4.1 CLASSIFICATION OF PILES:

Piles can be classified according to

1. The material used
2. The mode of transfer of load
3. The method of construction
4. The use and
5. Displacement of soil

1.Classification according to material used

There are four types of piles according to materials used

a) Steel piles
b) Concrete piles
c) Timber piles
d) Composite piles

a) Steel piles:

- Steel piles are generally either in the form of thick pipes or rolled steel H-section. Pipe steel piles are driven into ground with their ends open or closed. Piles are provided with a driving point or shoe at the lower end.
- Epoxy coatings are applied in the factory during manufacture of pipes to reduce corrosion of the steel pipes. Sometimes concrete encasement at site is done as a protection against corrosion. To take into account the corrosion, an additional thickness of the steel section is usually recommended.

b) Concrete piles

- Cement concrete is used in the construction of concrete piles. Concrete piles are either precast or cast in- situ. Precast concrete piles are prepared in a factory or a casting yard. The reinforcement is provided to resist handling and driving stresses. Precast piles can also be pre-stressed using high strength steel pre-tensioned cables.
- A cast in-situ pile is constructed by making a hole in the ground and then filling it with concrete. A cast in situ pile may be cased or uncased. A cased pile is constructed by driving a steel casing into the ground and filling it with concrete. An uncased pile is constructed by driving to the desired depth and gradually

withdrawing casing when fresh concrete is filled. An un-casted pile may have a pedestal.

c)Timber piles

- Timber piles are made from tree trunks after proper trimming. The timber used should be straight, sound and free from defects.
- Steel shoes are provided to prevent damage during driving. To avoid damage to the top of the pile, a metal bond or a cap is provided. Splicing of timber piles is done using pipe sleeve or metal straps and bolts. The length of the pipe sleeve should be at least five times the diameter of the pile.
- Timber piles below the water table have generally long life. However, above the water table, these are attacked by insects. The life of the timber piles can be increased by preservatives such as creosote oil. Timber piles should be used in massive environment where these are attacked by various.

d)Composite piles

- A composite pile is made of two materials. A composite pile may consist of the lower portionof steel and the upper portion of cast in-situ concrete.
- A composite may also have the lower portion of timber below the permanent water table and the upper portion of the concrete.
- As it is difficult to provide a proper joint between two dissimilar materials, composite piles are rarely used in practice.

2.Classification based on mode of transfer of load

a) Based on the mode of transfer of loads, the pile can be classified into three categories:

1. End bearing piles
2. Friction piles
3. Combined end bearing and friction piles

i. End bearing piles

- End bearing piles transmit the loads through their bottom tips. Such piles act as columns and transmit the load through a weak material to a firm stratum below. If bed rock is located within a responsible depth, piles can be extended to the rock.

- The ultimate capacity of the pile depends upon the bearing capacity of the rock. If instead of bed rock, a fairly compact and hard stratum of soil exists at a reasonable depth, piles can be extended a few minutes' piles are also known as "point-bearing piles".
- The ultimate load carried by the pile (Q_u) is equal to the load carried by the point or bottom end (Q_p)

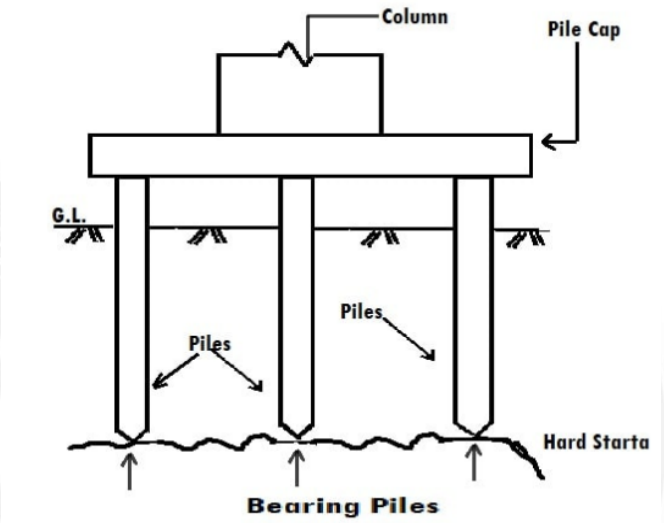

Fig1.End bearing pile

[Fig1 https://www.civilknowledges.com/pile-foundation/]

ii. Friction piles

- Friction piles do not reach the hard stratum. These piles transfer the loads through skin friction between the embedded surface of the pile and the surrounding soil. Friction piles are used when a hard stratum does not exist at a reasonable depth.
- The ultimate load (Q_u) carried by the pile is equal to the sum of the load carried by the pileis equal to the load transferred by skin friction (Q_s).
- Friction piles are known as floating piles as these do not reach the hard stratum.

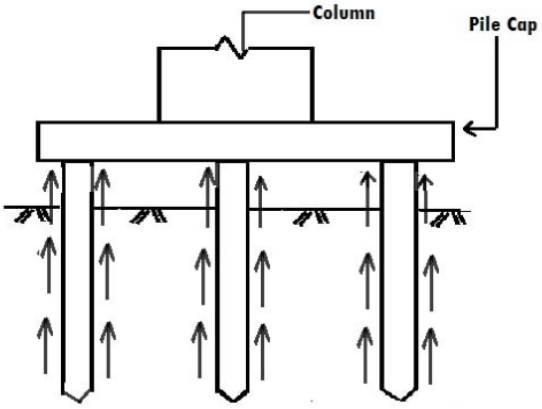

Fig2.FrictionPile

[Fig2 https://www.civilknowledges.com/pile-foundation/]

iii. Combined end bearing and friction piles

- The piles transfers load by a combination of end bearing at the bottom of the pile and friction along the surface of the pile shaft, the ultimate load carried by the pile is equal to the sum of the load carried by the pile point (Q_p) and the load carried by the skin friction(Q_s).

3) Classification based on method of installation

Based on the method of construction, the piles may be classified into the following 5 categories

i. Driven pile
ii. Driven and cast in situ piles
iii. Bored and cast in situ piles
iv. Screw piles
v. Jacked piles

i)Driven piles

These piles are driven into the soil by applying blows of a heavy hammer on their tops.

ii)Driven and cast in situ piles

These piles are formed by drawing a casing with a closed bottom end into the soil. The casing is later filled with concrete. The casing may or may not be withdrawn.

iii)Bored and cast in situ pile

These piles are formed by a hole into the ground and then filling it with concrete.

iv)Screw piles

These piles are screwed into soil.

v)Jacked piles

These piles are jacked into the soil by applying a downward force with the help of a hydraulicjack.

4)Classification based on use

The piles can be classified into the following 6 categories depending upon their use.

i. Load bearing piles
ii. Compaction piles
iii. Tension piles
iv. Sheet piles
v. Fender piles
vi. Anchor piles

i)Load bearing piles

These piles are used to transfer the load of the structure to a suitable stratum by end bearing by friction or by both.

ii)Compaction piles

These piles are driven into the loose granular soil to increase the relative density. The bearingcapacity of the soil is increased due to densification caused by vibrations.

iii)Sheet piles

Sheet piles forms a continuous wall or bulk head which are used for retaining earth or water.

iv)Fender piles

Fender piles are sheet piles which are used to protect water front structures from impact of ships and vessels.

v)Anchor piles

These piles are used to protect anchorage for anchored sheet piles. These piles provide resistant against horizontal pull for a sheet pile wall.

5)Classification based on displacement of soil:

Based on the volume of the soil displacement during installation the piles can be classified into 2 categories

1. Displacement piles
2. Non- displacement piles

1.Displacement piles

All driven piles are displacement piles as the soil is displacement laterally when the pile is installed. The soil gets densified. The installation may cause heaving of the surrounding ground. Precast concrete pile and closed end pipe pile are high displacement piles. Sheet H- piles are low displacement piles.

2.Non- displacement piles

Bored piles are non- displacement piles. As the soil is removed when the hole is bored, there is no displacement of the soil during installation. The installation of these piles causes very little change in the stresses in the surrounding soil.

Use of pile foundation is preferred:

- The load coming from the user structure is heavy and its distribution is uneven.
- The structure is located on a sea-shore or river bed when the foundation likely to affected by the scouring action of water. Hence they are useful in marine structures.
- The pile foundation to uses for the structures in the area where canals, deep drainage lines, etc. are to construct near the foundation.
- The top soil has a poor bearing capacity.
- The construction of the raft foundation or grillage foundation is likely to very costly or is practically impossible.
- The sub-soil water level is high so that the pumping of water from the open trenches for the shallow foundation is difficult and uneconomical.

Selection of Foundation:

The selection of pile foundation depends on the soil investigation data received from soil exploration bore holes at different depths. Selection of appropriate pile for the desired strength and requirement plays an important role in cost reduction and efficiency. In this article we discuss about the selection of type of piles based on soil conditions.

Factors affecting the selection of Pile Foundation

- The factors that affect the selection of pile foundations are,
- Soil conditions
- Loads from structures
- Nature of loads
- Number of piles to be used
- Cost of construction
- Type, size, and weight of the structure to be supported.
- Physical properties of the soil at the site.
- Depth to a stratum capable of supporting the piles.
- Possibility of variations in the depth to a supporting stratum.
- Availability of materials for piles.
- Number of piles required.
- Facilities for driving piles.
- Durability required.
- Types of structures adjacent to the project.
- Depth and kind of water, if any, above the ground into which the piles will be driven.