Welcome

DRE 211: Fundamentals of Infrastructure Design and Construction

Foundation of Structures

Md. Rasel Sheikh
Lecturer, Dept. of Disaster Resilience and Engineering, PSTU
Contents

1. Definition, objectives and function of foundation
2. Types of foundation
3. Materials used for foundation
The foundations of the building transfer the weight of the building to the ground. While 'foundation' is a general word, normally, every building has a number of individual foundations. Most buildings have some kind of foundation structure directly below every major column, so as to transfer the column loads directly to the ground.

A foundation (or, more commonly, foundations) is the element of an architectural structure which connects it to the ground, and transfers loads from the structure to the ground. Foundations are generally considered either shallow or deep.
Foundation Design Principles

The main objectives of foundation design are to:

ensure that the structural loads are transmitted to the subsoil safely, economically and without any unacceptable movement during the construction period and throughout the anticipated life of the building or structure
Basic Design Procedure

**Assessment of site conditions** in the context of the site & soil investigation report

**Calculation** of anticipated structural loading

**Choosing the foundation type**, should consider:
- Soil condition
- Type of structure
- Structural loading
- Economic factors
- Time factors relative to the proposed contract period
- Construction problem

**Sizing** the chosen foundation in the context of loading, ground bearing capacity & any likely future movement of the building / structure
Functions of foundation

1. Distribution of loads
2. Stability against sliding & overturning
3. Minimize differential settlement
4. Safe against undermining
5. Provide level surface
6. Minimize distress against soil movement
Functions of foundation........

- Distribution of loads
  - Foundation help to distribute the loads of super-structure to a large of the soil
  - Therefore, the intensity of load at its base does not exceed the safe bearing capacity of the soil
  - In the case of deep foundations, the super imposed loads are transmitted either through end bearing or both by side friction & end bearing
Functions of foundation

- **Stability against sliding & overturning**
  - Foundation imparts lateral stability to the super structure by anchoring it to the ground
  - It increases the stability against sliding & overturning due to horizontal forces to wind, earthquake, etc.
Functions of foundation

- Minimize differential settlement
  - Foundation distribute the super-imposed loads evenly on the sub-soil, even in the case of non-uniform loads
  - This can be achieved by constructing combined footing or raft foundation
Functions of foundation........

- **Safe against undermining**
  - Foundation provide safety against scouring or undermining by flood water or burrowing animals
Functions of foundation

- Minimize distress against soil movement
  - Distress or failure due to expansion or contraction of the sub-soil due to moisture variation in clayey & black cotton soils are minimized by the provision of special type foundations.
Basic Foundation Types

1. **Shallow foundations:** often called footings, are usually embedded about a metre or so into soil. One common type is the spread footing which consists of strips or pads of concrete (or other materials) which extend below the frost line and transfer the weight from walls and columns to the soil or bedrock.

2. **Deep foundation:** is used to transfer the load of a structure down through the upper weak layer of topsoil to the stronger layer of subsoil below. There are different types of deep footings including impact driven piles, drilled shafts, caissons, helical piles, geo-piers and earth stabilized columns. The naming conventions for different types of footings vary between different engineers. Historically, piles were wood, later steel, reinforced concrete, and pre-tensioned concrete.
Types of foundations

- Pad Foundation
- Raft Foundation
- Strip Foundation
- Piled Foundation
Pad foundation/footing

- Suitable for most subsoil except loose sand, loose gravels and fill areas
- Usually constructed of reinforced concrete, square in plan
- Typical pad foundation types are:
  - Isolated or pad foundation
  - Steel grillage
  - Rectangular pad
  - Combined column foundation
Strip foundation

- Suitable for most subsoil & light structure loadings
- Suitable for those encountered in low to medium rise domestic dwellings where mass concrete can be used

- Typical strip foundation types:
  - Traditional strip
  - Deep strip or trench fill
  - Reinforced concrete strip
  - Continuous column
Raft foundation

- Used to spread the load of the structure over a large base to reduce the load per unit area being imposed on the ground
- Particularly useful where low bearing capacity soils are encountered & where individual column loads are heavy
- Typical raft foundation:
  - Solid slab raft
  - Beam & slab raft
Pile foundation

- Can be defined as a series of columns constructed or inserted into the ground to transmit the loads of a structure to a lower level of subsoil.

- Can be used when suitable foundation conditions are not presented at or near ground level.

- Classification of piles (may be classified by their basic design function or method of construction):
  - End bearing piles
  - Friction or floating piles
  - Replacement piles
  - Displacement piles
Materials used for foundation

- Foundation must be constructed of a durable material of an adequate strength

- The most suitable material is **concrete**. But now-a-days RCC is best choice

- Concrete is a mixture of **cement, aggregates & water** in a controlled proportion
Cement

- Manufactured from clay & chalk
- Act as a binder of the concrete mix
- Cement can be supplied in bags (1 bag = 50kg) or in bulk
- Air tight sealed bags requiring a dry dump free store
- Bulk cement delivered by tanker (12 to 50 tonnes) & pumped into storage silo
Materials used for foundation...........

- **Aggregates**
  - 2 types of aggregates: coarse & fine aggregates
  - **Coarse aggregate** is defined as a material which is *retained on a 5mm sieve*
  - **Fine aggregate** is defined as a material which is *passes a 5mm sieve*
  - Aggregate can be either:
    - Natural rock which has disintegrated
    - Crushed stone
    - gravels
Materials used for foundation

- **Water**
  - Must be of a good quality fit for drinking
  - Water is added to start the chemical reaction & to give workability
  - The amount of water used is called the water/cement ratios, usually about 0.4 to 0.5
  - Too much water will produce a weak concrete mix of low strength
  - Whereas too little water will produce a concrete mix of low & inadequate workability.
Materials used for foundation............

- **Steel**
  - Characteristics
  - Strength: 40 grade, 60 grade etc.
  - Constructability
  - Fire resistance
  - Corrosion
  - Mold: deformed bar
Concrete mix

- This concrete mix expressed as a ratio, e.g., 1:2:4 or 1:3:6/20mm, which means:
  - 1 part of cement
  - 3 parts of fine aggregates
  - 6 parts of coarse aggregate
  - 20mm - maximum size of coarse aggregate for the mix
It is a different types of foundation for construction work.

THE END