SOIL EXPLORATION

Dr.Supia Khatun
Astt.Prof. Dept. of Civil Engineering
Aliah University, Newtown Campus, Kolkata 700156

er.sk1980@gmail.com

Sampling

Primary Objectives of Sampling

- **To get the material into the sampler**
- **To keep it their during withdrawal of the sampler**
- **To obtain the sample with least disturbance**

Sources of disturbances

Method of boring, stabilization, casing, sampler, withdrawal, preservation and transportation

Sampling

Types of soil samples

Conditions that contribute for the disturbance of samples and unreliable test result

- Distortion of the samples during pushing / driving of sampling tubes into the natural strata.
- Relief of in-situ pressure leading to surface cracks when samples are extracted from sampling tubes for laboratory tests. This is particularly applicable to over consolidated clay soils.
- Disturbances caused to the samples during extraction from sampling tubes.
- Disturbance to the samples during handling and transporting from the site to the laboratory.
- Evaporation of moisture from the sample due to improper sealing.
- Careless during sampling and testing

Types of sampler

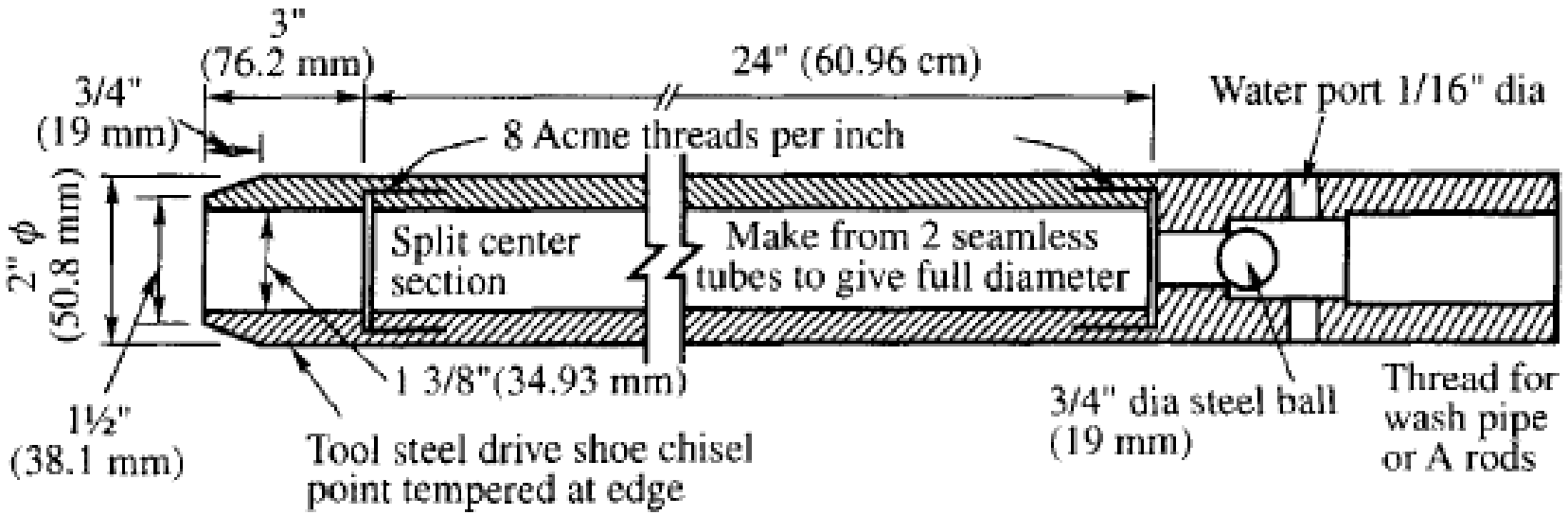
- Split spoon Sampler
- Thin walled sampler
- Piston Sampler
- Foil sampler
- Denison sampler

Split Spoon Sampler

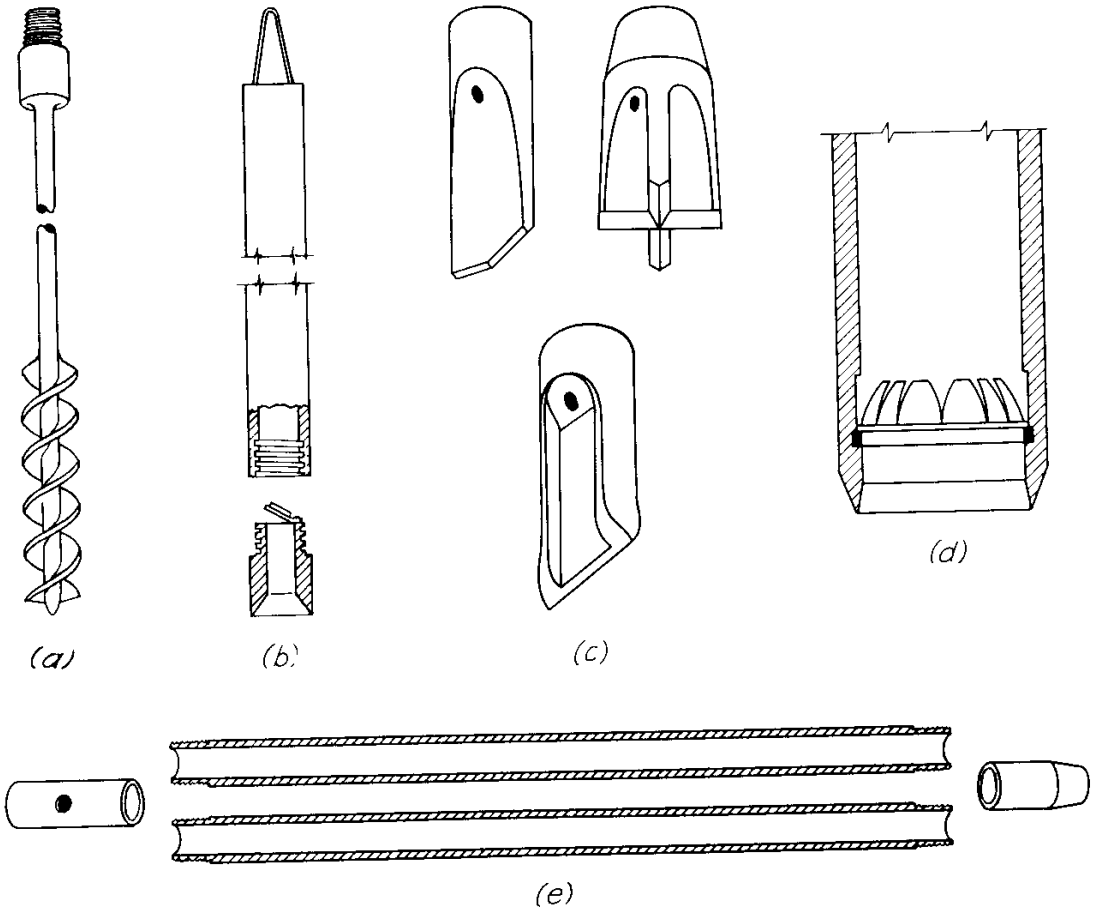
In order to obtain soil samples from exploratory drill holes, a sampling spoon is attached to the bottom of the wash pipe or drill rod in place of the bit and is lowered to the bottom of the hole. It is forced or driven into the soil to obtain a sample and is then removed from the hole.

Sampling spoons for exploratory borings commonly consists of a pipe with an inside diameter of about 1.5in and a length of 1 to 2 ft. the pipe is split lengthwise. Consequently the sampler is called a split spoon. While the sample is being taken the two halves of the spoon are held together at the ends by short pieces of threaded pipe. One piece serves to couple the spoon to the wash pipe. The other, which has been sharpened, serves as the cutting edge while the spoon is driven into the soil.

Split Spoon Sampler



Sampling tools

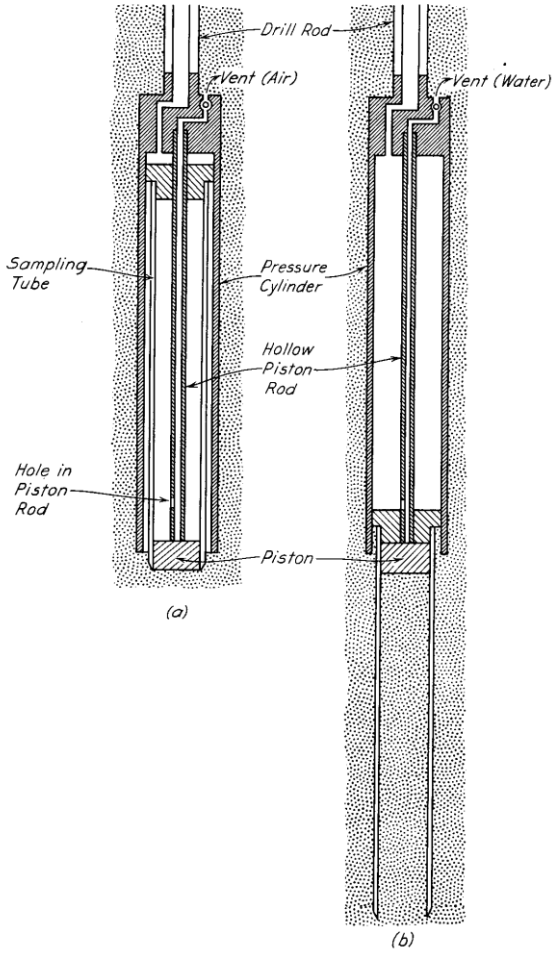


Thin Walled Sampler

- If the project calls for reliable information concerning the shearing resistance or stress-deformation characteristics of a deposit, the degree of disturbance of the samples must be recorded to the minimum compatible with the benefits to be obtained from the information. Whatever type of sampler is used, a certain amount of disturbance of the soil is inevitable.

- The degree of disturbance depends on the manner in which the sampler is forced into the soil and on the dimensions of the sampler. The greatest disturbance is caused by driving the sampler into the soil by successive blows of a hammer, and the best results can be obtained if the sampler is pushed into the ground at a high and constant speed.

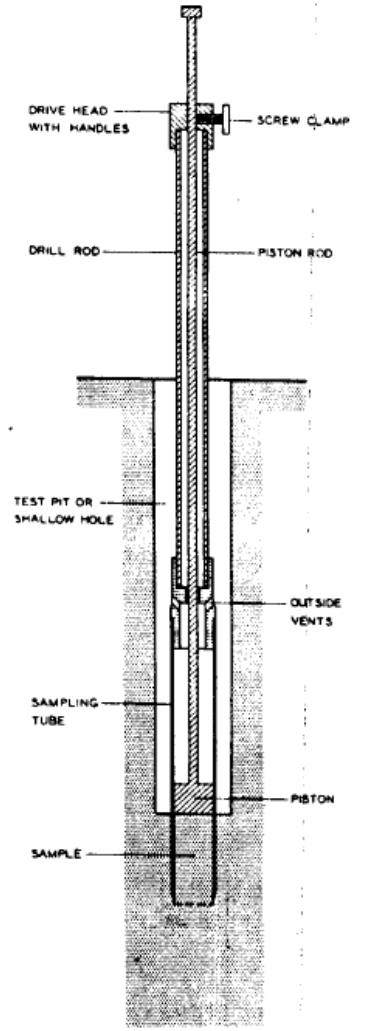
Piston Sampler



Sampler

Piston Sampler

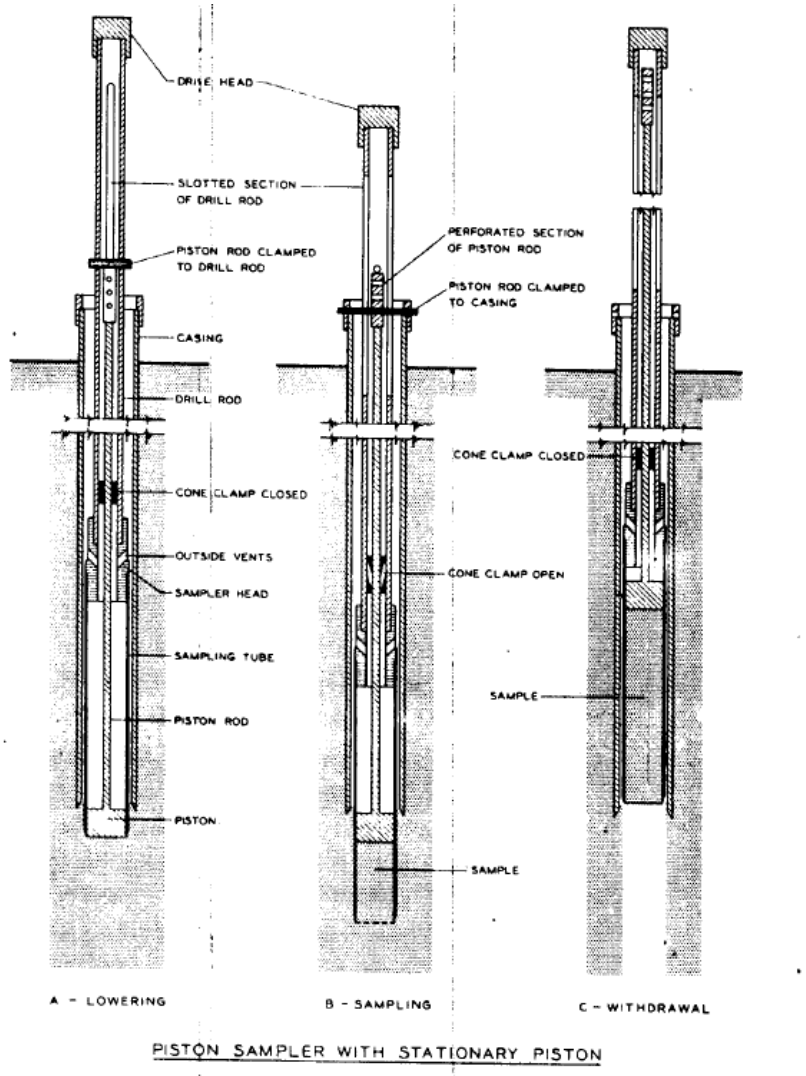
With
Free Piston



PISTON SAMPLER WITH FREE PISTON

Sampler

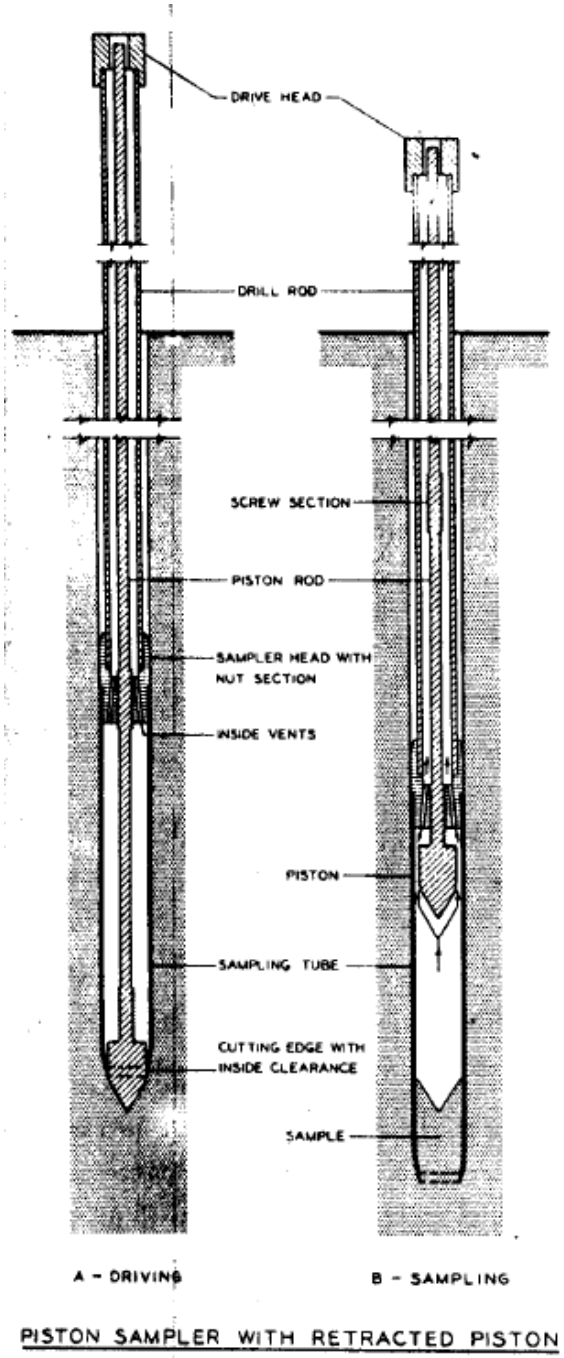
Piston Sampler With Stationary Piston



PISTON SAMPLER WITH STATIONARY PISTON

Sampler

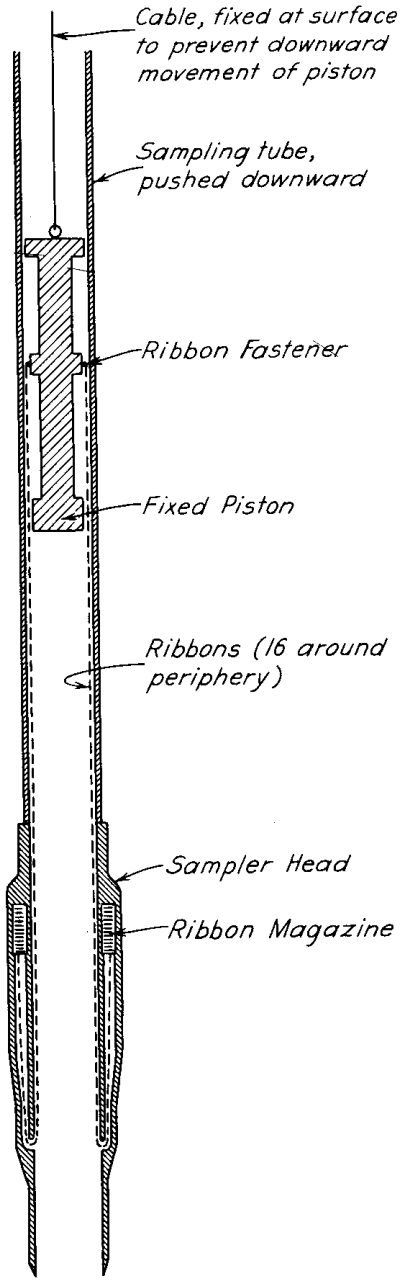
Piston Sampler With Retracted Piston



PISTON SAMPLER WITH RETRACTED PISTON

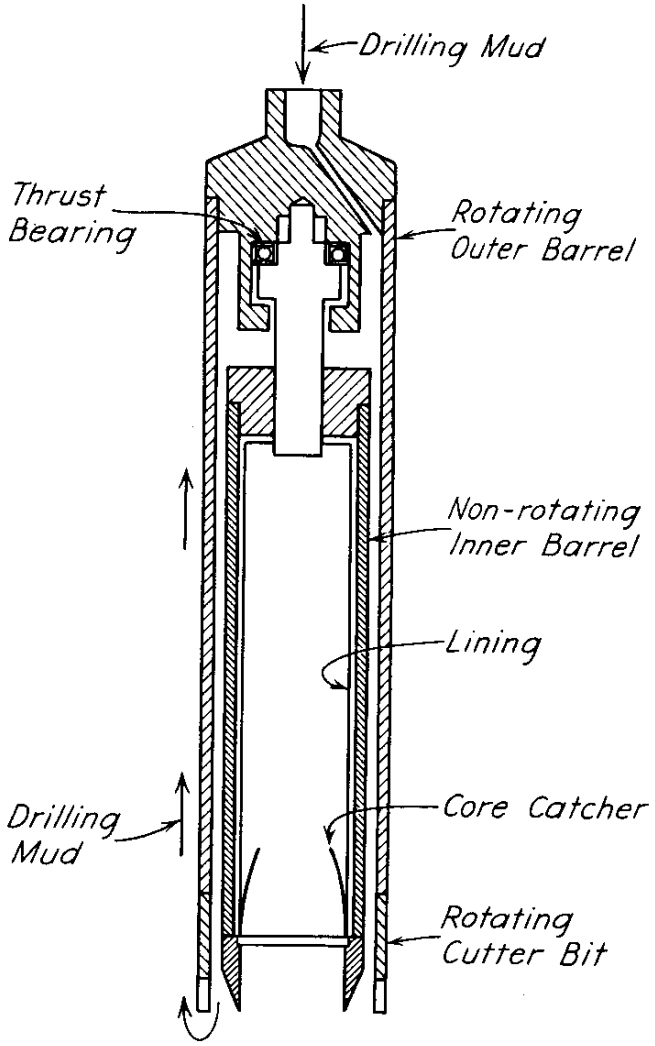
Sampler

Swedish Foil Sampler, Kjellam et al., 1950



Sampler

Denison Sampler



Sampler Design

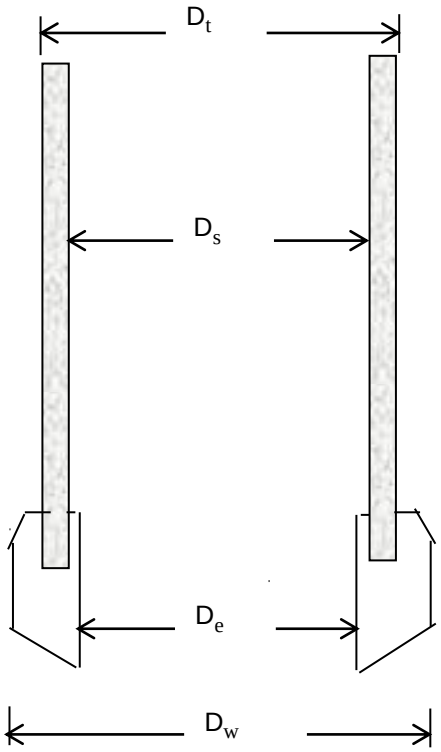
Necessity of Design

Sampler Design

Necessity of Design

Sampler Design

General Requirements of sampler



Sampler Design

General Requirements of sampler

Diameter of sample:- A diameter of 2 to 3 in(50 -75 mm) is usually satisfactory in detailed exploration and for samples intended for routine laboratory tests, where as a diameter of 4 to 6 in. is required when special tests or multiple tests on soil from a single stratum are to be performed.

Length of sampler:- Since the top and bottom sections of a sample often are partially disturbed, and since the danger of losing the sample during withdrawal decreases with its length, the sampler should preferably be long enough to utilize the safe depth of penetration, although practical consideration in some cases may limit the maximum net length to about 5 ft.

Sampler Design

General Requirements of sampler

Wall thickness and area ration:-The area ratio should be reduced to the minimum compatible with the purpose and structural strength of sampler and should preferably not exceed 10 to 15 percent, especially not for open drive samplers. It is possible that the allowable limit is higher for samplers with a stationary piston , but simple thin-wall samplers will generally cause less disturbance of the soil than the heavier composite samplers.

Shape of cutting edge:-The cutting edge should be sharp and never rounded or blunt, and the angle of taper should be as small as practicable. For a sampler with an area ratio exceeding 10 to 15 percent the angle of taper should be less than 10 degrees except close to the edge where the angle may be increased to 20 to 30 degrees in order to avoid an easily damaged feather edge.

Sampler Design

General Requirements of sampler

Inside clearance:-Except for very short samplers with no clearance, the inside clearance ratio should be from 0.5 to 0.3 percent according to the soil conditions. Larger ratios may be used under special conditions and when the primary object is to obtain long samples. An inside clearance ration of 0.75 to 1.5 percent is suggested for average conditions, but further experiments are desirable to determine the optimum values. Commercial tolerance on the internal diameter of the tubing should be taken into consideration.

Outside clearance:-Samplers used in cohesionless soils should have no outside clearance, but a small outside clearance is desirable although not necessary for samplers used in cohesive soils. Bearing in mind that the outside clearance increases the area ratio, it is tentatively suggested that the outside clearance ratio should not exceed 2 to 3 percent, but its optimum range of values has not yet been determined.

Sampler Design

General Requirements of sampler

Inside smoothness:-The inside of the sampling tube or liner should be clean and smooth without any protruding edges or irregularities which may engage the soil. When grooves or core retainers are used, the upper edge of the groove should be offset slightly and the space between individual valves or leaves should be filled in so that a smooth and continuous interior surface is preserved.

Preservation of sample:- the sampler should be so constructed that the sample can be preserved in the sampling tube itself or in a thin-walled liners. The tube or liner should be coated with the samples are to be stored lacquer or consist of noncorrosive material, at least when the samples are to be stored in the tubing for, an appreciable length of time. There is less danger of disturbance and loss of the sample when a continuous, in contrast to a sectionalized or split, liner is used

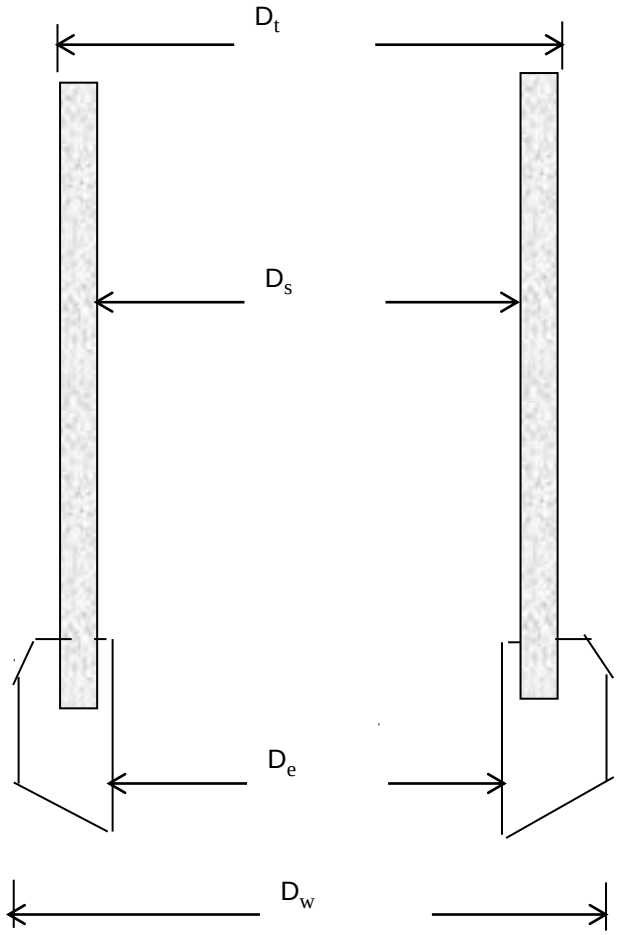
Sampler Design

Quality of sampler

Area ratio, Ca = $\frac{D_w^2 - De^2}{De^2}$

Inside clearance, Ci = $\frac{D_s - D_e}{D_e}$

Outside clearance, Co = $\frac{D_w - D_t}{D_t}$



Quality of Samples Collected

Total recovery ratio = L/H

True recovery ratio = L/(H-F)

Gross recovery ratio =Lg/H

Net recovery ratio = Ln/H

Where, L = original length of sample = Top of the sample to the cutting edge of the sample before withdrawal;
H = Depth of penetration = Original bottom of the bore hole to the cutting edge of the sampler;
F = Deflection of the soil at the cutting edge;
Lg = Top of the sample to the cutting edge of the sampler;
Ln = Net length of the sample from the top of the sample to bottom of the sample after trimmimg for sealing
S – Shortening = H – L= compression of sample only
if no excess soil enters into the sampler.

Quality of Rock Samples Collected

Rock Quality Designation, RQD = La/Lt

Where, La = Total length of intact hard and sound pieces of core of length greater then 100 mm arranged in its proper position

Lt = Total length of drilling

Relationship of RQD and in-situ Rock Quality

RQD	Rock Quality
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
0-25	Very Poor