

L4/P1

Soil sampling

Two types of samples may be obtained

Disturbed samples

Undisturbed samples

A disturbed sample is one obtained with **no attempt to retain the in-place structure**, however there is **no change in the constituents/composition**.

In a strict sense **no sample is perfectly undisturbed**, what we mean is that the disturbance is small

The samples must be representative (disturbed or undisturbed)

Both disturbed and undisturbed samples are collected as the bore-hole proceeds

1

L4/P2

The kind of samples that should be obtained from an exploratory drill hole depend on the purpose for which the exploration is made.

Disturbed samples can be used for

Visual observation and classification

Grain size analysis

Sp.Gr. determination

Atterberg limits determination

Organic content determination

Chemical tests (pH, chloride, Sulfate etc.)

Undisturbed samples are required for

Consolidation test

Shear strength (Direct shear, Unconfined compression, Triaxial test)

Permeability, Hydraulic conductivity

For proper identification and classification, representative samples are required. A **representative sample is one that contain all the constituents in their proportions**. Such samples are adequate for visual classification, mechanical analyses, determination of Atterberg limits, Unit weight/Sp.Gr of solid constituents, chemical/organic content etc.

Mechanical properties of the disturbed soil samples are **significantly altered** by the sampling process. For determination of stress~strain characteristics or density of the soil strata we need samples that have undergone negligible deformation during sampling. Such samples are called **undisturbed**, although a certain amount of disturbance is regarded as inevitable.

2

Sampling Tools

L4/P3

Disturbed samples are collected from the SPT spoon, auger etc. and



SOIL AUGER (75mm SDS type) - the hole is at right edge of soil.
As the soil (clay) gets heavier and more moisture the larger the pieces.

Disturbed Sampling by Auger (Hand operated, Power driven)

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SPT and disturbed sampling

L4/P4

When a borehole is extended to a predetermined depth, the drill tools are removed and the sampler is lowered to the bottom of the borehole.

The sampler is driven into the soil by hammer blows to the top of the drill rod.

The standard weight of the hammer is 140 lb (622.7 N) and for each blow the hammer drops a distance of 30 in (0.762 m). The number of blows for three 6" (152.4 mm) intervals of the spoon are recorded. The number of blows required for the last two intervals are added and is termed as the N-value (or SPT-N or Standard Penetration Number) at that depth.

The sampler is withdrawn, the shoe and coupling are removed and the soil sample recovered from the tube is collected (disturbed sample).

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L4/P5

Split Spoon Sampler

Consists of a tool-steel driving shoe, a steel tube that is split longitudinally in half and a coupling at the top. The coupling connects the sampler to the drill rod.
 Standard tube size: ID- 1 $\frac{3}{8}$ " (34.9 mm)
 OD- 2 $\frac{1}{2}$ " (63.5mm)

Video-SPT

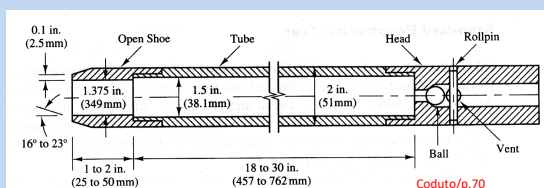
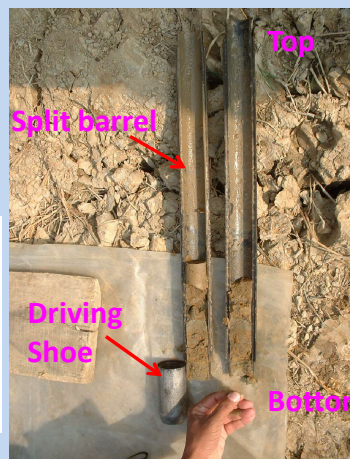


Figure 3.24 The SPT sampler (Adapted from ASTM D1586; Copyright ASTM, used with permission)

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L4/P7

Undisturbed samples are collected by:

- Shelby tube (thin-wall sampler)**
- Piston Sampler**
- Heavy wall sampler**
- Block sampling/ Hand-carved samples**

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Thin wall sampler / Shelby Tube

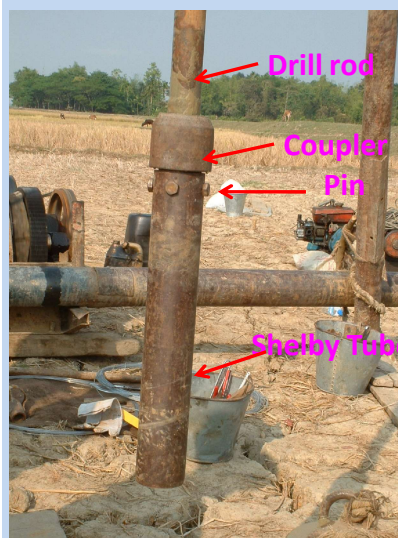
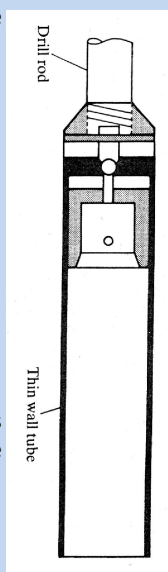
L4/P8

Soft to moderate stiff cohesive soils can be sampled having a diameter not less than 2 inch and an area ratio of about 10%.

Tubes of diameter 2 to 3 inch are commonly used in lengths varying from 2 to 3 ft.

The lower end of the tube is sharpened and slightly crimped to form the cutting edge. The upper end is machined for attachment to the drill rod.

For sampling the entire tube is pushed in to the ground at the bottom of the hole and is removed with the sample inside. The two ends of the tube are sealed (by wax) and sent to the laboratory.



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The degree of disturbance of collected samples depend on the way in which force is applied to the spoon/sampler, whether by pushing or driving, on the rate of penetration and on the dimensions of the sampler.

The degree of disturbance is roughly indicated by the area ratio

$$A_r(\%) = \frac{D_e^2 - D_i^2}{D_i^2} \times 100$$

Where D_e = external diameter of the cutting shoe

D_i = internal diameter of the cutting shoe

If $A_r \leq 10\%$, distortion is small in any soil type

The degree of disturbance is less if the sampler is advanced with a rapid steady motion instead of by intermittent pushing or driving.

L4/P6

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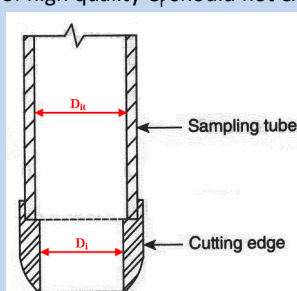
L4/P9

In order to obtain samples of soil several feet long, it is necessary to reduce the friction between the core and the inside of the tube. This is accomplished by crimping the cutting edge so that its inside diameter is slightly smaller than the inside diameter of the tube D_{it} .

The degree of sampling disturbance is also affected by the inside clearance ratio,

$$C_r (\%) = \frac{D_{it} - D_i}{D_i} \times 100$$

If the ratio become too large, the sample may expand excessively as it passes into the sampling tube and its strength may be considerably decreased. For undisturbed samples of high quality C_r should not exceed 1%.



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L4/P10

Sampling of cohesionless soil

Samples of cohesionless materials, such as sand below the water table cannot be retained in conventional sampling spoons. A **spring core catcher** fitted to the bottom of the sampling spoon may sometimes enable sampling of cohesionless soil. In deposits of very fine sand, or in sand containing small pebbles that may prevent the springs from closing, no recovery may be possible.



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Piston Sampler

L4/P11

Improved quality of samples and increased recovery of soft or slightly cohesive soils compared to thin wall tube sampler.

Consists of a thin-walled tube fitted with a piston that closes the end of the sampling tube until the apparatus is lowered to the desired depth. The sampling tube is then pushed past the piston, which remains on the surface of the soil at the bottom of the hole.

The presence of the piston prevents soft soils from squeezing rapidly into the tube and thus eliminates most of the distortion of the sample. The piston also helps to increase the length of the sample that can be recovered by creating a slight vacuum that tends to retain the sample if the top of the column of soil begins to separate from the piston. During the withdrawal of the sampler, the piston also prevents water pressure from acting on the top of the sample and thus increases the chances for recovery.

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Piston Sampler..... contd.

L4/P12

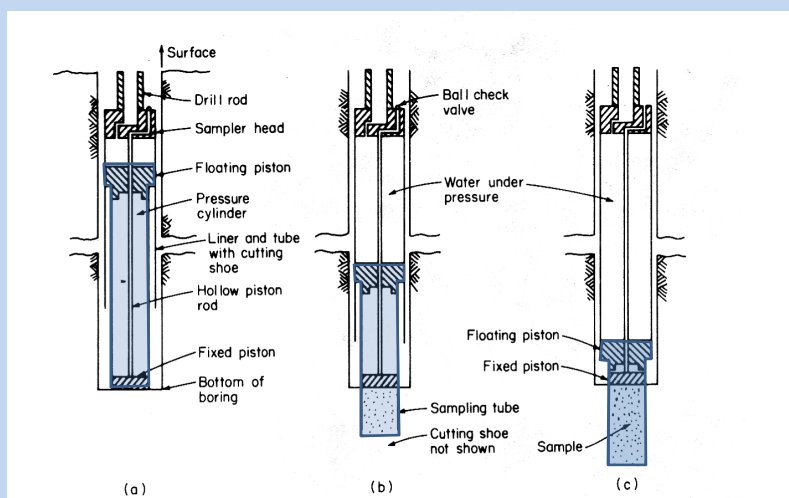
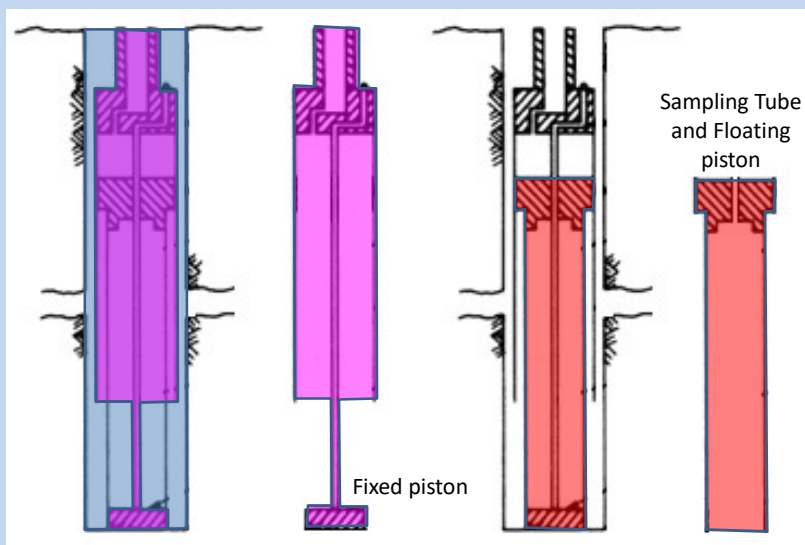


Figure 6-4 Piston sampling. (a) Sampler is lowered to bottom of boring and fixed piston is seated on soil. (b) Increasing pressure in the pressure cylinder advances the sample tube. (c) At full advance the sample is recovered on withdrawing the sampler unit. Note that many details are omitted for greater clarity.

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Piston Sampler..... contd.



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Hand-carved sample

Peck,Hensen,Thornburn, pp.112-113

L4/P13

Undisturbed samples may be carved from soils possessing little cohesion, provided the material is exposed in test pit, shaft or tunnel.

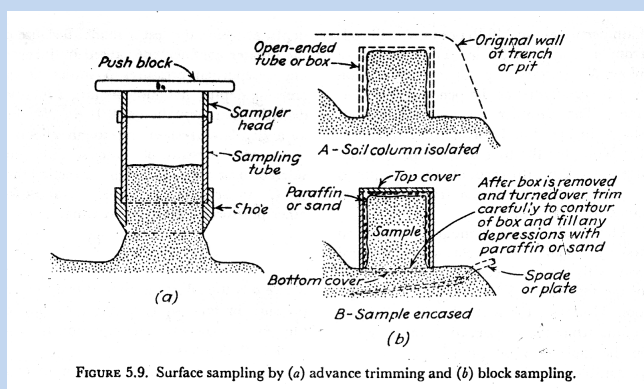


FIGURE 5.9. Surface sampling by (a) advance trimming and (b) block sampling.

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