Geotechnical Measurements and Explorations

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Lecture No. # 21

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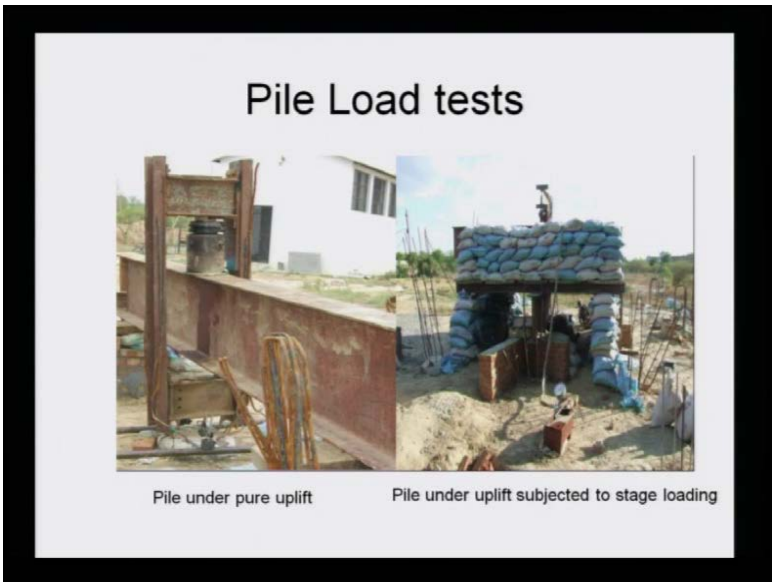

Now next is, is your pile load test, means piles under uplift load. If you look at this basic concept, sometimes what happen in upstroke structure, because of buildings are erected in the pile foundations, because of lateral load, the pile may subjected to uplift force. What will happen in pile uplift force? Pile will try to in uplift force; it will try to go in upward direction. So, to conduct in field, how you are going to conduct in the insitu conditions? This has been done at IIT Kanpur, geotechnical engineering laboratory.

This is a specially designed hollow girder, and this is again another girder. So what will happen? In this, if you look at here, this is the pile head, this is pile head, and these are the anchor piles both the ends, this is anchor piles. In the pile head, first we will do, this hollow girder has been fixed; by means of in pile head, whatever the main enforcements in the piles are there; it has been fixed. If you look at here, it has been welded with the main hollow girder. Then after that, you fix the girder inside placing it, inside the hollow girder, and give some gap here in the hollow girder up from the base. And fix it in such a

way that at the top of the girder, hydraulic jack can be rested, and the head of the hydraulic jack can be connected your hollow girder.

Now, once this is fixed with this position, so with these positions if this is fixed, how the mechanism going to work? That means once this is fixed, once you apply by means of hydraulic jack, it will try to push the hollow girder; it will try to push the hollow girder. As these hollow girder has been already fixed with the main pile head, so automatically it will try to impose reverse force in the in the girder. So what will happen, because of this gap, what will happen? This pile will come out; it will come out from the ground. In this way, you will get uplift load versus displacement. Now, here these are the, this is shown, this is the dial gauge. And this dial gauge is there, then diametrically opposite; as I said earlier, diametrically opposite; if you look at here, diametrically opposite. Here one, here dial gauge is here; other end, this side, this is the another dial gauge.

So with this by means of dial gauge, you can this the way, earlier we have conducted a pile load test in in compression, same way pile load test in uplift can be carried out. The load increment load has been applied here; with each increment of load, this displacement observed to be noted, then load versus settlement or load versus displacement curve to be plotted.

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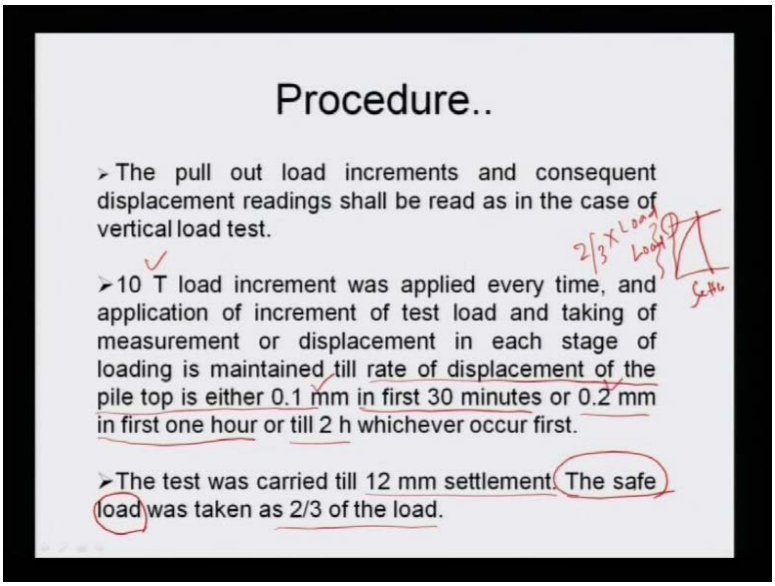

Now, what is the now the condition? The condition for this is, again if you look at here, taking the measurement or displacement in each stage, where you want to stop it. Now

the same way in case of compression, pile load test in compression same way, you wait till the rate of displacement of the pile top is either 0.1 mm in first 30 minutes or 0.2 mm in first 1 hour or till 2 hours of 0.2 mm, whichever occur first that means either this condition achieved first or this achieved first, that point you stop it and record what is the total displacement for a particular load, say 10 term.

The test will be carried out as I said up to 12 mm settlement, the safe load was taken as two-third of this load; in case of tensile load also, you can plot load versus settlement, load versus settlement. In this case, in load versus settlement, you go up to 12 mm of settlement or displacement, and measure the load, how much the load up to 12 mm? That load, with that load, two-third of this load is nothing but your safe load. So, it is thus procedure is same; this procedure is same as like your piles under compression load.

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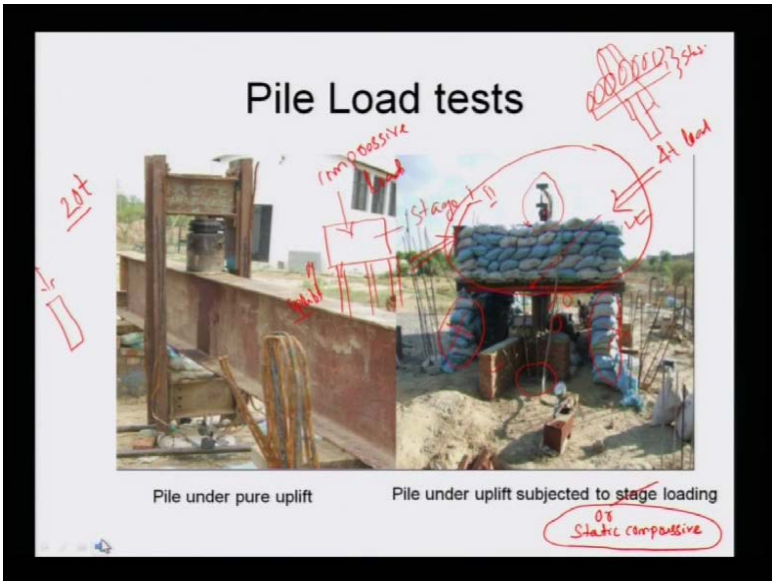

Now, next come back to another interesting thing; piles under uplift subjected to static loading or subjected to static compressive loading or subjected to stage loading, you can say that subjected to static compressive loading. What is it mean? This kind of load test in insitu condition, how far it has practical importance? What does it mean? Suppose this is a building, and below this building, suppose pile foundation it has been constructed over pile foundation. So what will happen? This multi-storey building over the period of time may be it cannot be considered within a day; so this multi-storey building has been constructed phase wise.

Suppose let us say, this is the building, and it has been constructed over the pile foundation, group of piles or maybe say group of piles or 3 by 3 or group of piles of 3 by 2 it has been constructed. How the load comes to the pile foundation? Suppose this is a building, multi-storey building, what will happen with this multistory building? It cannot construct within a day; it has been constructed phase wise that means stage wise, suppose this is called stage I, and this is called stage II, so this is called stage III.

Now in stages, once suppose stage I, has been constructed, what does it mean? Suppose already there is a construction of say one-third of this construction has been made, so what is its practical significance? That means suppose one stage, suppose say stage I, stage I, it has been constructed. Then over the pile foundation, what happen? The pile will be acted upon by compressive load, acted upon by compressive load. So, if there is any earthquake or if there is any wind load, the pile will try to come out that means there will be uplift. So uplift capacity of pile in presence of stage loading or you can say in presence of static compressive loading, how it bears? How it is, then the test philosophy is this is, if you look at here, the pile is somewhere else here inside, single pile; and with this single pile, these are the platform has been made both the end; with this platform, there are girder means one girder has been placed.

You see in this platform, this is the one girder, from this side one girder has been placed. And these are the anchor piles; one anchor pile is here, another anchor pile is at the other end. With anchor piles means, whatever the reinforcement were there, it has been connected to the girder. With the single girder, a platform has been made; a platform has been made initially; and to make this platform stable, it should be centric otherwise, it will fall down. So, some sandbag filling has been made; so that, where the girder can placed. Then over this platform, how much static load, you want to put it? That means suppose you want to put 20 percent of safe load of static load; that means suppose there is a pile load, if that pile is by compression, how much it fell? Suppose safe load is say, 20 ton. Now if safe load is 20 ton, suppose it has been constructed over five stages; five stages means, each stage, 4 ton load has been taken, so that means you decide.

Then in stage I, you apply the sand by means of sandbag over the platform; this is complete platform, apply your 4 ton load. Once you apply this 4 ton load, then wait for sometime; after that, place place hydraulic jack at the top; this is girder II, slightly come out, if you can see here. Then over this, place a girder; then over the girder, place a

hydraulic jack. From center of the pile, this is a pile is in between, whatever the reinforcement are there, it can be tied of with this girder and the hydraulic jack. So, this by application of hydraulic jack, what will happen? It will pull this pile up.

Then during this loading arrangement, remove the side by side sandbags, so that it can stand over this girder only; that means how it comes? This is the girder; over this girder, these are the dead loads. Then here is pile; then over this pile, another hydraulic jack is there; from hydraulic jack, from pile, the reinforcement has been tied off; that means once you give the loop, give the pressure on the hydraulic jack, it will try to pull against your static loading. So this is another test of pile load test; these are all brief idea about how in the field insitu conditions, the pile load test has been done. As I said, all the piles, here in this case, it has been made for cast insitu bored piles. Once again if I show it, these are all your cast insitu bored piles. This is all about pile load test. Now, we will start next parts, I will show something about your subsoil exploration about sampling, and others.

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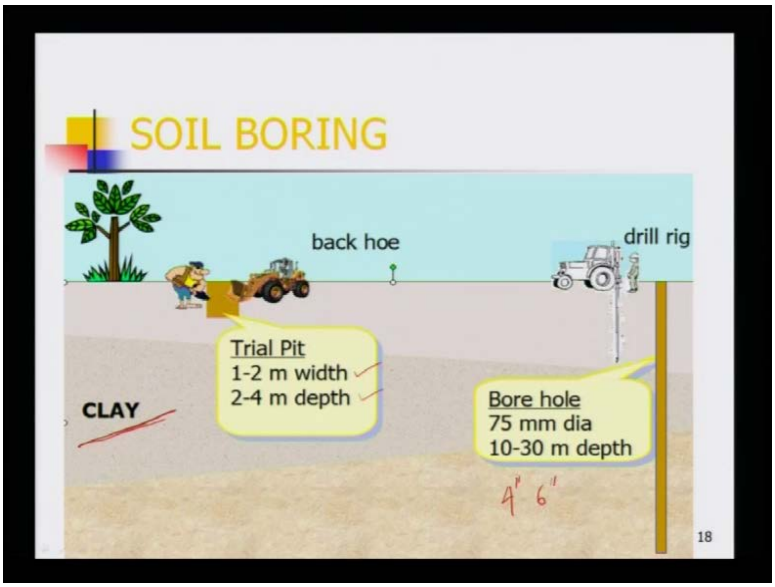

Another part I have already explained this soil boring, but I want to show this figure wise means, open pit or trench you can do it trail pit, up to you can limit is up to one point generally 1 point 1 to 2 meter width and 2 to 4 meter depth. It can be done kind of a clay, where you can very easily collect a soil sample by means of a trial pit. Bore hole, as I

said earlier, it is generally 74 mm dia, but you can in India, you can achieve the 4 inch bore hole, 6 inch bore hole, you can made it.

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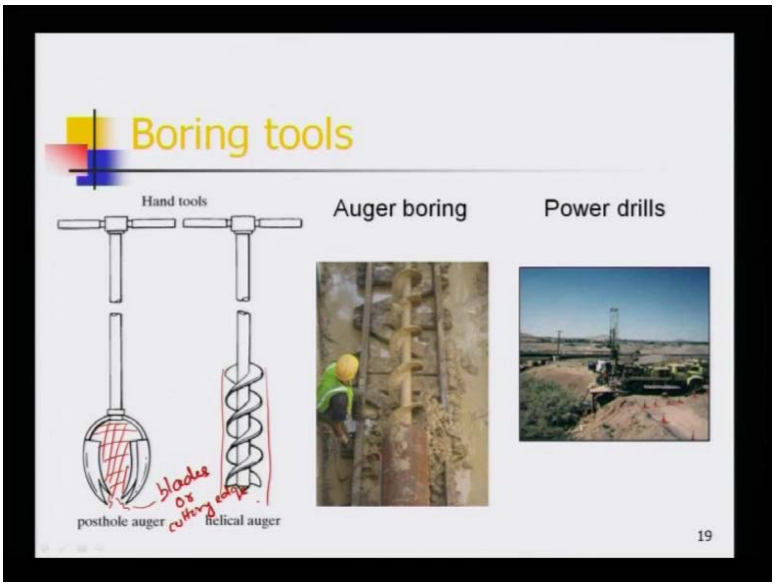

Now, some figure wise I am showing. Now augers; if you look at that, I have already discussed this, there are two types of augers; one is posthole auger, other is your helical auger. If you look at these posthole augers, these are your cutting edge or blades, blades or cutting edge. Once you rotate, what will happen? It will cut the soil, and slowly, slowly soil will go inside, and pack this, pack this, inside this pack it soil inside. Now in case of helical auger, helical auger sometimes it can be do it, it can make the hole up to this diameter; just it is showing, how what how it looks in figure wise, auger hand tools means posthole auger and helical auger.

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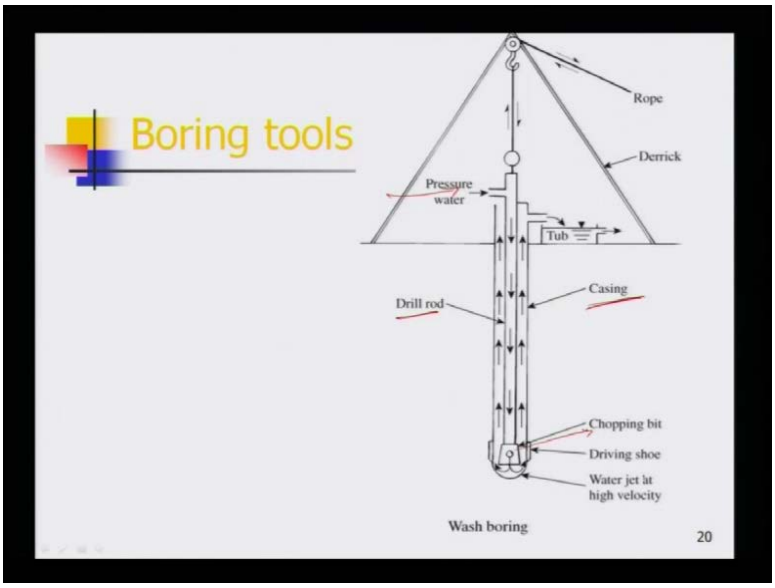

Next is your wash boring; how it has been done? If you look at here, this is your drill rod, this is drill rod, and this is your casing pipe, this is your casing pipe. This drill rod one end, pressurize water has been pumped inside; by means of water jet, and by means of water jet, it will go up, down, up, down, so that mixer with water, this is this is called chopping bit. Mixer of water, the soil will loosen. And one end soil will loosen means, other end, because there is a high pressurize water, other end it will come out, soil, water and mixer. This I want to show how it looks in figure, and this is a rope by means of rope manually somebody can pull this a drill rod, then drop it, so with with water, with this driving shoe, soil soil will loosen, and it will come out.

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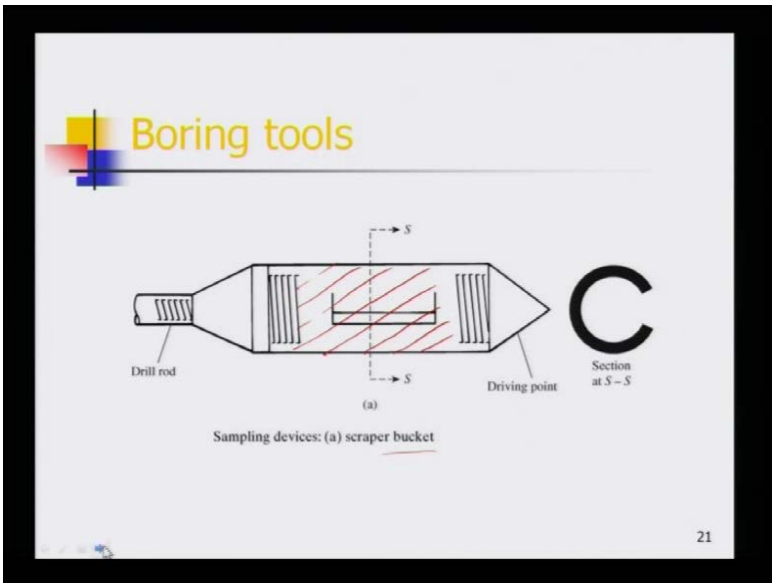

You see, these are all your sampling tools, boring tools, sampling tools, there are different kinds of boring tools, that is your scraper bucket and driving, this is your driving point. Once you push it inside, it will collect the samples in inside, I will show lateral in detail, the dimension required for different kinds of soils; what kind of soil, this is required.

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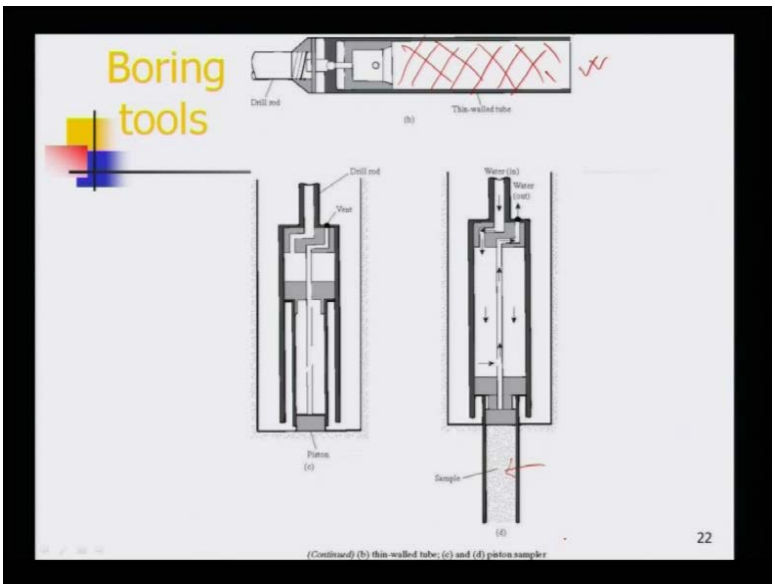

Another boring tool is thin wall tube; if you look at their thin wall tube, this is generally used; this is in India generally used. Once you in the drill rod, once you attach this thin

wall tube, and push it inside, undisturbed soil sample, you will collect. The dimensions and others will show you later. Another one is your piston sampler; by means of piston action, this soil sample will go inside; this is called piston sampler.

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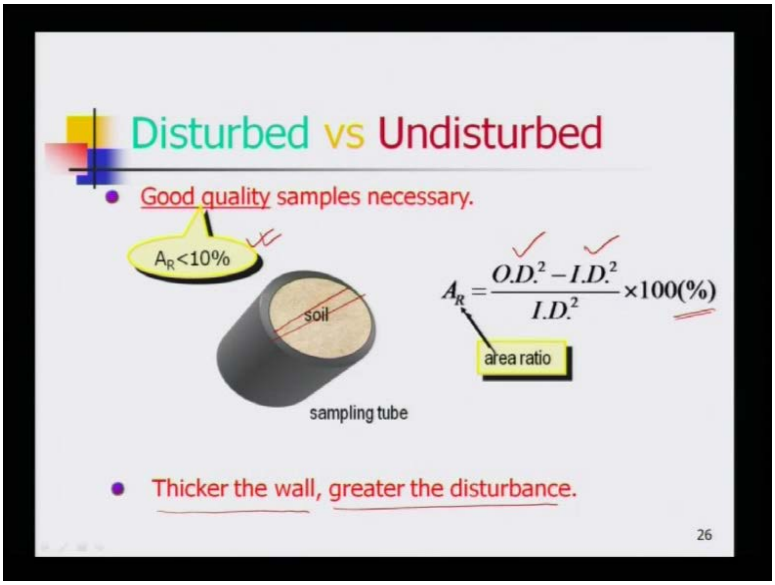

Now with this sampler, thin wall tube, piston sampler may how do you know that undisturbed, good undisturbed sample you have collected; all samples whatever you collect in the field, they are more or less disturbed. But I can say that, these are undisturbed, because depending upon this area ratio is outside diameter, this is the outside diameter minus outside diameter whole square minus inside diameter whole square divided by inside diameter into 100 percent, into 100, this gives in terms of percentage. Good quality of samples required that means as far as possible we say, the samples are undisturbed is if area ratio is less than 10 percent. Then we can say that this these are the good quality of samples and undisturbed samples. Another one is thicker the wall, greater the disturbance; wall will be more thick then disturbance will be generally more.

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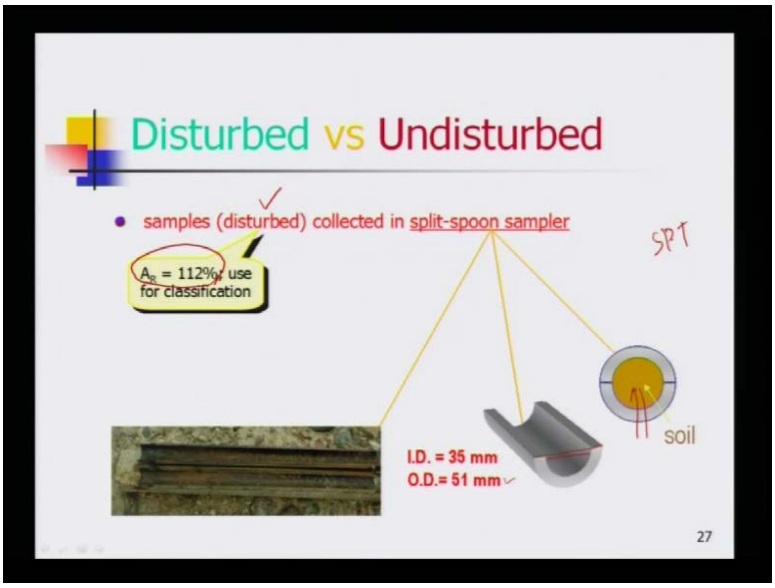

If you look at this split-spoon sampler, the outside diameter is 51 mm, inside diameter is 35 mm. The soil collected here, area ratio, here in split-spoon sampler, the area ratio is 112 percent. So, whatever soil collected from near split-spoon sampler inside this, this can be used for classifications; these cannot be said as undisturbed soil sample, because area ratio is more than 10 percent. So samples collected in split-spoon sampler, these are called disturbed sample. Where these split-spoon samplers used? In standard penetration test, split-spoon samplers sampler is used.

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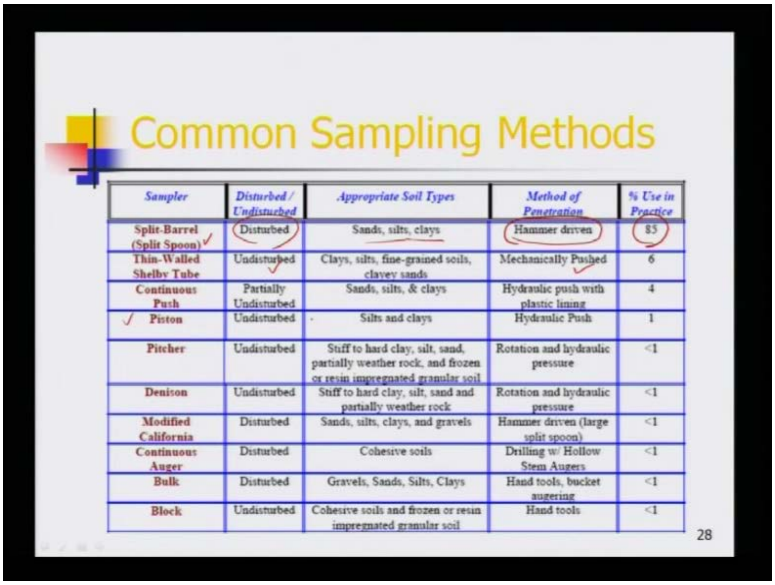

Sampler	Disturbed / Undisturbed	Appropriate Soil Types	Method of Penetration	% Use in Practice
Split-Barrel (Split Spoon)	Disturbed	Sands, silts, clays	Hammer driven	85
Thin-Walled Shelby Tube	Undisturbed	Clays, silts, fine-grained soils, clayey sands	Mechanically Pushed	6
Continuous Push	Partially Undisturbed	Sands, silts, & clays	Hydraulic push with plastic lining	4
Piston	Undisturbed	Silts and clays	Hydraulic Push	1
Pitcher	Undisturbed	Stiff to hard clay, silt, sand, partially weather rock, and frozen or resin impregnated granular soil	Rotation and hydraulic pressure	<1
Denison	Undisturbed	Stiff to hard clay, silt, sand and partially weather rock	Rotation and hydraulic pressure	<1
Modified California	Disturbed	Sands, silts, clays, and gravels	Hammer driven (large split spoon)	<1
Continuous Auger	Disturbed	Cohesive soils	Drilling w/ Hollow Stem Augers	<1
Bulk	Disturbed	Gravels, Sands, Silts, Clays	Hand tools, bucket augering	<1
Block	Undisturbed	Cohesive soils and frozen or resin impregnated granular soil	Hand tools	<1

Now, common sampling methods; method of penetration, appropriate soil type, disturbed or undisturbed sample you are going to get, and generally what is the percentage use in practice. If you look at here, split-spoon sampler, you will get disturbed; and what kind of soil type, what kind of soil we are going to use? If it is a sand, silt or clay, and how we get the samples? We get it by means of hammering; from the top, we hammer it, it penetrates inside; what is that percent used in practice? It has been used nearly 85 percent.

So, next is your thin walled shelby tube; you can get undisturbed; this thin walled tube, we say thin walled shelby tube; it can be used any kind of soil - clay, silt, fine-grained soil, clayey sand; and it is just simply pushed, mechanically pushed, so percentage in practice is 6 percent. And continuous push that is your partially undisturbed, sand, silts and clay; piston by means of piston, undisturbed silt and clay, hydraulic push; these are the all common sampling methods. How this sampling method has been done?

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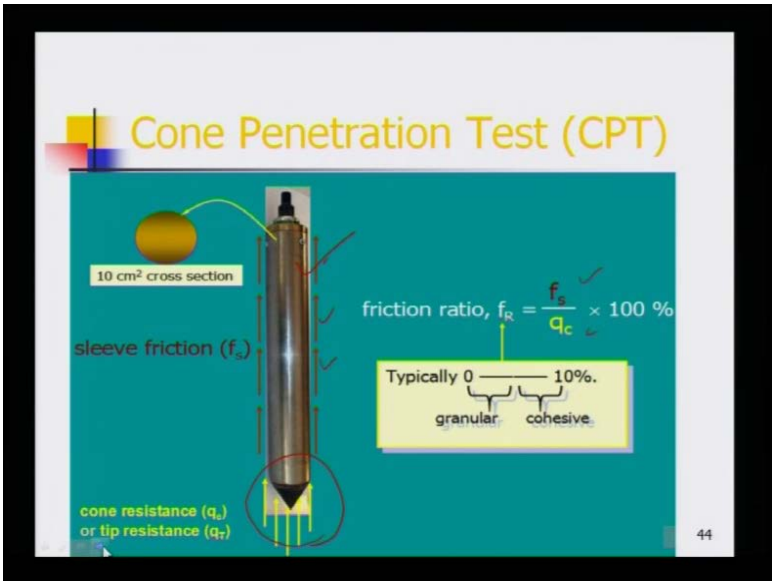

Now, this cone penetration test; I explained also in blackboard also. If you look at the figure, this is 10 centimeters cross section of cone, and this will be measured by means of sleeve friction; these are all sleeve friction, and cone resistance or tip resistance, you can measure it here. So, friction ratio f R is equal to f s by q c into 100 percent. Typically it will be 0 to 10 percent of this, has been used.

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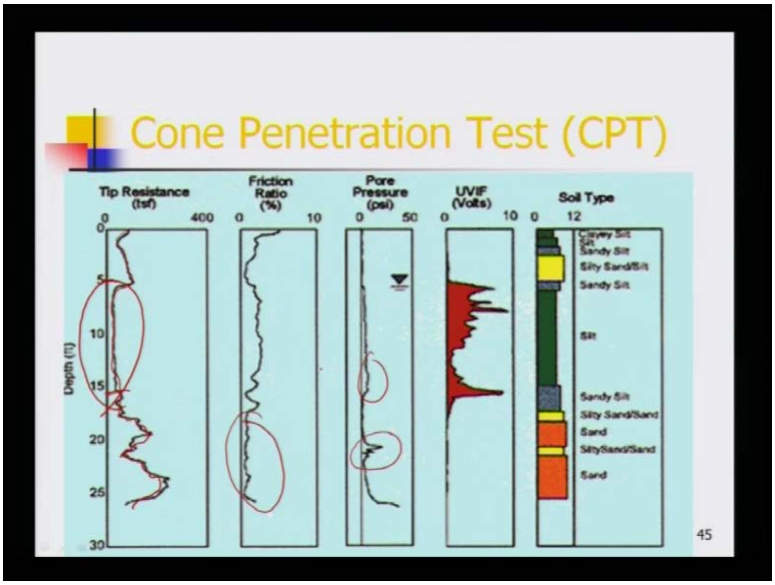

If you look at this diagram, cone penetration test; cone penetration test gives a continuous reading. The tip resistance, if you look at here, I can do it up to 30 meter, how it is varying? That means, the tip resistance, cone resistance from depth 5 meter to 15 meter, it is very less to take load. If I look at this friction ratio, friction ratio also similarly, here it is very less; then poor pressure ratio, poor pressure, how much poor pressure variation is there? It is somewhere else around 20 to 30; the pore pressure will be high.

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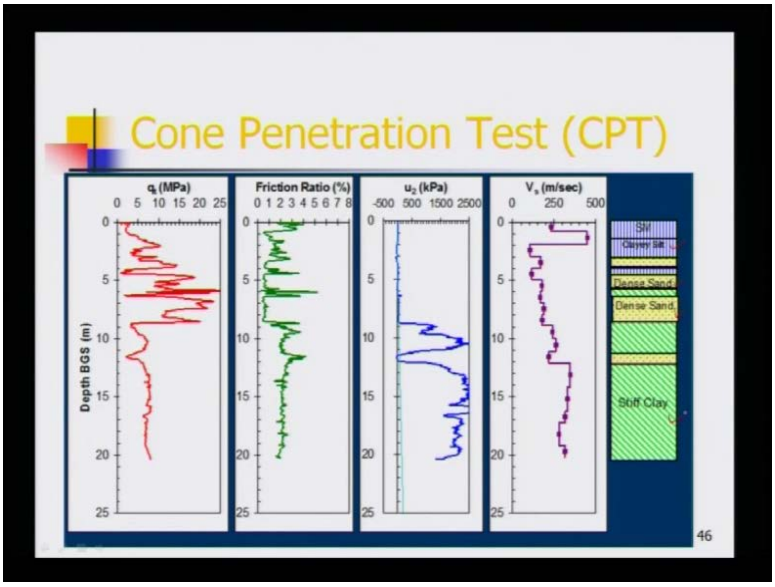

Now cone penetration resistance with these, it is shown again in terms of Mega Pascal, all these and velocity depending upon that. The classification has been made with this

cone resistance, this will be clay silt, and this will be dense sand, dense sand and stiff clay.

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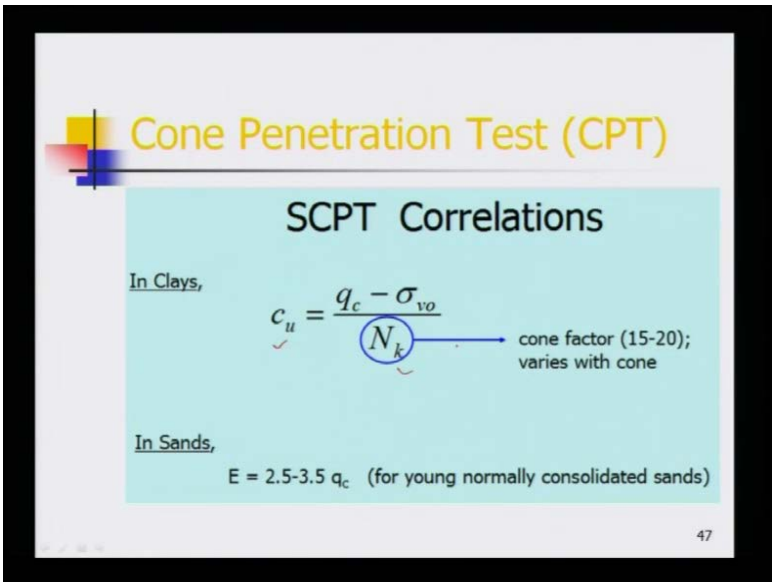

From cone penetration resistance, with this cone factor, I said also earlier with SCPT correlations C u versus N.

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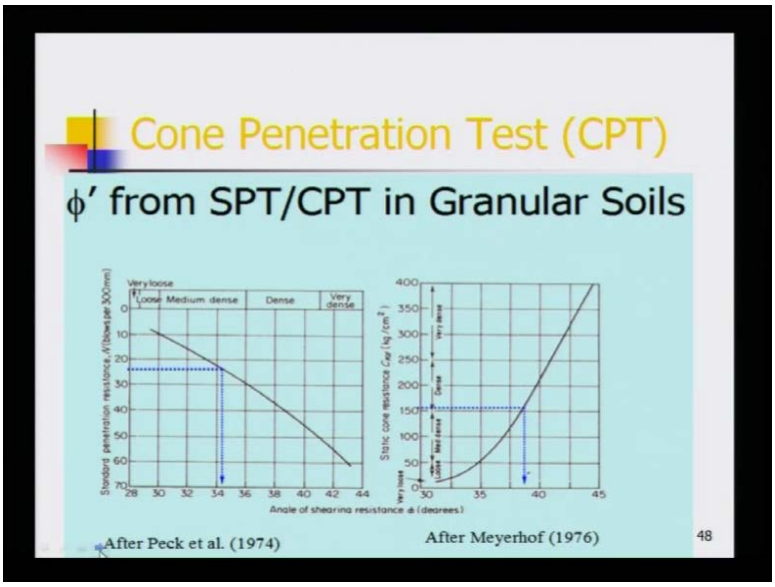

Now, standard presentation resistance versus angular frictions: These graphs already drawn.