



Lecture Three

Construction of Foundations

A Foundation is the element of a structure which connects the structure to the ground, and transfers loads from the structure to the ground. Foundations are generally considered either shallow or deep.

Foundation engineering is the application of soil mechanics and rock mechanics (Geotechnical engineering) in the design of foundation elements of structures.

Definition of **The Foundation** / is that part of the building that is usually constructed below the natural ground level and at a certain depth and with various materials, including reinforced and un reinforced concrete, bricks, stone, and iron, and it carries the weight of the origin to the layers of soil fit to withstand those weights.

Depth of foundation: Depth of foundation is determined by several factors, the most important of which are:

- 1- **Soil nature** and its layers suitable for bearing loads of origin.
- 2- **Weather conditions** and exposing the foundations to the effects of freezing and thawing, so it requires building the foundations at a depth of not less than 30 cm to protect them from this effect.
- 3- **The groundwater level** and making the foundations above this level to overcome construction difficulties upon implementation.
- 4- **The base site of the building** has certain services such as a basement, shelter, private parking place, etc.

5- Relationship between the depth of foundations and the passageway, channels, streams and other facilities which used for health, electrical and mechanical services for that origin.

6- The Relationship between the foundations of the adjacent buildings and the loads that they carry, and their effect on designing in the depth of the new foundations.

7 - Work the foundation in suitable depth so it not affect the trees that we wants it to stay.

The nature of the soil and its relationship to the foundations:-

Before beginning any structural of the facility, an on-site site inspection of the soil by an accredited engineering laboratory is required for design :

- 1- To recognize the physical, mechanical, and chemical properties of the soil.
- 2- The acceptance of each of the soil layers for the loads.
- 3- The appropriate base quality.
- 4- The expected descent. Soil Settlement (type and amount).

and the laboratory presents all of this in a detailed comprehensive report that enables the designer and the examiner to perform their duties.

The soil is classified according to its components and composition into (Clay soil), (Silt clay soil), (Sand soil) or by other mixing types. As for the amount of its tolerance, it is divided into two main types:

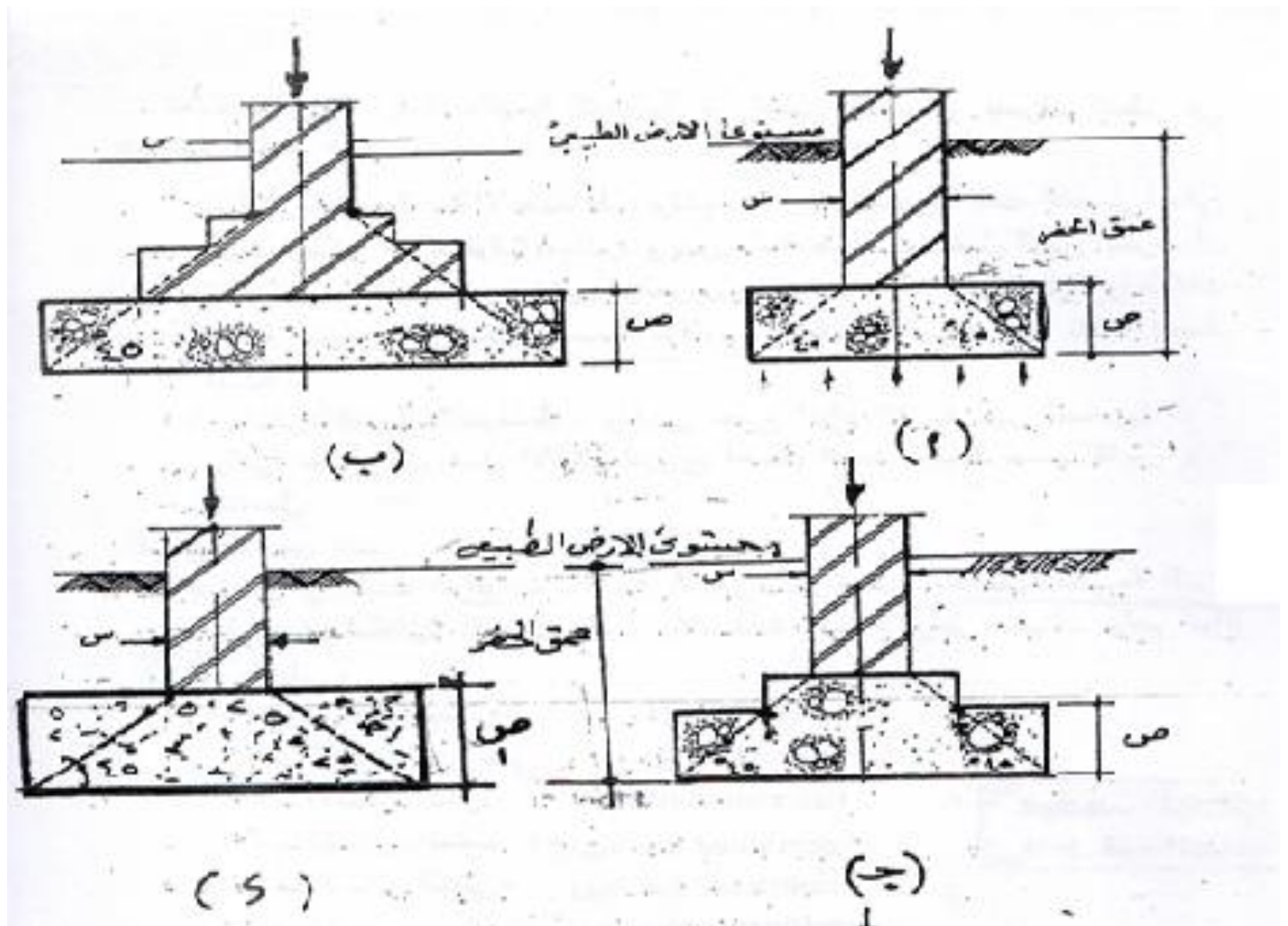
1- **Compressible soils** / it includes rocky soil with high tolerance where construction can be directly over it without the need to make foundations provided that the soil is sound free from cracks, veins, pockets, high porosity and oblique layers.

2- **Compact soil** / includes all types of non-rocky soils above.

Types of foundations: -

Different types of foundations are used in the construction, each according to their suitability for the nature of the soil and its bearing and the extent to which some can be used and used for specific purposes. The most important types of foundations are the following: -

1- Wall footing / This type is used with load-bearing walls and works from ordinary or reinforced concrete or in some cases, from extruded bricks and cement mortar. Figure (1) shows different types of wall foundations. The width of the foundation shall be equal to $(س + 2ص)$ as in (Figure 1-أ) where (س) represents the thickness of the wall and (ص) the thickness of the base provided that the base

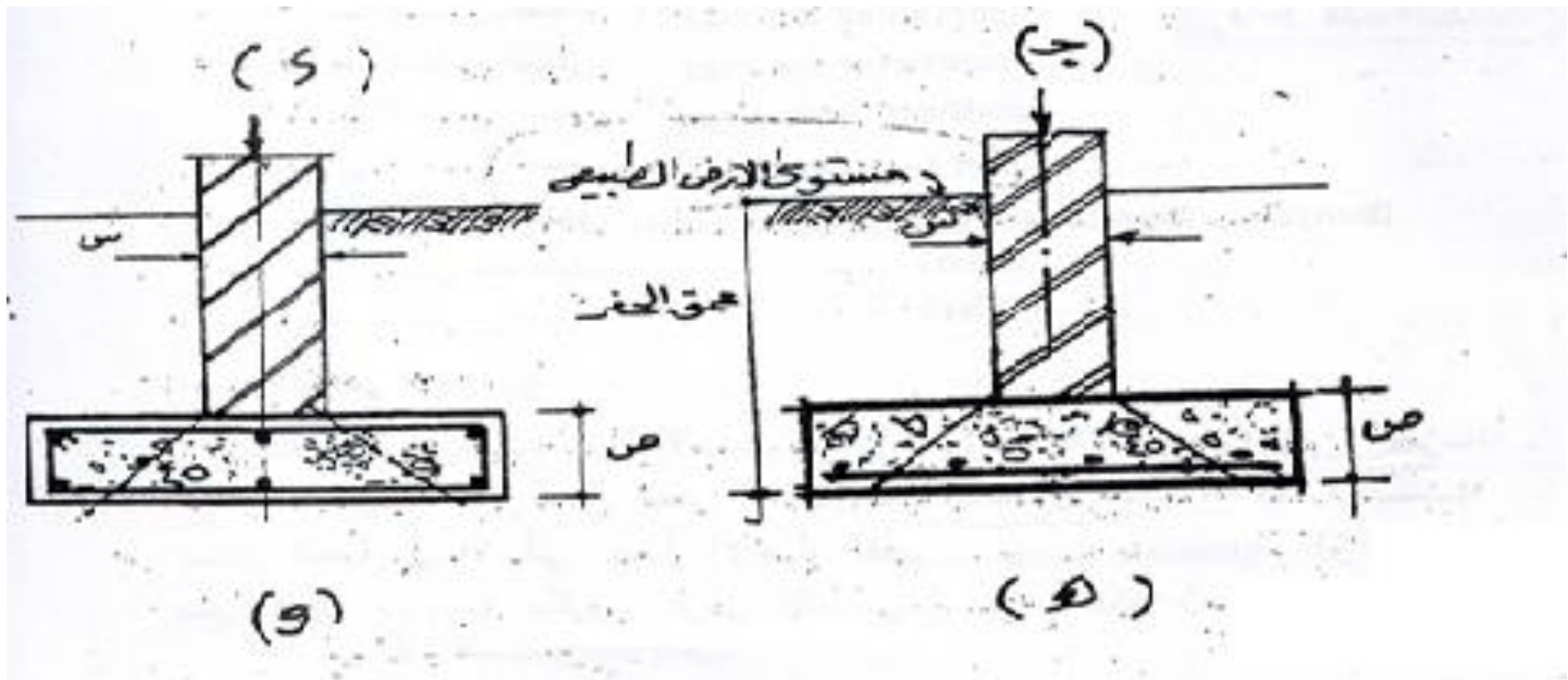


thickness is not less than (20) cm, mainly from unarmored concrete, and (15) cm, from reinforced concrete, according to the American code. If the width of the foundation is greater than $(2s + v)$, we can work the wall foundation according to one of the following procedures:

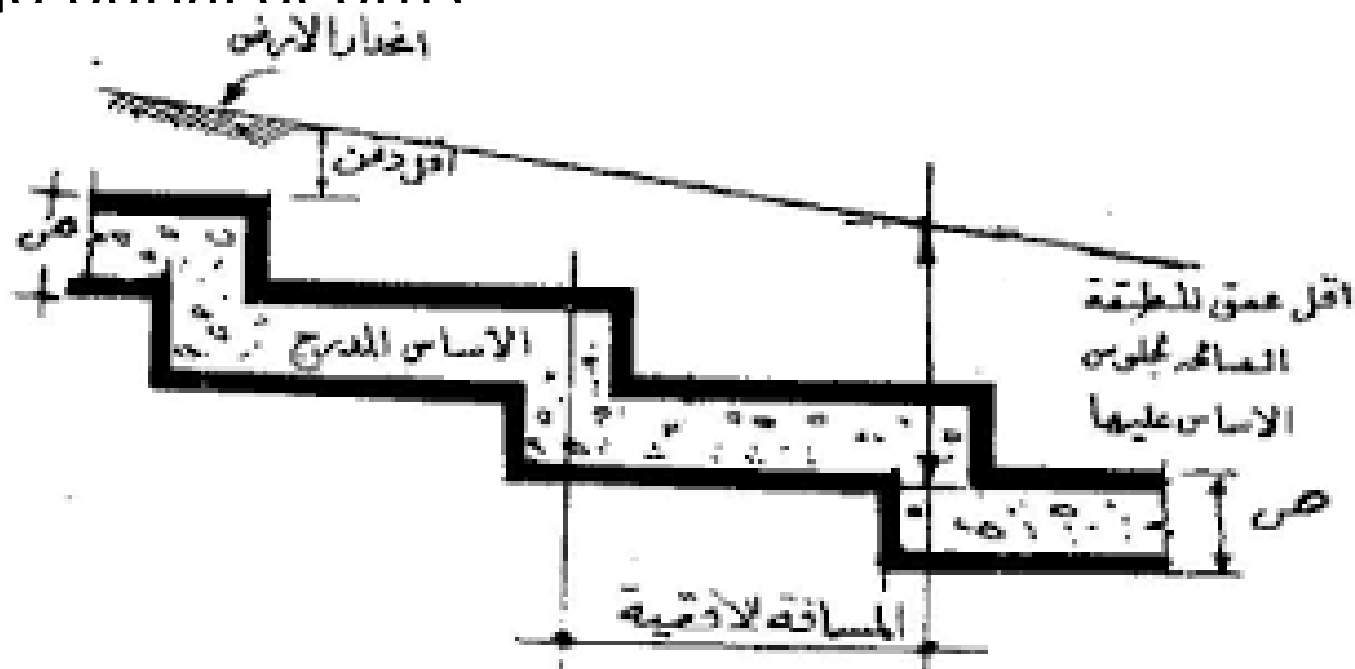
1- Make a gradient in the bearing wall (Figure 1- ب) or make a gradient on the concrete foundation (Figure 1- ج).

2- Increase the thickness of the base to be equal to (v) as in Figure (1-د).

3- The use of structural reinforcement without changing the thickness of the base as in Figure (1-هـ). It may require adding two-way reinforcement in one layer in the lower section or two layers one in the upper section and the other in the lower section as in Figure (1-و), depending on the need .



Stepped footing / walled foundation is used when the site has a slope, which makes drilling and burial over the foundations other than in large quantities if the designer want to make it to a single horizontal level. Therefore, this type is used to obtain a uniform, non-sharp gradient with acceptable digging and burial depths

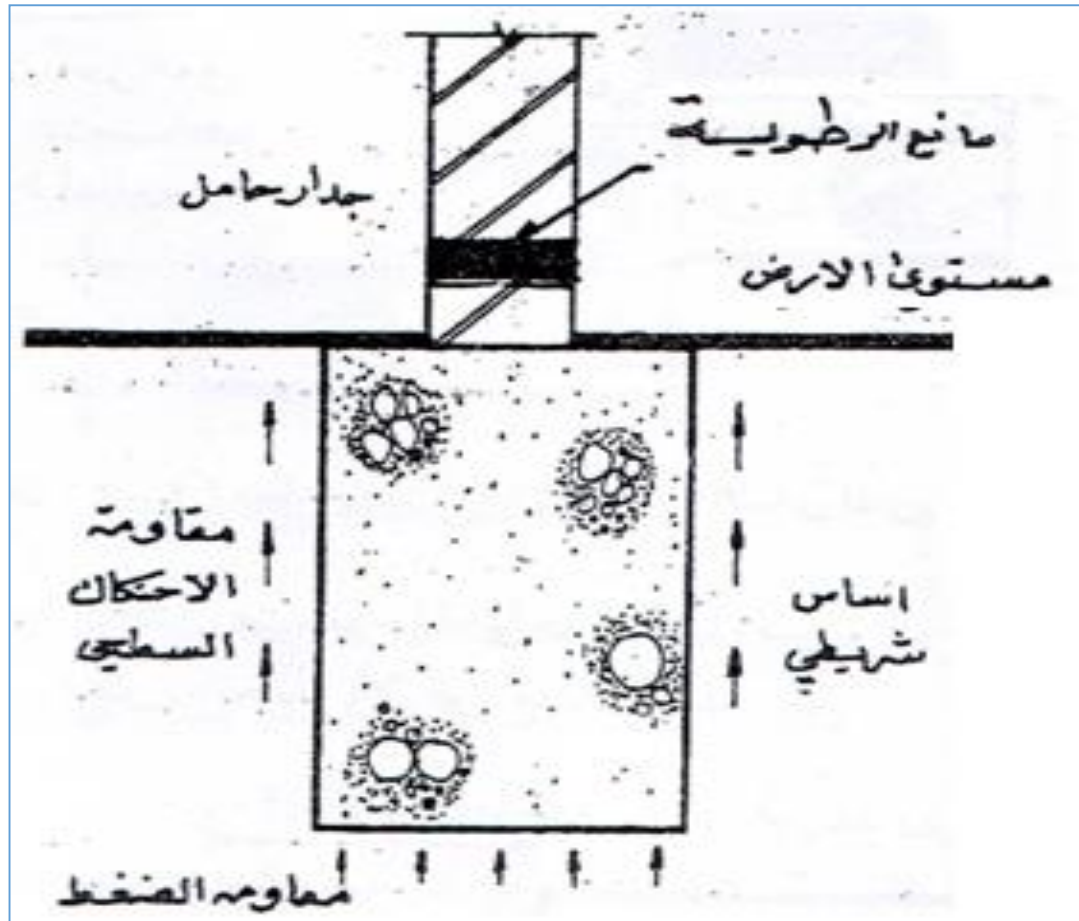


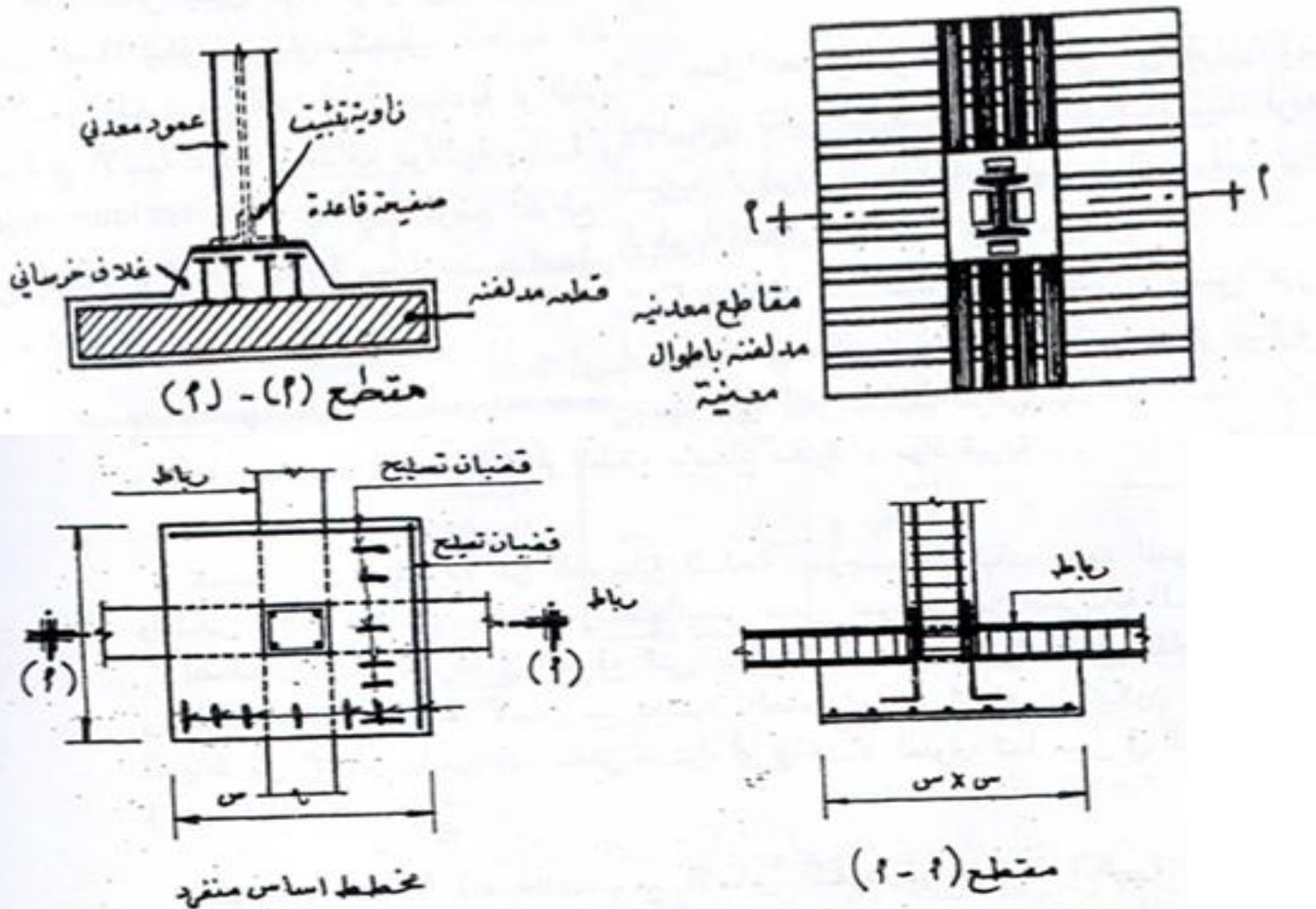
2- Strip footing : -

The strip foundation is used as a substitute for the parietal basis in sites where the tolerance of soil shear stress is high, which can benefit from the tolerance of the tape foundation its weight by resisting the surface friction between it and the adjacent soil to it and resisting the compression of the soil in its base as shown in fig. The tape basis is distinguished(Advantage) by important matters, including:

- 1- *Speed of operation* because it works in one section and one piece.
- 2- *It works as a hedge-block* between the two ends of the foundation and also works to reduce the leakage of moisture into the building sections above it.

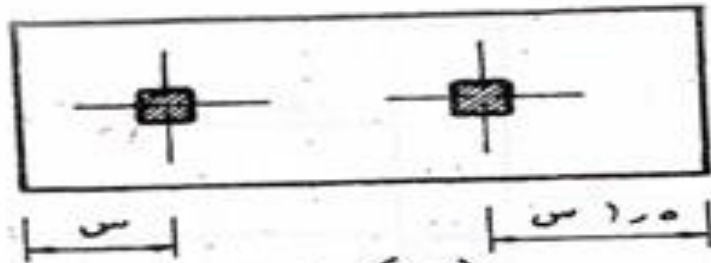
3- *It works as a deep beam* that is resistant to settlement , and it is preferable to add reinforcement with a small percentage to strengthen it for this purpose.





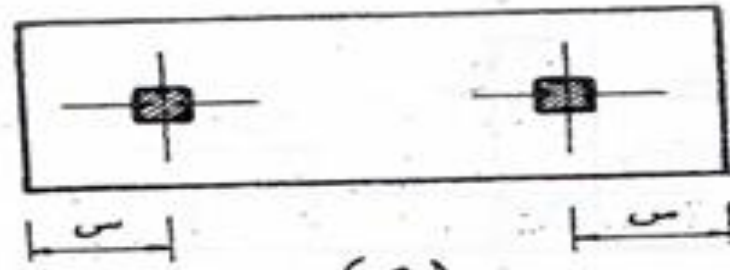
4-Combined Footing :-

A continuous foundation is a single foundation that carries two concentrated weights of two columns that are close to each other and that is in a symmetrical rectangle when the amount of the two centered equals is equal or asymmetric or trapezoidal rectangle or rectangular when the amount of the two centered heights varies or when one of the two columns is adjacent to the boundaries of the adjacent segment as shown in Figure.



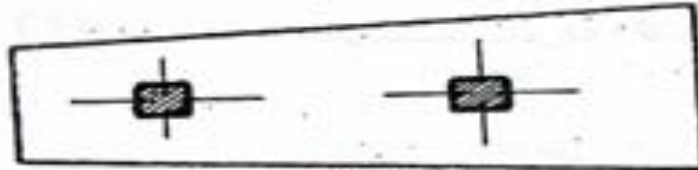
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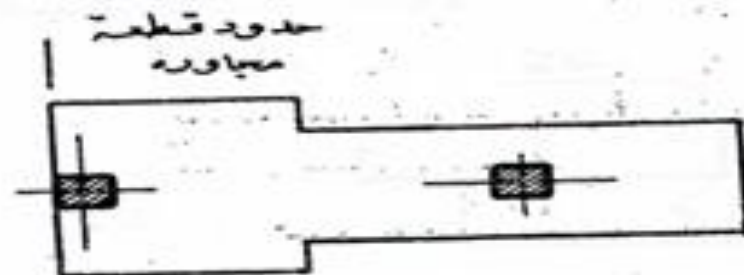
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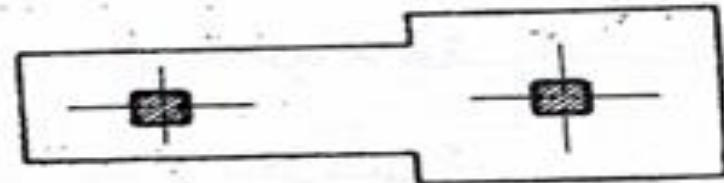
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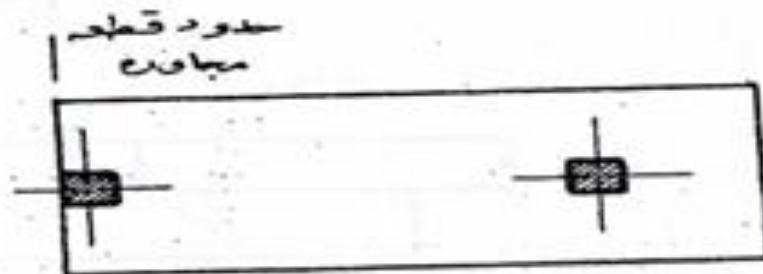
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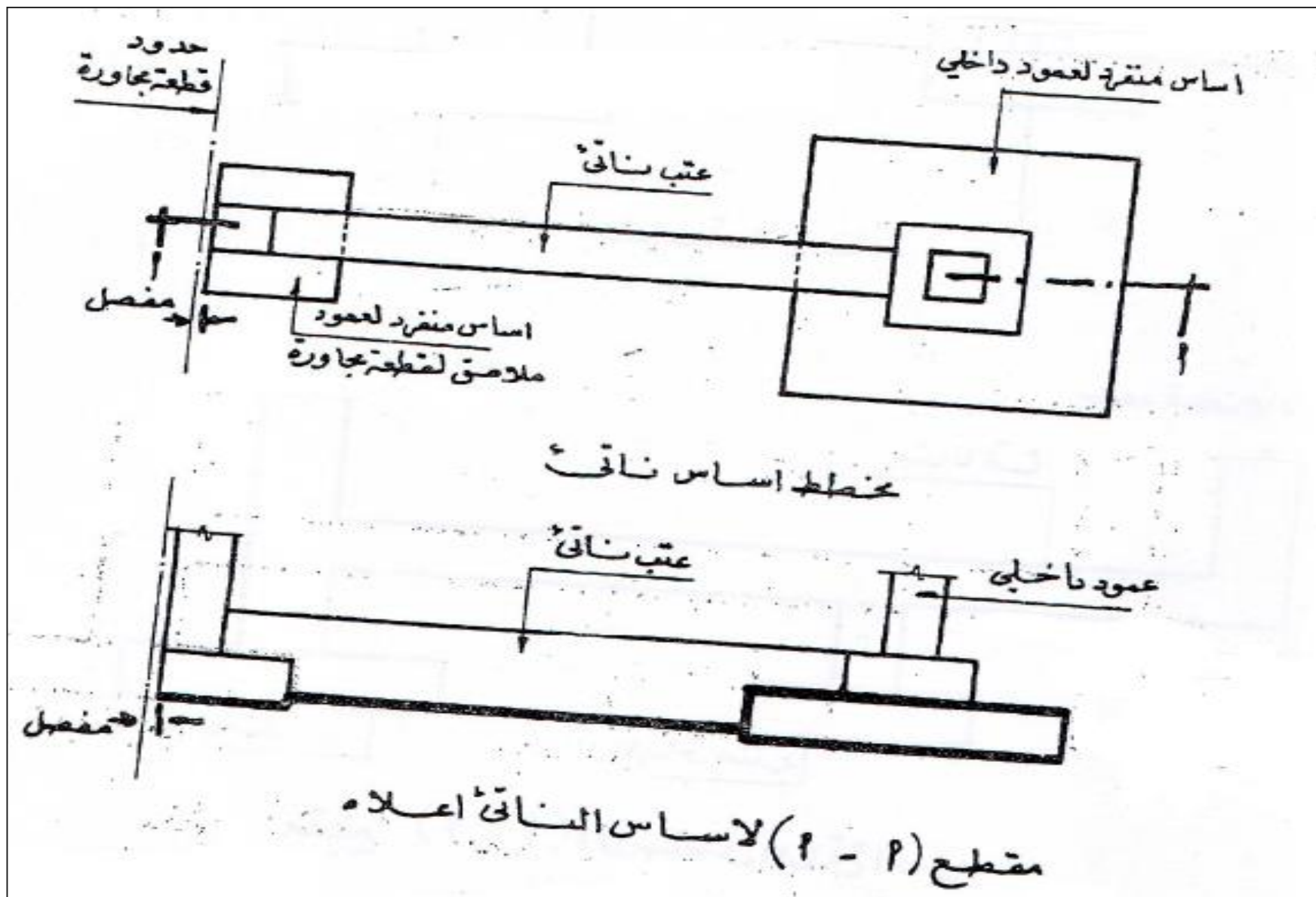


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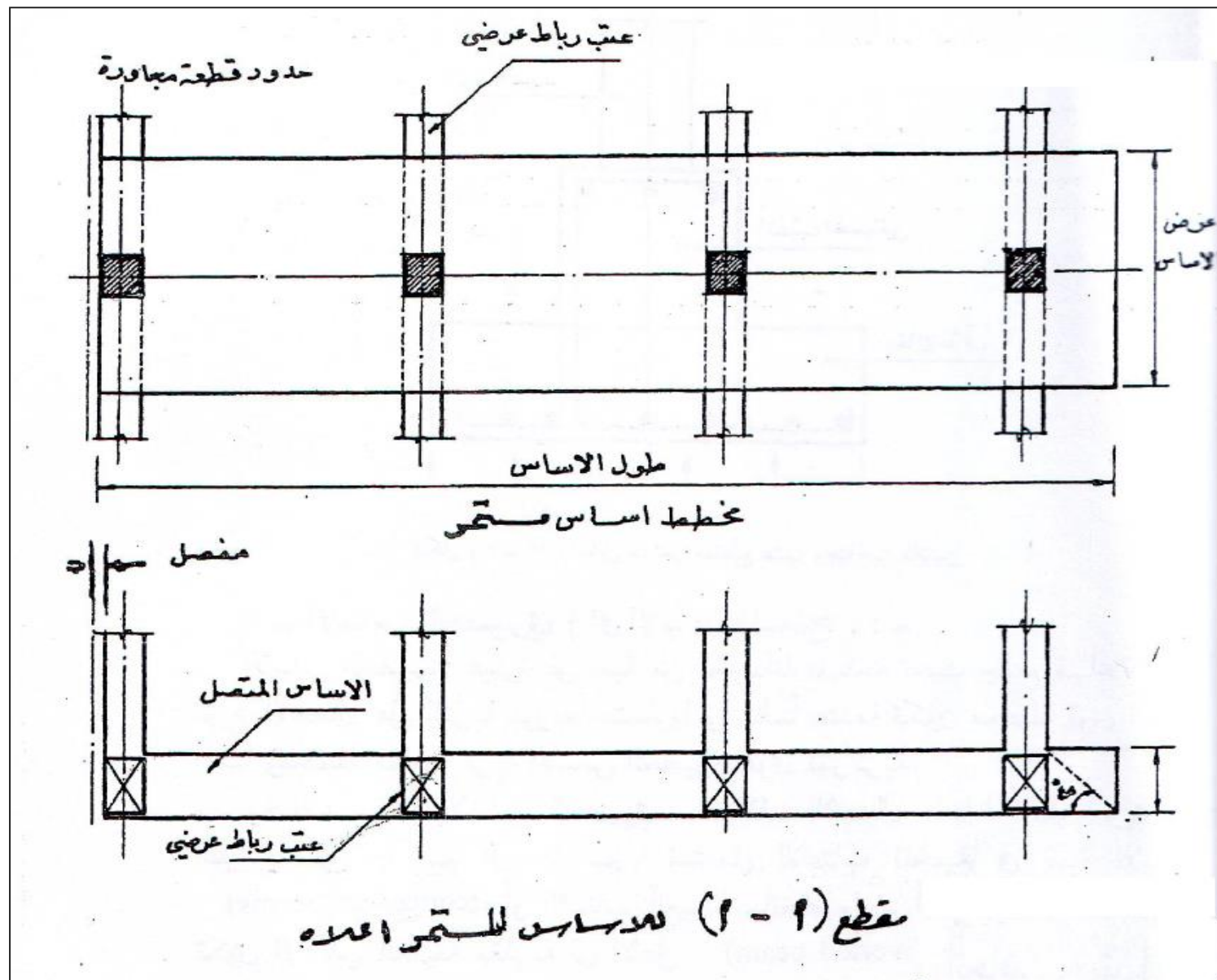
5-Cantilever footing:

The cantilever foundation is two single foundations connected by a Beam cantilever beam of reinforced concrete. The cantilever lintel transports the load of the outer shaft that has an asymmetric single base to the base of the inner shaft that has an asymmetric single base to the base of the inner shaft that has a symmetrical single basis. The cantilever foundation of the outer beams works when adjacent to the boundaries of adjacent buildings. As shown in Figure:



6-Continuous foundation:

The continuous foundation is a foundation for several columns located on the same axis. The concentrated weights of these columns are distributed over a rectangular area of fixed width and length equal to the sum of the lengths of the columns centers plus adding an appropriate length in one or both ends where it is not possible to add a length at the end of which the column is adjacent to the borders of an adjacent piece. As shown in Figure.



7- Raft foundation:

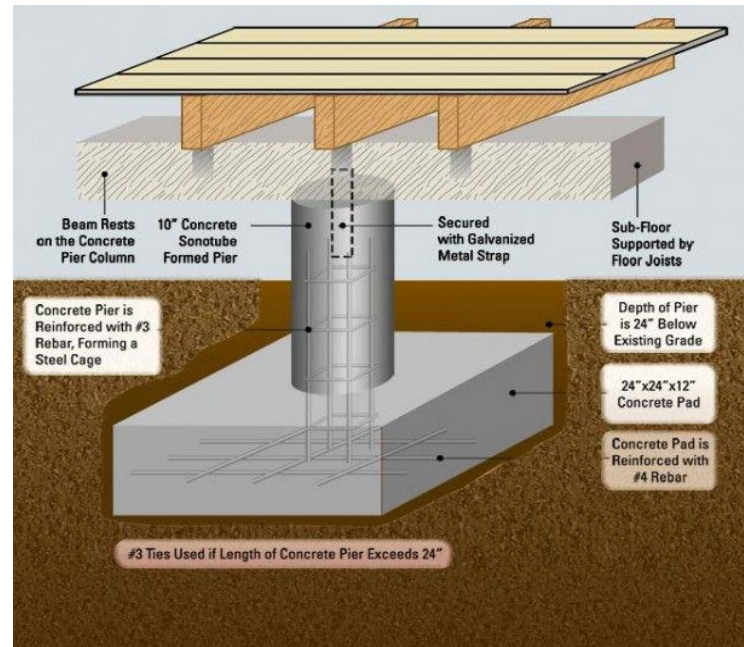
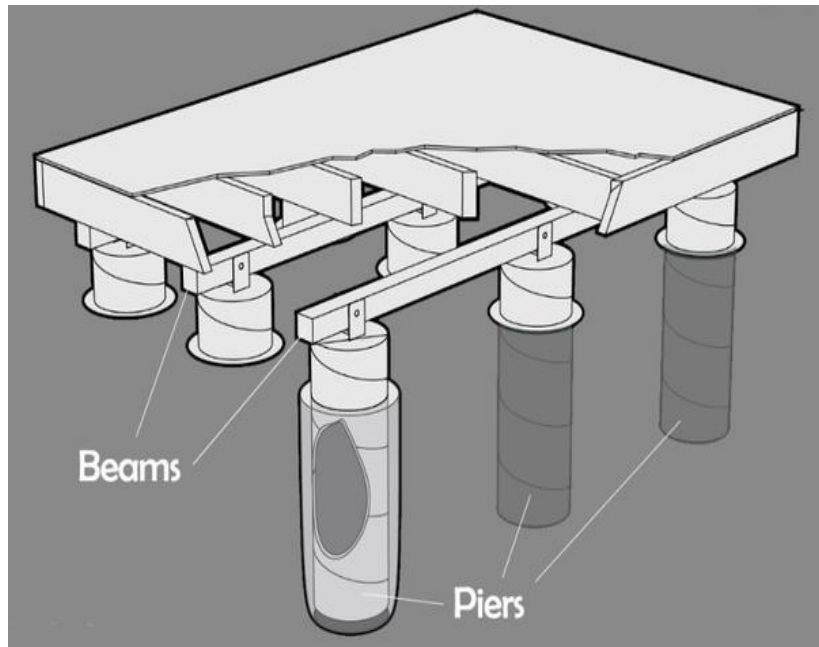
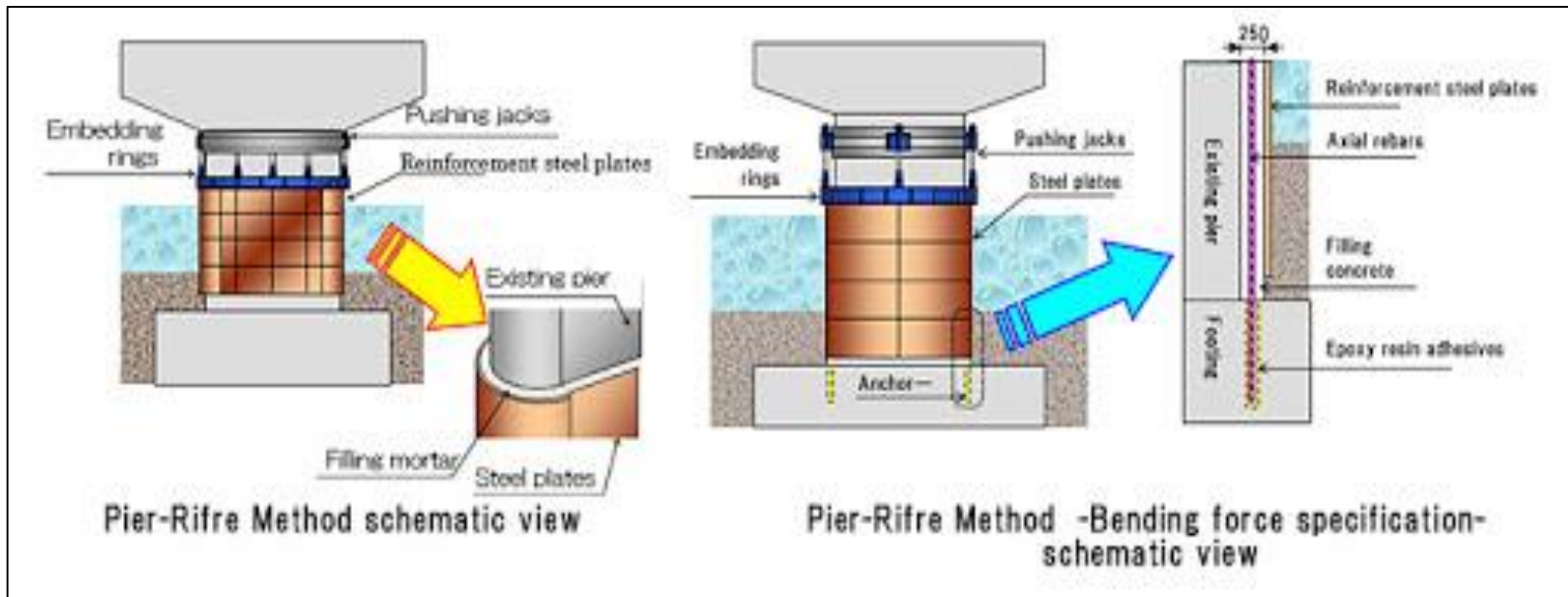
It is a cast of reinforced concrete under all the area of structure. The loads on the soil are distributed evenly and uniformly when the result of the strengths of the construction loads and the yield of the soil resistance of the Raft foundation is a central force. The thickness of the foundation ranges from (20) cm to (60) cm. And the Figure shows different types of Raft basis.

8- Tanked basement:

This foundation is used in heavy buildings that have a limited site area and their soils in the upper layers are weak and do not resist the loads imposed on them, which necessitates going deep to the level of the soil suitable for bearing. The acceptable descent for this type of foundation is (7.5 - 15) cm, and it is considered high cost and structural difficulties.

9- Pier and Beam Foundation:

The foundations of the supports consist of one or two supports, or sections with different shapes, including square, circular, or rectangular or oval in relation to some water installations such as dams and bridges so that the water runs smoothly at the support while noting that the support is located on the layers of the soil with high tolerance and then the support rises to above Ground level to move loads from columns and footboards of large spaces.



10 - Piles Foundations:

It is the part of the structure that is usually below the ground level and one of its primary tasks is to transfer the weight of the structure to the layers of soil capable of bearing its weight and the piles are considered the basis for the structure.



Settlement Foundations:

The Settlement of the foundations is a drop in the structure as a result of the movement of the ground water during the pores of the soil due to the gravity of the structure, the descent is greatly affected by the presence of groundwater, especially if its level is variable during the seasons of the year causing the movement of the soil particles , which affects its porosity and its resistance to compression under the influence of the projected loads. The Settlement is classified into the most important types:

1. Uniform settlement: which occurs in all departments of structure in the same amount. This type does not cause harm to the safety of the structure if it is within the permissible limits.

2. Differential settlement : It is a settlement that is not equal in all sections of the foundation. When it is greater than the permissible, it can cause damage to the structure.

3. The immediate settlement: It is that which occurs during a small period of time during the creation and shedding of loads. Accordingly, the risk is low.

4. Total settlement: The final settlement after a long period of time depends on many factors, including soil quality, amount of loads, groundwater level, and others.

QUESTIONS OF THIRD LECTURE

Q1/ What is the meaning of Foundation? And what are the factors that effecting in **foundation depth**?

Q2/ Why Before beginning any structural of the facility, an on-site **inspection of the soil** by an accredited engineering laboratory is required for design.?

Q3/ Define each of the following type of foundations (with drawing):

(Wall footing, Stepped footing, Strip footing, Isolated footing, Combined Footing, Continuous foundation, Raft foundation, Tanked basement, Pier and Beam Foundation, Piles Foundations).

Q4/ What is the meaning of settlement and what are its types?

Q4/ What the meaning of Strip footing and what are its advantages ?



Thanks For Your Listening