Performance And Cost-Based Comparative Assessment of Traditional and Optimization-Oriented Design Strategies for RCC Building

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***Abstract*—This study presents a comparative assessment of different optimisation-oriented structural systems for reinforced concrete (RCC) buildings under seismic loading conditions. A G+10 RCC building was analyzed using five structural configurations namely Normal RCC frame, Concrete Bracing system, Steel Bracing system, Shear Wall system, and Flag Shear Wall system. The objective of the study is to evaluate seismic performance and cost efficiency through optimization of structural configuration, material consumption, and lateral load-resisting systems. Structural analysis was carried out using ETABS software in accordance with IS 1893 provisions. Parameters such as storey displacement, inter-storey drift, stiffness, and time period were compared for all models. Results indicate that the Shear Wall and Flag Shear Wall systems significantly improve structural stiffness and reduce displacement and drift compared to the conventional RCC frame. The Steel Bracing system was found to provide balanced seismic performance with better economic efficiency. The study concludes that optimization-oriented structural systems improve seismic resistance, reduce material usage, and provide economical solutions for high-rise RCC buildings.**

***Index Terms*—RCC buildings, seismic performance, optimization, bracing systems, shear wall, structural efficiency, cost optimization.**

I. INTRODUCTION

Rapid urbanization and the increasing demand for high-rise structures have created the need for economical and efficient structural systems capable of resisting seismic forces. Traditional RCC framed structures often result in excessive displacement, larger member sizes, and higher material consumption due to conservative design approaches. To improve structural efficiency, advanced lateral load-resisting systems such as bracing systems and shear walls are increasingly adopted in modern construction.

This study evaluates the seismic behaviour and economic efficiency of different optimization-oriented structural systems for a G+10 RCC building. The comparative assessment includes Normal RCC frame, Concrete Bracing, Steel Bracing, Shear Wall, and Flag Shear Wall systems.

II. METHODOLOGY

Three-dimensional ETABS models of a G+10 RCC building were developed and analyzed. The building was subjected to dead load, live load, wind load, and seismic load as per the Indian Standard codes. Response Spectrum Analysis was carried out to evaluate seismic response. The following structural systems were considered:

1. Normal RCC Frame
2. Concrete Bracing Systems
3. Steel Bracing System
4. Shear Wall System
5. Flag Shear Wall System

The structural performance was evaluated using parameters such as storey displacement, inter-storey drift, time period, and stiffness.

Table I. Structural Systems Considered

System	Main Feature	Performance	Economy
Normal RCC	Conventional frame	Poor	Moderate
Concrete Bracing	Improved stiffness	Good	Moderate

Steel Bracing	Lightweight bracing	Very Good	Good
Shear Wall	High lateral rigidity	Excellent	Costly
Flag Shear Wall	Enhanced stability	Excellent	Good

III. RESULTS AND DISCUSSION

The comparative analysis shows that the Normal RCC frame exhibits maximum displacement and drift due to lower stiffness. The introduction of Concrete Bracing and Steel Bracing systems improves lateral stiffness and reduces deformation under seismic loading. The Shear Wall and Flag Shear Wall systems provide the highest stiffness and best control over displacement and inter-storey drift.

The Shear Wall system reduced top storey displacement by approximately 18–20% compared to the conventional frame. Similarly, inter-storey drift values remained well within the permissible codal limits specified in IS 1893:2016.

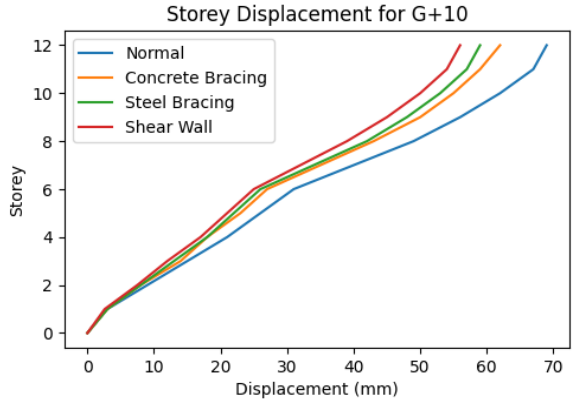

Fig. 1: Storey displacement comparison for G+10 RCC building.

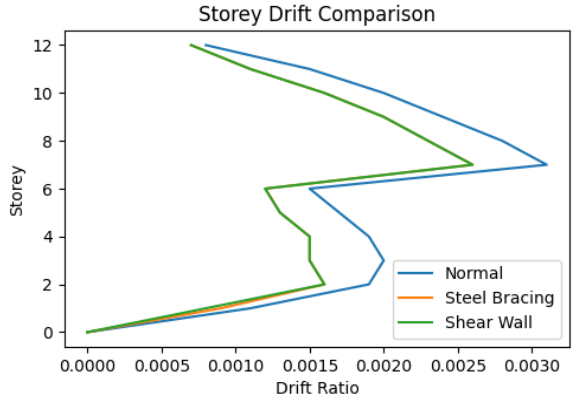

Fig. 2: Storey drift comparison for different structural systems.

Table II. Comparative Cost and Performance

System	Stiffness	Displacement	Cost Efficiency
Normal RCC	Low	High	Moderate
Concrete Bracing	Moderate	Moderate	Good
Steel Bracing	High	Low	Very Good
Flag Shear Wall	Very High	Very Low	Good
Shear Wall	Maximum	Minimum	Moderate

IV. CONCLUSION

The study demonstrates that optimization-oriented structural systems significantly increase the seismic performance and structural efficiency of RCC buildings. Bracing systems and shear walls effectively reduce displacement and drift while improving stiffness and lateral load resistance. The Steel Bracing system provides a balanced combination of structural performance and economic efficiency, whereas the Shear Wall system provides maximum seismic resistance and stiffness. The findings confirm that optimised structural configurations can reduce material consumption, improve safety, and provide sustainable solutions for modern earthquake-resistant RCC construction.

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