



**JECRC Foundation**



JAIPUR ENGINEERING COLLEGE  
AND RESEARCH CENTRE

# JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE DEPARTMENT OF CIVIL ENGINEERING

Class – III Semester /II Year

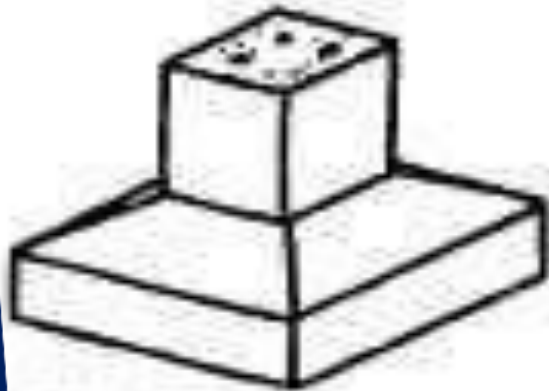
Subject –Building Materials And Construction

Chapter – 7(Foundation)

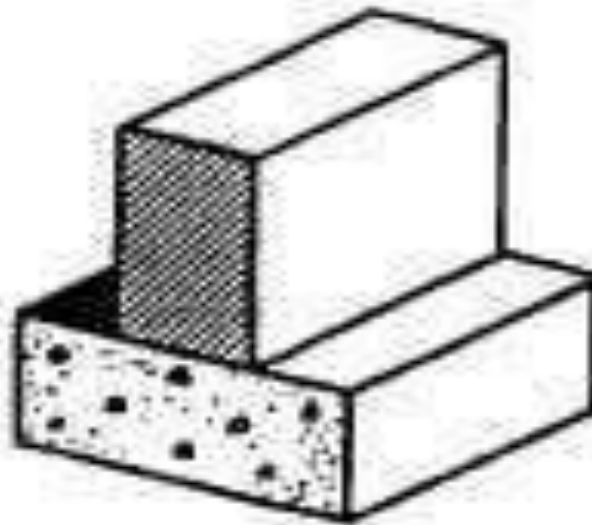
Presented by – Teekam Singh (Assistant Professor )

- Types of foundation
- Foundations may be broadly classified as
  - (a) shallow Foundation
  - (b) Deep foundation
- **(a) Shallow Foundation:** According to Terzaghi, a foundation is shallow if its depth is equal to or less than its width.
- Types of shallow foundation:
  - Spread footing
  - Combined footing
  - Strap Footing
  - Mat Foundation or Raft Foundation

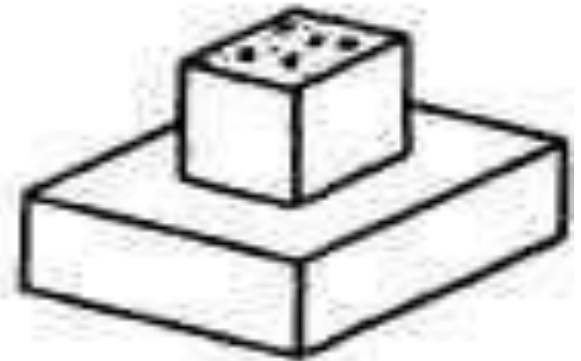
- **Spread Footing:-** Spread footings are those which spread the super-imposed load of wall or column over larger area. Spread footing support either column or wall.
- It may be following kinds
- **Single footing for column:** In which the loaded area of column has been spread to the large size through single spread. The base is generally made of concrete.
- **Stepped footing for column:** This type of footing provided for heavily loaded column which required greater spread with steps. The base is generally made of concrete.
- **Sloped footing for column:** In this type of footing concrete base does not have uniform thickness but is made sloped.
- **Wall footing without step:** It consist of concrete base without any steps including masonry wall.
- **Stepped footing for wall:** It consist of masonry wall have stepped footing with concrete base .



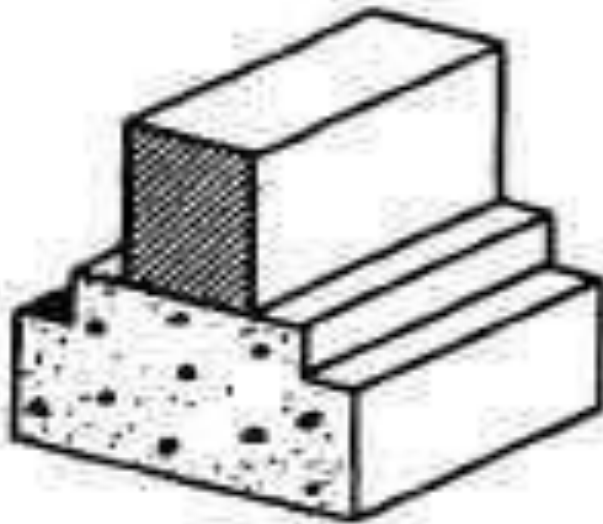
**SLOPED COLUMN  
FOOTING**



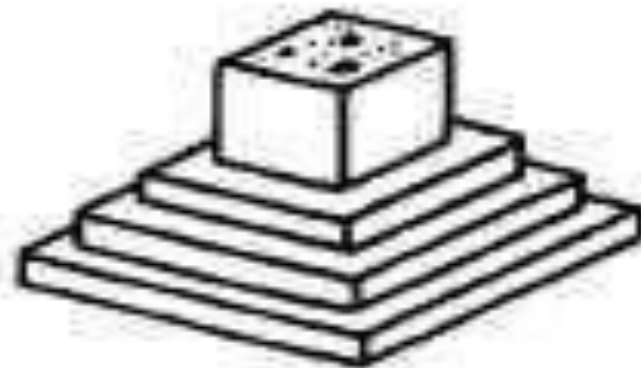
**SIMPLE WALL  
FOOTING**



**SIMPLE COLUMN  
FOOTING**



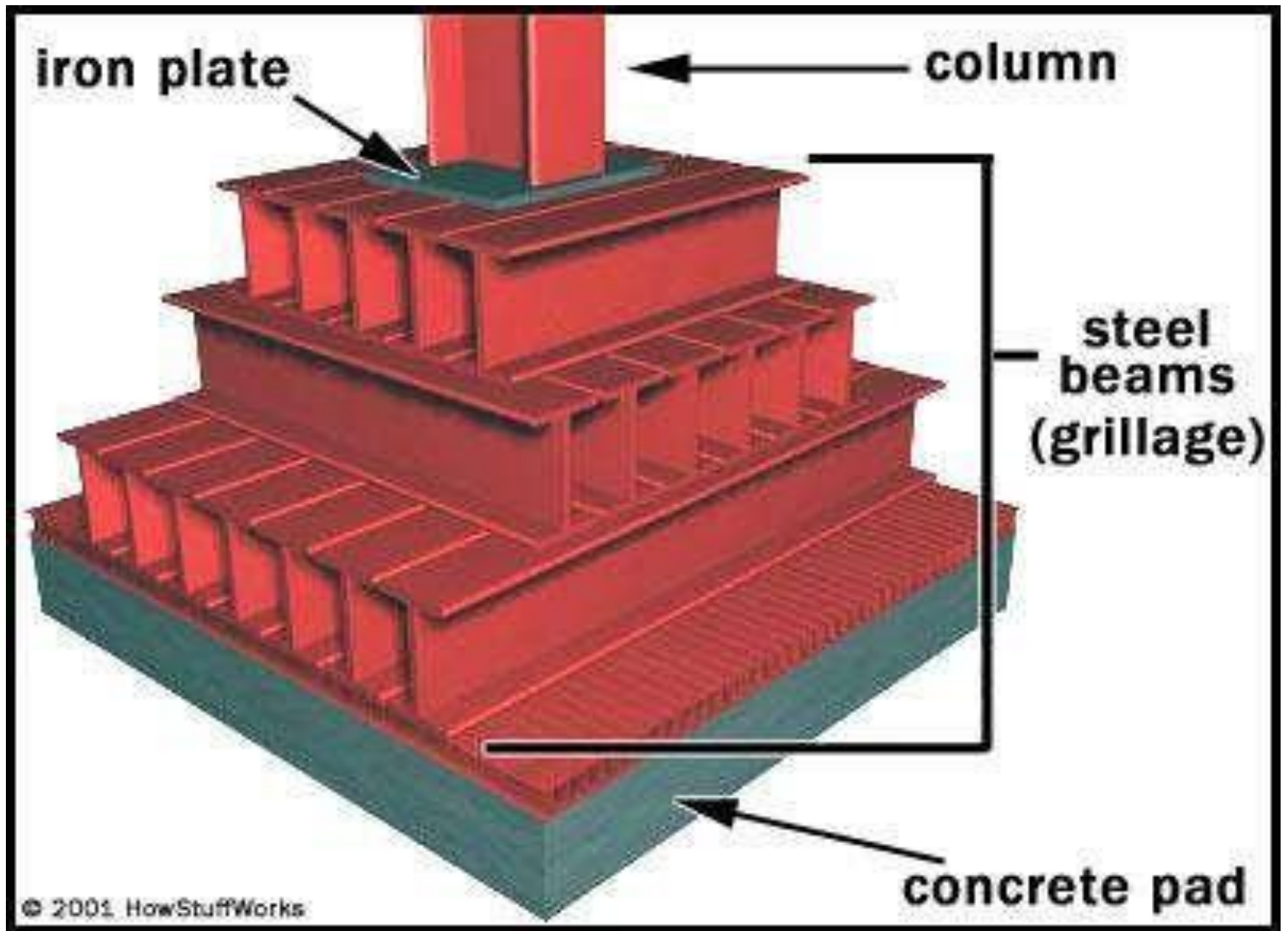
**STEPPED WALL**



**STEPPED COLUMN**

- **Grillage Foundation**

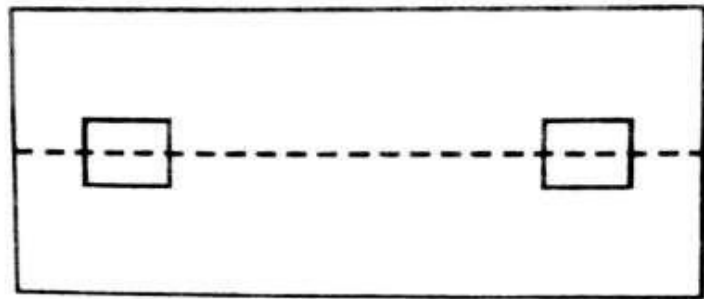
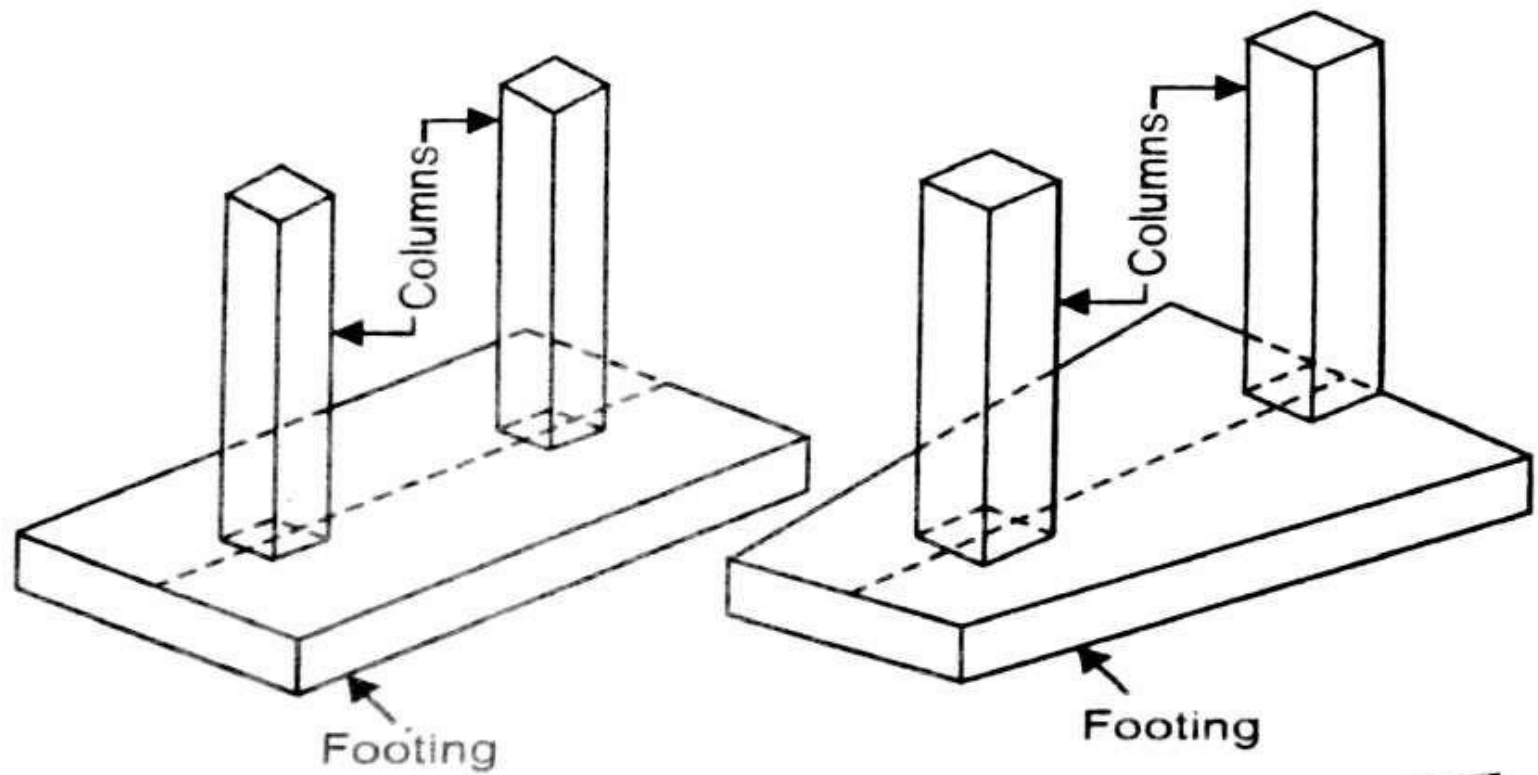
- It is special type of isolated footing generally provided for heavily loaded steel column and used in those location where bearing capacity of soil is poor.
- The depth of such foundation is limited to 1 to 1.5 m.
- The load of steel column is distributed over very large area by means of two or more tiers of steel joints.
- Each layer being laid at right angle to the layer below it.



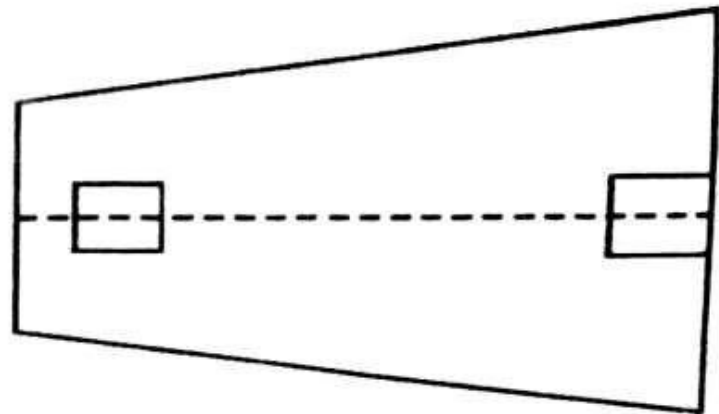
## Combined Footing:

- A spread footing which supports two or more columns is termed as combined footing.
- The combined footing may be of following kinds.
- **Rectangular combined footing:** The combined footings will be provide in rectangular in shape if columns carry equal loads. The design of rectangular combined footing should be done in such way that centre of gravity of column coincide with centroid of footing area.
- **Trapezoidal combined footing:** If columns carry unequal loads the footing is of trapezoidal shape are provided.
- **Combined column-wall footing:** It may be required to provide a combined footing for column and wall. Such combined footing are shown in fig.





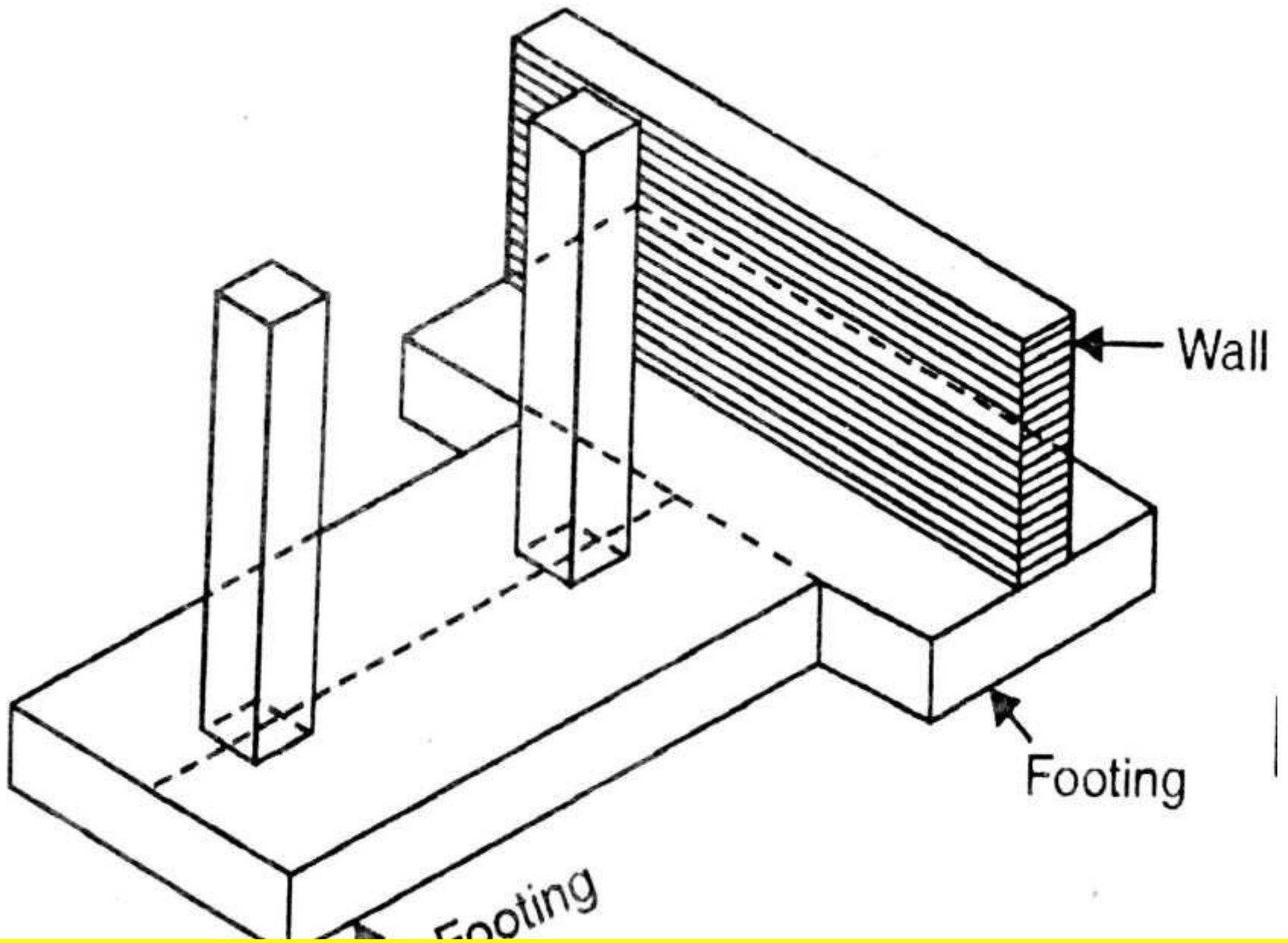
(a) Rectangular footing



(b) Trapezoidal footing

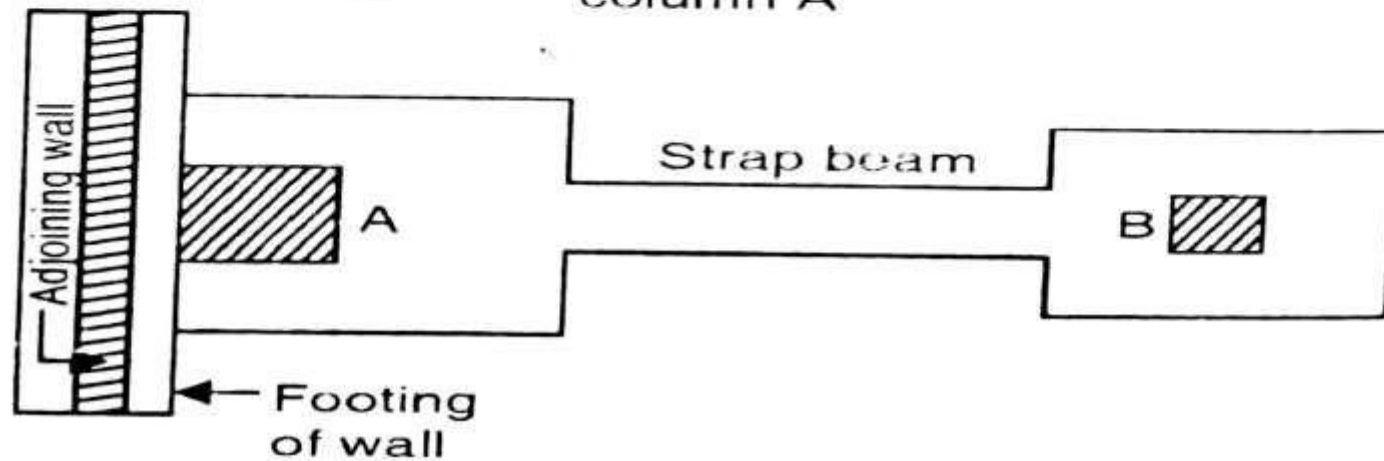
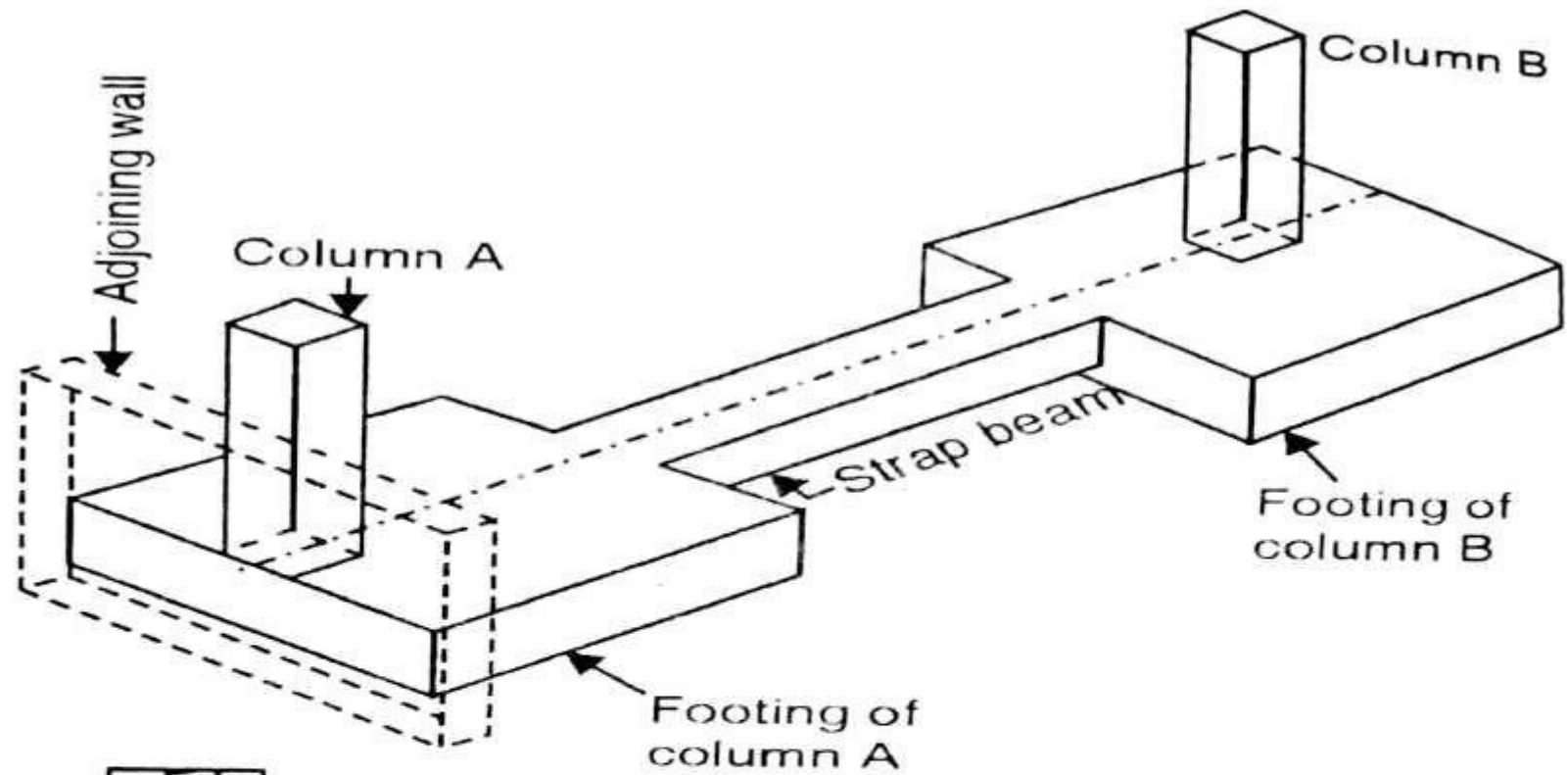
**FIG. 2.5. COMBINED FOOTINGS FOR COLUMNS.**





## Strap Footing:

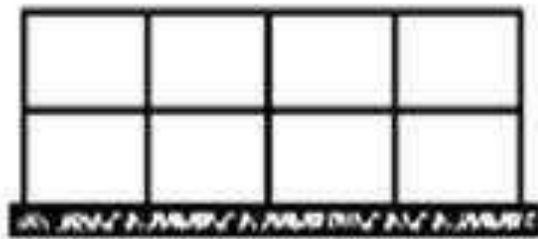
- If a Independent footing of two columns are connected by a beam, it is called a strap footing.
- A strap footing may be used where the distance between the column is so great that trapezoidal footing becomes quite narrow.
- The strap does not remain in contact with soil and does not transfer any pressure to the soil.



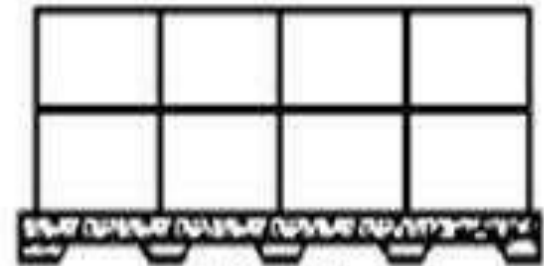
## Raft foundation:

- A raft Foundation is a combined footing that covers the entire area beneath a structure and support all the wall and column.
- They are used in areas where the soil masses contains compressible lenses or the soil is sufficiently erratic so that differential settlement would be difficult to control.
- Raft foundation may be divided in to three types based on their design and construction.
  - Solid slab system
  - Beam slab system
  - Cellular system

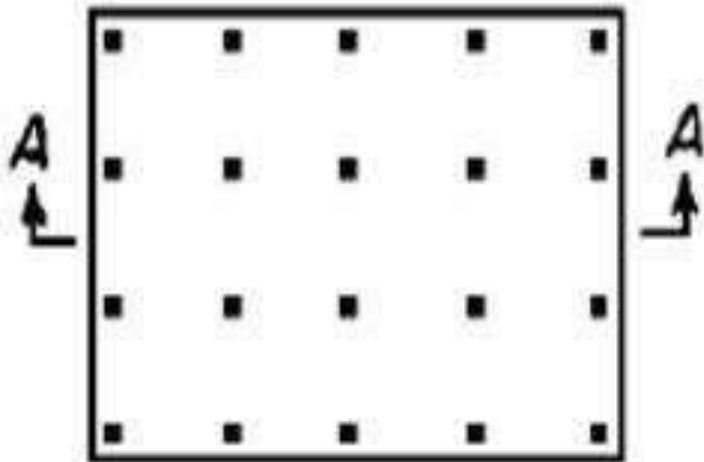
All the three types are basically the same, consisting of a large, generally unbroken area of slab covering the whole or large part of structure.



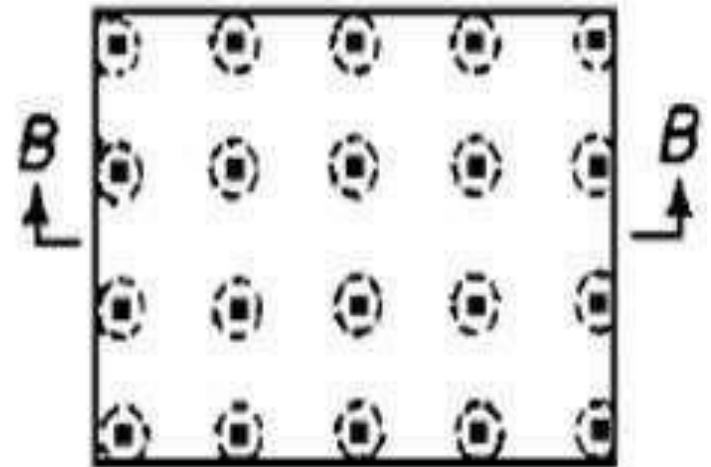
A-A



B-B



Flat plate



Flat plate thickened  
Under columns





- **Deep foundation**

- Deep foundation are those in which the depth of foundation is very large in comparison to its width.
- Deep foundation may be of following types
- Pile foundation
- Pier foundation
- Caissons or Well foundation

- **Pile Foundation**

- Pile Foundation is that type of foundation in which the loads are taken to a low level by means of vertical members which may be timber, concrete or steel.
- Pile foundation may be adopted when no firm bearing strata is available and the loading is uneven.

- Piles may be of following types

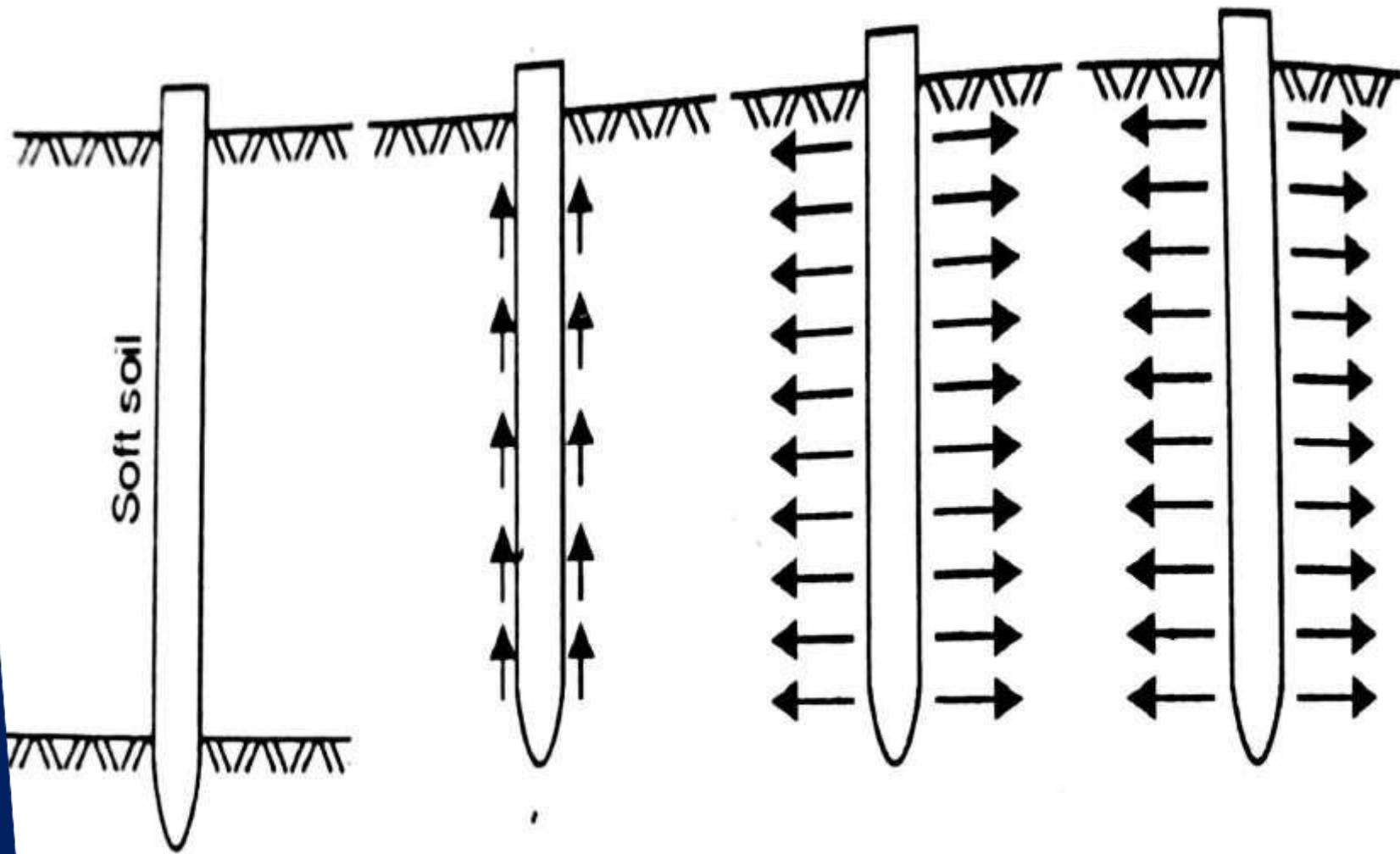
- End bearing piles

- Friction Pile

- Compaction pile



- **End bearing piles:** This types of piles are used to transfer load through water or soft soil to a suitable bearing stratum.
- **Friction Pile:** Friction piles are used to transfer loads to a depth of friction load carrying material by means of skin friction along the length of piles.
- **Compaction pile:** Compaction piles are used to compact loose granular soils, thus increasing their bearing capacity.

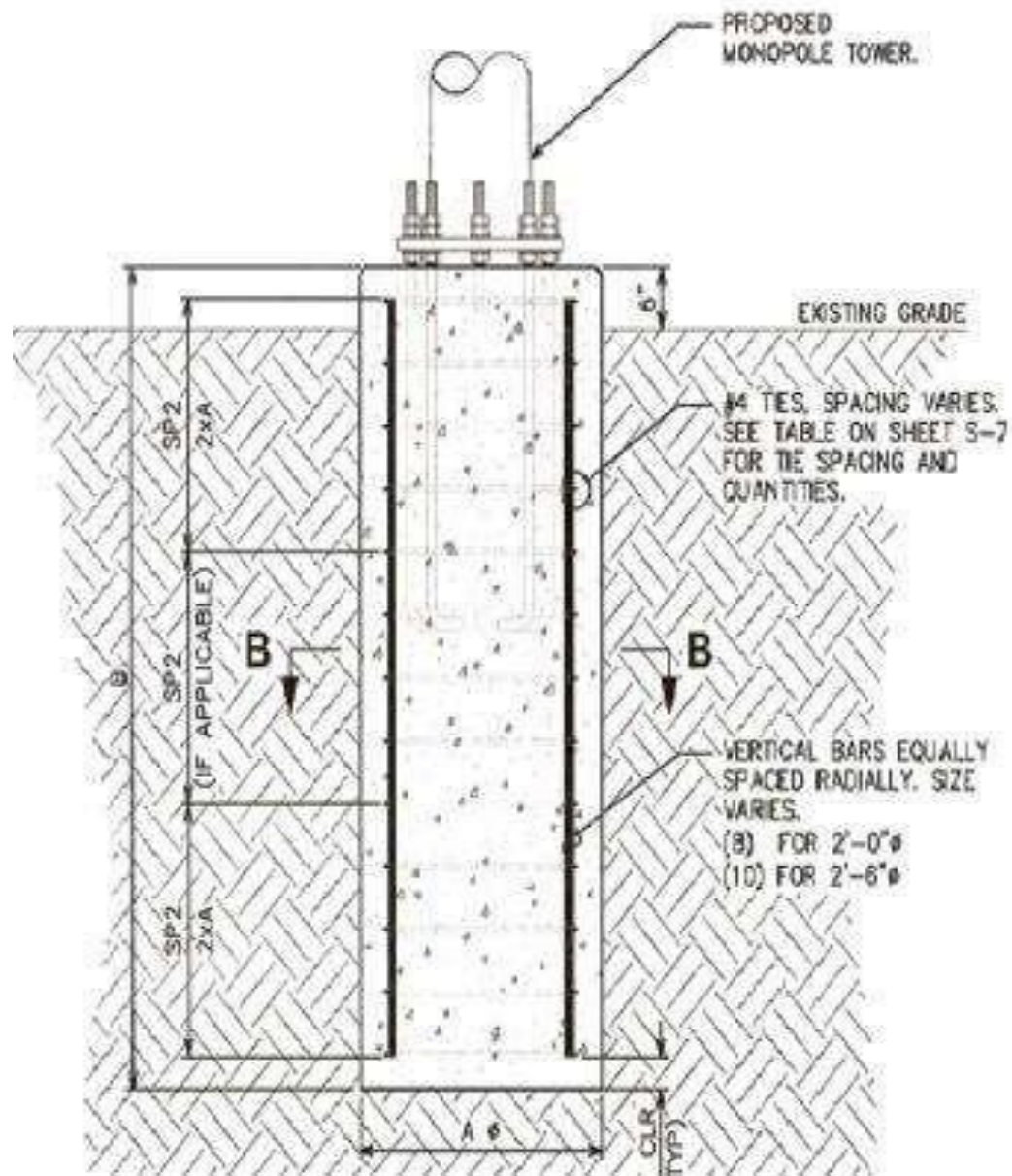


(a) End bearing pile

(b) Friction pile

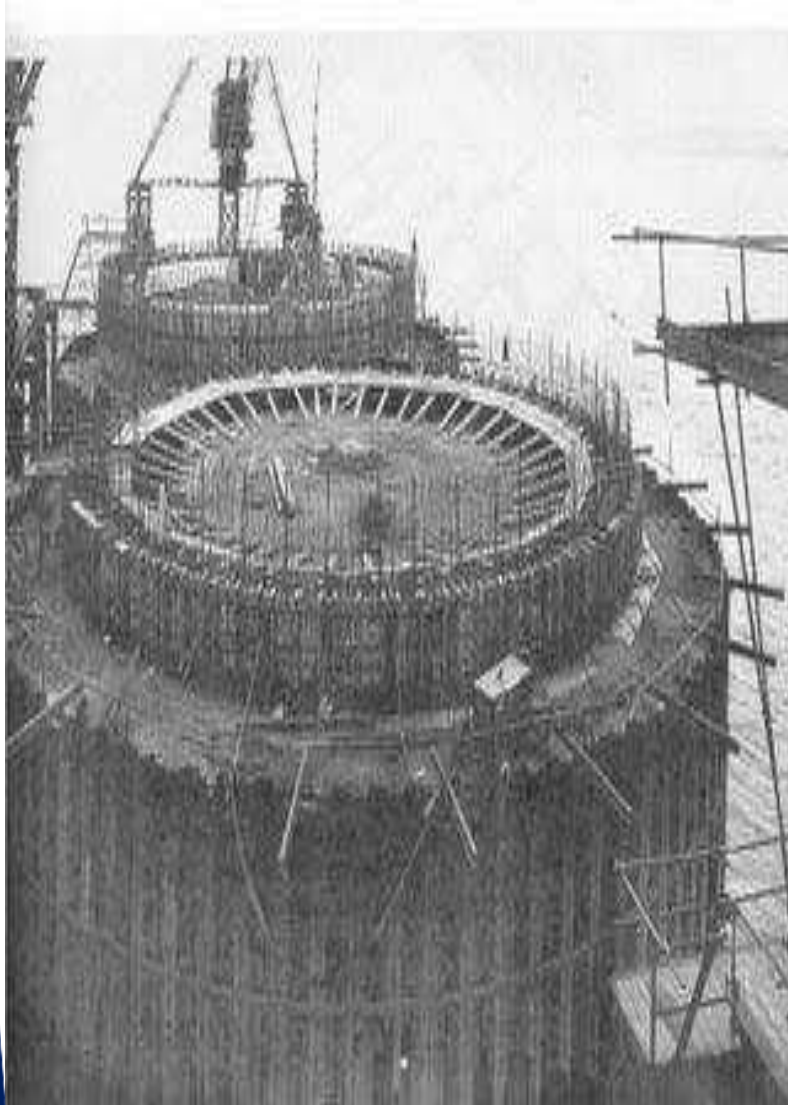
(c) Compaction pile

- **Pier foundation:**
- A Pier foundation consist of cylindrical column of large diameter to support and transfer large superimposed load to the firm strata below.
- Generally, pier foundation is shallow in depth than the pile foundation.



- **Well Foundation:**

- Well Foundation or Caisson are box like structures which are sunk from the surface of either land or water to the desired depth.
- They are much larger than the pier foundation or drilled caissons.
- Caisson foundations are used for major foundation works like
  - Bridge piers
  - Docks
  - Large water front structure such as pump house.



SHUTTERING WORK IN PROGRESS WELL FOUNDATION OF SIMBLE Br AT KM 18.044  
ON SIMBLE Br JAMMU-AKHNOOR ROAD



## • Foundations on Black Cotton Soil

- Black cotton soils and other expansive soils have typical characteristics of shrinkage and swelling due to moisture movement through them.
- When moisture enters between the soil particles under some hydrostatic pressure, the particles separate out, resulting in an increase in the volume.
- This increase in volume is commonly known as swelling. If this swelling is checked or restricted, high swelling pressure, acting in the upward direction, will be induced.
- This would result in several cracks in the walls and may sometimes damage the structural such as lintels, beams, slabs etc.

During summer season, moisture moves out of the soil and consequently, the soil shrinks.

Shrinkage cracks are formed on the ground surface. These shrinkage cracks some times also known as tension cracks, may be 10 to 15 cm wide on the ground surface.

Black cotton soils and other expansive soils are dangerous due to their shrinkage and swelling characteristics.

In addition, these soils have very poor bearing capacity, ranging from 5 t/m<sup>2</sup> to 10 t/m<sup>2</sup>.



- For designing footings on these soils, the following points should be kept in mind:
- 1. The safe bearing capacity should be properly determined, taking into account the effect of sustained loading. The bearing capacity of these soils may be limited to 5 to 10 t/m<sup>2</sup>.
- 2. The foundation should be taken at least 50 cm lower than the depth of moisture movement.
- 3. Where this soil occurs only in top layer, and where the thickness of this layer does not exceed 1 to 1.5 m, the entire layer of black cotton soil should be removed, and the foundation should be laid on non-shrinkable non-expansive soil.
- 5. Where the soil is highly expansive, it is very essential to have minimum contact between the soil and the footing. This can be best achieved by transmitting the loads through deep piles.
- 6. Where the bearing capacity of soil is poor, or soil is very soft, the bed of the foundation trench should be made firm or hard by ramming mooram.

## Types of foundation in black cotton soils.

Foundation in black cotton soils may be of the following types:

- 1.Strip foundation. For medium loads, strip foundation may be provided, along with special design features.
- 2.Pier foundation Piers are dug at regular interval and filled with cement concrete. The piers may rest on good bearing strata.
- 3.Under-reamed pile foundation. An under-reamed pile is a pile of shallow depth (1 to 6 m) having one bulb at its lower end.

- Under-reamed Pile Foundation

- Under-reamed piles are bored cast-in-situ concrete piles having bulk shaped enlargement near base.
- These piles are commonly recommended for providing safe and economical foundations in expansive soils such as black cotton soil having poor bearing capacity.
- In these type of foundation the structure is anchored to the ground at a depth where ground movement due to changes in moisture content negligible.
- A pile having one bulk is known as single under-reamed pile. It is seen that the load bearing capacity of the pile can be increased by increasing the number of bulk at the base.
- In such a case the pile is named as multi-under-reamed pile. The increase in the bearing capacity of the pile can also be achieved by increasing the diameter and the length of the pile.

- The method of construction of under-reamed pile is very simple. The holes for casting piles in the ground may be bored by using hand augers.
- After boring is carried out at the required depth, the base of the bore hole is enlarged in the form of a bulb near its base by use of a tool, known under-reamer.
- After the pile holes are ready for concreting, reinforcement cage are lowered in the holes and concrete is poured.

The piles should be cast at least 200 to 400 mm above the cut-off level. Later on, when the concrete is hardened, the extra length of each pile is broken and the pile top is brought to the desired level.

Thus, besides relative saving in direct cost (when compared with conventional isolated footings) it is possible to have overall saving in time of completion of a work by adopting under-reamed piles.



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*Thank  
you!*

**STAY HOME, STAY SAFE**