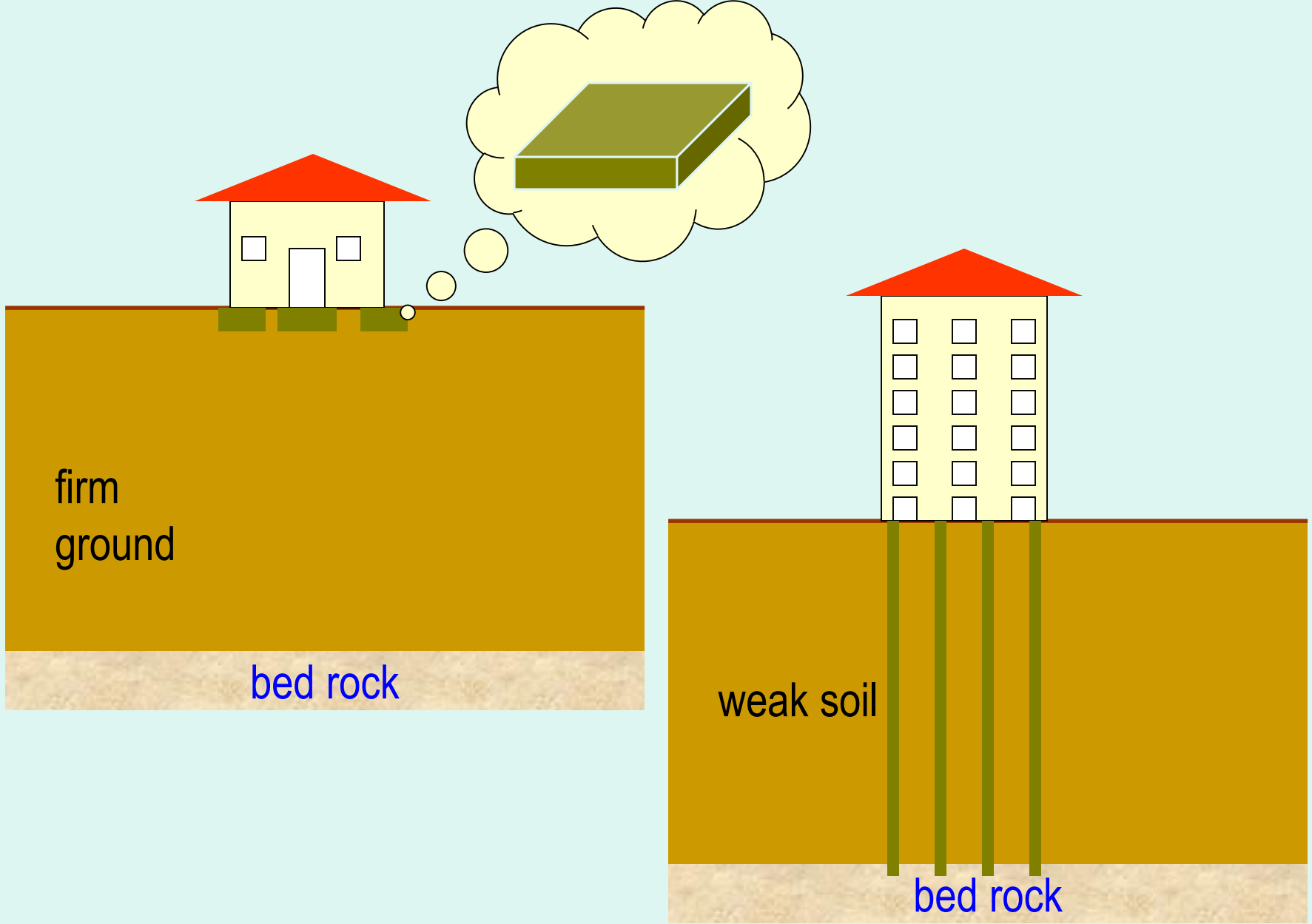


# Chapter-III- Foundation Types and Their Selections



- **Definition of Foundation:** The lowest artificially built part of a structure which transmits the load of the structure to the ground is called foundation.
- The foundation of a structure is always constructed below ground level to increase the lateral stability of the structure.



## Purposes Of Foundations

- Foundations are used for the following purposes:
  - i. To distribute the load of the structure over a large bearing area so as to bring intensity of loading within the safe bearing capacity of the soil lying underneath.
  - ii. To load the bearing surface at a uniform rate so as to prevent unequal settlement.
  - iii. To prevent the lateral movement of the supporting material.
  - iv. To secure a level and firm bed for building operations.
  - v. To increase the stability of the structure as a whole.

# Types of Foundations

Foundations can be broadly classified into the following two categories:

- Shallow foundations
- Deep foundations

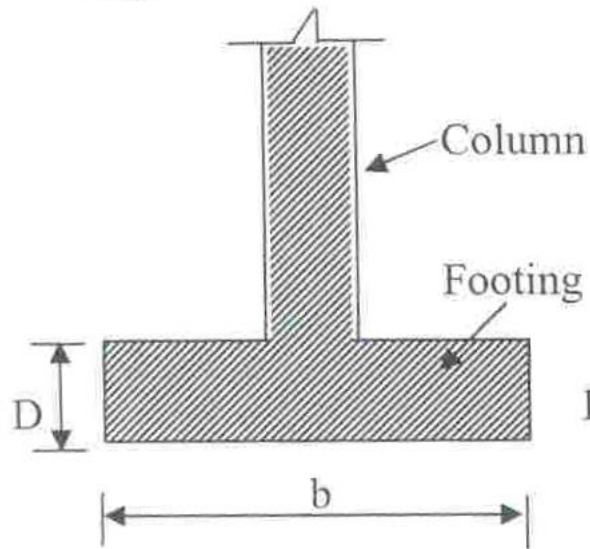
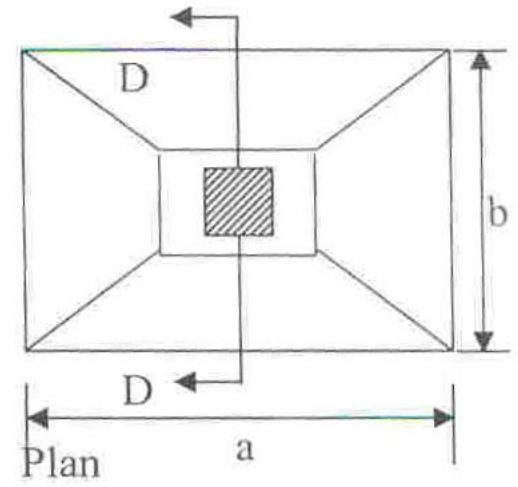
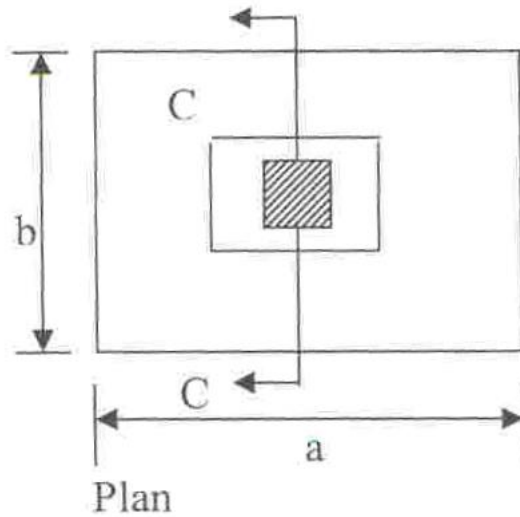
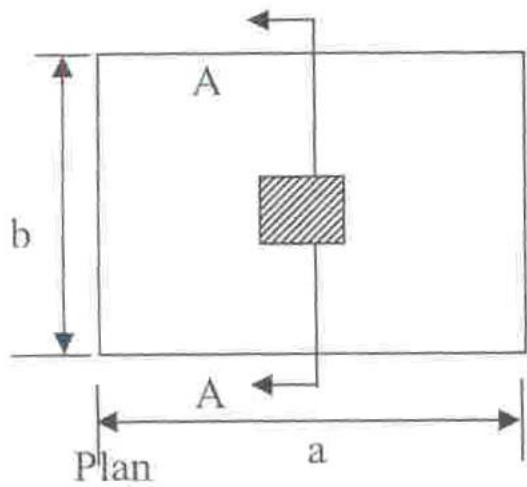
1. **Shallow Foundations** :- The foundations provided immediately beneath the lowest part of the structure, near to the ground level are known as shallow foundations.

Shallow foundations are further classified into the following types:

- » **Spread or Isolated footings**
- » **Combined footing**
- » **Cantilever footing**
- » **Continuous or wall footing**
- » **Raft foundation**

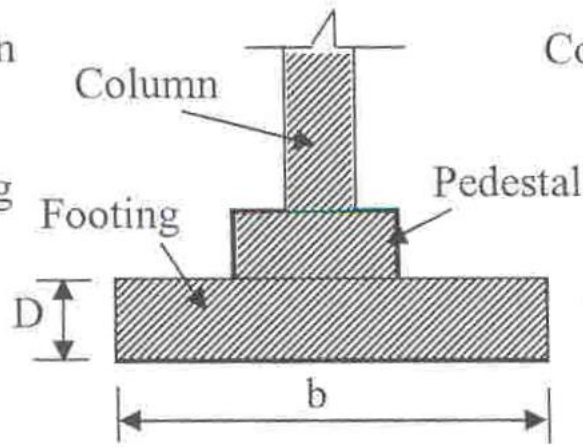
**Spread or Isolated Footings:** used to support individual column.

- These are the most common type of foundation, primarily because of their **cost and ease of construction**.
- They are most often used:
  - in small to medium size structures,
  - on sites with moderate to good soil conditions,
  - on some large structures when they are located at sites underlain by exceptionally good soil or shallow bedrock.
- Isolated footings are **stepped type, simple type or slope type**



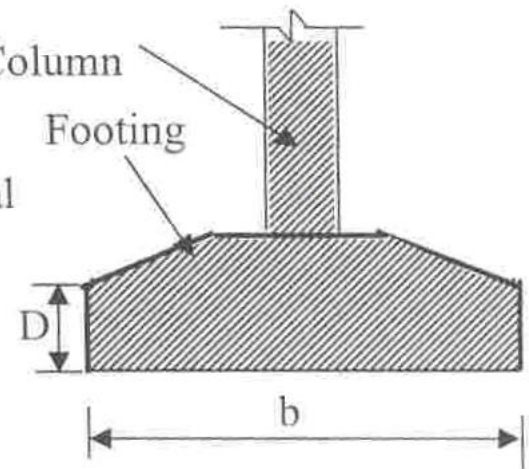
Section A-A

Single spread footing



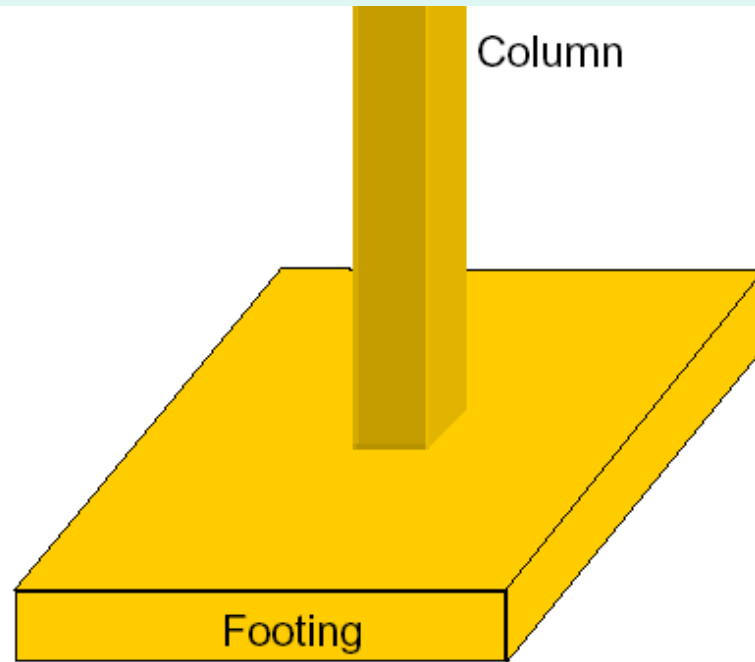
Section C-C

Stepped spread footing



Section D-D

Sloped spread footing



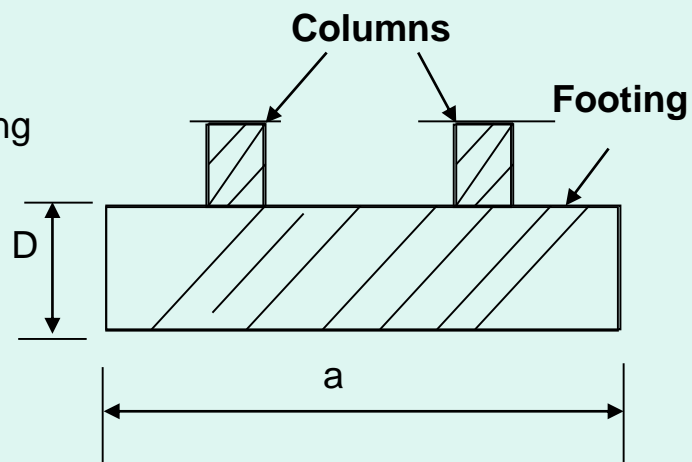
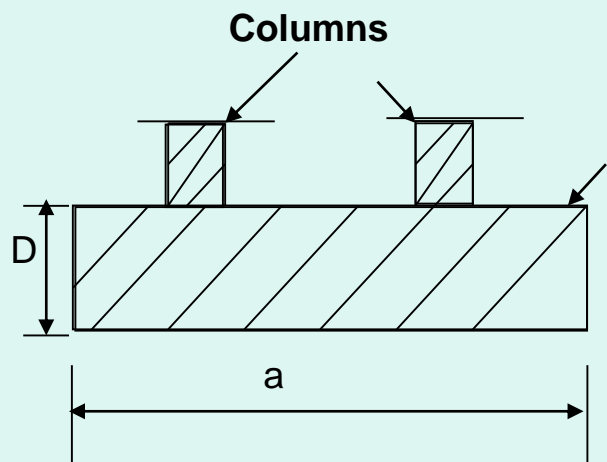
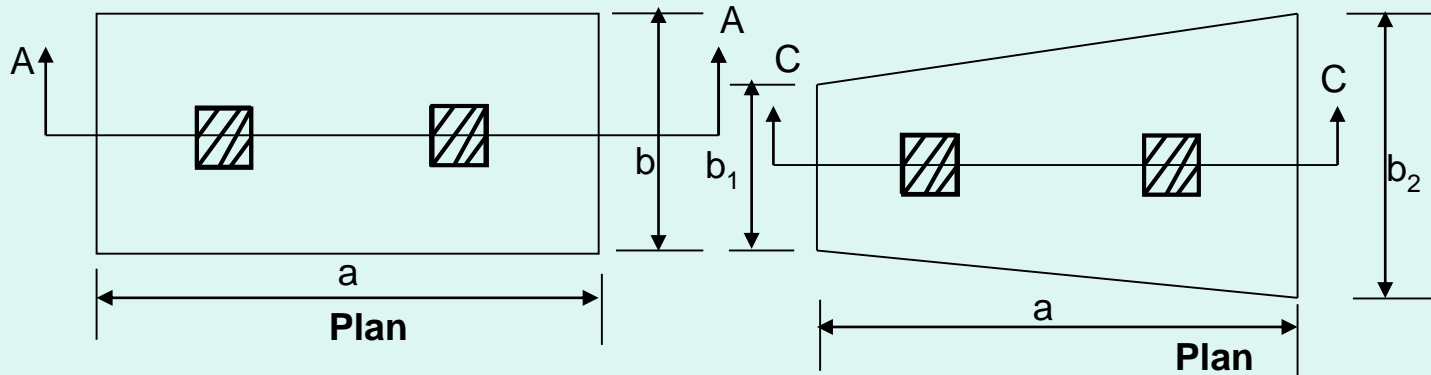
Column

Footing

**Isolated Footing**

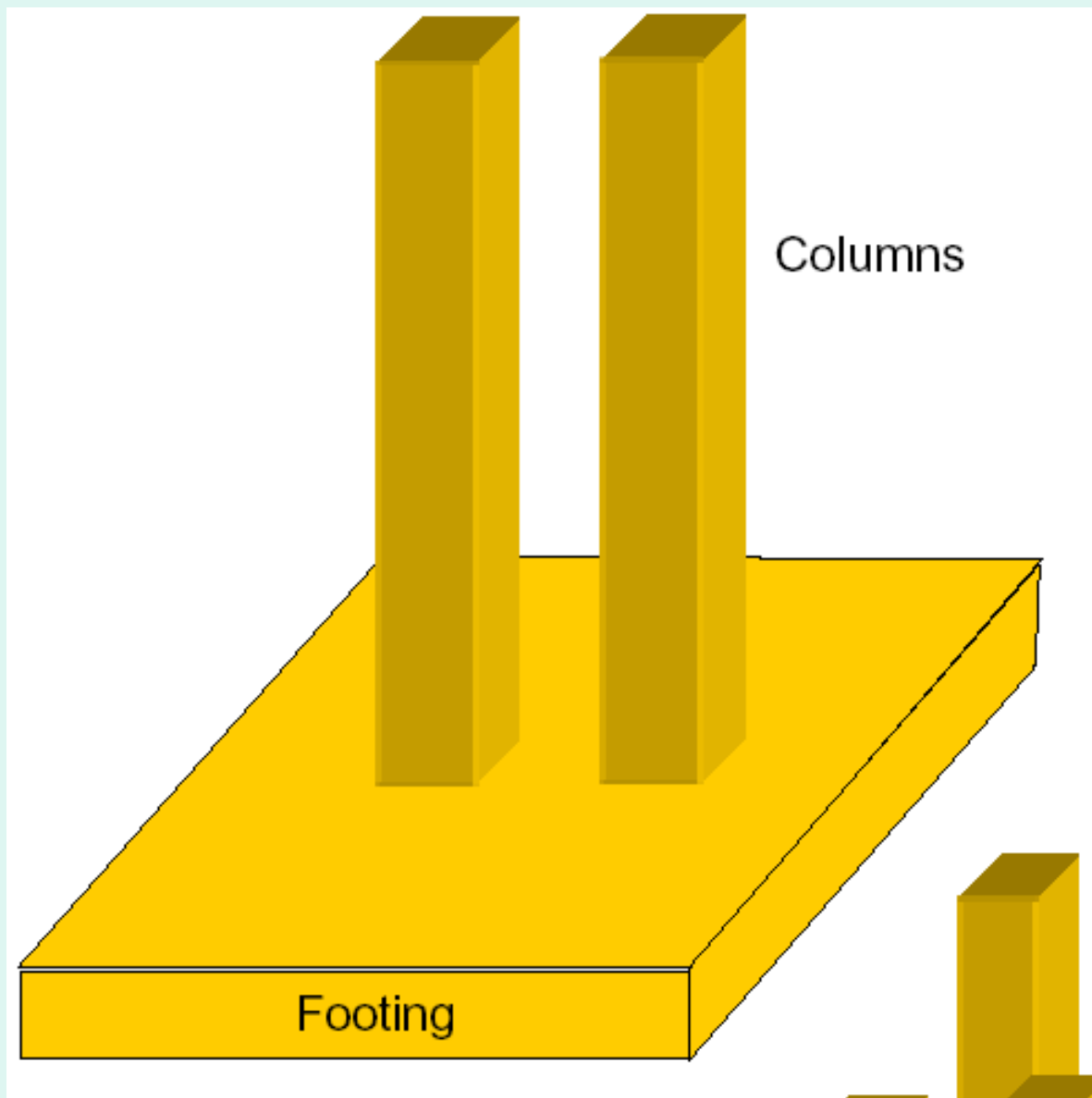
**Combined Footing:** supports two or sometimes three column in a row.

- Combined footing is used when property lines, equipment locations, column spacing or other considerations limit the footing clearance at the column locations.
- **Combined footing can be:**
  - **rectangular** in shape if both the columns carry equal loads, or
  - **trapezoidal** if there is a space limitation and they carry unequal loads.



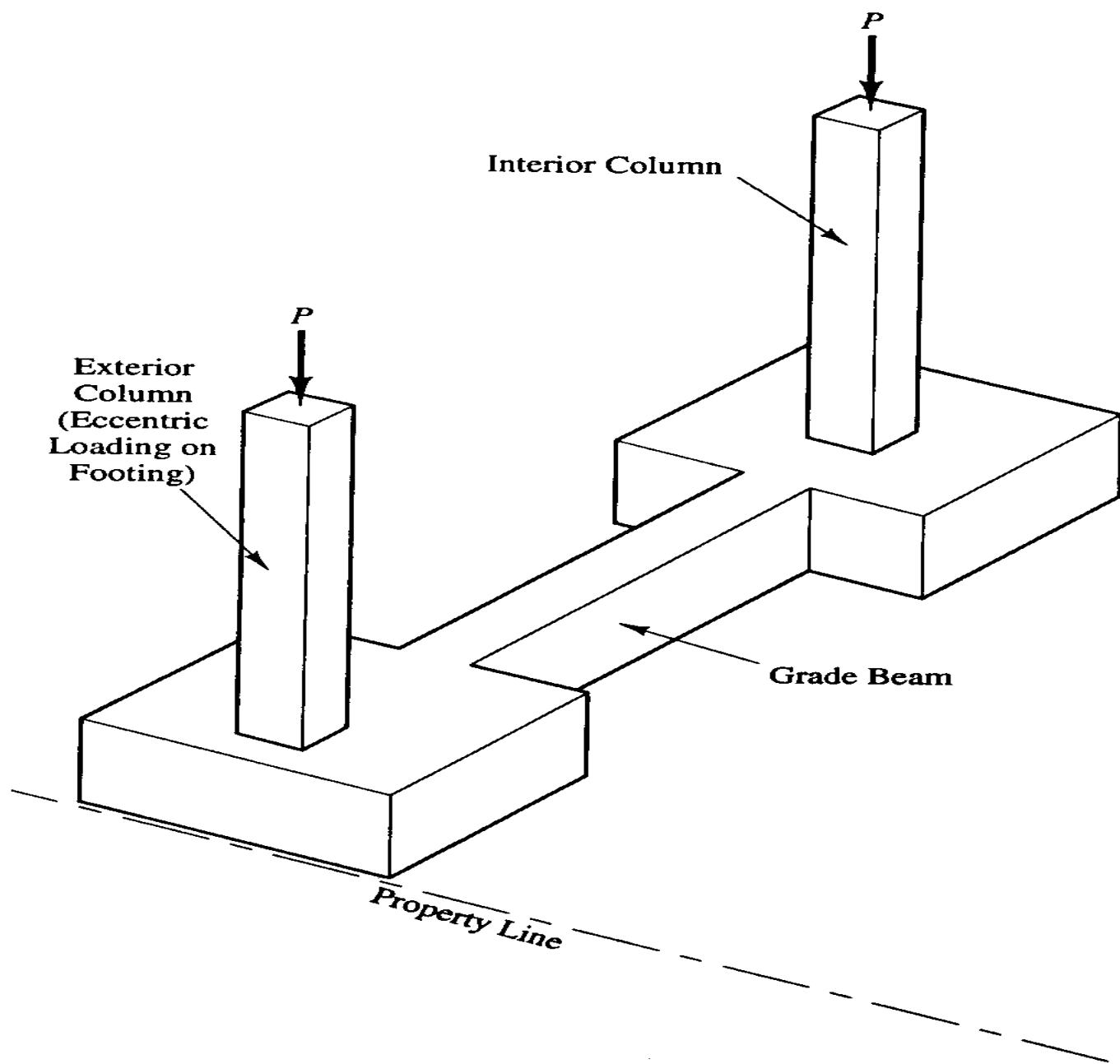
Section A.A  
Combined footing (rectangular)

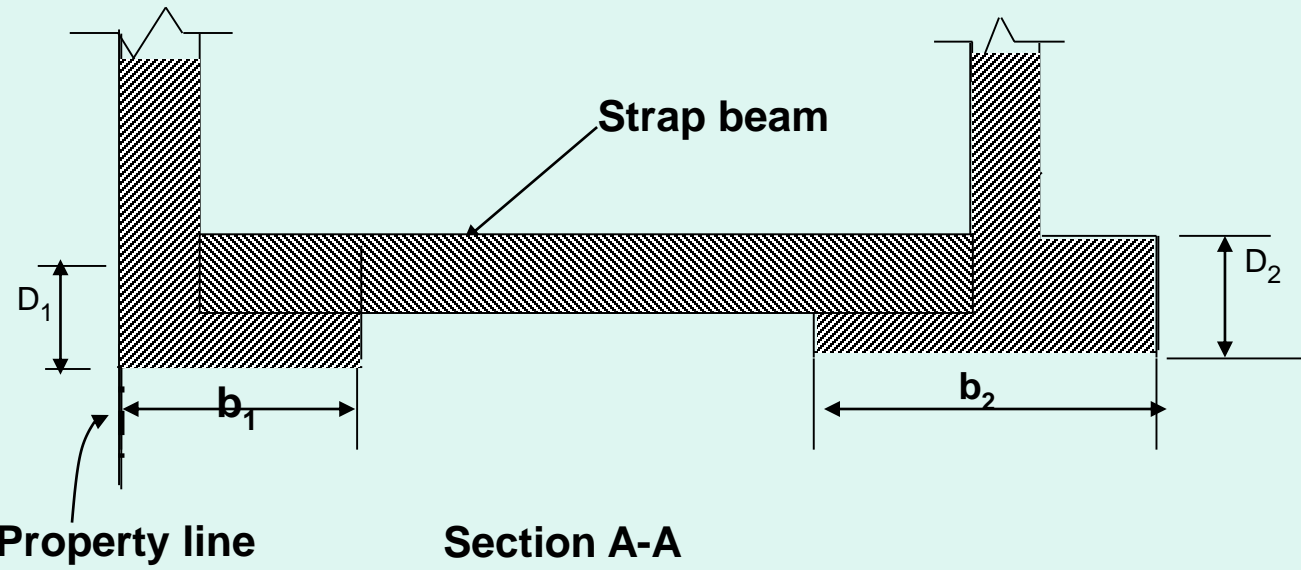
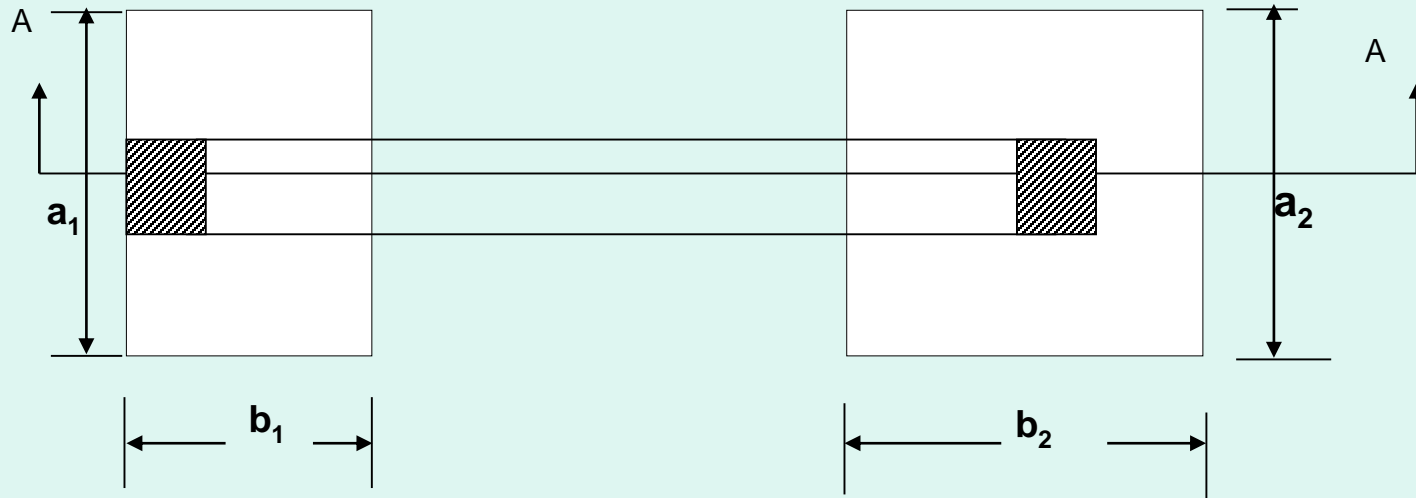
Section C.C  
Combined footing (trapezoidal)



**Cantilever or Strap Footing:** consists of two individual footings connected by a beam called a strap.

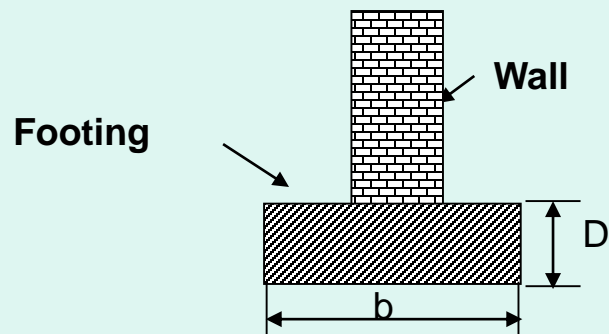
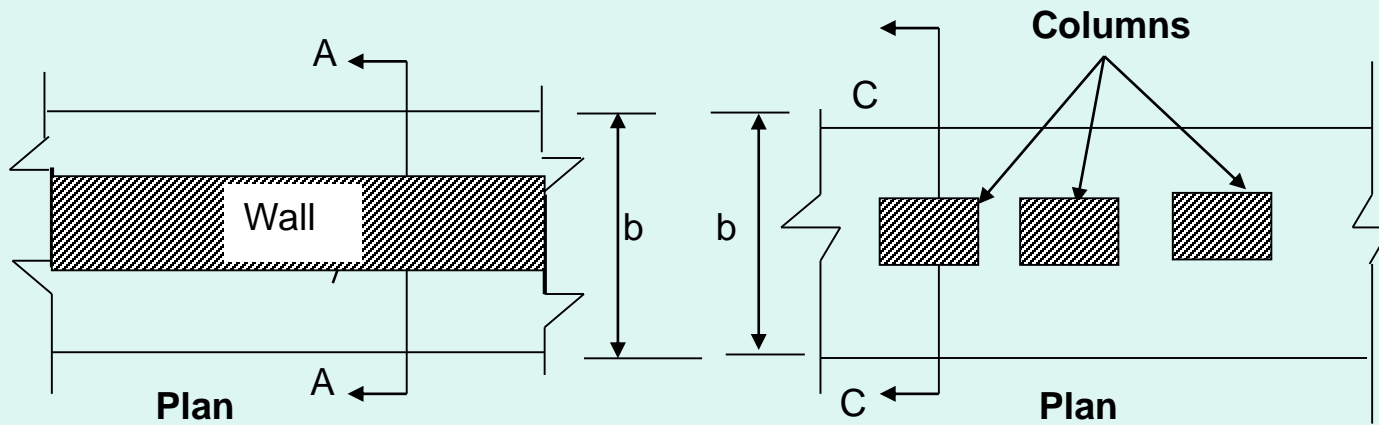
- Cantilever footing may be used:
  - where the distance between the columns is so great that a trapezoidal combined footing becomes quite narrow, with resulting high bending moments.
- The strap beam does not remain in contact with soil so a strap doesn't transfer any pressure to the soil.





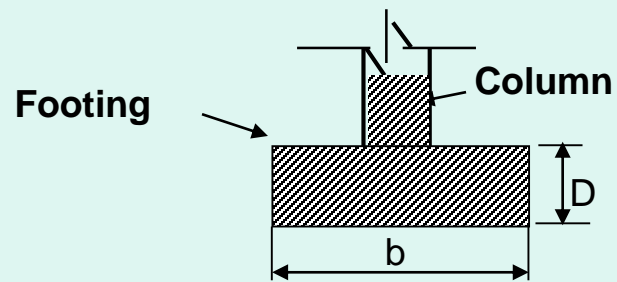
# Continuous or wall footing or strip footing:

- In this type of footing, a single continuous reinforced concrete slab is provided as foundation of load bearing wall.
- A strip footing is also provided for a row of columns which are so closely spaced that their spread footings overlap or nearly touch each other.



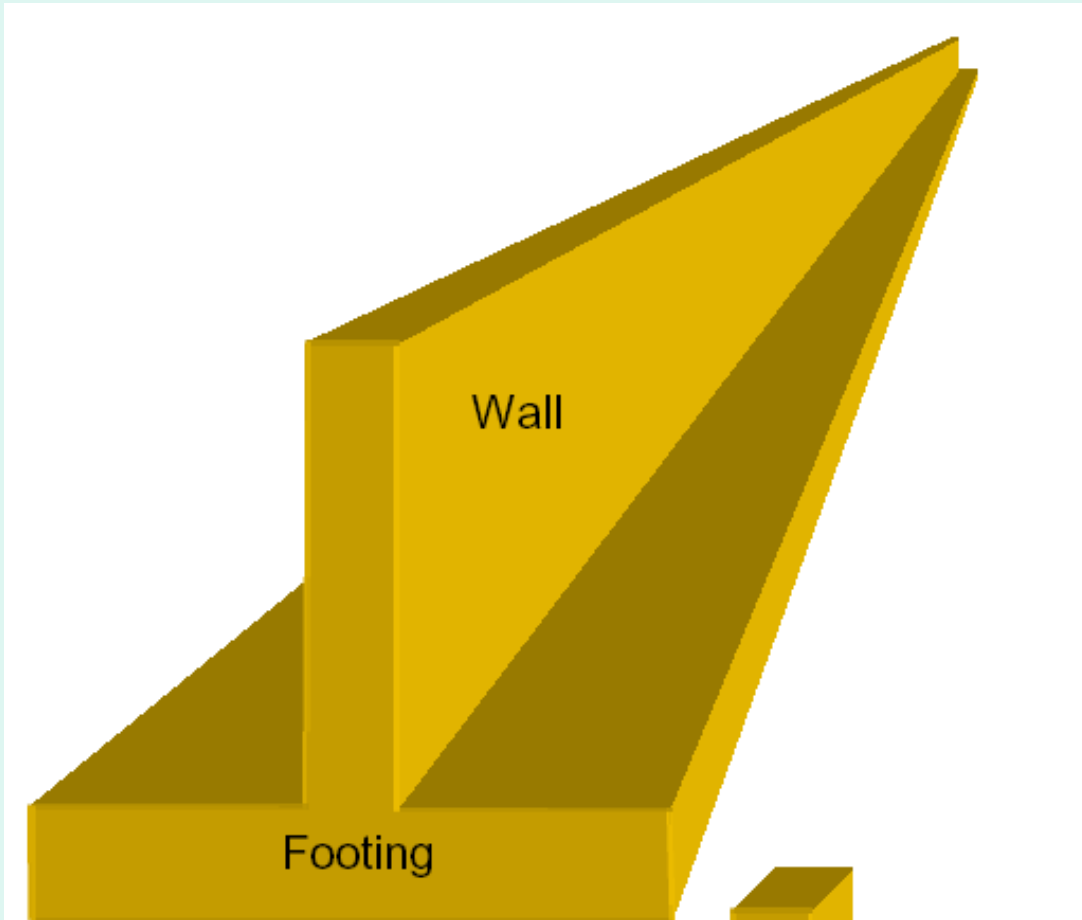
**Section A.A**

**Wall on footing**



**Section C-C**

**Columns on footing**

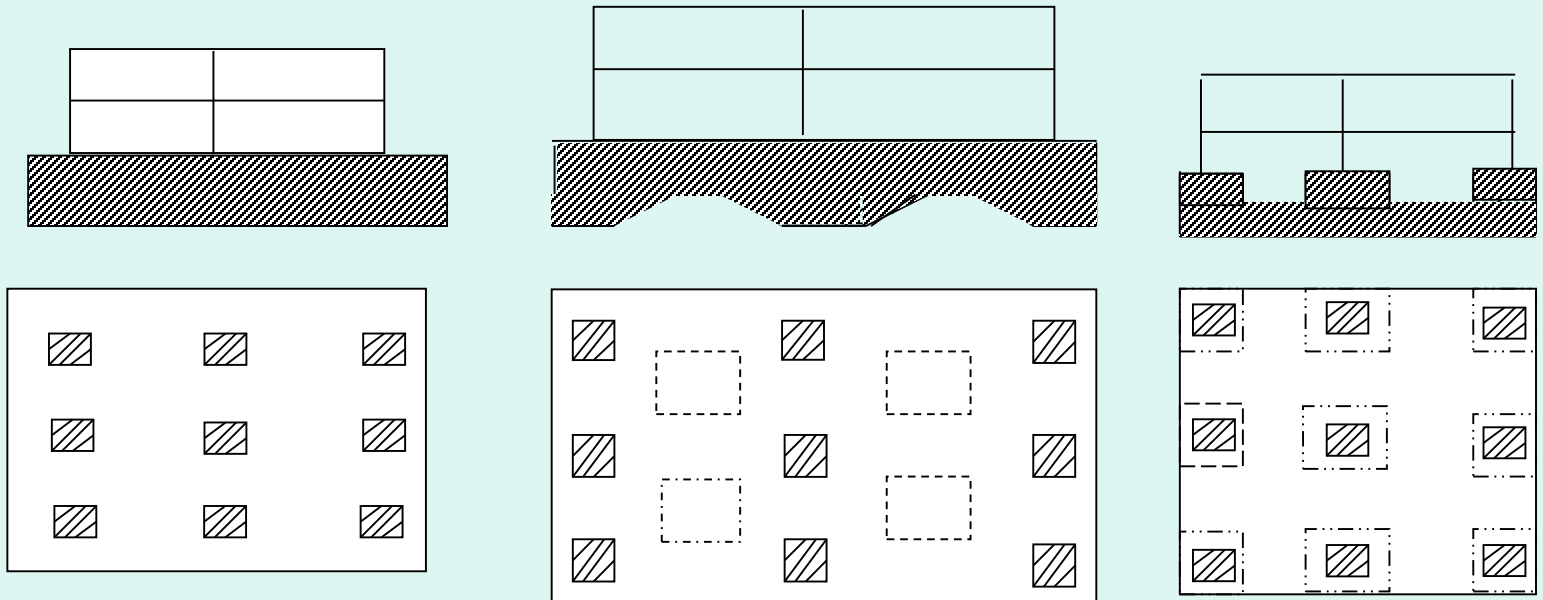


**Mat (Raft) Foundation:** is a combined footing that covers the entire area beneath a structure and supports all the columns.

- Foundation engineers often consider mats when dealing with any one of the following conditions:
  - The structural loads are so high or the soil conditions so poor that spread footings would be exceptionally large.

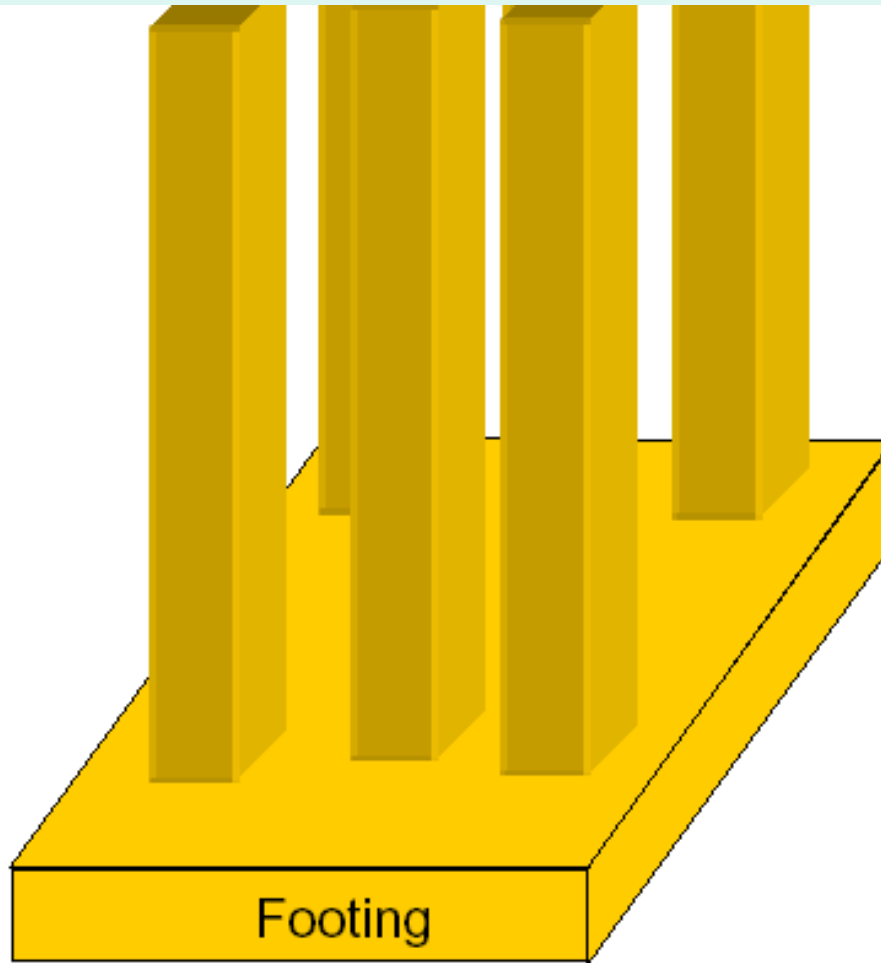
*As a general rule of thumb, if spread footings would cover more than 50 percent of the building footprint area, a mat or some type of deep foundation will usually be more economical.*
  - The soil is very erratic and prone to excessive differential settlement.
  - The structural loads are erratic, and thus increase the likelihood of excessive differential settlement.

- The lateral loads are not uniformly distributed through the structure and thus may cause differential horizontal movement in spread footings.
- The uplift loads are larger than spread footings can accommodate.
- The bottom of the structure is located below ground water table, so waterproofing is an important concern. Because mats are monolithic, they are easier to waterproof.



Flat plate mat foundation

Two-way beam and slab  
(Ribbed mat)



**Mat or Raft Foundation**

**2.Deep Foundations:** When the soil at or near the ground surface is not capable of supporting a structure, deep foundations are required to transfer the loads to deeper strata.

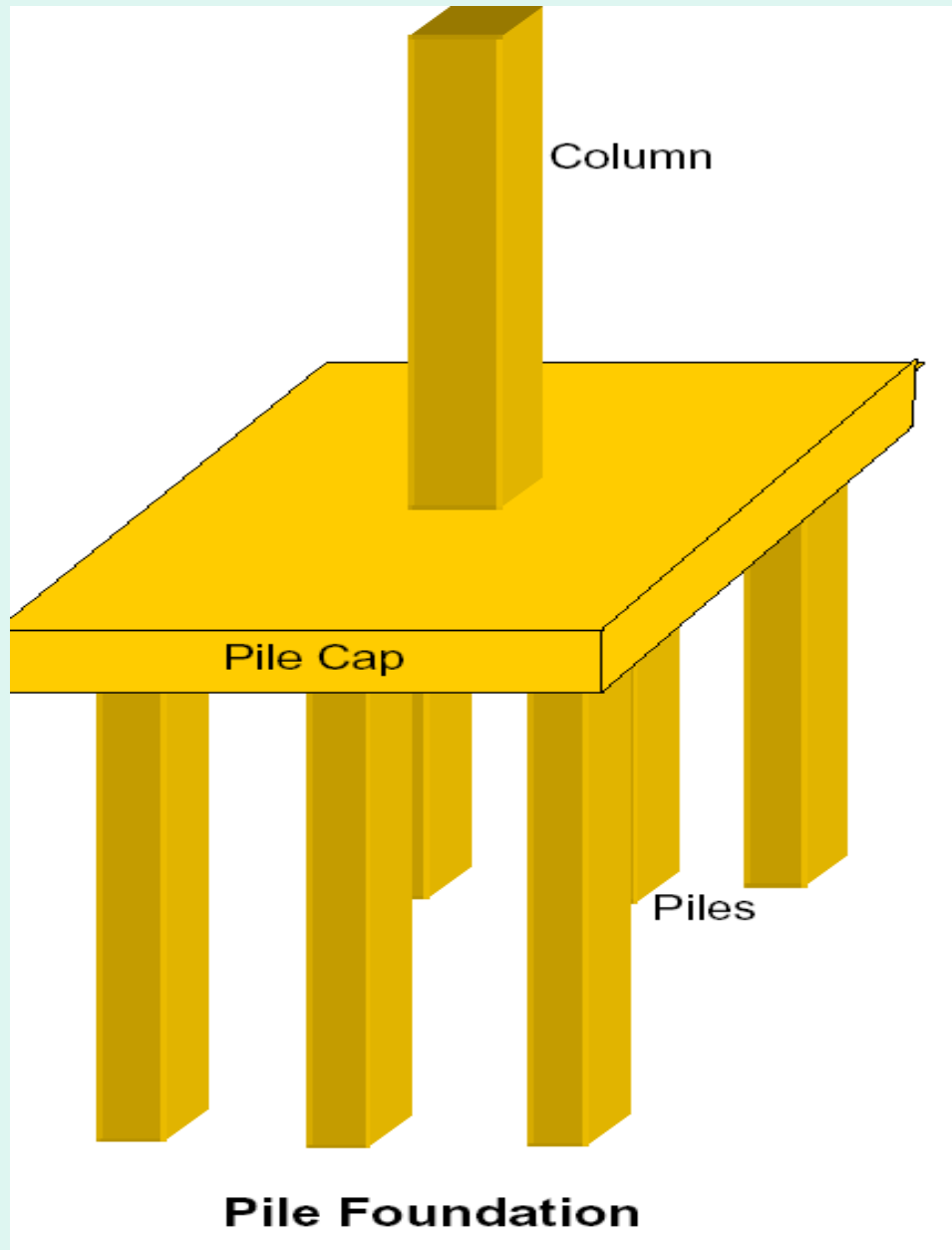
- Deep foundations are, therefore, used
  - » when surface soil is unsuitable for shallow foundation, and a firm stratum is so deep that it cannot be reached economically by shallow foundations.
- The most common types of deep foundations are **piles, piers and caissons.**
- **Pile:** is a slender structural member made of steel, concrete or wood.
  - **A pile is either driven into the soil or formed in-situ by excavating a hole and filling it with concrete.**





Boulanger

- **Pier:** A pier is a vertical column of relatively large cross-section than a pile.
  - » A pier is installed in a dry area excavating a cylindrical hole of large diameter to the desired depth and then backfilling it with concrete.
- **Caisson:** A caisson is a type of foundation of the shape of hollow prismatic box, which is built above the ground and then sunk to the required depth as a single unit.
- It is a watertight box or chamber used for laying foundation under water.
- A pier and caisson differ basically only in the method of construction



- **Selection of Foundation Type**
- In selecting the foundation type the following points must be considered
  - **Function of the structure**
  - **Loads it must carry**
  - **Subsurface conditions**
  - **Cost of foundation in comparison with the cost of the superstructure.**
- Having these points in mind one should apply the following steps in order to arrive at a decision.
  - Obtain at least approximate information concerning the nature of the superstructure and the loads to be transmitted to the foundation
  - Determine the subsurface condition in a general way.

- Consider each of the usual types of foundations in order to judge whether or not
  - **They could be constructed under existing conditions.**
  - **They are capable of carrying the required load.**
  - **They experience serious differential settlements.**
- The types that are found to be unsuitable should then be eliminated.
- Undertake a detailed study of the most promising types. Such a study may require additional information on loads and subsurface conditions.
- Determine the approximate size of footing or the approximate length and number of piles required
- Prepare an estimate for the cost of each promising type of foundation.
- Select the type that represents the most acceptable compromise between performance and cost.