Landscape Architecture and Site Planning – Basic Fundamentals
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Module-07 Lecture-34
Landform Design

Hello friends! So now we are discussing about the landform design. We are gradually entering into the planning and various other aspects. Now I will discuss about one more issue in the landform design.

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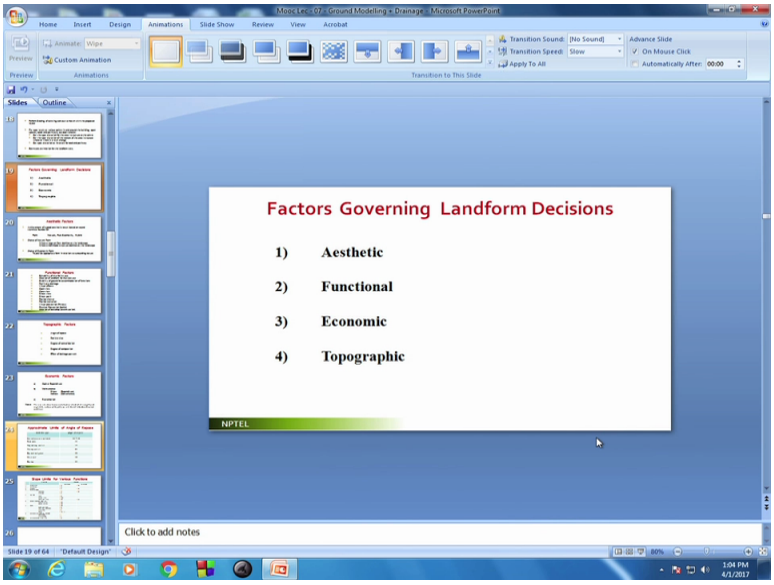

There are certain factors which will be governing by landform decisions. See first is the aesthetic, next is the functional, third is economic and fourth is the topographic. Here again, I will put the note of cautioning that you do not try to prioritize which one is most important, which one is the first.

But one thing is very true that since it is a landform and dealing with a soil, whether is functionally good or bad, aesthetically good or bad, topography matter will definitely be one of the prime concern. And since landform means you are changing the profiles with the topographic factors, then naturally economic factor also will be very, very important. Very bluntly saying, you have a landscape project to be designed which has been commissioned by a client. It has some topography which you want to change. That means you want to do the landform work.

The moment you do that and you explain this pictorially to your client, he will be very happy, he will say yes, wonderful, please do that. And then you painstakingly work it out, estimate the earthwork, estimate the costing of it and then you go to the client back and saying that okay, it is going to cost you about say 30 lakhs. Client will say dump it, do not do it, you do not have to do anything, I cannot spend 30 lakhs just for changing my levels.

This is the irony of these projects. Okay. The point is let us try to understand these factors very briefly. How you handle it and what will be your fate in front of your client, that the time will say. But let us think of it technically and also ideally what is it, which factors are going to govern when you are going to do the landform decisions. I have listed this in this form, so let me go by that form itself.

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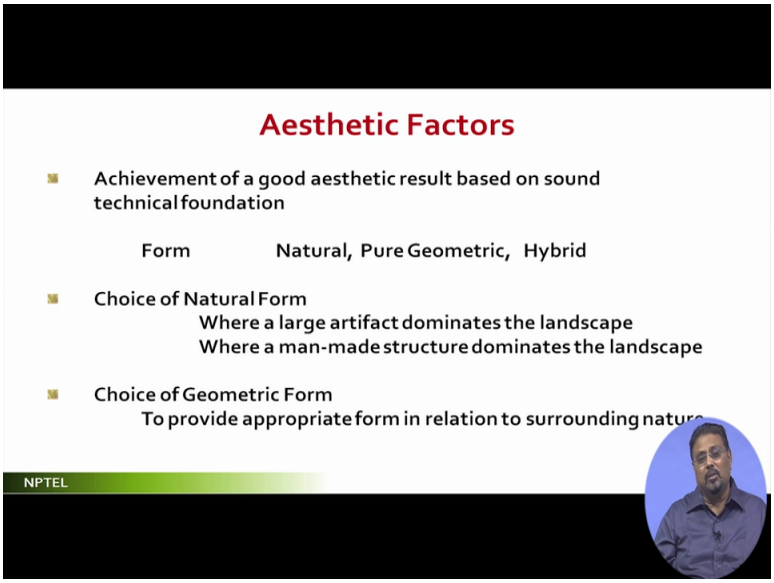

Aesthetically if you look at it, basically what happens is any landform work that you do, it must be based on a good aesthetic, based on sound technical foundation. It should be absolutely technically, geotechnically correct, whatever goodness we are going to give. So you are definitely and also I can tell you if something is technically perfect, it also is likely to be good looking and this is phenomenally true for anything. Here actually in aesthetics what we are referring to is a form. There are three kinds of forms, two basic kinds. One is the natural form, that means the profile is curved.

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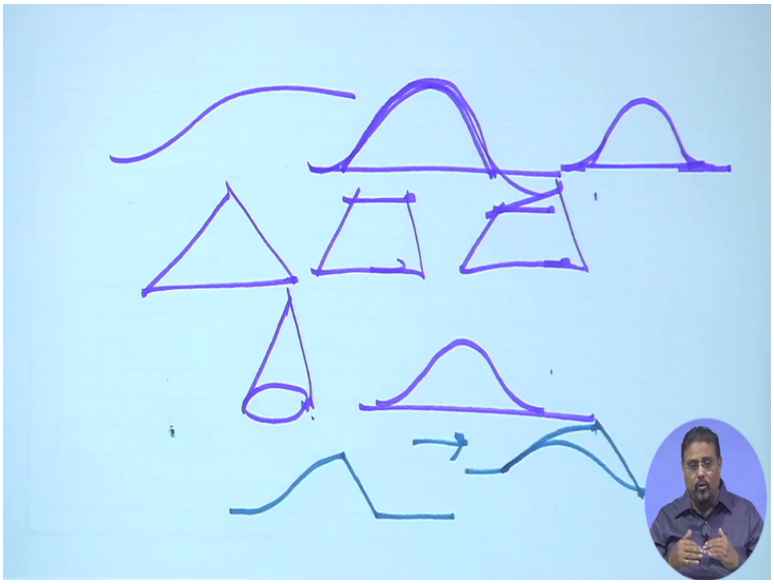

Whenever we try to explain, we say something which is curvilinear, these are natural forms. And something which is geometric which you try to make it, which can be explained through geometry, this is geometric. Whether it is truncated pyramid, whether it is truncated sloped pyramid, whether it is a cone, whatever, which can be represented with geometry. Now the question is this one that I have drawn which I am saying natural, can this be geometrically explained? Yes, it could be, probably because if suppose you make such geometric figure where it is absolutely paraboloid, half of the paraboloid, then it is geometric, no doubt about it.

But the mind and the eye generally perceives this as non-geometric, so natural. And then if it is something like if you make a pure paraboloid section over here, people will always understand yes, this is geometric. The moment you round up this particular basis, then people will start thinking it is natural. So this natural in geometry, let us try to see with respect to perceptions. Some form, landform which is very geometrically representable are geometric forms.

And some forms which are maybe geometrically representable but perceptually it is profiled, then it will be natural. This is a point, let us stick to it. And there could be hybrid. What is that hybrid? Is something like this. There may be a form which you have generated where you have gone like this, natural and then straight down here, geometric, this is hybrid. Where do you see this? In nature has created this kind of thing. I can cite you an example. Nature creates this. You go to the sand dunes, go to the deserts.

In the deserts, you think that always sand is something like this? No. You go and see this and if this is the windward direction and this is a (())(05:26) direction, you will definitely find that the moment this particular sand is, sand bar is increasing in heights, at one point of time then it becomes a profile like this what I have drawn. This becomes geometric. So the idea is that geometric or non-geometric, it is a matter of what you want in your project. Okay?

It is a matter of choice, what you are choosing. I can tell you one thing that by phenomena the users are always very much fascinated by natural forms, they expect a natural form in the site. In the landscape which is supposed to be a replication of nature to a great extent, in such cases, the expectation of the user is or the landscape connotation is that to see more of natural forms. The moment you start making geometric, they try to correlate with a geometric forms of the buildings and other building elements, so it is your choice how you do it.

But there are certain rules or I will not say this is, strongly that you do this. Quite often, you have found that if suppose there is a very geometric artifacts which you are trying to accentuate, then it is always better to place one of the natural form. Or suppose you have a natural profiles which is to be placed in your landscape, then it may be preferred that you put it on the geometric form. An example let me tell you.

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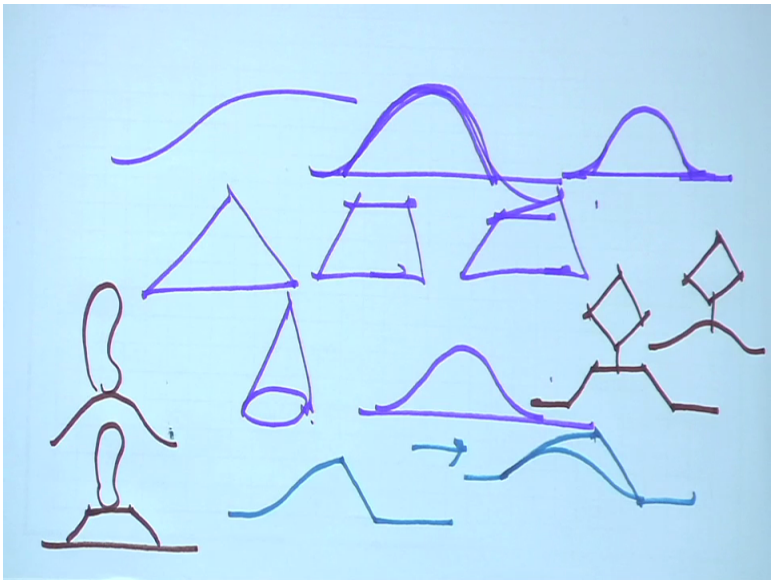

I think I should draw here itself so that it remains in your, if suppose you have a cuboid to be placed as a sculpture, then if you do geometric form, then it hurts, it hurts. What is preferred?

The cuboid because it is a very geometric form and you negate the effect of this with a natural form. Contrary of it, if suppose you have a profile, a sculpture like this and you are trying to place it over a natural form, generally I will not say it is conflicting. But people would have preferred that accentuating this with another natural form is not very positive.

So what is preferred is that okay, you place it over a geometric form, it gets accentuated, it gets more focused. This is a very common thumb rule which you can use that now you decide. At the same time, so I will not say this is very, very strong recommendation that you have to do, but these are as we have understood from people's perception.

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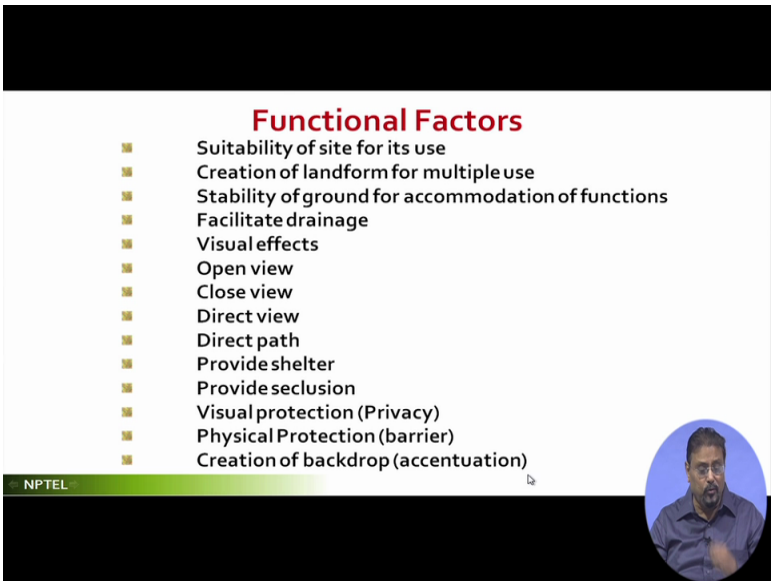

Then comes functional factors. In the functional factors, I have given a series of list. This particular list are, I am just reading out one by one and I am going to give a very brief discussion of it because each one of them can be discussed over a good length of time. The functional factor the, which is going to govern in my landform design is suitability of the site for its use. That means stabilizing the site, changing the slopes. These are functional factors. Nothing to do with aesthetics. Aesthetics is additional if you get it.

So suitability of site for its use, creation of landform for multiple use, that means you are creating such kind of landforms, such profiles which you can use for various things. There may be a place which is going to hold the water as a edge of the drain. At the same time, just the base

of it at the top is for people to walk as permanent. So all these are profiles are functionally going to help you.

When you think about the landform works, when you are being governed by all these four, you take note of each one of them and which one is the best fitted for this particular project, you do that and also crosscheck with the rest. Okay. Stability of ground for accommodation of function, this is for the strength. The suitability of site for its use in terms of placement and the stability of the ground for its accommodation is in terms of strength, bearing capacity and all that.

Then facilitated drainage which I said it is a very essential thing for our work. Visual effects, how it looks, aesthetics. Open view means you have say the, when we say the landform activity is functionally true for opening view, that means if you have some landform which is obstructing your view to the other side and your analysis, visual analysis has indicated that the other side is a good view and now you want to remove it. The moment you remove it and this becomes open view.

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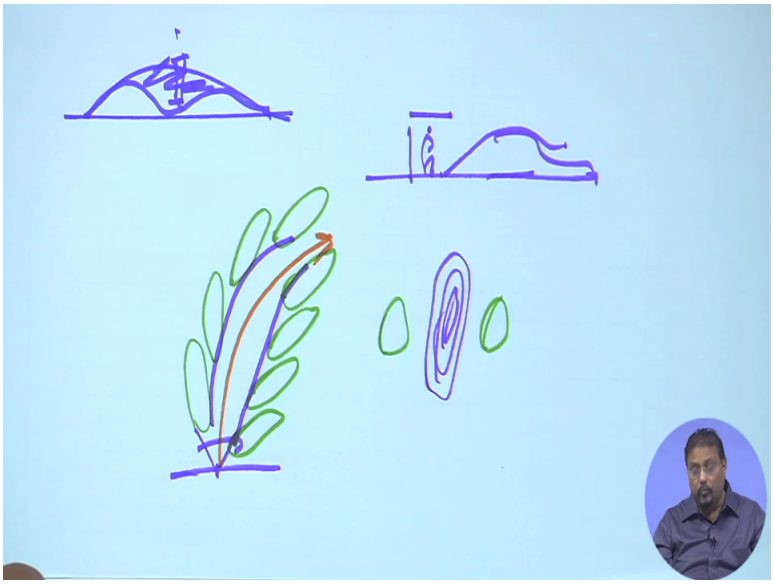

A very simple sketch of this is if suppose you have some element on the other side which you could see but you are not being able to see. The moment you break it, this part is removed. You have opened the view and now you are seeing something, okay? So this is how the opening view. The similar is the, contrary to this is closing view. If suppose you have some site from where you have some unpleasant visibility to something which is brought in your site and you want to stop

it, or maybe within your site but non-conducive from this particular site, then you make a mound, close it.

Directing view, this is when you think in this term like basically I am drawing in plan, the mounds are, suppose you keep on making mounds like this and now you put somebody at this particular point to view it and trying to see, what will happen? The person who is seeing this, this is in plan, the person who is seeing this, he will see the projected surface of this, this, this and this, and also projected surface of this.

The moment it is generated in the image of the person, then automatically the whole view is being, by obstruction of this, whole view is going to be directed. So always if I try take a test of people who, what is this, perception of this, they will say that when I was looking at it, the whole thing appeared to be directed towards this. Okay? So this is directing view and now take the same thing for directing path.

Means, here the moment you find that the mounds are turning like this, this, this and this and other mounds are turning like this and this, automatically you will conceive or perceive that there must be a path leading to this. So directing path and directing views, closing views, open views, these are all functional aspects of the landform. Provide shelter, provide shelter is essentially, this I will try cite in another way. What happens is if suppose somebody is standing here, nothing around. He has to have a feeling of shelter. The best possible way is to have something above.

You remember the behavioral things I was talking about. Okay, this is not possible. Then something on the side. If this is not possible, maybe a mound, this will work. This will have a feeling of shelter, that means I am being, I have a shelter to fall back on but actually it is sloping outward, upward. But still the mind perceives like that and that you remember the sensation, perception and the intellection process in which (man) user perceives this as one of the shelter. Okay. Then provide seclusion. When you can, there is one function here, there is one function here, another function here. You want to make a separation of this. You can always create a mound in between, secluded simply. So these are all different functional aspects of it.

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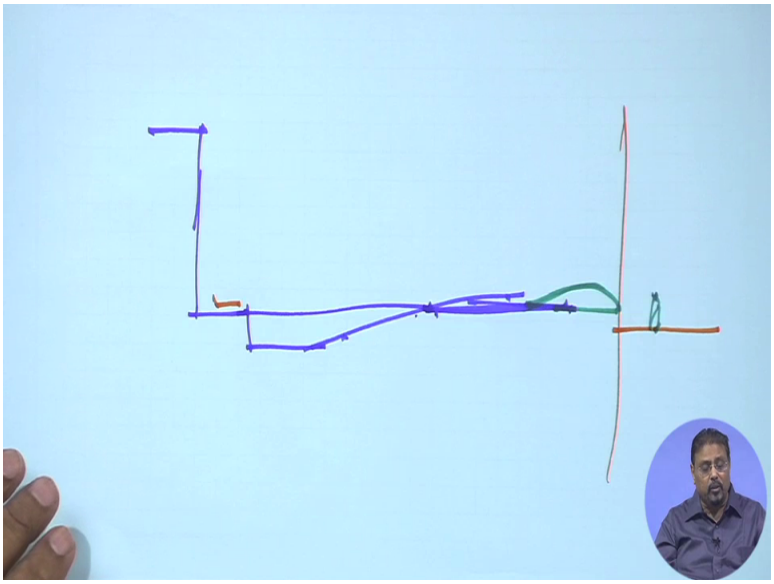

Then visual protection for privacy, I will cite one example for, very interesting example which you can always, you will understand this. Suppose you have a, you have a hotel and then you have a swimming pool, the hotel swimming pool here, okay? And here is the building. Hotel swimming pools, sorry, hotel swimming pool is something like this. And here people are using this desk for sunbathing and all that but they do not want to be seen by others who are on the other side.

Suppose the property ends here and there is a path here, there is road here and nobody wants to be viewed from here. Very simple solution that lies with, in this is by seclusion. What is the seclusion that you will do? You will just make one mound and the mound height should be just above the eye level. Once you have done this somewhere else, then automatically this visibility of this particular area is now stopped, so gives privacy. This is what is like say you can always do this in different forms. Physical protection as a barrier means you are now making the mounds as a barrier, that means you cannot cross over. Okay?

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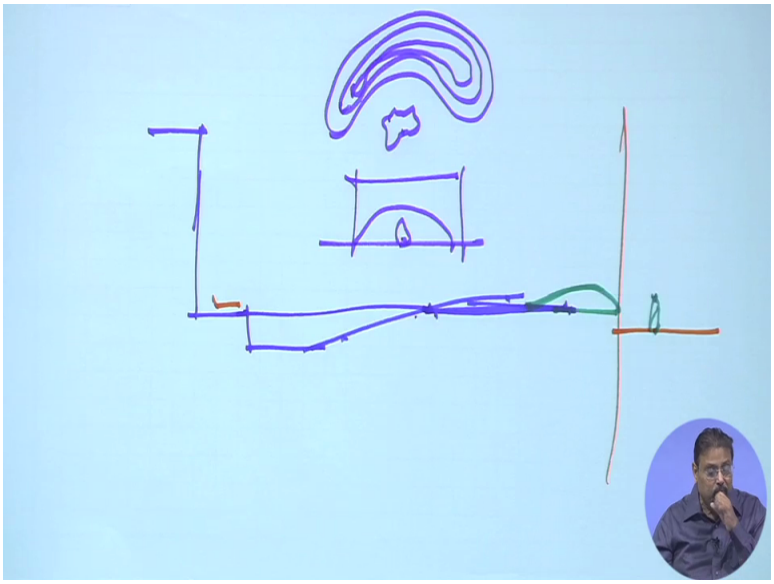

And creation of the backdrop which is something like this. When you have some objects over here which you want to highlight with the mounds. I am always citing this landform as a mounds here because that will be best perceived like this. With this, the moment you look at it in a view frame, you will find that this is the object and then there is a mound at the back. This gives you a kind of backdrop which accentuates. This is how you have to look it in terms of the functional factors. And if once you understand this, you can always also start analyzing different examples that you are seeing yourself around you which I am not being able to see. So you try to correlate this with respect to that.

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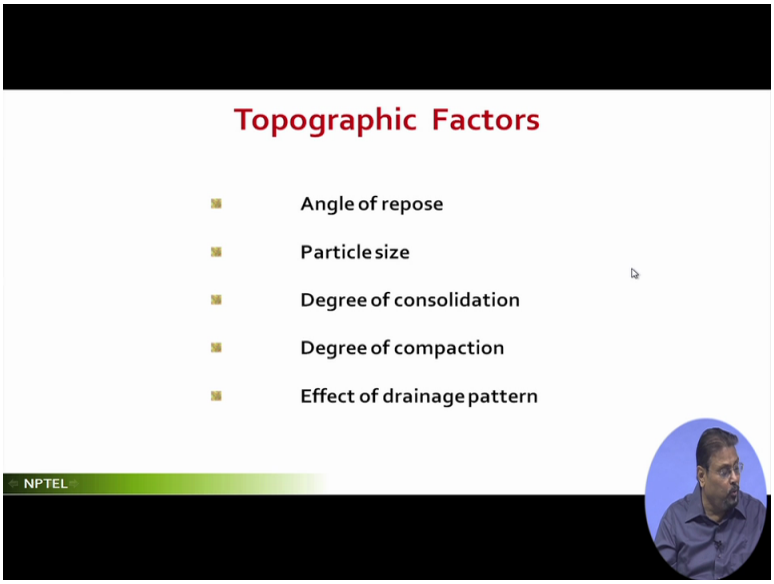

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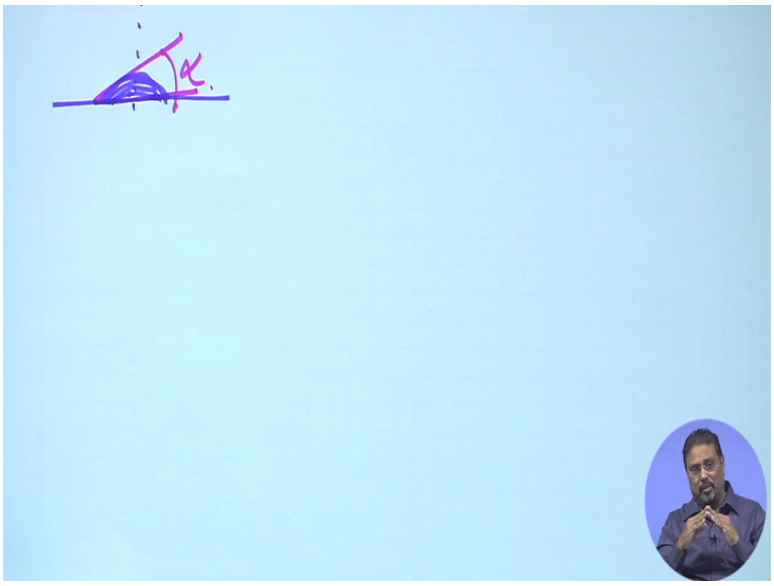

Next is topographical factors in which few things which are very, very important. One is the angle of repose. Angle of repose is the angle that is being generated between, if suppose the best way to understand this, if this is ground and you pour the bulk material, the loose material. You keep on pouring. Once you start pouring, you will find that this is going to take a shape of a similar kind of geometry. And once you do this and if it is loose materials, by virtue of the size, volume and the profiles of this, automatically there is a generic angle that is created. And this angle is generated between this. This is the angle which is the angle of repose.

If suppose you just, the best way to understand this is, have you seen the sand clock? Sand clock if you put it, you will find that once from the top bowl the sand is falling in a line and it makes a sort of cone at the center. And you measure the angle between the horizon and this and turn the clock and see again, it is again making a cone. Measure, it will be identical. And this is a phenomenon. So angle of repose, why you have to understand? Because in case you are using the bulk materials or loose materials, in such cases that angle of repose will be very much active, very much required.

And most often, what happens in your landform work in terms of materials is that they are being, particles are being held by two things. One is by cohesion between each other in conjunction with many other intermediate materials whether it is water or other organic components or by friction. That means one material, one particle is falling on the other and not being able to move by friction. So the cohesion and the friction, these two are very important parameters to be seen in the bulk materials, that means the loose materials.

Best way to understand is with respect to sand, with respect to rocks, with respect to globe, something which is round. Like say cables. Take a bucket of cables and start pouring it at a particular limited area. Automatically, you will find that it will make a kind of conical thing like this. Okay? This gives you an idea about the angle of repose.

Then comes the particle size. Particle size matters. If the particle is too big in size and the friction is not good enough to hold the particles against each other, then it will roll down. Okay? And so particle size matters. Then degree of consolidation and compaction, these two I always discuss together for one reason. One is the degree of consolidation is basically natural process of consolidation. Means you have, you remember that I said the composition of the soil which has the water, air and all.

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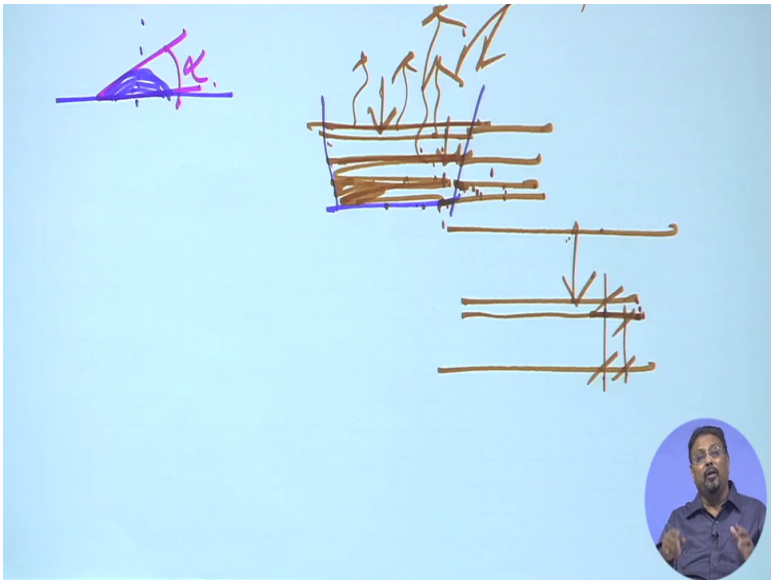

So if in case you have the soil, let me take a bucket within which let me put some soil. Okay? Loose soil. Just pour the soil. It is filing it up here. What will happen here is and let us take the organic component at 5 percent as integral part of the entire minerals. So I have three things now here: The mineral component, the air and the water. Okay? Now you allow it to be consolidated by its own self weight. Now this will have water and also air. Air, water is trying to replace the air, so once the water is trying to replace and does not get any access that grease out, this air will be now coming, almost trying to come to the upper level.

And then after some time, it will just, it would come out. And another thing is if suppose you give heat to this and you will find that this particular heat which is now heat in this particular surface and by conduction this particular heat is being ultimately transmitted to the end, then in between the air spaces that has, that also will come here, come out and also the water will evaporate.

So when this thing is happening, water and air is trying to escape from this and secondly is the self-weight of this particular material one over, one layer over the other. So the first layer, second layer, third layer if you start putting, I am showing into a basket but in the real scenario it is naturally being done. First layer you put, it will, leave it for one season. The rain water will fall on this and the air temperature or the solar radiation will evaporate the water.

And once the water is evaporated, then the air spaces are there. Air voids which is being created now will be displaced with the higher heavy particles above and that particle will now displace all these things. And once the particle is displacing the air, air is coming out, so it is now (hold) filling up all these interspaces naturally, in the natural process. Then when you are putting the next layer, the same process is happening over this.

If suppose originally you have found that this particular layer was of this depth and if you could measure, then when you are putting the next layer, you will find that the depth probably will be reducing a little bit. Now this is the displacement which will take place because of the additional weight that is coming over here. Because this is no longer susceptible to any kind of evaporation of the water and all because that has happened already, now this weight is now going to reduce here.

So what happens is if you are working in the profession, you must have seen that when you take for earth fill, or sand fill or such kind of filling, in such cases what you do is you try to measure the volume and the volume in its consolidated positions. If you take the volume in the loose position, then you are a loser because you want to fill up this much and you have considered this as a volume and from the supplier you got so much of volume and by consolidation this is going to reduce. So you could not match your volume that is to be created, that is to be consolidated, so you are loser. So at that point what you do is you take, always consider the volume that, the height or the volume that you will be considering when it is in the consolidated form.

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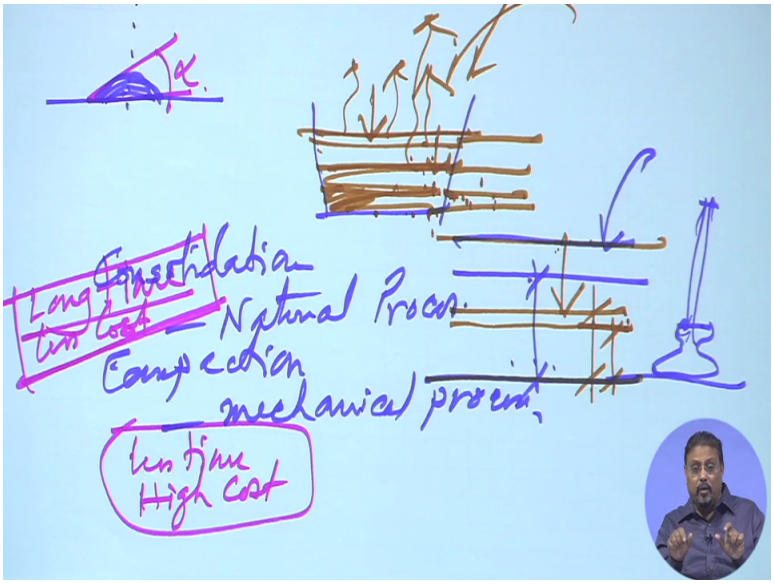

So now let me just very categorically differentiate between these two. Consolidation is a natural process, never forget. Consolidation is a natural process. And what is then compaction? Compaction is a mechanical process. Here what happening is, you are trying to put pressure on this particular soil with some external devices whether it is by bulldozer or whether it is by steamroller, whether it is by diesel roller or roller something like that. That means you are trying put, even you are trying to put pressure with the usual handheld tamping gadget, is something like this. You must have seen this. This kind of tamping gadget, you have to keep on pressing, pressing in all these parts.

Basically what you are doing is you are putting pressure on the upper layer and the upper layer is now putting pressure to the lower layer. And in between the air spaces and the water spaces are now being replaced with the small small granules and air and water is escaping. At one point of time, if it was the original layer, original layer by tamping or by rolling or whatever, this comes to be the finished layer. And by then this has reached to a compaction level.

And there are measurements. There is a something called Proctor compaction test. By this Proctor compaction test, you can measure. Means after you do this with mechanical devices and then you take up sample soil and see what is then, what is its compaction level that you have received, and if it is about say 95 percent or plus, then you become very happy. Okay, this is a

good compacted soil. And if you find it is lesser than that and farther lesser, then you must know that your mechanical devices did not work properly or neither it has been done very seriously.

So the thing is I can also tell you one thing. In the compaction process, very quickly you can always achieve your compaction level to the desired level. But the consolidation process, it takes time because you are leaving it to the nature, the rainfall, the sunrise, sunset, the solar incidences, ray incidences; all these matters. So here, two things to be noticed.

In the consolidation, you will find it is a natural process, so it takes long time. And since you are not using mechanical devices, the cost is less, less cost. That is for the consolidation thing. In this compaction, it takes less time but high cost. Now these two are contradictory, is not it? But still you have to take a call. Would you like to go for this or like to go for this? Now let me give an argument based on which you will decide.

If suppose the project has to be commissioned very fast, you do not care for the cost because the cost will be recovered from the clients, then you go for this compaction. Quickly do it, compact it and sell it off or set it off. In such cases, within the less time you use even if high cost but you know the higher return would be coming whether in terms of revenue or in terms of utility. Another thing, when you go for such kind of compaction, if it is too larger domain where you have to go for compaction, then it becomes really cost-ineffective.

And if it is a very large area to be compacted or consolidated, it is always better to go for consolidation. It is because of this, the road embankments, rail embankments, whenever new rail routes or new roads or highways are being constructed, generally they prefer the (compact) consolidation. What they do is it is, now I would say let us mix it up. For such larger chunks, you go for consolidation. So wait for that time. But when it comes to a certain level which is consolidated enough in terms of strength, then the top layer you go for compaction.

So it is not necessary that you have to, if you follow consolidation, you have to go for consolidation till the end, no. So this is how you really work it out. Okay? So what is a degree of consolidation, what is a degree of compaction that is required, that is going to be a guiding factor and also the effect of drainage pattern. Effect of drainage pattern is like suppose you have the soil and the topography factor is it has a certain slopes and the drainage is passing over this, then it is definitely you subject, will be subjected to two things.

One is a surficial water erosion, another is the under surface creeping erosions. Creeping erosions is basically destability, means this is what I was citing in our second case is where maximum landslides that you do find where the slope is such that the water is coming in and ultimately destabilizing the under surface of the earth, of the soil. And you are not seeing the top surface, top surface only slides or glides but the lower portion got destabilized. Top portion is not destabilized by the water. Water is flowing over this but the lower portion has got destabilized. And once this get destabilized, the whole bulk at the top rolls out. This is how the whole thing happens. So, topographic factor that you take into consideration.

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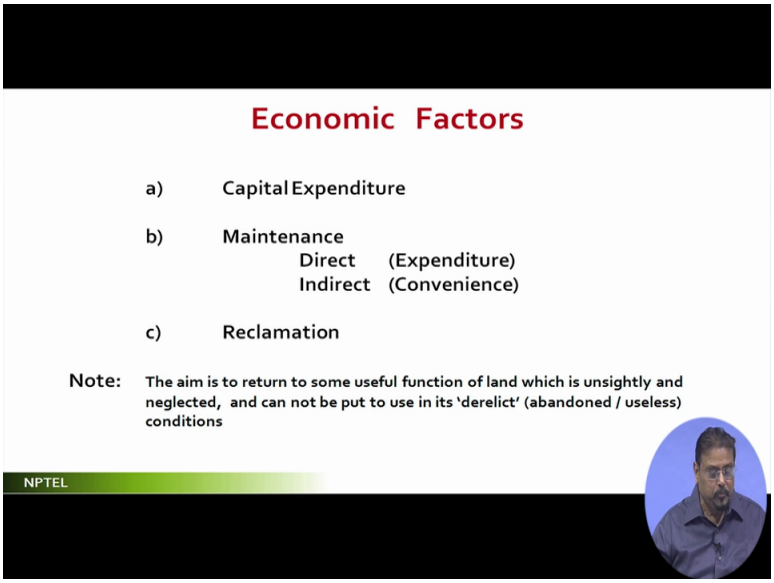

And then is the economic factor. This is something which is very, very critical because end of all, that whatever you do, it costs. So there are three things to be seen. One is the capital expenditure, that the first expenditure that you are going to do. And there is maintenance expenditure. And the maintenance expenditure, there is a direct expenditure. That means see, when you make the landform, the capital expenditure you do it, you incorporate it.

And but to keep it retained in the shape or the profile that you wanted, you have to do some bit of work every year. Okay? Some maintenance work you have to do. So that direct maintenance which is going to be an expenditure. But what is very important is to also notice if there is any indirect expenditure that you are incurring or you are compelling them to have. What is that indirect expenditure? Is something like this, let me explain.

If suppose you have made a mound which is of a certain slope and the slope has to be maintained and here to maintain this, you are, originally what you could have probably achieved with a machine, now you are not being able to have it, so you have to have more manpower. And the more manpower, basically you are incurring mainly because of the inconvenience that you have created because of the slope. So indirect expenditure is connected with inconvenience that you have created by changing the profile and this cannot be disregarded.

I will tell you most often, this becomes a real (())(26:45), we do not realize. It looks so good, we have done it. And the direct maintenance is also possible but the thing is some portions that you have done where indirect expenditure becomes higher. So in such cases, it fails. Okay. Another is reclamation. Means, when you are trying to reclaim something. In this case, what happens is I would always say that if you are reclaiming for the good cause and it is worthy, then the cost is all right. But still these are all economic factors. Okay. Basically what you are trying to do in reclamation is that you are trying to convert that derelict line into some useful use.

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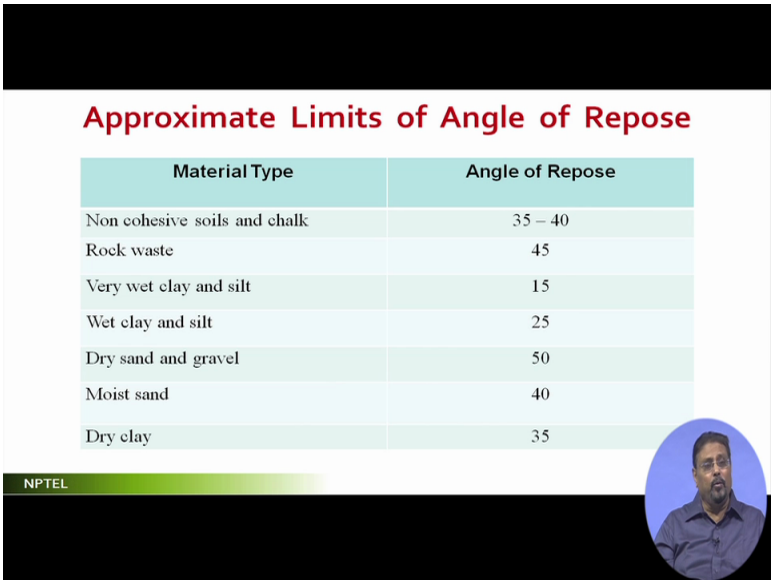

Here, I will just keep this slide for few seconds. And just to give an idea, the different materials which are used for the landform works are of this kind: non-cohesive soils or chalks, rock waste, very wet clay and silt, wet clay and slit, dry sand and gravel, moist sand and dry clay. And they have their standard angle of repose which are less variable. So, I am keeping this particular slide

for a few seconds just so that you read it out. And again, you read it and try to understand this but I am not going to discuss about it.

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And also I am giving a slide over here. This gives a slope limits for various functions. Let me explain. You will read the slopes you are served. Essentially, what happens is there are different spaces or different functions in the landscape. And if you remember that when we are doing the slope analysis, we are always trying to find out whether the slope is suitable for some functions. Now based on the project and its objective, you have a list of functions. And each function has some maximum and minimum slope limits. Okay? The maximum slope limits is it is basically that how much you can go up to in terms of stiffness.

And the minimum slope limit is essentially connected with the drainage requirement. That means it must have minimum so much of slope so that if water falls on that, it should be draining out, it should not get collected over there as a sheet of water. But however in fact, you will see that the minimum slope limits are, basically 1 is to 100. If you make steeper than that, water will roll out but at least 1 is to 100, you give. And people generally think that okay, if it is no slope, it is better, that dead slope or zero slope is not good in our landscape sites.

So there are different kind of activities that we very commonly have in our landscape and which where the maximum slope is being given over here. In this, I will just draw your attention to one.

See the running track has 1 is to 1000 slope, rest okay I understand. The parking spaces, 1 is to 20 and then the service areas, 1 is to 20. Walkways, 1 is to 25, negotiable. All right.

The thing is but 1 is to 1000, it simply indicates one thing that if suppose you are having in your own landscape projects at running track, it should not be having almost any slope, absolutely flat. The reason is that the runner must not have any kind of slope impediments. Okay? So this is how you look at it in terms of such various functions. So what you do is, how you use it? You can extend this particular list from the other references as well. I am just giving an idea.

What you do is you take a list of functions that you want to accommodate within your site and then you try to find out what is its minimum and maximum slopes, desirable slopes. And then when you are trying to place it, try to see is it being matching with the slopes where you are trying to place it because the preliminary or prima facie placement of functions that you have already done in your slope analysis, okay?

Now what you do is you do a little bit of modifications in the, in locality, in local areas and then ultimately decide what will be the kind of levels that you are going to give. Okay. This is how, means you will see that how the landform design is becoming so very technical and so very constructive because ultimately you have to instruct the contractor the way you want it. Okay. I will discuss a little farther on this in my next lecture.