16. FOUNDATION

The selection of the foundation type for a particular site depends on the following considerations:

1. Nature of subsoil.
2. Nature and extent of difficulties
3. Availability of expertise and equipment

Depending upon their nature and depth, foundations have been categorized as follows:

(i) Open foundations or shallow foundations

(ii) Deep foundations

OPEN FOUNDATIONS

This is the most common type of foundation and can be laid using open excavation by allowing natural slopes on both sides. This type of foundation is practicable for a depth up to 5m and is normally convenient above the water table. The base of the structure is enlarged or spread to provide individual support. Since spread foundations are constructed in open excavations, therefore they are termed as open foundations. The various types of spread footings are:

1. Wall footings,
2. Isolated footings,
3. Combined footings,
4. Inverted arch footings,
5. Continuous footings
6. Cantilever footing
7. Grillage footing

1. **Wall Footings:** These footings can either be simple or stepped. The base course of these footings can be concrete or of entirely one material. They have only one projection beyond the width of the wall on either side. The width of the concrete base should be at least equal to twice the width of the wall. The depth of the concrete bed is at least equal to the projection. Generally the projection provided in the footing is 15cm, on either side

and the concrete mix comprises of cement, sand and aggregate in proportion of 1:3:6 or 1:4:8.

2. **Isolated or Column Footings:** They are used to support individual columns. In case of heavy loaded columns, steel reinforcements is provided. Generally, 15cm offset is provided on all sides of concrete bed. The footing of concrete columns may be slab, stepped or sloped type.

3. **Combined Footings:** A combined footing supports two or more columns in a row. The combined footing can be rectangular in shape if both the columns carry equal loads or can be trapezoidal if both the loads are unequal. Generally they are constructed of reinforced concrete. The location of the center of the gravity of the column loads and centroid of the footing should coincide.

4. **Inverted arch footing:** This type of footing is used on soft soils to reduce the depth of the foundation. Loads above an opening are transmitted from supporting walls through inverted arches to the soil. In this type of footings the end columns must bes stable enough to resist the outward pressure caused by the arch action.

5. **Continuous footings:** In this type of footing a single continuous R.C. slab is provided as foundation of two or three or more columns in a row. This type of footing is suitable at locations liable to earthquake activities. This also prevents differential settlements in structures.

6. **Strap or cantilever footings:** Strap footing consists of two or more individual footings connected by a beam called strap. This type of footing is used where the distance between the columns is so great that the trapezoidal footing becomes quite narrow with bending moments.

7. **Grillage footings:** this type of footings is used to transmit heavy loads from steel columns to the soils having low bearing power. This type of arrangements prevents deep excavations and provides necessary area at base to reduce the intensity of the pressure.

RAFT FOUNDATIONS

A raft or mat is a combined footing that covers the entire area beneath a structure and supports all the columns. They are used where the soil mass contains compressible lenses so that the differential settlement would be difficult to control. Raft foundation is also used to reduce the settlement above highly compressible soils by making the weight of the structure and raft approximately equal to the weight of the soil excavated. The raft is composed of reinforced concrete beam with a relatively thin slab underneath.

DEEP FOUNDATIONS

These foundations carry loads from a structure through weak incompressible soils or fills on to the stronger and less compressible soils or rocks at depth. These foundations are in general used as basements, buoyancy rafts, caissons, cylinders, shaft and piles

1. Basements. They are constructed in place in an open excavations. They are hollow substructures designed to provide working space below ground level.

2. Buoyancy Rafts. They are hollow substructures designed to provide a buoyant substructure beneath which reduce net loadings on the soil to the desired low density.

3.Caissons. They are hollow s8ubstructures designed to be constructed on or near the surface and then sunk as single units to their required level.

4.Cylinders. They are single small cell caissons.

5.Shaft Foundations. They are constructed within deep excavation supported by lining constructed in place and subsequently filled with concrete.

6.Pile Foundations. The pile foundation is a construction supported on piles. A pile is an element of construction composed of timber, concrete or steel or a combination of them. The piles may be placed separately or they may be placed in form of a cluster throughout the structure.

Classification of piles:

1. Classification based on function: Bearing Pile, Friction Pile, Screw Pile, compaction Pile, Uplift Pile, Batter Pile and Sheet Pile
2. Classification based on materials and composition: Cement concrete piles, Timber piles, Steel piles, Sand Piles, and Composite piles.