Site exploration

Objectives : At the end of this lesson, you shall be able to,
- **define site exploration**
- **state the purposes of exploration**
- **explain preliminary investigation**
- **explain various method of site exploration**

Introduction

The knowledge of soil characteristics and the factors influencing their properties will help the investigation in the identification of individual soils encountered in soils exploration and in the selection of right type of foundation for the building.

Definition:

For designing a right type of foundation safely and economically, a designer must possess sufficient information about the physical properties and the arrangement of the underlying materials. The field and laboratory investigations required to get this essential information are known as soil/site exploration.

General inspection of site

It is desirable to visit the site of work and inspect the same carefully from the view point of foundation details. The nature and thickness of strata of soil may be estimated by studying the excavation details of near by construciton or by examining the open side of a near by well etc. The general inspection of site of work serves as a guide for determine the type of foundation to be adopted for the proposed work. It also helps in getting the following data

Purposes

Before starting the exploration work, the following data should be collected.

1 The nature, thickness and variation of soil strata in the region.

2 Procuring representative samples for assessing the physical properties of the soil strata encountered, which in turn, will help in the design and mode of construction of the proposed foundations.

3 The seasonal variation in ground water table and their possible effects on the soil strata met.

4 The strength and compressibility values of soil bed.

5 If necessary, the depth of underlying rock bed.

Preliminary Investigation

The following information regarding the proposed site should be collected.

1 The soil condition at different depths.

2 Location of water table and its seasonal variations.

3 The depth of rocks.

4 Behavior of soils at site, which can be known from the type of construction and conditions of the structure in the adjoining properties.

5 The general topographical features of site, viz, site on the top of hill, in a valley, on an abandoned lot, or reclaimed ground etc.

Methods of site exploration

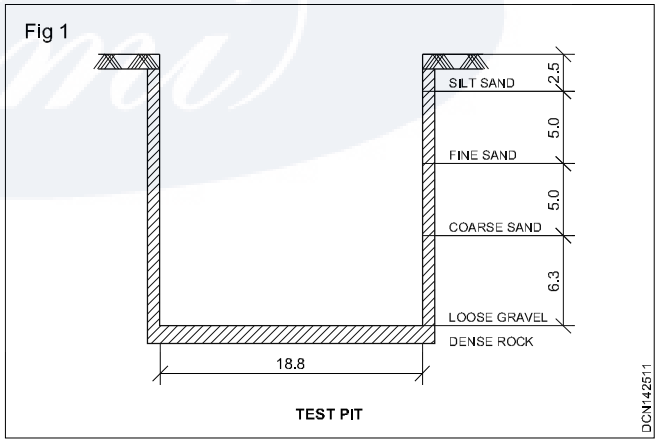
1 Open excavation (test pits)

1 This method is useful when hard soil is available within a maximum depth of 1.5m

2 A square pit, with side as about 1.50 m ,is excavated up to a depth at which sufficiently hard soil is avaiable

3 A sufficient number of test pits should be dug on the site to know the variation of the ground

Fig 1



Probing

1 Probing consists of driving either a hollow tube or a steel rod or an iron rod into the ground

2 This method is possible to examine the ground for a maximum depth of 3 m.

Auger boring

1 An auger may be of post-hole type or screw type or shell type

2 Auger is worked by applying leverage at the top the auger is driven into the ground and turned like a screw the auger is withdrawn and the material caught in the slit is inspected.

3 With the help of this method ,it is possible to inspect the ground for a depth of 6 m to 8 m.

Fig 2

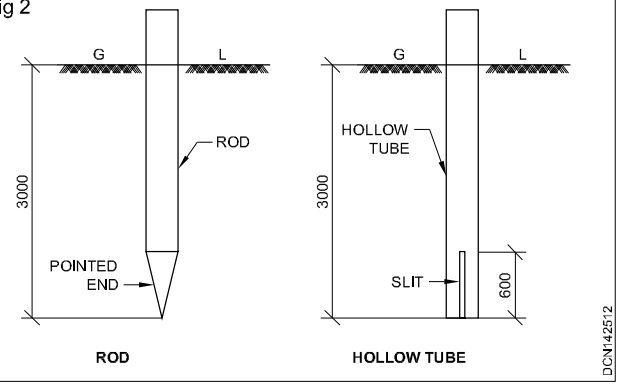


Fig 3

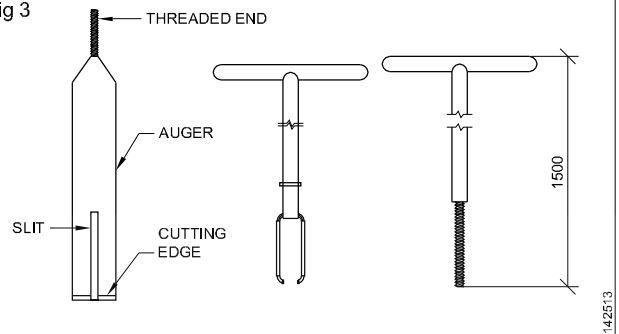
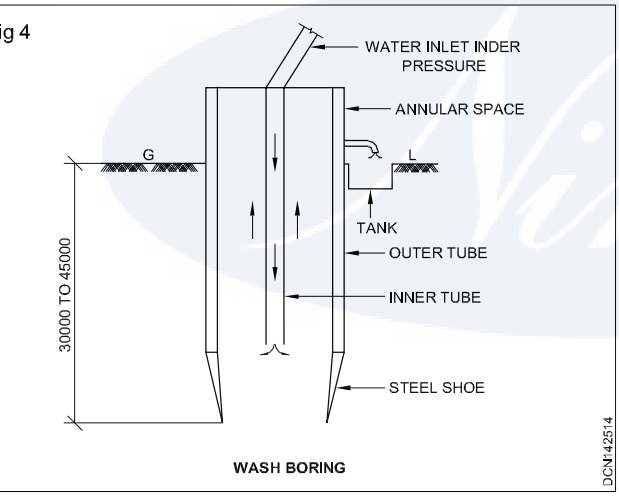


Fig 4



4 **Wash boring**

The wash boring is the term used to denote a method in which a casing is driven into the ground and the material inside the casing is washed out and brought to the surface for inspection.

5 Sub-Surface sounding

1 In this method, the resistance of the soil with depth is measured by means of a tool known as penetro-meter under static or dynamic loading.

2 This test is useful for :

i) Finding the depth of bed rock or stratum.

ii) Knowing the general exploration of erratic soil profiles and

iii) Testing cohesion less soils from which it is difficult to obtain the undisturbed samples.

6 Deep boring

1 It becomes essential to carry out deep boring for big important engineering structures such as dams.

2 The machines used for deep boring are as follows.

i) Percussion boring machine.

ii) Core or rotary drilling machine.

7 Geophysical method

1 This method is used when the exploration depth is substantial and the speed of investigation is of primary importance.The method is mainly adopted to as certain the depth at which useful minerals and oils are available.

2 The two most commonly adopted methods are as follows.

i) Electrical resistivity method.

ii) Seismic refraction method.

Bearing capacity of soil

Objectives : At the end of this lesson, you shall be able to,

- **define bearing capacity of soil**
- **explain safe bearing capacity of soil**
- **state ultimate bearing capacity of soil**
- **describe methods for determining the bearing capacity of soil**
- **explain methods of increasing bearing capacity of soil**
- **state the safe bearing capacity of various soil.**

Introduction

Bearing Capacity of soil is used to indicate the maximum load per unit area, which the soil will resist safely without displacement, the load of the structure.

Safe Bearing capacity of soil

It is the maximum pressure, which the soil can carry safely.

Ultimate Bearing capacity of soil

The gross pressure intensity at which the soil fails.

Safe Bearing capacity =

The basic requirement of any structural components of a building is that it should be strong enough to carry or support all possible type of loads

There are three types of load on the foundations

Design Loads

Dead load

Live load

Wind load

Dead load

This is the load of the material used for the various components of a builidng such as wall floor roof etc. All permanent loads are thus included in that load. Sometimes a dead load of 10kg/m2 of the floor area is allowed for construction of a partition wall.

The weight of common material are given below:

Sl.No.	Materials	Weight in kg/m2
1	Aluminium	2590
2	Bitumen	1440
3	Coal tar	1000
4	Clay (dry)	1440
5	Clay (damp)	1760
6	Earth (dry)	1410-1840
7	Earth (moist)	1600-2000
8	Sand	1540-1600
9	Sand(moist)	1760-2000
10	Alcohol	780
11	Ice	910
12	Nitric Acid(91%)	1540
13	Sulphuric Acid(87%)	1790
14	Vegetable oil	930
15	Water(fresh)	1000
16	Brick	1600-1920
17	Cement(ordinary)	1440
18	Chalk	2240
19	Glass	2400-2720
20	Lime stone	2400-2240
21	Sand stone	2240-2400
22	Steel	7850
23	Timber	650-720
24	Brick masonry	1920
25	Plain concrete	2300
26	Reinforced concrete	2400
27	Cast iron	7200
28	Copper	8590
29	Lead	11360
30	Marble	2700
31	Lime mortar	1740
32	Plaster cement	2080
33	Stone masonry	2500
34	Asbestos cement sheet	12-15.60
35	G.I Sheet(0.5mm thick)	5
36	G.I. Sheet(1.63mm)	13
37	Mangalore tiles	68

Live load

This is the movable load on the floor and hence it is variable. It is also sometimes known as super imposed load. It includes load of person standing on a floor, weight of material temporarily stored on a floor, weight of snow on a roof etc. For the purpose of dressing the live load is converted into equipement dead load. Super imposed load for floors of different types are as follows:

Sl.	Material	Load kg/m^2
1	Residential building, hospital room and ward and hotel, bed room etc	250
2	Office building, church,school building, art gallories,stairs in residential building retail shop and light garages	400
3	Assembly building, public building dance hall, theatre restaurants, gymnasium, stair in public builidng light workshop	500
4	Heavy workshop,printing press and factories	750
5	Work houses, book stall, sanitary stores and heavy garages	1000

Wind load

In case of tall building the effect of wind should be considered. The exposed sides and roofs of such building are subjected to wind pressure. And its affect is to reduce the pressure on the foundation on the wind ward side and to increase the pressure on the foundation on the lee-ward side.

The wind pressure will depend on the velocity of the ground. The relation between wind pressure and wind is generally expressed by the formula .

$P = 0.00750^2$

where p = wind pressure v = velocity of wind in km/hour

Bearing capacity of soil

A foundation should be designed to satisfy to essential conditions.

i) It must have some specified safety againce ultimate failure.

ii) The settlement under working load should not exceed the allowable limits for the super structure.

The bearing capacity of soil is defined as the maximum load per unit area which will resist safely without displacement.

The ultimate bearing capacity is defined as the maximum gross pressure at the base of the foundation at which the soil mass fails in shear. Gross pressure is the total pressure at the base of the foundation, due to the weight of the super structure, self weight of the foundation and weight of earth fill if any. The safe bearing capacity may be defined as ultimate bearing capacity divided by factor of safety.

$$\text{Safe bearing capacity} = = \frac{\text{Ultimate Bearing capacity}}{\text{Factor of safety}}$$

Factor of safety means only a number to be selected depends on how accurately soil conditions are known. Is generally 2-3 for stable building.

MAXIMUM SAFE BEARING CAPACITY OF VARIOUS SOIL

Sl No	Description of soil	M.S.B.C in Tone/m
1	Very soft, wet, pasty or muddy clay	5
2	Black cotton soil in dry condition	15
3	Soft clay	10
4	Moist clay and sand clay mixture	15
5	Medium clay	25
6	Compact clay nearly dry	45
7	Fine sand, loose and dry	10
8	Medium sand compact and clay	25
9	Compacts and prevented from spreading	45
10	Loose gravel	25
11	Compact gravel and moorum	45
12	Soft rock	45
13	Laminated rocks such as lime stone and sand stone	165
14	Hard rock without defects such as granite trap	330

Method for determining bearing capacity of soil

The bearing capacity of soil can be determined by any one of the following methods

- Analytical method
- Method of loading
- Method of dropping a weight

Analytical Methods

Rankine's gives an analytical method for determining the ultimate bearing capacity is,

$$Qf = r_0 \frac{(1+\sin\theta)^2}{(1-\sin\theta)^2}$$

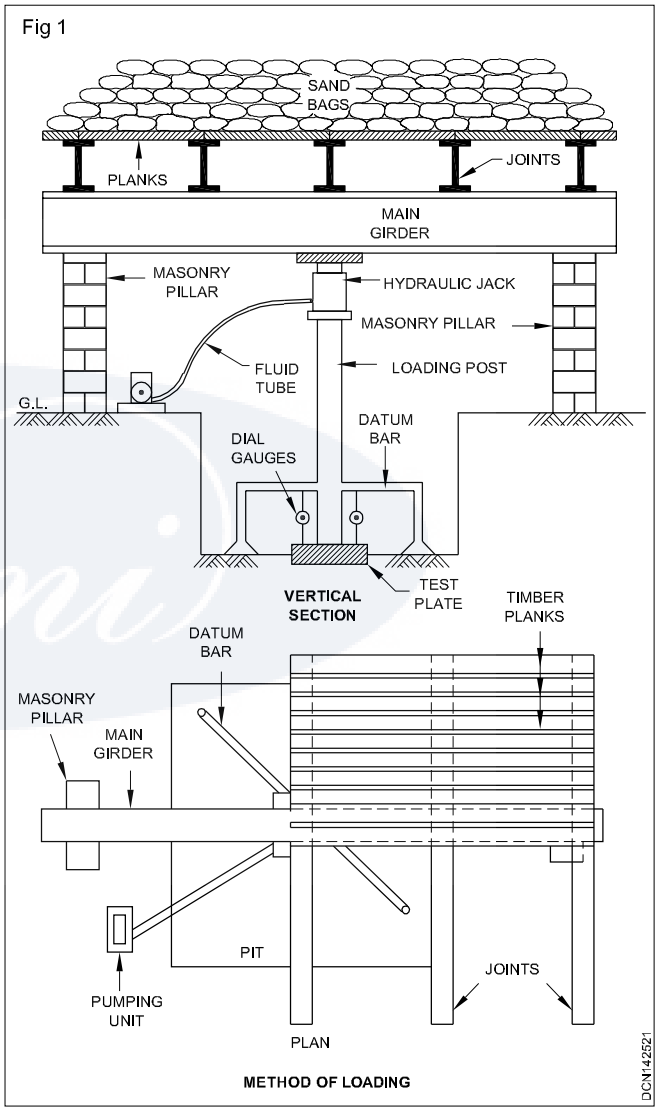
Where Qf = Ultimate bearing capacity

ro = density of soil at depth D

q = The angle of internal friction of soil.

Method of loading

Fig 1



This is a field test to determine the ultimate bearing capacity of soil and the probable settlement under a given loading. The test essentially consists in loading a rigid plate (usually of steel) at the foundation level.

Determine the settlement, corresponding to each load increment. The ultimate bearing capacity is taken as load at which the plate, start sinking at a rapid rate.

The ultimate bearing capacity in tone/m