Analysis of a Mid Rise Structure Considering Floating Column with different Arrangements of Beams below using Staad.Pro : A Review

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ABSTRACT

Article Info
Volume 5, Issue 4
Page Number : 47-52
Publication Issue :
July-August-2021
Article History
Accepted : 30 July 2021
Published : 02 Aug 2021

Floating columns are one of the important aspects of multi-storey structures due to their various advantages thus seem to be unavoidable. Floating columns are generally not found reliable in seismic prone areas. This research is followed towards analyzing the performance of floating column's structure considering different beam arrangements prone to seismic load.
In this paper we are presenting review of literatures related analysis of floating column structures using analysis tools and lateral load conditions.
Keywords : Floating columns, STAAD.Pro, Story drift, Base shear, Story displacement.

I. INTRODUCTION

Multi Storey structure were introduced for crating spaces to accommodate larger population in limits spaces and further their need arise to have column free spaces due to shortage of space, population and also for aesthetic and functional requirements. Such floating columns come along with a disadvantage in such structures constructed in seismically active areas. The seismic tremor that is formed at various floor levels in a structure should be conveyed down along the stature to the ground by the most limited way. Deviation or brokenness in this shift in load brings the poor performance of the structure. The conduct of a structure during seismic forces relies fundamentally upon its general shape, size and geometry, notwithstanding how the forces of the earthquake are conveyed to the ground. Numerous structures with an open ground storey planned for supporting failure or were seriously damaged in Gujarat during the 2001 Bhuj tremor.

II. LITERATURE SURVEY

Kandukuri Sunitha and Kiran Kumar Reddy (2017) the research paper presented the analysis of a G+4,G+9,G+14 storey normal building and a G+4,G+9,G+14 storey floating column building for external lateral forces. The analysis was done by the use of ETABS. The intensities of the past earthquakes i.e., applying the ground motions to the structures, from that displacement time history values was compared with the primary aim to identify whether the structure was safe or unsafe with floating column when built in seismically active areas and also to find floating column building was economical or not. The results concluded that by the maximum displacement and storey drift values was increasing for floating columns. The drift ratios stated that by increasing the height of the building the deflection and storey drift drastically changed. The axial forces increased in the columns other than floating columns due to transfer of loads of the floating columns to the conventional columns. Shear walls building prove to present safe behavior in every parameter of building safety but shear walls cannot be considered economical for building with lesser height. The building with bracing system worked well in case of smaller height than in high rise building; difference was stated in higher stories of the building. The bending moment in columns was greater in the top stories and lesser in the bottom stories. Kapil Dev Mishra and Dr A. K. Jain (2018) the research paper considered analysis of a multi storied Plaza building of storey (G+2+3) having different position of floating columns (4 columns of mid ordinate axis or 4 columns of diagonal axis) at different height of building (at the level above second floor) at two different zones (ZONE III 10 and ZONE IV). The plan area of building up to second floor was 30m×30m and above this floor area was reduced to 20m×20m. Height up to second floor of the building was used for parking or commercial shops having floor height of 4m and above this it was used for residential and office purpose. Floating columns was provided at office floor. The results stated that Maximum Bending Moments as well as Maximum Support Reaction for the structures having floating columns was higher than that of structures without floating columns. Maximum Bending Moments at seismic Zone IV was greater than that of Zone III. Structures having floating column constructed in Zone IV was more affected by earthquake than Zone III. Waykule .S.B et al (2017) the research paper presented static analysis for a multistorey building with and without floating columns. Different cases of the building was presented by varying the location of floating columns floor wise. The structural response of the building models with respect to, Base shear, and Storey displacements was investigated. The analysis was carried out using software sap2000v17. The results stated that base shear decreased on first floor due to introduction of floating column in comparison to structure without floating column. Displacement was maximum at each storey with floating column in comparison to structure with traditional columns. Trupanshu Patel et al (2017) the research paper presented the behaviour of G+3 buildings having floating columns. The research constituted of 29 models and these models were modelled and analysed by SAP 2000. It was analysed for local zone III (surat), medium soil condition, and results are tabulated for horizontal and vertical displacements. The results stated that buildings with provisions of floating columns at corners, on any floor presented poor performance compare to other considered cases. Hence corner provisions of floating columns should be considered as critical case. As the position of floating columns changes from corner to the centre of stiffness of typical floor, there was decrement in value of displacements, higher decrement was visible in vertical displacements, comparison to the horizontal one. As the position of floating columns changes from 1st – 2nd – 3rd – 4th floor there was higher vertical displacements in floors, above the floor provided with floating columns. i.e provisions of floating 11 columns at 1st floor shows higher vertical displacements at 2nd, 3rd and 4th floor. The incremental load considered in the model on one side amounts to about 5% increases in eccentricity. Infill walls provided seismic strengthening of the floating column building. It also assisted in reduction of seismic response of the building. Horizontal displacement reduced by 182.26% (max) and vertical displacement reduced by 140.03% (max) after infill provisions. Revising the design of structural members after provision of infill walls presented that revision tends to reduce the quantity of steel and concrete. Hence it proved not only in reduction of the seismic response but also made the structure economical. Provision of infill walls tends to reduce the size and cost of structural members in comparison of the buildings without infill walls. Shiwli Roy and Gargi Danda de (2015) the research paper presented analysis of various types of structures G+3, G+5 and G+10 for RCC column and floating column. The difference between G+3, G+5 and G+ 10 structures are shown by graphs and charts. Comparison will be done on bending moment and shear force between these structures. This paper presents the analysis of floating column and RCC column by using STAAD PRO V8i. The analysis on floating column for G+3, G+5 and G+ 10 structures stated that if the height of the structure increases, the shear force and bending moment also increases. The column shear varies according to the situation and the orientation of columns. The moment at every floor increases and shear force increases but it was same for each floor column. The variation in shear force presented that the shear force is maximum for G+10 structure and the difference between normal and floating column for shear force was 4.368KN for G+3 structure, 7.133 KN for G+5 structure and 13.793KN for G+10 structure. The variation in shear force presented that the Bending moment is maximum for G+10 structure and the difference between normal and floating column for bending moment is 0.004KN for G+3 structure, 0.004 KN for G+5 structure and 0.003KN for G+10 structure. Avinash Pardhi et al (2016) the research paper presented the seismic performance of building with and without floating columns 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 i.e. floating columns starting from different stories were considered for the study. The building was modeled using 12 finite element software ETABS. The beams and columns were modeled as two nodded element with six degrees of freedom at each node. The slab was modeled as membrane element with three degrees of freedom at each node. Equivalent static analysis and response spectra dynamic analysis was performed on the various buildings and their seismic performance is evaluated. The primary motive was to evaluate the seismic response of building with floating columns and compare it with the normal building. The conclusion stated that, by using floating columns large functional space can be provided which can be utilize for storage and parking In some situations floating columns may prove to be economical in some cases. The floating columns were not suitable in high seismic zone since abrupt change in stiffness. There was a requirement of a large size of girder beam to support floating column. Floating columns leads to stiffness irregularities in building. Flow of load path increases by providing floating columns. The load from structural members was transferred to the foundation by the shortest possible path. Badgire Udhav S et al (2015) the research paper presented modeling and analysis of (G+10) with a floating column building, with specially moment resisting frames in two orthogonal directions. The building was considered to be located in Zone III as per IS 1893:2002. The structure was modeled using the software STAD Pro. V8i. The analytical models of the building include all the component that influence the mass, strength, stiffness and deformability of structure. The building structural system constituted of beam, column, slab, wall, foundation retaining wall, elevator, and staircase and analysis of RCC frame (G+10) with floating columns in different locations was done and investigation was carried on parameters as base shear & Drift between floating columns located in outer periphery (4 sides & 2 Sides). The conclusion stated that the difference in the probabilities of failure with floating column was more than floating column. Column shears values was increasing or decreasing significantly depending upon position and orientation of column. S.B. Waykule et al (2016) the research paper stated analysis of G+5 Building with and without floating column in highly seismic zone v. Two models were created such as floating column in first model and without floating column building. Linear static and time history analysis was carried out of all the two models from linear static 13 analysis compare all the of models result obtained in the form of seismic parameter such as time period, base shear, storey displacement, storey drift .and from time history analysis plot the response of all the models. Modeling and analysis was done using sap 2000v17 software. It was observed that building with floating had more time period and less base shear in comparison to structure without floating column. Storey displacement and storey drift was found maximum in structure with floating column in comparison to general structure. In respect to dynamic analysis, the floating column at different location resulted into variation in dynamic response. Sharma R. K and Dr.Shelke N. L (2016) the research paper carried analysis of G+5, G+7, G+9, G+11 and G+13 storey building with floating column and without floating, where the modelling and analysis of the structure was done using Staad Pro V8i software by using Response spectrum analysis. The paper dealt with the results variation in displacement of structure, base shear, Seismic weight calculation of building from manual calculation and Staad pro V8i. The response spectrum analysis stated that the floating column building was having more displacements than a building without any floating column. So Floating column building was unsafe than a normal building. After the analysis of building, it was found that quantity of steel and concrete have to increase in floating column building to keep it safe in earthquake excitation. So floating column building becomes uneconomical as compare to normal building. By the lateral stiffness calculation at each floor for the structure it was observed that the building with floating column will make the soft storey effect worse while the normal building without any floating columns have less soft storey effect. So the floating column building was unsafe. The Torsional effect in earthquake excitation was more in floating column building as compare to normal building resulting in overturning effect which occurs in floating column building and structure becomes unsafe. The results lead to the conclusion that floating column building should not be prefer in severe seismic prone area. When there is increase in the sizes of beam and column than the structure provides more displacement in floating column building in comparison to normal building. Due to 14 increase in sizes, the cost of construction increases so that the building with floating columns becomes uneconomical. So construction of floating column building should be avoided in extreme seismic zones. Kishalay Maitra and N. H. M. Kamrujjaman Serker (2018) the research paper presented static and dynamic analyses using response spectrum method for multi-story building with and without floating columns. Different cases of the building were presented by varying the location of floating column and increasing the column size. The study highlighted the performance of floating column building and compared with normal building under seismic load. Results stated that story displacement increased by 56.96% in floating column building compared to normal building. Torsional irregularity was found when floating column was introduced unsymmetrically. It was also found that fundamental time period was increasing in floating column building and lateral stiffness was decreasing in floating column building. When the lost cross sectional area due to floating columns were distributed among ground floor columns then it was found that story displacement as well as fundamental time period decreased and lateral stiffness increased. Waykule.S.B et al (2016) the research paper presented analysis of G+5 Building with and without floating column in highly seismic zone v. Four models were created such as floating column at first, second, and third floor buildings and without floating column building. Linear static and time history analysis was carried out of all the four models. The model was designed and analyzed using application SAP 2000 v17 and results were analyzed on seismic parameters as time period, base shear ,storey displacement ,storey drift and time history analysis plot of the structure. Results stated that building with floating column had more time period in comparison to building without floating column. Shifting of floating column from first storey towards top storey of the building results in increasing base shear. The building with floating column has less base shear as compared to building without floating column. The dynamic analysis stated that floating column at different location results into variation in dynamic response. Rupali Goud (2017) the primary objective of the research paper was to compare the response of RC frame buildings with and without floating columns under 15 earthquake loading and under normal loading. The effect of earthquake forces on various building models for various parameters was proposed to be carried out using response spectrum analysis. The analysis results were compared on basis in the building such as storey drifts, storey displacement, and amount of steel required. The results stated that structures with short natural period suffered higher accelerations. Thus the increase in period of the structure with isolated base makes sure that the structure was completely safe from the resonance range of the earthquake. The building with floating columns experienced more storey shear than that of the normal building. This increased the structural member sizes. So the floating column building was uneconomical to that of a normal building. Lateral displacements was more in time history analysis compared with other two method of analysis. Maximum displacement increased in floating column model when compared with without floating column model. The decrease in the base shear in base isolated model compared to fixed base models was due to the decrease in spectral acceleration values due to the period shift. The inter storey drift was maximum at 3rd level in without floating column model and 1st level in with floating column model in three cases of analysis. Priya Prasannan and Ancy Mathew (2017) the research paper main objective was to present the seismic response of the effect of varying the location of floating columns floor wise and within the floor of multi storied RC building on various structural response quantities of the building using response spectrum analysis. The model was designed and analyzed using ETABS 2015 application. The parameters namely total base shear force, storey displacement, storey drift, story acceleration of a building was presented in respect to various configuration of floating columns. The results stated that time Period was more when floating columns was provided at ground floors. Story drift and story displacement was more when floating columns was provided in fifth floor. Shear wall provided at diagonal corners could be used as the best effective method to resist the lateral forces when shear wall was provided, displacement was decreased to 1/3rd of the initial displacement. Story drift was decreased to half of the initial story drift. Story shear was increased to one-fourth of the initial story shear value. 16 Results stated a caution that as buildings with complexities are popular, but carry a risk of having damages during Earthquakes. Therefore, such buildings should be designed properly taking care of their dynamic character. Pradeep D. et al (2017) the primary objective of the paper was to propose two models of the building, one with floating column at different floor levels and the other one without floating column. The models were designed and analyzed using analytical application ETABS Ver 2016. The proposed models were analyzed on seismic parameter such time period, base shear, storey displacement, storey drift. The results stated that storey shear force was maximum for the first storey and it decreased to a minimum in the top storey. The building located in medium soil experience 25%larger base shear than building located in hard soil.

Structure with floating column at bottom stories experiences same base shear but has larger inter storey drifts when compared with the building with floating column at the periphery of the building. Structure located in hard soil exhibits less displacement and drifts when compared with building located in medium soil. Structure without floating column presented 35% lesser displacement when compared with the buildings with floating columns. Snehal Ashok Bhoyar (2017) the research paper presented the comparative analysis of a structural behavior with and without floating columns for a regular and irregular building plan. The research was subjected to seismic load on G+5 regular as well as irregular plan with or without floating column for external lateral forces where the analysis was done using ETABS software by equivalent static method. The conclusion stated that the probabilities of failure of building (either regular or irregular in plan) with floating column was found to be more than without floating column. The performances of building may vary according to position and orientation of floating column.

III. CONCLUSION

Many solutions have been developed in the past few decades following the introduction of new seismic necessities and the availability of advanced materials in the field of civil engineering. Specific evaluation methods and strategies and performance targets have 17 also been developed and adopted by many advanced countries. Floating column technology is based on increasing the size or space requirement through the use of this technique where we remove the column located to have proper space. This technology is used to develop a innovative method wherever architectural requirement is important with structure safety.

IV. REFERENCES

[1]. Kandukuri Sunitha and Kiran Kumar Reddy, [Seismic Analysis of Multistorey Building with Floating Column by using Tabs], International Journal of Engineering Technology Science and Research, ISSN 2394 – 3386 Volume 4, Issue 8 August 2017.

[2]. Kapil Dev Mishra and Dr A. K. Jain, [Comparative Study of Floating and Non Floating Column of Plaza Building Subjected to Seismic Loading by Using Staad-Pro Software], International Journal of Engineering Development and Research, Volume 6, Issue 3 | ISSN: 2321-9939, 2018.

[3]. Waykule .S.B, Dr.C.P.Pise, C.M. Deshmukh, Y .P. Pawar, S .S Kadam, D .D .Mohite and S.V. Lale, [Comparative Study of floating column of multi storey building by using software], International Journal of Engineering Research and Application, ISSN : 2248-9622, Vol. 7, Issue 1, (Part -3) January 2017, pp.31-38.

[4]. Trupanshu Patel, Jasmin Gadhiya and Aditya Bhatt, [Effect of floating column on RCC building with and without infill wall subjected seismic force], International Journal of Engineering Trends and Technology (IJETT) – Volume 47 Number 4 May 2017.

[5]. Shiwli Roy and Gargi Danda de, [BEHAVIOURAL STUDIES OF FLOATING COLUMN ON FRAMED STRUCTURE], International Journal of Research in Engineering and Technology, Volume: 09 Issue: 09 | September-2015.

[6]. Avinash Pardhi, Parakh Shah, SatishYadav, Pundlik Sapat and Amit Kumar Jha, [SEISMIC ANALYSIS OF RCC BUILDING WITH & WITHOUT FLOATING COLUMNS], International Journal of Advanced Technology in Engineering and Science, Vol no. 4, Issue no. 3, March 2016.

Cite this article as :

Awaneesh Nema, Vedant Shrivastava, "Analysis of a Mid Rise Structure Considering Floating Column with different Arrangements of Beams below using Staad.Pro : A Review", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 5 Issue 4, pp. 47-52, July-August 2021.

URL : https://ijsrce.com/IJSRCE21548