INVESTIGATE THE BEHAVIOUR OF FLOATING COLUMNS IN MULTI-STORY BUILDINGS UNDER SEISMIC IMPACT - A REVIEW

Soumya Raikwar
M.Tech Scholar
Department of Civil Engineering

Sheetal Verma
Asst. Professor
Department of Civil Engineering

School Of Engineering
Sri Satya Sai University Of Technology & Medical Sciences, Sehore (M. P.)
School Of Engineering

Abstract- In present-days scenario buildings per floating column could be a distinctive feature within the modern multistory construction in metropolitan India. Such features are extremely undesirable in building innate seismically active areas. This study emphasises how important it is to clearly identify the existence of the floating column when inspecting a building. Alternative solutions are offered to lessen the anomaly caused by the floating columns, such as stiffness balancing the top floor and the storey above.

To analyse the reactivity of the construction under various earthquake excitation having changing frequency content possessing the PGA and time duration factor constant, FEM codes are constructed for 2D multi-story structures with and without floating columns. For both the frames with and without floating columns, the time antiquity of floor displacement, base shear, inter-storey drift, and overturning moment are estimated.

Keywords— floating column, multi storey, seismically active areas, stiffness, FEM, time duration factor, inter storey drift, base shear.

I. INTRODUCTION

Due to space constraints, population growth, and other factors, multi-story structures in metropolitan areas must now feature column-free space. This is necessary for both functional and aesthetic reasons. At one or more floors, floating columns are given in buildings. In a building constructed in a seismically active area, these floating columns pose a significant risk. The shortest path must be used to carry the seismic forces that are generated at various floor levels in a building down to the ground. A building performs poorly if this load transfer path deviates from it or becomes interrupted. The way an earthquake's forces are transmitted to the ground, the building's general shape, scale, and geometry all affect how it moves during an earthquake. During the Gujarat earthquake of 2001, numerous structures with an open ground floor designed for parking collapsed or sustained damage. A column is a vertical building component that supports the foundation underneath it by bearing the weight of parallel beams attached to it. Floating Column: A floating column is a vertical element without a basis that sits on a beam.

Many urban multi-storey buildings in India, today have open first storey as an unavoidable feature and primarily being adopted to provide lodgings for parking or reception lobbies in the first storey. Whereas the total seismic base shear as

experienced by a building during an earthquake is reliant on its natural period, the seismic force distribution is dependent on the dissemination of stiffness and mass along the height.

A building's behavior during earthquakes can be significantly influenced by its overall design, scale, and geometry, as well as by how the earthquake forces are transmitted to the ground. Any deviation from this load transfer path or disconnection between it and the ground causes the building to perform poorly. Earthquake forces that occur at various floor levels in a building must be sent down along the height to the ground by the

shortest way. Buildings with vertical setbacks, such as hotel towers that are a few storeys wider than the rest, create an abrupt increase in earthquake forces at the level of incoherence. Buildings with unusually tall storeys or those with a particular story that has few columns or walls are more likely to suffer damage or collapse. There are gaps in the load transfer path in structures with columns that sling or hover on beams at an intermediate floor rather than extending all the way to the foundation. In tall buildings, the ground floor and first floor columns are replaced to allow for a greater opening at ground level and to improve access to the public space at the base. Some Eastern European academics proposed the soft base level in the 1950s and 1960s in order to attain the huge apertures at the bottom level. In this type of structure, a frame is constructed at the base to support the top structure. Although it is believed that this type of structure performs better during earthquakes, it has been shown via recent experiences that this idea is false. Many of these structures shifted following the Romania earthquake in 1978. A column is defined as a vertical element that begins at the foundation and disperses the weight to the ground. Similar to a floating column, a floating column is a vertical component that ends at the ground level (termination level) of a structure. owing to an architectural need and its support by a beam. The columns below the beams take over the load in turn. In actuality, the columns below the termination level, which is typically the stilt level, are not as carefully constructed and are more prone to failure. The employment of transfer girders to gather the vertical and lateral load from the high-rise building element and then distribute it to the widely spread column allows for a greater aperture at the ground floor level to be obtained at the moment. However, in the analysis of the transfer girder, taking into account the impact of interacting force demands thorough modeling in order to have a better grasp of the structural behavior and examination. This is because it is outside the scope of simple and approximative formula development. In past, transfer girder was considered as RC member. But then past many year the transfer girder is designed as PC member as of its 2 advantages over the RC member. For floating columns, the transfer girder and columns supporting transfer girder desires exceptional attention. If load factor needs to be augmented for transfer girder and its columns to have additional safety of structure, shall be adopted. In the given system, floating columns must not be treated to carry any earthquake forces. Therefore earthquake forces are resisted by column/shear wall without considering contribution of floating column. In this manner, the entire system is given some seismic safety. However, floating columns are strong enough to support gravity loads, but transfer girders need to be of the right size and exhibit the least amount of deflection. Despite the fact that the floating column is only safe under lateral loading, they are used in many projects. Particularly in earthquake-prone areas, transfer girders need to be adequately designed and detailed. When there are no lateral loads, design and specification are not difficult. The 3-D study of the transfer girder is necessary to comprehend its appropriate behavior, and extreme caution must be used at the connection where the floating column meets the transfer girder.

II. OVERVIEW OF WORK

Modelling of floating column using SAP2000.
Dynamic response spectrum analysis (RSA) using SAP2000.
3. Comparison of the response parameters of floating column building with normal building.

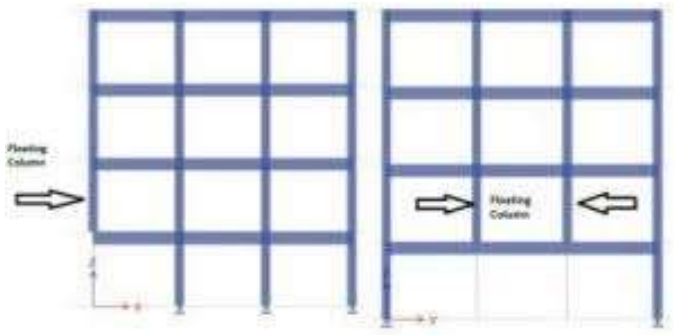

Fig. 1.2: Typical behaviour of floating column

III. LITERATURE REVIEW

Literature based on the modelling of multi-storey building using floating column and transfer beam under seismic behaviour. From the detailed literature review, inference is studied.

Sasidhar T (2017) performed the analysis of buildings using program ETABS. They considered a housing building G+5 and different cases of elimination of columns in dissimilar positions and in various floors of the housing building. Equivalent analysis is done on a mathematical model and results are related or compared with the existing building model. It was concluded that, the use of floating columns results in increased shear, increased bending moments and increased steel requirements of the buildings.

Mohamed Aqeeb Ulla (2016) studied earthquake behaviour of reinforced concrete buildings by means of non-linear static analysis by considering presence of floating columns. Linear analysis practices of structures give a decent suggestion of elastic ability of the structures and designate where first yielding will occur. Using nonlinear analysis procedure, the model integrates directly the force-deformation characteristics of individual parts of structures and fundamentals due to in-elastic physical behaviour and response. Several models were prepared and analysed for non-linear responses. They concluded that overall strength capacity of the building totally depends on the applied forces and the base-shear capacity. It was considered that, shear of the storey depends on the mass of the structural model.

Ms. Waykule S.B (2016) in their study of performance of floating column for seismic analysis of multi-storey concrete building performed the analysis and evaluation of building with and without floating column in highly seismic prone zone v. 4-models were produced by changing the place of floating column. Linear static and time history analysis were performed on all the four models and the results were compared with each other. From time history analysis, response of all the 4-models were plotted. In this paper, they concluded that, the floating column at dissimilar position results into dissimilarity in dynamic response and building with floating column has much more storey drift in comparison with conventional one.

Rahman A. (2015) in "Effect of floating columns on seismic response of multi-storeyed RC framed buildings" explores the effects of the abnormality which is formed by
Disjointedness or cut-offs of a column in a building exposed to seismic forces. Dynamic and static analysis using response-spectrum method were performed for a high-rise G+6 storey building by fluctuating the location of floating columns floor-wise. It has been noted that by introducing a floating column in a RC building the time period increases and this is generally due to the decrease in the stiffness. It also decreases the base reaction and spectral acceleration.

Udhav B (2015) in their paper analysis of multi-storey building with floating column studied the behaviour of an existing structure which was a G+10 residential building. Various building models were created using STAAD Pro software and analysis was done using static method. The systematic building models comprises of all the modules which effect the mass, deformability, stiffness and finally the strength of structure. The structural building system consists of a column, block, wall, beam, elevator, staircase, slab, footing and retaining wall. The results shows that the column shear
Changes in accordance with the condition and location of column, also the curvature at every single floor or storey rises and shear force gradually rises but it is almost equivalent at every floor for respective columns.

Niroomandi, Maheri & Mahini (2010) retrofitted an eight-storey frame strengthened previously with a steel bracing system with web- bonded CFRP. Comparing the seismic performance of the FRP retrofitted frame at joints with that of the steel X-braced retrofitting method, it was concluded that both retrofitting schemes have comparable abilities to increase the ductility reduction factor and the over-strength factor; the former comparing better on ductility and the latter on over-strength. The steel bracing of the RC frame can be advantageous if a substantial increase in the stiffness and the lateral load resisting capacity is required. Similarly, FRP retrofitting at joints can be used in conjunction with FRP retrofitting of beams and columns to attain the desired increases

IV. NEED FOR THE PROPOSED WORK

Construction of multi-story buildings for residential, commercial, or industrial purposes is becoming a typical occurrence. These multi-story buildings require a lot of parking or open space at the ground level.

Some columns from the floors above cause issues in multi-story inhabited buildings that need to accommodate the number of parking spaces and the turning radius. These columns are created as floating columns in such circumstances. There may be a demand for a conference room or banquet hall on the lower floors of a commercial structure. For these reasons, we prefer a clear, unobstructed area than one with columns in between. Floating columns enter the picture in this situation. The ability to change the floor plans above is made possible via floating columns.

V. OBJECTIVE OF THE WORK

The salient objectives of the study have been identified as follows:

The objective of the present work is to study the behaviour of multi-storey buildings with floating columns under earthquake excitations.
To study the behaviour of floating columns and non-floating columns with seismic
Behaviour
To study flow of forces and variations in column forces in a building by varying locations of floating column floor wise.

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