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Comparative Study of Conventional Structure with Monolithic Structure

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Abstract: ***In this research, comparative study carried out between conventional structural systems with monolithic structural system (reinforced concrete wall structure). In India, monolithic construction system carried out only for lower rise structure; if we consider this structural system mid to high rise structure then it may more feasible, adoptable and economic comparing conventional structural system. In this system all slabs, stairs, wall with opening or without opening cast together in one operation. Etabs software is used for analysis and design of both structural systems.***

Keywords: Monolithic system, Conventional System, Comparison, Structural Performance

1. Introduction

Generally, a building can be defined as 'An enclosed structure intended for human occupancy'. A building has two basic parts; Substructure or foundations and Superstructure. Over many years, engineers have observed that, there are different type of structural system which categorized by construction material (e.g. concrete, masonry, steel, or wood) and each structural system have different performance against lateral forces or gravity loads. Broad categories of structural systems are: Load Bearing wall systems (e.g. masonry, concrete), Building frame systems (e.g. concrete, steel, and wood), Moment-resisting frame systems, Dual systems, Cantilever column systems. In this, reinforced concrete shear walls are widely used in tall building for its excellent seismic behavior. A well designed structure with shear wall can decrease the project cost. In this research two different structural systems were made, (i) Beam-column structure (conventional system) (ii) Shear wall structure (monolithic system).

In Monolithic System; all walls, slabs, stairs, together with door and window openings are cast in place in one operation at site by use of specially designed, easy to handle with less labour and equipment efforts modular form work made of Aluminum Plastic composite. In this system the lateral and gravity load resisting system consists of reinforced concrete walls and reinforced concrete slabs. Reinforced concrete structural walls are the main vertical structural elements with a dual role of resisting both the gravity and lateral loads.

2. Objective and Scope

The main objectives of this study are to determine the suitability, adoptability and economic feasibility of conventional structural system against monolithic structural system and comparative study of conventional structural system with monolithic structural system and for both structural system comparison of storey drift, storey shear, storey displacement, modal time and base shear.

The main scope of this study is to study related to different type of Structural Systems, to study of various provisions of IS 13920:1993 for shear wall, to perform dynamic analysis of G+10, G+15 and G+20 storey building using response spectrum method, problem formulation for zone III and Comparative study will be carried out for; Different thickness of shear wall.

3. Literature Review

Can balkaya and Erol kalkan modeled a multistorey reinforced concrete wall building and FEM analysis carried out. They concluded that, due to high stress concentrations around the openings, the use of the diagonal shear reinforcement in addition to the edge reinforcement in these locations may lead to significant contribution for retarding and slowing down the crack propagation. Also monolithic buildings provide better seismic performance in addition to their low construction cost compared to conventional buildings.

H. Gonzales and F. López-Almansa presents a numerical seismic assessment of seven existing thin shear–wall and mid-height buildings which located in Peru. Static and dynamic nonlinear analyses have been carried out for both system. They concluded that, the seismic strengths of all the analyzed buildings are insufficient. In most of the cases the Damage Limit States for Life Safety, Immediate Occupancy and Collapse Prevention are achieved first in the coupling beams. Improvements in seismic performance of building if there is doing feasible modification in coupling beam.

Beatrice Belletti , Cecilia Damoni and Antonello Gasperi presents the seismic performance of a regular multi-storey RC structural wall building vertically connected with ordinary reinforcement is investigated and carried out different modeling approaches for pushover analyses. They concluded that, through lumped plasticity model a reliable seismic response has been obtained, comparable to that one obtained with more refined models.

N. H. Abdul Hamid and M. A. Masrom research slab-wall joint performance in RC wall construction during lateral

loading. They prepare a slab-wall model and by using linear potentiometers and actuator they concluded that, stiffness of wall-slab joint started to decrease from 0.2% drift until 2.1% drift and lost it stiffness after 2.1% drift.

Rajesh m n and S K Prasad RC wall building modeled and analyzed using SAP 2000's pushover analysis by using layered shell elements. Various parameters such as aspect ratio of walls, reinforcement detailing aspects and presence of openings are chosen to study the seismic performance of RC walled building. Finally concluded, by providing boundary element base shear capacity increases.

4. Methodology

For this study, a residential building with lift room having a 3-meters height for each story is modeled. The section of structural elements is rectangular with common dimensions. The buildings are modeled using software ETAB v15, two different models - Conventional Structural System and Monolithic Structural System. Dead load & live load calculation is as per IS 875(1987), and Earthquake load calculation is as per IS 1893(2002) taking EQ Zone-III by using static coefficient method. The data for these frames are given below.

Seismic Zone – III, No of storeys –1 to 10, Floor Height – 3m, Thickness of Shear wall– 150 mm, Materials – M20, M25, Fe 415, Depth of Slab – 150mm, Unit Weight of RCC – 25 kN/m3,Type of soil – Medium. Size of beam 300x600 mm, Size of column 300x750 mm.

Figure 1: Building plan

5. Results

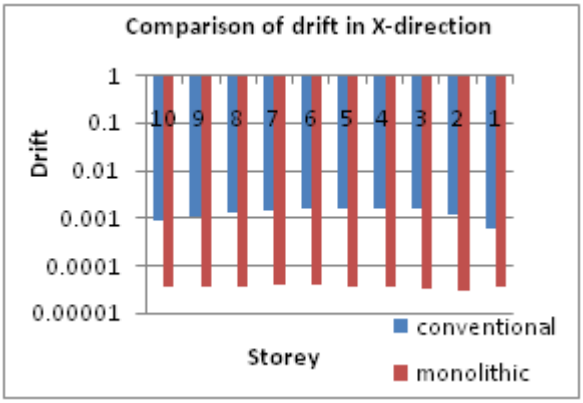

Figure 2: Comparison of drift in X-direction for G+10storey

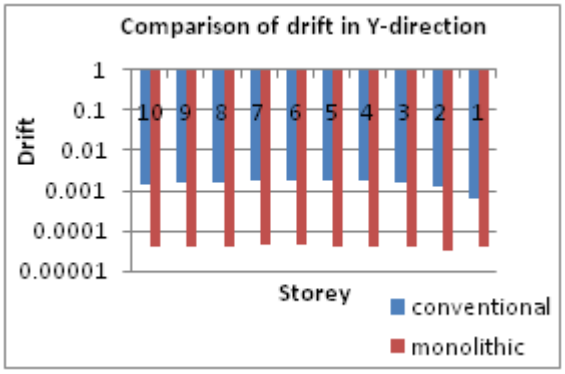

Figure 3: Comparison of drift in Y-direction for G+10storey

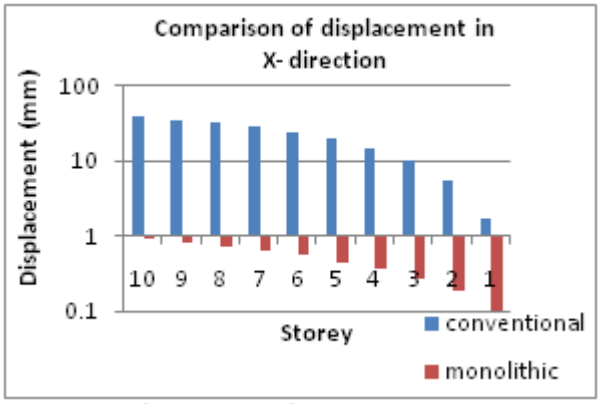

Figure 4: Comparison of displacement in X-direction for G+10 storey

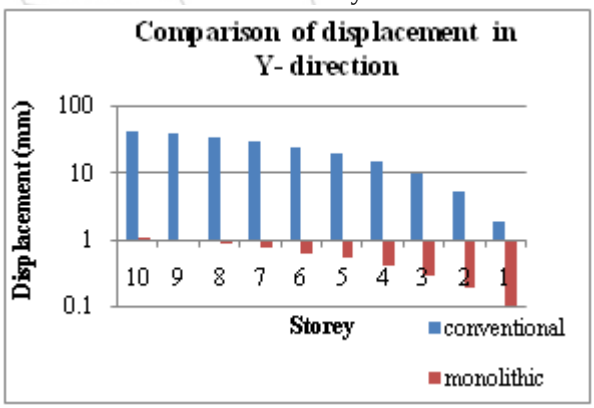

Figure 5: Comparison of displacement in Y-direction for G+10 storey

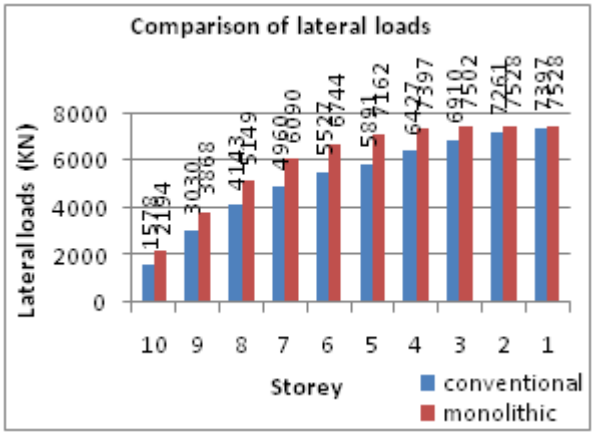

Figure 6: Comparison of lateral loads for G+10 storey

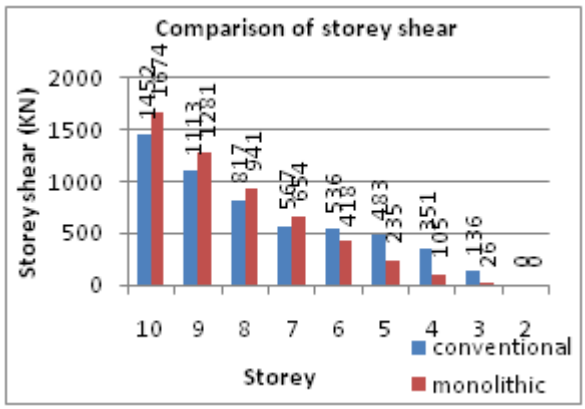

Figure 7: Comparison of storey shear for G+10 storey

Table 1: Comparison of time period and base shear

Structural system	*Conventional*	*Monolithic*
Time period	1.567 sec.	0.176 sec.
Base shear	7397 kN	7528 kN

6. Conclusion

One to ten storey conventional and monolithic system were analysed and designed as per the codal provisions and the results are compared in various aspects. It is found that storey displacement in monolithic structural System decreases as compared to conventional structural system in both the directions. Drift is also decreases in both the directions for monolithic structural system as compared to conventional structural system. As modal time period is less in monolithic structural system. Also advantages like, rapid construction work and all over project cost will be reducing.

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