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Study of Different Types of Flat Slab is Structured Design as per 1893 Part – 1

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ABSTRACT

The necessity for high-rise structures in today's developing environment has spurred advancements in civil and structural engineering. This trend towards high-rise construction is driven by the perpetual demand for space in metropolitan and developing cities. Swift construction coupled with high-quality workmanship is imperative in this context. Flat slab construction offers distinct advantages over conventional methods, including reduced floor-to-floor height, enhancing construction flexibility, and minimizing construction duration. However, the use of flat slab construction is restricted in higher seismic zones according to I.S.1893-2016 regulations. In this study, various parameters such as deflection, story drift, overturning moment resistance, and base reactions are investigated. Three models are compared: conventional slab, pure flat slab, and flat slab with shear wall reinforcement. Given the vulnerability of flat slab structures to lateral loading in higher seismic zones, the primary aim of this research is to demonstrate that incorporating shear walls in flat slab designs yields comparable results to conventional slab structures. Analysis is conducted using Etabs software, with results compared across different seismic zones.

Keywords: Base Shear, ETABS Software, Flat Slab, Pushover Analysis, Response Reduction Factor.

INTRODUCTION

India, with the second-highest population globally, faces diminishing availability of land due to its status as a developing country. Consequently, companies are increasingly turning to the construction of high-rise buildings to utilize remaining land efficiently. While many countries utilize steel structures for construction, in India, such structures are relatively uncommon due to limited knowledge and economic constraints. As a result, concrete remains the predominant material in the construction industry. Consequently, numerous scientists are conducting research on concrete behavior, earthquake effects, and earthquake-resistant design for various zones and soil conditions, all essential considerations in construction activities.

Advantages of Flat Slab:

Accelerates construction pace.

Simplifies construction and reduces costs due to simplified formwork and ease of reinforcement placement.

Offers an aesthetically pleasing appearance with plain ceilings, facilitating easy provision of acoustical treatment in the absence of beams.

Economical for spans up to 10m and lighter loads compared to RCC.

Exhibits reduced self-weight compared to RCC, resulting in decreased dead load and positive effects on columns and foundations.

Major Problems in Flat Slab:

Lack of rigidity in slab-column connections compared to beam-column joints.

High shear concentration around columns, increasing the risk of column punching through the slab.

Pronounced deflections due to the lesser depth of the slab.

OBJECTIVE OF THE WORK

- To study the behavior of G+ 24 storey’s building with three different models.

- To carry out response spectrum analysis.
- To compare the results of the models and put comments forward.

Result:-

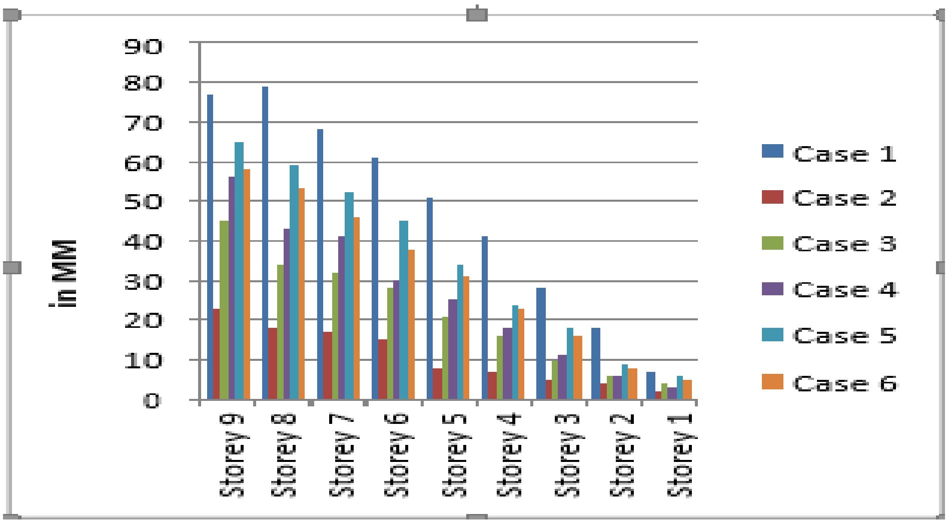
Direction	Conventional Frame Structure (mm)	Flat Slab Structure (mm)	Flat Slab with Shear Wall (mm)
X Direction	7	8.9	7.7
Y Direction	8.4	12.8	9.6

Table 1: Deflection in Zone I

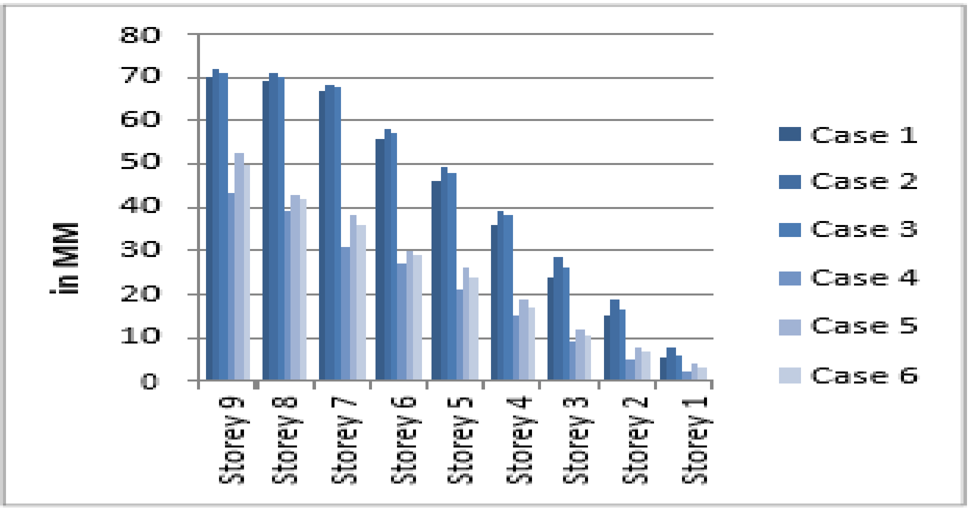
Direction	Conventional Frame Structure (mm)	Flat Slab Structure (mm)	Flat Slab with Shear Wall (mm)
X Direction	7.6	8.2	8.4
Y Direction	8.9	13.7	10.3

Table 2: Deflection in Zone II

The reports for the analysis is been exported from the modelling, and further collected and compared with all the cases shown below:



Graph 1: Comparison of Maximum Displacement Along X-Direction



Graph 2: Comparison of Maximum Displacement Along Y-Direction

Conclusion-

Based on this study, it is evident that flat slab structures exhibit greater flexibility compared to conventional frame structures, which may lead to inferior performance in higher seismic zones. However, when shear walls are incorporated into flat slab structures, they demonstrate properties that are comparable to, or even superior to, conventional structures. The following conclusions were drawn from the investigation:

The displacement of asymmetric buildings without retrofitting is significantly higher compared to models with shear walls. Specifically, the maximum displacement observed in the lateral direction is approximately 38.8% greater in the case without shear walls.

Models with shear walls positioned at high-stress concentrated areas exhibit reduced displacement values. The structure with a centrally positioned shear wall (Case 4) shows 34.8% less displacement compared to the one with a shear wall at the center (Case 3). Additionally, Case 4 demonstrates the least displacement, with values as low as 44 mm along the Y-direction and 19 mm along the X-direction, representing a significant improvement over the initial displacement of 78 mm without shear walls.

Analysis of output files from Etabs suggests that with proper local supervision, the construction of flat slab structures can be more economical than conventional slabs. Therefore, it is inferred that despite the vulnerability of flat slabs to lateral loads, their inclusion in higher seismic zones with shear walls can yield results similar to those of conventional structures. Moreover, the flat slab structure with shear walls can achieve comparable performance with a lower wall plan density than what is recommended by the I.S. code, though this may vary depending on the specific structure..

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