Foundation Design
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Lecture - 4A
Subsoil Investigation or Site Investigation
Part-7

We have covered almost all tests, few test are I kept it. There I will I will describe as this course when you go on. I do not want to spend particularly subsoil investigations it is a kind of outlook and pre prescription, more focus on this course is on foundation design.

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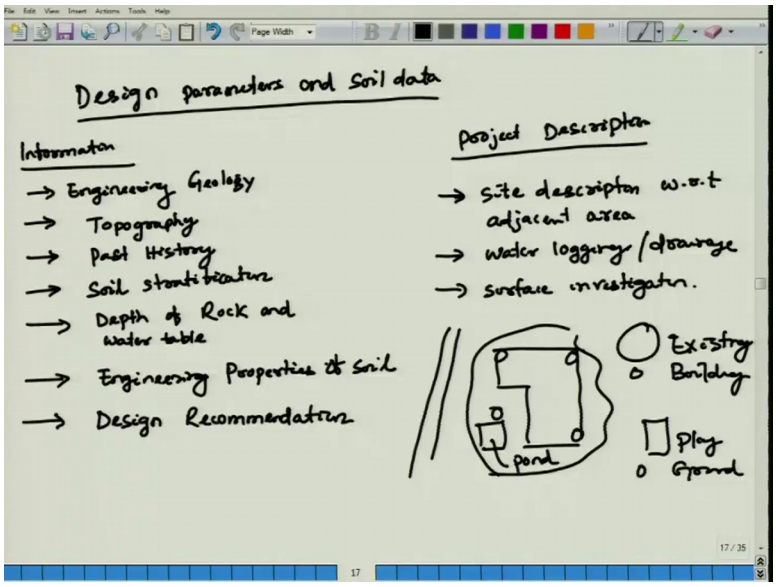

Now before you conclude based on these subsoil investigations, and you need to have to have your design parameters, and soil data. This you have to provide your design engineer. So, what is the information? Information given regarding your subsoil investigation: first one is your engineering geology. Second one is your topography. Third one is your past history. Fourth one is your soil stratification. And fifth one is your depth of rock and water table. Sixth one is your engineering properties of your soil. Then last one is your design recommendations.

So, in that particular in that report, slightly you have to give your project descriptions. What project description you are going to give it? Particularly, you are going to give general level or site description with respect to adjacent area. Then your problem of your

water logging, problem of your water logging or you can say that drainage then surface investigation.

So, basically for example, this is the area where is your proposed constructions. This is your planned structure, and there is a pond here, nala or pond is here. Then suppose for example, nearby your lady there is a playground existing. Then there is a existing building then basically how do you take a call even if there are different thumb rules we can take corners 1 2 3 and as there is a pond nearby. So, you can consider one point for your boreholes existing building one point here or playground we can put it here.

So, basically this you are site descriptions means project report reveals test locations your project report in detail. It will reveal what are the test locations what are the test you are supposed to do, and any information about the weak soil near the site or nearby the sites. Then next is you are; I have discussed method of investigations.

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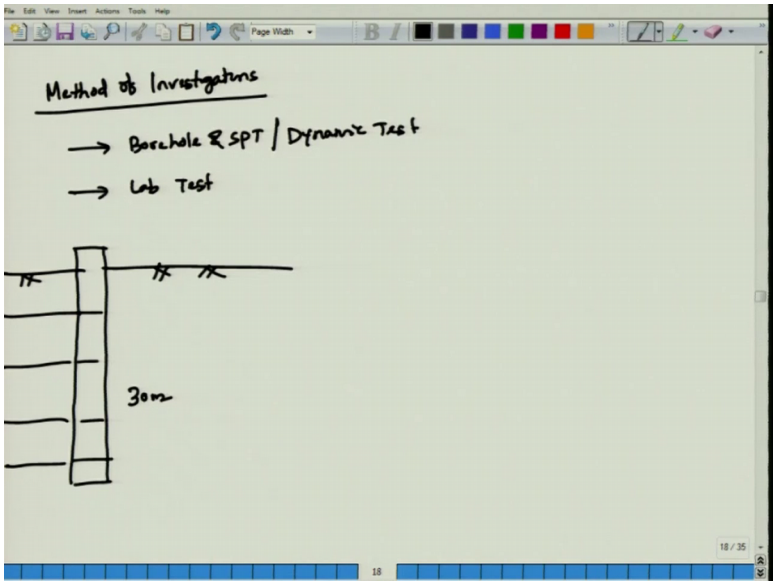

Next you have to go for your method of investigations. In method of investigations there are 2 parts one is your laboratory one is your field. Generally, in the field you go for borehole and SPT or any dynamic test, then your laboratory test. Laboratory test to find it out engineering properties and classifications: means suppose you are conducting a borehole here.

For example, one borehole says up to 30 meter. So, you are collecting soil samples every 2 meter, 2 meter, 2 meter interval; that means, from every 2 meter interval you are suppose to get disturb as well as undisturbed samples. From disturb samples you can classify the soil, so that you can get soil stress stratifications as well as engineering property. That means, c phi this after collecting the soil sample you go to the lab and do your test. And sampling while doing in sampling you should be very careful very careful about your undisturbed soil samples, as for as possible you should collect undisturbed soil samples. This is what is your method of investigation I have finished.

Now how you are going to this is most important, how you are going to report this. What you get it one is your laboratory report one is your field report and before that is your preliminary investigations subsoil investigations.

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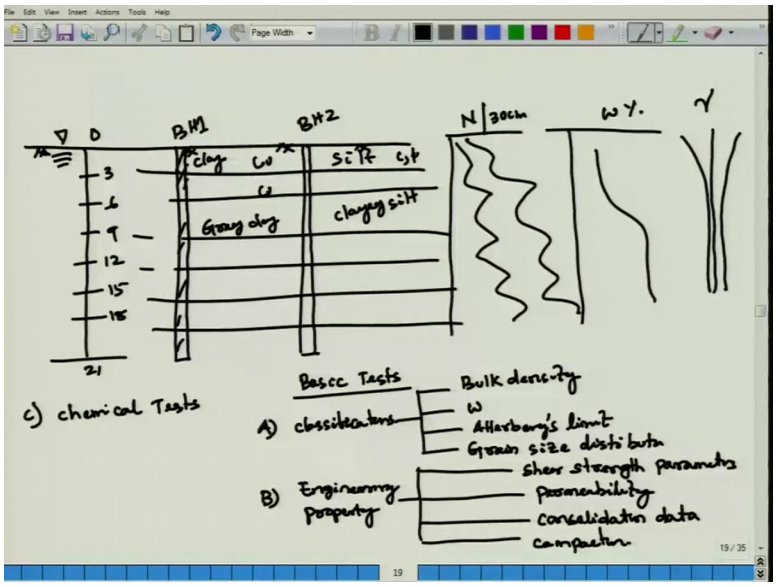

That carries a report, then once your laboratory and field test is over you have to prepare in a data sheet, that is called data logger. That is called data logger. For example, I am just showing it, I can show you in a ppt also and this is your ground level, and this is your depth suppose I put it 0 3 6 9 12 15 18 then suppose 21 every 3 meter 3 meter suppose there are 2 boreholes draw it like this. I will just show you a ppt also data loggers mark it this is your BH 1. Then another one is your borehole 2 any number boreholes whatever you have decided this is your borehole 2.

Now, every depth you mark it. Then what is your classification, in this case it is clay in this case it is silt, in this the clay is continuing all of sudden it changes. Suppose this is grey clay and this is your clay silt and there is a water tabularity ground surface you mark it. Then at the same site for both these cases you mark SPTN this is your SPTN for 30 centimeter, you just show how it is vary in borehole one as well as borehole 2 SPTN. Also you show in a data logger what is your natural moisture content once you collect undisturbed sample, we will get your natural moisture content and depth wise how it is varying natural moisture content. As well as also gamma unit weight of your soil that also we can say that how it is varying with your depth wise that also show it.

So, this basically this is a data logger. Once this data logger designing in your c you can say between 0 to 9 meter it is purely clay soils. And put the value undrained cohesion what is there undrained cohesion, if there is a silt what is the value of c as well as phi all details engineering property you have to put it. This layer from 0 to 6 meter or 0 to 9 meter this is a clay soil of undrained cohesion is almost vary in layer wise this value is this this is this this is this for borehole 1. Now for borehole 2 there are 2 boreholes suppose for example, you have take a. So, from 0 to 9 meter it is silt hence 9 meter to rest it is clay silt clay silt.

Now, what are the properties did you have also carried out your SPTN how your SPTN is varying different locations what is your natural moisture content is varying what is the gamma it is varying, basically what is the gamma it is varying. Now particularly if you look at what are the tests you are suppose to carry out in your laboratory basic test. So, classifications one is your classifications.

So, basically in classifications you have to find it out bulk density, natural moisture content, and natural moisture content. Then I will retain w or omega, attarbergs limit, then grain soil distribution. Then is your second part, this is part 1 second part is your engineering property. In engineering property what you are suppose to get it from your undisturbed soil samples, shear strength parameter, then permeability, then is your consolidation data, consolidation data for what for settlement calculations, then compactions. Then is there any if it is organic soils, then you have to go for chemical test. So, this is all about your particularly in bold of data you have to show it. So, once this information got it by the design engineer you will take a call what kind of foundation and at what depth what is the dimension of your foundations to be design.

So, in brief I am saying all things I covered design parameters and soil data basic information you prepare it write it project descriptions; that means, where it is located nearby what are the existing buildings, roads, playgrounds or any nala, or any pond, it is there you prepare a mark. Then method of investigations both laboratory and field test you have to take a call how many number of boreholes and what depth you have to go for the boreholes, and what are the samples you are collecting whether you go for SPT or cpt you take a call.

Then at the end prepare a data log all information in your data log then what are the different test you are suppose to do basic test in your laboratory: first one is your classifications bulk density, natural moisture content, attarbergs limits, grain size distribution, engineering properties, shear strength parameter, permeability, consolidation, data compaction. If it is organic soil then you prepare go for chemical test.

So, I will show you some video or something in ppt form, I will show you.

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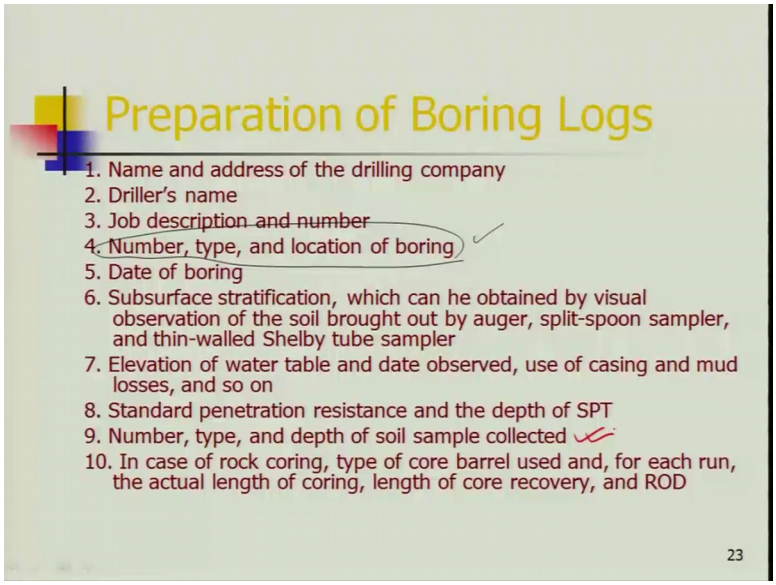

So, how it has been prepared it will be more way to see. So, before preparing your bore log data bore logs. So, particularly it will be name and address of drilling company or agency who has done the drilling. Collected on disturb soil sample drillers name job descriptions and number means, if it is a multi story or multi places you are doing job 1 job 2 job 3 and number, how many number of numbers you are doing. Number type and

location of your boreholes, this is most important number type and location of your boreholes.

How many numbers, what are the type of boreholes and location of the boreholes. Date of the boring that is more important subsurface, stratifications stratification means every depth wise is there any variation that has to be shown, which can be obtained by visual observations of the soil brought out by auger split spoon sampler, and thin walled Shelby tube sampler. Evaluate some of water table and date observed use of casing mud losses and so on.

Standard penetration resistance and depth of SPT number type depth of soil sample collected. This is also more important. Number type and depth of the soil sample collected I have explained. In case of rock coring type of core barrel used and for each run the actual length of coring and length of core recover all these data before preparing it you keep it in your mind.

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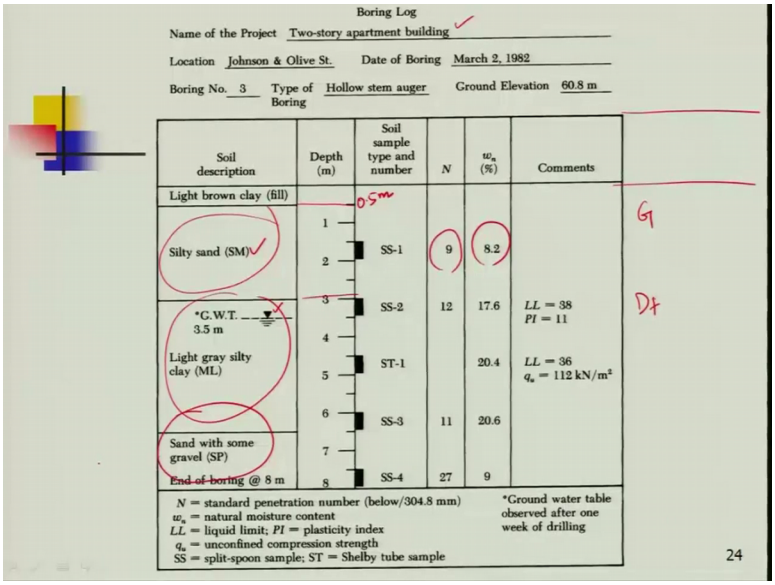

Boring Log

Name of the Project Two-story apartment building

Location Johnson & Olive St. Date of Boring March 2, 1982

Boring No. 3 Type of Boring Hollow stem auger Ground Elevation 60.8 m

Soil description	Depth (m)	Soil sample type and number	N	w_n (%)	Comments
Light brown clay (fill)					
Silty sand (SM)	1				
	2	SS-1	9	8.2	
	3	SS-2	12	17.6	$LL = 38$, $PI = 11$
*G.W.T. 3.5 m	4				
Light gray silty clay (ML)	5	ST-1		20.4	$LL = 36$, $q_u = 112$ kN/m²
	6	SS-3	11	20.6	
Sand with some gravel (SP)	7				
End of boring @ 8 m	8	SS-4	27	9	

N = standard penetration number (below/304.8 mm)
w_n = natural moisture content
LL = liquid limit; PI = plasticity index
q_u = unconfined compression strength
SS = split-spoon sample; ST = Shelby tube sample

*Ground water table observed after one week of drilling

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Now look at here, this is a boring data bore log or boring log we generally called boring log. How it is name of the project 2 story apartment building locations date of boring march 2 1982? Boring number 3; that means, earlier there are also 1 2 boring. Type of boring, hollow stem auger, how you use it by means of forward boring it has been done by means of mechanical. Or you have done by means of drilling machines; ground

elevation where you are doing the boring ground elevation 60.8 meter look at here. This is as for example, depth put it 1 2 3 4 5 6 7 8.

Now, if you look at here any surface up to 0.5 meter this is a filling soil this is a particularly filling soil, this filling soil is your light brown clay right, then there is a silty sand and also I put it classifications also, it has to be put it if it is a silty sand what is a actually engineering classification. It is sm this silty sand is varying it will look at here this is your 0.5 meter it is up to your 3 meter. There is no change of your profile from here to here. Same soil profile is there. Then what is your SPTN value particularly this step SPTN is a 9 then moisture content is your 8.2.

Now, come back here a ground water table is located at 3.5 meter the symbol as I said earlier ground water table you put it then put it like this it should be very clear legible and it can be very distinguish somebody can see ground water table is at 3.5 meter. Then here light grey silty clay ml, now this look at your SPT from 3 to 6 it is 12, 6 to 7 it is 11 8 is your 27 sand with some gravel beyond this it is not possible to go for it SPT because you are getting a hard stone or sand it is not possible to collect it; now where you can find it out liquid limit plastic limit that you mention it.

This is how your bore log data say if you are carrying out now this is a only information about boring classifications SPTN natural moisture content. If you have carried out any dynamic test seismic your seismic down hole seismic cross hole though, I am not gone yet dynamic test I keep it some part around the lecture during your foundation design machine foundation there I am clubbing it. So, there what you are suppose to get it, g low strength shear modulus, g as well as your 0 velocity and anywhere else there is a liquefaction or earthquake then you have to go for 0 velocity as well as over water pressure measurement.

So, this will continue this will continue all the parameters will be there. Once design engineer got these parameters and did description about the site then they will take a call where first part is your depth of your foundations. Second very most important whether you will go for a shallow foundation or deep foundations, if you go for a shallow foundation what kind of foundation, you are suppose to do? Strip square rectangular I will go for this.

Once you go for that foundation at what date you are going to put it. Depth is one meter below the ground surface fine, then once you put it then what should be your size of your foundations. If it is a square 2 meter by 2 meter is enough that does not mean that if it, you have to put it a shallow foundation 10 meter by 10 meter the cost of your foundation is much more than your actual super structures.

There the there are some limitations some experience some judgment has to come into picture. Then what kind of loading come in to this structures all calculation design engineer will do and they will take a call look at here. This is only 2 story apartment building. Sometimes you go for a 10 story 15 story 20 story in metros. There also adopt foundation has been used it is a 2 story building. So, very simple 2 story building you can go for a shallow foundation either you can go for a square or isolated putting or rectangular putting when decision you have to take a call what kind of foundation. This is what your basic requirement before your design, and this part as an geotechnical engineer as a design engineer you have to interpolate.

As geotechnical engineer you have to give this. If someone is working as a geotechnical engineer both you have sometimes in abroad sometimes in us some places they take only one geotechnical engineer. So, you have to do subsoil investigation and look at the report, also you have to do some structural design foundation designs. These are one is to one. So, this report based on this report other calculations has to be carried out. If there are wrong reporting, this value is this may lead your faulty foundation designs. So, this is a preliminary this is this is basic subsoil investigation then followed by your foundation design as well as your analysis. This is where I want to stop it because this covers your complete subsoil investigations

Now, I will start next part just in brief I am starting then I will go for in details as the followed following classes. Now just this is basically introduction I am starting.

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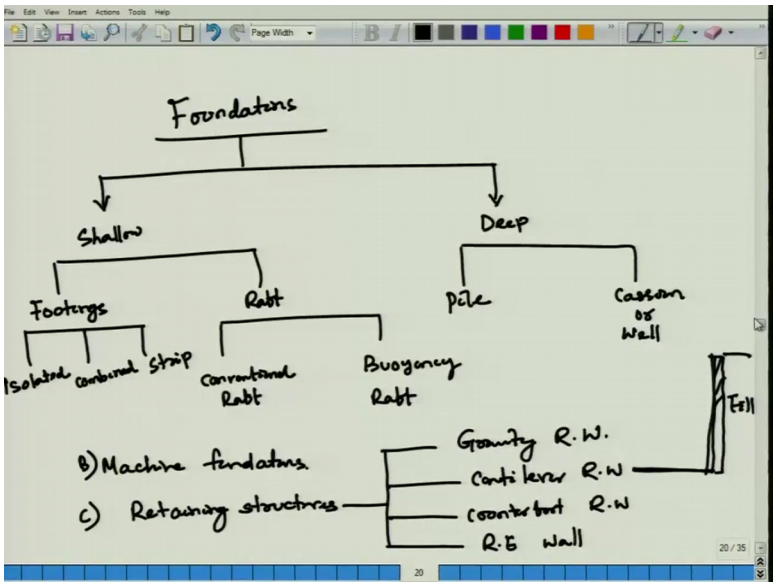

So, first part is over your subsoil investigations. Before I go for your bearing capacity settlement analysis (Refer Time: 23:31) bearing capacity, mirror bearing capacity, water table corrections and all other things just in brief foundations. If I say very simple way before design foundation, I can put it in a 2 basket. One is your shallow other is your deep foundations. So, shallow foundations, again I put it footings, then second one is your raft. In footings I put it isolated, then combined then is your strip. I will discuss one by one. Then raft I put it in 2 category. One is your conventional raft sometimes it is difficult to write particularly in this plane, so then buoyancy raft. Then deep foundations in deep foundations, particularly I put it in pile caisson or well foundations. So, pile raft pile these are all coming.

This is all total, if I if I make it not making you confused the foundation basically classified into 2 types. One is your shallow foundation second is your deep foundations. In shallow foundations I classify into 2 parts. One is your footing other is your raft. In footing first one is your isolated footing, second one is your combined footing, third one is your strip footing. Isolated combined end strip and raft foundation it has been classified into 2 conventional raft, and buoyancy raft and deep foundation, if I make it into 2 parts one is your pile foundation other is your caisson as well as retaining walls this is all about your foundations.

Another part machine foundation will come into picture. If I classify into 2 parts shallow and deep that is fine another is your machine foundations right. This is your machine foundation. Third part is most important that is also part of your geotechnical that is your retaining structures. That part is you are retaining structures. If I put it retaining structures into parts, gravity retaining wall gravity retaining wall RW means retaining wall then cantilevers retaining wall then counters fort f o r t retaining wall right, then RE walls.

RE walls means they imposed start walls this is required retaining structures because you have to elevate particularly there is a low lying area road is here you have to elevate, you have to elevate at certain height by means of a wall then other site you fill soil. So, that here flood can be passed this is also most important. This is what all design aspects we are going to discuss.

And I will go in brief what are the classifications, what are the different types of foundation in brief. Maybe, one lecture then I will go for your bearing capacity settlement all other things.

Thank you.