Landscape Architecture and Site Planning – Basic Fundamentals
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Module-07 Lecture-33
Landform Design

Good morning. So in the last lecture I discussed about the broad steps of the landform design. You remember I had explained about the soil structure.

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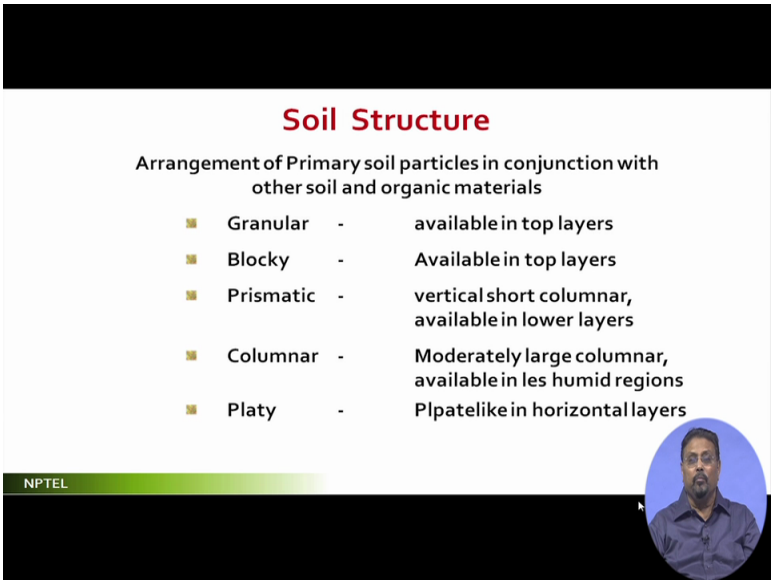

Let me give you some brief idea about the soil structure. Let me put all these things together. So basically the structure is different components, mainly the main particles being held with other particles. But there are different, as per technical literature, there are different descriptions of the structure. One is granular, there may be even fine granular.

Say, granular means we have the granules which are holding to each other, which are quite significantly large in size or differential sizes. But there could be, generally this is a layer which we find at the top layer of the standard good earth or good soil. That can be even fine granular. That means you have the granular but the particle sizes are very, very small. So if you hold it, it almost comes out like a sort of dust. That is also possible. I am not going to that detail of it but it is something like say granular, different granules. The blocky means different kind of blocks.

It, the granules are held together and ultimately they make individual blocks and the blocks are being held together. There are also found in the top layer and these are the layers which are very used, these are the kind of top soils which are very useful, I will explain how. There is something which is prismatic, which is short columnar aspects. The prismatic form, that is a cuboid kind of thing, short columnar. And there are columnars which are a little bigger, it means longer heights. Okay?

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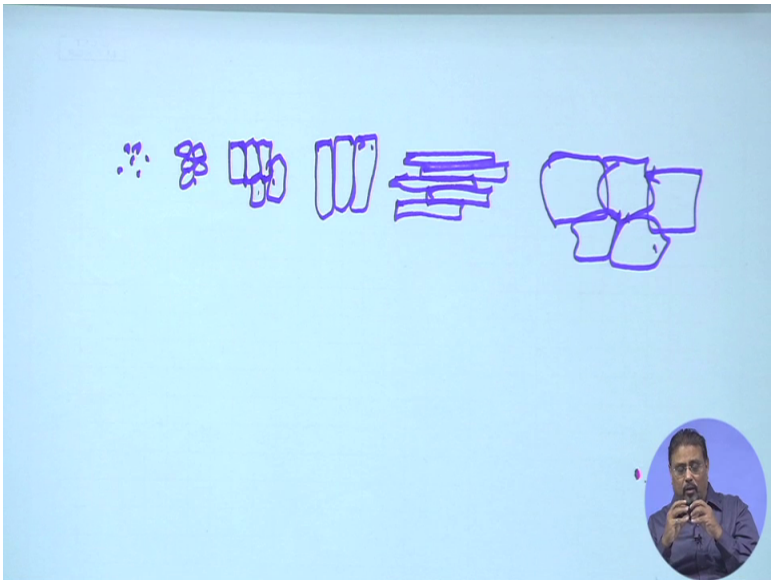

And I will just, I think I should give you a little bit of idea of this. Very small granular and this is granular, okay? And this is the blocks which are prismatic in different forms. And this is columnar, slightly more profile like this. Quite often, you will see this kind of soils when the top surface is fairly bare. Okay? And there another is platy, that is basically the different plates of soil layers. Now, and the massive, the large blocks. Means you find that okay, is a good kind of a soil. Now, see this kind of structures now if you try to identify, the best is to identify in the nature when you do see. You will find if the soil is very, very dusty and you find, means how would you understand just prima facie, just having a very, very browsing over the soil that which type it is.

You will find that if there is a little bit of wind flow, then there will be a dust, air which will be flowing with it; dust flowing with air, then you should know that it is very finely granular. Okay? And then if you find no, it is not that dusty, it is not that dusty but still there is a layer of dust, then you should understand there is a granular layer, there is a granular structure.

But at the top surface because of the wind erosion, the granules have been now further sub-broken and they become small fine granular and the top layers are flowing out here. But overall, it does not look very, very dusty. When you look at the blocky one, means you will find that there are, if you just take one like say one foot by one foot by one foot, 1 cubic foot soil if you take, you will find that the sizes are not very large, not very larger, they are almost cuboid kind of things.

The prismatic, when you will find that there are multiple such kind of structures which if you want, you probably, one prism you can separate from the other. And the columnar is when you will find that there are multiple such layers which got created. Basically what happens is the structure, okay I will explain that later. The platy is when you find that okay, there is one layer and then there is another layer, then below that there is another layer but they are mostly aligned horizontally. Up to that columnar, they are aligned vertically. And this vertically or horizontally unless you have very close look, you will not be able to make out.

But certainly, if you look at the platy one, then you will find that it is very much, very much flat. So there are plates. If you see alluvium soils, they are quite granular in nature. If you see black cotton soil, that goes differently in different time. Now the point is one is the structure, another is a type of soil. The alluvium soil which has a good quantity of and a good mix of, very fair mix of clay and the sand and the silt, so maybe that some layers of this will be having some fine granular but overall it is going to have a good structure. But in the black cotton what happens is this particular soil type which is highly susceptible to expansion and contraction by the addition of water and where the soil particles are very fine in size, that means more of clay within.

So in such case, what happens is black cotton in this the quality of the soil, the structure of the soil is very soft. When it is wet, based in the normal situation when there is more amount of water within it, you if you plan for something, maybe in some other time when there is a depletion of water from that, it cracks. So this expansion and contraction of this particular soil makes it structurally very unstable. Structurally means soil structurally unstable, I am not talking about the building of the material structure, I am talking about the soil structurally unstable.

Situation is like say prismatic, columnar, they are fairly stable. So what happens is when you are thinking about the bearing capacity, in such cases, these forms or these structures matter. Now

how about platy? The platy one is like this. Basically if you go to the Sikkim region, you will find that the hills, large hills and there are lots of landslides, frequent landslides. If there are frequent landslides, then you have to also investigate why such landslides are occurring.

It is mainly because of the geomorphological character of that particular soil is. It is mica-schist rock and the mica-schist, in the mica as a material, soil material or mineral if you see, it is very strong actually. Means if it is a plates, if you put a pressure, it will take actual forces. No problem. The moment you bring it vertically up, you will find that this will slide. Okay?

Now in such situation what happens is when it is structurally very, very weak when it is vertically placed but the mica itself is formed in the nature horizontally, so you do not have to worry about it. But I do worry for one reason. Since it is platy and if there is a creeping of water within, then since the whole of these individual plates are being held with in-between components and the components are not strong enough to hold each other because water has creeped in and made it almost like lubricant, then the mica-schist particles start dissolving into the water. And it, at this particular intersection point, it becomes a very dissolved, sticky lubricant stuff. In such case, what happens is the plates slide against each other. And once the plate slides and plate is sliding, that means now the stability is gone. So structure matters a lot.

When you are thinking of putting some functions, try to see the structure. There are different ways of trying to see. One of the most common thing that we do is we try to find out the bearing capacity of the soil. Bearing capacity of the soil basically is what? You are putting additional weight onto the soil surface with for whatever reason whether it is a foundation or your pathway or anything where people are going to walk. That means additional weight you are going to give.

Now if you are thinking about additional weight that is being exerted on that particular surface and the surface should have sufficient amount of strength and stability or the structural bondage to counteract, so that your reactor forces are almost equivalent to that if not more. So walking on a rock is not a problem at all but walking on a soft soil is a little problem. Walking on sand is more a problem. Walking on clay, soft clays soil is furthermore problem. So you have to understand this. So this structure you have to take into consideration. So whenever this study is done, your soil structure is understood.

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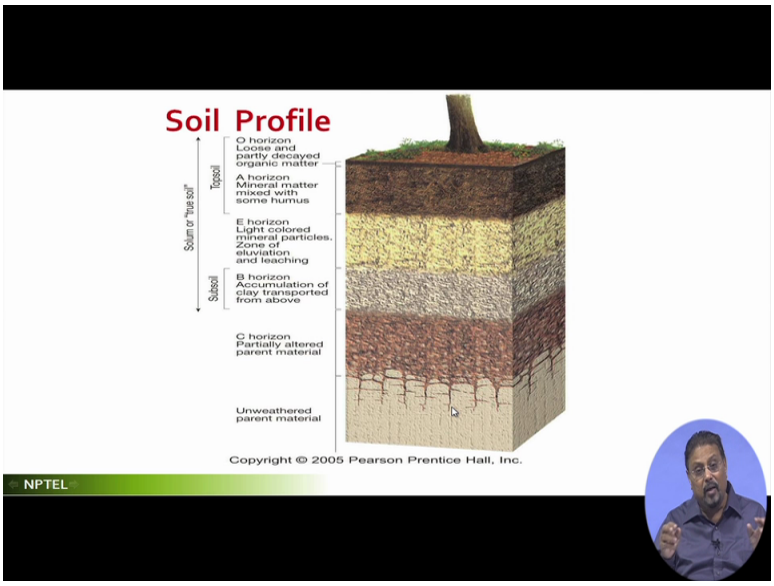

There is one profile which is there in the documents, in published documents which I have taken over here for your reference. Okay? So basically what happens is like it is called O horizon, A horizon, E horizon, B horizon and such. I am not going to discuss this, much on this. But essentially you will see if you cut a section through the soil in whichever part you are, wherever you are, if you suppose want to see what is the soil structure, basically what happens is soil structure varies by depth also.

In this, let me explain with respect to this. Basically this is the parental material over which some soil surfaces came in either by water erosion or wind erosion or it got created by granulations of all these things. Over the years, there had been some kind of pressures on this particular soil, soil become more granulated. So originally there was a parent material and along with that, there may be a mix of some kind of vegetations, decayed vegetations or some other organic components.

So it keeps on going and changing, and it takes thousand and thousand years. Mind it, this particular if suppose you consider about 1 meter depth, it takes thousand years to get this created. So always whenever you are disturbing this, you must know something which got created over thousand years, you are going to change it in just one hour by cutting, digging, throwing this. So when you are taking this particular soil, if you really look at this structure, the original undisturbed soil, so what happens is whenever you are trying to find out soil stability in such cases, what you do?

For geotechnical investigation, what you do is you take the soil in the undisturbed situation. You break the soil and then you take to the lab and then you are trying to find out the stability of this is meaningless, because you already, by breaking it, you have added your air into it and the particles stability, structural bondage you have broken.

Once you have broken the structural bondage, you have no reason to study what is the structural strength of this or structural bondage of this. So in such kind of cases, you be very, very careful but please go through this, I am not going to elaborate on this. So essentially I am going to highlight that more you go deeper, deeper and deeper, the parental material remains and at different layers, it keeps on getting changed and ultimately what we have on the top layer of the soil that we do see, it is a change over time, changed over a long time. So the change is over these different layers, it happens over years and years. And we are more concerned about this for short low-depth landscape materials and we are concerned about this depth for larger trees and or say structural foundations.

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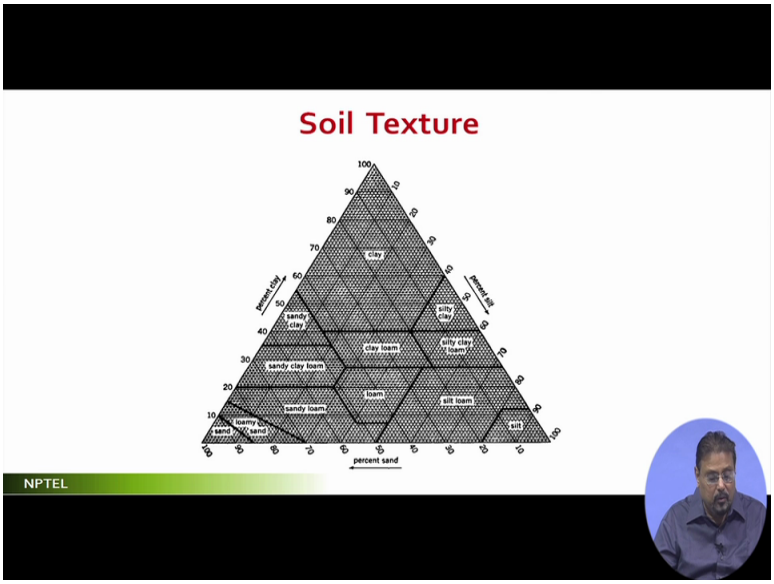

Okay. I am just highlighting the soil texture now. Basically this is the monograph I was referring to. In this, what happens is how do you read this monograph? I repeat, how do you read this monograph? This monograph is trying to give you an idea, what is the composition of sand, silt and clay. Basically what is the sand, silt and clay? There are nothing but the different particle

sizes. What is below clay? It is a powder. I will just go to the next slide and then come back here, I will come back to this monograph again.

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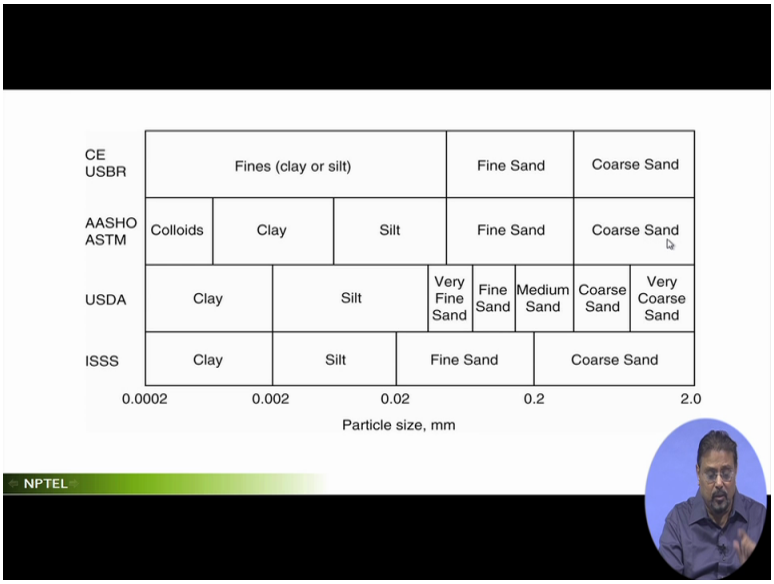

There is a different kind of, different kind of classification of this texture by different agencies. Okay? Let me just, I do not need to see which agencies being what, let me see with respect to this. Basically if you look at this here, coarse sand is the big size which is 2mm, a sand. So most often, the coarse sand that you use for buildings or any others is 2mm. When it comes to say less than 1mm, below this and being a little higher than 0.02mm in particle size, that particular size is, that range will be called as a fine sand. Below this, when it is in between say 0.002, it starts with the size from 0.002 to 0.02 and then slightly above, that will be called as silt.

When you are between 0.0002 and 0.002, starts with that particular range, it is a clay and ranging up to say this particular line. And below this, it is colloids or powders which floats with the water. Okay? Now see, if you now see, I am just trying to make a drawing which is slightly exaggerated in space.

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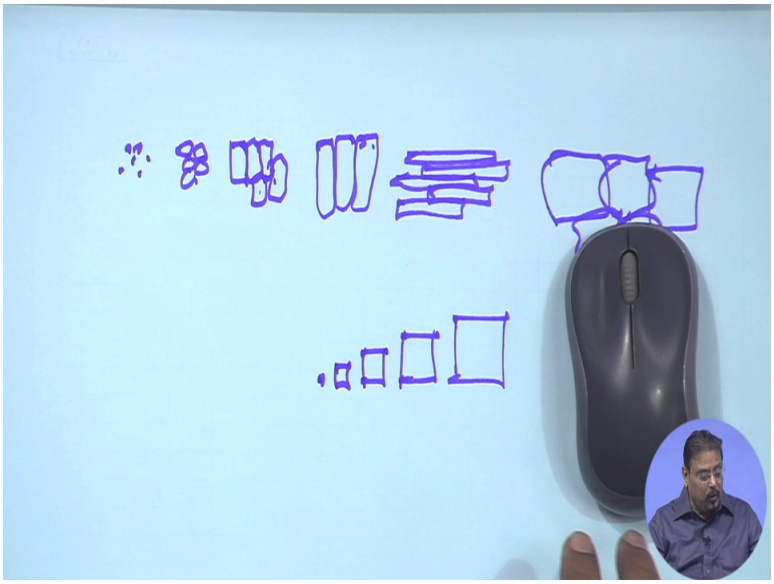

I am drawing it from this side. Coarse sand and then fine sand and then silt and then clay and then colloid or powder. This is how it is with respect to my this particular chart that I am showing, coarse sand, and then fine sand, silt, clay and colloids. So these different sizes will matter.

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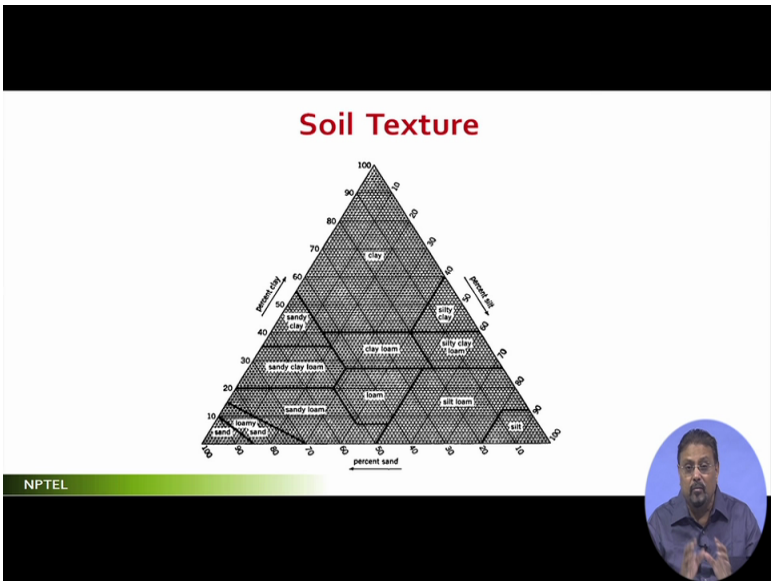

Now if I look into this the earlier slide, with respect to this, empirically even also studied in the fields with in the laboratory test, it has given a classification of texture in depending on a range of composition of this: The composition of sand, composition of silt and the composition of clay.

How to read this? See, when you are seeing, checking what percentage of sand, it starts with 0 here, 10 percent of the sand, 20 percent of the sand, read it like this. 10 percent of, 0 percent of the sand, that means no sand. 10 percent of the sand, 20, 30, 40, 50, 60, 70, 80, 90, 100, so it is 100 percent of sand. Okay?

Check it with the clays, starts with this as a scale of 0 of clay, 10, 20, 30 to ultimately 100. Start from this. So basically it is how to follow. Start your one scale from right to left and then upward and then downward. Now you will find one thing. Let us look at this triangle. At this triangle, this range. What happens is we have about 10 percent of the sand and more than 90 percent of the silt, okay? And then the clay, 10 percent of the clay like this. Once it is coming here, that means it is here it is mostly silt, only 10 percent of the sand and 10 percent of the clay. What is at this particular point? 0 percent of the sand and 0 percent of the clay and naturally 100 percent of the silt.

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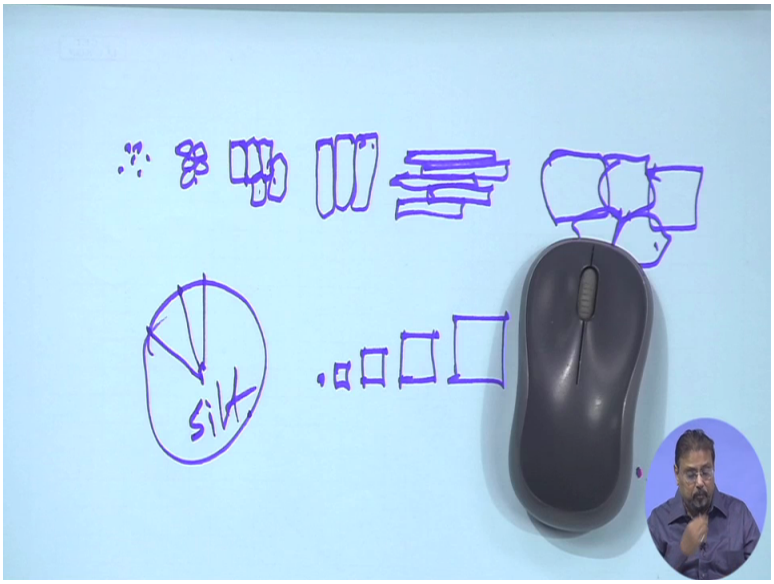

If I now take a say a portion in which I found that it is 10 percent is clay and 10 percent is sand and the rest is silt, so naturally this is silt and it is basically a range. And then within that, it is a, there is a characteristics like which is called loam. Loam means basically a good proportion of all these. This matters a lot in two sense, one is in terms of its stability and also in terms of its vegetation, vegetation capability, okay?

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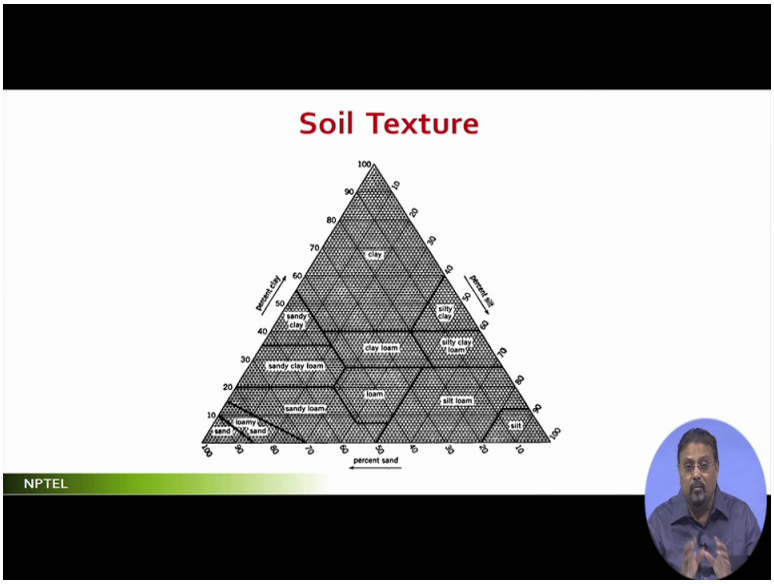

In this what happens is if you look at it, see, follow this particular chart, this is a region where this has been considered to be loamy and the loamy is the best kind of soil that is good for vegetation purposes and also it is for strength.

More you go to a sand, okay, more you go to a sand unless it is being bonded with a good quantum of say other organic matters, it becomes almost a loose material. If you be more in this clay zones, it will be, see, this portion is being called clay. But very interestingly if you see, about say 40 percent is the silt but still we are considering this particular portion of that soil as a clay. That means this will be termed as a clay soil, clayey soil. That means we have more of clay.

So if suppose certain quantum of the clay which is much greater in proportion, that soil becomes very, very weak in terms of our stability and also in terms of our vegetative capability. What happens, when I will talk about the plantations, I might give a little more detail. But let me tell you at this particular point, the soil that you have, the texture that you have, the voids that you do have, it is going to have manifold activity, functioning. One is that the roots are going to go through that.

Roots are not going to penetrate through the particles, roots are going to penetrate through the interspaces. So if you have a very weak texture, then what happens is roots become stronger but the textures are like say clay that it is very, very weak, it does not hold. So clay soil is really not very good for vegetation purposes.

Silt soil, at the same time, let us look at sandy soil, it is a larger structure, okay? Larger structure, then the roots. Unless there are other components which are holding those particles, the roots do not hold. And another thing is the flow of water. See, one is roots passing through the interspaces and also another is flow of water through this. If the flow of water is good, then it holds the water. Now what happens is any of this extreme like say silt or sand, sand or silt or clay, any of these extremes are not good, not healthy for our vegetative purposes, neither for strength purposes.

What happens is we require a good mix. See that mix is something like you look at this. If I come by this, let me take this particular point where my cursor is at this moment, here at this particular point. What is the value of or proportion? It is 40 percent of the sand, come from here, 40 percent of the silt. And then if it is 40-40 of this, then it is definitely 20 percent of the clay. Okay?

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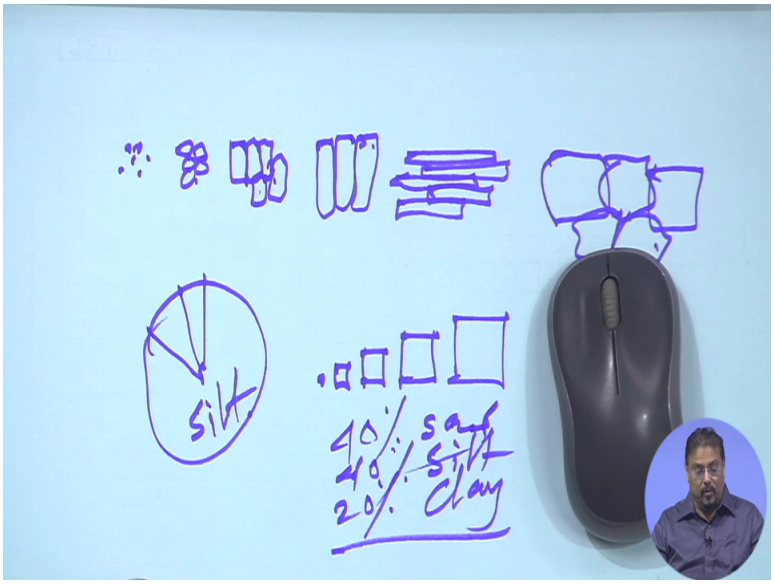

That means if I have 40 of sand, 40 of silt and 20 of clay, this is considered to be as one of the best possible combination or the mix in the texture which is very, very suitable for our vegetative purposes as well and also structurally stable. But structure we are saying that it is being held together with many other elements like organic components and all that. So this proportion is very important and that is what is a loamy one.

So whenever we try to do some vegetation purposes, we try to see what is the loaminess of this. So what we do is we pick a sample of the soil from the field wherever I am going to work and then I take it to the laboratory and there we try to disintegrate and try to find out the different proportions of the sands, silt and the clay. And then, if you find that it is within this particular range, we say this soil is good for my given purpose. That is how we work it out. Okay. And here we are saying vegetative purposes, at the same time, we are talking about the stability of it.

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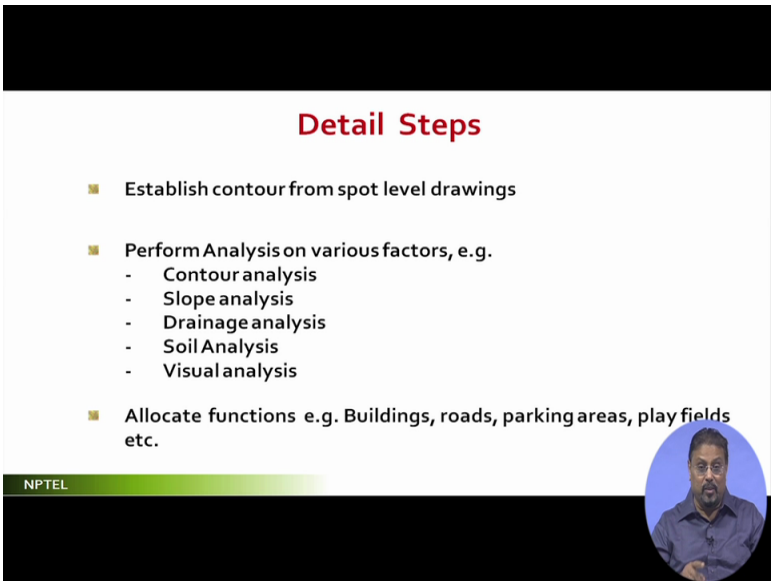

Now, the detail steps. Here see, so far what I was discussing was about the soil but now I am saying that how to do the landform work. So it is sometime the soil will come in or the profile will come in, so follow this. There are three, first three points which I have noted down here. Let me tell you by steps. First step is that you establish contour from the spot level drawing. Now this is the step, first step of the landform design which you are not doing at the design stage.

If you recall when I was saying that when you start doing your site analysis and investigation, 50 percent of your design decisions are taken there. So establishing contour from the spot level drawings is the first step of the landform work. That means you are trying to understand the levels of it. And this task has been taken care of or has been already undertaken during your site analysis time. Okay. Rather site survey time.

You have instructed your surveyor that how to really find out the positions of different elevations. See, it is meaningless to go for very minutely measuring all the elevations, it is not

necessary. If you find a flat land where few corner or reference points, elevation will give you good idea about the topography, that is good enough. But if you find in between there are some bit of changes which I have explained in my earlier lectures, that some bit of changes, then you further subdivide and go for detailed elevation recording.

So your that is, from there establishing a contour is the first step of the landform work. So here when you go to the site for commissions and you are establishing the contour based on the survey drawing and before that you have looked into it, your idea about the landform or probable proposals already has cropped up there itself. And then after that the stage, Perform Analysis and this analysis which I have said which you have already done, so second step is also done.

Third step is now we have taken the whole side and now you are deciding which function to come where. That has come in your broad step as well, okay, in which you decide exactly what function, what is area, what is its slope requirement and how much it is going to cover, at what elevation I am going to place. You remember I said that in contour analysis drawing that there you decide which function will go to what elevations. I do not recall whether I have given that example but I am just repeating maybe.

If suppose in my whole landscape projects, I decide that there has to be overhead tank, the overhead tank which will be supplying water from the municipal lines. What will be the best position of that overhead tank in my site? Obviously if you look at the whole contours, the highest point is the best location. So you take a decision about the overhead tank's location as the highest point of your site based on the contour analysis, elevations.

Now if you find that highest point also has a very steep slope, then it will be negated. When I mix with contour analysis and the slope analysis trying to find out where is the position of my overhead tank, then it probably the highest elevation where the slope is like this, does not work. Maybe the next higher position where the slope is gentle, this is the next position. I hope you understand that how you are mixing all this analysis together to take decisions. But all these decisions were individually taken for each of this analysis without or being oblivious to the other analysis or being blind to the other analysis. And this is what is the kind of study that you should do.

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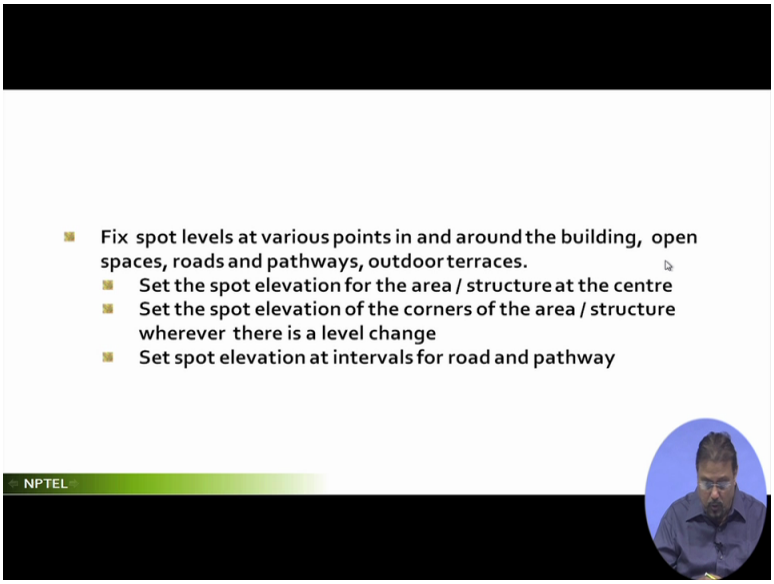

Okay. So you have allocated the functions. Now, you fix the spot levels. Here what is a spot level that you are fixing? You take one particular, see you take the whole project, then you decide this is my final level, I am going to take the final level as this. Okay? Let me explain. When you are fixing the spot levels, it is how you are doing it.

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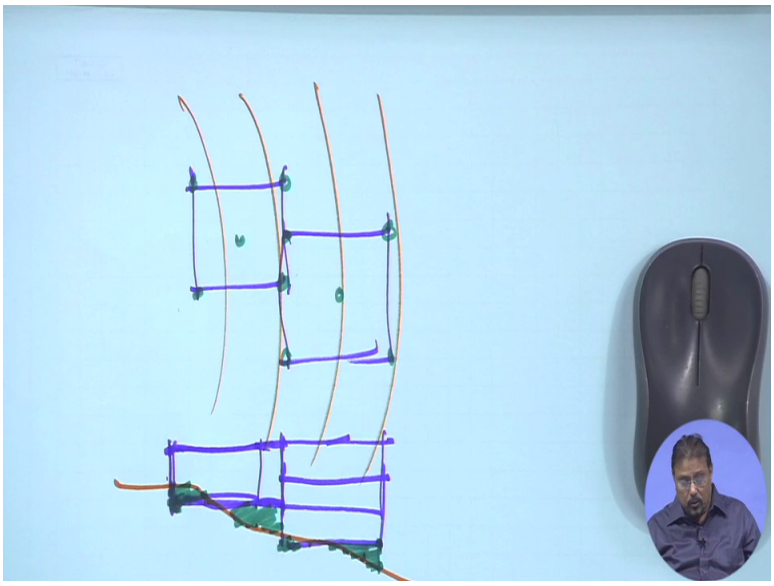

I am just trying to give a very simple example for this. One example I will give this, another example I will give you the playfield because that is the example I found my students have very clearly understood. Okay. In this, suppose you find that your contour line is going like this. Now

you are deciding the spot level. In this particular contour line if I try to draw the profile, this elevation, this is the next elevation, next elevation, next elevation. That means my site is something like this in which the building is supposed to be placed. I am showing you with respect to building because that is best understood at this moment.

Suppose the building that I have drawn over here is supposed to be something like this. But across the contour line if I am seeing, I would see that this particular thing which looks to be at the same level cannot be at the same level, so I lower it down. So my next changed level is this. Once I am doing this, then I have now another task to do. I have to take a decision that okay, what is the spot level of this particular corner, this corner, this corner, this one and also the center. This corner, this corner, here, here, also the center. So all the spot levels I decide.

Now you just check with respect to this drawing. If this was the original level but my spot level that I decided is below the original level, then that means this much of cut I have to take this. And if suppose, I have decided the spot level which is higher than this, then this is the area I am going to fill. And at this point, I am going to cut and at this point, I am going to fill. This is how the whole thing is.

So you decide about the spot levels of all these things and then you try to work out. So this exercise is very, very important. So what you do, there are two kinds of spaces that you will find, one is the planar, something like this. Another may be a curvilinear kind but the thing is I will still take it as a flat, say a plane which is being shown in different profile.

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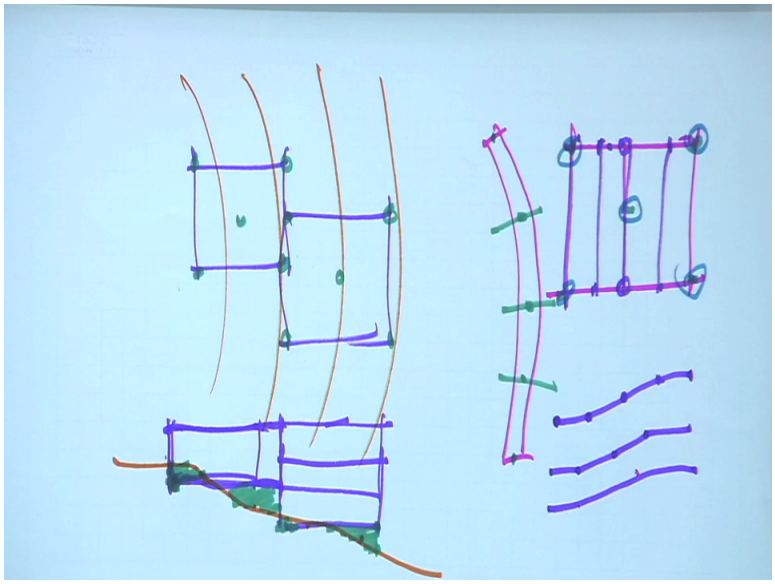

Another is linear, that is road, drains and other things. Road, drains, fences, position of trees, they are linear because they are basically coming in this profile. And what I am saying as planar is this. That means one space like this, another is linear. In such cases, what will happen is you will take, what you have to do is you take the levels and decide the levels of all these. In this case, what happens is you have to take, decide about the levels at intermediate points, here, here, here, here because this is, this may be the slope because it is linear. It is taking a longer stretch. So naturally the level at this point, elevation at this point and this point may not be same.

So naturally this will be in slope. And if it is in slope, then you have to decide about the slope of the path and then at intermediate level. So when you plan for it, you will find that you have to now decide about the changed level of this, changed level of this, this, this, here. Another example, with this particular drawing let me show you.

If suppose I decide that I am going to have a break over here, the moment I think about the break, then naturally what will happen is I will have another spot levels to be worked out at this point. Okay? This is how it is. Now in this situation, suppose I decide no, the spot level is not going to be broken into three such levels, there will be other intermediate levels the spot levels are broken into, then I am expecting that my profile of the site is something like this where this is one spot level, another level here, another level here, another level here and another level here.

So basically what I have done, I have created multiple such breaks. And now here this particular thing in reality when it is, it is something like one break, next break, the next break and the next break but then you are going to refine it in the finalization of your drawing and then it becomes a smooth curve. Okay? This is how the whole thing is worked. So this you have to understand. Okay?

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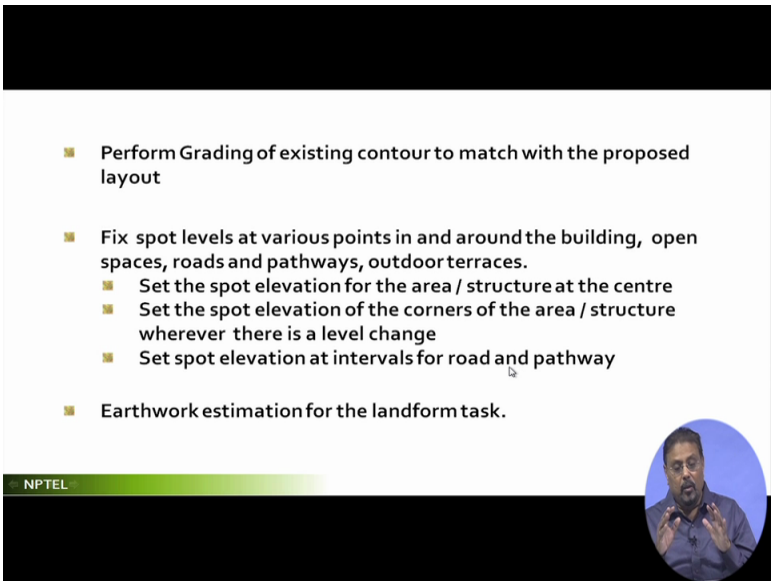

And perform the grading of existing contours. Basically what is happening is, okay, this is a part of this itself. See the grading is the activity in which you are fixing the spot levels and then after that what you do is you perform earthwork estimation. So now if I summarize, you have studied, you have got a project in which in the landscape you are now trying to make the landform design and for the landform design, first you have studied the soil types and you will make a different divisions of the soils.

And once you have done this, it is you have got the existing contours, now you and the slopes. Now, you are going to change it. Once you are going to change it, you are going to see to it that you are making it a kind of different profiles. Once you are making the different profiles, then naturally, once you are making the different profiles, then you are changing the levels. So you have understood the soil very, very well.

Once you have understood the soil, then you are changing the profile and making a technical drawing. And once you have made the technical drawing, then you are going to make it, make an

estimation of this. This estimation will give you an idea that how it is to be handled. So in the next discussion, I will go for detailing of that. Enjoy it.