Ground Improvement
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Lecture 51
Geosynthetics in Ground Improvement

Hello everyone. Once again, I welcome you to this Ground Improvement lecture. We are in 11th Module and which is Application of Geosynthetics in ground improvement. We have discussed already several types of ground improvement technique and out of that there are quite a few just by applying force, we try to bring the particles together or closer and densify.

That is actually comes under that there will be ruler, there are dynamic, deep dynamic compaction, repeated plate compaction that. And then there are some methods like where actually we can remove the water and then automatically because of this removal of water and because of the created that and force applied that soil green again will come closer, then that way soil will be densified.

That is a consultation process, that is another way of densifying the soil and then we have done some methods actually by dynamic replacement. Then some grouting and there is some chemical modification. So, these are all different types of ground improvement we have done and in between we have done dewatering because the presence of water table during construction gives a lot of problem.

So, because of that during construction we need to remove the water and that way; how to remove; that you can permanently or temporarily remove de-water lower the groundwater table by dewatering technique. So, these are all various techniques used in (ground) construction, when the ground condition is not suitable for construction.

And there is also another technique where we can use geosynthetics and in fact, this additional material will be used with that along with your material and it will perform different types of functions. It can be for reinforcement, it can be barrier, it can be filter, and it can be of drainage purpose, it can be many other applications.

So, this geosynthetics is a very popular, versatile material now, in geotechnical engineering and it is used in various applications. Initially I will be giving 2-3 lectures on the geosynthetics in

general and what it is; how it is and what is the applications; and its functions. And then I will try to discuss in length one or two applications that whisks, for example, geosynthetics in reinforcing the soil, that is one or similar type of things one or two I will take because otherwise you will not be able to complete, we have only 6 to 8 (module) lectures are left. So, now with this let me start the first slide; the geosynthetics in ground improvement.

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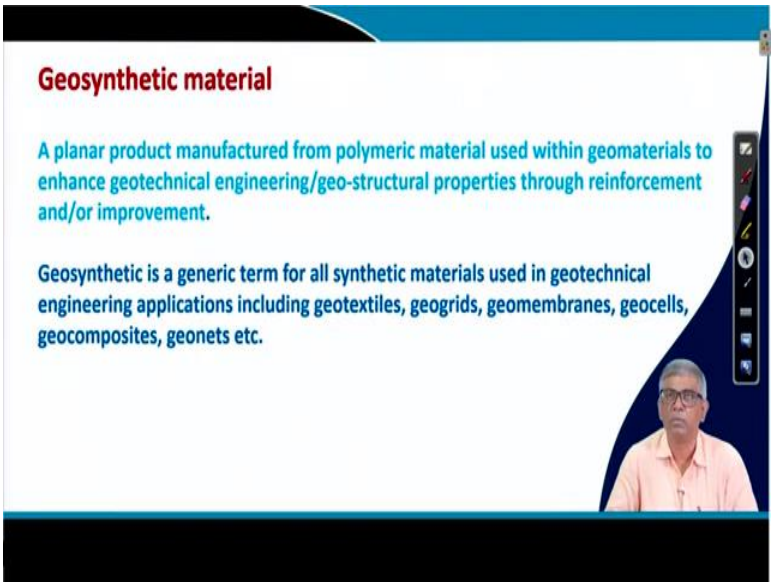

Initially it will be the first slide, this first lecture will be basically introduction and various uses. And first of all, geosynthetics material, this is actually a planner product manufactured from polymeric material. That is generally it is a polymer and it is strength wise very high. And because of this use of polymer and it is used within geo-materials to enhance various geotechnical properties. Sometimes drainage properties, sometimes strength properties, sometimes compressibility properties like that.

And geosynthetics is a very generic term it can be off many types of things. Namely, it can be named as sometimes geotextile, sometimes it is geogrid, sometimes it is geomembrane sometimes geo-cells, sometimes geo-composite, somewhere it is units, many other names also available which are used in geotechnical engineering.

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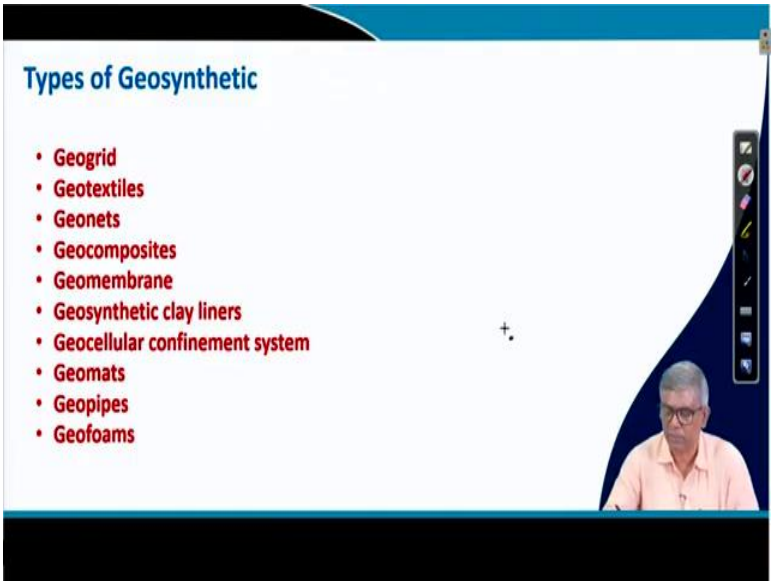

So, let me take the next slide and you can see that I have once again I named here, I listed the various types of geosynthetic and one is geogrid, geotextile, geonets, geocomposites, geomembrane, geosynthetic clay liners, geocellular confinement system, geomats, geopipes and geofoams. And each of them has different types of application that we will see later on. First of all, let us see what is; what is geogrid; what is geotextile, what is your nets; how it looks like, I will just give one by one this on this sorry.

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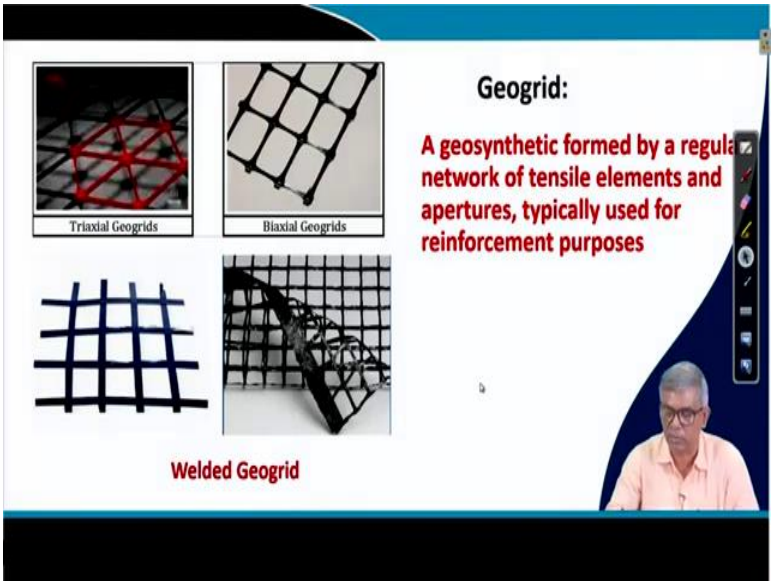

So, here actually geogrid, you can see here by the name itself it is quite obvious it is grid formation, that geosynthetics formed by a regular network of tensile elements and apertures. You can see here, these are actually along these it will have tension, I go along that. This is actually biaxial, geo-axial, tri-axial geogrids like that, welded geogrid, different types of geogrids again available, so this is actually geogrids. It will be used within the soil to enhance some property; which property, we will discuss later on this is not the right time to discuss on it. Let me go to the next one, this is geo grid different types of geo grid already I have shown.

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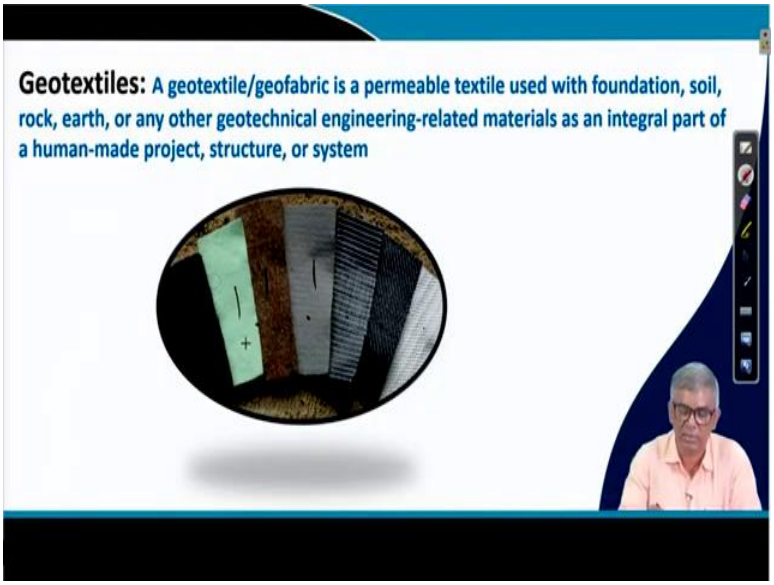

Next one is geotextiles. And this geotextile again from the name itself it is quite obvious textile means is like cloth and so, geotextile or geo fabric it is also known as geofabric is a permeable textile used with foundation, soil, rock, art or any other geotechnical engineering, related engineering related materials as an integral part of the human made project, structure or system.

So, that means, this geotextile and soil, rock or any other geotechnical material will be worked as an integral part and sometime, Suppose, this is the different kinds of geotextile and they used to actually like that there are many correct classifications are there we are not going in details. There are different types of design geotextiles are shown here and these are used sometimes as a tensile material.

Sometime as a separator, sometime as a drainage barrier like that many applications will be there. So, this is actually the photograph of different geotextile available in the market

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Next, will be geonets, and you can see from the name itself again it is quite obvious it will like net, geonets are made of stacked, cris-crossing polymers strands that provide in plane drainage actually can see it provides drainage and also there will be, this there are biplanar geonets, there are triplanar geonets and how it looks that it is shown here, it is shown here.

So, these geonets nearly all geonets are made of polyethylene, polyethylene okay. So, this one It will be generally very strong material and various applications will be there which we will be discussing later on right not just not right now.

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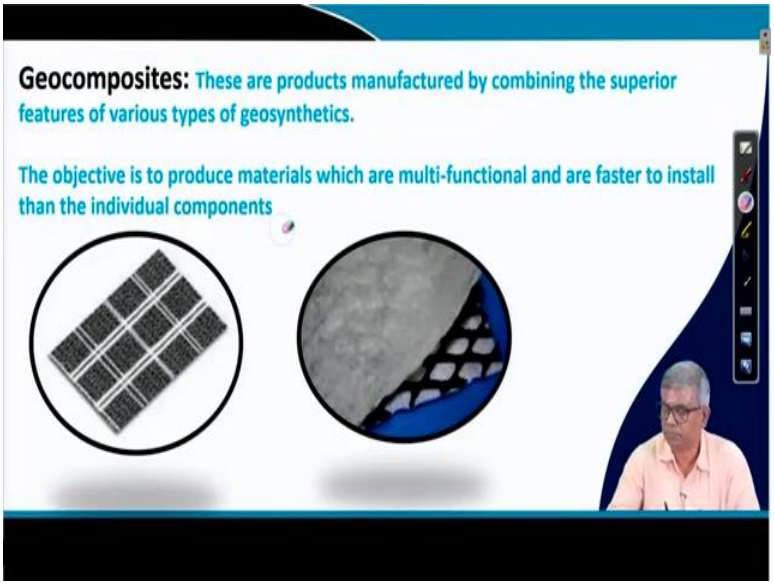

And next one is, you can see geocomposites, sometime that geogrid and it will be covered with some geotextile and it will solve some purpose, it will give some strength in addition to that you will provide as a drainage barrier, so that is what this is mentioned that these are products manufactured by combining the superior features of various types of geosynthetics.

Two three features actually together it can perform because of that, that is called geocomposites, an objective is to produce material which are multifunctional. Already by the name itself it is there; one second it is repeated here that it is produced in such a way that it will be multifunctional and are faster in to install than individual components.

So, if I had a particular geocomposites suppose, perform two functions and if I individually to use one after another installation and everything will be comparatively longer, lengthy than using geocomposite, that is the advantage. Geo composites also available and these are our picture of geo composites, it is actually, it performs more than one application of geosynthetics.

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Next one is geomembrane and this membrane from the name itself is quite clear geomembranes are relatively impermeable sheets of plastics. So, when there is some permanent separation is required you do not want to permit something to move, pass through then this type of membranes are used.

And so, this is some photographs of membrane you can see, this sheet like material, plastic material, it will have very little or no openings so that it can be used as a purely as a barrier, preventing the flow.

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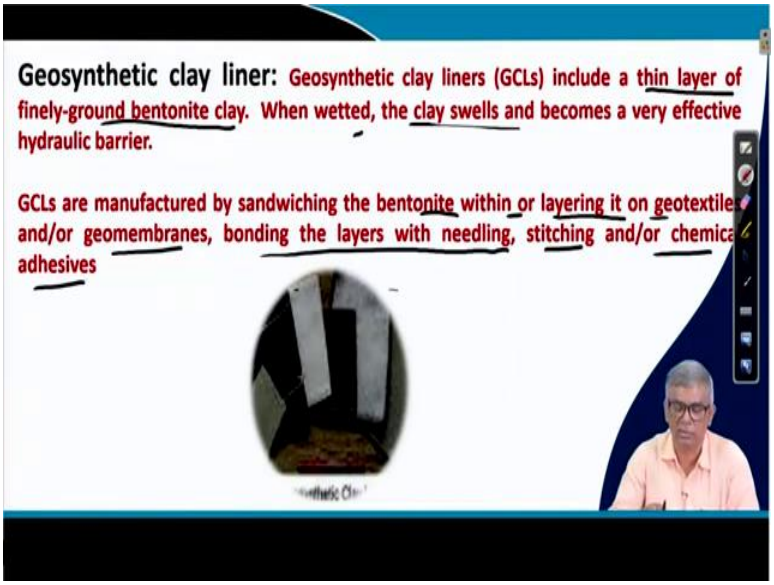

Next one, you can see geosynthetic clay liner. This is again a typical material which is also a combination of a number of things and it will be sometime clay liners, after, when we dump the waste and they are actually we give a clay liner to prevent, leach it, come out from that source and mixed with other groundwater or soil.

So, that clay liner there are different ways it can be done when, in the introduction of geosynthetics there is geosynthetics clay liner there actually in the geosynthetics it will have in between there will be bentonite clay will be there and then bentonite clay when come in contact with water it will be swelling and then that will give you together geosynthetics and this clay together will give you a very good liner where actually it will not allow to any leach to pass.

This geosynthetics clay liner include a thin layer of finely ground bentonite clay, that is why already I have mentioned. So, this is a thin layer of finely grounded ground bentonite clay when we did the clay swells and becomes a very effective hydraulic barrier and geosynthetics clay liner manufactured by sandwiching the bentonite within or layering it on geotextile and or geomembranes bonding the layers with needling, stitching or chemical adhesives.

Either way, two sets between there will be bentonites and then it will be stitched or it will be can be glued by adhesive or it can be chemicals by that it can be beneficial some pictures of geosynthetic clay liners have given here.

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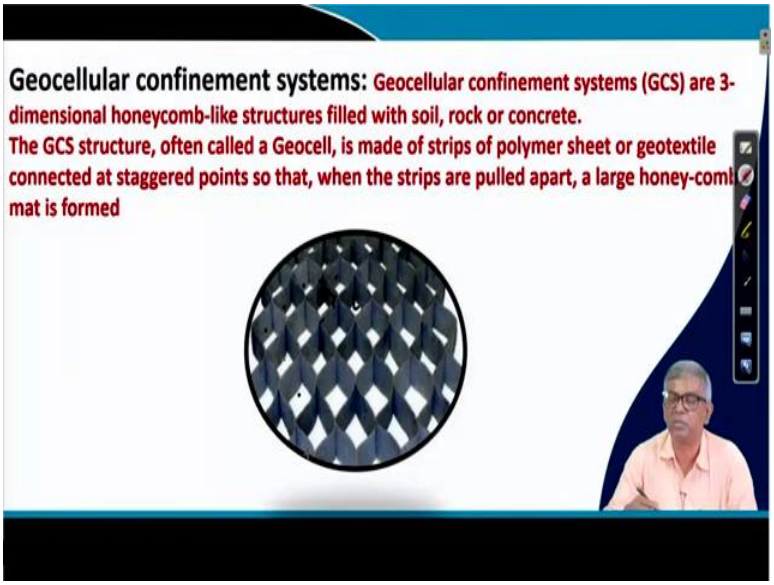

And geocellular confinement system here actually the first I can show in your picture itself, here actually you can see that geosynthetics is manufactured I such way, if you pull them then this type of opening will form, this type of opening form. This opening actually can be filled up with some soil or sand, good sand and then it will be cover, thin cover if you give then this layer will have a better effect than any other material, normal material.

Because of this confinement this whatever soil will be inside here because of this confinement it cannot spread laterally. Because of that, it will have better stability, strength and everything. So, that is another application of geosynthetics, good application and this coming very popularly nowadays that is in the name of geocell.

Geo cellular confinement systems are three-dimensional honeycomb like structure. That is what I have already mentioned and filled with soil rock or concrete anything it can be, sometime in the pavement also they are using by competing with concrete particularly in the village road they can make it with concrete and finally at the top thin layer can be given, then it will be nicely effective road can be made.

And then GCS structure often called a geocell, this particularly this structure with pillar builds with our soil or rock, soil or concrete then that is called geocell is made of strip of polymer sheet or geotextile connected at staggered points. So, that when the strips are pulled apart, a large

honeycomb structure is matt is formed. That is what, it was initially it will be like that, but you unfold it, it forms like this.

And it will be laid on the ground and then it will be pulled up externally and then it will be compacted, then it will give you a very strong base. So, this is another important use of geosynthetics.

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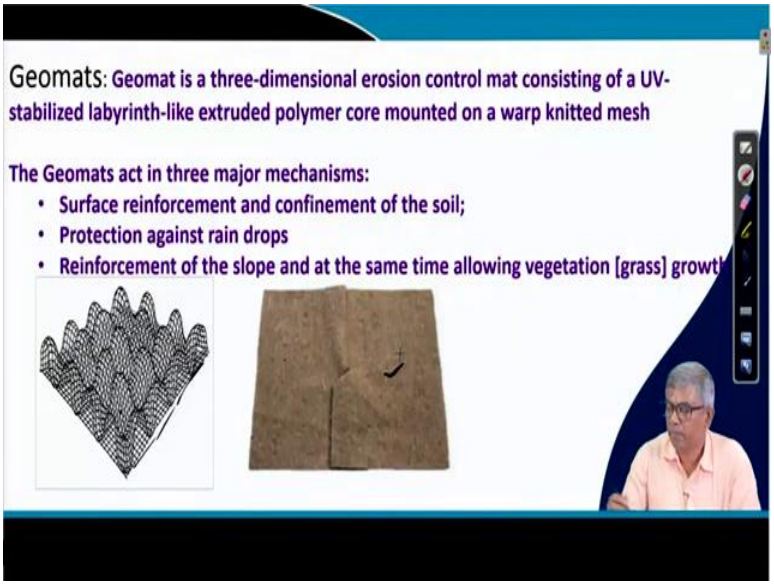

Next one, you can see geomats. Geomat is a three dimensional again erosion control mat consisting of a UV stabilized Labyrinth like extruded polymer core mounted on a wrap knitted mesh, we can see here from the figure at the bottom that this one, this can be wrapped and over that there is a, there is another cover, this together is name as geomet.

Geomat act in three major mechanism, surface reinforcement and confinement of the soil. So, these are the confinements and again it is surface enforcement, protection against raindrops that we saw erosion control also it is very much use. And enforcement of the slope and the same time allowing vegetation to grow.

Because of this opening, if it is there, it will be, there will be a reinforcement it is acting as enforcement, vegetation growth, everything will be there and also erosion control for all three because vegetation growth actually indirectly will be controlling the erosion. So, this is another

application of the geomat, geomet can be of like this, when it is a mesh type and again cloth type mat can be like this. So, two types of geomat will be there (soil).

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Let me go to next one, geopipe. Geopipe again made of, the pipe made of geosynthetics and they are also from the name itself is quite obvious, it is a pipe and these pipes are used for drainage purposes and barriers location. You can see that there is a wide variety of civil engineering application for these products including highway and railway edge drains.

At the edge actually, there will be these types of pipes will be there, water will be collected and get through this it will be passed away from the main structure of the road or railway. Then interest interceptor drains. When interceptor drains are there finally that drains will be intercepted, we collecting the water and that water through these drains will be discharged away from the main structure.

And leachate removal system again sometime you are in the various clay dump, waste dump application, there are also some times if there is excessive leachate formation is there that can be also discharged in a systematic manner. There are several such use is there. So, by and large, this is pipe; used for various discharge purpose actually.

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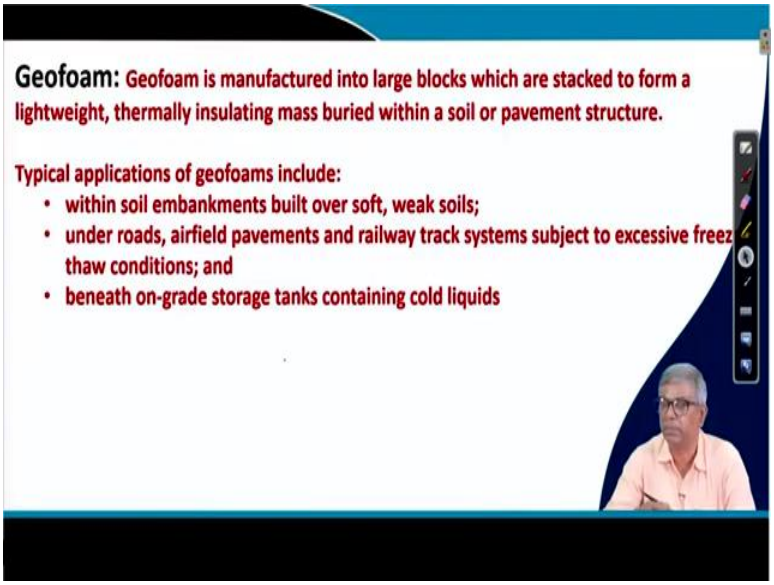

Then geofoam it is again another various important addition in the geosynthetics, it is a lightweight and because of that it has very large number of applications and geofoam is manufactured large blocks which are stacked to form a lightweight thermally insulating mass within a soil or pavement structure. Sometime to also there are another type of geofoam also is there because of this lightweight backfill can be some time made of this type of geophone and as a result actually because of the light backfield you require a less strong structure.

That is also one other application. So, typical application again is given here, there are a number of the application will be there, within soil embankments, within soil embankments built over soft weak soil, if there is soft weak soil then we cannot make a normal soil which is having more unit rate is higher and this type of geosynthetic geophone which is lighter that can be stacked and formed embankment.

That it will give strength at the same time it will have less weight because of that, it will because of that the subway will not have much problem. Then under roads, airfields pavements and railway track system subject to excessive freezing though condition. So, that actually can be in that soil replacing this soil, if this type of material is there, then that can be controlled.

That is another application and beneath on grade storage tank containing cold liquids, that is again another application of geophone. So, there are this way different types of application of geosynthetics can be there. So, let me, this is again by this actually just what I have shown there

are different types of geosynthetics, what it is, how it looks, I have described on some briefly somewhere I have a mentioned the application. But application again our function will come again in the next lecture, which I will be giving you in detail.

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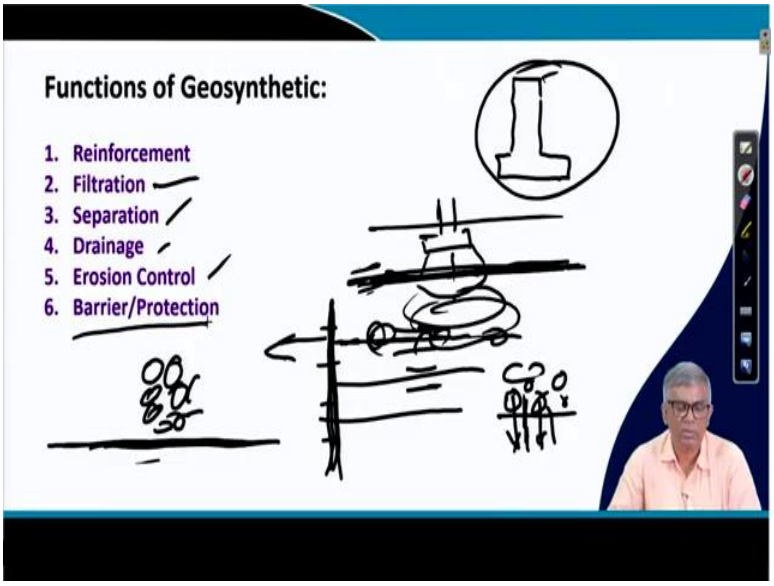

Let me come to next slide, this is actually that whatever I have shown that there are different types of geosynthetics. Now, these different types of geosynthetics can be used for different purposes; that is what I have mentioned at the beginning. That is why functions of geosynthetics. So, here is actually reinforcement, geosynthetics can be used as a reinforcement. How it is actually?

Suppose, there is a soil and comparatively soft soil here and all this soil is quite good, but it just below these there is a soft soil and if we want to make a foundation here something like this, and then what will happen this because of these excessive loads here and there may be excessive settlement.

As a reinforcement means if I lay a layer of geosynthetics here, then while this pushing this while downward, this reinforcement actually will get pull this direction, this info will get pulled these directions. So, it will be pulled this direction. So, then from the soil here and between the soil it will have some friction.

Because of that friction, it will not allow to move much, that way because of that, but if the, this reinforcement is not strong enough, then if it is hold here, it will hold there and there is a pressure here it will break. So, because of that all geosynthetics when it will be used as a reinforcement it will very high strength and strength will be there.

So, that is the requirement. There will be layer of geosynthetics will be laid here then foundation will be there. If there is soft soil, it will prevent excessive settlement and as a result it will have improved bearing capacity. This is one application and very popular application actually.

Then there is another application is there as reinforcement on a retaining wall. We do retaining wall, something like this and nowadays you might have seen that near actually flyovers approach you will see a different pattern structure, they are actually not really a conventional wall, they are all facing element and those facing elements actually holding the entire embankment which is 4, 5, 6 meter, 8 meter, 10 meters high.

So, it will be something like and this is thin and from each element there are a number of elements and interconnected, from each element actually there will be reinforcement will be laid inside and then it will be compact, soil will be compacted over that here like this. And because of this loading and because of this embankment loading, this wall will have tendency to move this direction.

As a result, this reinforcement will get a pull towards this direction and then between the soil and the reinforcement will have interaction it will get a frictional resistance will develop around this direction. As in this mechanism that valve will not have any movement or will have minimum movement. So, this is the way actually this type of conventional retaining wall can be avoided by providing this type of that is called mechanically stabilized retaining wall MSUI.

That is a reinforcement, then there is a next one was the filtration. Filtration means, there is a which I will show you later as the next lecture that when there is a flow of water and then obviously, we will have that there is a tendency of the water to carry fine particles. And then so, filtration means actually if you have a layer and when water passing through it, then fine particle will be restricted only water will be allowed.

That way filtration purpose that this is can be used and there is a separation means actually when we work with soil particularly in the root at different layers, different types of soil with that there, there be boulders, there will be subgrade, then there will be bigger size of soil, then there will be stones like that in different layers, different types of soil or other material will be there.

If the subgrade is soft and over that there is something like this is there and load is applied then there will be tendency of entering or punching these bigger particles inside and fine particles enter like this and because of that, ultimately the stability or strength would be reduced or sometime it will be collapse also can be there.

To prevent this one, sometime there are bigger material this is the layer actually and this is the subgrade in between we can make one geosynthetics layer and that will work as separator separation or separators There are also many other separators will be there, I will give you some examples later on.

And then there is a drainage and filtration actually. Similar, a lot of mass then erosion control that erosion control means because of the rain water or flowing water sometime the soil will be eroded. To prevent that you can provide geosynthetics and one that geosynthetics again we can allow vegetation to grow and that way erosion control can be there and there can be barrier and there can be protection.

That is also similar to that all are interrelated. So, we discuss may be in the next lecture. By enlarge they are these are actually various functions of geosynthetics. And we will show with in detail various functions of geosynthetics by some figure and with more functions as in the maybe in the subsequent lecture. And with this, I will try to close this particular lecture. I will take up in the next lecture, the functions in detail. Thank you.