

Pile Foundation

By

Venkatesh Taduvai

Introduction

- Pile foundation is a type of deep foundation. It is used where foundation work is not possible by ordinary method of open pit excavation.
- Pile foundation is one type of deep foundation. It is used where the good soil is at higher depth (10 or 15 m) or soil having low bearing capacity. Pile is also used for tall structures. In pile foundation load coming from the super structure is taken by pile cap and equally distributed in no. of piles. Pile transfers this load in to the soil.

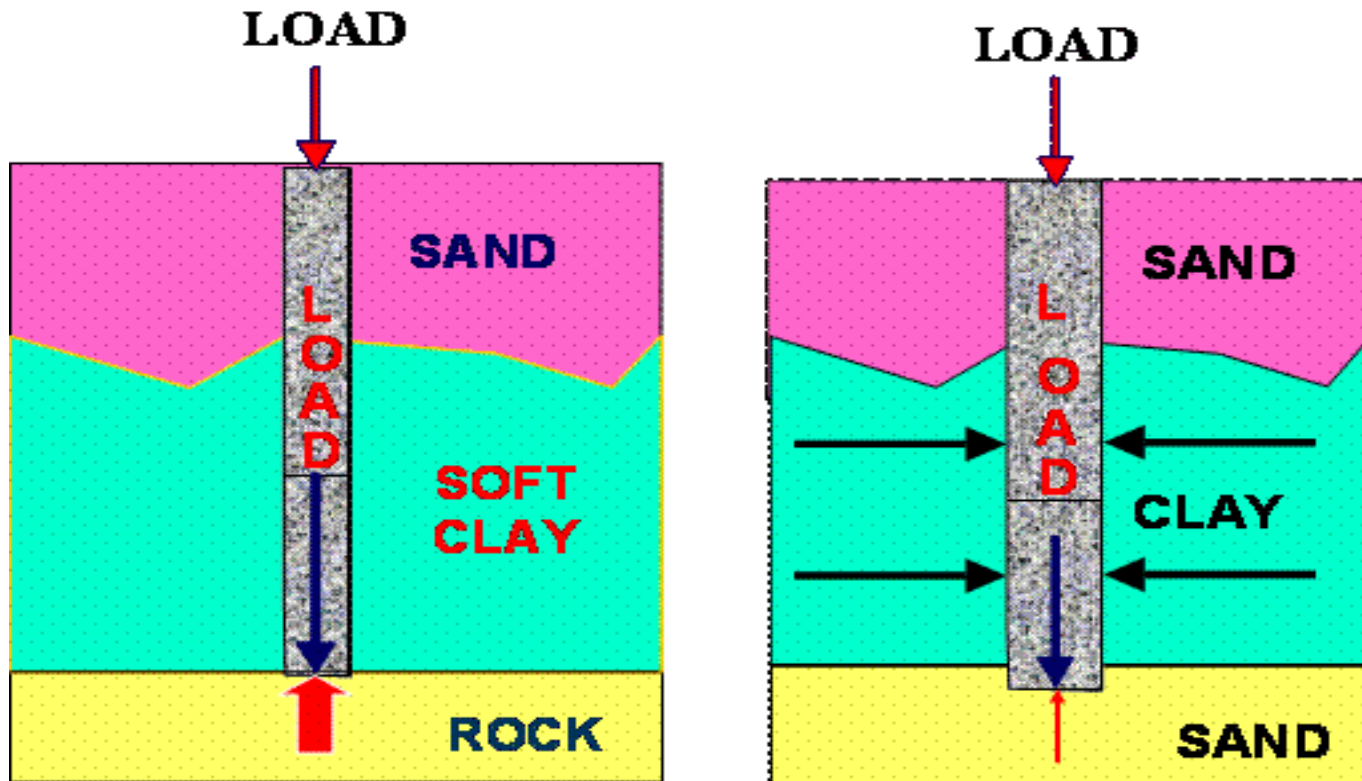
Following are the situation in which a pile foundation are used:

- ❖ The load of super structure is heavy and its distribution is uneven.
- ❖ The top soil has poor bearing capacity.
- ❖ Subsoil water level is high so that pumping of water from the open trenches for the shallow foundation is difficult and uneconomical.
- ❖ large fluctuation in subsoil water level.
- ❖ structure is situated near river bed, where there is danger of scouring action of water.
- ❖ the top soil is of expansive nature.

Classification of Piles

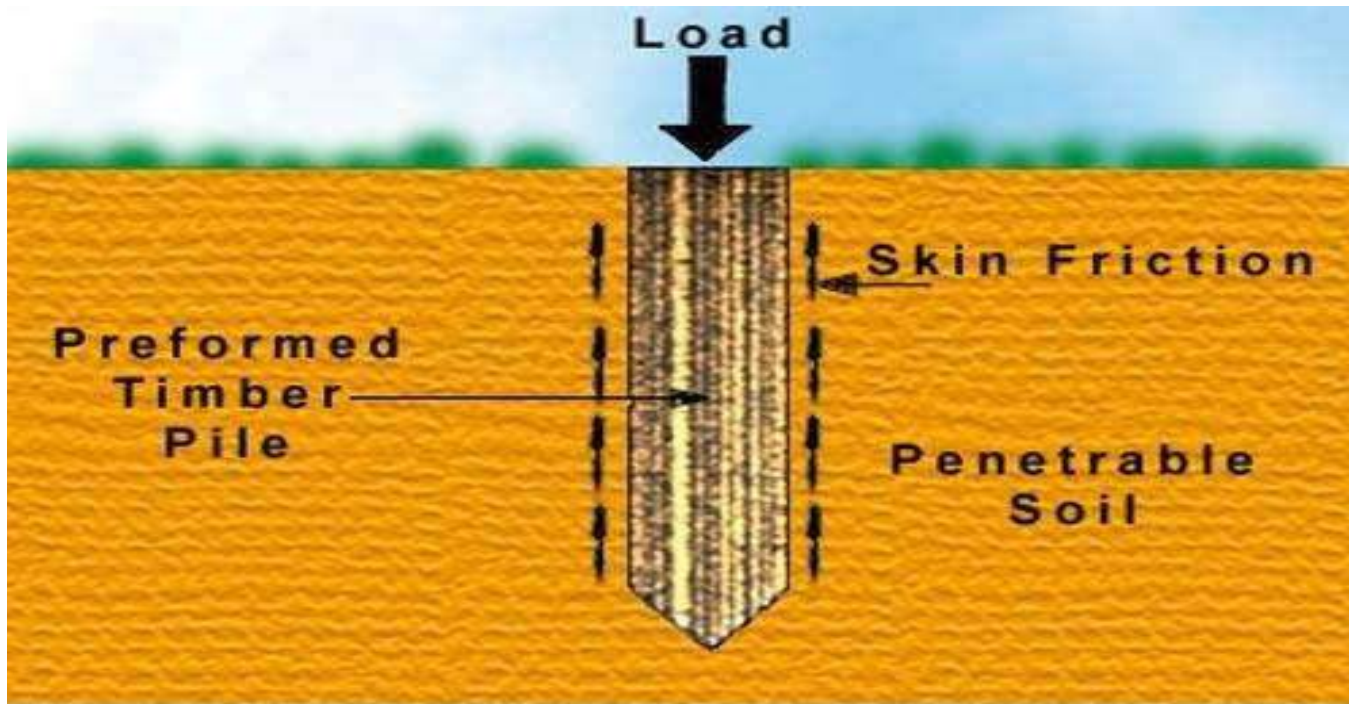
End Bearing Piles

These piles are used to transfer the load through water or soft soil of ground to a suitable hard bearing stratum.



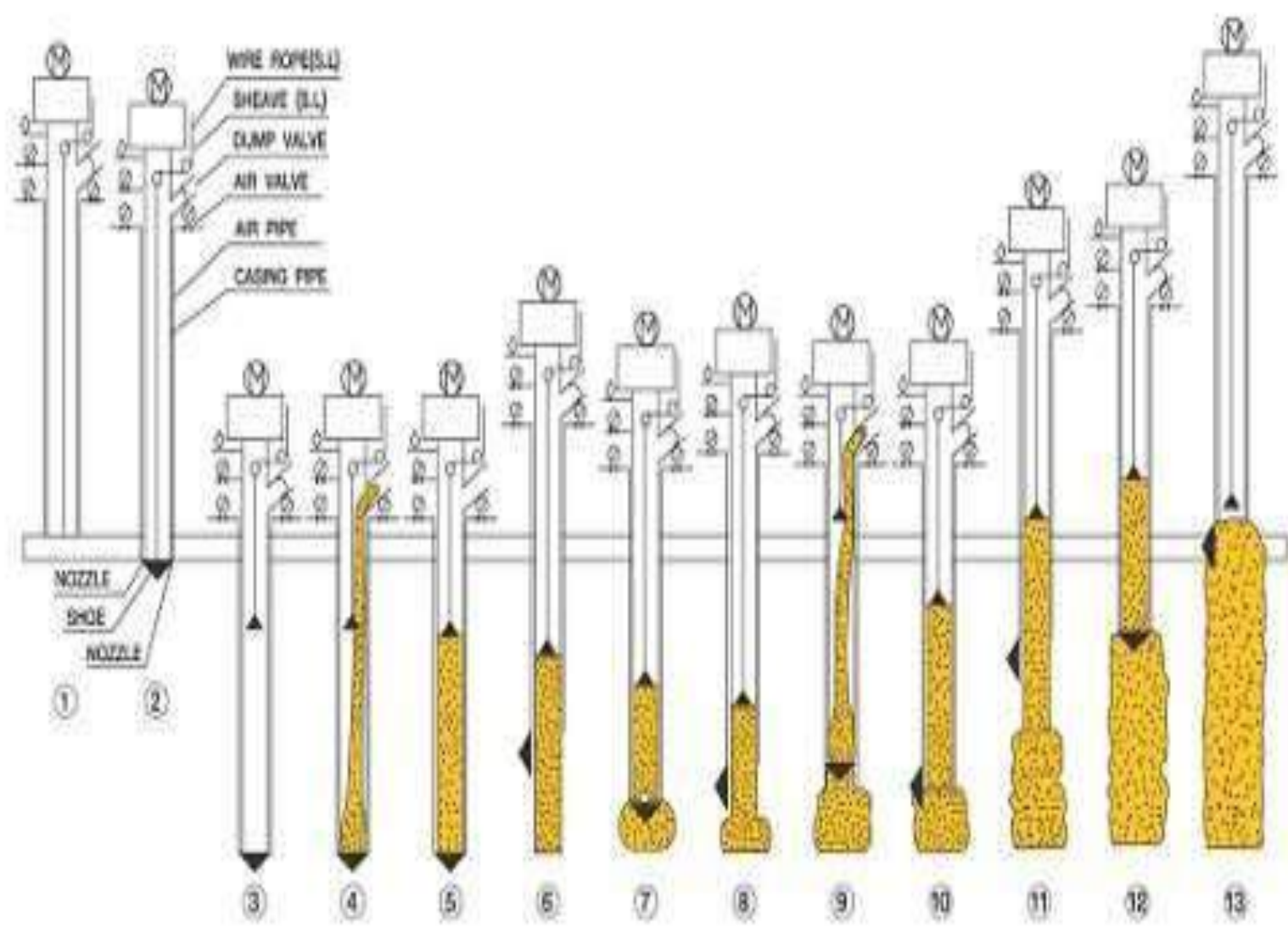
Friction Piles

These piles are used to transfer loads to a depth of a friction load carrying material by mean of a skin friction along the length of piles.



Compaction piles:

Compaction piles are used to compact loose granular soil, thus increasing their bearing capacity. The compaction piles themselves don't carry load. The pile tube, driven to compact the soil, is gradually taken out and sand is filled in its place thus forming a 'sand pile'.



Tension or Uplift piles:

These piles anchor down the structure subjected to uplift due to hydrostatic pressure or due to overturning moment.



Anchor piles:

These provide anchorage against the horizontal pull from sheet piling or any other pulling.





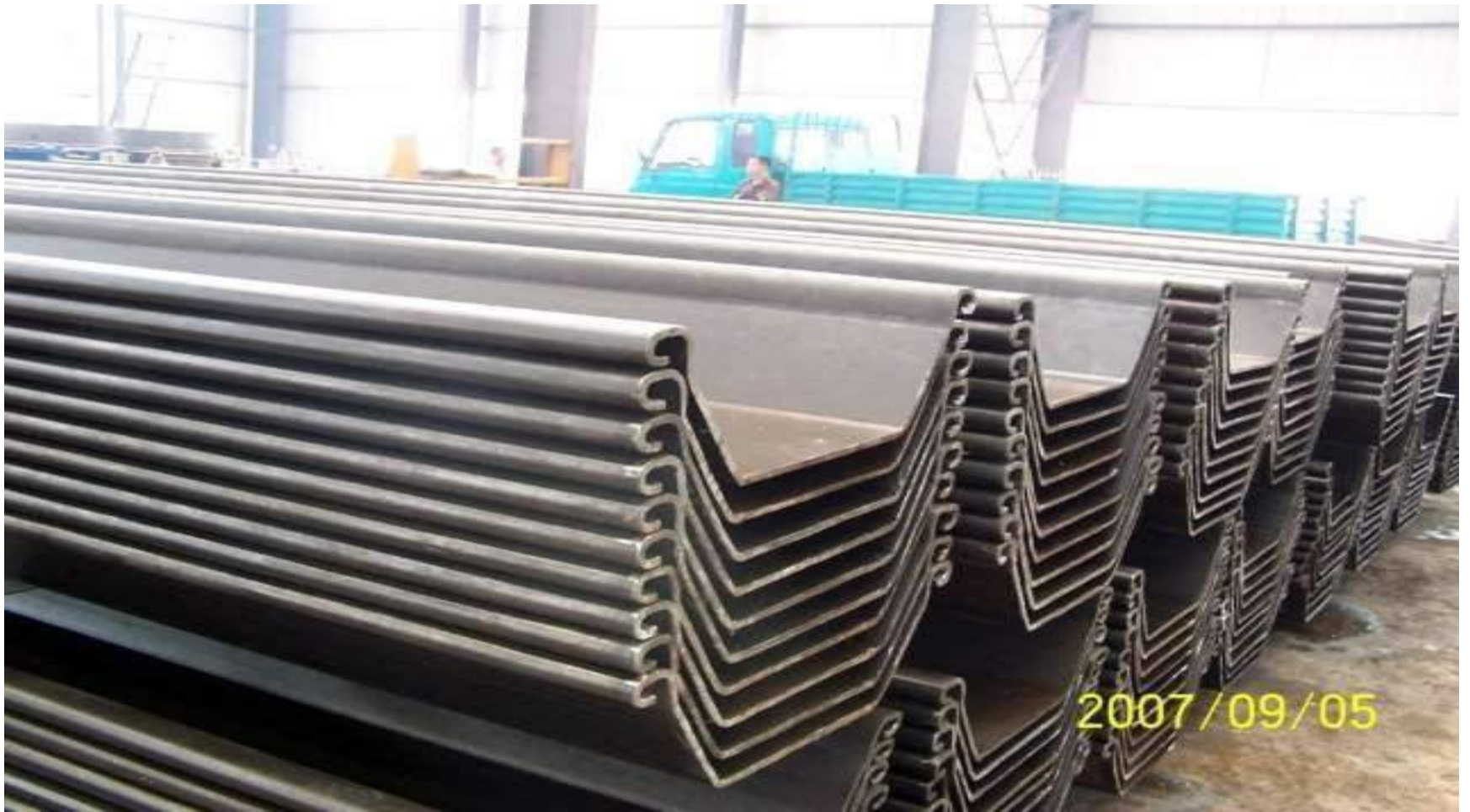
Fender piles

These are used to protect water from structure against impact from ships or other floating objects.





Sheet Piles



Batter pile

These piles are used to resist large horizontal or inclined forces



Cohesion piles

These piles transmit most of their load to the soil through skin friction. This process of driving such piles close to each other in groups greatly reduces the porosity and compressibility of the soil within and around the groups. Therefore piles of this category are sometimes called compaction piles. During the process of driving the pile into the ground, the soil becomes moulded.

CLASSIFICATION BASED ON MATERIAL AND COMPOSITION:

1. CONCRETE PILES

- (a) Pre-cast
- (b) Cast-in-situ
 - (i) Driven Piles: Cased or Uncased
 - (ii) Bored Piles: pressure piles, under reamed piles and bored compaction piles.

2. TIMBER PILES

3. STEEL PILES

- (a) H-pile
- (b) Pipe pile
- (c) Steel pile

4. COMPOSITE PILES

- (a) Concrete and Timber
- (b) Concrete and Steel

PRE-CAST CONCRETE PILES

- The precast concrete piles are generally used for maximum design load of about 80 tonnes. They must be reinforced to withstand handling stresses.
- They require space for casting and storage, more time to set and curing before installation and heavy machine are required for handling purpose and driving.
- These piles require heavy pile driving machinery which is mechanically operated.
- The size of pile may vary from 30cm to 50cm in cross-sectional dimension, and upto 20m length or more in length.
- Reinforcement may include longitudinal steel bars of 20mm to 40mm in diameter, 4 to 8 nos. with lateral tie 5 to 10mm wire spaced at 10cm c/c for top and bottom 1m length and 30cm c/c for the middle length.
- A cast steel shoe, properly secured to pile by mild steel straps, is provided at its lower end.
- Toe protect the pile and help in penetrating into hard strata during driving.

PROCEDURE FOR FORMING PRECAST CONCRETE PILES:

- The form work of required space is prepared. Usually metal forms are used for mass manufacture. The inner sides of the form is coated with either soap solution so that soil does not adhere to the side.
- The reinforcement cage, as per design, is placed in the form, maintaining proper cover all around. Cast steel shoe is also placed, and is secured to the reinforcement with the help of mild steel straps.
- Concrete is then placed in the form and well vibrated with the help of form vibrators. Mix of concrete 1:2:4 with maximum size of aggregate equal to 19mm.
- When the pile is driven into soil it is subjected to impact stress at its head.
- Remove the form after three days. But the piles are kept in same place for 7days. The piles are then shifted to curing tank where concrete is allowed to mature for at least 4weeks before being driven.
- Maturing period can be reduced if, rapid hardening cement is used instead of normal Portland cement.

DRIVEN PILES (CASED OR UNCASD)

BORED PILES (PRESSURE PILES, BORED COMPACTION AND UNDER-REAMED PILES)

CASED –IN-SITU CONCRETE PILES:-

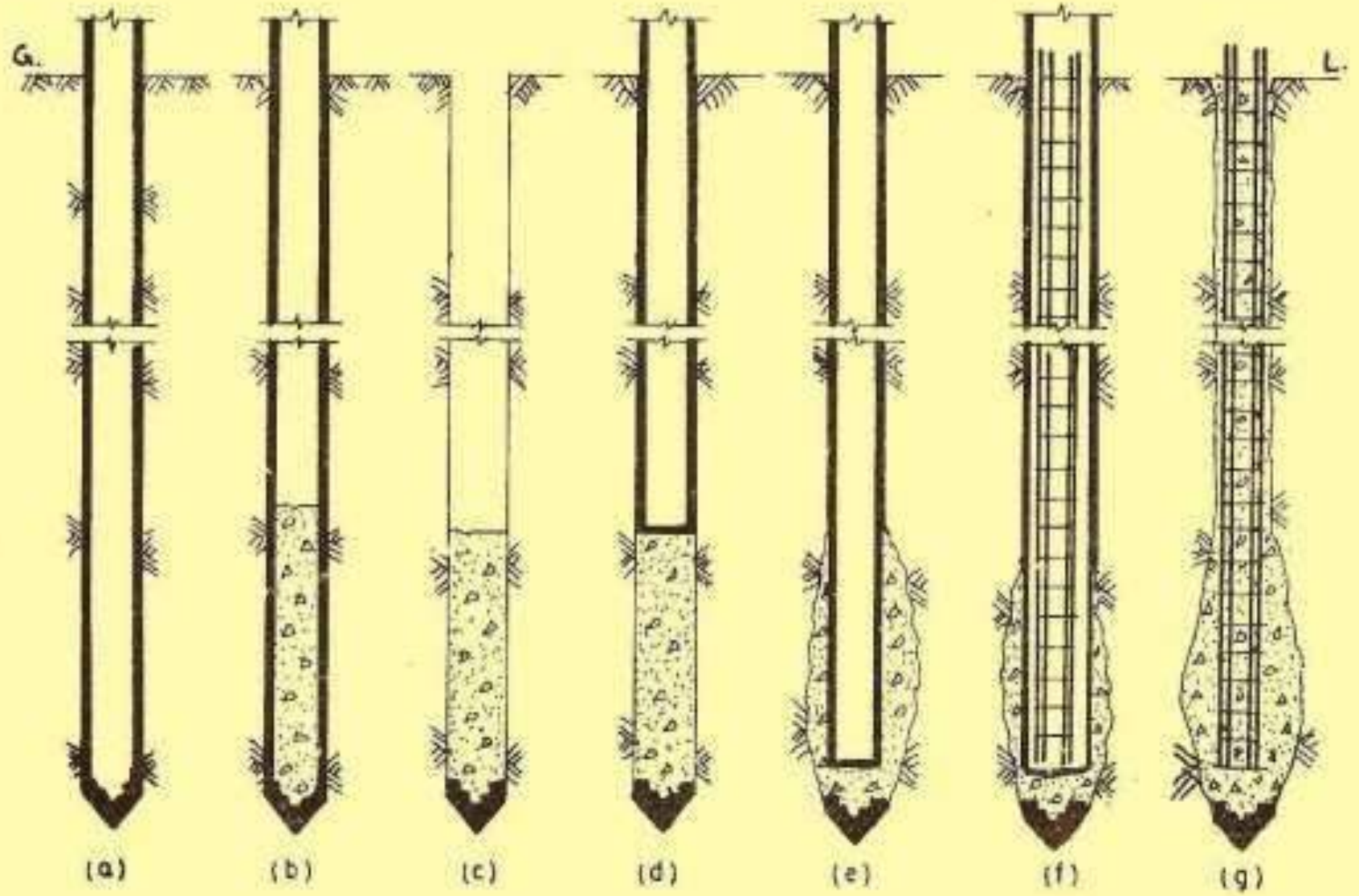
- ❖ This method is practically suitable for all type of ground condition.
- ❖ Shell is driven into intimate contact with the surrounding soil and remains in place to maintain driving resistance and protect the concrete filling during the place of other adjacent piles.
- ❖ Cased pile can be easily cut or extended to meet the variation in shell length.

FOLLOWING ARE THE COMMON TYPE OF CASED CAST-IN-SITU CONCRETE PILES:

1. Raymond standard pile and step-taper pile
2. Mc-Artuhr cased pile
3. Swage pile
4. Western button bottom pile

RAYMOND PILES:

- (RAYMOND STANDARD CONCRETE PILE) is used primarily as a friction pile. It is uniform heavy taper of 1in30 result in short piles for equal driving resistance or higher driving resistance for equal lengths, than piles of lesser or no taper.
- Length of piles varies from 6 to 12m. diameter of piles vary from 40 to 60cm at top and 20 to 30 at bottom
- The shell is driven into the ground with a collapsible steel core in it having the same taper.



- When the pile is driven to desired depth the core is mechanically collapsed and withdrawn, leaving the shell inside the ground.
- Shell is inspected internally by using the flash or drop light.
- Shell is gradually filled with concrete up to the top.

RAYMOND STEEP TAPER CONCRETE PILE)

- This type of core driven pile is used either as an end bearing pile.
- Can be driven in any type of soil.
- The pile uses shell section in different length. The bottom most section is made of heavier gauge and enclosed with flat steel.
- Joints between the sections of shell are screwed and connected.
- Shell are driven with a rigid core, rigid core provides high degree of penetration and efficiently transmit the hammer energy to the bearing strata.

- Third stage: corrugated steel shell is inserted in the pipe, resting on button. Steel plate with a bolt hole in it is welded on the bottom of the shell, before lowering it, so that the hole may
- fit over the central bolt in button.
- Nut is tightened with the help of long wrench.
- Fourth stage: casing is removed, leaving the button in place, and the shell is filled with concrete.