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Experimental Study on Floating Column Design in Structures

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ABSTRACT

The usage of floating columns for additional space is a recent trend that caters to functional needs. The architectural feature known as the floating column responds poorly to earthquakes. As a result, it should be avoided in areas prone to earthquakes. Earthquakes affect mostly where there is a weak structure; in modern buildings, apertures are widespread for lifts, lighting, and other architectural features. This review displays the results of numerous research studies. Different researchers used various floating column locations across the structure. The main goal of research conducted by various researchers is to compare structures with floating columns and without floating columns.

1. Introduction

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 story. The vertical section termed as a floating column is supported by a transfer beam but is not attached to the footings. Because their load transfer channel is blocked, they are known as the "Floating Columns." To fulfil their functional requirements, multi-story buildings must include column-free spaces in the bottom floor or first floor 31. 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. Floating Column is meticulously created to ensure that the final design can handle loads and will be durable and functional throughout its lifespan to tolerate external loading. Traditional building constructions are created using stiffness. and strength standards.

Numerous projects have already made use of floating columns to increase the amount of space on the ground floor. These open areas might be necessary for a parking lot or an assembly hall. The bearn that supports the column is under a concentrated load from the column. In seismic regions. existing constructions created with these kinds of discontinuous parts are in risk. But instead of demolishing those buildings, research can be done to make them stronger. To lessen lateral distortion, the rigidity of these columns can be raised retroactively or given by bracing. Many high-rise buildings are planned and built using architectural complexity. The case of seismic forces calls for ductility. The ductility and energy dissipation of a structure increase with its plastic deform ability without collapse. As a result, the earthquake's actual forces are reduced. Due to space limitations, the idea of horizontal structure development is becoming obsolete.

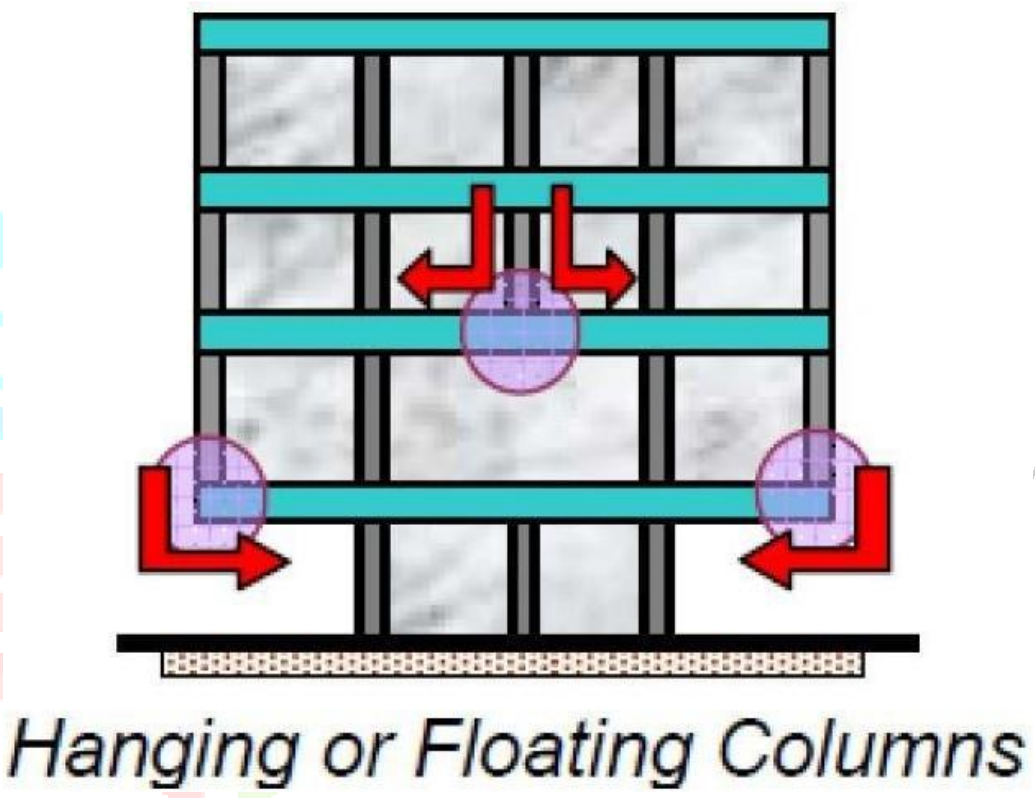


Fig 1.1 Floating Column

2. Methodology

2.1 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 . 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 start off when lying on a bar on any floor or on some other average floor.

2.2 Load Transfer Mechanism :

Unlike conventional columns, floating columns do not connect directly to the foundation. Their load is transferred to a transfer beam, creating a potential "soft story" or discontinuity in the load path. A floating column transfers its load not to the foundation, but as a concentrated point load onto a specialized, heavy-duty "transfer beam" or transfer girder, which subsequently shifts the load to adjacent conventional columns. This discontinuous path creates high shear and bending stress, often acting as a "rotational fuse".

2.3 Transfer Beam Design :

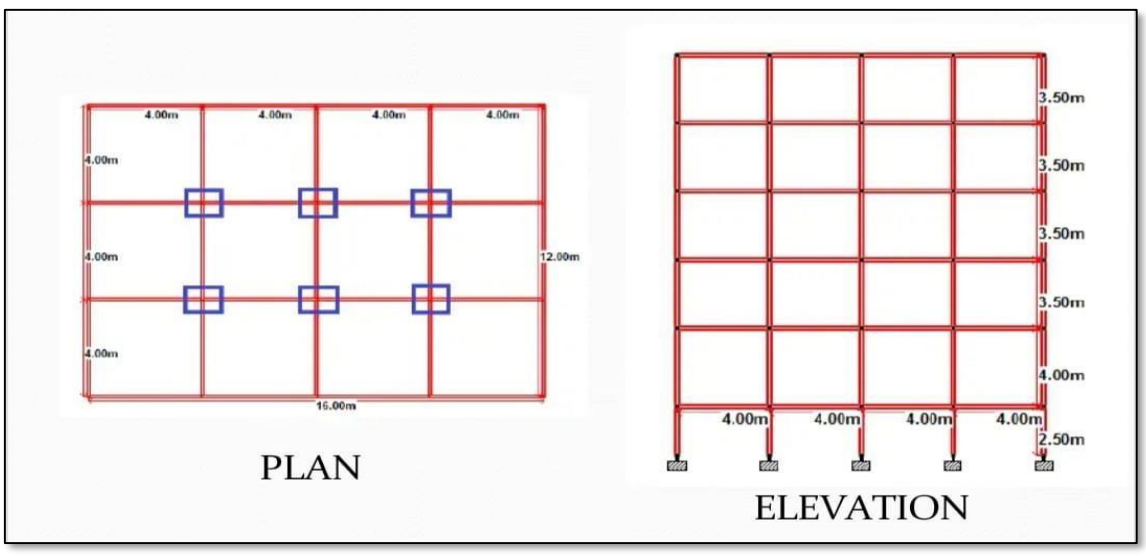
The beam supporting the floating column is critical and must be designed as a heavily reinforced girder to handle high shear and bending moments, often requiring a large cross-section. Transfer beams in floating column systems are critical structural members designed to support discontinuous columns and transfer heavy axial loads, moments, and shear to adjacent, continuous columns. They require high stiffness to limit deflection, often acting as deep beams or thickened beams designed for high bending and shear loads.

2.4 Structural Analysis & Modeling :

Software like ETABS, STAAD Pro, or Protastructure is used, where the column is modeled as a point load on the supporting beam. In software like Protastructure, the supporting beam is marked as a cantilever to handle this load. Floating columns, which rest on beams rather than directly on foundations, create vertical irregularities, increasing bending moments, shear forces, and lateral displacement (storey drift) in the supporting "transfer" beams. Structural modeling, typically done in ETABS, SAP2000, or ProtaStructure, requires treating the support as a transfer beam (or cantilever) to accurately model the concentrated load

3. Result & Discussion

- Comparison of maximum axial force occurring in the model Y in zone 5 is as shown below



FLOOR	MAX AXIAL FORCE NON FLOATING COLUMN	COLUMN POSITION	MAX AXIAL FORCE FLOATING COLUMN	COLUMN POSITION
BASE	2147.481	1R-3C	3141.936	1R-3C
GF	1807.108	1R-3C	2796.168	1R-3C
F1	1650.455	2R-3C	2138.456	1R-3C
F2	1199.169	2R-3C	1540.481	1R-3C
F3	750.864	2R-3C	957.997	1R-3C
F4	304.66	2R-3C	379.547	1R-3C

Fig. No 3.1

4. Variation in maximum axial loads

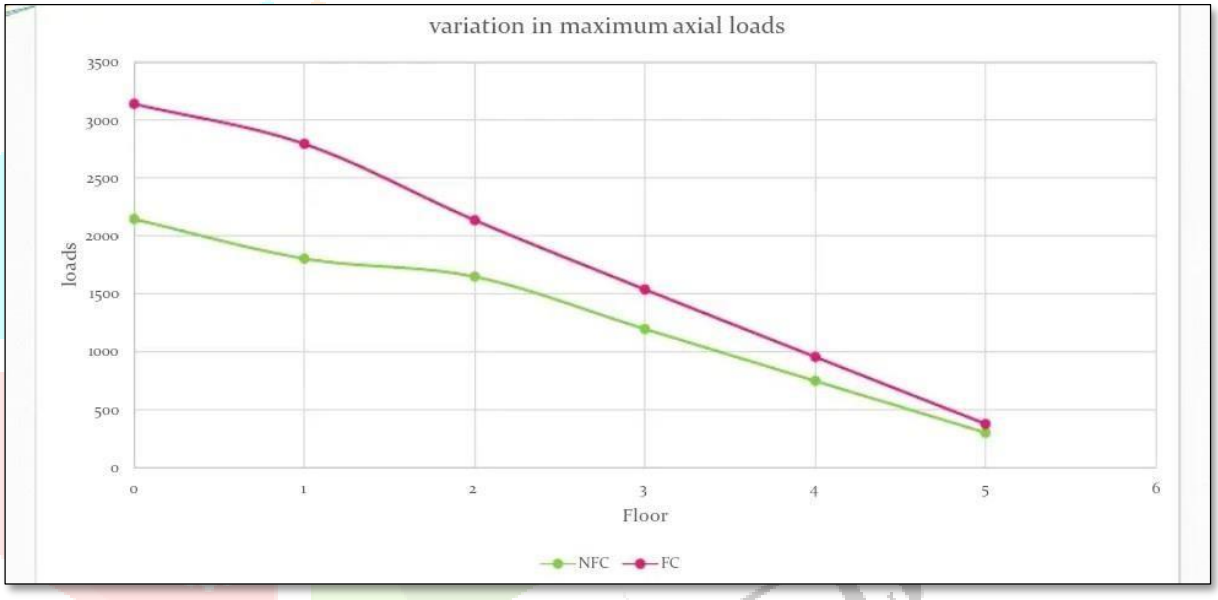


Fig no. 4.1

In case of columns, the maximum axial load is coming in the middle columns of the second and third rows when the structure is non-floating type. In the floating type structure when the specific columns are removed the maximum loads gets redistributed and the middle columns of the first and fourth row experiences the max load.

5. Effect of Earthquake

There is not much change in axial load because the maximum load or design load occurs due to dead and live load.

But in case of moment and flexure, it is observed that the maximum load occurs due to the dead, live and earthquake load.

We can see that there is a haphazard change in moment for a structure with floating column, hence it is important that we design the structure properly after studying the effects of earthquake load.

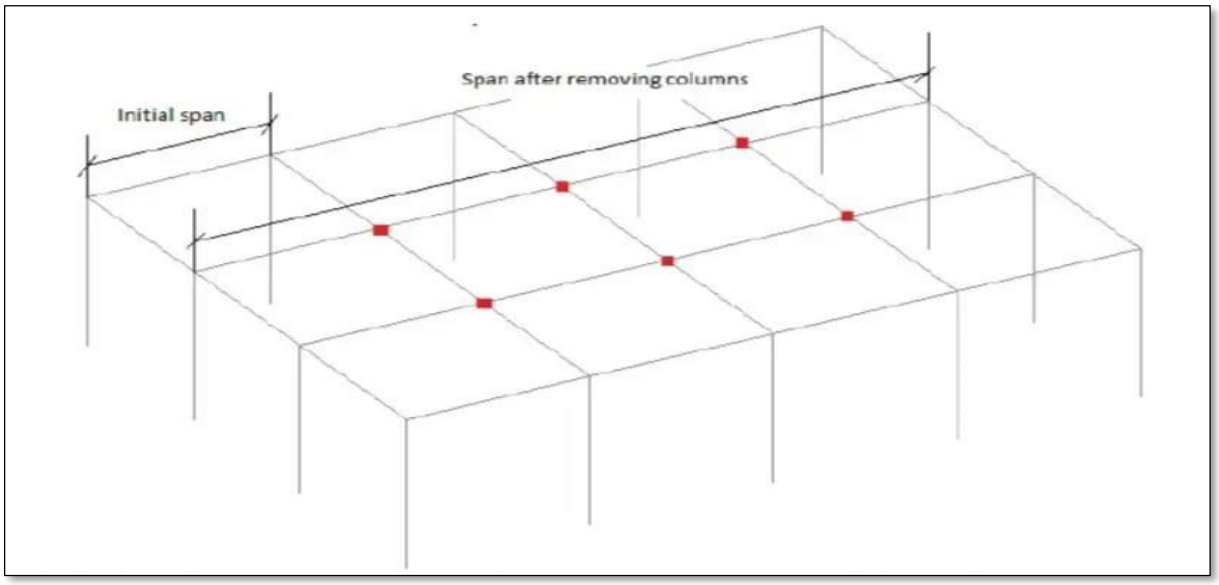


Fig no. 5.1

6. Whenever we remove a column, the stiffness of the beam changes as the span of the beam changes. Hence it is necessary that we change it's moment of inertia accordingly so that deflection should be minimum.

6. Conclusion

Floating columns are structural members that terminate at an intermediate floor level, transferring loads to beams rather than the foundation, often used to create flexible, open floor spaces. While architecturally advantageous, they significantly reduce seismic resistance, increase lateral displacement, and introduce vulnerability, making them unsafe in high-seismic zones.

As we move to the upper floors, the variation in moment for a normal structure and the one with floating columns, increases.

This happens because the entire beam moment is transferred to the single connecting column. Whereas in intermediate beams, the moment is distributed by the two connecting columns.

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