International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 15 Issue 5, May-2026

Seismic Analysis of RCC Framed Structures with Stub Columns

Varun Kumar Sikka[1], Rajender Singh[2]

[1]Assistant Professor, Department of Civil Engineering, Rattan Institute of Technology and Management, Haryana, India
[2]Research Scholar, Department of Civil Engineering, Rattan Institute of Technology and Management, Haryana, India

ABSTRACT

Seismic forces are a major consideration in the design and analysis of reinforced concrete (RCC) framed structures, especially in earthquake-prone regions. Structural irregularities such as stub (floating) columns introduce discontinuities in load transfer paths, significantly affecting the dynamic response and seismic performance of buildings. The present study investigates the seismic behavior of multi-storey RCC framed structures with stub columns at various locations and storey levels. A G+10 RCC building with plan dimensions of 25 m × 20 m located in Seismic Zone IV is modeled and analyzed using ETABS software. The analysis is carried out using the Response Spectrum Method as per IS 1893:2016 provisions. Different configurations including regular structures, and structures with internal, external, and combined stub columns are analyzed. Key parameters such as base shear, fundamental time period, storey displacement, storey drift, and storey shear are evaluated. The results indicate that the presence of stub columns leads to reduction in stiffness, increase in natural time period, and significant amplification in lateral displacements. Internal stub column configurations demonstrate comparatively better seismic performance than external configurations. It is concluded that although stub columns enhance architectural flexibility, they adversely influence seismic behavior and require careful structural planning.

INTRODUCTION

General

Earthquakes generate dynamic ground motions that induce inertia forces in structures, resulting in stresses, deformations, and potential structural failure. Unlike static loading conditions, seismic forces are cyclic and involve repeated reversals of stress, making structural design more complex. To ensure safety, RCC structures must be designed with adequate strength, stiffness, and ductility.

Modern buildings often incorporate architectural irregularities due to functional and aesthetic requirements. One of the most common irregularities is the provision of stub (floating) columns, where vertical load-carrying members are discontinued at certain levels and supported by beams. This leads to:

- Discontinuity in load transfer
- Increased bending moments in beams
- Stress concentration at supporting levels
- Increased lateral displacement

Thus, the presence of stub columns significantly influences the seismic response of RCC structures.

Need Of The Study

Structural and non-structural damages during earthquakes are primarily due to excessive lateral displacements and irregular load distribution. Buildings with discontinuities such as stub columns are more vulnerable under seismic loading due to lack of proper load path continuity.

In modern construction, stub columns are unavoidable due to requirements like:

- Parking floors
- Architectural aesthetics
- Open spaces in lower floors

Therefore, it becomes essential to study the seismic performance of such structures and evaluate their safety under earthquake forces.

Objective And Scope Of Project
The main objectives of the present study are:
- To study the seismic behavior of RCC framed structures with stub columns
- To perform dynamic analysis using Response Spectrum Method
- To evaluate key parameters such as displacement, drift, base shear, and time period
- To compare different configurations of stub columns
- To identify safer structural configurations

METHODOLOGY

Building Description
- Type: G+10 RCC Frame Structure
- Plan Dimension: 25 m × 20 m
- Storey Height: 3 m
- Seismic Zone: IV
- Soil Type: Medium
- Concrete Grade: M30 (columns), M25 (beams)

Structural Models
The following models are considered:
- Model A: Regular building without stub columns
- Model B: Internal stub columns
- Model C: External stub columns
- Model D: Combined internal and external stub columns

Each model is analyzed at different storey levels (Ground, 3rd, 6th, and 9th floors).

Loading And Analysis
Loads considered:
- Dead Load
- Live Load
- Seismic Load (IS 1893:2016)

Analysis method:
- Response Spectrum Analysis
- 5% damping considered
- Modal analysis performed

RESULTS AND DISCUSSION

Base Shear
The base shear values show slight variation among different models. Regular structures exhibit higher base shear due to greater stiffness, whereas structures with stub columns show slight reduction.

Observation:
- Base shear decreases slightly for stub column models
- Variation depends on location of discontinuity

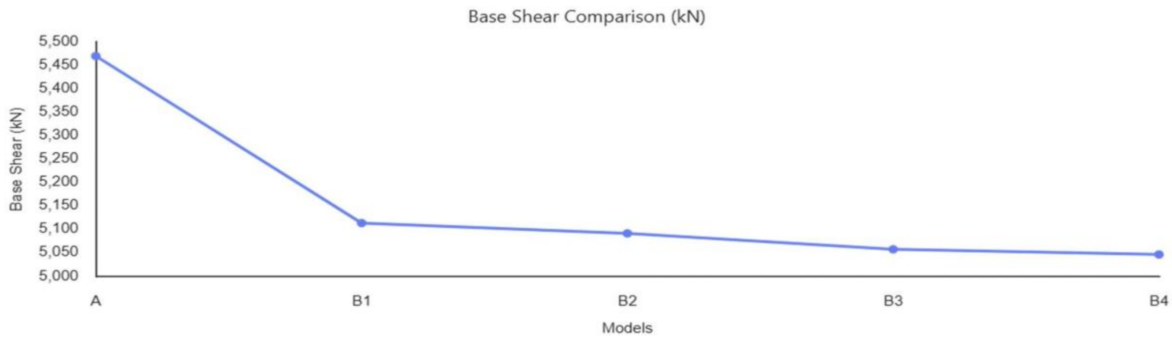


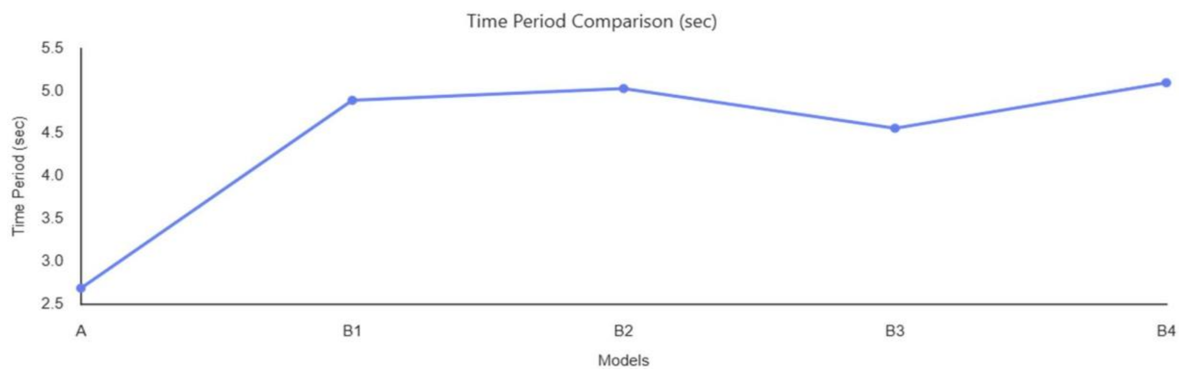
Figure shows the variation of base shear for different structural configurations. It is observed that the introduction of stub columns slightly reduces the base shear due to increased flexibility of the structure.

TIME PERIOD

The introduction of stub columns increases the fundamental time period of the structure. Observation:

- Increase up to ~25–30%
- Maximum in higher-level stub column cases

Reason: Reduction in stiffness leads to increased flexibility.



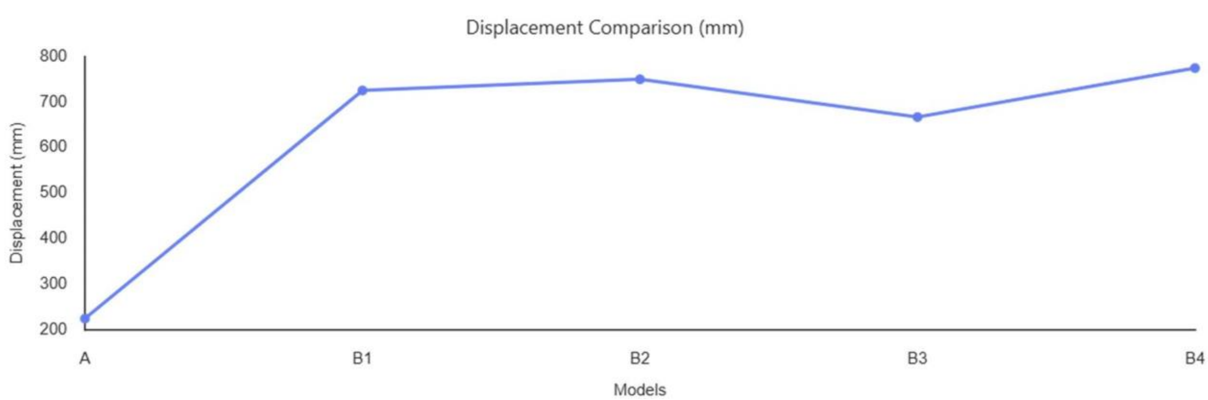
The fundamental time period increases significantly with the inclusion of stub columns. This indicates a reduction in stiffness, making the structure more flexible and susceptible to larger displacements.

Displacement

Lateral displacement significantly increases due to stub columns. Observation:

- Displacement increases up to 2–3 times
- Maximum for external stub columns

Conclusion: Stub columns create unsafe conditions due to excessive drift.



The displacement graph clearly indicates a substantial increase in lateral deflection for models with stub columns. Maximum displacement is observed in higher-level stub column cases, indicating higher vulnerability under seismic loading.

STOREY SHEAR

- Gradual decrease with height
- Irregular variation in stub column structures

Conclusion: Non-uniform load transfer due to discontinuity.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

- Stub columns reduce structural stiffness
- Increase in fundamental time period observed
- Lateral displacement increases significantly
- External stub columns are most critical
- Internal stub columns perform comparatively better
- Load path discontinuity leads to stress concentration

Recommendations

- Avoid stub columns in seismic zones where possible
- Provide shear walls or bracing systems
- Ensure continuous load transfer path
- Adopt ductile detailing as per IS codes

Limitations

- Linear elastic behavior assumed
- Soil-structure interaction not considered
- Material nonlinearity ignored
- Temperature and damping variation not included

REFERENCES

[1] **Nikhil Bandwal, Anant Pande, Vaishali Mendhe, Amurta Yadav** "To study the seismic behaviour of RC building with floating columns." Vol .03,Issue.08. May- 2014.

[2] **Isha Rohilla, S.M Gupta,Babita Saini** "Seismic response of multi-storey irregular building with floating column." Vol.4 Issue03 March 2015, PP 506-518.

[3] **Hardik, Sidharth Shah** "Push over analysis of RC frame structure with floating column and soft storey in different earth quake zone." Vol.04 Issue 04 April 2015, PP 114-121.

[4] **Umesh P.Patil, Shaivanand s Hallur**. "Seismic Analysis of G+5 framed structure with and without using floating columns using ETABS- 2013 software." PP 1482- 1489.

[5] **Prerna Nautiyal, Saleem Akhtar and Geeta Batham**, "Seismic Response Evaluation of RC frame building with floating column considering different soil condition". Vol4 Feb 2014,PP 132-138.

[6] **A P Mundad , S.W Sawdatkar** "Comparative seismic analysis of multi-storey building with floating column and without floating column" Vol .04 Issue 05 Oct 2015, pp 3395-3400

[7] **Malaviya , Saurav** " Comparative study of effect of floating column on the cost analysis of a structure designed on staad pro" vol .05 Issue05 May- 2015

[8] **Agarwal pankaj , Shrinkhande Manish (2009)** , " Eathquake resistant design of structure " PHI learning private limited , New Delhi

[9] **Srikanth , Yogendra** "seismic response of complex building with floating column " vol.02 Issue 04. 2014.

[10] **T . Raja Shekhar** , " study of behaviour of seismic analysis of mulitstoried building with and without floating column".