General exploration:-

1. → The primary objective is to get the appro picture of sub-soil condition.

2. → This type of exploration is recommended to erratic (heterogenous) soil profile.

3. → Shallow test pits, subsurface penetration and sounding and geophysical methods are used.

4. → General exploration gives information about following things

a) Depth & composition of soil strata

b) Depth of rock

c) Ground water level

d) Engg. properties of soil / rock sample

e) Preliminary selection of foundation typ

Detailed exploration:-

→ It is done when large engineering works, heavy loads & complex & costly foundation

→ Information about soil properties like shear strength, compressibility, density index & perm

→ Open well at the site should be used to know the water level.

→ Otherwise bore hole can also be used for recording water level.

Depth of Exploration:-

→ Exploration should be carried out upto such depth which is known as significant depth.

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→ Significant depth depends upon
  a) type of structure
  b) its weight size
  c) soil profile

→ Depth of exploration for different types of work
  a) Isolated footing: one & half time the width
  b) Pile foundation: 10 to 30 meteres
  c) Base of retaining wall: one and half time the base width.
  d) Dams: height < 30m = ½ of bottom width
     height > 30m = upto bed rock

Methods of site exploration:-

→ Direct methods
  a) open excavation / trenches / test pits.
  b) Boring

→ Indirect methods
  a) sub-surface sounding
  b) geophysical methods

Open excavation:-

→ Test pits & trenches are used for all types of soil.
→ soil can be inspected in their natural condition.
→ Open excavation is generally suitable for shallow depth (upto 3m)
→ for greater depth (>6m), lateral supports and lowering of ground water is required

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then excavation can be done.

Boring methods:-

1. Auger boring:-

→ It is used for soft soil above water table.

→ Hand auger used upto depth of 6m

→ It is used for highway exploration.

→ The soil brought by auger is used for only identification purpose.

2. SHELL boring:-

→ It is used when soil is soft or stiff or hard clay found. Also used for sandy soil.

→ It is used upto depth of 50m.

3. WASH BORING:-

→ It is fast & simple method for all soil type.

→ It is not applicable for rocky surface

→ The soil is forced to come above ground level.

→ only we can know about different soil layers.

4. percussion boring:-

→ It is applicable for soil & rock

→ The sample will get fully disturbed

5. Rotary boring:-

→ It is very fast method for making

hole in rocks & soils.

→ A drill bit is used to bring out rocks & soil by the help of water solution.

Soil samples!-

→ It is of 2 types!-

1) Distorbed sample!-

It is that sample in which the natural structure of the soil get partly or fully modified or destroyed.

2) Undisturbed sample!-

It is that sample whose natural structure & properties remain preserved.

Stationary piston sampler!-

* It contains a picton attached to along piston rod extending upto ground surface.
* when the sampling level is reached the piston rod is clamped & sampler tube is used to bring out the soil.
* The picton prevents the entry of water into the tube.
* It is useful in case of saturated sand & soft soil.

Rotary samplers!-

* It is a core barrel type with cutting teeth on outer tube.
* It is useful for hard cohesive soil.

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Indirect methods of exploration:

1. Standard penetration Test:-

→ It is performed in a clean hole of 55 to 150 mm dia.

→ A thick wall split-tube sampler of outside dia 50.8 mm & 35 mm internal dia is driven into the soil under the blow of 63.5 kg hammer with 75 cm of free fall.

→ The sampler is first driven through 15 cm then further driven through 30 cm or till 100 blows given.

In-Situ vane shear test:-

→ It can be done in laboratory or in the field also.

→ It helps in determining undrained shear strength of cohesive soil.

→ A vane shear tester consists of four steel plate placed orthogonally.

→ A torsion spring is attached to it.

→ The rotation of vane shears will occur. The rotation of spring in degree will be indicated by the pointer attached to wheel shaft.

→ The torque is calculated by measuring with spring dial reading with spring constant.

→ The field shear vane is of (10-20) cm in height and (5-10) cm in dia with blade thickness of about 3.5 mm.

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max^m failure developed at failure surface
$= \pi dH z_f$

The shear strength of the cylindrical surface $= 2\pi r dr z_f$

So, max^m moment of total shear resistance about the axis of torque rod is

$$T = (\pi dH z_f)\frac{d}{2} + 2\int_0^{d/2}(2\pi r dr z_f)r$$

$$= \pi z_f\left[\frac{d^2H}{2} + \frac{d^3}{6}\right]$$

$$= \pi d^2 z_f\left[\frac{H}{2} + \frac{d}{6}\right]$$

Sub-soil investigation report:-

→ It is obtained from the bore holes, laboratory data & site observation

→ The report consist of

1) Scope of investigation
2) Description of proposal structure, location and geological condition.
3) Details of field exploration programme like no of boring, its location, depth.

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Rock Mechanics

It is a part of engg geology which deals with the rock as an engg material and also the changes in mechanical behaviour in rocks (stress, strain).

Problems:-

Problems of rock mechanics are classified into 3 types

1) problem of stability
2) " " elastic & plastic deformation
3) Drainage problem.

problem ① & ② occurs due to the load imposed, magnitude and distribution of stresses.

* There are different types of problems like fissures, cavities, joints and other discontinuities.

* Reaction of particular type of rock when put in use, load carrying capacity of rock at different depths, effect of rock defect on its strength property.

Scope of rock mechanics:-

* The study of rock mechanics help in knowing the load bearing capacity of rock.

* Finding out the faults in rock & measures to rectify it.

* Helps in knowing settlement properties of rock.

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Defects in Rock mass:-

1. Fractures
2. Cracks
3. Fissures
4. Stratification
5. Joints
6. Faults
7. Folds
8. Cavities

causes of defect in rock mass:-

* There are 2 type of movement in the earth crust due to which structure of rock get modified
  a) Epeirogenic or continent building movement.
  b) mountain-building movement.

* continent building movement are continuous but slow.

* mountain building movement is more severe but effects periodically.

STRIKE & DIP:-

Strike:

The direction of the line along which an inclined bed meets a horizontal plane is called as the strike.

* It is described as N(-)E, N(-)W etc

Dip:-

It is the max^{m} slope of a particular inclined plane.

→ It is described as (-) N, (-) S.

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Joints:-

Cracks along which the fractured rock masses appear to have altered in relative displacement is known as joints.

→ Any breakage in rock mass irrespective of its size is called as fracture.

→ Joints occur in all types of rocks.

→ In sedimentary rocks these are 2 sets of mutually perpendicular joints both ⊥r to bedding plane.

→ In igneous rock these are 3 regular set of joints.

① Flat - laying joints.
② Q joints or cross joints
③ S joints or longitudinal joints

→ Flat laying joints are approximately hori and are parallel to the bedding plane

→ Q- joints are perpendicular to flow line

→ S- joints are parallel to the flow lin

Bedding plane:-

It is the plane which separates the sedimentary and stratified rocks in different layers.

Recovery ratio:-

It is being defined as the percentage ratio between the length of the core covered and the length of the core

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drilled in a single time, related to quantity of rock encountered in boring.

Rock quality designation (RQD):-

→ It is defined as the sum of total of length of the core recovery and length of core run i.e drilling done is called core recovery ratio.

$$RQD = \frac{\text{total length of core recovered}}{\text{length of drilling done}}$$

→ When core recovery is expressed in (%age) when length of rock core (<10cm) is called RQD.

→ It gives good assessment for the quality of rock.

RQD	Quality of rock
0-25	very poor
25-50	poor
50-75	fair
75-90	good
90-100	Excellent

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