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Post Tensioning Voided Flat Slab

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Abstract:
In developing countries like India, the use of post-tensioning method due to its various Applications has been increasing day by day. Also, the Post-tension flat slab construction has long been popular for medium to high rise building such as office buildings, hospitals, Residential buildings, university, and parking buildings. In the present study, a commercial office building has been selected to perform a parametric study. Various slab system i.e. Flat slab with RC beam, RC slab with RC beam, Post tensioning flat slab with drop panel and Post tensioning flat slab without drop panel with Post-tensioning voided flat slab have been studied to compare their performance by applying Time History Analysis. Various parameters,such as thickness of slab, grade of concrete, punching shear, column size etc. have been selected for the present study to arrive at the best suitable slab system By using these voided systems, it is possible to lighten the weight of slabs as much as 35%. "A 21-inch-thick slab can be reduced by the equivalent of 4 to 5 inches in thickness of concrete or 30 to 40 pounds per square foot of dead load," as concluded by a research. A typical slab with 40-foot spans is 16 inches thick, but a voided slab with these spans can reduce the equivalent solid thickness to about 12 inches. This reduced weight of building floors also permits engineers to reduce columns, walls, and foundations as much as 40%, although concrete can't be removed from all locations in a floor slab; voids are omitted near columns to maintain slab punching-shear capacity.

Index Terms: **Flat slab brief overview, composition and materials , loads imposed , Design and modelling**

1. INTRODUCTION

The slab is a very important structural member in a building. When the load acting on the slab is large or clear span between columns is more, the slab thickness increases. It leads to higher consumption of materials such as concrete and steel, which not only increases the self weight of the slab but also increases the costs. Increased dead loads further increase the foundation loads, thereby, requiring stronger foundations and further escalating the overall costs. In a conventional RCC frame structure, load is transferred from the slab to the beams, from beams to the columns, from columns to the footings and ultimately to the hard strata underground. Such a structure permits lower slab thicknesses by virtue of the support available in the form of beams. However in a large multi-storey building structure, the number of beams and their running lengths might be so large that the economy obtained by lowering the slab thickness may become redundant. In this case, a flat slab is the most suitable alternative for a floor system. In many domestic and industrial buildings a thick concrete slab, supported on foundations or directly on the subsoil, is used to construct the ground floor of a building. These can either be "ground-bearing" or "suspended" slabs. In high rise buildings and skyscrapers, thinner, pre-cast concrete slabs are slung between the steel frames to form the floors and ceilings on each level.

2. OBJECTIVES

- To design and analyze a post-tensioned voided flat slab for a multi-storey building structure.
- To present a post tensioned voided flat slab as an alternative to conventional RCC flat slab.
- To improve the rate of construction by faster removal of formwork.
- To use recycled HDPE plastic spheres in the bubble deck slab to reduce its impact on the environment

3. SCOPE

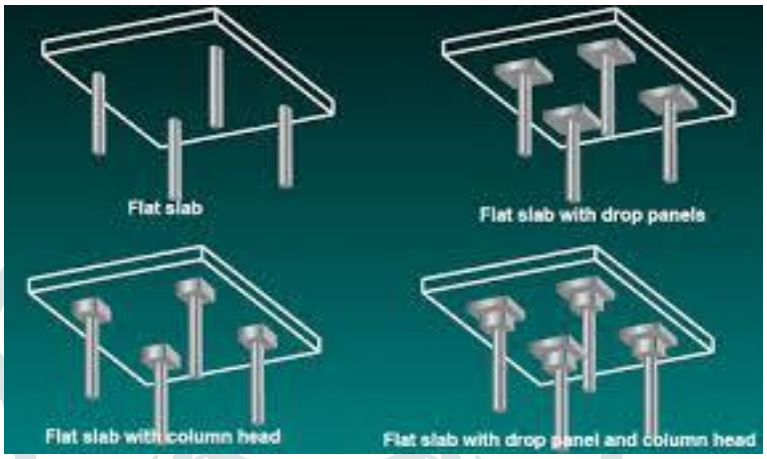
- It is fast construction ,more economical and time saving construction.
- Tremendous architectural flexibility enabling column free space .

4 .METHODOLOGY

4.1. FLAT SLAB

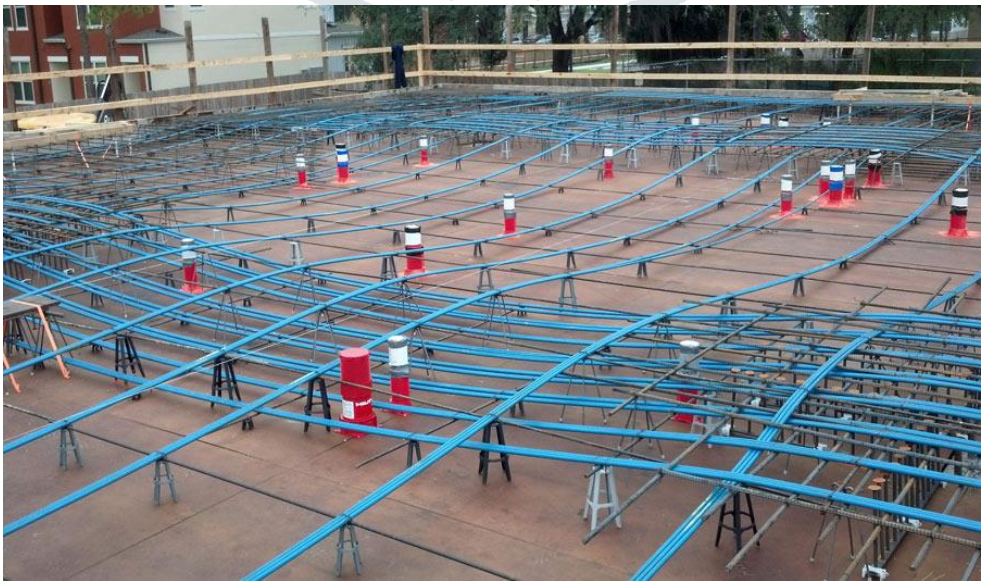
A flat slab consists of a reinforced concrete slab that is directly supported by concrete columns without the use of intermediate beams. Due to the elimination of beams and direct resting of the slab on columns, large bending moments and shear forces are developed near the columns. To prevent cracking of the concrete and failure, a column head or drop panel may be provided. A column head increases the shear strength of the slab and reduces bending moment by reducing the clear or effective span of the slab. A drop

panel improves the shear strength and negative moment carrying capacity of the slab and increases the stiffness, thus reducing deflections.



4.2 POST TENSIONED VOIDED FLAT SLAB

Post-tensioned flat slabs are a common variation of the conventional plate structure where most of the reinforcement is replaced by post-tensioned strands of very high strength steel. The structural advantage of post tensioning over conventional RCC is that the slab is nearly crack- free at full service load. This leads to a smaller deflection compared to conventional RCC slabs because of higher rigidity of the un-cracked section. Hence reduction in thickness of the slab is the rationale for using post-tensioning system for spans over 10m and above. Further the lack of cracking leads to a watertight structure Post-tensioning: The process of tensioning done after casting of concrete is known as Post-tensioning. Post-tensioning helps in overcoming the difficulty of fixing required profile of tendons in pre-tensioning. Ducts are placed with the required tendon profile by fixing them to the reinforcement cage. Concrete is cast around the duct. There are two possibilities of laying tendons. First, the tendons can be kept in the duct before casting and then concrete is poured. Second, tendons are threaded through the ducts after casting of concrete. Usually one end is anchored in concrete and the other end is anchored by external anchorage system after stressing. Stressing is done by hydraulic jacks after concrete attains its required strength. Pre-stessing force from tendons is transferred to concrete at anchorage ends



4.3 Flat Slab with Bubble Deck

Concrete is very strong in compression but relatively weak in tension. Steel, on the other hand, is very strong in tension. Hence, in a reinforced concrete structure, the tensile forces are resisted by steel reinforcement whereas the compressive forces are taken up by concrete. This makes concrete present in tension zones redundant, since all of the tensile stresses are taken up by steel. Moreover, in a flat slab the loads are transferred through the columns only; thus making the concrete in the central portion of the slab ineffective. This ineffective concrete can be removed and replaced by hollow plastic spheres. Such a slab is known as a bubble deck slab. High density polyethylene (HDPE) hollow plastic spheres replace the ineffective concrete in the centre of the slab, thus decreasing the dead weight and increasing the efficiency of the floor. The method which replaces the concrete by recycled balls with less amount of concrete is known as Bubble Deck Technology. Bubble Deck slab uses hollow balls made by recycled plastic and therefore it is an innovative method of virtually eliminating the concrete present in the middle of a conventional slab which does not contribute to the structural self weight and also leads to 30 to 50% lighter slab which reduces the loads on the columns, walls and foundation, and of course of the entire building. Also, since recycled plastic is used, environmental pollution is lowered which results in greener structures.

5. CONCLUSION

- Concrete is heavy, and 5% of the world's CO2 is created during the manufacture of the cement that goes into it. Then there is the aggregate that is dug out and the trucks that have to carry it. Not only that, but most of the concrete that is in a slab isn't even needed; it is just a spacer between the bottom, where the reinforcing steel is in tension, and the top, where the concrete is in compression. Hence, this ineffective concrete can be replaced by hollow plastic spheres made up of high density polyethylene.
- The spheres being lighter and much cheaper than concrete, will effectively help in reducing the overall structural load whilst also being economical. Additionally, post tensioning will be employed to further improve structural properties of the slab such as lesser deflections, higher strength, larger spans, etc. The use of flat slabs will further lower concrete consumption due to the elimination of beams.
- The use of bubble deck technology aims at reducing about 35% of concrete consumption whereas use of post tensioning will allow faster removal and reuse of formwork as compared to a conventional slab.
- Flat slabs construction offers considerable flexibility to the occupier who can easily alter internal layouts to accommodate changes in the use of structure.

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