Geotechnical Measurements and Explorations

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Lecture No. #11

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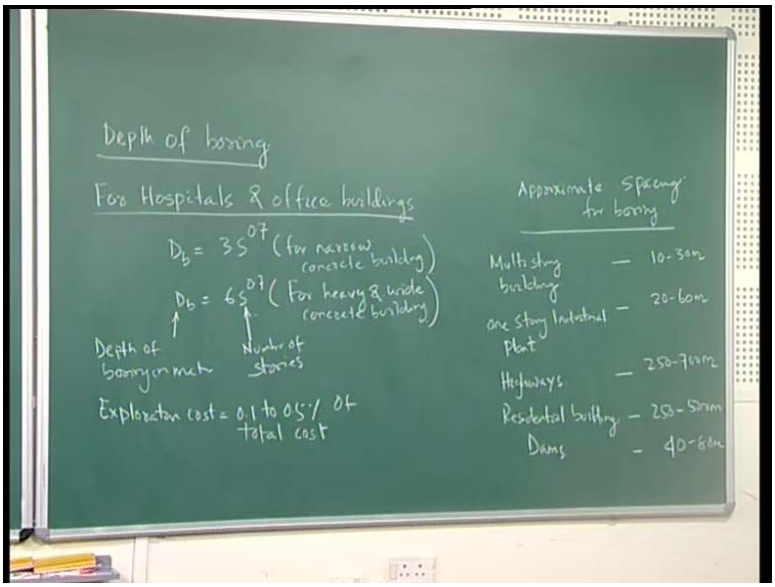

Another rules for depth of boring for hospitals and office buildings (No audio from 00:23 to 00:39) for hospitals and office buildings depth of boring is equal to 3 S 0.7 or narrow concrete building, then (No audio from 01:06 to 01:27) where D b is D b is depth of boring in meter, S is equal number of stories, the exploration cost 0.1 to 0.5 percent of total cost. Approximate spacing for boring multi-storey building, then one storey industrial plant, then highways, then residential, then dams, multi-storey is 10 to 40 meter, one storey industrial plant is your 20 to 60 meter, then highways 250 to 700 meter, residential building 250 to 500 meter, dams 40 to 80 meter.

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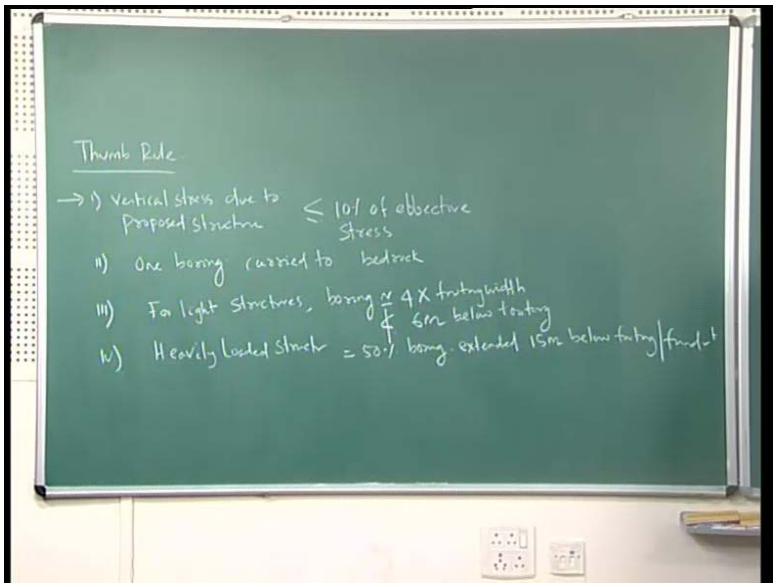

Also sometimes we use this thumb rule. (No audio from 04:00 to 04:13) Vertical stress due to proposed structure, which is equal to less than equal to 10 percent of effective stress, then it may be it may be… So, one boring carried to bedrock bedrock or at least level below the anticipated level of influence of the building where may be bedrock coming into picture. Then for light storey structures for light structures boring should be extended four times footing with, not less than 6 meter below footing or heavily loaded structure 50 percent boring should be extended 15 meter below footing or foundation.

Now, if you look at this there are two parameters; one is your depth of boring, another is your number of boreholes, you are supposed to carry out. And if you look at this depth of boring last class we consider based on the stresses acted on that, but there are certain thumb rules also applied, guidelines also given for hospital and office buildings this depth of boring is three times of S for narrow concrete, and for heavy and wide concrete building. S is your number of storeys, S is your number of storeys, so three times number of storeys to the power 0.67, six times numbers of storeys to the power 0.7.

So, one thing is exploration cost, whatever you are going to do the soft surface exploration, exploration cost is always you have to maintain 0.1 to 0.5 percent of total cost. Now, this is just approximate spacing of the boring some guidelines are there, now for multi-storey building generally it is preferred between 10 to 30 meter, the spacing of the boring between 10 to 30 meter for multistory building, one storey industrial plant 20

to 60 meter for highways - highways as it is continuing it is 250 to 700 meter, and residential building 250 to 500 meter, and dams 40 to 80 meter.

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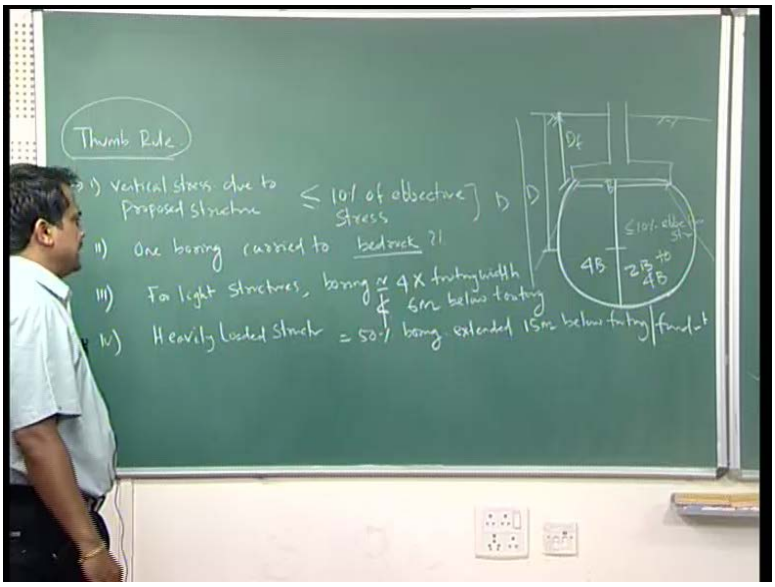

Now, instead of going these this may be you can use this thumb rule, what thumb rule says - vertical structure increase in the vertical stress, vertical stress due to proposed structure that means increase in stress due to proposed structure, where it should be less than 10 percent of effective stress. (No audio from 09:00 to 09:10) That means increase in stress or vertical stress due to proposed structure, it should be less than below the footing, somewhere else less than equal to 10 percent of effective stress. So, that is your depth of boring, then if below the foundation if bedrock is nearby try to try to go for a borehole at least one boring should be carried out up to the bedrock, if bedrock is available, then for residential buildings boring should be done at least four times width of the footing.

If we look at here, generally the pressure bulb is two times B to 4 B, this is my width of the footing, so for residential building or light structures boring should be done; that means depth of boring should be four times width footing, that means this is 4 B plus this depth. This is your depth of foundation, so four times width of the footing plus depth of foundation this total will be, this is your depth of boring or or it should not be less than 6 meter below the footing for heavily loaded structures, that means multi-storey buildings 50 percent of boring.

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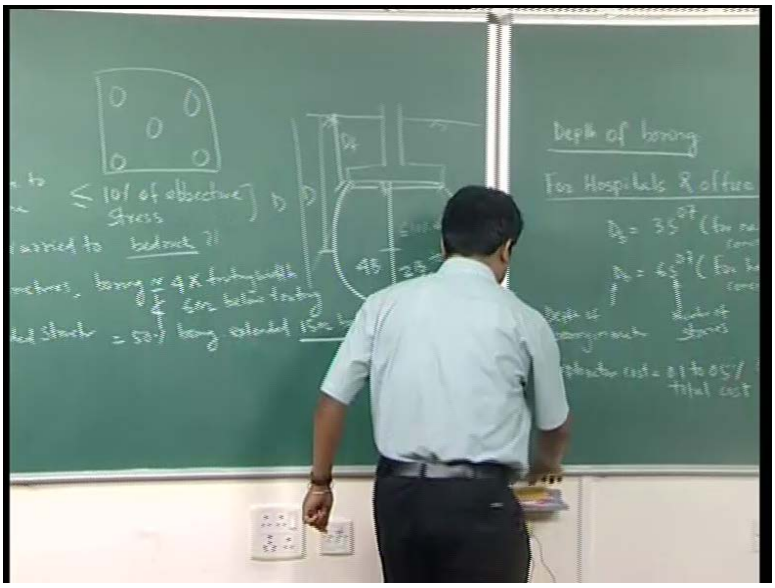

50 percent of boring, suppose this is an area, 50 percent of boring extended below 15 meter below the footing, at least 50 percent of boring suppose it is decided number of bore holes to be carried out in multi-storey buildings say five number of bore holes. With this five number of bore holes at least two boreholes should be extended up to a depth of 15 meter below the footing. These are all this thumb rules thumb rules, so may be certain guidelines are there, so practicing engineers they decide from case to case what criteria they are going to use, and also depth, and spacing of the boring means particularly depth is more more important parameter means what depth you are going to carry out your boring, and collect the undisturbed soil sample. And spacing depending upon that this spacing also it decides, how much your spacing going to take between the each boring what is that spacing you are going to take it.

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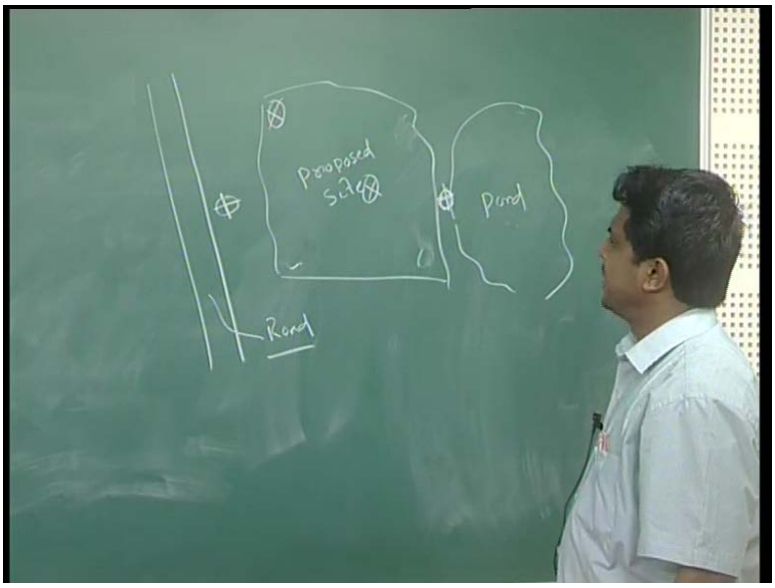

Now, we can discuss one more thing, suppose this is a proposed site, this is a proposed site it has been planned to go for multi-storey building, and nearby you see nearby there is a pond, and nearby there is also a road. Now, how do you decide how many number of bore holes you are going to carry out, if you look at this is a proposed site; the proposed site is very close to pond, because once there is a pond this water table may raise or water table may fall depending upon the weather.

So, this has a effect - effect of a water table to the proposed site, so nearby this pond fast is nearby the pond go for a one borehole, I am talking about number of bore holes, then if there is a road or may be a rail track rail track, so because of the road or traffic load, because of this there is a kind of cyclic load may come into picture. So, may be one more boring you can go nearby the road, so that you can get how much the soil, how much the disturbed means soil profile it is coming. Now, if this is the proposed site after this two bore you can decide, because bottom line is your the cost of your subsoil exploration should be 0.1 to 0.5 percent of total cost.

Now, you can decide 1, 2, 3, 4, 5 at the center or you can decide one at the corner, one at the center; it depends upon the how this proposed structure means what is this structure? Is it a light structure, is it a multi-storey building or it is for industry purpose. Depending upon the use the number of bore holes has to be decided, but depth you can go for from

this thumb rule or based on this stress criteria or may be based on the residential building or may be other criteria practicing engineer used.

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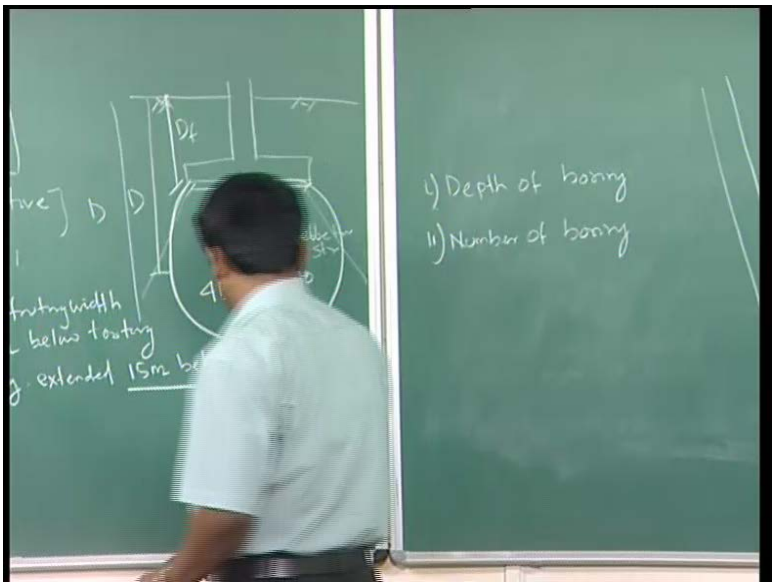

So, these are the two major parameter before you start planning your subsoil exploration, one is your depth of boring, and second is your number of boring. Now, let us start with this boring, now this is this is about planning depth and number of bores.

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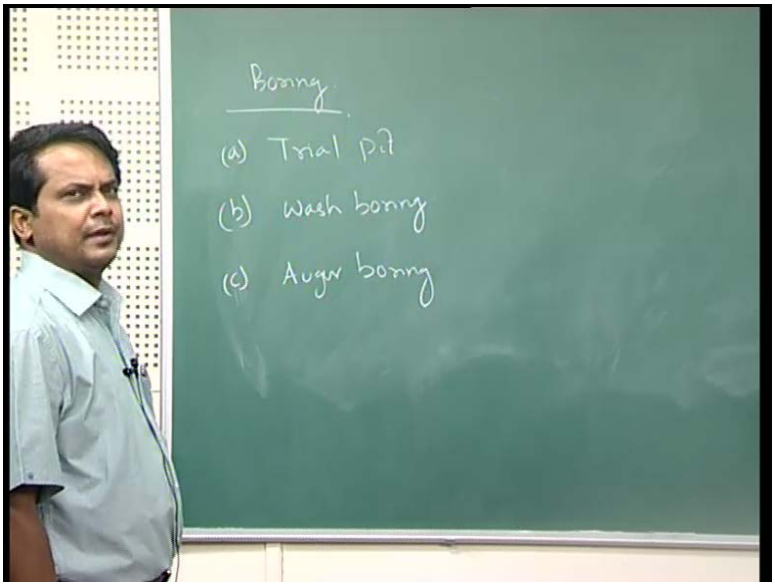

Now boring: how what are the different boring? One is you can do it by means of a trial pit, second is your wash boring, third is your auger boring; there are three kinds of boring. One is your trial pit, second is your wash boring, third is your auger boring.

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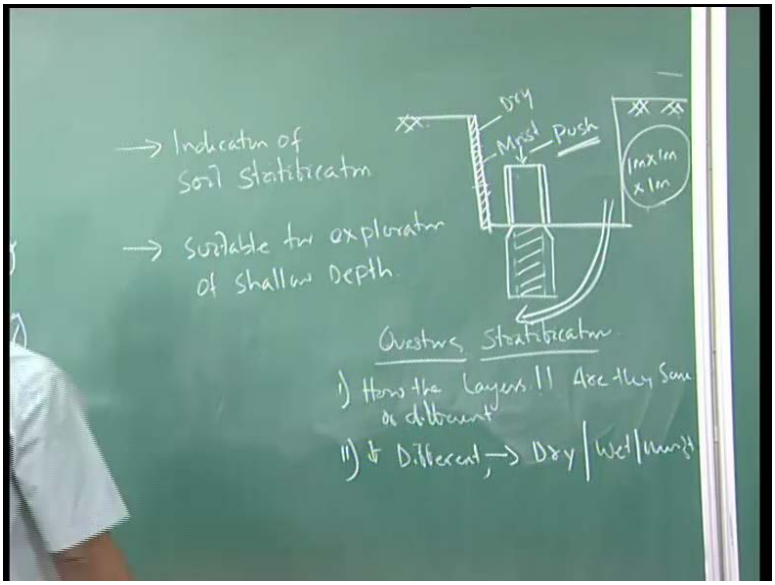

Now, let us start with your trial pit. (No audio from 16:17 to 17:35) Now come back to trial pit, first criteria is this trial pit where you are going to use, if it is required for subsoil exploration up to a shallow depth; shallow depth means subsoil exploration say up to 2 to 5 meter depth, then or may be up to maximum say 7, 8 meter depth, so then you can go for trial pit. What does it mean by trial pit? A pit approximately one meter by one meter by one meter, it is not necessarily that it should be one meter by one meter by one meter.

What I said approximately one meter by one meter by one meter, you do this pit, then once the pit has done, so you go inside. First, you look at how the soil's stratification within that one meter is it varying the soil stratification, if it is varying what is that indication? Suppose, this one is very dry, you can look at by visual inspection, it is very dry. Even, if you take a soil from this stratification in your hand, and pinch, and you can rub it, you can find it out whether it is a coarse grain or fine grain. You take this soil, and drop with your forefinger, and middle finger, then you can find it out whether it is whether it is fine grain or coarse grain, if it is a coarse grain you can clearly observe there are particles, and is there any moist questions during stratification.

First is how the soil layers, how the layers? Are they same or different, if different how it looks? How it looks? Is it if different, is it dry or wet or moist. So, this gives an idea, whether there is a soil stratification varying at shallow depth or may be the soil profile up to the shallow depth will be same. Once this stratification you can observe by visual identification, then you can take this casing pipe here, and push it not by hammer. You push it inside, push it inside, so that slowly you push it, push it inside. So, this casing pipe will go inside, so once it go inside you take out by means of chisels, this casing pipe make it out.

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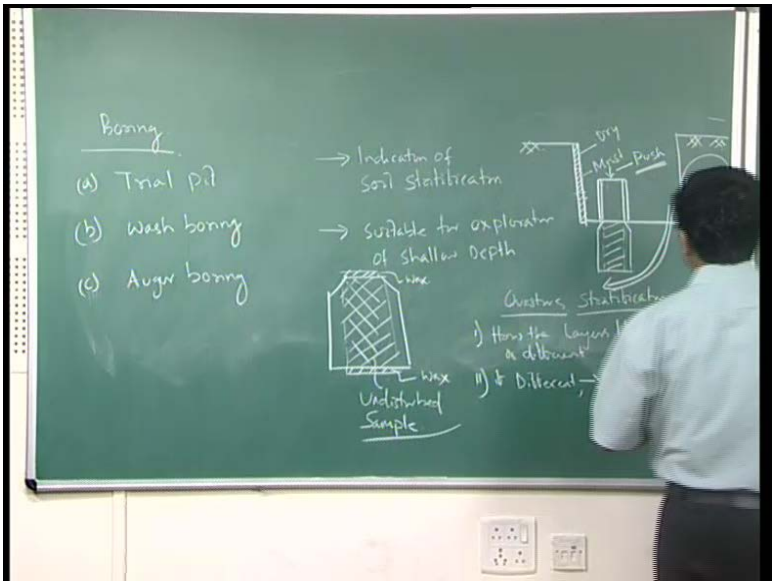

Once you make it out, the casing pipe (No audio from 21:03 to 21:11) it collects undisturbed sample, by means of wax by means of wax both the ends by means of wax, you make it water tight, this is your wax water tight, so that moisture content preserved - moisture content preserved. Then this undisturbed soil sample can be taken to the lab for soil testing, this about this sampling tube samples, this we will discuss after this part of the boring, then come back to next is your wash boring.

(No audio from 22:07 to 23:40)

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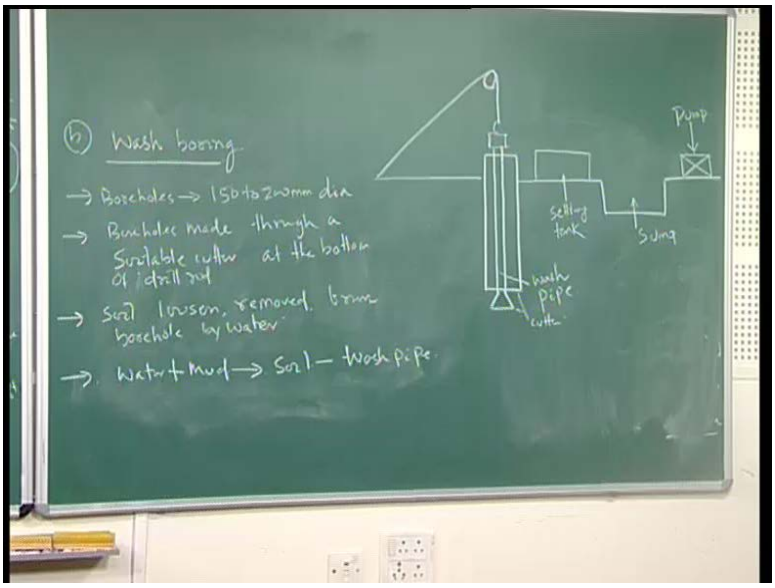

Now, in this wash boring bore holes made generally 150 to 200 mm dia, suitable cutter - this is a suitable cutter dia with a suitable cutter at the bottom of drilling rod. Bore holes made through a suitable cutter at a bottom at the bottom of drill rod, soil is loosen and removed from the bore hole by water soil loosen and removed from bore hole by water or water mud - water plus mud, it carries soil up to the annular space through wash pipe. Just after this once boring is over we will discuss this is what kind of soil it is required, this is what kind of soil, and auger boring if soil profile is there, because these are the techniques what boring means trial pit where you are going to apply wash boring where and auger boring.

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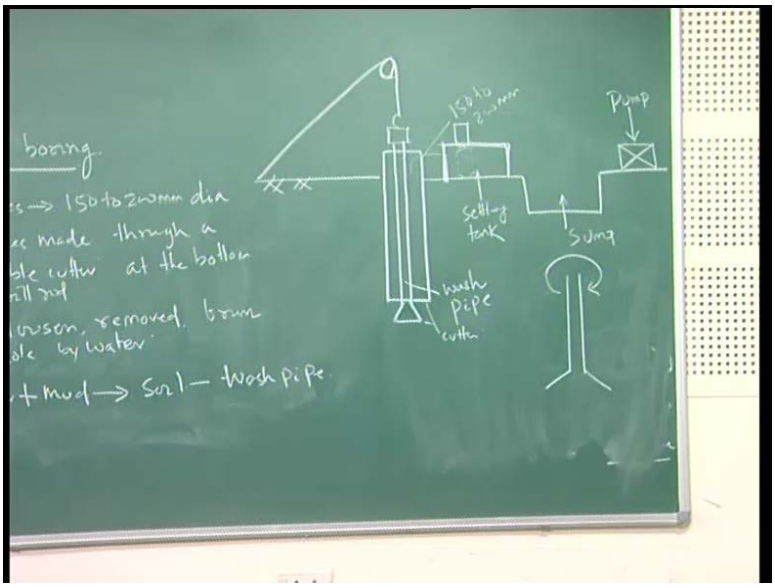

Now, come back to wash boring, in this method what this is a diagram, in this method generally borehole of 150 to 200 mm dia has been done. How you made it, generally a cutter particular a cutter once there is a drill rod is like this at the end, there is a cutter there is a cutter at the end is there. Once the drill rod rotate this cutter will move, so it will cut from the ground surface. So, with this help with this help what will happen? Soil will loosen, and this bore hole has been made, now by means of by means of water injected inside, the soil loosen soil will mix up with this water, and it will become mud means mixture of soil and water, it will come out it will come out through the wash pipe, and outside it will come out, and nearby some tank has been prepared.

Where the soil plus water has been settled means soil soil has been kept in inside a settling tank, where this soil settle, then water comes out over the period of time soil settle. So, once soil settle, then you can insert the pipe mold inside, then you can collect your undisturbed sample. This kind of soil particularly wash boring, particularly this kind of technique wash boring technique indirectly it is giving remolded soil sample remolded soil sample, because once you are going to do boring here, and collected soil in loose condition with water, and taking out here. And make the soil plus water settle in a settling tank, so this is this is remolded disturbed sample put it there, once it settle, then you collect your undisturbed sample. What kind of soil this wash boring generally adopted; that you think, because these are the all techniques I am going to discuss also

what kind of soils this wash boring to be applied, and for trial pit I have already said this is suitable for shallow depth.

Now, come back to auger boring.

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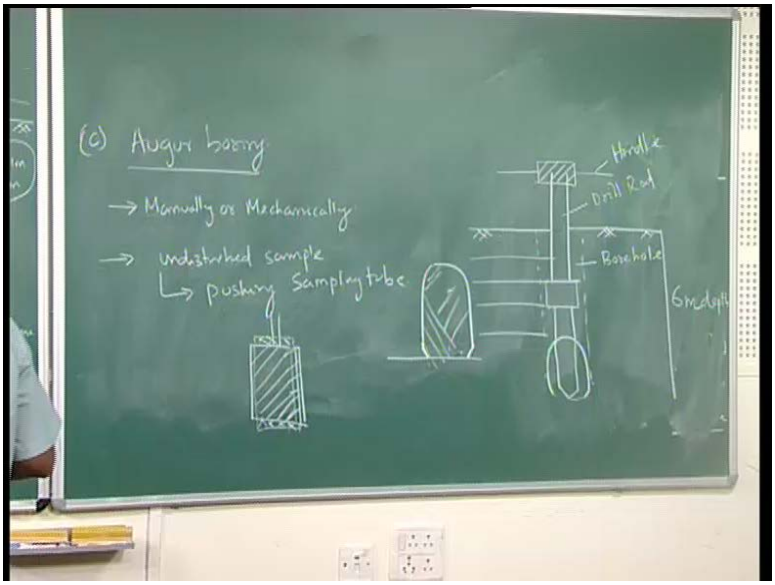

Manually or mechanically operated, undisturbed samples obtain pushing pushing sampling tube. Now, if you look at this auger boring if you look at this auger boring, generally this may be this may be manually or mechanically done, this is a drill rod shaft, it is connected by means of auger.

This auger, particularly this augur is this kind of safe with there is slightly cutting edge, this cutting edge at the end. So, once it go inside by means of drill rod, this is your handle, and this is your drill rod, you can do it manually or mechanically. Once this drill rod manually or mechanically you rotate it, what will happen? It will start cut the soil, where where it is lying, means it will start from the surface cut the soil; once it cut the soil, the soil goes inside. So, once it pull no more cutting is there you can take out, and remove the soil from the augur, then again you advance, that means layer by layer layer by layer, you drill the bore hole you drill the bore hole, and go. Then once this bore hole has been made, suppose it has been said you collect undisturbed sample at 6 meter depth that means first you do the boring by means of auger boring.

Once boring has been made d e p t h; once boring has been made this auger has been detached from the dill drill shaft, then sampling tube has been connected sampling tube sampling tube connected with this drill shaft. So, that it can be pushed inside the soil below the 6 meter, so you will collect undisturbed sample, once you will collect this undisturbed sample take out from the ground surface, then after collecting undisturbed sample; once you collect the undisturbed sample put wax or vax outside cover it. So that, it become you make it watertight, once it is watertight this natural moister content has been preserved, and it can be taken to lab for laboratory testings.

Now, this is first part we have finished planning, first part we have finished your planning that means boring number of number of boring, number of boreholes, and depth of boreholes planning is over. Then technique how do you decide by how do you do the boring, either you go do it by trial pit or wash boring or auger boring, third one is your rotary boring, this I will show not third one.

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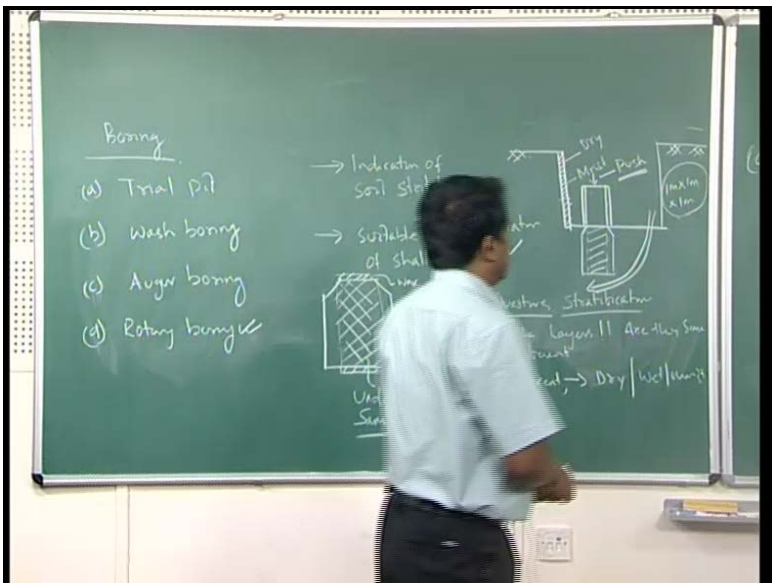

This is a fourth one, this I will show some photographs, so it will clear, clear the completely it will clear, the visualization how this rotary boring has been done or conducted.

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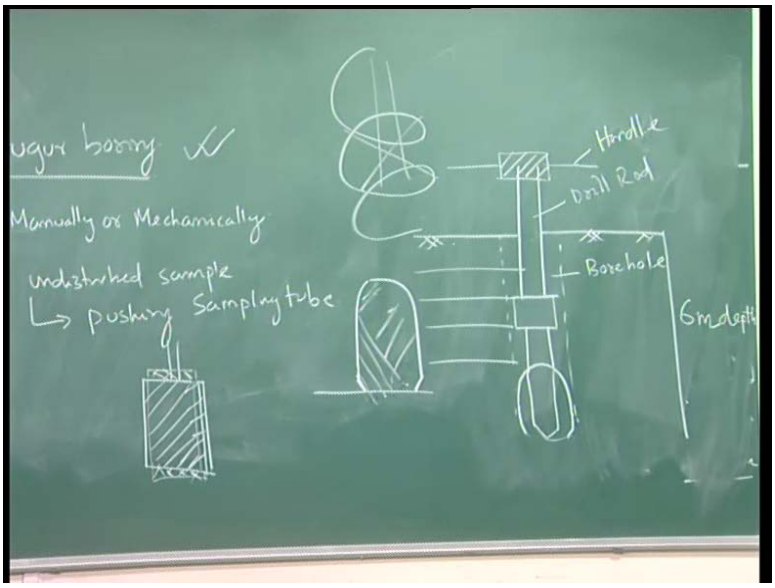

Generally in India generally in India people do it by means of auger boring, because manpower is cheap, and this can be done manually also. If you look nearby somewhere else manually while constructing house, people do it by means of handle, this auger post, so it cut it. This kind of auger they use or sometimes, they use also blades cross blades, so it will rotate so that soil can be taken out or may be sometimes spiral blades used, so that soil can be taken out. So, this particularly auger boring is most means more popular most popular in India.

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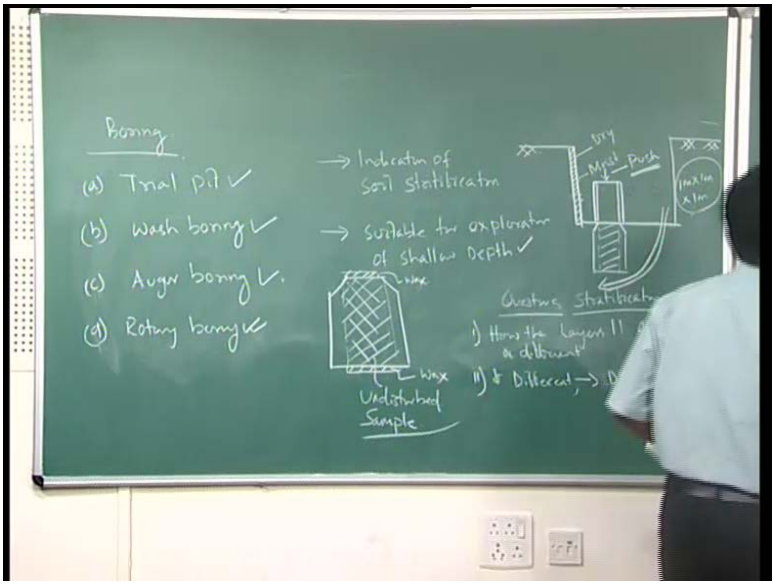

So these are the four types of boring. One is your type trial pit, then second is your wash boring, third is your auger boring, fourth is your rotary boring. Now, what are the field test remaining? What are the means not remaining, what are the field test?

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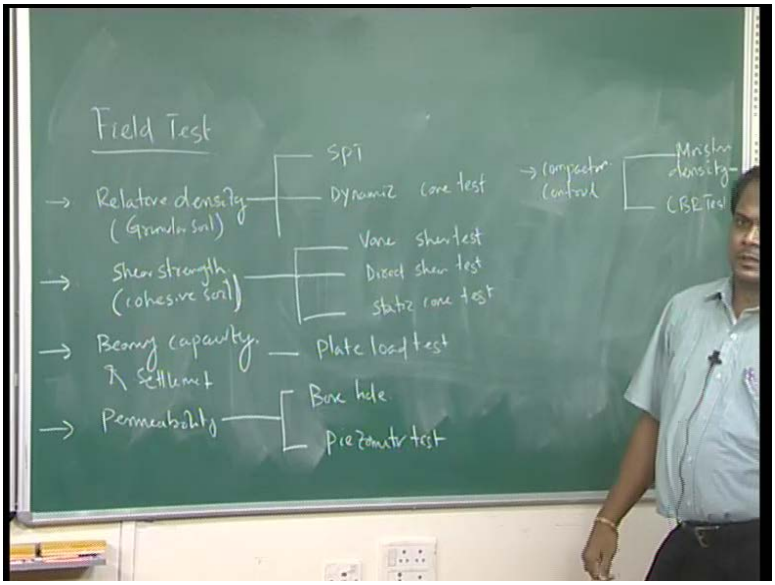

Supposed to be carried out, first part is your planning, that means depth, and number of bore holes, second part is your boring by means of what are the different boring methodology, trial pit wash boring auger boring and rotary boring. Now, once the boring is over, that means soil sample has been collected, undisturbed soil sample for laboratory test.

Then what are the field test? It it is required to do and what purpose? First one is your relative density, so this granular soil, it is SPT standard penetration test or dynamic cone test. Second one is your shear strength, cohesive soil, in this case three test field test - three filed test; vane shear test, direct shear test, then static cone test. Then bearing capacity, and settlement; in this case plate load test permeability permeability bore hole or piezometer test. Then then compaction control, here it is moisture density or CBR test.