STUDY THE BEHAVIOR OF FLOATING COLUMN IN MULTI STOREY BUILDINGS UNDER THE SEISMIC IMPACT - A REVIEW

Shivangali Rawat
M.Tech Scholar
Department of Civil Engineering

Dr. Pradeep Kumar TV
Associate Professor
Department of Civil Engineering

IES Institute of Technology and Management
Bhopal, M.P

Abstract

In present layouts buildings structure with floating column is a basic feature in the modern multistorey construction in urban India. Such features are highly infelicitous in buildings built in seismically active areas. This study underlines the importance of explicitly recognizing the presence of the floating column in the analysis of building. Substitute measures, involving obduracy balance of the first storey and the storey above, are lodged to reduce the irregularity introduced by the floating columns.

FEM codes are created for 2D multi storey frames with or without floating column to review the responses of the structure under various earthquake excitation having differing frequency content keeping the PGA and time duration factor constant. The time history of floor displacement, base shear, inter storey drift, overturning moment are computed for both the frames with or without floating column.

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

I. INTRODUCTION

In modern times, multi-storey buildings in urban cities are essential to have column free space due to shortage of space, population and also for functional and aesthetic and requirements. Buildings are provided with floating columns at one or more floors. These floating columns are highly risky in a building constructed in seismically active areas. The earthquake forces that are developed at different floor levels in a building needs to be carried down along the height to the ground by the shortest path. Deviation or discontinuity in this load transfer path result in poor performance of the building. The motion of a building during earthquakes depends on its overall shape, size and geometry, in incorporation to how the earthquake forces are carried to the ground. Many buildings with an open ground storey intended for parking collapsed or were damaged in Gujarat during the 2001 earthquake. Column: The column is a vertical member of building which transfers its weight and load of parallel beams to the foundation under it. Floating Column: The floating column is a vertical member which rests on a beam and doesn't have a foundation.

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.

The behaviour of a building during earthquakes be influenced by critically on its overall shape, size and geometry, in addition to how the earthquake forces are passed to the ground. The earthquake forces developing at different floor levels in a building need to be conveyed down along the height to the ground by the shortest path; any deviancy or disjointedness 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 incoherence. Buildings that have less columns or walls in a certain storey or with remarkably tall storey tend to damage or collapse which is introduced in that storey. Buildings with columns that sling or hover on beams at an intermediary storey and do not go all the way to the foundation, have gaps in the load transfer path. In tall building column is superseded at ground and first floor level to enable larger opening at ground level to make access contented to the public area at the base. In 1950's and 1960's, some Eastern Europe researchers proposed the soft base level to achieve the large openings at the bottom level. A frame is built at bottom level to support the upper structure in this such kind of structure. It is thought that this kind of structure has superior performance during earthquake, but according to the current experiences, it has been demonstrated that the concept is wrong. In 1978, many this kind of building warped during the Romania earthquake. A column is thought to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is likewise a vertical element which finishes at lower level (termination level) of the building. Due to architectural prerequisite and its rest on beam. The beams in turn handovers the load to other columns below it. In practice, the true columns below the termination level [usually the stilt level] are not fabricated with care and more likely to failure. At the present time larger opening at the ground floor level is achieved by use of transfer girder to collect the vertical and lateral load from the high-rise building element and then dispense them to the widely spaced column. However in the analysis of the transfer girder, consideration of the effect of interactive force in the overall analysis is beyond the range of the development of simple and approximate formula, and requires proper modelling in order to have greater understanding the structural behaviour and scrutiny. 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. This way the overall system as some breathing safety during earthquake. However, floating columns are capable enough to carry gravity loading on the other hand transfer girder must be of adequate dimensions with very minimum deflection. Though the floating column is unsafe exclusively under lateral loading, there are many projects in which they are adopted. Transfer girder must be design and detailed properly, especially in earthquake zones. If there are no lateral load, the design and specifying is not hard. To understand proper behaviour of transfer girder, its 3-D analysis must be done and must be very careful at the joint 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.

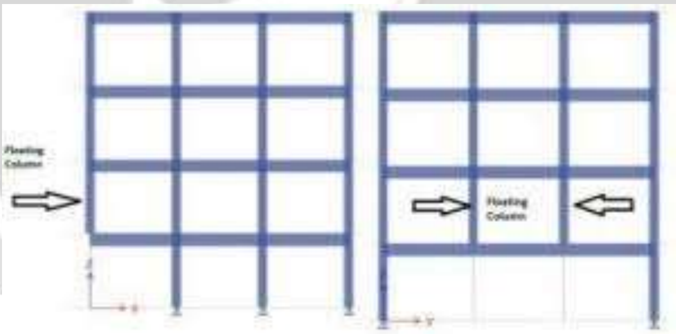

Fig. 1.2: Typical behaviour of floating column

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

Now a day's multi-storey building construction for residential, industrial or commercial purpose has become a common feature. These multi-storey building need plentiful of parking or open spaces below.

In multi-storey inhabited building to provide accommodations for the number of parking places and the turning radius, some of the columns from the floors above create a problem. In such cases, these columns are designed as floating columns. Even in commercial building there might be a need for conference hall or banquet hall on the lower floors. For these purposes, we have a preference to have a clear open space rather than having columns in between. This is where floating columns come into the picture. Floating columns gives the liberty to alter the floor plans above.

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.

REFERENCES

1. Behela S (2012) - “Seismic analysis of multi-storey building with floating column”,
Department of Civil Engineering, National Institute of Technology Rourkela-May 2012.

2. Poonam, et al. (2012) - “Study of response of structurally irregular building frames to seismic excitations”, IJCSEIERD, ISSN 2249-6866, Vol.2, Issue 2 (2012) 25-31.

3. Malaviya P, Saurav (2014) - “Comparative study of effects of floating column on the cost analysis of a structure designed on STADD Pro V8i”, International Journal of
Scientific & Engineering Research, Vol 5, Issue 5, May-2014.

4. Sekhar TR, Prasad PV (2014) - ‘Study of seismic analysis of multi-storey building with and without floating column”, carib.j. SciTech, 2014, vol2, 697-710.

5. Mundada AP and Sawdatkar SG (2014) - “Comparative seismic analysis of multi storey building with and without floating column”, International Journal of Current
Engineering and Technology, Vol.4, No.5 (Oct2014).

6. Nanabala S.G et al. (2014) - “Seismic analysis of normal building and floating column building”, International Journal of Engineering Research & Technology.

7. Nautiyal P. (2014)-“Seismic response evaluations of RC frame building with floating column considering different soil conditions”, International Journal of Current
Engineering and Technology, Vol.4, No.1.

8.Banerjee S., et al. (2014)- “Estimation of park-Ang damage index for floating column building with infill wall”, 55th annual Technical, Journal of Orissa State Centre, Institute of Engineers(India), 2014, pp.211-217.

9. Sudheer K.V. (2015) - “Design and analysis of a high rise building with and without floating columns”, International Journal for Scientific Research & Development,
Vol.3, Issue10, 2015.

10. Roy S, de Danda G. (2015) - “Behavioural studies of floating column on framed structure”, International Journal of Research in Engineering and Technology, ISSN,
Volume: 9, Issue: 9, Sep 2015

11. Rohilla I, et al. (2015) - “Seismic response of multi-storey irregular building with floating column”, International Journal of Research and Technology, Vol.4, issue 3,
Mar-2015

12. Bhensdadia H, et al. (2015) - “Pushover analysis of RC structure with floating column and soft storey in different earthquake zones”, International Journal of Research in
Engineering and Technology. Vol. 4, issue 4, Apr-2015.

13. Udhav B, et al (2015) - “Analysis of multi-storey building with floating column”,
International Journal of Engineering Research, Vol. 4, Issue no. 9, Sep-2015.

14. Rehman A. (2015) - “Effect of floating columns on seismic response of multi-storeyed RC framed buildings”, International Journal of Engineering Research & Technology, Vol.4 issue 6, June-2015.

15.Ms. Waykule S.B, et al (2016)- “Study of behaviour of floating column for seismic analysis of multi-storey building”, IRJET, Vol. 3, Issue 8, Aug-2016.

16. Mohamed Aqeeb F, et al (2016)-“Seismic analysis of RC buildings with floating columns using nonlinear static analysis”, IRJET, Volume: 03 Issue: 08 | Aug-2016

17. Sasidhar T, et al (2017) - “Analysis of multi-storeyed building with and without floating column using ETABS”, Volume 8, Issue 6, June 2017, pp. 91–98, Article ID: IJCIET_08_06_011