Foundation Design
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Lecture - 1A
Subsoil Investigation or Site Investigation
Part-1

So, we will start this Foundation Design course. And particularly this course, it is helpful to both UG as well PG post graduate students and particularly for under graduate students basic understanding and design of your foundations. So, we where you go to in details: so first will start with this Subsoil Investigations or Site Investigations.

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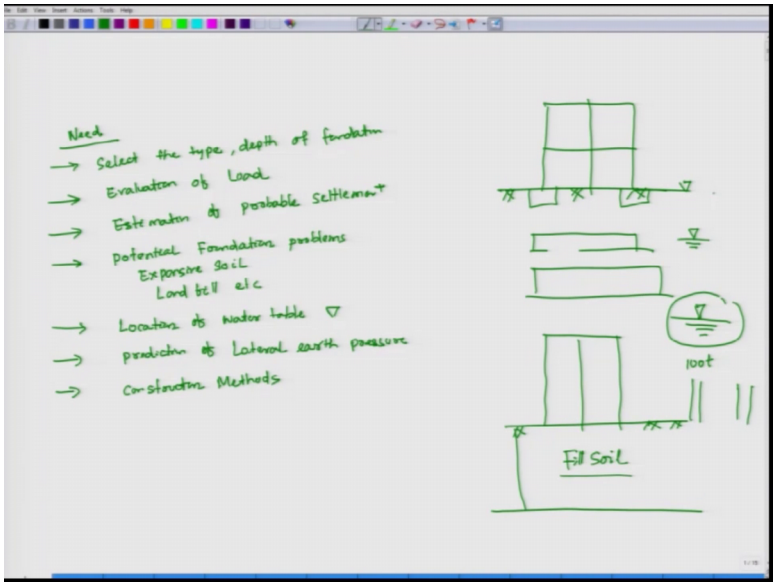

If I say why this a site investigation is required; that means, if I say it is a need what for it is a need is I can write it; that means, first you select the type depth of foundation. Second one evaluation of load. Third one is your estimation of probable settlement, then potential foundation problem. In potential foundation problems particularly expansive soil, expansive soil then any land fills etc. Then will start with these locations of water table location of water table generally known; what is the water table I will show by this mark. This if it is their NGO technical engineering this is your water table then prediction of lateral earth pressure, then your construction methods.

So, before you go for your subsoil investigation first you ask yourself questions or may be site investigation, why you need for your site investigations. If you go for a soil investigation or site investigations what are the things you are expected from that investigations, you are supposed to get it. Suppose there is a kind of a building here. So, in this building it is propose to maybe it is a multi store a building, it is propose to be laid over the ground surface.

So, in this case what is the type of the foundation and what is be a depth of the foundations. In brief I can somebody can say what is will be your types of the foundations before it is starts I can say it that it may be type of the foundation it may be a it may be you can say that it may be a isolated footing, or it may be a kind of combined footing or may it may be a completely type of rough footing. These are all going to discuss later part. Then evaluation of the loads, how the loads are coming what are the different loads supposed to come.

The loading is supposed to be because of your from starting from the building, it will come from building, to how the how the building hence to be constructed. What are the different tricks how many columns are their; what is your column load? Suppose this is the building if I say this is the building multi story building it will be laid over this above up the ground surface, then I can say how many columns are there column loads because generally what will happen it load will be transfer from at the top from the slab to beam to columns.

So, then what is your individual column loads that is that is requirement, whether these individual column loads whatever it is coming suppose it is individual column loads like this individual column loads suppose it is hundred ton capacity this hundred ton capacity this ground is going to take this load or not, second point. Third point suppose you give a kind of isolated footing what is your probable settlement what is will be a probable settlement means. Basically what is your immediate settlement what is your consolidation settlement, I hope both these settlement analysis has been covered in soil mechanics part. Then is there any foundation problems? Is there any foundation problems like if there is expansive soil then soil shrinkage problem we will come or may be there kind of there may be a kind of land fill particularly ground; that means, in this ground it has been elevated this ground up to this surface by means of filling or by means of fill soils.

So, these are all your foundation problems to be encounter. So, from site investigations this information's are required. Then second part is a location of the water table that is most important location of the water table how are below your ground surface, it is near the ground surface or some aerials at some distance below the ground surface or may be far away below your ground surface. This water table is their look at these symbols and footing here water table this is the way of the water table generally we write it in this way this is your water table locations.

So, site investigation gives particularly or where the water table locates, based on your suppose what will happen you try to understand if water table is for below the ground surface, what will happen is there any change in capacity of the soils. No if water table is at the ground surface what will happen then total stress becomes effective stress. Then ones poor water pressure increase it is gamma value become gamma effective and the value will be changed. Or the strength will be in indirectly it will be reduced, expected capacity of suppose water table is that here; what is your bearing capacity of the soil suppose you calculate.

Suppose you water table at the ground surface what is the bearing capacity of the soil, then if I compare both this cases what will happen in this case what is the bearing capacity and in this case this bearing capacity will be reduced half reduced, half means; that means, it will be completely the strength will be reduced half. This is what from your site investigations this information we are suppose to get and it is required for your design of your foundations.

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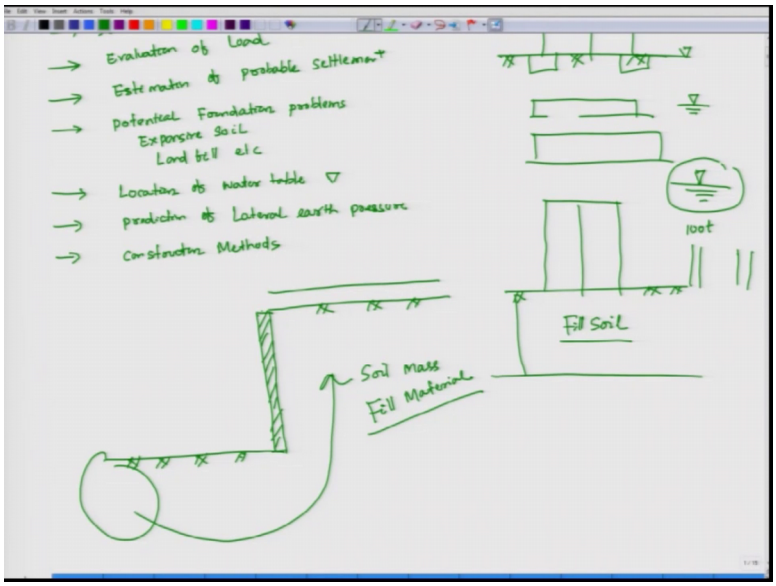

Then prediction of lateral earth pressures, prediction of lateral earth pressures. It is particularly it is required prediction of lateral earth pressure, if I say suppose there is a wall here retaining wall here. So, generally what happen initially this is your ground surface or may be your soil. So, it is a very low line area. So, it has been planed and this has to be raised up to a certain height by means of retaining wall retaining wall properties to retain the soil mass at one end; that means, this site you can always retain your soil mass soil mass this site.

Then here you can start constructing road or any other things. So, ones this is your plant thing then what will happen, from your subsoil investigation suppose you are taking the soil from here as a filling material here. Same version soil whatever it is available if you are taking at a filling material to retain this soil mass filling material. Your subsoil investigation will take or will say how much pressure it will generate on a wall, on a retaining wall, how much pressure it is going to generate, these information you are supposed to get it then construction methods then from your subsoil investigations, once it is over you are supposed to get different construction methods.

How you are going to do the constructions what are the methods you are going to apply and this is what your supposed to get all information's, that is why this is there is a need first one is a it gives once your subsoil investigation type and depth of the foundations what type of foundation, you are supposed to do it isolated combined raft and below at

what depth you are supposed to put it. I cannot put it your foundation at the ground surface at what depth you are going to put it this information from their you can get it once you get the subsoil investigation report from their you are suppose to find it out type in depth of the foundations. And you can find it out how much load soil or the foundation can take it then you can find it out probable settlements probable settlements in terms of immediate as well as consolidation settlement is there any potential foundation problems.

That means, there are 2 problems one is your I can say in broadly expansive soils; that means, swelling or shrinkage property you have to find it out means you have already determined from there you classified this soil is expansive soil, if it is expansive soil for this kind of soils different foundations will be adopted then is there any land fill; that means, it was a low line and it was recently filled by means of soil then location of your water table then prediction of lateral earth pressures and constructions methods.

This is what this information requires. This information need for your foundation design for this information you need to have to have your site investigation or subsoil investigations. Now come to if I go to these subsoil investigations, then I come to what are the different programs. If I write it, what are the different programs?

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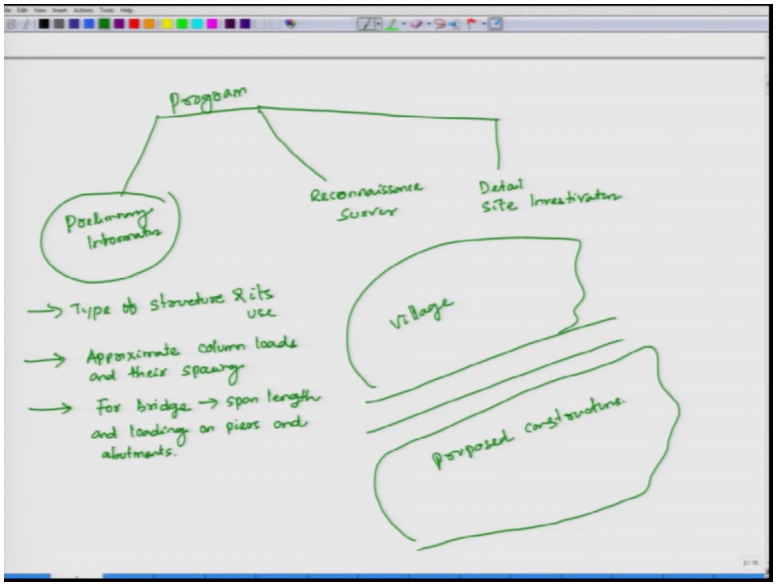

Then I can put it. There are two: one is your preliminary information preliminary information. Second one is your reconnaissance survey connaissance reconnaissance

survey. And I can put it third one as your detail site investigations, detail site investigations.

So, total program I classified into 3 types or 3 parts. One is your preliminary information's, second is your reconnaissance survey, third is your detail investigation or detail site investigation. So, in preliminary what your suppose to get it, if somebody say let us start with this program it is the basic information's preliminary is your basic information's, what you are suppose to get it from preliminary in the investigations. Let me write it type of structure and it is use. Second one is your approximate column loads, and their spacing. Then third one is your particularly for bridge span length and loading on piers and abutments.

So preliminary information suppose for example, I am drawing a very a rough sketch there is a road here. This site already there is a village, village and this site this area propose it is proposed to be means building should be constructed proposed constructions, proposed constructions. So, before with that you go to this site and take a survey get information preliminary before you go for reconnaissance survey as well as detail site investigation go there. And nearby you go there somewhere else if you in a village there is a somewhere else building is their you can see what type of structure it is their. Why are it is a single store RCC multi store RCC or by hard or by simple as visual in village buildings or simple kind of this mod house.

Then how many years it is existing how for it is use this information gives you nearby type of the structure. If there is a structure is available nearby in that village, then what are the different types of columns they have used? And what are the approximate column loads they have taken into considerations. And this gives information; if you suppose somebody say in this village there are buildings available people are people are making buildings for last, they are staying inside these building RCC buildings for last 20 years and there is no problem: absolutely no problem inside these buildings. That means that gives an indication that this soil conditions here are in good state. So, that it takes load coming from super structure.

So this gives an indication what type of soil nearby where is your proposed construction is required. Then come to next part reconnaissance survey, where here what you are suppose to get it here, what you are suppose to get it reconnaissance survey if I remove

this preliminary investigations. Then I will start with this reconnaissance survey particularly this one.

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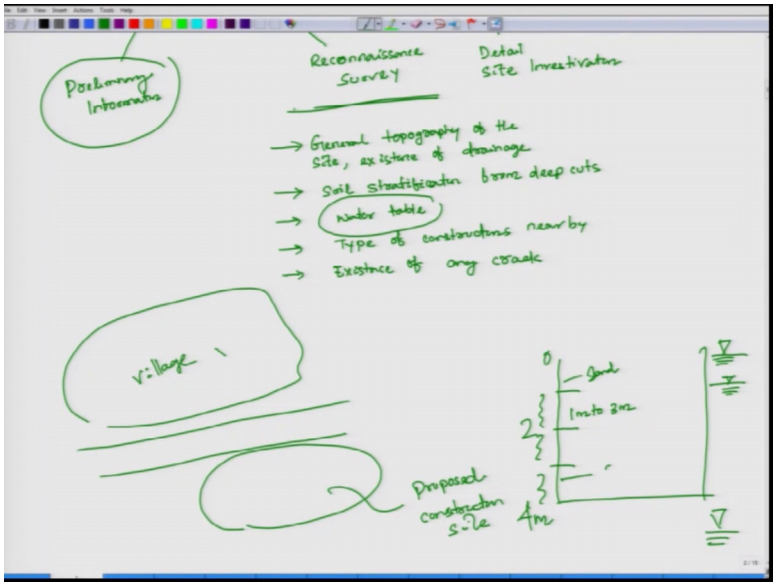

What you are supposed to get it? You are suppose to get this information, general topography of the site existence of drainage, then soil stratification, soil stratification from deep cuts. Then water table, then type of constructions nearby and existence of any crack.

Once you finish your preliminary information's then will you go for reconnaissance survey. In this reconnaissance survey, suppose there is a site, as I said there is a site there is a site here there is a as I explained earlier there is a road here and this site is village and this is your proposed construction site. General topography of the site and existence of the drainage whether it is a plaint area hilly what is your general topography. Then existence of drainage; that means, you can take information nearby from the village if in rainy season water logging particularly in rainy season you can ask people go there in rainy season what happen, if there is a full rainy season what will happen. How long it takes water to drainage.

Sometimes in a village if I go, I generally ask in rainy season can you tell me how long it take water to drainage sometimes they say when rainy season, there is a rain it comes within an hour water goes out completely. Sometimes they say no it takes it takes 4 to 5 days water to completely evaporated or goes down this gives an indication of drainage of

your soil, nearby the soil is their how far you are a drainage means, how your drainage is going below this whether the soil is paroles or soil is not paroles that gives an indication that will come detail in your detail site investigation.

Then second part is your soil stratification from deep cuts if possible nearby you can make a cut with help of lever manual lever, you can make a cut one side you can make a cut 1 meter to 3 meter or 1 meter to 1 meter to 3 meter. Sometime visual in go for one meter or one point 5 meter or 2 meter then by visual inspection, you can see what will happen, if I make a cut here deep cut, not shallow cut deep cut. I will try to go beyond also 3 meter sometimes it possible. Then I can see depth wise. Means by looking at the color looking at the color how is your is the soil is same or soil is changing. How your stratification is varying, if you go then if you see a deep cut or general in ground surface nearby the surface there is a color there is a different kind because up to 1 meter, 1.5 meter, 2 meter generally there is a filling soil or may be kind of other water is their.

So, beyond this you can very easily see the colors. And how do know that it is your soil stratification is varying. You can take pinch of soil at the site, from the site once you make a deep cut pinch of soil then raw bit in your 4 as well as thumb you raw bit like this. Once you raw bit the soil may be a kind of a bulky or kind of a loom type once you raw bit you can very easily identify, the soil inside particles small particles if it they are sand particles there very easily you can identify. If it is a sticky sometimes soil will be kind of a sticky that also gives an indication that this soil is indicating this gives an indication that soil is particularly either is a fine grind soil or some sand soils are there or may be clay soils are there every layer you can find it out.

Then you can see whether the same soil is continued in throughout or this stratification is changing. Approximately suppose I can say from here 0 to 2 meter soil looks like brown. 2 to 4 meter soil looks like grey, if I take a pinch of soil and raw bit here I found that it is kind of sticky. Here if I raw bit then you can find out I can we can we can observe that there are sand particles available. So, this gives come kind of indication whether the soil stratification is varying along the depth or same soil is suppose to present. Then water tables before you go for your detail site investigations. This water table information you can get it nearby the village, you can always ask means there are tube wells, village tube wells there are village wells.

You can ask in generally, what is the depth of the water table. Generally, you locate you can ask 3 types if depth of the water table are in summer in winter in rainy season. They sometimes they we are facing in the tube well in a during summer season this waters are not coming we are getting water below 20 meter, then you can give an you can get an information in rainy season water table is at the ground surface or may be below slightly below, your ground surface in winter are may be in summer water table is for below there is a tube. Well, you can analyze ask near by the village in the tube. Well, what depth water table, what depth tube. Well, has been bore they can say it is bore it has been bore for 20 to thirty meter, but in summer sometimes it goes beyond this this gives an indication there is a fluctuation of water table there is a fluctuation of water table as varying your seasons summer winter as well as rainy seasons.

Then last one is your existence of any crack what is it mean existence of any crack, these are all indications these are not detail investigations, because these 2 information's particularly you need before you go for detail site investigations, whatever the information you are getting from preliminary information as well as reconnaissance survey these information is an indicating or indications these are the things.

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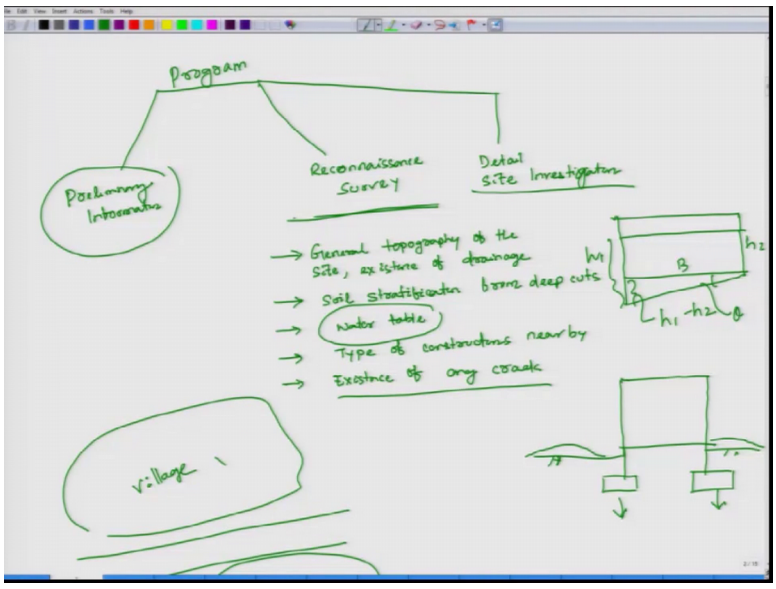

So, this test your suppose to do it existence of any crack, how do get it go to the nearby village, if there is a building there is a building already existing building is a their. Suppose you can say this has been built by means of isolated footings, then you can find

it out, if there is a crack. Yes, there is a crack. Question is you can you can see it visually there is a crack. How the crack propagate, it is only wall crack or the crack propagate between the joint of column, if see I say this is my column. This is beam, crack staked diagonally approximately get in your column and beam or any other cracks. What does it mean.

Suppose for example, you find that cracks side walls. Whatever the side wall in the building there is a crack. This is not going to hamper any serious problems in future. Suppose there is a crack between your beam and column joint, and it travel propagate in this phasal that gives an indications that soils below the ground surface is in expansive in nature; that means, why it happen because of your differential settlement. What is differential settlement? That means, settlement in these foundations below here footing and settlement below here footing are not equal. Suppose if I take like this they putting here. So, settlement at one edge and settlement at other edge is not necessarily to be equal, because below this there is a soil.

So, what will happen, if there is a settlement here? For example, in this case if settlement is here moved here settlement at the corner is there; that means, what is my differential settlement. This will be my differential settlement. Because this is my h, h 1 this is my h 2 and this part will be h 1 minus h 2. And this will be b, and this will come in terms of theta. So, there are course available, Indian standard. What should be a permissible differential settlement? If there is a crack, if you are observing there is a diagonal crack; that means, there is a differential settlement and this differential settlement is because of what expansive soil. If there are expansive soils, then you can take a call in detail site investigation. What site investigation or what soil investigation in the laboratory as well as in the field you are going to recommend.

So, this is what the indications. Another part in the nearby building you just move around, one is crack. So, beam and column in this case, if this building is existed then what will happen. If just move around just move around look at your crack fine there is a crack there is no crack, you just move around. Once you move around sometimes you can find it out this kind of hibs nearby. If there is a hib, this says there will be a general shear failure; that means, soil strength is much better. Whether you are suppose to get or not suppose to get, it is up to how for how experience. You are you can suppose to you

can you can identify same thing I can identify same things at begin are you may not identify.

So, this all indications, all information's you collect it preliminary information, reconnaissance information, survey you get it. Once you get it you come back and take a (Refer Time: 30:37). What are the detail sites investigations you are suppose to do? And how you are going to do it?

So next class, I will start you detail site investigation what are the programs, how you are going to plan it, I will stop it.

Thank you.