Module 1 : Site Exploration and Geotechnical Investigation

Lecture 3 : Soil samplings and samplers [Section 3.1 : Soil sampling, Disturbed samples, Undisturbed samples]

Objectives

In this section you will learn the following

- Soil Sampling
- Disturbed samples
- Undisturbed samples
- Requirement of good sampling process

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3 Soil samplings and samplers

1 Soil Sampling

In general soil samples are categorized as shown in fig. 1.5

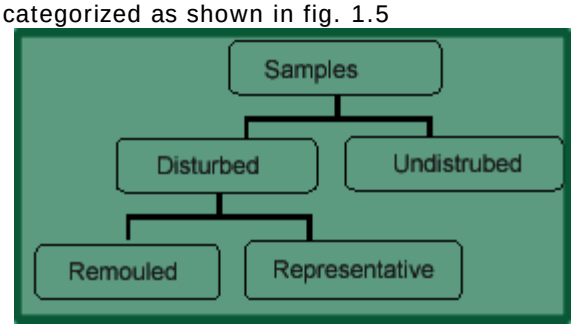

Fig. 1.5 Types of samples

2 Disturbed samples:

The structure of the soil is disturbed to the considerable degree by the action of the boring tools or the excavation equipments.
The disturbances can be classified in following basic types:

- Change in the stress condition,
- Change in the water content and the void ratio,
- Disturbance of the soil structure,
- Chemical changes,
- Mixing and segregation of soil constituents

The causes of the disturbances are listed below:

- Method of advancing the borehole,
- Mechanism used to advance the sampler,
- Dimension and type of sampler,
- Procedure followed in sampling and boring.

If all the constituents are present in the sample which represents the same soil type from any place, then it is called a representive sample. In the remoulded sample the engineering properties get changed due to remoulding.

3 Undisturbed samples:

It retains as closely as practicable the true insitu structure and water content of the soil. For undisturbed sample the stress changes can not be avoided. The following requirements are looked for:

- No change due to disturbance of the soil structure,
- No change in void ratio and water content,
- No change in constituents and chemical properties.

4 Requirement of good sampling process

- Inside clearance ratio $(C_i) = \frac{D_s - D_c}{D_c} x100\%$

  The soil is under great stress as it enters the sampler and has a tendency to laterally expand. The inside clearance should be large enough to allow a part of lateral expansion to take place, but it should not be so large that it permits excessive deformations and causes disturbances of the sample. For good sampling process, the inside clearance ratio should be within 0.5 to 3 %. For sands silts and clays, the ratio should be 0.5 % and for stiff and hard clays (below water table), it should be 1.5 %. For stiff expansive type of clays, it should be 3.0 %.

- Area ratio $(A_r) = \frac{D_w^2 - D_c^2}{D_c^2} x100\%$

The penetration resistance of the sampler, the possibility of entrance of excess soil and danger of disturbance of sample all increase with increase in area ratio. The allowable area ratio intended for obtaining undisturbed samples depends on diameter, design and method of operation of the sampler. The area ratio should be preferably be less than 10 %, but it is possible that the greater area ratio can be tolerated when the sampler is provided with a stationary piston and / or the cutting edge having very small angle of taper (θ).

- Outside clearance ratio $(C_o) = \frac{D_w - D_T}{D_T} x100\%$

For good sampling process, the ratio should be within 0-2 %.

- Minimum inside diameter = D_s = 75mm.

The length (L) should be at least equal to (the intended length + 100mm) for residual soils.

For soft soils depending upon the sensitivity, (L / D_s) ratios are given in table 1.1

- The cutting edge angle (θ – refer fig. 1.6) should be within 20^0.
- The tube should be uniform and should not have any protrusions or irregularities. The inside of the tube should beclean and smooth.

Recovery ratio $(R) = \frac{L}{H} x100\%$

Where, L is the length of the sample within the tube,

H is the depth of penetration of the sampling tube.

It represents the disturbance of the soil sample. For good sampling the recovery ratio should be 96 to 98 %.

- Wall friction can be reduced by suitable inside clearance, smooth finish and oiling.
- The non-returned wall should have large orifice to allow air and water to escape.

Fig. 1.6 Sampling tube

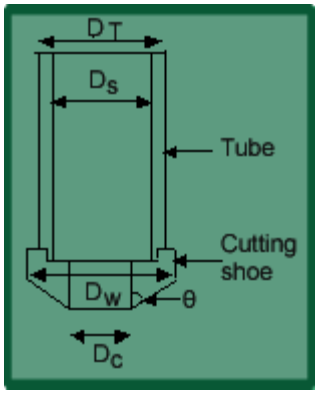

Table 1.1 : Sensitivity vs (L/D_s) ratio

Sensitivity	(L/D_s)
> 30	20
5 to 30	12
< 5	12

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Recap

In this section you have learnt the following

- Soil Sampling
- Disturbed samples
- Undisturbed samples
- Requirement of good sampling process

Recap

In this section you have learnt the following

- Different types of samplers
- Standard split spoon
- Open-drive and piston samplers
- Piston type sampler
- Preservation of samples

Congratulations, you have finished Lecture 3. To view the next lecture select it from the left hand side menu of the page

Module 1 : Site Exploration and Geotechnical Investigation

Lecture 3 : Soil samplings and samplers [Section 3.2 : Different types of samplers]

Objectives

In this section you will learn the following

- Different types of samplers
- Standard split spoon
- Open-drive and piston samplers
- Piston type sampler
- Preservation of samples

3 Soil samplings and samplers

3.2 Different types of samplers

1. Standard split spoon

It consists of tool-steel driving shoe at the bottom, a steel tube (that is split longitudinally in to halves) in the middle, and a coupling at the top. The steel tube in the middle has inside and out side diameters of 34.9mm and 50.8mm, respectively.

When the bore hole is advanced to a desired depth, the drilling tools are removed. The split-spoon sampler is attached to the drilling rod and then lowered to the bottom of the bore hole. The sampler is driven in to the soil at the bottom of the bore hole by means of hammer blows. The hammer blows occur at the top of the drilling rod. The hammer weights 623N. For each blow, the hammer drops a distance of 0.762m. The number of blows required for driving the sampler through three 152.4mm interval is recorded. The sum of the number of blows required for driving the last two 152.4mm intervals is referred to as the standard penetration number; N. it is also commonly called the blow count. After driving is completed, the sampler is with drawn and the shoe and coupling are removed. The soil sample collected inside the split tube is then removed and transferred to the laboratory in small glass jars. Determination of the standard penetration number and collection of split-spoon samples are usually done at 1.5m.

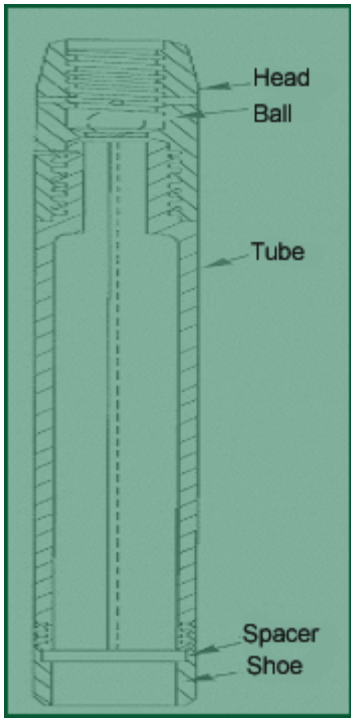

Fig.1.7 Split Spoon Sampler

2 Open-drive and piston samplers

Undisturbed samples are may be obtained from boreholes by open drive samplers or piston samplers. Open drive samples consist of thin-walled tubes which are pushed or driven in to the soil at the bottom of the hole and then rotated to detach the lower end of the sample from the soil. Most soft or moderately stiff cohesive soil can be sampled without extensive disturbance in thin-walled seamless steel tubes having diameter not less 50 mm. the lower end of the tube is sharpened to from a cutting edge and the other end is machined for attachment to the drill rods. The entire tube is pushed or driven in to the soil at the bottom of the hole and is removed sample with inside. The two ends of the tube are then sealed and sample shifted to the laboratory.

3. Piston type sampler

Good quality undisturbed samples are obtained from piston samplers which use thin-walled sampling tubes with a piston inside. While the tube is being lowered to the bottom of the drill hole, the piston rods and piston are held at the bottom of the sampler by means of a drill rod which rises to the top of the bore hole. The presence of the piston prevents excess soil from squeezing in to the tube and thus, maintains the integrity of the sample.

Preservation of samples

Undisturbed samples which are to be tested after some time should be maintained in such a way that the natural water content is retained and no evaporation are allowed.

Usually, two coats of 12mm thick paraffin wax and petroleum jelly are applied in molten state on either end of the sample is preserved in a humidity controlled room. In the absence of such facilities, the sampling tubes should be covered by Hessian bags and sprinkled with water from time to time. Block samples may be coated with 6mm thick paraffin wax and kept in air-tight box with saw dust filling the annular space between the box and the sample.