

Course Code: ESC106A

Course Title: Construction Materials and Engineering Mechanics

Lecture No. 2:

Building Materials and Masonry

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Lecture Intended Learning Outcomes

At the end of this lecture, student will be able to:

- Define soil and explain its properties
- Describe materials of construction
- Describe the desirable properties and applications of different building materials such as stone, bricks, lime, mortar, etc.
- Explain the properties of cement and types of foundation
- Differentiate materials used in masonry construction and the construction methods



Contents

Soil- Formation and Index properties

Construction materials and technology: Stones, sand, cement, concrete, bricks, lime and mortar

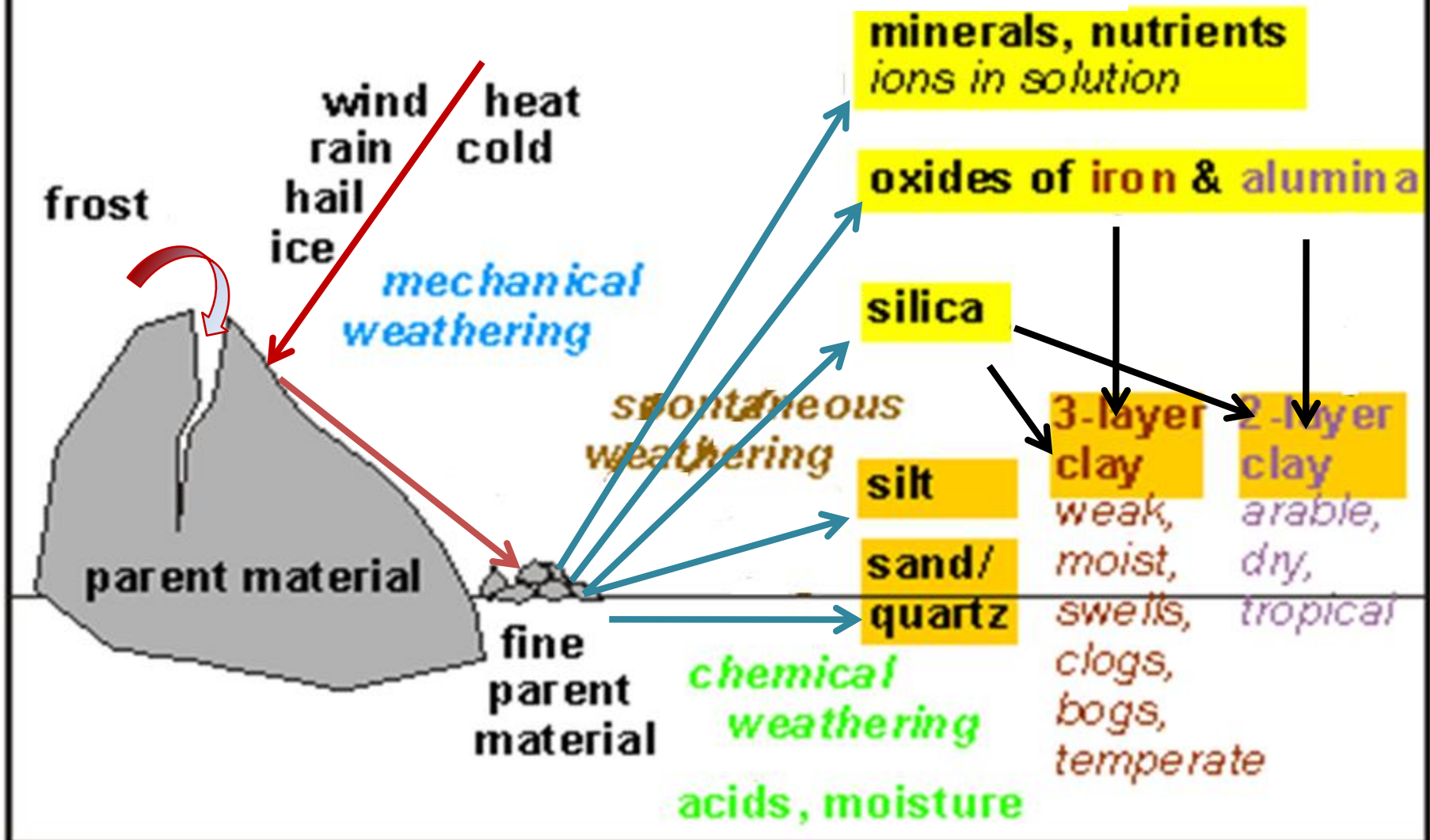


Soil

Soil is formed from rock due to erosion and weathering action



Formation of Soil



Properties of soil

Index Properties of Soil

The following are the Index Properties of soil:

1. Water content
2. Specific Gravity
3. In-situ density
4. Particle size distribution
5. Consistency limits



Foundation

- It is the lower most part of the building that transfers the load of the structure to the soil

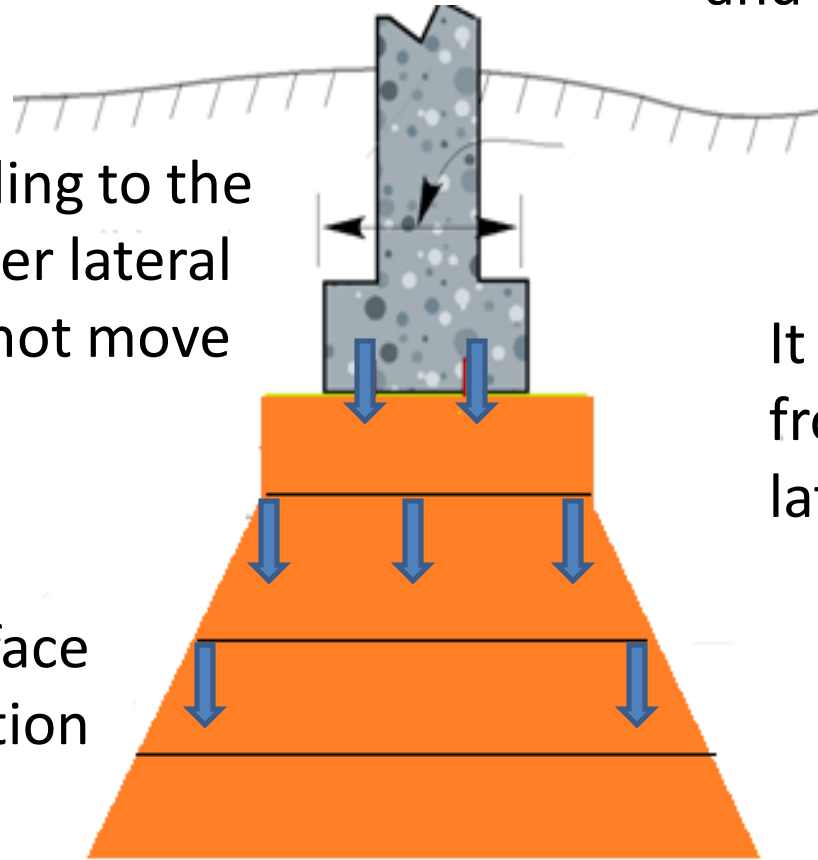


Functions and requirements of foundation

To distribute the load from the structure to soil evenly and safely

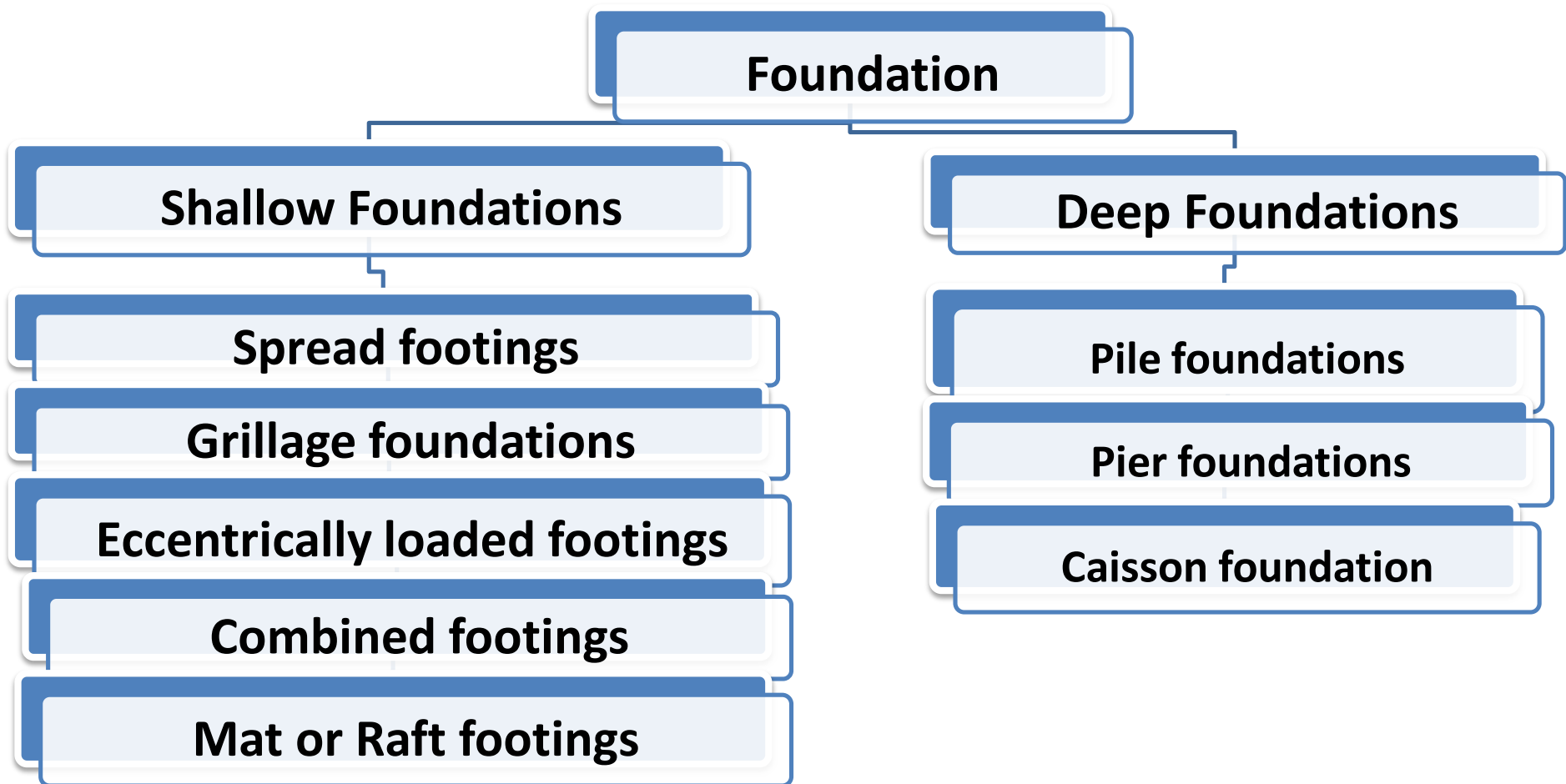
To anchor the building to the ground so that under lateral loads building will not move

It gives level surface for the construction of super structure



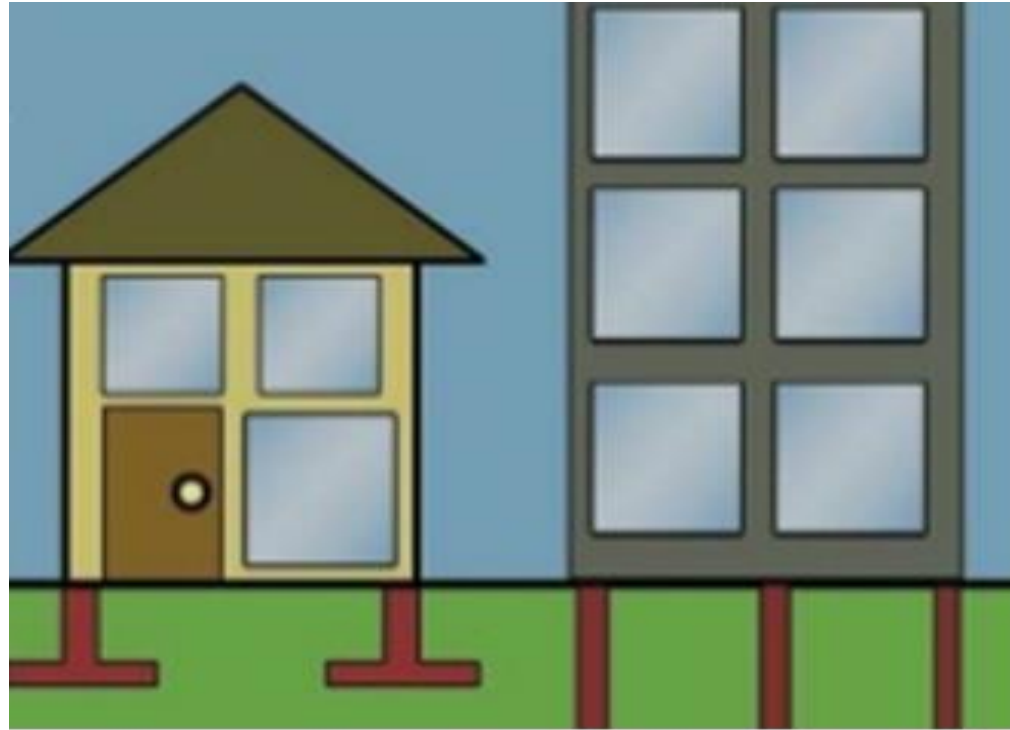
It prevents the building from overturning due to lateral forces

Classification of Foundation



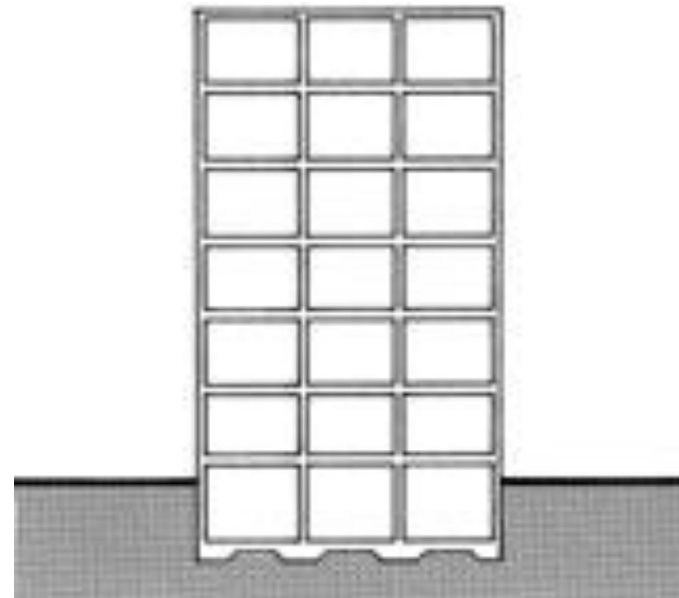
Shallow Foundations and Deep Foundations

A shallow foundation is also known as an open foundation since such foundation is constructed by open excavation

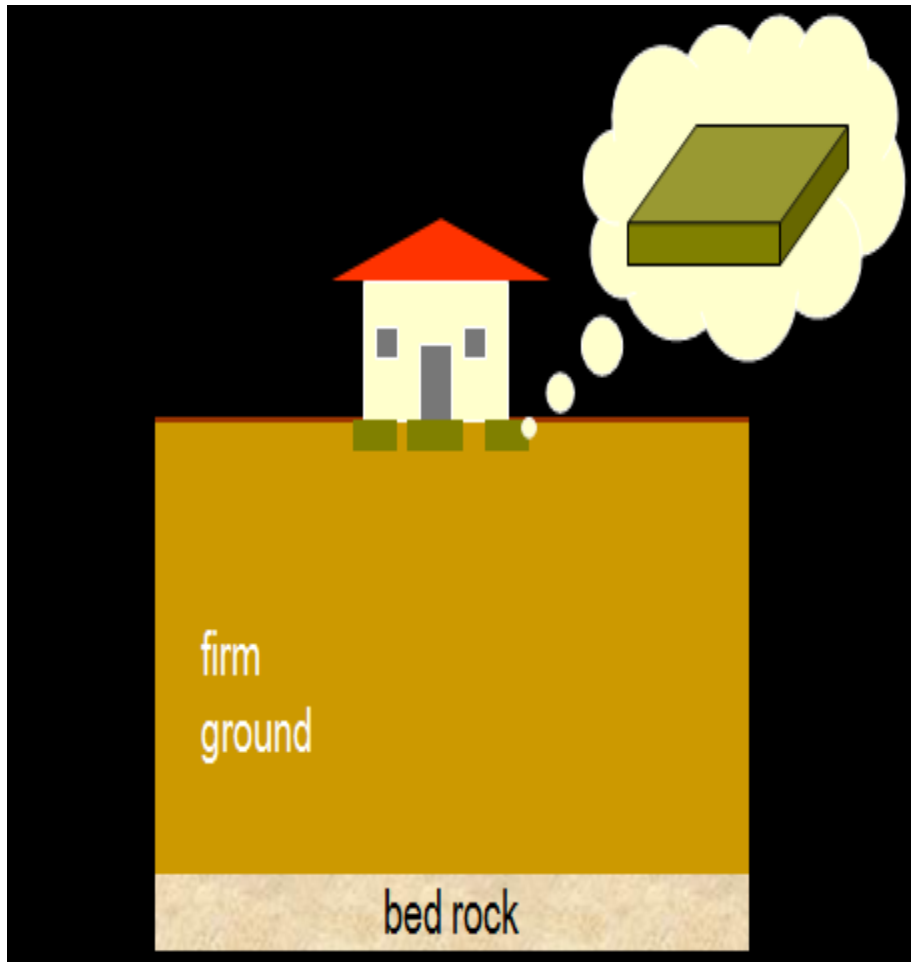


Deep foundations are those in which the depth of the foundation is very large in comparison to its width

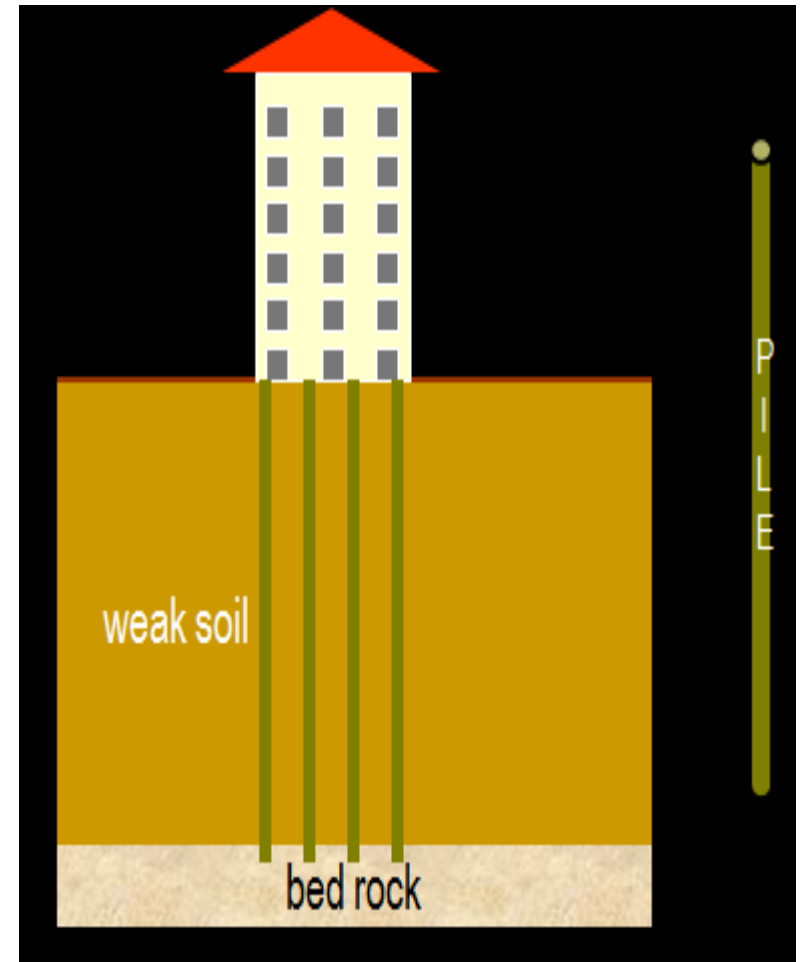
Shallow Foundations and Deep Foundations



Shallow Foundations and Deep Foundations

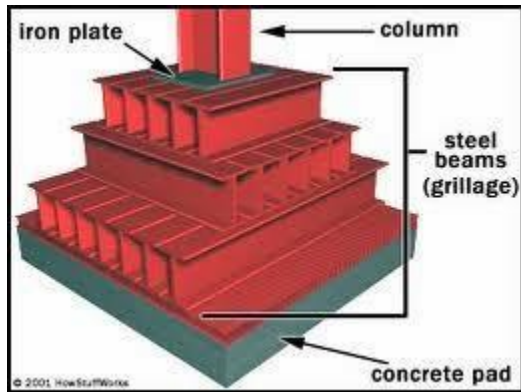


Shallow Foundations

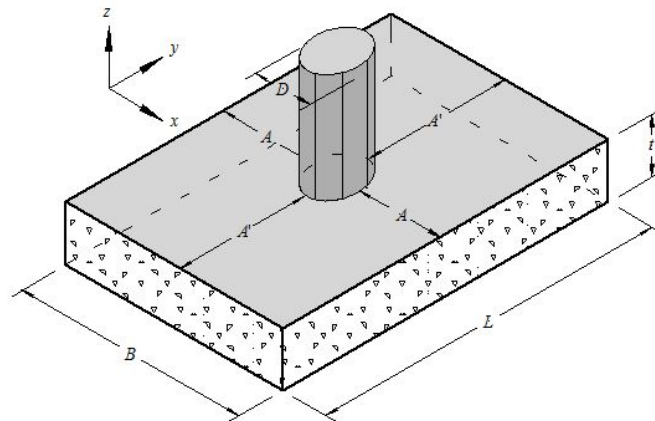


Deep Foundations

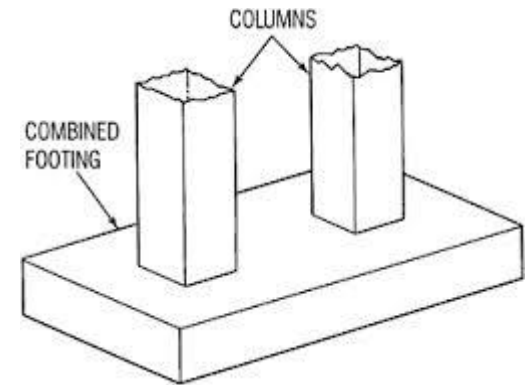
Classification of Foundation



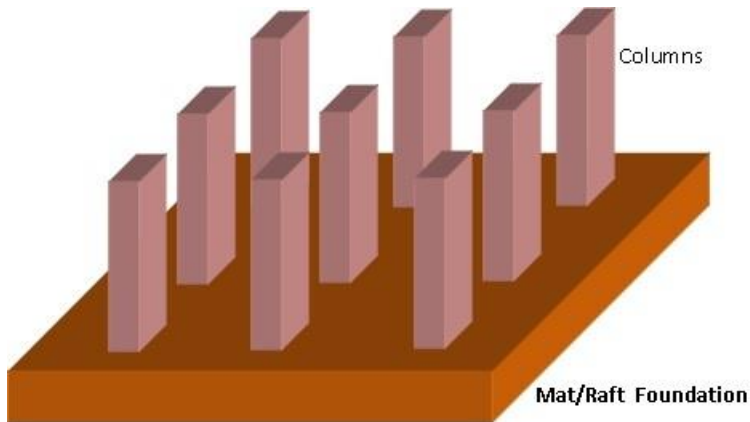
Grillage foundation



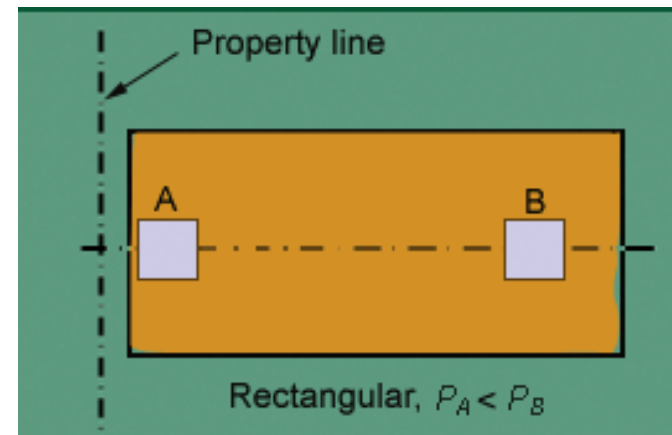
Spread footings



Combined footings

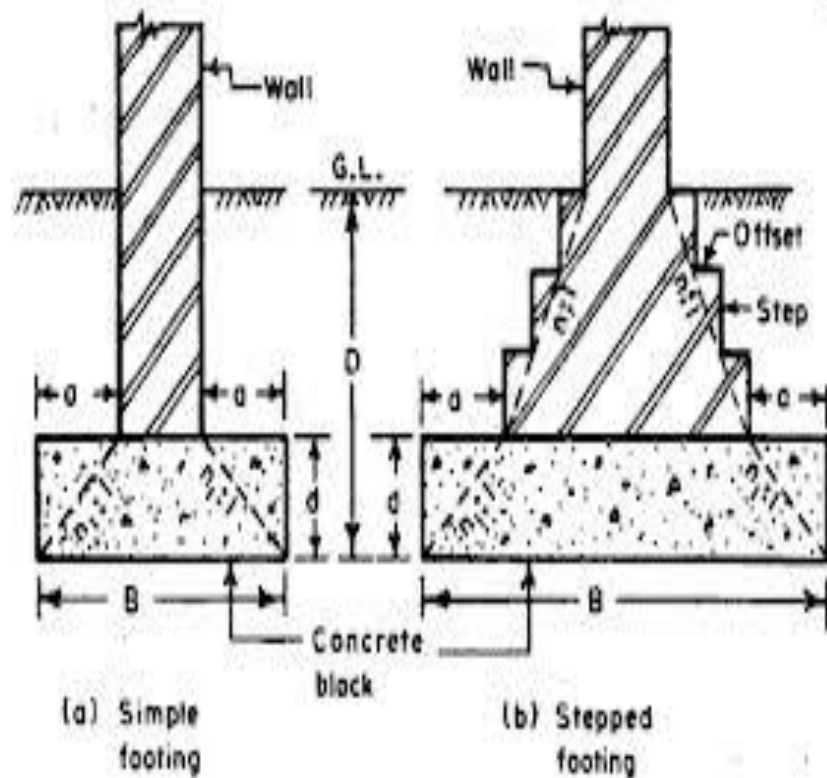


Mat/Raft foundation

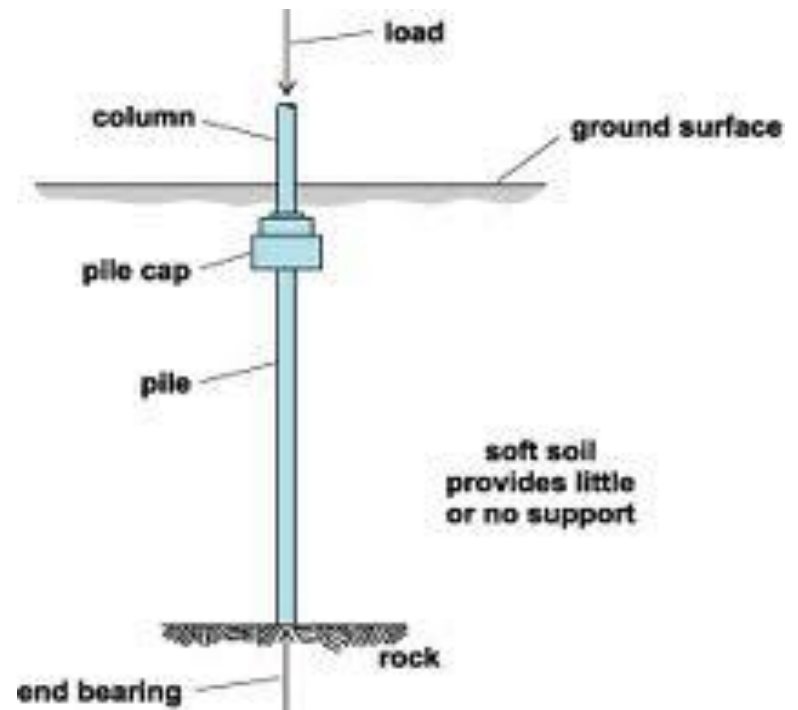


Eccentrically loaded foundation

Shallow Foundations and Deep Foundations



Shallow Foundations



Deep Foundations

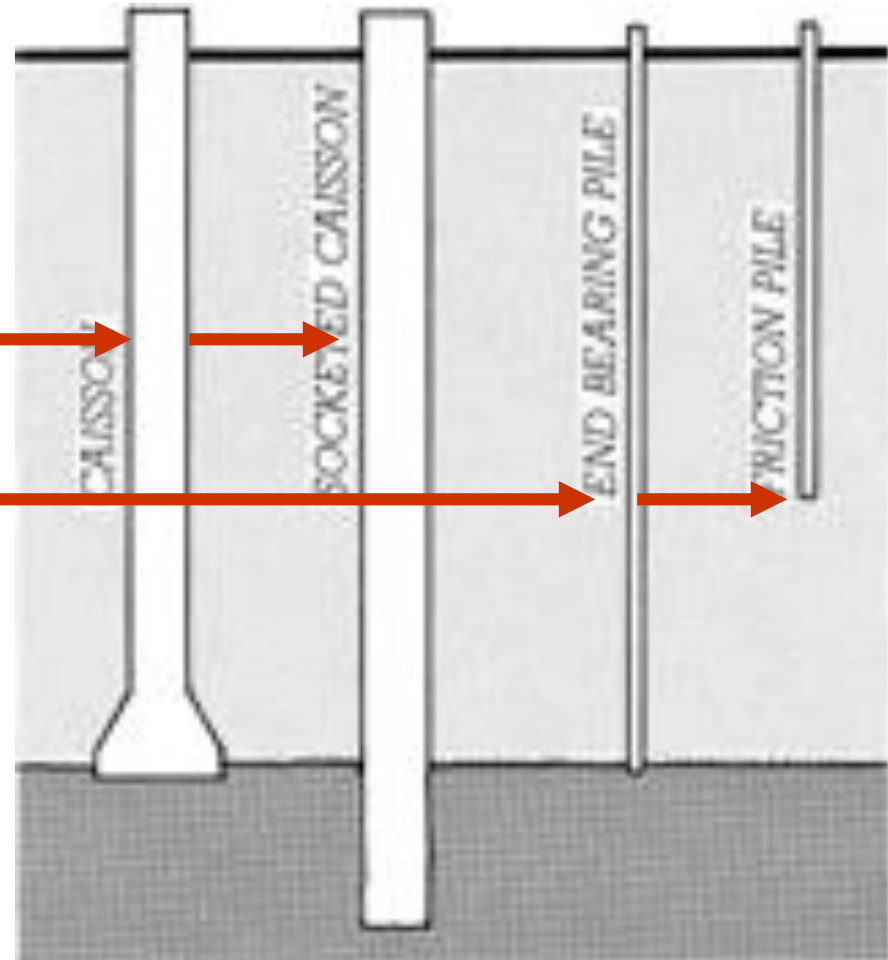
Deep Foundations - Purpose

transfer building loads deep into the earth

Basic types

- Drilled (& poured)

- Driven



Driven Piles



Deep Foundation

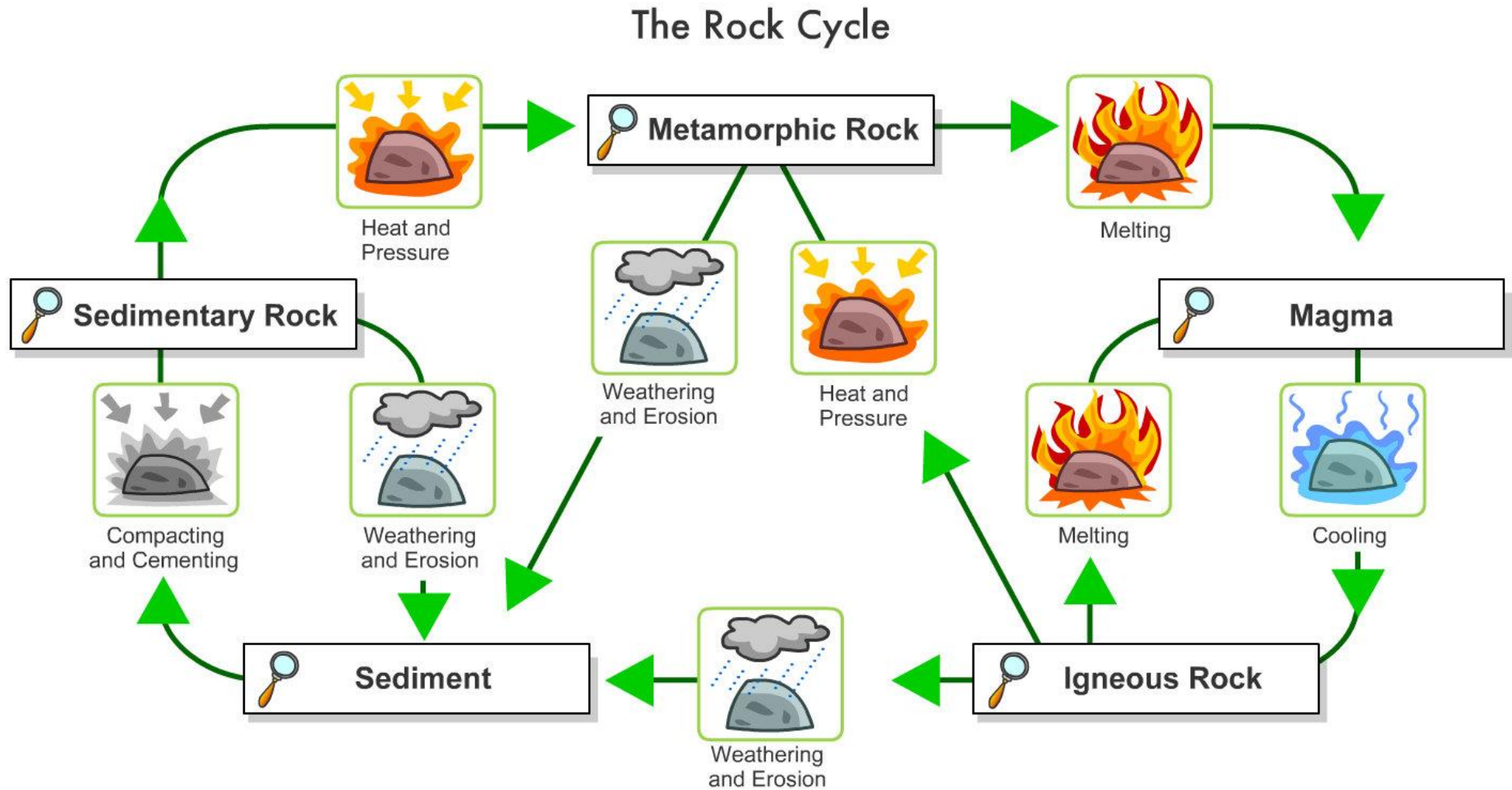


Bridge pier



Caisson

Formation of Rocks



Types of Rocks

Igneous rocks



Sedimentary rocks



Metamorphic rocks



Stones

- **Stones are derived from rocks,** which form the earth's crust and have no definite shape or chemical combination but are mixtures of two or more minerals.



Properties of Stone

- Crushing Strength
- Hardness
- Percentage wear
- Resistance to fire
- Water absorption
- Specific gravity
- Durability
- Appearance



Uses of Stone



Stone masonry



Arches



Walls

Uses of Stone



Piers



Abutments



Retaining Walls

Sand

- Sand is a naturally occurring granular material composed of finely divided rock and mineral particles



Properties of Sand

It should be,

- well graded
- clean and coarse
- strong and durable
- clean and free from coatings of clay and silt
- not contain salt which absorbs moisture from atmosphere



Uses of Sand

It adds to the density of the mortar and fills up the gap between the building blocks and spreads the binding material



It prevents the shrinkage of the cementing material

The cost of cementing material per unit volume is reduced as this low cost material increases the volume of mortar

It sub-divides the paste of binding material into thin films and allows it to adhere and spread.

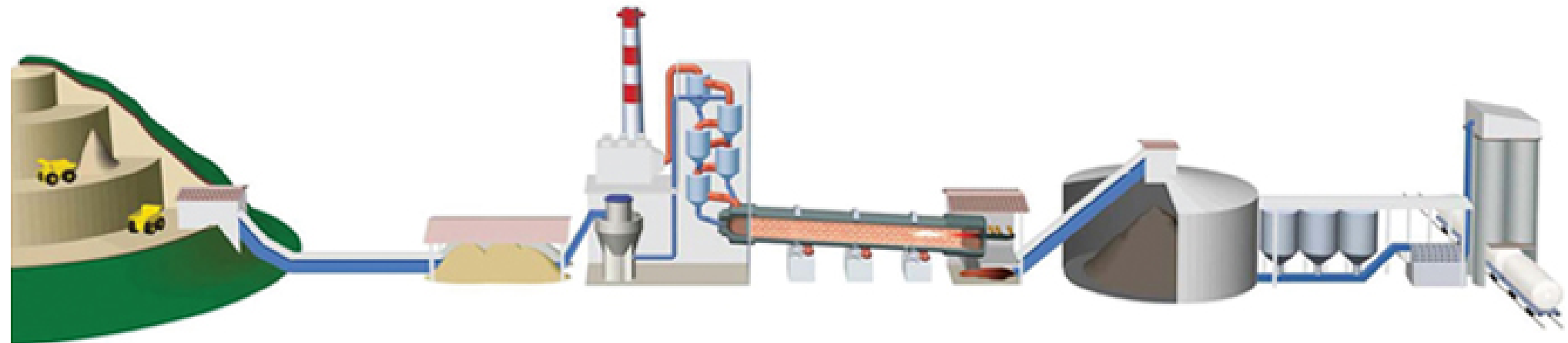


Cement

- The cement is obtained by burning admixture of calcareous (calcium) and argillaceous (clay) material at a very high temperature and then grinding the clinker so produced to a fine powder



Cement



QUARRYING

Limestone and small amounts of sand and clay are extracted, usually from a quarry located near the cement manufacturing plant.

RAW MATERIALS PREPARATION

The extracted materials are analyzed, blended with additional mineral components depending on the type of limestone available, and finely ground for further processing.

CLINKER PRODUCTION

The materials are heated in a kiln reaching a temperature of $1,470^{\circ}\text{C}$. The heat transforms the materials into a molten product called clinker, which is then rapidly cooled.

CEMENT GRINDING AND DISTRIBUTION

The clinker is stored and then finely ground. Gypsum is added to control setting time, along with supplementary cementing materials, such as fly ash or slag, to obtain a fine powder called cement, with the desired properties of strength and chemical resistance.



Properties of cement

Chemical properties

| | | |
|------------------------|--|-----|
| Tricalcium silicate | $3 \text{ CaO} \cdot \text{SiO}_2$ (C3S) | 40% |
| Dicalcium silicate | $2 \text{ CaO} \cdot \text{SiO}_2$ (C2S) | 30% |
| Tricalcium aluminate | $3 \text{ CaO} \cdot \text{Al}_2\text{O}_3$ (C3A) | 11% |
| Tetracalcium aluminate | $4 \text{ CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$ (C3AF) | 11% |

Physical properties

- Fineness
- Setting time
- Soundness



Concrete

- Plain concrete, commonly known as concrete is a word of Latin derivation (con – together) (crete – to grow)
- Concrete consists of cement, aggregates (fine and coarse), water



Properties of Concrete

- It gains strength over time
- Being naturally fire-resistant concrete forms a highly effective barrier to fire spread
- More durable and is resistant to wear and tear
- Achieves required characteristic strength



Uses of Cement

Cement mortar is used for plastering and pointing

Cement mortar is used for masonry works

For manufacturing cement pipes, garden seats, dust bins, flower pots etc

It is used for flooring



Bricks

- Bricks are obtained by moulding clay in the rectangular blocks of uniform size and then by drying and burning these blocks
- Standard size of brick is 19cmx9cmx9cm and the nominal size of the brick is 20cmx10cmx10cm



Desirable Properties of Bricks

- The colour of the brick should be red or copper and uniform
- It should be well burnt in kilns
- The surface should be even and free from cracks
- The edges should be sharp
- They are durable
- They are low cost material
- They possess good strength
- They are easily available
- Brick are light in compared to stones





In chimneys



As a building block



In lining sewer lines

Uses of Bricks



Used as aggregates



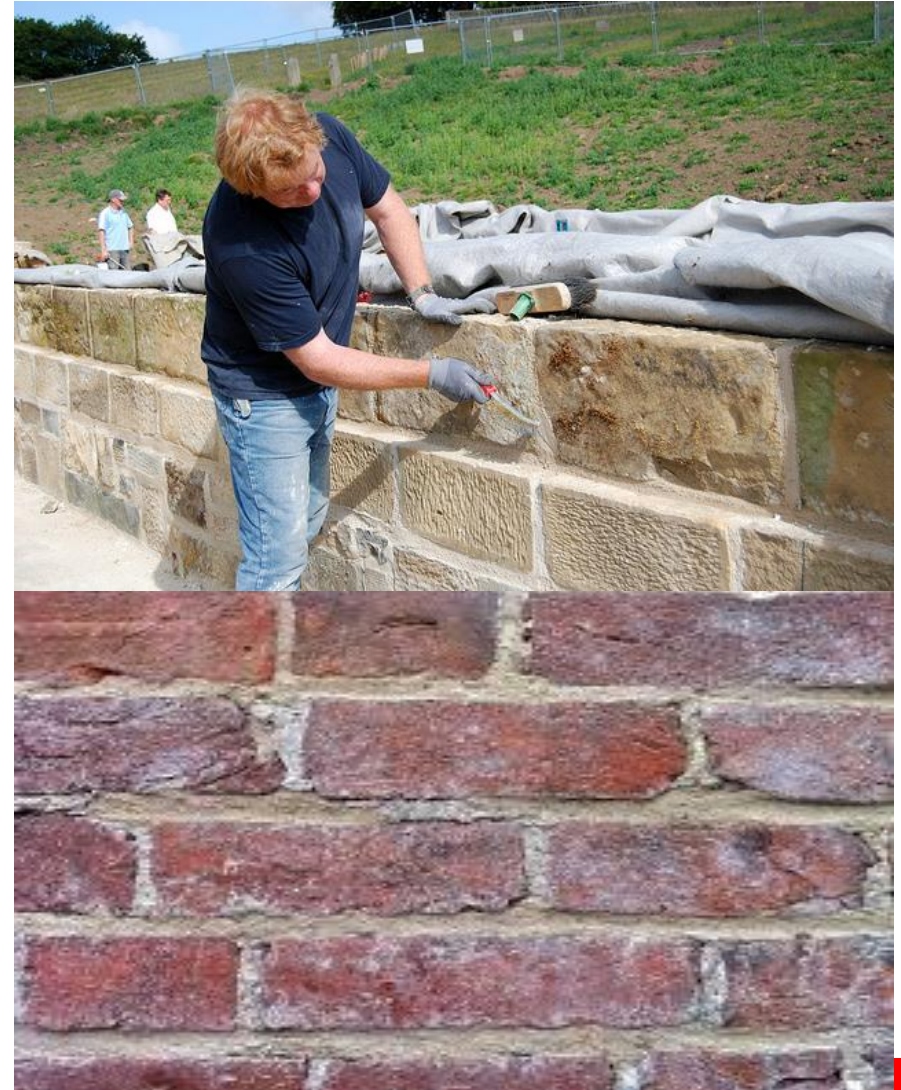
In Lintels

Lime Mortar

- Lime has been used as a cementing material since ancient times in India and abroad

Properties of lime:

- Lime is good at absorbing and releasing moisture
- Condensation on the surface
- Strength and long lasting adhesion
- It is light weight and flexible
- Safer for adjacent materials



Uses of Lime

- Lime is used as a primary ingredient in masonry mortars
- It used for interior and exterior plastering of walls
- Cement-lime mortars have shown higher bond and shear strength, and lower water leakage.



Summary

- Soil is formed from rock due to erosion and weathering action
- The index properties of soil are water content, specific gravity, particle size distribution and consistency limits
- Foundations can be broadly classified into shallow and deep foundations
- Materials used in building construction include concrete, stone, bricks, lime, mortar, etc.

