



WRE 214:

Lecture One

Foundations and piles

Pile foundation :

- Introduction
- Use of piles
- Selection of type of pile
- Types of piles
- Causes of failure of pile



Types of foundation: أنواع الأسس

- Shallow foundation الأسس الضحلة
- Deep foundation الأسس العميقة
 - Pile foundation أسس الركائز
 - Cofferdam foundation أسس مشابهة للسدود
 - Caissons foundation الأسس الصندوقية



What is pile ? ماهية الركيزة

- A pile is a slender structural member made of concrete, steel, wood or composite material.
- A pile is either driven into the soil or formed in-site by excavating a hole and filling it with concrete.

Pile foundation

- Pile foundation is that type of deep foundation in which the loads are taken to a low level by means of vertical members which may be

- * Timber خشبية
- * Concrete خرسانة
- * Steel الحديد

What are the most important uses of the piles ?

The most important uses of the piles in construction work are for the following cases:

1. The load of the super-structure is heavy and its distribution is uneven.
2. The top soil has poor bearing capacity and the soil is weak, it does not resist the loads distributed to it through other types of foundations.
3. The subsoil water is high so that pumping of water from the open trenches for the shallow foundation is difficult and uneconomical.
4. Large fluctuation in subsoil water level.
5. The structure is situated on sea shore or river bed, where there is danger of scouring action of water.
6. Canal or deep drainage line exist near the foundation.
7. For foundation of transmission towers and off-shore platforms which are subjected to uplift forces.

8- When the soil is clayey with shrinkage and seasonal swelling due to changes in soil moisture and groundwater movement in its layers.

9- When the structure is above the water surface, such as docks and water outlets.

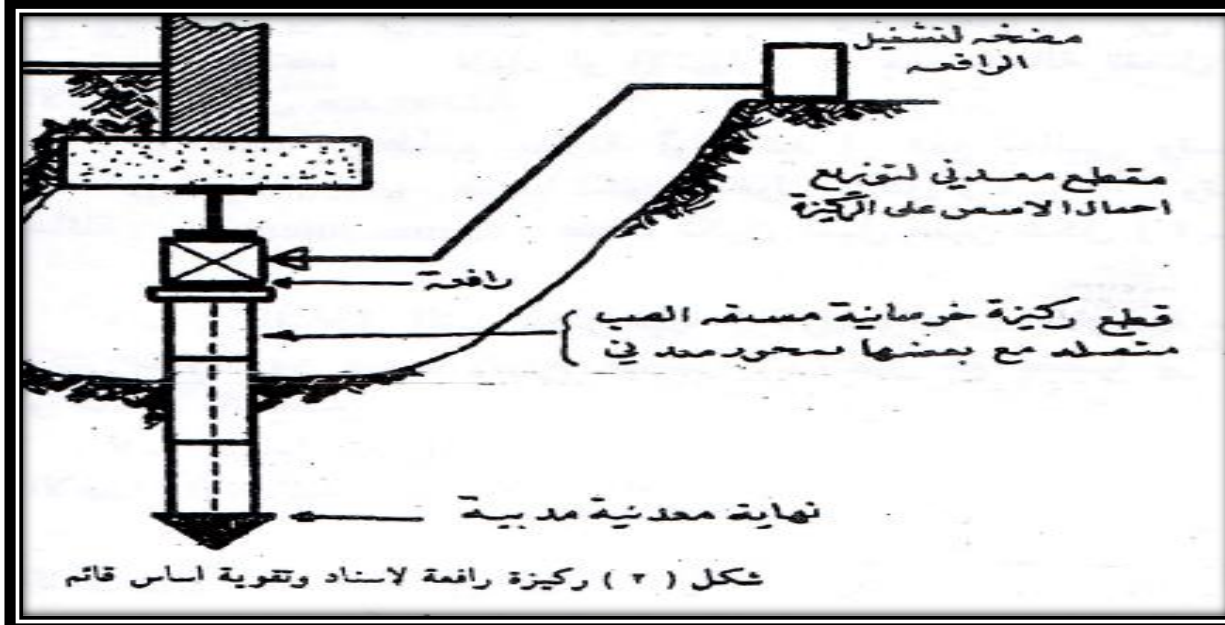
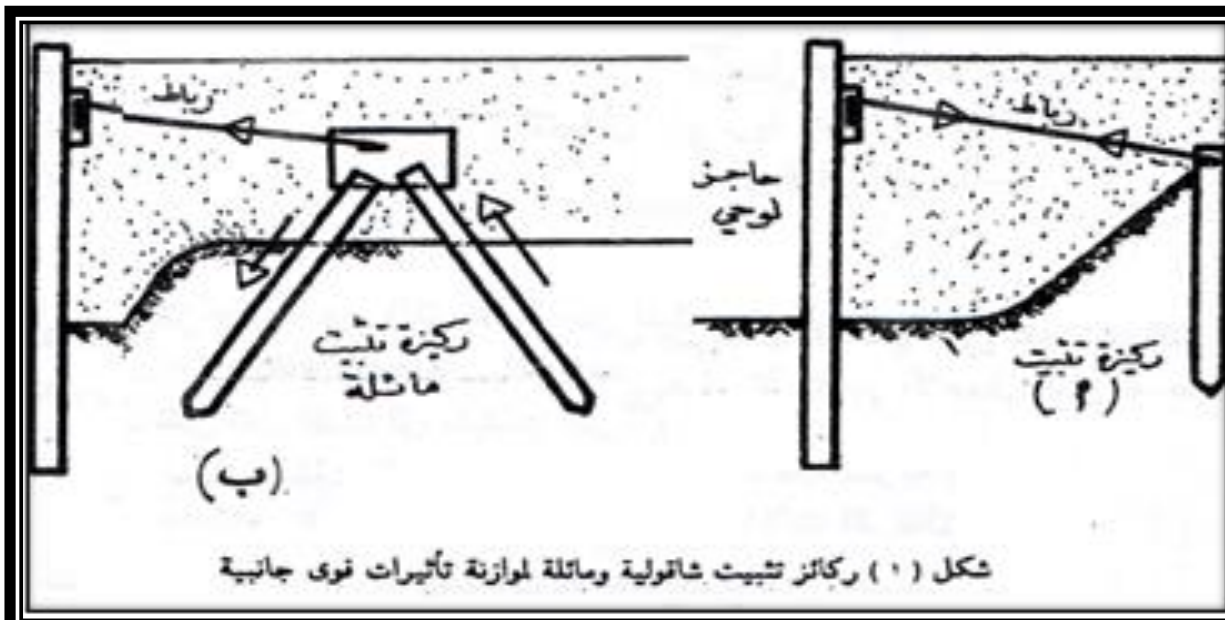
10- When the foundations of the other types cannot be dug deep, because there are adjacent buildings with foundations close to the surface of the earth so that if the new foundation is dug, the adjacent building will be exposed to cracking, descending and collapse.

11- When it requires supporting and strengthening weak foundations using jacked piles.

12- When it requires resistance to side loads resulting from pushing soil or water reserves where sheet piles are often used.

13- In regions where earthquakes and earthquakes abound, where the piles are more resistant than others, and they are distributed in groups that communicate with each other by reinforcing ligaments in one or two directions.

14- When it requires balancing the forces of tension, pushing sideways, and they are called anchoring piles when they are vertical (vertical) and are called diagonal anchoring pillars when they are formed with a certain inclination.



What are Factor Affecting Selection Of Type Of Piles? ماهي العوامل المؤثرة على اختيار نوع الركيزة

1. Nature and type of structure
2. Location
3. Material, equipment and fund availability
4. Type of soil and its properties
5. Ground water table
6. Durability of pile
7. Length and number of pile
8. Case study of adjacent building
9. Facility for pile driving
10. Erosion of soil near structure

Classification of Piles: تصنيف الركائز

A. Based on function اعتماداً على أدائها

B. Based on materials اعتماداً على مادتها

C. Based on method of installation اعتماداً على طريقة وضعها

A. Based on function :

1. End bearing Pile

2. Friction Pile

3. Compaction Pile

4. Tension Pile

5. Anchor Pile

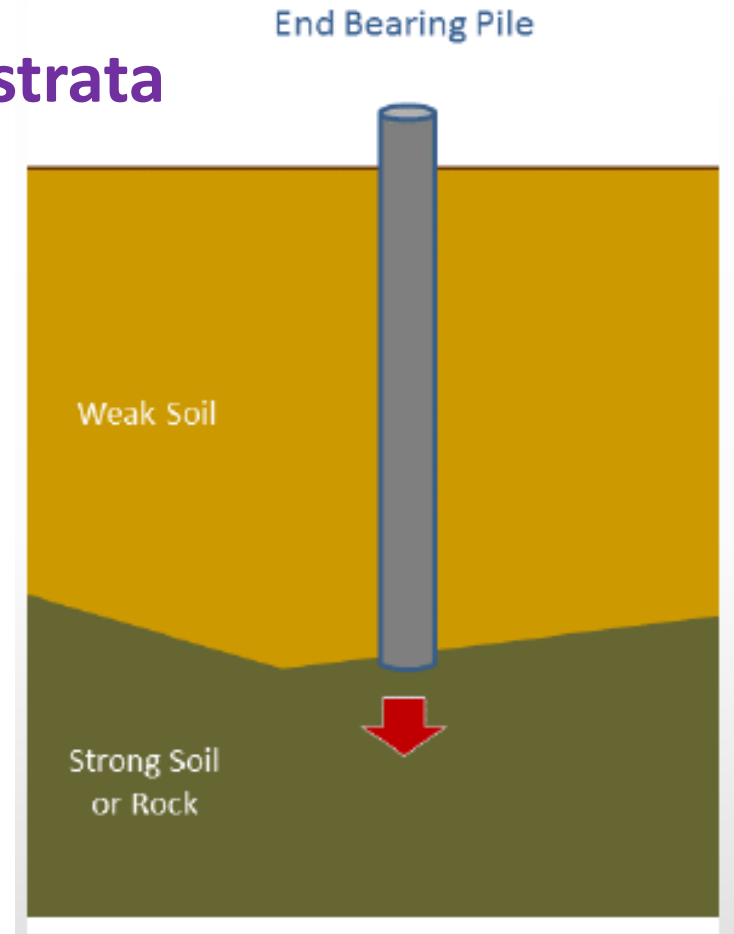
6. Fender(Guard) Pile

7. Better Pile

8. sheet Pile

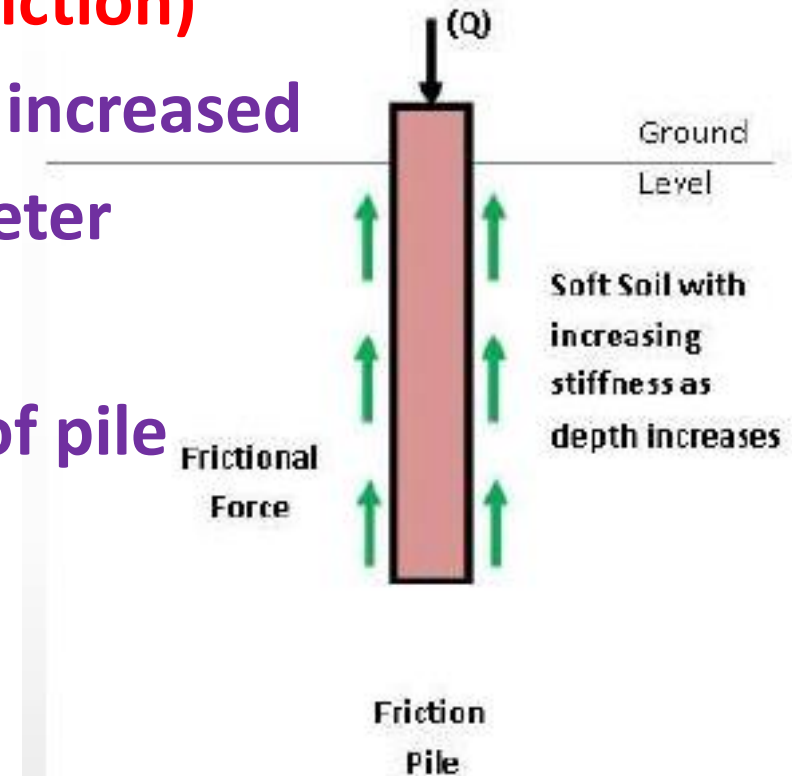
End bearing Pile ركيزة تحمل طرفية

- Penetrate through the soft soil
- Bottom or tips rest on hard strata
- Work as **column** تعمل كعمود
- For this pile $Q_u = Q_p$
where, Q_u = ultimate load
 Q_p = Pile load



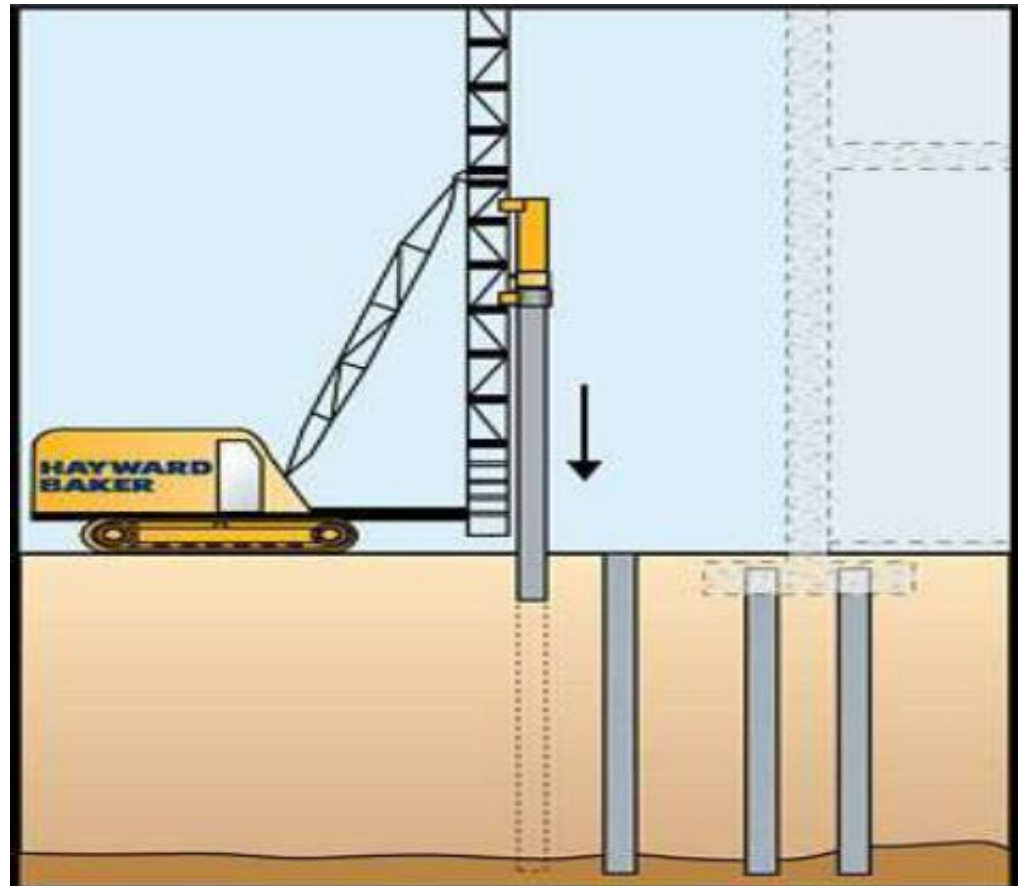
Friction Pile : ركيزة احتكاك

- Loose soil extend to a greater depth
- Pile are driven at depth when **friction resistance** developed **equal to load**
- In that case $Q_u = Q_s$ ($Q_s =$ skin friction)
- Total friction resistance can be increased
 - Increasing length and diameter
 - Making Pile surface rough
 - Placing closely or grouping of pile



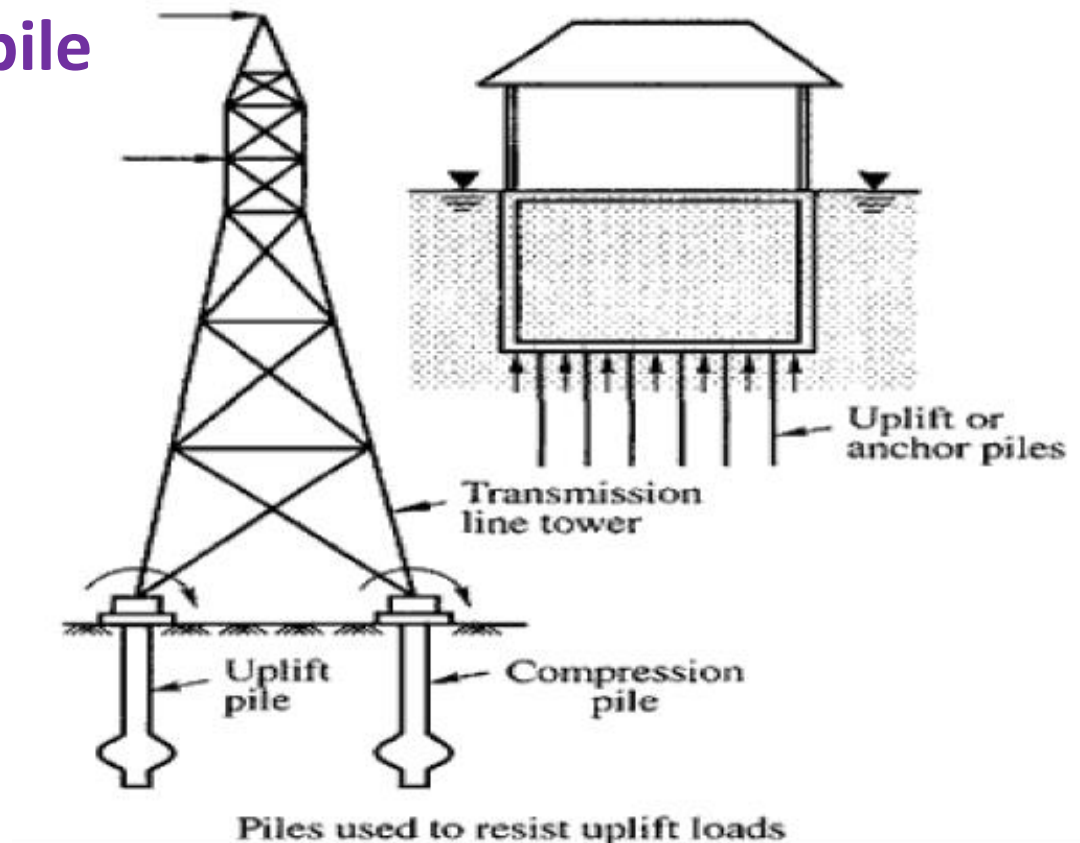
Compaction Pile ركيزة حدل (رص)

- Pile do not carry any load
- For increase the bearing capacity of soil



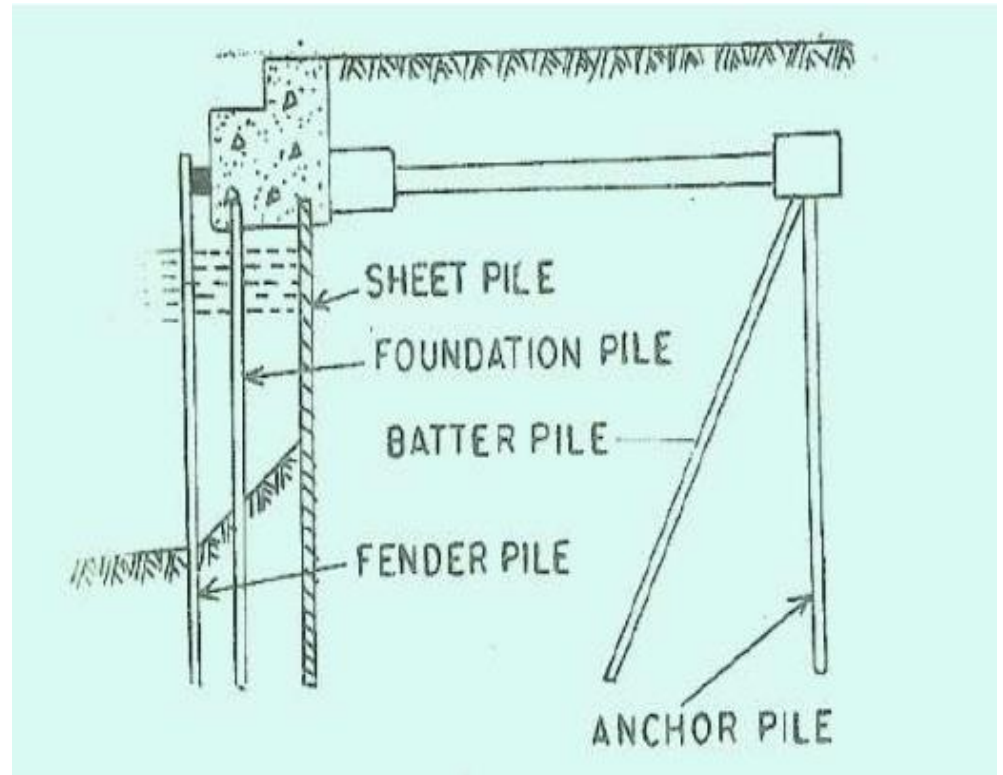
Tension pile

- When structure subjected to uplift due to hydrostatic pressure or over turning moment
- Also known as uplift pile



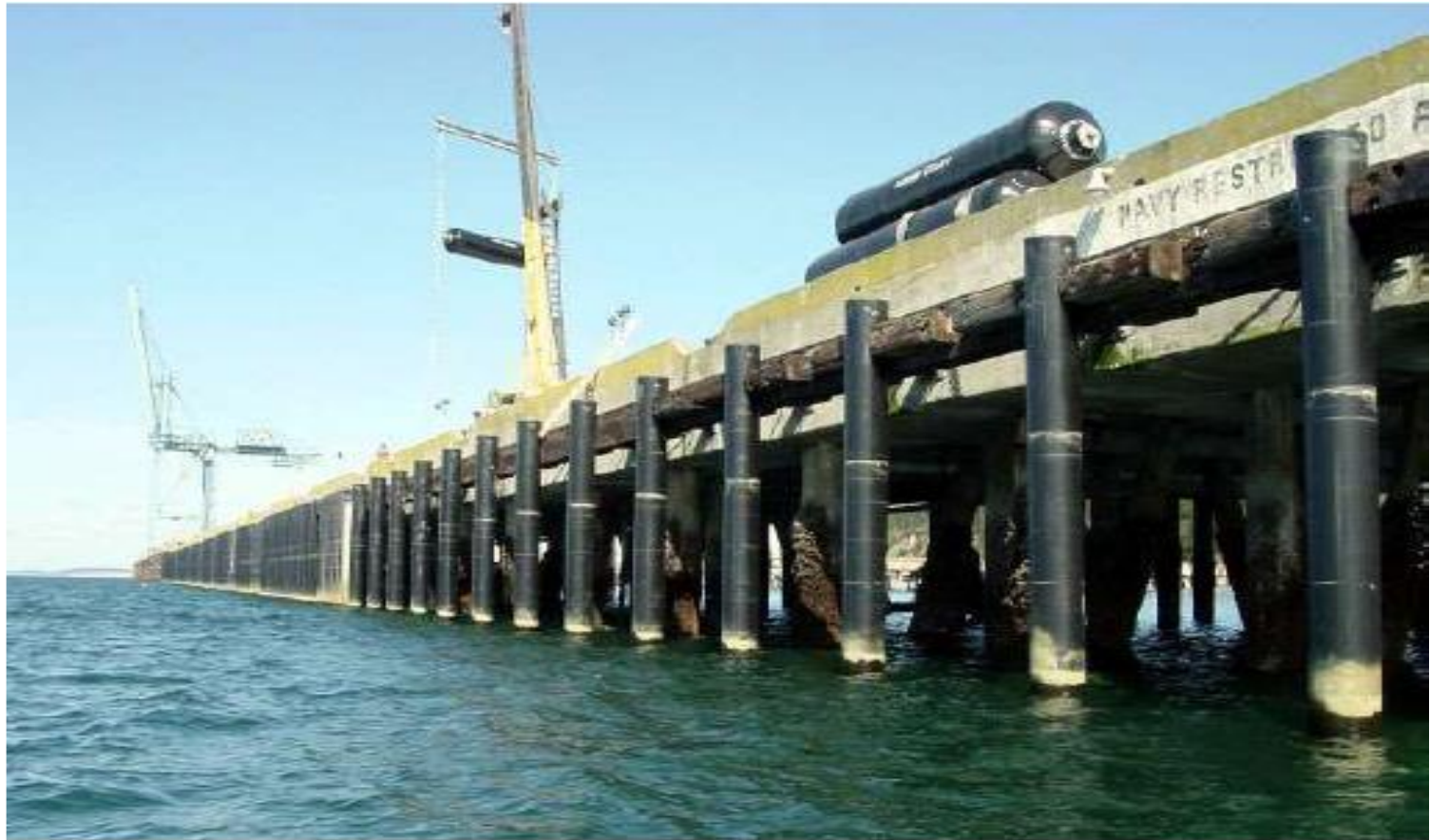
Anchor piles

- These provided anchorage against the horizontal pull from sheet pulling or any other pulling.



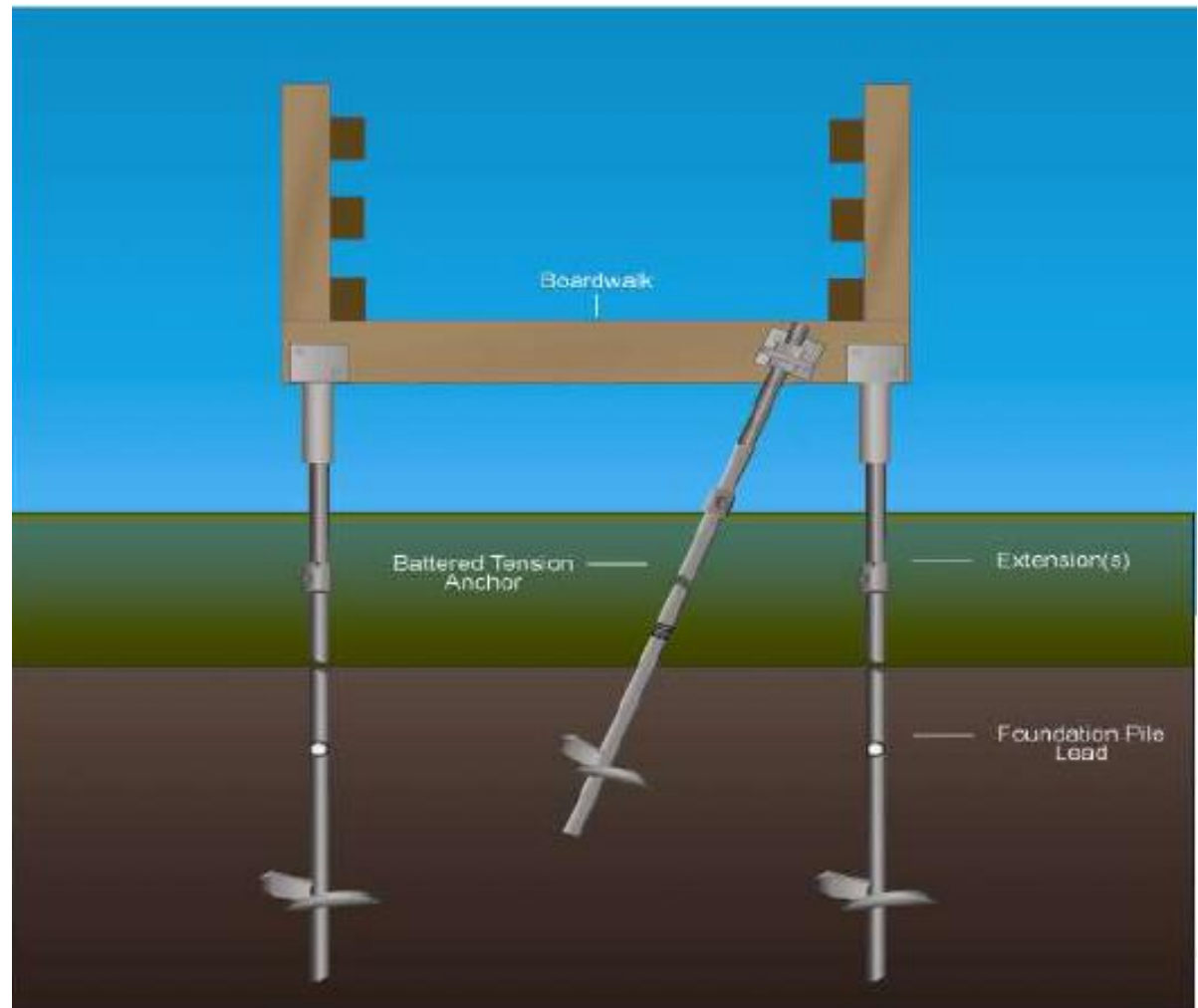
Fender pile

- These are used to protect water front structures against impact from ships or other floating objects.



Better(Recovered) Pile

- They are used for resist large horizontal forces or inclined forces.



Sheet Pile: الرقائق الصفائحية

- They are used as bulk heads or as impervious cutoff to reduce seepage and uplift under hydraulic structures.
- Sheet pile is classified as
 1. Concrete sheet piles
 2. Steel sheet pile
 3. Timber sheet pile



Classification Based on Pile Material

- Concrete piles ركائز خرسانية
- Steel piles ركائز معدنية (حديدية)
- Timber piles ركائز خشبية
- Composite pile ركائز مركبة
- Sand pile ركائز رملية

Concrete Piles

- Pre cast piles ركائز خرسانية مسبقة الصب
- Cast-in-situ piles ركائز خرسانية صب موقعي
- Pre stressed piles ركائز خرسانية مسبقة الاجهاد



Pre Cast Concrete Pile : ركائز خرسانية مسبقة الصب

- It is those which are manufactured in factory or at a place away from the construction site and then driven into ground at the place required.
- It requires heavy pile **driving machinery**.
- It may be square, octagonal or circular in cross section.
- Size of pile vary from **30 cm to 50 cm in cross section** and up to **20 m or more length**.
- Grade of concrete should be **M20**.

Cast In Situ:

What are the Stages of work in situ concrete piles?

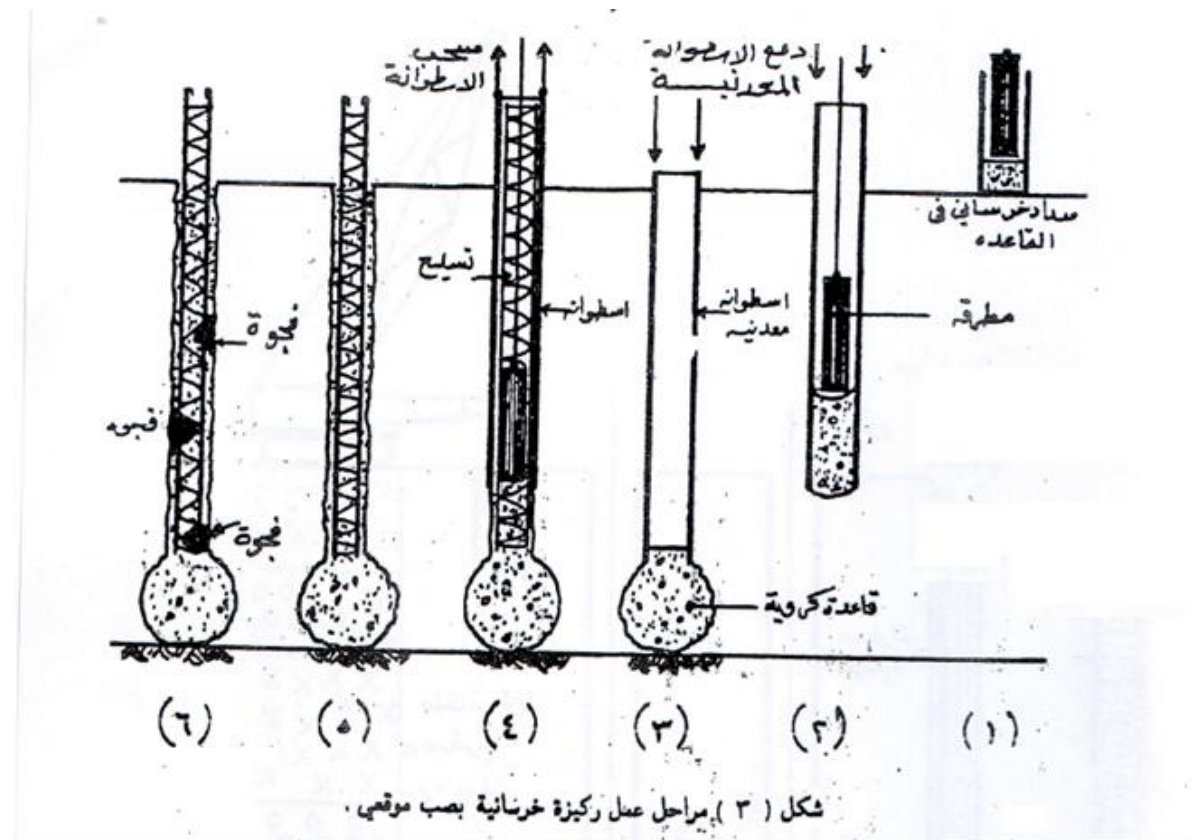
- A bore is dug into the ground by inserting a casing.
- Bore is filled with cement concrete after placing reinforcement.
- The casing be kept in position or it may be withdraw.
- The piles with casing are known as cased cast in situ concrete pile.
- The piles without casing are known as uncased cast in situ concrete pile.

What are the Stages of work in situ concrete piles with Spherical base its diameter equal 3 times piles diameter ?

1. A charge of zero-slump concrete is poured into the bottom of a steel driving pipe that is placed vertically on the ground. A diesel-operated drop hammer is then driven on the concrete, forming a watertight concrete plug.
2. The concrete plug is driven into the ground by the drop hammer. The pipe is also dragged into the ground due to friction developed between the steel and the concrete.
3. When the desired depth is reached, the pipe is held in position by leads—structures which guide and align the pile and hammer. The hammer is then applied to the concrete, driving it outwards through the bottom of the pile and forming a mushroom-shaped base.

4. At this point, a cylindrical rebar cage can be driven into the concrete if supplementary reinforcement is desired.

5. Additional charges of concrete are added and driven while the steel casing is simultaneously pulled up until the shaft of the pile is formed.



Cased Piles

- Raymond piles
- Mac Arthur piles
- BSP base driven piles
- Swage piles
- Button bottom piles



Uncased piles

- Simplex piles
- Franki piles
- Vibro piles
- Pedestal piles
- Pressure piles



Steel Piles

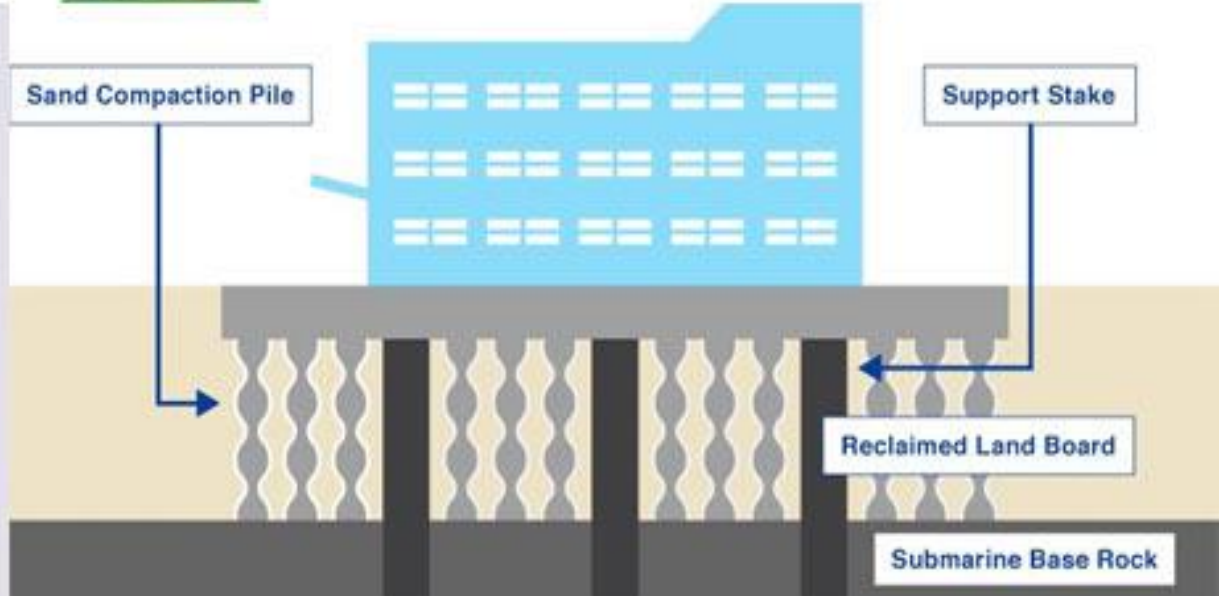
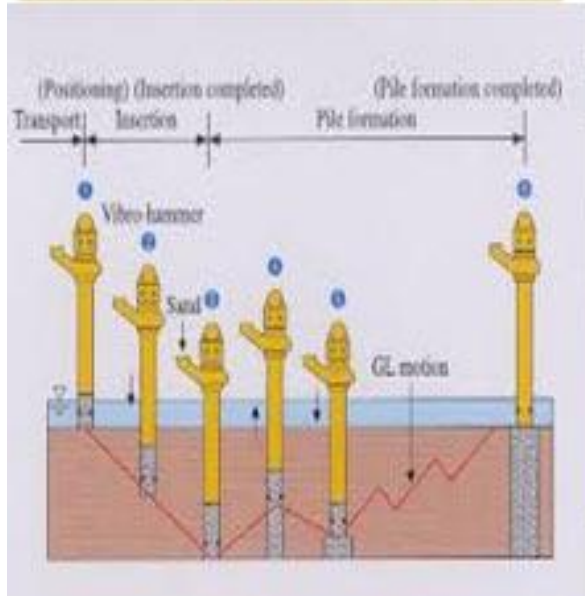
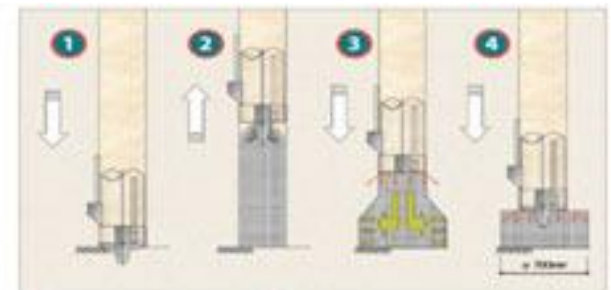
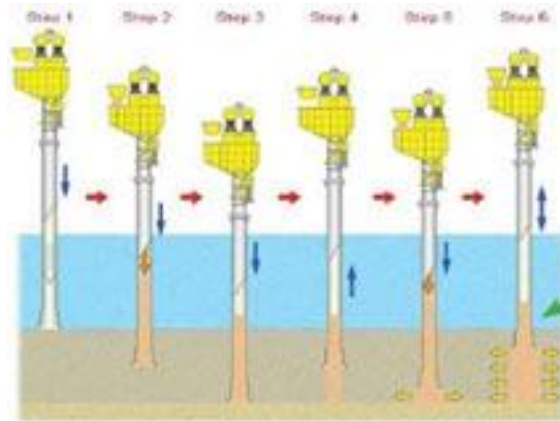
- Commonly used steel piles are;
 - * H-piles
 - * Box piles
 - * Tube piles



Sand Piles

- These pile are formed by making hole in ground and fill with the sand and well rammed.
- The sand to be used should be moist at time of placing.
- Bore hole diameter usually 30 cm. length of sand pile is kept about 12 times its diameter.
- The top of sand pile is filled with concrete.
- Sand pile are placed at 2 to 3 m spacing.
- Load test should be carried out determining the bearing capacity of sand pile.

- Properly compacted sand pile can carry load up to 100 tone/m² or more.



Cause s Of Failure Of Pile: أسباب فشل الركائز

Most common causes of failure of piles:

- Absence of statistical data of nature of soil strata
- Load coming on pile is high than design load.
- Bad workmanship
- Attack by insets on wood.
- Breakage due to over driving (timber pile).
- Buckling of pile.
- Damage due to absence of protective cover.
- Improper type of pile, method of driving, classification of soil.
- Insufficient reinforcement in case of R.C.C
- Misinterpretation of result from pile load test.
- Wrong formula use for determining load bearing capacity.

Pile Cap:

- To protect the top of pile from blow of hammer on top, pile cap is provided.
- Pile carry load from structure and distribute it to various pile.
- Generally, Pile cap is made of steel. Thickness and size of cap is depend on shape and size of pile hammer.
- Pile should penetrate into the cap at least 10 cm length.
- For group pile a common R.C.C. is provided for all the pile.

QUESTIONS OF LECTURE FOUR(H.W)

Q1/What is the pile and what are its Classification based on function?

Q2/What is the pile and what are its Classification based on Pile Material?

Q3/What are Factor Affecting Selection Of Type Of Piles?

Q4/What are the most important uses of the piles?

Q5/What are the Stages of work in situ concrete piles?

Q6/What are the Stages of work in situ concrete piles with Spherical base its diameter equal 3 times piles diameter?

7/What are the Causes of Failure of Pile?

Q8/What is pile cap? explain briefly?

Q9/What is Sand Piles? explain briefly?

Q10/What is Pre Cast Concrete Pile? explain briefly?

Q11/What is Sheet Pile? explain briefly?

Q12/What is Friction Pile? explain briefly?



Thanks For Your Listening