Seismic Analysis of a Floating Column Building and a Normal Building – A Review

Mayuri Prakash Suryawanshi[1], Prof. Dr. N. P. Phadtare[2]
[1] *PG Student, Department of Civil Engineering, Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon, Maharashtra, India.*
[2]*Professor, Department of Civil Engineering, Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon, Maharashtra, India.*

Abstract*— Modern multi-storey buildings are constructed with irregularities such as soft storey, vertical or plan irregularity, floating column and heavy loads. These type of structures have become a very common construction practice in urban India. It is observed that most of the RC structures with such irregularities constructed are highly undesirable in seismically active areas from the results of past earthquake studies. These effects occurred due to various reasons, such as non-uniform distribution of mass, stiffness and strength. The paper aims towards the review of study of dynamic structural behavior of multi storey building with floating columns conducted by various authors in the past. The analysis is done on building models having different numbers of storey with simple and complex floor plans with floating columns at different floors in different zones. Shear walls, infill walls and bracings are provided to increase the lateral load carrying capacity of the building. Various methods such as Response spectrum method and Time history method are used for linear and non-linear dynamic analysis of building using FEM software. Dynamic action is caused on building by both wind and earthquakes. Finite element base software namely ETABs, SAP2000, STAAD.Pro v8i, used for the analysis which can easily determine the parameter such as lateral forces, shear force, axial force, bending moment, storey shear, storey drift, storey displacement. The analysis results of structural response are plotted to compare and discuss.

***Index Terms* — Multi-storey buildings, Floating Columns, Static and Dynamic Analysis, Seismic Analysis, Finite Element Analysis, Response spectrum method and Time history method**

I. INTRODUCTION

India is a developing country, where urbanization is at the faster rate in the country including adopting the methods and type of constructing buildings which is under vast development in the past few decades. As a part of urbanization multi-storey buildings with architectural complexities are constructed. These complexities are nothing but soft storey, floating column, heavy load, the reduction in stiffness, etc. Now a day's most of the urban multi-storey buildings have open first storey as an unavoidable feature. Accommodation of parking or reception lobbies is the primary use of these open first story in the multi-storey buildings constructed. But Conventional Civil Engineering structures are designed on the basis of strength and stiffness criteria. Usually the ground storey is kept free without any constructions, except the columns which transfer the building weight to the ground.

Major structural collapses occur when a building is under the action of dynamic loads which includes both earthquake and wind loads. In these modern days, most of the structures are involved with architectural importance and it is highly impossible to plan with regular shapes. These irregularities are responsible for structural collapse of buildings under the action of dynamic loads. Hence, extensive research is required for achieving ultimate performance even with a poor configuration. A building is said to be a regular when the about the axis and it is said to be the irregular when it lacks symmetry and discontinuity in geometry, mass or load resisting elements. During an earthquake, failure of structure starts at points of weakness. This weakness arises due to discontinuity in mass, stiffness and geometry of structure. The structures having this discontinuity are termed as Irregular structures. Irregular structures contribute a large portion of urban infrastructure.

Earthquakes are one of the most devastating natural hazards that cause great loss of life. Most recent earthquakes have shown that the irregular distribution of mass, stiffness and strengths may cause serious damage in structural systems, such buildings undergo torsional motions. An ideal multistory building designed to resist lateral loads due to earthquake would consist of only symmetric

distribution of mass and stiffness in plan at every storey and a uniform distribution along height of the building. Such a building would respond only laterally and is considered as torsionally balanced (TB) building. But it is very difficult to achieve such a condition because of restrictions such as architectural requirement and functional needs. The structures, whose performances were evaluated in this study, are designed with the provisions from IS: 1893-2002.Floating column "A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground, and the term "Floating Column" is also a vertical element which at its lower level rests on a beam which is a horizontal member A common form of discontinuity in load path in moment frames arises with a floating columns, i.e., when a column coming from top of the building is discontinued at a lower level, usually at the ground storey. In such cases, loads from the overhanging portions take a detour and travel to the nearest column that is continuous till the foundation. This leads to increased demand on the columns in the ground story and can cause failure of these columns.

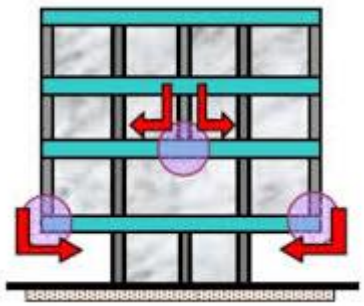

Fig - 1: Building with Floating Column

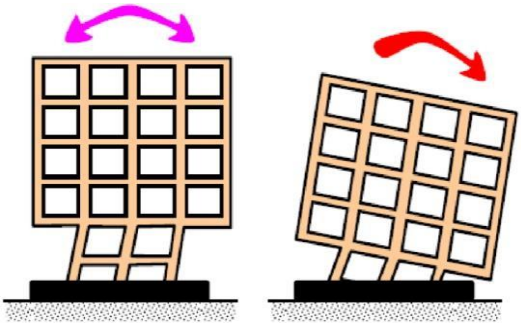

Fig - 2: Buildings with floating columns: Overloading of columns in ground storey cause failure of buildings with floating columns during strong earthquake shaking.

II. LITERATURE REVIEW

1. BABAR KHAN, Er.VIKAS KUMAR [1], (2022), This paper refers as "EXPERIMENTAL STUDY ON THE SEISMIC ANALYSIS OF MULTISTORIED BUILDING WITH FLOATING COLUMN", in which A comparative study and analysis is performed between a normal column building that is the building with all regular columns and other structural and non-structural members in it and on the other hand a floating column building at various zones as per the specifications in IS- 1893(2002)part 1. A detail study is carried out on the floating column building to find out the variations in the structural response of the building with floating columns at "parallel positions, at one edge column position and at the centre portion", observed from the parameters like maximum displacements in the building at each floor, story drifts and the results obtained are beyond the deformation limits. The Author of this paper conclude that , i) the normal column building is more efficient when compared with other models i.e. floating column buildings. Ii) the building with floating column at Zone 2 and Zone 3 can be safe designed by increasing the dimensions of the beams and columns, whereas in Zone 4 and Zone 5 the Recommendations are ultimately to be followed in the design. iii) the recommendations such as shear walls, infill walls, bracings are considered in the modelling and analysis and observed that they can also be designed as an earthquake resistant up to an extent, such that on introduction of floating columns in the RC frames increases the time period of bare frames due to decrease in the stiffness. iv) On comparison of the results obtained for each model, it is observed that the building with normal column building have lesser displacements and story drifts when compared with the floating column models. v) Similarly, when the floating column models are compared with each other, it is observed that the floating column building at one Edge column position have higher displacements and story drifts followed by floating column at parallel positions and finally the floating column at the centre portion.

2. Parul Rastogi, Vipin Tiwari [2], (2021), This paper refers as "A REVIEW PAPER ON SEISMIC ANALYSIS OF MULTI STOREY BUILDING WITH FLOATING COLUMNS AT DIFFERENT LOCATIONS OF SHEAR WALL", in which the authors aim towards the review of study of dynamic structural behavior of multi storey building with floating columns conducted by various authors in the past and use of shear walls at different locations to improve strength and stiffness of the buildings. The

analysis is done on building models having different numbers of storey with simple and complex floor plans with floating columns at different floors in different zones. Shear walls, infill walls and bracings are provided to increase the lateral load carrying capacity of the building. Various methods such as Response spectrum method and Time history method are used for linear and non-linear dynamic analysis of building using FEM software. Dynamic action is caused on building by both wind and earthquakes. Finite element base software namely ETABs, SAP2000, STAAD.Pro v8i, used for the analysis which can easily determine the parameter such as lateral forces, shear force, axial force, bending moment, storey shear, storey drift, storey displacement. The analysis results of structural response are plotted to compare and discuss. The author reviewed various literatures and concluder that, i) Base shear increases in case of core centre Shear wall in building when compared to corner and side shear wall in building. ii) Building with floating column worked well in case of corner shear well than in other location of shear wall in building. iii) Displacement varies as the shear wall location changes. Changing the position of shear wall will affect the attraction of forces, so that wall must be in proper position. iv)Shear wall which are provided from foundation to the roof top, are one of the excellent mean for providing earthquake resistance in high rise building. These are little expensive but desirable for safe structure. v)The moment resisting frame with shear walls are very good in resisting lateral force such as earthquake and wind force. vi)There is very much increment in Base shear for building with floating column because larger beam and column sizes are provided to resist load of floating column. vii)Base shear obtained from pushover analysis is much more than base shear obtained from the equivalent static analysis. viii)The axial forces are increases in the columns other than floating column due to transfer of loads of the floating column to the conventional column. ix) Whether the floating column is on the ground floor or in eighth floor, the displacement values increases when a floating column is provided in edge or middle than the outer face of the frame. x)Floating column should be avoided in high rise building in zone V because of its poor performance. xi)Maximum displacement and storey drift increases for building with Floating columns.

3. Sreekanth Gandla Nanabala, Pradeep Kumar Ramancharla, Arunakanthi E [3], (2014), This paper refers as "SEISMIC ANALYSIS OF A NORMAL BUILDING AND FLOATING COLUMN BUILDING" in which the analysis of a G+5 storey normal building and G+5 storey floating column building for external lateral forces using SAP2000, is done. This paper study the variations of both buildings such as time history values by applying the intensities such as ground motions of the past earthquakes. Such that the study highlights whether the structure with floating columns are safe or unsafe in seismically active areas and also observe the structure is economical or uneconomical. This paper studies the G+5 storey building with all columns that is a normal building and the other building without edge columns in the ground floor that is a floating column building's behaviour when excited to the lateral loads. After the comparison of the buildings it is found that the G+5 without edge columns is not safe in seismic zone as the lateral displacement in a floating column building is higher than a normal building, so the floating column building is unsafe in seismic areas. When the lateral stiffness of both the buildings are compared then it is observed that the building with floating columns will suffer extreme soft storey effect where on the other side the normal building is free from soft storey effect completely. In the analysis carried out between the buildings the quantity of steel and concrete are 40% and 42% more in floating column building than the normal building. Hence it is concluded that the floating column building is unsafe and uneconomical and not preferable for construction when compared with the normal column building.

4. Prof. Sarita Singla, Er. Ashfi Rahman [4], (2015), This paper refers as "EFFECT OF FLOATING COLUMNS ON SEISMIC RESPONSE OF MULTI-STOREYED RC FRAMED BUILDINGS", The authors have investigated the effects of the structural irregularity which is produced by the discontinuity of a column in a building subjected to seismic loads. In this paper static analysis and dynamic analysis using response spectrum method is done for a multi-storeyed building with and without floating columns. Different cases of the building are studied by varying the location of floating columns floor wise and within the floor. The structural response of the building models with respect to Fundamental time period, Spectral acceleration, Base shear, Storey drift and Storey displacements is investigated. The analysis is carried out using software STAAD Pro V8i software. A 12.5m x 24m multi-storeyed building (G+6), with special moment resisting frame was selected for study. The building had a one brick thick exterior wall along the periphery and all the interior walls are half

brick thick. It was considered to be located in Zone IV on Type II soil. In this study first a normal building (NB) without any floating columns is modeled. Then, two types of models, namely 1 and 2 are modeled. In model 1, the floating columns are located at ground floor and in model 2 they are located at first floor. For each model three different cases are studied by varying the location of floating columns. In all six cases have been studied namely-NB, 1A, 1B, 1C, 2A, 2B and 2C.

Authors Concluded that i) In building with floating columns there is an increase in fundamental time period in both X-direction as well as Z-direction as compared to building without floating columns (NB). ii) By introduction of floating columns in a building base shear and spectral acceleration decreases. Thus, it has this technical and functional advantage over conventional construction. iii) The storey displacements increase when floating columns are introduced in the building. The deflections were more in Model 1 as compared to Model 2, which proves that buildings with floating columns in ground floor are more vulnerable during earthquake. It was also observed that deflections increase marginally in that storey where floating columns are located. iv) The effect on various parameters reflects the deficiencies, if floating columns are incorporated in a building without considering any measure for safer construction. The failure of storeys having floating columns can have a serious effect on progressive collapse of the building. Hence, floating columns should be avoided as far as possible in seismic regions and if they are unavoidable, then the structure should be strengthened by adopting some remedial features.

5. Sreadha A R, C.Pany [5], (2020), This paper refers as "SEISMIC STUDY OF MULTISTOREY BUILDING USING FLOATING COLUMN", In this paper the authors have studied the nature of a multi-storey building under quake forces with and without of floating columns. Analysis focus the importance of specially identifying the presence of the floating column within the study of the structure, establish its correlation with the building without a floating column using designing software Extended three dimensional analysis of building systems (ETABS). They also discussed the performance of structure having floating column in seismically active areas. Besides these, various parameter such as maximum displacement, effect on number of storey on drift, base shear are also studied. G+5 storey structure is modeled and studied. Equivalent static analysis of structures and Response spectrum analysis (dynamic) is done. In model 1 structure without floating column is considered and is analyzed for zone 4. In model 2 floating column is introduced at 1st floor at the outer section of the plan. This model is analyzed for zone 4. In model 3 floating column is introduced at 5th floor at the outer section of the plan. This model is analyzed for zone 4. The authors concluded that, i) Structure with floating column shows maximum displacement when compare to the structure without floating column. ii) With increase in storey number displacement increase, that is from lower to higher storey displacement increase. iii) When floating column is shifted towards higher storey lateral displacement increases. iv) Structure without floating column shows minimum storey drift while with floating column shows maximum storey drift. v) Structure without floating column shows minimum base shear while with floating column shows maximum base shear. Further it can be concluded that floating column at higher floor must be avoided in high rise building design.

6. Mr. Gaurav Pandey, Mr. Sagar Jamle. [6], (2018), This paper refers as "OPTIMUM LOCATION OF FLOATING COLUMN IN MULTISTOREY BUILDING WITH SEISMIC LOADING" In this paper comparative study about analysis of G + 14 story building with and without floating column at various location within the floors for periphery columns at various levels for seismic zone V is done by the authirs. The motive of this paper is to compare the response of RC frame buildings with and without floating columns under earthquake loading and under normal loading. The effect of earthquake forces on various building models for various parameters is proposed to be carried out with the help of response spectrum analysis. A comparative study of the results obtained is carried out for all models. The building with floating columns at top stories will provide optimum results for four cases. A G+14 storied model of building is analyzed having 5 bays in x direction and 3 bays in z direction for a total of 11 cases with and without floating column at various locations within the floor level and in different stories.

Table -1: Details of Models

S.No.	Building Configuration Cases	Abbre-viation
1	Modelling and analysis of G+14 building without floating column.	A

2	Modelling and analysis of G+14 building with floating column at all four corners in ground floor only.	B
3	Modelling and analysis of G+14 building with floating column at all four corners in G+3 only.	C
4	Modelling and analysis of G+14 building with floating column at all four corners in G+6 only.	D
5	Modelling and analysis of G+14 building with floating column at all four corners in G+9 only.	E
6	Modelling and analysis of G+14 building with floating column at all four corners in G+12 only.	F
7	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in ground floor only.	G
8	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in G+3 only.	H
9	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in G+6 only.	I
10	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in G+9 only.	J
11	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in G+12 only.	K

Authors concluded the following 1. When columns as a floating column are eliminated in G + 14 story building at various location within the floors at various levels for seismic zone V that Cases E, F, J & K are seeming to be most efficient case among all 11 cases. 2. On comparing it has been concluded that the maximum Nodal displacement obtained for Cases F & K with a minimum value of 166.815mm & 167.446mm respectively. 3. Comparing the Story drift for all cases in both longitudinal and transverse direction, Cases E, F, J & K are observed as most efficient. 4. On analyzing shear force and bending moment values, Case "J" i.e. floating column at center of outer periphery all around in G+9 only found to be optimum for both X & Z directions among all cases. 5. As per comparative results, Cases E, F, J & K for axial forces values are found to be nearly equal among all the models.

7. Kishalay Maitra, N. H. M. Kamrujjaman Serker [7], (2018), This paper refers as, "EVALUATION OF SEISMIC PERFORMANCE OF FLOATING COLUMN BUILDING", author carried out static and dynamic analyses using response spectrum method have been carried out for multi-story building with and without floating columns. Different cases of the building have been studied by varying the location of floating column and increasing the column size. Case 1 - In this case usual building is considered. Beams size is considered 18" x 12" for both X and Y direction. Column size considered for exterior 12" x 12" and for interior 15" x 12". Case 2 - Here left side edge column of ground floor of the building is sorted out. Other columns properties and their location are same. Case 3 - In this case ground floor column size is increased. Left side column size is sorted out. Exterior column size is considered 14" x 12". And interior column is considered as 16" x 12". Case 4 - Here all edge side column of ground floor is sorted out. The location and properties of other column and beam are kept same. Case 5 - In this case all edge side column of ground floor is sorted out and ground floor column size is increased. Column size considered as 20" x 15". Using this models author concluded that i) Maximum story displacement and story drift is more in floating column building compared to normal building. ii. Torsional irregularity exist in floating column building in Case 2 and Case 3 where floating column is introduced only left side column but in Case 4 and Case 5 where all edge side is removed but torsional irregularity does not exist. So, it can be concluded that torsional irregularity does not depend on floating column number or ground floor column size, its mainly depend on floating column location. iii. Story stiffness is less in floating column building compared to normal building but when ground floor column size increases then story stiffness increase in floating column building. iv. Fundamental time period of floating column building is greater than normal building. v. From mode shape it is observed that when floating column is provided unsymmetrically then torsional mode is found early compared to normal and symmetrical floating column building.

8. A.P. Mundada and S.G. Sawdatkar, [8],(2014), This paper refers as, "COMPARATIVE SEISMIC ANALYSIS OF MULTISTOREY BUILDING WITH AND WITHOUT FLOATING COLUMN", the author studied 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. Case 1 It is the model in which all the columns are rested on the ground. All the columns rise

up to the top floor of the building and no column is floated or terminated at any level .it refers to normal frame building. Case 2a In this all the column are not rested on the ground level. Certain columns are floated from the first floor to upper floors. Also some columns are terminated at 1st floor from which the columns are floated. In this case, the plan covers more area than as compared to case1. Cantilever projections are also provided at certain points. Case 2b It is same as case 2a except that struts are provided below the floating columns in order to balance the moments and provides stability. Certain columns i.e. similar columns in all three models are considered and checked for its moments in X and Z directions, deflection and column shear at each floor. A column in all the models are analyzed and compared with all the cases.

Based on the analysis results following conclusions are drawn, 1. The probability of failure of Case 2a is higher by comparing values of Mx and Mz with other cases. In case 1 the columns are provided from ground level and rise up to the top floor in continuity. Thus it has more stability and resistance to seismic forces. Due to the floating columns moments are greatly increase on the adjacent column and these adjacent columns are to be checked and design for these increase moments 2. The probabilities of failure of without floating column are less as compared to with floating column. In this case, the moment values are significantly less than with floating column (Case 2a) 3. The difference in the probabilities of failure with floating column is more than floating column with inclined compressive member i.e. struts. (Case2b). 4. From the study, It is found that, the deflection in Case 2a (with floating column) is more than the deflection in Case 2b (floating column with struts).Thus due the provisions of struts in the building with floating columns ,the deflection is greatly reduced. This is because struts provide stability to the columns balancing the moments. 5. In Case 2a and Case2b, column shear values are increasing or decreasing significantly depending upon position and orientation of column. 6. Moments at every node or every slab level varies significantly. Thus at every node the moments has to be checked and design for every level separately for the safety and economy purpose 7. Provision of floating column is advantageous in increasing FSI of the building but is a risky factor and increases the vulnerability of the building.

9. Meghana B .S., T.H. Sadashiva Murthy [9], (2016), This paper refers as, “EFFECT OF FLOATING COLUMN ON THE BEHAVIOUR OF COMPOSITE MULTISTORIED BUILDING SUBJECTED TO SEISMIC LOAD”, In this paper study is done by using ETABS. For study of various effects, the steel concrete composite structure with floating column in different positions in plan, in buildings of various heights such as G+3, G+10 and G+15 in lower and higher earthquake prone zones was considered. They concluded that the floating column provided in edges of outer face of building is more critical and base shear value decreased due to introduction of floating column.

10. S.B. Waykule et.al [10], (2016), This paper refers as, “STUDY OF BEHAVIOUR OF FLOATING COLUMN FOR SEISMIC ANALYSIS OF MULTISTOREY BUILDING”, Here in this paper G+5 Building with and without floating column in highly seismic zone v was analysed. For these four models are created such as floating column at 1st, 2nd, and 3rd floor buildings and without floating column building. Linear static and time history analysis were carried out of all the four models from linear static analysis compare all the of models result obtained in the form of seismic parameter such as time period, base shear, storey displacement, storey drift. this paper concluded that building with floating column has more time period as compared to building without floating columns. It was also observed that in building with floating column has less base shear as compared to building without floating column.

11. Prajakta Agawane, Girish Joshi [11], (2021), This paper refers as, “STUDY OF BEHAVIOUR OF MULTISTOREY BUILDING WITH FLOATING COLUMN: A REVIEW”, The authors reviewed different literatures and concluded that floating columns in seismic areas can be destructive and if needed to implant should be done with proper studies. Different models of multistorey building were analyzed for the study. From this comparative seismic analysis of multistorey building with and without floating column analytical study was carried out on floating column and other columns affected due to floating column. From this study effect of floating column on various parameters of building such as time period, base shear, storey displacement, storey drift for different models was analysed. After analyzation of various models, it can be concluded that Storey displacement increases as the height of the building increases and storey drift increases as storey displacement increases. The base shear value decreases due to introduction of floating column.

12. S K Singh et.al. [12], (2021), This paper refers as, "ANALYSIS OF G+5 STOREYS BUILDING WITH AND WITHOUT FLOATING COLUMN", authors Considered the standard G + 5 RC building of plan with 15mx15m dimensions, this structure is considered to be in Zone IV as per IS 1893-2016 with and without floating column and concluded that, i) The probability of failure of the build with a float column may be more than the probability of not having a float column. Building performance may vary depending on the position and orientation of the floating column. ii) Loads applied laterally in the X and Y direction on every floor, the lateral displacements of the building with floating columns in the X and Y directions are larger in a comparison to the normal building. iii) The building with a floating column will suffer from severe floor drift compared to the normal building. iv) It is concluded that it is not preferable to provide floating columns in buildings expecting that there is an appropriate objective and functional requirements for it. Though it is to be provided, proper care must be taken while planning and designing the structure.

III. CONCLUSIONS

It can be concluded that the probability of failure of the build with a float column may be more than the probability of not having a float column. Building performance may vary depending on the position and orientation of the floating column. From the study of all literature review it was observed that floating columns in seismic areas can be destructive and if needed to implant should be done with proper studies. The multi storey building with floating column undergoes large displacement than model having no floating column. from the study it can also be concluded that as far as possible, the floating columns are to be avoided especially in the seismic prone areas and if not possible then floating column should be provided symmetrically to avoid torsional irregularity as well as column size should be increased to get rid of from soft story effect. With increase in dimensions of all members also it is getting more displacements than a normal buildings and also the cost for construction also increased.

IV. REFERENCES

[1] Babar Khan and Er.Vikas Kumar, "Experimental Study on the Seismic Analysis of Multistoried Building With Floating Column," International Journal of Engineering Inventions e-ISSN: 2278-7461, p-ISSN: 2319-6491 Volume 11, Issue 3 [May.-June. 2022] PP: 105-109.

[2] Parul Rastogi, Vipin Tiwari, "A Review Paper on Seismic Analysis of Multi Storey Building with Floating Columns at Different Locations of Shear Wall," International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653, Volume 9 Issue IV Apr 2021, PP: 934 – 937.

[3] Sreekanth Gandla Nanabala, Pradeep Kumar Ramancharla, Arunakanthi E, "Seismic Analysis of A Normal Building and Floating Column Building," International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 www.ijert.org IJERTV3IS090685 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Vol. 3 Issue 9, September- 2014, PP: 981 - 987.

[4] Prof. Sarita Singla and Er. Ashfi Rahman, "Effect of Floating Columns on Seismic Response of Multi-Storeyed RC Framed Buildings," International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 4 Issue 06, June-2015, PP: 1131 – 1136.

[5] Sreadha A R and C.Pany, "Seismic Study of Multistorey Building using Floating Column," International Journal of Emerging Science and Engineering (IJESE) ISSN: 2319–6378, Volume-6 Issue-9, April 2020, PP: 6 – 11

[6] Mr. Gaurav Pandey and Mr. Sagar Jamle, "Optimum Location Of Floating Column In Multistorey Building With Seismic Loading," International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056, p-ISSN: 2395-0072 Volume: 05 Issue: 10 | Oct 2018, PP: 971 – 976.

[7] Kishalay Maitra and N. H. M. Kamrujjaman Serker, "Evaluation of Seismic Performance of Floating Column Building," American Journal of Civil Engineering 2018; 6(2): doi: 10.11648/j.ajce.20180602.11 ISSN: 2330-8729 (Print); ISSN: 2330-8737 (Online), PP: 55 – 59.

[8] A.P. MundadaȦ and S.G. Sawdatkar, "Comparative Seismic Analysis of Multistorey Building with and without Floating Column," International Journal of Current Engineering and Technology, Vol.4, No.5 (Oct 2014), E-ISSN 2277 – 4106, P-ISSN 2347 – 5161, PP: 3395 – 3400.

[9] Meghana B .S. and T.H. Sadashiva Murthy, " Effect Of Floating Column On The Behaviour Of Composite Multistoried Building Subjected To Seismic Load," International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 06 | June-2016, e-ISSN: 2395 -0056, p-ISSN: 2395-0072, PP: 2613 – 2619.

[10] S.B. Waykule et. al., "Study Of Behaviour Of Floating Column For Seismic Analysis Of Multistorey Building," International Journal of Civil Engineering and Technology (IJCIET) Volume 7, Issue 6, November-December 2016, pp. 676–685, ISSN Print: 0976-6308 and ISSN Online: 0976-6316.

[11] Prajakta Agawane and Girish Joshi, " Study of Behaviour of Multistorey Building with Floating Column: A Review," International Journal of Research in Engineering, Science and Management Volume 4, Issue 4, April 2021 https://www.ijresm.com | ISSN (Online): 2581-5792, PP: 85 – 88.

[12] S K Singh et. al., "Analysis of G+5 Storeys Building With and Without Floating Column," IOP Conf. Series: Earth and Environmental Science 889 (2021) 012008, doi:10.1088/1755-1315/889/1/012008, PP: 1 – 12.