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Comparative Study of Flat Slabs and Conventional RC Slabs

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Abstract:
Flat Slab is better understood as the slab without beams resting directly on supports like columns & or walls. By virtue of that large Bending Moment & Shear Forces are developed close to the columns. These stresses brings about the cracks in concrete & may provoke the failure of slab, thus there is a need to provide a larger area at the top of column recognized as column head/capital. Flat slab buildings are commonly used for the construction because use of flat slab building provides many advantages over conventional RC Frame building in terms of economical, use of space, easier formwork, architectural flexibility and importantly shorter construction time.

Key Words: Flat Slabs, RC Frame Building, Storey Drift, etc

I. INTRODUCTION

Non-destructive testing is defined to evaluating the continuity, integrity, security or some physical properties of materials, components or structures via a variety of physical principles without compromising performance of object to be tested. Purpose is to detect whether material or structure is flawed, or tests the defectives' shape, orientation, size, distribution, etc., and judges the contents of materials. Nowadays, widely used non-destructive testing methods of metal fatigue detection include ray inspection, ultrasonic and acoustic emission detection, electrical and electromagnetic detection. Modern NDT techniques also include computer data and image processing, image recognition and synthesis, etc. Some presently available NDT with drone quad copter techniques are introduced in this paper.

THE STRUCTURAL FRAME ELEMENTS

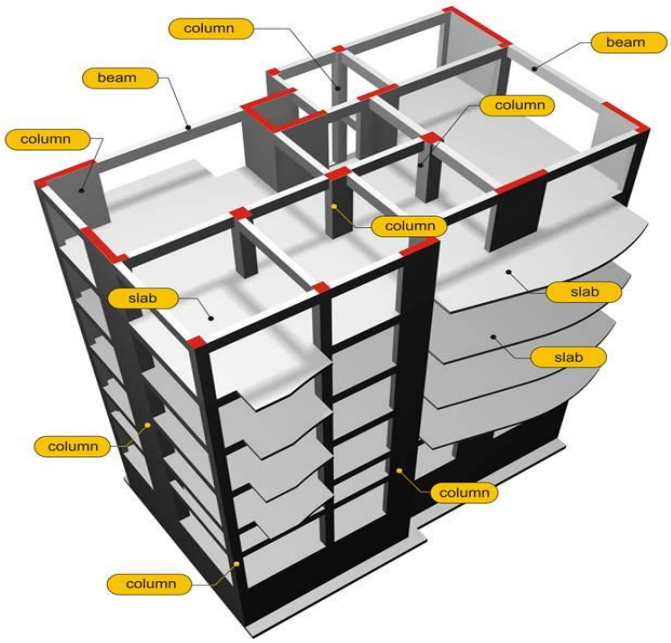


Figure.1.Structural Frame Elements

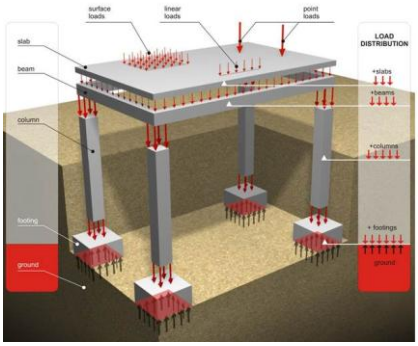


Figure.2.Load Path from the Structure Slab To the Ground

The structural frame must have enough strength to securely bear the gravity loads throughout the entire life span of the building. An adequate load bearing system is based on a continuous load path throughout the structure:

- The slabs carry the floor loads of each storey.
- The beams carry the loads transferred to them by the slabs as well as the weight of the walls seated on them.
- The columns carry the beam loads and they transmit them to the foundation.
- The footings (foundation) carry the column loads and transfer them to the ground.

2. METHODOLOGIES

1. SLABS

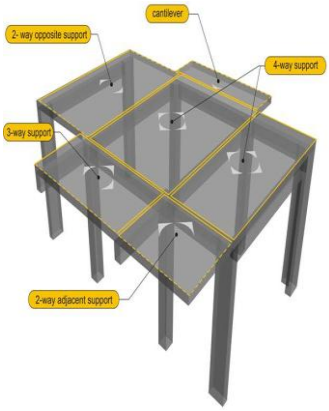


Figure.3. Slabs

Slabs are surface plane elements that bear loads transverse to their plan. Slabs are statically indeterminate elements therefore redistributing the stresses applied to them. This ability makes them highly safe against bending and shear failure. Cantilever slabs do not dispose of this property as they are statically determinate elements and therefore need special care in their construction.

FLAT SLAB

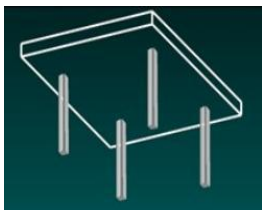
A flat slab consists of a reinforced concrete slab that is directly supported by concrete columns without the use of intermediate beams. C.A.P. Turner constructed flat slabs in U.S.A. in 1906 mainly using intuitive and conceptual ideas, which was start of this type of construction. Many slabs were load-tested between 1910- 20 in U.S.A. It was only in 1914 that Nicholas proposed a method of analysis of flat slabs based on simple statics. This method is used even today for the design of flat slabs and flat plates and is known as the direct design method. Structural engineers commonly use the equivalent frame method with equivalent beams such as the one proposed by Jacob S. Grossman in practical engineering for the analysis of flat plate structures. Floor systems consisting of flat slabs are very popular in countries where cast-in place construction is predominant form of construction because of many advantages in terms of architectural flexibility, use of space, easier formwork, and shorter construction time. Flat slabs are being used mainly in office buildings due to reduced formwork cost, fast excavation, and easy installation.

Figure.4. Attractive and optimum use of flat slab for better illumination

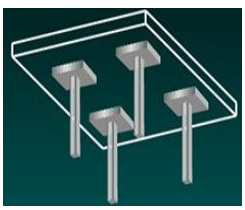
Types of Flat slab

The following are the different types of flat slab as shown in fig

1. Flat plate
2. Flat slab with drop panel
3. Flat slab with column head or column capital
4. Flat slab with drop panel and column head



Flat Plate



Flat Slab with Drop

Flat Slab with Column Head

Flat Slab with Drop Panel and Column Head

Figure.5. Types of Flat Slabs

Uses of Drop panel

1. Stiffen the slab and hence reduce deflection.
2. Increase negative moment capacity of slab.
3. Increases shear strength of slab.

Uses of column head

1. Reduces the moment in the slab by reducing the effective or clear span
2. Increases shear strength of slab.

3. BEAMS

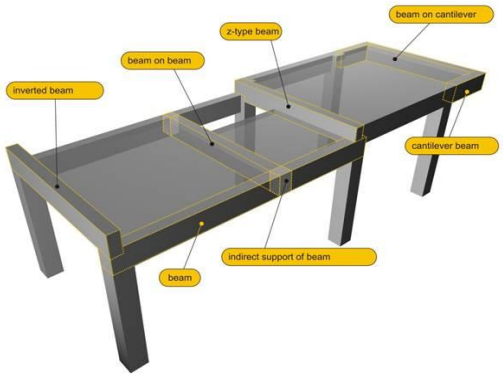


Figure.6. Beams

- Beams are the horizontal or inclined bearing elements of the structural system that connect columns and support slabs. When beams support slabs, they function together with the slab thus forming a "T" section beam. Depending on the relative levels of the slabs compared to the levels of the beams T beams are called common beams, inverted beams or "Z" beams.

4. COLUMNS

- The vertical load bearing elements of the structural frame are usually called with a common name: *"***columns"**.

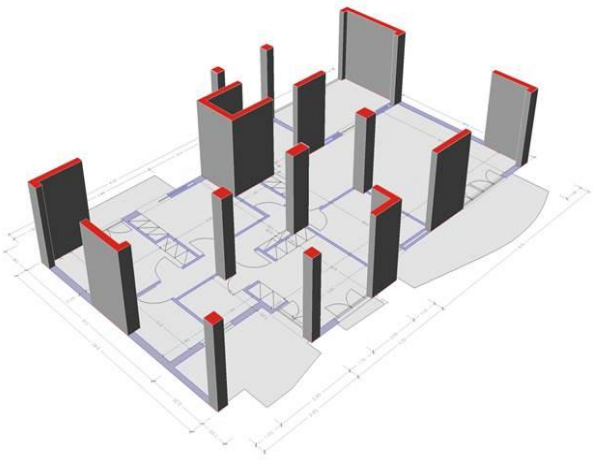


Figure.7.3d Display Of Storey Columns

- Due to their varied behavior, their different design rules and most of all, their differences in reinforcement and detailing, they are separated into three major categories namely columns, shear walls and composite elements**.**

5. FOUNDATION

SPREAD FOOTINGS

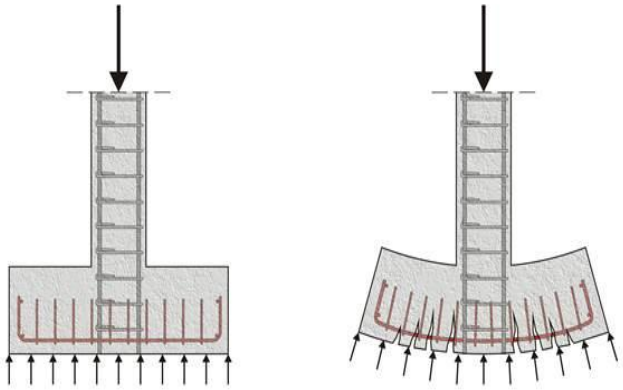


Figure.8. Soil pressures and deformation of an isolated spread footing

The spread footing behaves like an inverted cantilever with loads applied in the upward direction. As a rule, a spread footing is a quite rigid element therefore, the applied soil stresses are almost linear and in case of a symmetric (with respect to the pedestal) footing, they are orthogonal. These soil pressures are the loads carried by the footing that behaves like a slab and is deformed by the way shown at the figure. The real deformation is in the order of a millimeter and although it is not visible to the human eye, it always has that same form. The reinforcement is placed at the lower surface of the footing both along the x and y axis.

6. DESIGNS

1. DESIGN OF SLAB

Slabs are to be designed under limit state method by reference of IS 456:2000.

- When the slab is supported in two way directions it acts as two way supported slab.
- A two way slab is economical compared to one way slab.

DESIGN OF THE FLAT SLAB STRUCTURES

Despite the rapid growth of flat plate/slab construction, literature and tools available for designers to design and engineer flat plate/slabs in India, has been limited in terms of both Indian standards and Indian research papers. Indian engineers often have to resort to other standards to design flat plate/slab. The following is a discussion of the process of designing flat plate/slabs to meet Indian codes. Limitations in the Indian codes IS 456:2000 are overcome by utilizing ACI-318. Maintaining the Integrity of the Specifications

- The design of flat slab structures involves three steps*:*
- 1) Framing system
- 2) Engineering analysis
- 3) Reinforcement design and detailing

Framing System:

Initial framing system formulation provides a detailed geometric description of the column spacing and overhang. Even though the architect provides this part of the design, the engineer should emphasize on the following:
1) Three continuous spans in each direction or have an overhang at least one-forth times adjacent span length in case of only two continuous spans.
2) Typical panel must be rectangular
3) The spans must be similar in length i.e. adjacent span in each direction must not differ in length by one-third

Advantages of Flat Slab

- Increases speed of construction
- The construction is simple and economical because of the simplified form work, the ease of placement of reinforcement.
- The plain ceiling gives an attractive and pleasing appearance; in absence of beams, provision of acoustical treatment is easy.
- In general flat slab construction is economical for spans up to 10m and relatively light loads.
- Compare to the RCC less self weight, which results in reduced dead load, which also has a beneficial effect upon the columns and foundations

7. CONCLUSION

Flat plate/slab construction is a developing technology in India. Flat plate/slab can be designed and built either by conventional rcc or post-tensioning. However, due to issues mentioned above with pt construction in india and its higher cost, conventional rcc should be the preferred choice for spans up to 10 meters. Design of conventional rcc flat plate/slab in India, utilizing Indian codes, has many shortcomings, which have to be addressed and revised soon. Until then Indian engineers will continue to use Indian codes in combination with other standards like the aci, bs or euro code to design and analyze flat slabs/plates.

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