Foundations (Cont.)

10- Piles:

This is an element of construction placed in the ground either vertically or slightly inclined to:

1. Increase the load carrying capacity of the soil.
2. Support the layer of subsoil subject to side force
3. Compact the subsoil

The reasons for use piles as foundations are:

1. When the soil is poor and cannot carry the load with other types of foundation
2. When the soil is clay and has seasonal shrinkage and swell according to the moisture content and ground water movement
3. When the structure construct above water like water intake
4. When we cannot excavate deep because of the existing building foundation close to new building
5. When we need to equilibrium to tensile or lateral forces then the piles called (anchor piles) when it is vertical and (batter piles) when it is with slope
6. For earthquake region
7. When ground water not deep from natural ground level
8. When it need to support existing building foundation by used jacked piles
9. When it need to support side pressure like soil or water by used sheet piles

Classification of piles:

Piles can be classified according to:

1. The method it transmit load to subsoil, then it classified to:
   a. Friction pile: These are designed to transmit the loads by the frictional force existing between the sides of the pile and the ground.
   b. Bearing pile: These are transmitting the super-imposed load to stronger strata below.
   c. Combine work pile: These are transmitting the loads by the frictional force and carry stronger strata below. Most of the piles designed like this type.
2. Material used:
   a. Wooden piles: Usually timber trees are used as piles after bark and the branches are removed.
Chemical preservation or mechanical protection is commonly provided as a treatment of wooden piles.

Advantages of wooden piles:
   i. They are less expensive as most of the timber available can be used after suitable treatment.
   ii. They can be made in longer lengths by joining the individual pieces easily.
   iii. Cutting of these piles is very easy.
   iv. They can be driven quickly and with lighter machinery.

Disadvantages:
   i. They deteriorate by the action of water or insects.
   ii. They have a lesser load bearing capacity.
   iii. Whenever long piles are to be driven, it if necessary to join a number of small individual units and this entails lot of joining work and the cost is high.

b. Concrete piles: Concrete piles can be broadly classified into two types:
   i. Precast concrete piles: These are cast at a suitable place, cured and afterwards driven like a timber piles.
   ii. Cast-in-situ piles: These are cast at the place where they have to rest finally. They may have a casting which also remains intact.

  Precast concrete piles: Precast concrete piles are commonly of square section with chamfered corners. Other shapes, e.g. octagonal types are also available. Octagonal type has a better appearance and steel reinforcement can also be placed in it easily. Whenever these piles are to be driven through hard soils, cast iron or mild steel shoes are used at the end which is driven into the soil. Generally for normal work 1:2:4 mix is used whereas for heavy loads and for driven through harder soils 1:1½:3 mix is employed.

  Precast concrete piles are constructed without taper but have pointed lower ends. Whenever tapering is desired, it should not exceed 2cm per meter length of the pile. The reinforcement consists of longitudinal bars with spiral at the top and bottom ends and suitable ties in between.

  Cast-in-situ piles: A Cast-in-situ pile is a concrete pile built in its permanent location within a hole made for this purpose. The various types of cast-in-situ piles are:
   i. Simplex pile: A hollow cylinder steel pipe is driven into the ground to the required depth. A cast iron or steel base is placed under the pipe to displace
the soil. The reinforcement is placed into the pipe, if needed. Concrete is poured to the depth about one meter into this pipe. After pouring concrete, the enclosing pipe is withdrawn to some extent. Concrete is again poured into the pipe and the pipe is withdrawn. As the casting is pulled out, the hole gets filled with concrete which act as a pile.

![Fig.3-15 Casting of simplex pile](image)

**Fig.3-15 Casting of simplex pile**

ii. Pedestal pile: The first step in the construction of this type of pile is to drive a casing and a core into the ground. The core is removed and concrete is placed to some depth inside the casing. The core is again placed and casing is pulled up by about meter while the pressure is being exerted on the concrete with the core. The concrete is rammed so as to form pedestal. The core is removed and concrete poured into casing. Finally, as the concrete get filled, the casing is withdrawn.

![Fig.3-16 Pedestal piles](image)

**Fig.3-16 Pedestal piles**
iii. Raymond pile: A thin sheet steel tapered shell is driven into the soil with a steel mandrill inside. The mandrill is removed and suitable reinforcement placed, if necessary. The shell is filled with concrete.

iv. Mac Arthur case pile: This is formed by driving into the ground a heavy steel casing in which a core is inserted. The core is removed and a corrugated steel sheet is introduced. The shell is filled with concrete and casing is withdrawn.

v. Vibro piles: Vibro piles are formed by driving a steel tube fitted with a C.I. shoe into the ground. The tube is filled with concrete and is extracted by a succession of upward pulling and downward tamping blows. The pile thus gets enlarged every time and fits in the surrounding soil securely.
Advantages of precast concrete piles:

i. Best concrete can be prepared by proper workmanship. Any defect can immediately repair.

ii. The reinforcement remains in proper position and does not get displaced.

iii. The concrete has only to withstand loads after complete curing has taken place.

iv. They can be cast before hand and a quick driving progress can be ensured.

v. They are more convenient through wet conditions.

vi. They are more suitable when a part of their length is to remain exposed.

vii. They are not affected by any other additional forces which act on them while adjacent piles are driven.

Disadvantages of precast concrete piles:

i. They are heavy and difficult to transport.

ii. Lapping of additional length means extra cost, labor and energy.

iii. They have to be heavier in section to withstand the handling stresses.

iv. The shocks of driving make them weaker.

Advantages of cast-in-situ piles:

i. There is less wastage of material as exact length of pile is cast.
ii. The time spent on curing etc. is saved.
iii. They can bear heavier loads by improving upon their cross sectional profile, e.g. Pedestal piles

Disadvantages of cast- in- situ piles:
   i. Good quality concrete cannot be easily obtained due to unusual height of dumping.
   ii. The reinforcement is liable to get displaced.
   iii. They cannot use under water.
   iv. The green concrete loses strength after coming in contact with the soil.
   v. The shells are affected by casting additional piles adjacent to them.

c. Steel Piles: Steel pile may be of I-section or hollow pipe. Because of a small sectional area, steel piles are easy to drive. The pipes are driven with open ends. Compressed air may be used to drive out the soil within the pipe and thus facilitate driving. These pipes are filled with concrete. Steel piles are mostly used as bearing piles because of their less available surface area to take the loads by frictional forces.

![Fig.3-19 Steel H-pile](image)
Another form of steel pile is the screw pile which is used in very soft soils. Shafts of screw piles can be of cast iron or mild steel.

Fig.3-20 Screw pile

Reference:

Building construction, S.K. SHARMA