

Lecture #05

Building Construction Engineering

Deep foundation:-

It is defined as;

"The foundation in which we excavate more than 1.5m below the ground level."

(*) Deep foundation are provided when bearing capacity of soil is not good and we make multi-storey building. If soil is not good then it will not take load from the superstructure so we provide deep foundation.

(*) Deep foundations are provided deep underground. For deep foundations we excavate upto 800ft.

(*) Deep foundations are provided in form of group of pile, grouped by pile cap.

Pile:- Pile can be considered as nail driven into ground. Individual pile is not allowed. So we group them with the help of pile cap.

(*) Pile is a part of deep foundation.

(*) Capacity of group of pile is greater than sum of pile due to interaction between individual piles.

(*) Pile raft System:- (Hybrid System)

In which pile (part of deep) & raft (type of shallow) in order to share load.
↓
are provided.

Elements of Deep Foundation:-

i. Piles:-

It is like thin column having very short diameter while large length that is buried into ground.

→ Since it has small diameter there is no chance of buckling i.e. buckling is prohibited because soil is confined from all sides.

Surrounding soil resist buckling.

Material used for Piles:-

Depending upon type of soil and nature of building we have different piles.

Steel Pile:-

The piles that are made from steel.

Reinforced Pile:-

A pile that is made from reinforced concrete.

Prestress Pile:-

Prestressed mean when you apply stress on reinforced concrete before laying.

→ First we apply stress on R.C due to which

it compressed we add further r.c to it due to which its strength is further increase. Some of piles are made from such method.

Timber Piles:-

The piles that are made from timber i.e wood to transmit load.

Types of Piles:-

i- Friction Piles:-

When the pile is driven into ground and it transmit load to ground through pile called friction pile.

(ii) End bearing Piles:-

The pile that transfer load to hard strata with help of end of pile. There is no load transfer of load to soil through friction.

(*) The piles that are driven into ground should not be closer more than 3 feet or 3 piles diameter.

→ The usual diameter of pile is varies from 9" to 18".

* If the diameter of pile is 9" then the distance between two piles should not close more than 3 feet or this diameter i.e 36".

If distance is less than we are unable to work.

Piers:-

The long thin column having some diameter (more than pile) which are constructed at site called pier.

→ It is called cast insitu.

(*) Also called cast or cassion.

Where as piles are prefabricated that is constructed in factory and then we drive it into the ground.

(*) Cast insitu means depending upon the cast we make piers on site.

→ Pier can be made of any required size depending upon nature of building.

→ Pier can be used as individually.

Types of Pier:-

Two types of pier.

i. Friction pier:-

The pier that transmit load through friction surrounding the pier to soil.

ii. End bearing pier:-

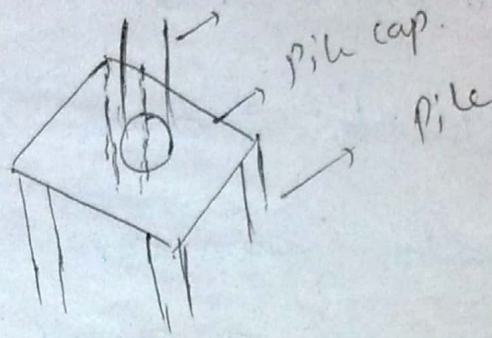
The pier that transmit load to hard stratum of load without friction is called end bearing pier.

The usual diameter of pier ranges from 18" to 36".

→ But this diameter depend upon nature of superstructure.

(*) In case of end bearing pier the end we make large so that load distribute evenly.

→ A pier is generally reinforced with steel cage before concreting.



We provide pile cap so that load equally distributed over all piers so that differential settlement not occur.

Steps for Construction of deep foundation:-

(i) Step #01

Fixed location:-

First step is to locate the location for pile & piers where it is to be driven.

(ii) Provide Machines:-

Second step is to provide all machines and assemblies that help us

Step #3

Start drilling upto located depth using Auger drilling method. etc.

Remove the soil and insert the insitu pier or pre fabricated piles.

Step #4

Pouring concrete into the cage from casting yard to working site through RMC (Ready mix concrete).

→ Then quarry it 7 days.

(*) We also add admixture in order to enhance the properties of concrete to work in water and dry it early.

(*) Once the piles are constructed they are cased or grouped at the top to prevent lateral displacement.

Pile Cap:-

We provide pile cap to all piles in order to group them and to distribute load evenly, near the surface of ground.

→ Pile cap are of different shapes depending upon no. of piles.

3 piles → Equilateral Pile cap.

Four piles = Rectangular pile cap.

(*) Pile reinforcement shall be anchored (in form of hooks) in pile cap.

Pile load test:-

This test is performed at site in which we have sample of piers whether piers withstand with load or not.
 ↓ we check ↑ pile

→ This test is conducted upto 28 days at site

(*) Pile has certain design depend upon the length and parameter of building, soil capacity.

We performed this experiment in order to check the capacity of piers.

Three types of test:-

Three types of test are used.

- i. Vertical pile load test.
- ii. Lateral load test.
- iii. Pull out test.

(*) We will apply load i.e. For e.g. 100 tons so we will increase load gradually. For example first we will add 12.5 tons, 25 and so on with certain amount of time.
 → Then we will reduce the load gradually

and we get graph for loading and unloading.

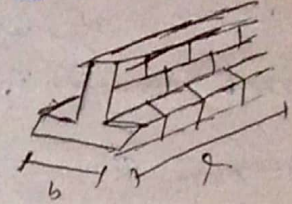
Types of Shallow Foundation:-

In strip footing the length of foundation is greater than the breadth of foundation.

i- Wall footing:-

It is also called strip footing.

→ In order to transmit the load of wall to soil successfully we provide footing to wall that is called footing (wall) or strip footing.



(ii) Isolated Footing:-

This type of footing is provided for such structures which are lightly loaded and the soil bearing capacity is good enough to transmit load successfully to ground.

Consider a column in

ground with footing is example of isolated footing

which is not combine with footing of other

member like column.



Isolated footing

We give more area so that load distributed easily.

(iii) Combine footing:-

This type of foundation provided when soil bearing capacity low.

These type of footings are combine with each other called combine footing.

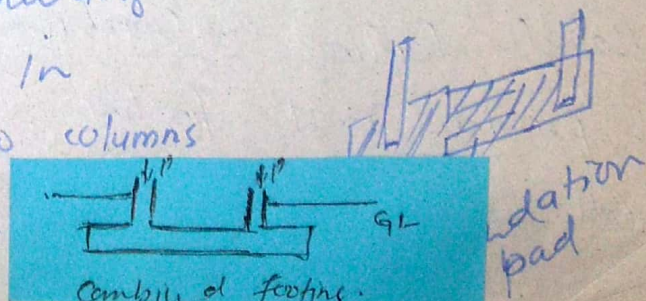
→ When two columns are heavily loaded and close to each other instead of using isolated footing we make combine footing.

It give strength to building.

→ Consider the fig. in

which footing of two columns

are joint i.e. combine footing.



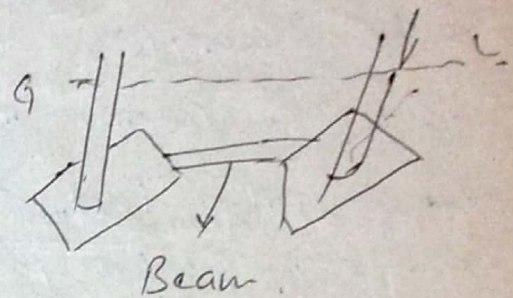
(4) Strapped Footing :-

It is also called ^{cumulative} strapped footing.

In this type of footing, the footing of two members say column are connected through beam instead of footing pad as in case of combine footing.

→ We do it when there large enough distance b/w the member because footing will required more materials than this. It is economically good.

* The beam is provided not at footing but in masonry place. Then we call it cumulative footing.



Mat footing :-

The foundation that is provided throughout the building is called mat footing.

→ Some people called it carpet footing.

(*) If capacity of soil is not good or if more load of building so we used such type of footing. In this type of footing, the RC slab is provided through out the foot print.

foot print is path or plane on which construction will carry & that will excavated.

(*) If you excavate 50% (more) for either isolate footing or combine footing it is better to provide mat footing.

→ All the foot print is excavated at same level.

This foundation cover the entire area of building.

Raft footing:-

It is type of mat foundation.

We provide two slabs and there is empty space between them.

On such type of footing, the amount of soil excavate from ground should be equal to weight of building so it means we not apply extra load on soil & the building is said to the building float on surface.

If the weight of building is more than the weight of soil that we excavate then consolidation will occur in ~~soil~~ building.

Steps of foundation built:-

Three steps.

i. Plan ii. Design iii. Executing.

i. Plan:-

The imaginary horizontal sectioning of building called its plane when see from top.
→ The horizontal sectioning at plinth level and remove the upper section called foundation plan.

Items of foundation plan:-

These are four basic items that is found in foundation plan.

i. Position

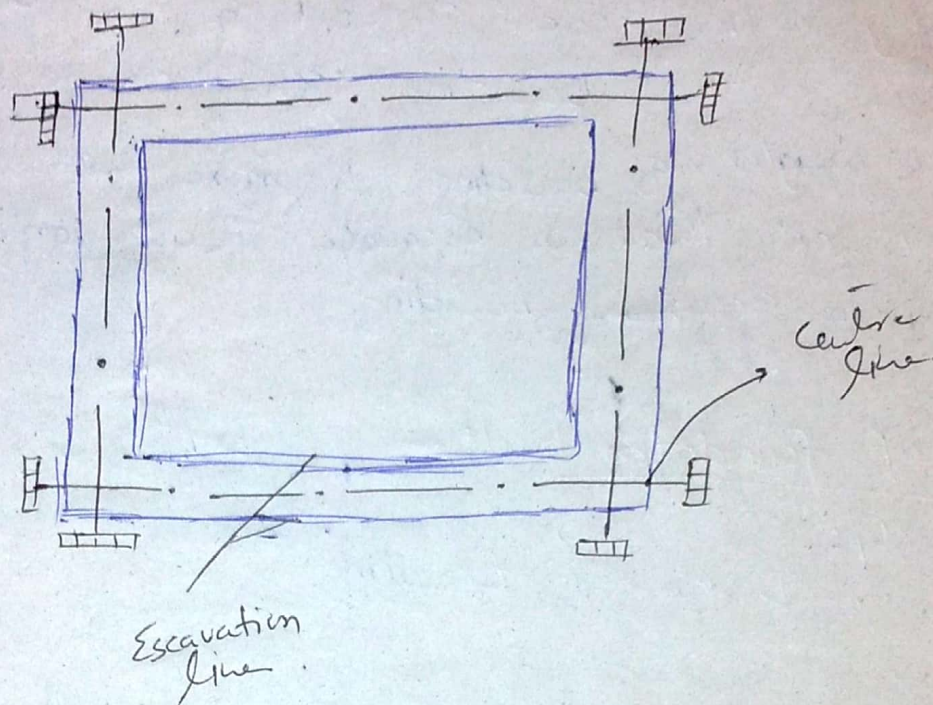
In order to show position of something in foundation plan we provide grid which help us to locate position.

ii. Distance Between Grids:-

We should also know distance between grids both vertically and horizontally (should maintain symmetry of building). → (Thumb rule).

iii We should also know width of foundation.

iv We should also know about types of foundation used in building plane.



Foundation Laying out:-

The process of marking position or location of trenches that is to be excavated. This process is also called setting out, ~~trace out~~, lay out or ground tracing.

(*) Before excavating foundation we go that site and remove all the useless and wastage from that place. Similarly if some part need to be level we level it.

Then by using string or cord whose ends are firm with pegs. This string will give

length of external wall to each side of this line we mark line that show boundary of foundation. Now we have to draw perpendicular line to this centre line which can be done by numbers of methods.

Method #1:-

By calculation i.e By Pythagorous Theorem.
We will place a mark on centre line at 4'
Now other string i.e should be make perpendicular to it will mark at 3'. Now by measuring tape it hypotenous give us 5' so our reading is right i.e - that string is perpendicular to centre line.

Method #2:-

By Large Set Square:-
This is also one of method to connect the string with each other at right angle.

Method #3

Theodolite:-
This machine help us to connect strings at right angle.

(*) Similarly other strings are connected at same manner in order to get area for excavation of foundation.

(*) The sides line of centre line are make by line.

- (*) By brick we can also replace it with peg, if peg is not available.

Excavation:-

After foundation laying out we excavate foundation on that limited areas either with help of excavator or manually with the help of labours.

Points to be noted:-

- (*) The soil that is excavated should be kept away from trenches because it can again fall in trenches.
- (*) The trenches should be so wide so that a man or labour can safely move or walk.
- (*) If there is drain water flowing we should make such obstruction so drain water not enter.
- (*) Try to retain shape of trench by creating braces on each side so that soil is not stiff or good may fall in it.
- (*) Level that place and remove the unnecessary things.

Shoring:-

It is a process of providing support to end of trenches in order to save from collapse.

→ It is also called bracing, timbering.

→ It is called timbering because all the supports are made of wood.

Purpose of Shoring:-

- i) During excavation if soil is not good so it will fall so we provide support to it.
- ii) to provide safety to workers i.e. labours.

Members of Shoring:-

All these three members are made of wood.

i. Poling board:-

It is vertical member of shoring made of wood which has direct contact or indirect contact with side of trenches.

ii. Sheeting:-

Large plank of wood directly placed with side of trench.

iii) Strut:-

The horizontal member of timber that is driven into trenches between poling board is known as strut.

→ Now other strut is provide at 5' from the previous strut.

If soil is good distance may vary to 40'.

Types of Shoring:-

Shoring is of two types.

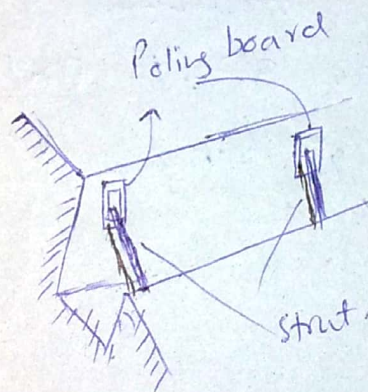
i. Stay Shoring:-

If soil is good then we neglect the sheeting so this kind of shoring is called stay shoring.

(*) As soil is good so we provide just piling board and strut. Other strut is made at distance of 5'.

→ We can also use pair of struts.

Diagram:-



ii. Box Shoring:-

To provide more safety in case of loose soil in form of box by providing sheeting to whole trench.

→ In case if we have lengthy sheets we provide horizontally.

→ In case short plants we provide vertically.

Laying of footing Concrete:-

Before pouring concrete into trenches we should first clear trench, level it by mean of rammer. After ramming it we will provide foundation bed of lean concrete (1:4:8) PCC.

Because if foundation is direct contact with soil there will several chemical action occur. The footing will be made from PCC (1:2:4) or (1:3:6).

(*) The height for foundation bed should be 3-4".

(*) After curing 2-3 day will then made footing of (1:2:4) PCC.

→ And pour by concrete upto ground level.