foundation. Lateral forces accumulated at the upper floor during the earthquake have to be transmitted by the projected cantilever beams. Overturning forces thus developed overwhelm the columns of the ground floor. Under this situation the columns begin to deform and buckle, resulting in total collapse. This is because of primary deficiency in the strength of ground floor columns, projecting cantilever beams and ductile detailing of beam column joint. In case of floating column, shear is induced to overturning forces to another resting element of the low level. This imposition of overturning forces overwhelms the columns of lower level through connecting elements. Therefore the most critical region of damage is the connecting element (link between discontinuous columns to lower level column) and lower level columns. Therefore, the primary concern in load path irregularity is the strength of lower level columns and strength of the connecting beams that support the load of discontinuous frame. Floating column provided in a structural system is highly undesirable especially in higher zones like III, IV & V.

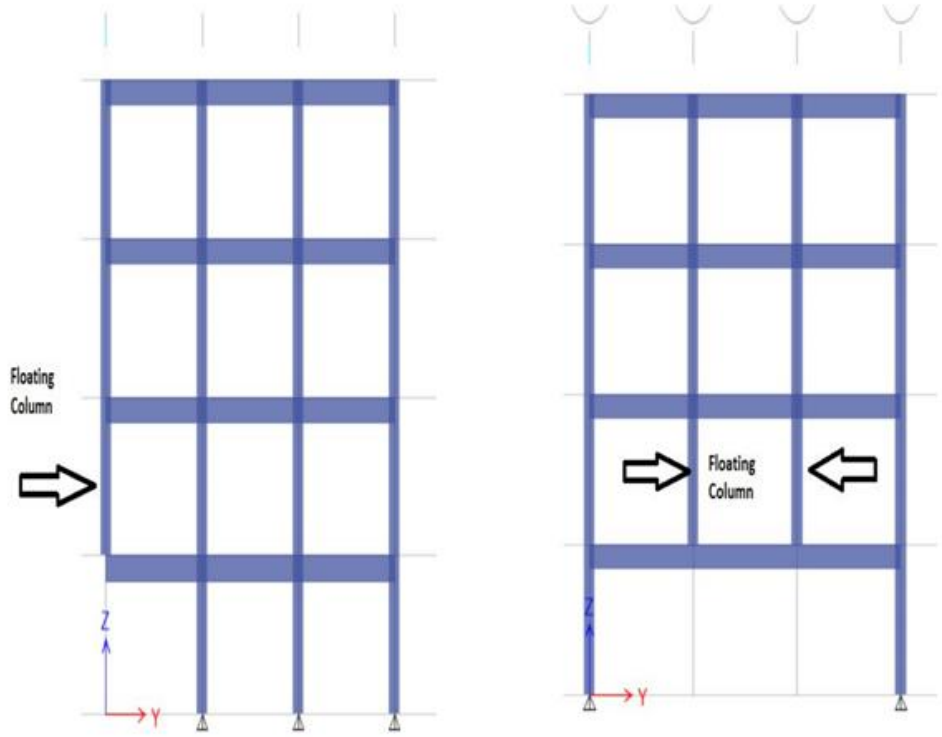

Fig 1-0-1 Floating Column

3.1 Problem Statement

How the floating columns gives response to the seismic forces and also to study the weak critical members of the structure having floating column.

3.2 Aim And Objective

1. To study the seismic response of the building with floating columns
2.To study and identify critical structural members in the building with floating columns.
3. To study the flow of forces and increase or decrease in the column forces in the building.

1.5 Scope

1.To study the effect of floating column on the building.
2.To evaluate the seismic forces in floating column.

IV. METHODOLOGY

The methodology worked out to achieve the above-mentioned objectives is as follows:
i) Review the existing literatures ii) Select a building model for the study. iii) Model the selected building without floating column.
Model 1: Building withoutfloating column.
Model 2: Building with floating column from 10th storey to 15th storey
Model 3: Building with floating column from 5th storey to 15th storey

Model 4: Building with floating column from 1th storey to 15th storeyiv) Linear and none liner analysis of the selected building model and a comparative study on the results obtained from the analyses.

V. OBSERVATIONS OF RESULTS AND DISCUSSIONS

Model description

Name of parameter	Value	Unit
Number of stories	16	Nos.
Storey height	3.0	m
Total height of the structure	48	m
Length in long direction	24	m
Length in short direction	18	m
Ground level to storey5	(800X800)	mm
Storey5 to storey 10	(600X600)	mm
Storey10 up to storey 15	(450X450)	mm
Size of beam	(230X450)	mm
Thickness of Deck	125	mm
Density of concrete	25	kN/m^3
Density of Siporex brick	5.88	kN/m^3
(2) Floor finish	1	kN/m^2
Live load	3	kN/m^2
Importance factor (I)	1	-
Seismic zone	IV	-

Responded reduction factor	5	-
Soil type	Medium	-

VI. STRUCTURAL MODELING

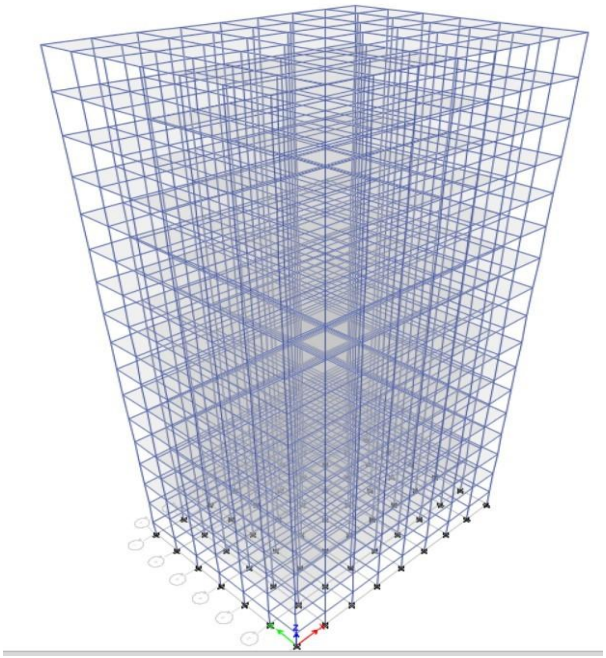

Figure. 3D view of model

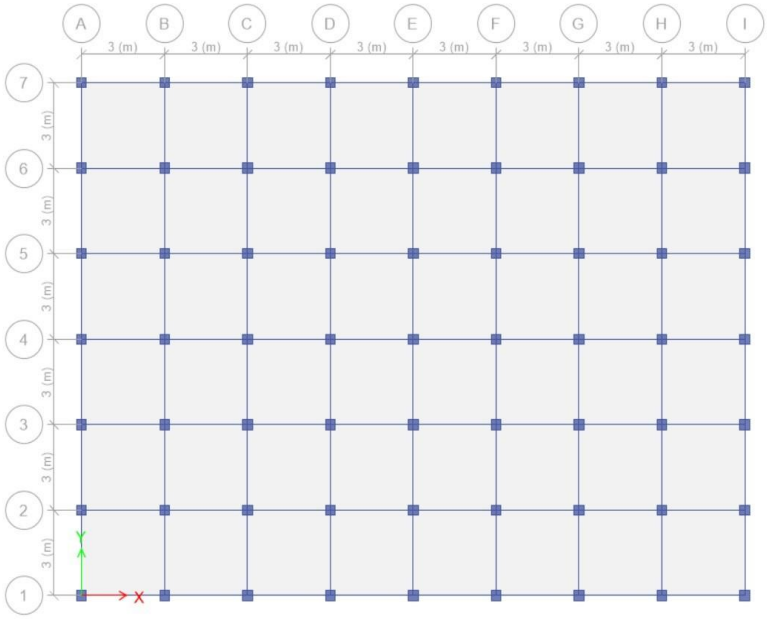

Figure. Plan of model

6.1 Advantages And Disadvantages

6.1.1 Advantages

1) By using floating columns large functional space can be provided which can be utilize for storage and parking
2) In some situations floating columns may prove to be economical in some cases

6.1.2 Disadvantages

1) Not suitable in high seismic zone since abrupt change in stiffness was observed 2) Required large size of girder beam to support floating column.
3) Floating columns leads to stiffness irregularities in building
4) Flow of load path increases by providing floating columns. The load from structural members shall be transfer to the foundation by the shortest possible path.

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