SOIL EXPLORATION

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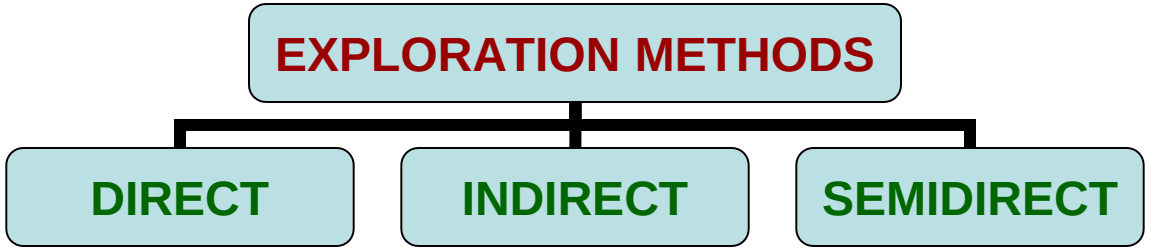

EXPLORATION METHODS
DIRECT
INDIRECT
SEMIDIRECT

SEMIDIRECT METHODS

Essential equipments of boring

- Drilling and sampling equipment
- Clean out equipment
- Drilling rods cables
- Motors and winces for lowering, operating & withdrawing drilling tools, drill rod and casing
- Tripod or mast
- Pumps for circulation of water as drilling fluid to remove materials from bore holes in wash boring.

SEMIDIRECT METHODS

Displacement Methods

Continuous Sampling

Wash boring

Percussion Drilling

Rotary Drilling

SEMIDIRECT METHODS

Factors governing the efficiency of methods

- Character of Soil / Material to be penetrated
- Diameter of bore hole
- Depth of bore hole

SEMIDIRECT METHODS

Selection of methods of boring

Materials encountered and relative efficiency of methods

Facility and accuracy of method with which changes in the soil layer and Ground water condition can be determined

Possible disturbance of the material later to the sample

Displacement Method

The bore hole diameter sunk in this method is about 25 to 75 mm.

This method is used for short depth and the borehole is created through displacement of soil.

It is the easiest and cheapest method.

The advancement of bore hole is made by pushing piston sampler.

During pushing it stabilize soil.

Disadvantage of the method: It disturbed the soil at the bottom of a bore hole.

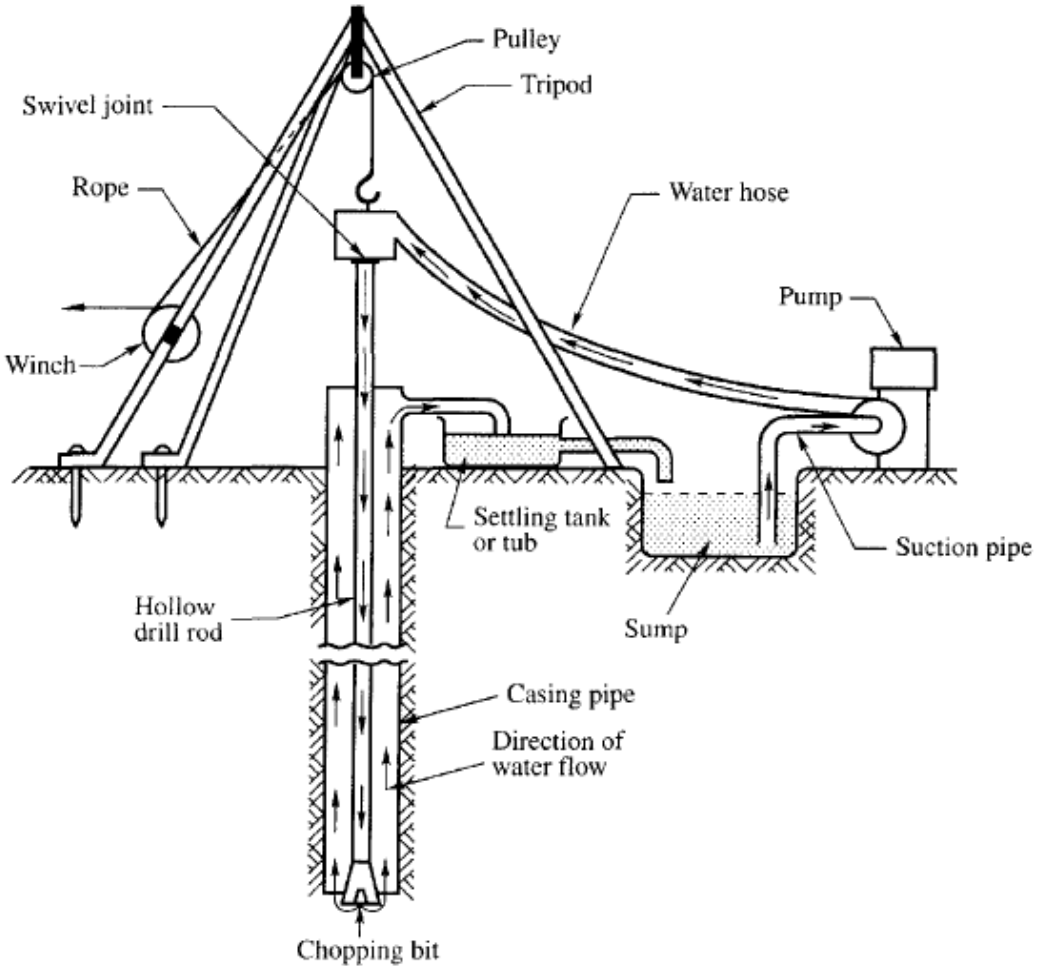
Continuous Sampling

It may be required in soft soil or in very stiff clay.

The advantage of continuous sampling is that it is more reliable and detail information of soil condition than any other method.

The method is more expensive and slow than other methods of borings where intermediate sampling is done.

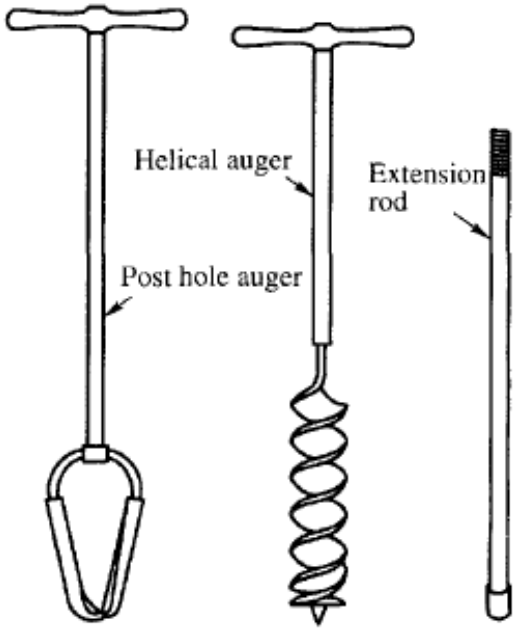
Wash boring


Pulley
Tripod
Swivel joint
Rope
Water hose
Pump
Winch
Settling tank
or tub
Suction pipe
Hollow
drill rod
Sump
Casing pipe
Direction of
water flow
Chopping bit

Wash boring

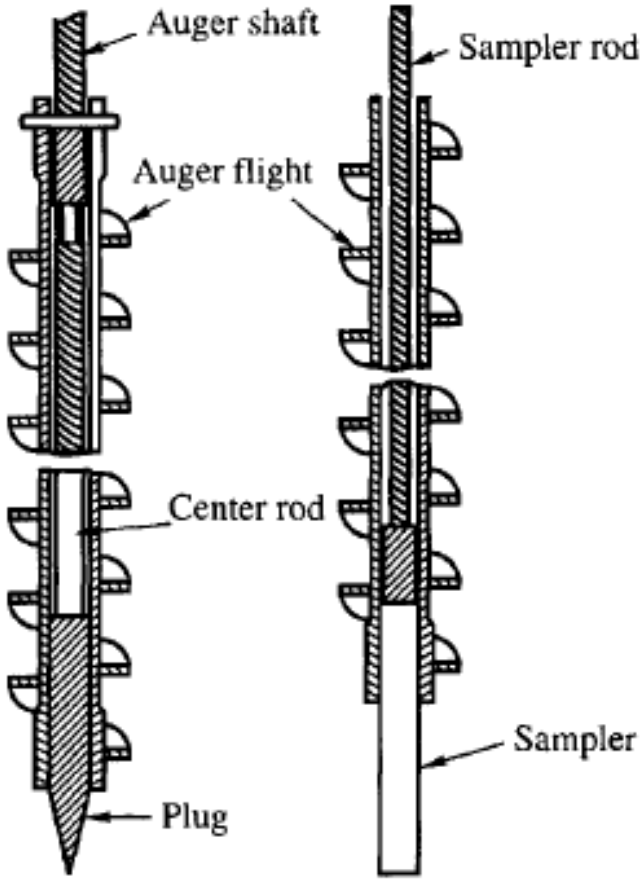
The simple equipment described here has the advantage that an experienced driller by the feel of the wash pipe as it is churned and rotated and by the colour of the wash water, can usually detect the change in the character of the material

Auger boring



Hand Driven Augers

Auger boring



Hollow Stem Auger

Auger boring

Shallow borings are almost universally made by means of auger.
Hand operated augers can work up to 6 m, but beyond this depth power driven augers are used. The auger, usually turned into the soil for a short distance and then withdrawn with the soil clinging to it.
The soil is removed for examination, the auger again inserted into the hole and turned further.
If the hole fails then casing should be used to stop collapse of the side of the bore hole.
The casing should be driven to a depth not greater than the top of the next sample and should be cleaned out by means of the auger.
Auger boring can not be made in sand below the water table because the material will not adhere to the auger.

Percussion Drilling

Used for deep exploration.

Dia. of bore hole preferable 150-200 mm.

Cutting equipment- heavy drill bit.

Weight of bit- 400kg – 1000kg

Drop-0.5m to 1.5m.

Frequency of drop of about 40 to 60 times/ min

Percussion Drilling

In this type of drilling the material removes give average sample of about 1.0 m making the identification of layer somewhat difficult.

The change of layer is identified by the rate of advancement of bore hole.

The main advantage is that the drill rod is eliminated and as such a deeper hole can be made but due to the type of cutting procedure, it is difficult to get undisturbed sample.

It is used to penetrate hard rock.

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Rotary Drilling

The drill bit cuts, grinds and chips

Motor operated so it is a rapid process.

Cleaning of bore hole by pumping water (for small depth) or drilling fluid.

Casing-upto a certain depth.

Rotary drill bits are used

Rotary Drilling

Types of drill bit depends upon character of material cuts.

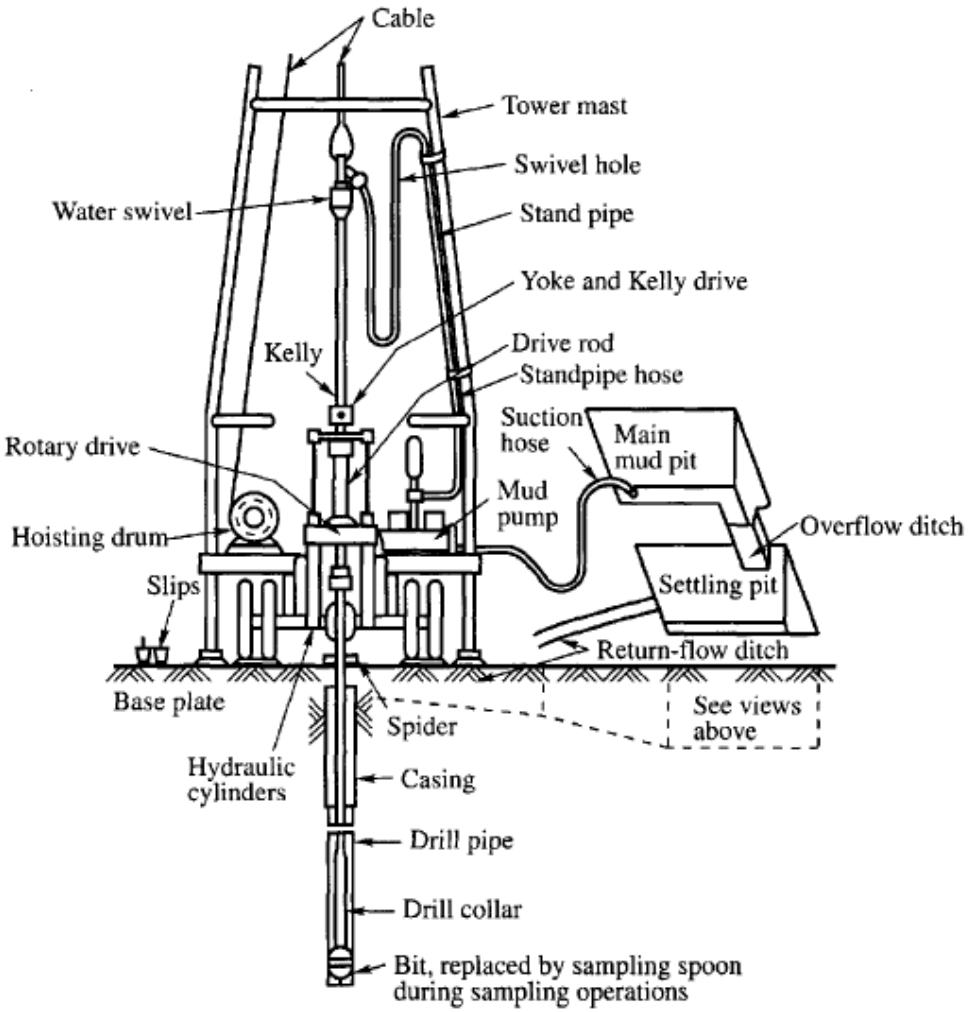
Soft soil- fish tail or two bladed

Stiff soil or soft rock 3-4 two bladed.

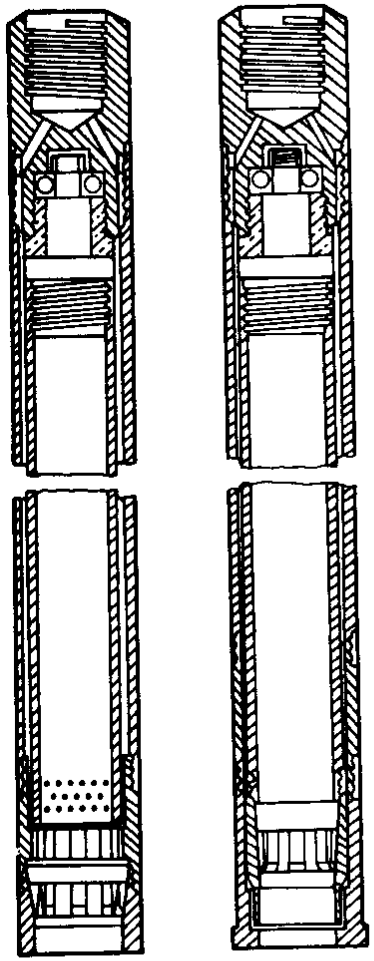
Hard rock-two core, 3 core rock bits.

Less than 100 mm dia of bore is not suitable usually 150-200 mm. dia holes are drilled by the method.

Rotary Drilling



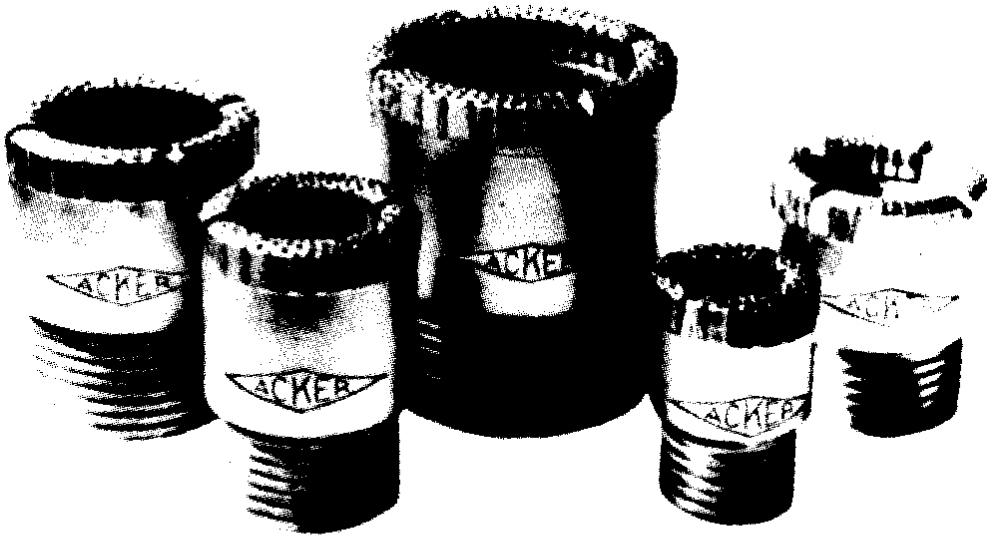
Rotary Drilling



Standard double-tube core barrel

Series "M" double-tube core barrel

(*a*)



Diamond coring bits

(*b*)

Rotary Drilling

Limitations:

Large diameter is not possible.

Without adequate experience the change of layers can not be detected accurately because of first mechanised drilling and removal of cuts through circulation of fluid.

However from the rate of progress of bore hole the change in character of soil can be identified.

Because of high progress of drilling this method is always used for exploration work.

Rotary Drilling

The progress is rapid in this system but rotary drilling is unsuitable in deposits of coarse gravel, numerous stone, boulder deposits, fissured rocks and at position of strong ground water flow, which may wash out the drilling fluid.

Due to the machine operation and design of the drill bits clean bore holes of uniform diameter are made in this process and the soils at the bottom of the bore holes are least disturbed leading to undisturbed sample.

Stabilization of Borehole

Why?

Stabilization of Borehole

Caving of sides

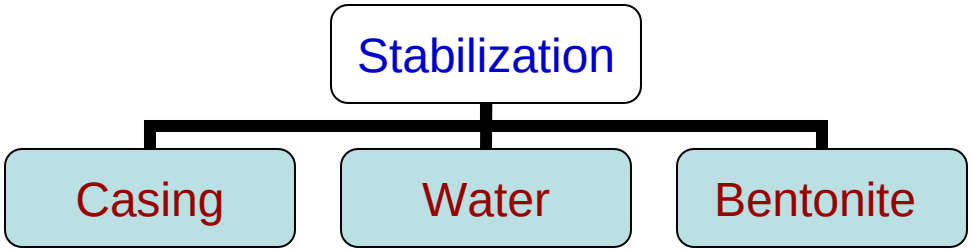
Heaving of bottom

Stabilization of Borehole

For prevention of caving of sides and from the bottom of bore holes and to avoid disturbance of sampling, stabilization of bore hole is done.

Uncased bore holes are stable for shallow depth above the ground water table.

Stabilization of Borehole



Casing

Pipes of length ranging from 1 to 3 m are used for casing.

Casing pipes are either driven or pushed into the hole as the hole advances.

Stabilization with water

In porous soil water will start to flow through the porous soil as a result of which capillary action will start.

With water – the characteristics of the ground water will be disturbed pore water seepage for ground water table.

Stabilization with drilling fluid or drilling mud

Specification of drilling fluid - high colloidal, gelforming, thixtropic clay. Bentonite with chemicals.

The chemicals are added to control dispersion, thixtropy, viscosity and gel strength.

The drilling fluid stabilises the bore hole sides better then the water due to its higher specific gravity of the solution and due to formation of mud cake lining on the surface of the bore hole.

Drilling fluid decreases swelling of cohesive soil stabilizes cohesionless soil and helps cutting and removal of soil from the bore hole as it increases the specific gravity of the soil.

SELECTION OF BORING METHODS BASED ON SOIL TYPES

Types of soil	Method of boring
Common Cohesion and plastic soils	Displacement, Wash, Auger Continuous sampling (percussion, Rotary)
Slightly Cohesive and Brittle soils including Silt ,Loose Sand above Ground Water	As above but keep boring dry for undisturbed sampling above ground water.
Very Soft and Sticky Soils	Displacement, Wash Bailer, Sand pumps Continuous Sampling (Auger, Rotary)
Saturated Silt and Loose sand	Displacement, Wash Bailer, Sand pumps Continuous Sampling (Rotary)
Compact or Stiff and Brittle Soils including Dense sand, Partially Dried Soils	Wash, Augers Percussion, Rotary Continuous Sampling
Hard, Highly Compacted or Partially Cemented Soils, no Gravel or Stone	Percussion, Rotary Continuous Sampling
Coarse Gravelly and Stony Soils including Compact and Coarse Glacial Till	Percussion, Barrel Auger Loosen by Explosives Thick-Wall Drive Sampler
Gaseous or Expanding Soils(Organic Soft Clay, Silt, Sand)	According to soil but keep boring filled with water or drilling fluid
Gradually or Sudden Change in Soil Properties within a Single drive	As above according in basic soil type
Soils with Secondary Structure.	As above according in basic soil type

Summary of activities regarding advancement and cleaning of bore hole

Stabilisation of bore hole – above water table water should not be used

Boring above GWT to be kept dry

Boring below GWT water/fluid may be used

Advancement of casing – Just prior to sampling the bore hole should be advanced little beyond the casing or at least up to the bottom of the casing.

In case of loose cohesionless soil the casing should be driven without much vibration. The casing should be pushed into the soil by pushing or by some other static load.

Summary of activities regarding advancement and cleaning of bore hole

Cleaning of bore hole bottom by Auger, Bailer, Water jet, Sand pump.

For piston sampler cleaning requirement of bore hole is not much. But for open sampler the bottom should be cleaned properly to remove non representative and segregated soil.

The auger can smoothly clean the bottom without much disturbance. The bottom should be cleaned with shielded horizontal jets and not by open vertical jets.

The entire cross section of the casing should be cleaned.

Sampling – from the bottom of the last sample taken a spacing of 3 D has to be maintained for the next sample

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Summary of activities regarding advancement and cleaning of bore hole

Time factor – Deformation and failure of soils are time dependent processes and absorption of moisture or drying affect the nature of the samples collected. Therefore, the samples have to be collected immediately after cleaning of the bottom of he bore hole and the casing has to be driven immediately after collection of sample.