Foundation Design
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Lecture - 2A
Subsoil Investigation or Site Investigation
Part-3

So last class I have started details Site Investigation. It includes planning making test boreholes collection of soil samples and laboratory test. Also we have discussed number of boreholes to be decided and depth of the boreholes. Now there are different boring techniques. So, I will go one-by-one.

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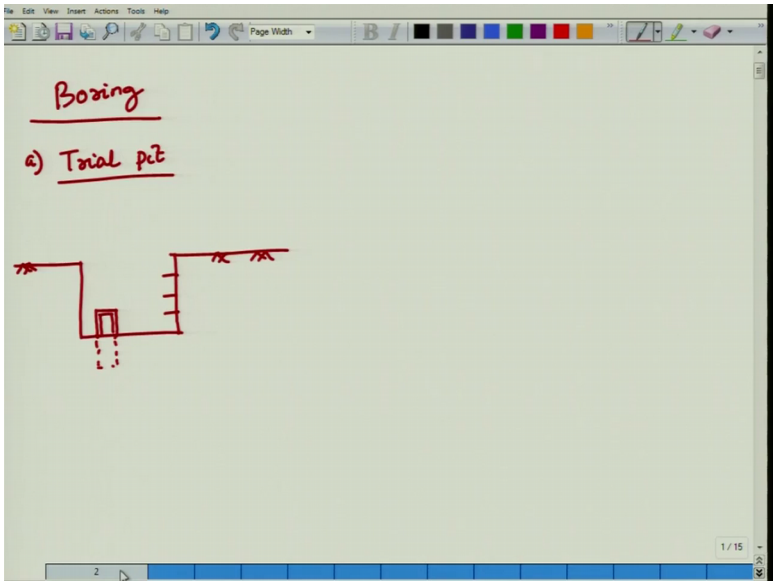

So, if I go this boring, first one as I said, it is the trail pit. Trail pit, in this trail pit generally make a pit of one meter by one meter by one meter. Then push this sampler tubes. This sampler tubes inside the ground surface; that means, this sampler tubes has to be pushed inside the pit. Remember it has to be pushed not it as not going to be hammer.

So basically, what is it mean by doing this pit sampling? So, trail pit is you are getting stratifications of the pit from the side you can get it whether any change in soil stratification or not. And at the same time you can collect also undisturbed of soil samples. So, it is only possible when soil of soft or medium consistency. If it is hard it is

not possible and it will be suitable for a shallow surface exploresense, this is the case appear trail pit.

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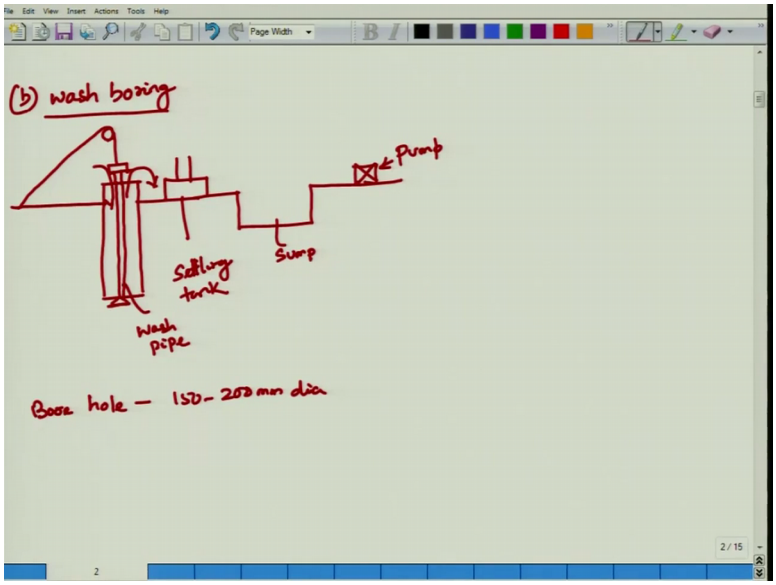

Now, go to wash boring, second part is your technique wash boring. This is your wash boring. In wash boring, let me draw this diagram then you can have some idea. So, in wash boring, the technique, the bore hole of 150 to 200 meter mm dia drills through. And generally this soil is losing and removed from the bore hole by stream of water. That means, one it is a parallel process you are doing a bore hole at this same time this. At this stream of water you are injecting inside one side and other side these soil losing. And other side soil with water it will come out and settle in a settling tank. And then at this settle down over the period of time, from the settling tank you can take or you can push your sampling tube to collect undisturbed soil sample, I cannot say it undisturbed soil sample. Rather it will be a molded soil sample it will be a re molded soil samples.

So, if you can imagine where it is possible for this your wash borings. Wash boring particularly hard soil, where it will be a very difficult kind of very difficult very difficult had of stiff very difficult to collect undisturbed soil samples. It will be very difficult to push your sampling tube. In that case in localize you make a bore hole then wash pipe inside you put it one side you inject your water. So, with water is soil will be losing and other sides soil water mode will be prove out.

And it will settle down in a settling tank then you leave it. That means, you first destroyed it then take it out then it leave it then water will be percolated will your settling tank. So, only soil will be there, and then what will happen? This soil will be again remolded then up to remolded you take out your undisturbed soil samples and do you test the detail merits and demerits particularly trail pit wash boring augur boring, I will discuss later part also, about your sampled tubes different sampling tubes as when use to collect your undisturbed soil sample, that also I am going to discus next means in the further feature classes.

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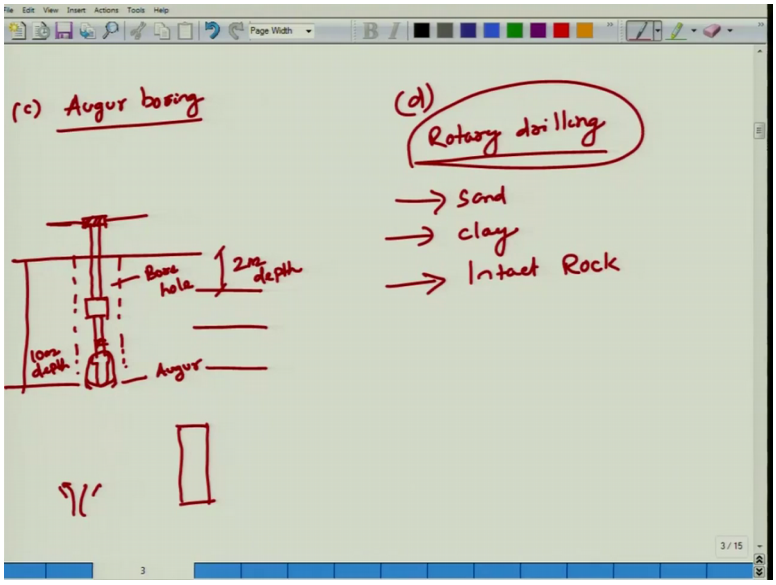

So, third on is your augur boring. Augur boring if I draw it. So, there is a bore hole, then this augur. Then there is a handle here. So, there are 2 type of augur boring. One is manually other is mechanically. So, in case of manually in India man power is labor cheap. So, generally people prepared for manually what will happen by means of augur if you look at the base, there are blades at the end there are blade like these. So, you push it inside and rotate it by means of handle. So, it will try to cut it.

So, then soil will go inside, then you push it inside. So, in this way what will happen you are going to make boreholes up to your requisite depth, than once your made your boreholes suppose it is required to go for bore hole or may be collect your soil sample for example, up to 10 meter depth 10 meter depth, and you need to collect soil sample every 2 meter depth.

So, what you are suppose to do by means of augur boring either it is a manually or mechanically. So, take the augur bored makes you bore hole up to 2 meter depth. Thens once after 2 meter take out this augur remove this augur then are the best after removing there are arrangement here. You can connect it sampling tubes. Generally sampling tubes are of size this this part I am going to discuss later. Then connect it sampling tube. Then lowered down in your sampling tube up to 2 meter depth then push it. So, that soil will go inside so that you can collect undisturbed soil samples.

So, this way 2 meter in augur boring doing bore hole, then detached your augur part attached, your sampled tube collects undisturbed soil sample, then detached sampled tube. Then connect augur then again drill go up to 4 meter, then again take out your augur connect sampling tube call it your on disturb soil sampled. This way augur boring generally, it as to be done. So, in India generally augur boring mechanically manually. Manually people do it because manually what happened 2 persons will be there. This is your handle they will just rotate; it they rotate it. So, that augur will go down then this is your rotary drilling.

It generally down by means of drill bits and it is a advance. This I am going to show you some ppt power point presentations as well as videos. So, any whether it is a hard stratum whether it is a soft stratum by means of drill bits you can make boreholes at the same time, you can collect undisturbed soil samples at any depth. So, it can be used it can be used of any kind of soil. It can be used sand, it can be used clay, it can be used for intact rocks.

So, this is well advanced. This generally people take it by means of truck attached it in a truck, and take it out and do it. It is a advantage of this rotary drilling within no time you can finish it. This will be slightly costlier as compare to augur boring because what will happen augur boring, it takes time generally India people prefer to do it by means of manually, here it as to be done by means of rotary drill by machines push it inside drill it make bore hole then collect undisturbed soil samples at regular enterable and come out.

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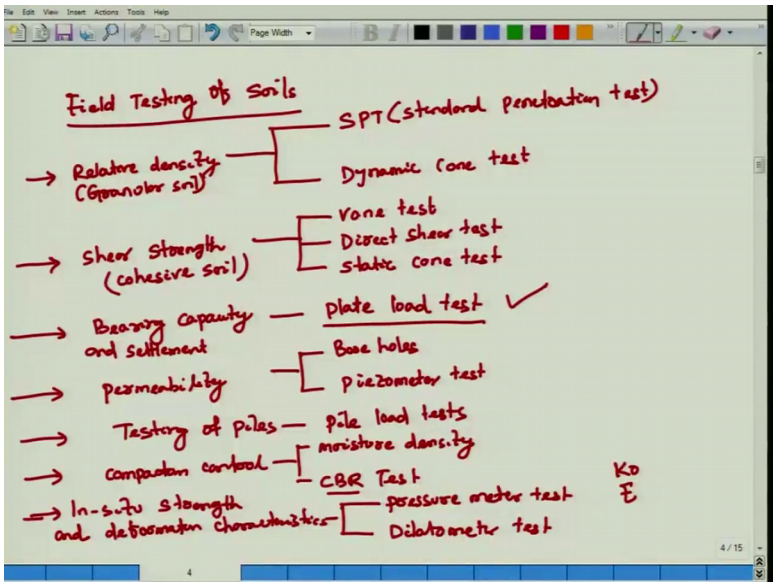

I will start next what are the different field testing of soils. First one is your relative density. It is for granulur soil or irrelative density, what are the test to be carried out this is called SPT. Hole form is your standard penetration test, for using this is a new term youre your learning in new terminology SPT standard penetration test. Then second one is your dynamic cone test, is a relative density. Second one is your shear strength in c 2 conditions; that means, in field there are 2 parts one is your laboratory one is your field particularly cohesive soil.

So, what are the test in the field, vone test, second one is your direct shear, test third one is your static cone test, then bearing capacity and settlement. This is your plate load test. Then permeability, boreholes and piezometer test, then testing of piles, pile load test. Then compaction control, moisture density. Then CBR test. Then in situ strength and deformation characteristics sub soil in situ strength, strength and deformation characteristics. In this case, pressure meter test, then dilatometer test, there are many other part I am going to let me finish it then I can make it.

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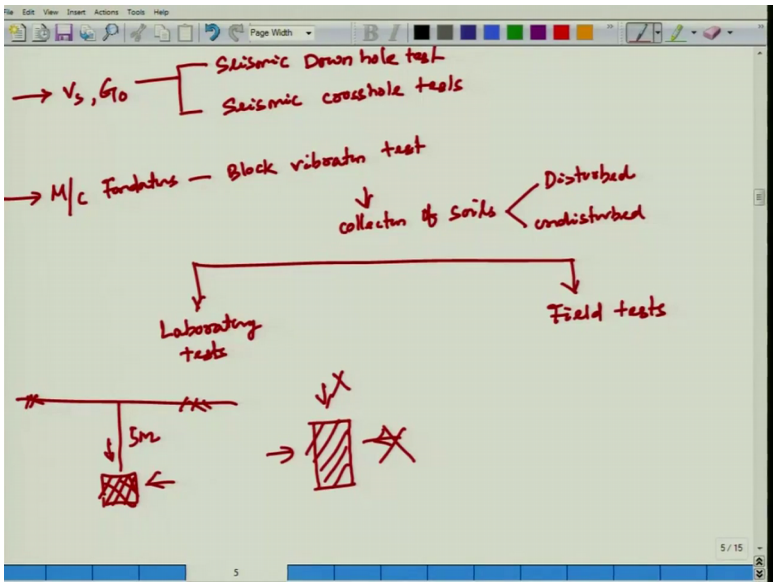

Then dynamic properties 0 velocity, vs 0 velocity vs, low stream shear modules g 0, seismic down hole test. Seismic cross hole test, then your machine foundations. For machine foundations, block vibration test. It if I make it into 2 components particularly geo technically investigations and subsoil explorations, I can say it first one is your collection of soils earlier I have say either it is disturbed or undisturbed.

Then from there from collection of soil samples we can do it, laboratory test. Sometimes I will collecting this soil samples. So, in doing the laboratory test this soil samples become remolded. It is not giving a true state appears soil inside your ground surface, why? Because for example, let us say for example, this here your collecting undisturbed sample at a dept say 5 meter. This is the undisturbed sample we are collecting at a depth of 5 meter.

So, before collecting what happened? What is the physics there will be a vertical stress; there will be all round companying process? The movement you take out this soil undisturbed soil sample from here by sampler tube. This is my sampler tube. Inside the sampler tube you have collected in your undisturbed soil samples. So, what will happen once I am taking out from the ground surface, is conpainment left lost; that means, over button pressure it is lost, companying pressure it is lost, then I am taking to the laboratory. And making arrangement of calculating what is it is over button, what is it is compainment and I am applying. By the time from here to I am taking to laboratory this

soil as lost it compainment. At the same time, there is the temperature here. Below the ground surface once I am taking out till putting in the laboratory there is also loss in temperatures.

So, this may not give the true value of pure engineering property job 3 soils. Sometimes it required actual test in the field, so then your field test. So, first one is the boring, boreholes collections of soil sample disturb one disturbed. Then there are 2 parts as a said earlier the cost of the testing or subsoil exploration, it will be 0.1 to 0.5 percent of total coast of your enter building or enter structure.

So, you cannot spend more. Then you are laboratory test second part is your field test. Whenever it is required for field test you go for a field test. Now if I come back field testing program of your soil. So, what are the different test where suppose to conduct. For to know your relative density it is particularly your manual of soils phi soils, it as been extended or c phi soils also. So, SPT, this is called standard penetration test. Will go in details all details standard penetration test means, penetration value then dynamic cone test.

Shear strength cohesive. Shear strength cohesive we can measure the laboratory, absolutely no problem. Shear strength sometimes cohesive soils it is required to measure in the field. So, it will be vone your test, direct shear test we can do it direct shear test you know in your soil mechanics you are conducted in previous semester. Direct shear test also. This also can be done in the field, vone your test direct shear test as well as static cone test. This is the cone penetration test sometimes would say CPT. Dynamic cone test is different then CPT cone penetration test.

Now, bearing capacity and settlement in c 2 bearing capacity and settlement, if somebody ask, there is a ground I am going to construct a building and below 2 meter I want to lay you my foundation. So, what is the bearing capacity of soil below 2 meter. So, in that case you have to go for plate load test. Plate bearing test, every test having merits and demerits will discuss in brief. Then permeability, permeability where it is required dones reserves there permeability major factor. Because if you do not know the permeability then it your flow channel flow field it will create problem. In that case you can go by means of boreholes or piezometer test. Testing piles, testing piles is required

for your d foundations. In that case you have to go for a pilo test real, pilo test in the particularly in your site and fine it out it is bearing a capacity.

Then compaction control where it has been used example road and embankment what you are doing in compaction control, in the laboratory. You are doing by means of recto compactions and modified compactions. So, these are all laboratory based as I said just before there are limitation in a laboratory test. So, here actually whatever you have done in the laboratory test, whether it will going to same parameter, it is giving in the field then there are 2 test one is your moisture density other is your CBR test. CBR full form is your California bearing resource test, then in situ strength and deformation characteristic.

In situ strength if you look at here bearing capacity also in situ strength. This is for your shallow depth. For a deeper we can go for a pressure meter test. What you are suppose to measure it K 0 E, modules of elasticity, strength parameter as well as your deformation. Then dilatometer test. For dynamic conditions particularly response analysis liquid fractions, earth quakes, you need certain values 0 velocity E mu and g. These are the parameters required for your module.

So, dynamics your modules g 0; so there are 2 field test available seismic down hole seismic cross hole. Also there are many also available generally this is has per your (Refer Time: 24:40) standard. Sometimes you want to go for a machine foundation. So, in case of machine foundations, what I did test you have to do? Block vibration test. There are also minute other test are there that also in brief I will discuss. Seismic reflections seismic reflex and test to find it out you water table.

Then ground red penetration rather gpr, that also required for geological point of you, then many field test, particularly the advantage of your field test to do your field test these are giving without having any scale effect, without having over button pressure lost or compoinment lost. This will give you true value inside the ground surface the parameters.

So, these test in brief because there this is the foundation design. Unless if you do not know from this parameters, then you have to recommend as an geotechnical engineer, fine I will go for one bore hole I will collects soil sample below 10 meter. At the same time I will do one test field test standard penetration test. It gives me penetration value. I

will not do this under penetration test, rather I will do it one test that is my plate load test that will give bearing capacity and settlement. So, these values will be required for you modeling for your foundation design as well as analysis. That is why these as to be finish within certain period of means very briefly, so that my emphasis will be on foundation design as well as analysis.

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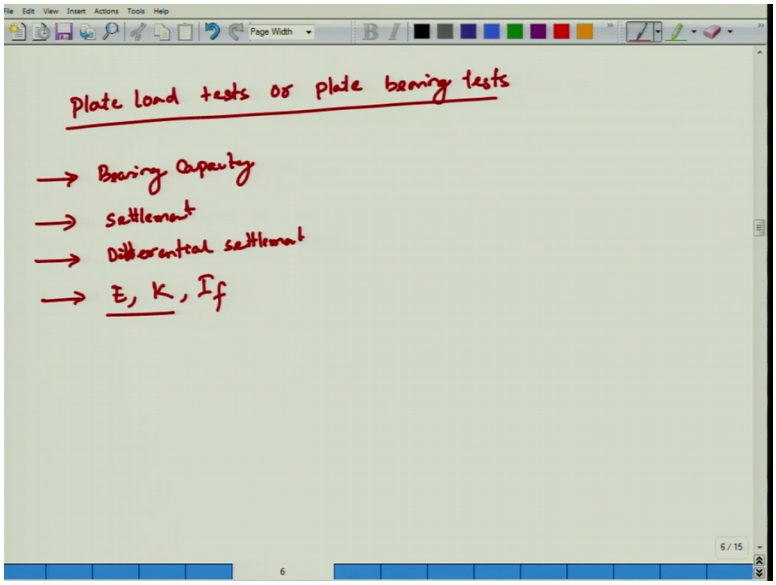

Let me start one of the field test program that is your plate bearing test. Plate load test or called plate bearing test. So, plate bearing test what you are suppose to get. You are supposed to get bearing capacity, settlement, differential settlement, E sub grade modules K. Then influence factor, these are all parameter you are suppose to get with a single test plate bearing test, there are scale effect.

So, these test covers widely. If I do a test plate load test at the shallow surface I can say that 2 meter or 5 meter depth bearing capacity of soil is this my structural load is coming this. What is the permissively settlement what should be the settlement, what is the differential settlement come low versus settlement curves, I am suppose to get modules of elasticity sub grade modules as well as differential settlement from. Not from load it versus settlement curve. Load versus settlement curves I am suppose to get E K.

These are the things I am going to discus in the next class. I will start the field test one-by-one, but now I am going to in brief not in details, because my emphasis will be more

on foundation design and analysis modeling part rather this will be in brief. So, that this parameters are input parameter for your foundation designing analysis.

Thank you.