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Comparative Study on A RCC Building Constructed With Regular Columns and Floated Columns Using E-Tabs

Y. Navya Sri¹, T. Sai Kumar², A. Abhishek³, M. Teja⁴, G. Vivek⁵, P. Haragopal⁶

Students, Department of Civil, NSRIT, Sontyam, Visakhapatnam, India^{1,2,3,4,5}

Assistant Professor, Department of Civil, NSRIT, Sontyam, Visakhapatnam, India⁶

ABSTRACT: This study presents a detailed comparison of a building's structural performance, contrasting designs that utilize floated columns with those employing standard columns. The primary goal is to clarify the specific engineering attributes, load-handling capabilities, and overall stability of these two column types in a practical construction setting. A pre-existing 2B+G+8 residential building serves as the model for this investigation. Using ETABS software, we've developed building models and analyzed their behavior under different load scenarios. The analysis will focus on critical technical aspects, including material characteristics, construction techniques, and structural responses to varied loads. Advanced computational tools and simulation methods will be used to model and simulate the building's dynamic response, providing a detailed understanding of the structural integrity of both floated and conventional column configurations. Floated columns, supported by beams without direct foundation contact, are commonly used in multi-story buildings, particularly where ground-floor parking and open spaces are desired on upper floors. These columns introduce a discontinuity in the load transfer path. Designed primarily for gravitational loads, their ability to withstand seismic forces is limited. Such constructions are common in urban settings but are less favored in earthquake-prone areas due to the load path discontinuity. The results could significantly impact architects, engineers, and construction professionals, influencing design standards and construction practices to enhance structural performance, safety, and cost-effectiveness in building projects.

KEYWORDS: Floating Column, E-TABS, Regular column, loading conditions, Structural Integrity

I. INTRODUCTION

The construction sector consistently pursues novel strategies to boost building efficiency, longevity, and safety. One area of focus involves the selection of column types in structural design. Conventional methods typically employ standard columns, but innovative technologies introduce floated columns, potentially revolutionizing building construction. This research presents a detailed comparative analysis, contrasting the structural performance of buildings with floated columns against those with traditional columns.

Columns, the vertical load-bearing elements, transfer loads through beams; floated columns are supported by beams rather than direct foundations. The supporting beam in a floated column acts as a foundation, and should not extend beyond the foundation. Building codes often exclude balconies from the floor space index (FSI), which is the ratio of built-up area to plot area. Floated columns are often used at building edges that extend outwards. The current study examines the effects of floated columns in multi-story buildings, comparing scenarios with and without them.

A floated column is supported by beams or slabs on intermediate floors, without direct connection to footings or pedestals they are also called hanging columns. Floated columns have gained interest for potential advantages such as better load distribution, less material use, and enhanced earthquake resistance.

Codes and standards:

These are the applicable codes and standards for the analysis, design of Proposed 2B+G+8 RCC Building.

- IS 456: 2000 - Code of Practice for Plain and Reinforced Concrete.
- IS 875 (Part 1) — 1987, Code of Practice for Design Loads (other than Earthquake) for buildings & structures - Dead loads.



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- IS 875 (Part 2) — 1987, Code of practice for Design Loads (other than earthquake) for buildings & structures - Imposed Loads.
- IS 875 (Part-3) — 2015, Code of practice for Design Loads (other than earthquakes) for buildings & structures Wind loads.
- IS 1893 (Part-1) — 2016 Criteria for Earthquake resistant design of structures: General provisions and buildings.
- IS 1786:2008 - High Strength Deformed Steel Bars and Wires for Concrete Reinforcement specification.

Structural layout:

The basic structure description and layout of Proposed 2B+G+8 RCC Building was Designed as per the IS CODE standards. Basic structure description and building accessories are listed in Table 1

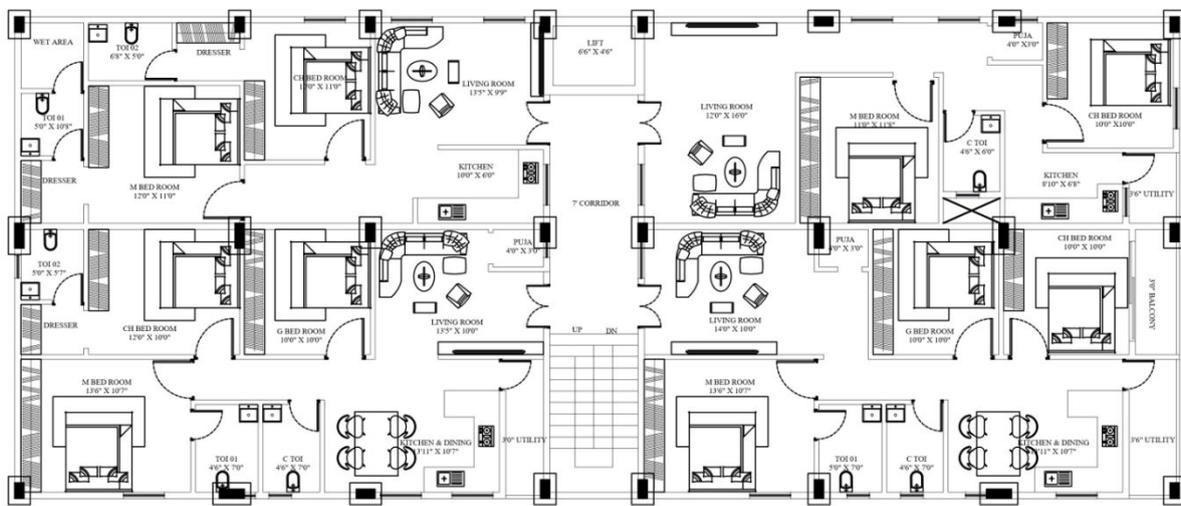


Fig: Floor Plan (92'6" X 38'6")

Loads and combinations:

The design loads shall be calculated as described in the following sections. Dead load consists of self-weight of various structural elements indicated in the Table 2.

Live loads are gravity loads produced by the use and occupancy of the building or the structures. This includes the weight of all movable loads such as personal, tools miscellaneous equipment, movable partitions, storage material etc. Live loads considered in the structure as per IS 875 Part 2 Code are tabulated in Table 3

Earthquake loads:

The loads due to Earthquake are generated by the response of the structure to design spectrum as specified in IS 1893 (Part 1) 2016. The building site is located in Earthquake Zone II and seismic zone factors corresponding to that zone are adopted in calculation of response. The masses considered in the structure, generating the earthquake loads are due to dead weight of permanent construction, 50% live load on the structure and it's tabulated in Table 4.

Wind loads:

The loads due to wind are calculated as per the provisions specified in IS 875 (Part 3)

. Wind load parameters are given in Table 5, Design Wind pressure is calculated as: $P_d = -k_d \times k_a \times k_c \times 0.6 V^2$, the internal pressure coefficient considered, $C_{pi} = +/ - 0.5$

Load combinations:

Structure has to be designed for both strength and serviceability criteria. For the strength design, load combinations as specified in IS 456-2000 shall be used. For ascertaining safety under service load conditions, the un-factored load combinations as specified in IS Code shall be used. These combinations are primarily framed for serviceability condition requirements such as member local deflections and overall structural deflection checks. Various load



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combinations as per the partial safety factors given in IS 456– 2000 are listed below for strength and serviceability criteria and it's shown in the Table 6.

Layout Diagram:

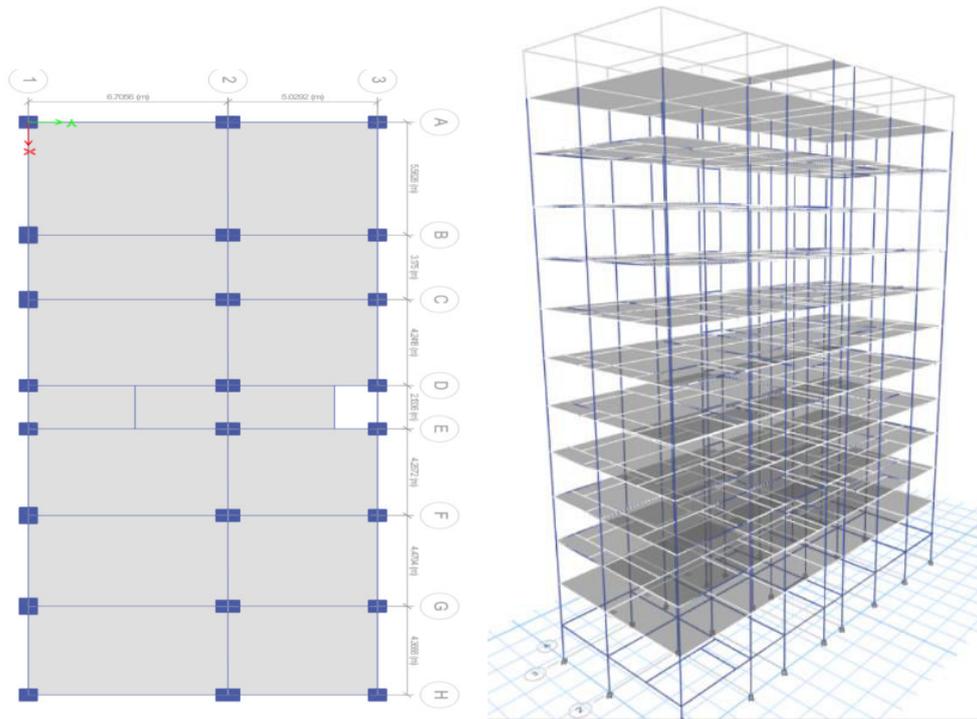


Fig : Regular column

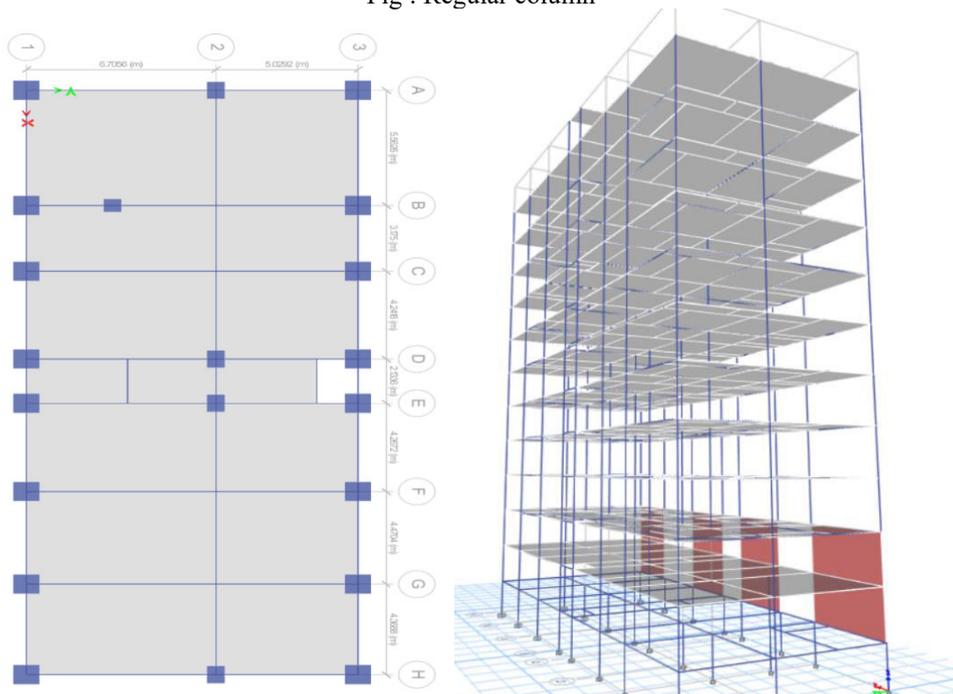


Fig : Floated column



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Table 1
Structure Description (ETABS).

SI. No	DESCRIPTION	DETAILS
1	Length * Width	28.04 m * 11.5 m
2	Height	39 m

Table 2
Dead Loads (ETABS).

SI. No	ITEMS	WEIGHT
1	Self-weight factor	1.0
2	Slab load Including Floor Finish	1.2 KN/m ²
4	Wall load (3m height wall)	8.1 KN/m
5	Internal Wall load (3m height wall)	6 KN/m
6	Wall load (1 m height wall) - Parapet	2 KN/m
7	Stair case	22 KN/m

Table 3
Live Loads (E TABS).

SI. No	ITEMS	WEIGHT
1	(G + 8) all rooms Corridor	2.0 KN/m
2	Roof Live	6 KN/m 1.5 KN/m

Table 4
Earthquake Loads (ETABS).

Zone	Zone Factor	Importance Factor	Response Reduction Factor	Damping Ratio
II	0.1	1.5	5	0.05

Table 5
Wind Load Parameters (ETABS).

Parameters	
Regional basic wind	50 m/s
Terrain Category	1
Risk Coefficient, K1	1.0
Terrain, Height and Structure size factor, K2	As per building height



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Topography factor, K3	1.0
Importance factor for Cyclonic region K4	1.0
Directionality factor, Kd	0.9
Area Averaging Factor, Ka	0.9
Combination Factor, Kc	0.9
Design life of the building	50
Percentage of opening in the building	5-20%

Table 6
Load Combinations\

STRENGTH DESIGN	SERVICEABILITY DESIGN
1. 1.5 DL + 1.5 LL	1. 1.0 DL + 1.0 LL
2. 1.2 DL + 1.2 LL + 1.2 WL/EL	2. 1.0 DL + 0.8 LL + 0.8 WL/EL
3. 1.5 DL + 1.5 WL/EL	3. 1.0 DL + 1.0 WL/EL
4. 0.9 DL + 1.5 WL/EL	

II. RESULTS AND DISCUSSION

- The research expects to demonstrate the advantages and disadvantages of floated columns compared to traditional columns, focusing on aspects like load distribution, material use, earthquake resistance, and dynamic responses.
- The outcomes will highlight how floated columns can offer benefits such as better load management and reduced material usage, while also revealing potential limitations in altering the load path and excluding balcony areas from the floor space index.

SFD & BMD For Regular Column:

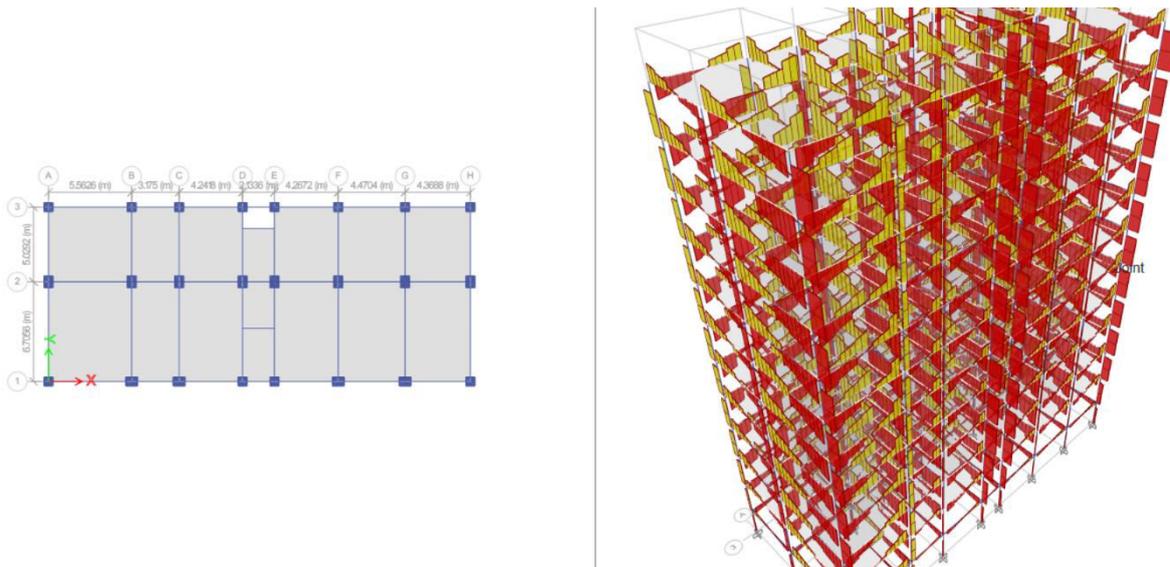


Fig: Shear Force Diagram



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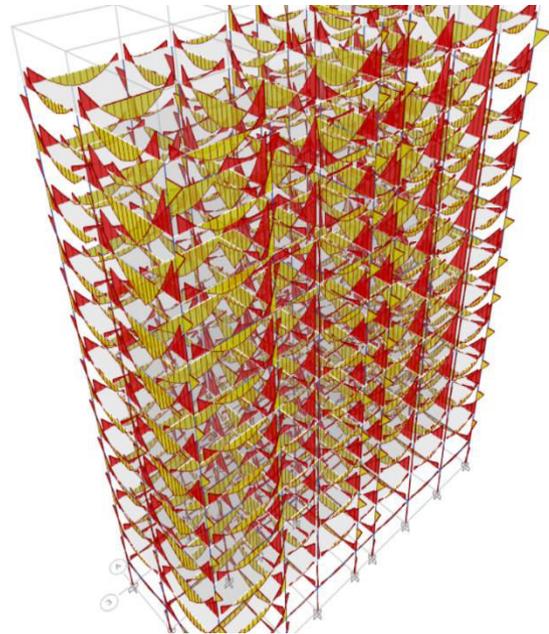
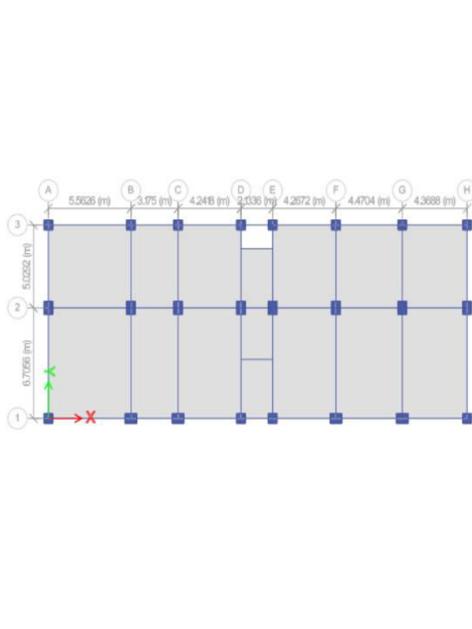


Fig: Bending Moment Diagram

SFD & BMD For Floated Column:

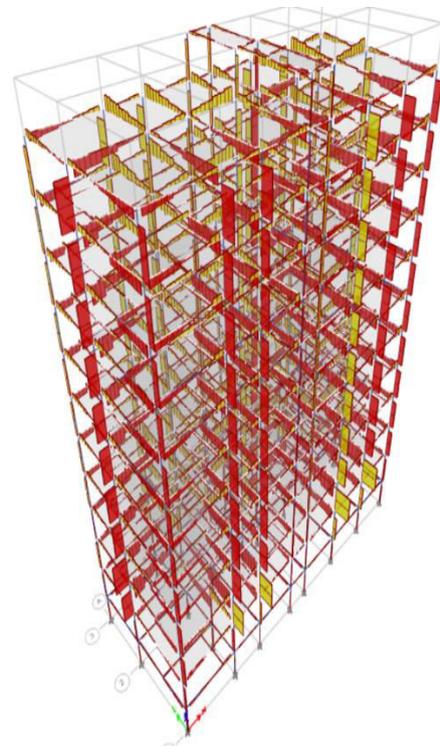
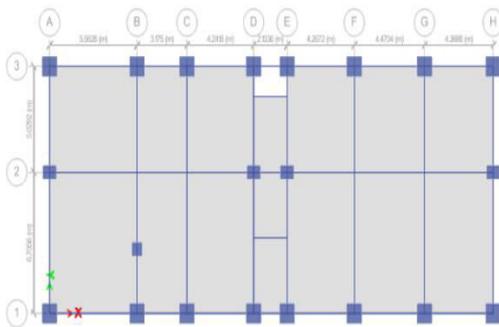


Fig: Shear Force Diagram



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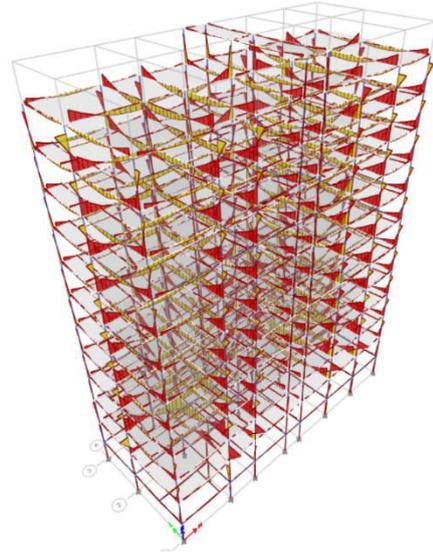
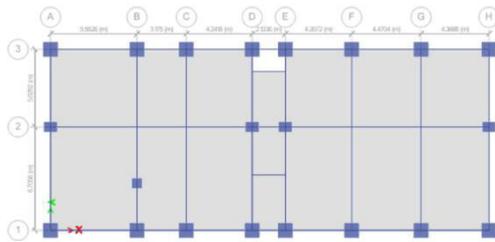


Fig: Bending Moment Diagram

III. CONCLUSION

The study aims to provide empirical data and quantitative insights into the structural performance differences between floated (hanging) columns and regular columns. It seeks to guide architects and engineers in choosing the appropriate column type, influencing design standards and construction practices to improve structural integrity, safety, and cost-effectiveness in building projects.

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