



Review on Analytical Investigation of the Structural Behaviour of High-Rise Buildings Incorporating Floating Columns for Long-Span Applications Using STAAD.Pro

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ABSTRACT

Floating columns have become an important structural solution in modern high-rise buildings because they provide large unobstructed spaces for parking areas, commercial complexes, auditoriums, and other long-span applications. However, the discontinuity introduced in the load transfer path by floating columns significantly influences the structural behaviour of buildings, particularly under wind and seismic loading. This review paper presents a comprehensive analysis of the existing literature on the structural performance of high-rise buildings incorporating floating columns. Research studies published in recent years are critically reviewed with emphasis on analytical methods, modelling techniques, software tools, and key performance parameters such as storey displacement, storey drift, base shear, axial force, shear force, bending moment, torsional response, and structural stability. The review highlights the influence of floating column location, building irregularity, bracing systems, infill walls, and long-span configurations on the overall structural response. It is observed that although numerous studies have investigated floating-column structures using ETABS, limited research has focused on comprehensive analytical investigations using STAAD.Pro for long-span high-rise applications. The review also identifies current research gaps and future directions aimed at improving the safety, stability, and economic design of floating-column buildings. The findings of this review provide valuable insights for researchers and practicing structural engineers involved in the design and analysis of modern high-rise structures.

Keywords: High-rise buildings, Floating columns, Long-span structures, STAAD.Pro, Structural behaviour, Seismic analysis, Wind analysis, Storey displacement, Storey drift, Load transfer, Structural stability, RCC buildings.

1. INTRODUCTION

Now-a-days the demand of area for construction is going on increasing everywhere. The shortage of place in different regions has guided to the evolution of vertical growth restoring from low-rise to average-rise and high-rise or tall structures. For High rise structures Reinforced Cement Concrete is preferred. R.C.C. structures are always subjected to gravity loads (i.e. vertical loads) and lateral loads (i.e. horizontal loads), gravity loads consider live load, dead load, superimposed load, and lateral loads consider earthquake load and wind load. Previously structures were designed and drafted for only gravity loads that may not have protection against lateral or horizontal loads due to low height of structure. The floating

column is a vertical member which rest on a beam and doesn't have a foundation [1]. The floating column act as a point load on the beam and this beam transfers the load to the columns below it. It belongs to a vertical member that is laid on a beam and it doesn't deliver the load directly to the foundation. The arrangement of a hanging column is in such a way that it simply floats or is being hung over a base (beam or slab) with no fixed support below with the foundation. This gives the vertical column the name floating or hanging column. There are many projects in which floating columns are adopted, especially above the ground floor, where transfer girders are employed, so that more open space is available on the ground floor. These open spaces may be required for an assembly hall or parking purpose. Commonly the building with the bracing system has more lateral stability as compared to normal moment-resisting framed buildings [2].

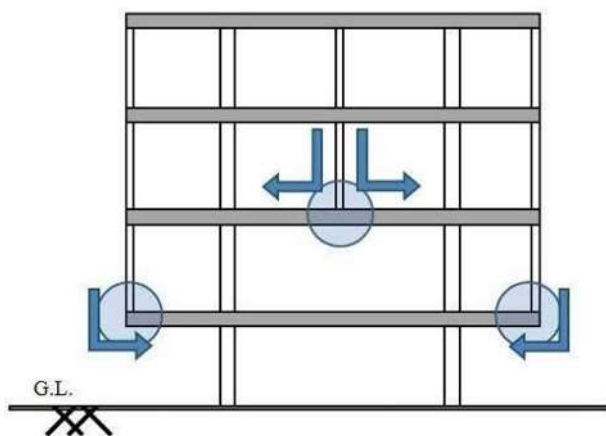


Fig.1.1 Floating column is a vertical member

General Various multi-story buildings are currently being built with floating columns at varied locations for the attractive view, for gaining more space in the parking lot for mobility, and for the planning of various plans at various stories [3]. The vertical section, referred to as a floating column, is supported by a transfer beam but is not directly attached to the footings. Because their load transfer channel is blocked, they are known as the "Floating Columns." [4]. To fulfil their functional requirements, multi-story buildings must include column-free spaces in the bottom floor or first floor [5]. The main requirement for designing earthquake-resistant buildings or structures with floating columns is that the buildings must be able to withstand earthquakes of low intensity without causing significant property damage or loss of life, as well as moderate earthquakes without causing significant structural damage but causing some nonstructural damage [6]. The Floating Column is meticulously designed to ensure that the final product can withstand loads and remain durable and functional throughout its lifespan, capable of tolerating external loading.

2. VERTICAL STRUCTURAL MEMBER

A column is a vertical structural member which transmits the loads from the superstructure. The load transfer mechanism in a building is generally from slab to beam and from the beam the column takes the load and transfers it safely to the foundation but in the case of floating

column the load transfer mechanism is different from a normal column building. Since in a floating column building the columns are not continued till the foundation level the loads which are coming from the beam or which are coming from the superstructure are not directly transferred to the foundation instead these columns transfers the load to the beams on which these floating column rests and these beams transfers the same load to the column below which has a direct contact with the foundation. These beams are often referred to as transfer beam or girder beam. Nowadays in most of the multi storey building floating column is a very common feature and is introduced mainly with an aim of accommodating the parking facilities which becomes difficult if the columns are continued till the foundation level [7].

3. FLOATING COLUMN

A floating column is a vertical element that transfers load from one beam to another. They are a specific kind of column that is built over a beam or slab of any middle level of a building and is not supported by any footing. They are also known as hanging columns. They do not transfer the load to the foundation immediately. Instead, they serve as a point load by transferring the load to the beam or slab on which they are built [8]. When an underlying portion is upright but does not transmit the pile to the formation after unwinding on a pillar, a gliding segment is used. It acts like a light load on the Beam, transmitting mass to a vertical section beneath the surface via the base frame and the level part. The gliding phase can begin when lying on a bar on any floor or a standard floor. In any incident, the key aspect that differs from usual is where the coasting part rests on the shaft [9].

4. ADVANTAGES OF FLOATING COLUMNS

1. A floating column is primarily used to meet the architectural requirements of a building. Floating columns are noticeable when there is a large span hall with rooms on the upper floor like a hotel or auditorium on the lower floor.
2. Floating columns are useful in the construction of soft floors.
3. The project layout at each site may be different.
4. The rooms can be divided and some area can be raised without raising the whole area [10].

5. PROBLEM IDENTIFICATION

The increasing demand for open spaces in commercial and residential high-rise buildings has led to the widespread use of floating columns for creating long-span areas such as parking, auditoriums, and shopping floors. However, floating columns introduce discontinuities in the load transfer path, resulting in irregular structural behavior, increased lateral displacement, stress concentration, and reduced seismic performance. Although several studies have examined floating column systems, limited research has focused on their structural response in high-rise buildings with long-span applications under various loading conditions. Therefore, this research aims to analytically investigate the behavior of high-rise buildings incorporating floating columns using STAAD.Pro, with emphasis on evaluating displacement, drift, bending moments, shear forces, axial forces, and overall structural stability to support safer and more efficient structural design [11].

Research Gap

Research on multi-storey buildings has extensively covered various structural systems and designs. However, a notable research gap exists in the comparative analysis of multi-storey buildings with and without floating columns. Existing studies often focus on traditional column designs, neglecting the potential benefits and challenges associated with floating columns. The literature lacks a comprehensive investigation into the structural performance, cost-effectiveness, and sustainability aspects of these two design approaches. Additionally, limited attention has been given to the influence of floating columns on seismic resistance and architectural flexibility. Addressing this research gap is crucial for enhancing the understanding of the advantages and limitations of floating columns in multi-storey buildings, providing valuable insights for architects, engineers, and stakeholders involved in building construction and design [12].

6. LITERATURE REVIEW

1. Nagar, R., Vyas, S., Dhurvey, P., & Gour, C. P. (2026)

Nagar and co-authors [4] investigated the seismic performance of tall buildings containing floating columns. Their study focused on understanding how floating columns influence the overall dynamic response of high-rise structures during earthquakes. Structural parameters including storey drift, displacement, internal forces, and stability were analyzed. The research concluded that floating columns increase structural irregularity and require detailed seismic assessment to ensure safe building performance.

2. Yadav, S. S. (2025)

Yadav [7] performed a comparative seismic analysis of steel structures with and without floating columns using ETABS. The research also examined the effectiveness of X-bracing and diagonal bracing systems in improving structural performance. Parameters such as displacement, drift, base shear, and member forces were analyzed. The study concluded that bracing systems significantly enhanced the seismic resistance of floating-column steel structures by reducing lateral deformation.

3. Baig, M. M., & Pahwa, M. S. (2025)

Baig and Pahwa [9] investigated the earthquake behavior of regular and irregular high-rise RCC framed structures with and without floating columns. Their study assessed various seismic response parameters, including storey displacement, drift, base shear, and force distribution. The findings indicated that irregular buildings containing floating columns experienced higher seismic demand and required enhanced structural design for improved safety.

4. Jongen, A. J. (2025)

Jongen [15] presented a spatial and structural feasibility study of floating high-rise buildings in Rotterdam's city waters. The research explored the structural feasibility, load-carrying mechanisms, stability, and design considerations of floating high-rise structures constructed over water. The study demonstrated that floating high-rise concepts offer a sustainable solution for urban expansion in water-constrained regions, provided that structural stability, buoyancy, and environmental loading are carefully addressed through appropriate engineering design.



5. Raju T, H., Venkata Rama Sundari, M., Saxena, A., Gupta, M., Praveen, Zabibah, R. S., & Manideep, B. (2024)

Raju and colleagues [14] performed a comparative dynamic analysis of multi-storey buildings with and without floating columns. The research investigated the influence of floating columns on the dynamic characteristics of structures by analyzing natural time period, storey displacement, storey drift, base shear, and structural stability. The findings showed that floating columns altered the dynamic response of buildings and increased seismic vulnerability, thereby requiring optimized structural design for improved performance.

6. Prakash, A., Kamala Raju, Y., Krishna Munipally, S., Shiva Nayak, P., & Al-Attab, K. (2024)

Prakash and co-authors [1] investigated the structural behavior of an unsymmetrical multi-storey building incorporating floating columns in a seismic zone using ETABS. The study focused on evaluating the influence of floating columns on seismic performance by analyzing parameters such as storey displacement, storey drift, base shear, and member forces. Comparative analyses were carried out for different structural configurations under earthquake loading. The results indicated that floating columns significantly affected the lateral response of the building, emphasizing the need for careful structural design in seismically active regions.

7. Bamniya, K., & Koushal, M. (2024)

Bamniya and Koushal [8] carried out a dynamic analysis of multi-storeyed buildings with and without floating columns. The study focused on evaluating structural performance under earthquake loading by comparing displacement, drift, base shear, and internal force distribution. The results showed that floating columns increased structural irregularity and adversely affected the seismic response compared to conventional building configurations.

8. Dawar, K., & Prajapati, M. K. (2024)

Dawar and Prajapati [12] investigated the design and analysis of floating column buildings with particular emphasis on torsional behavior. The research examined the effect of floating columns on torsional irregularity, lateral displacement, storey drift, and overall structural response under seismic loading. The findings indicated that floating columns significantly increased torsional effects, highlighting the importance of proper structural planning and member detailing to improve building stability.

9. Tapkire, P. P., & Kadam, P. N. (2024)

Tapkire and Kadam [6] conducted a dynamic analysis of high-rise buildings with different structural irregularities, including floating columns. The study compared buildings with and without floating columns under dynamic loading by evaluating displacement, storey drift, natural time period, and base shear. The results indicated that floating columns increased lateral deformation and reduced structural stiffness, thereby affecting the seismic performance of high-rise buildings.

10. Hooda, Y., & Goyal, P. K. (2023)



Hooda and Goyal [2] assessed the seismic performance of buildings with floating columns constructed on sloping ground. The study examined the combined effects of ground slope and floating columns on structural response under earthquake loading. Performance parameters such as displacement, drift, base shear, and stability were evaluated. The findings revealed that sloping ground conditions further intensified the adverse effects of floating columns, making proper seismic design and structural detailing essential.

11. Jha, N., Simkhada, P., & Ramasubramani, R. (2023)

Jha and colleagues [3] analyzed and designed G+15 high-rise residential buildings with and without floating columns in Nepal using ETABS. The research compared conventional and floating-column structures by evaluating storey displacement, storey drift, base shear, and structural safety under seismic loading. The results showed that buildings incorporating floating columns exhibited greater lateral displacement and irregular structural behavior, highlighting the importance of appropriate design measures.

12. Gazanfer, M., & Chinta, R. (2023)

Gazanfer and Chinta [11] analyzed multistorey irregular buildings with and without floating columns using ETABS. The study focused on evaluating the influence of floating columns on the seismic performance of irregular structures by comparing parameters such as storey displacement, storey drift, base shear, and structural stability. The results demonstrated that floating columns increased lateral displacement and structural irregularity, making detailed seismic analysis essential for ensuring safe building performance.

13. Bosh, P., Awall, M. R., & Hasan, M. (2023)

Bosh and co-authors [13] conducted a comparative seismic analysis of multi-storey buildings with and without floating columns. The study evaluated structural performance under earthquake loading using parameters such as storey displacement, storey drift, base shear, and internal force distribution. The results revealed that buildings with floating columns experienced greater lateral deformation and irregular load transfer compared to conventional structures, emphasizing the need for careful seismic design.

14. Khalotia, D., Murkute, P., & Sikarwar, B. P. S. (2022)

Khalotia and colleagues [5] examined the effects of infill masonry walls and floating columns on the support reactions of a high-rise building located in Seismic Zone II. The study evaluated maximum support reactions, internal forces, and structural behavior under earthquake loading. The findings demonstrated that both infill walls and floating columns considerably influenced force distribution and support reactions, affecting the seismic response of the structure.

15. Kakatkar, V., Jambhale, N., Khed, V. C., & Mendigeri, S. (2022)

Kakatkar and co-authors [10] conducted a comparative study on the influence of floating column positions in RCC multi-storey buildings subjected to seismic forces. Different floating column locations were analyzed to evaluate their effects on storey displacement, drift, base shear, and structural stability. The study concluded that the location of floating columns plays a significant role in seismic performance, and appropriate positioning can improve overall structural behavior while minimizing adverse effects.



7. CONCLUSION

Floating columns provide architectural flexibility and facilitate long-span spaces in high-rise buildings; however, they also introduce structural irregularities that significantly influence load transfer and seismic performance. The reviewed studies indicate that floating columns generally increase storey displacement, storey drift, torsional effects, and internal member forces compared with conventional structural systems. The literature also reveals that the position of floating columns, building configuration, and lateral load-resisting systems play a crucial role in overall structural stability. Furthermore, most existing research has been carried, while comprehensive investigations using STAAD.Pro for long-span high-rise applications remain limited. Therefore, further analytical studies are required to optimize floating column configurations and develop safer, more economical, and code-compliant structural designs.

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