

Geosynthetics Testing Laboratory
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Lecture - 03
Functions


Welcome I am Professor J. N. Mandal, Department of Civil Engineering, IIT, Bombay. So, I will take the lecture on the Geosynthetics Testing Laboratory, before the geosynthetics testing one should know how to design this geosynthetics infrastructure. So, these design can be done by functional concept, specification concept and also by cost. But you should know that what are the different types of the function of the geosynthetics material?

When you design for any application you should know that what are those function and this is very important. So, here I am showing you the different types of the function.

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Function vs. Geosynthetic Type

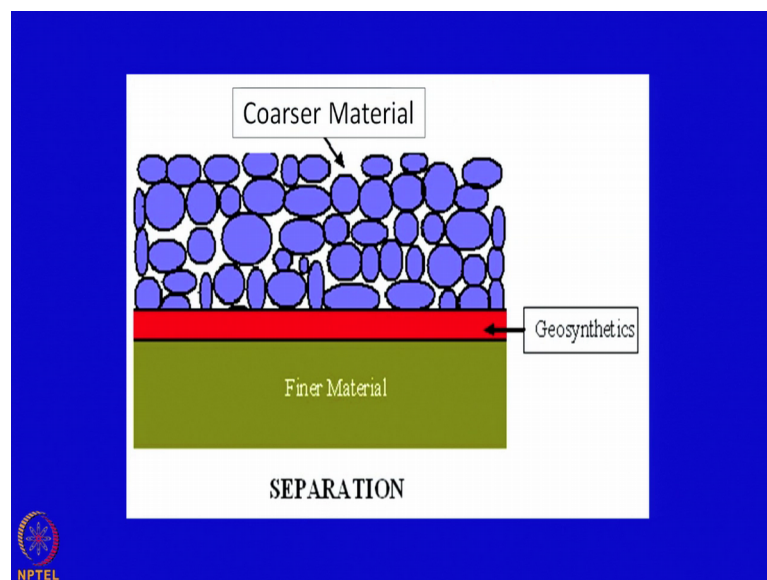
Type of Geosynthetic	Separation	Reinforcement	Filtration	Drainage	Containment
Geotextile	√	√	√	√	
Geogrid		√			
Geonet				√	
Geomembrane					√
Geosynthetic clay liner					√
Geopipe				√	
Geofoam	√				
Geocomposite	√	√	√	√	√



So, these function as a separation function, reinforcement function, filtration function, drainage function and containment. There are many other functions which can be used for the design of the land form by these are some few specific function I am presenting here.

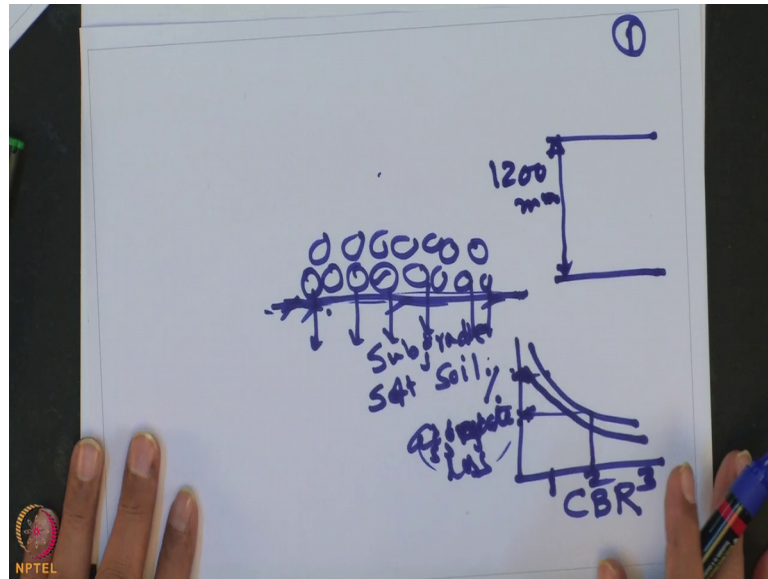
So, the material like this geotextile material which acts as a separation also the reinforcement and the filtration drainage and geogrid material because it used for further inputs while wall or retaining wall that is why it acts as a reinforcement. Geonet material is act function as a drainage. Geomembrane material is a impermeable material that is why it act as a containment. Geosynthetic clay liner that is alternative to the geomembrane so that is why it act as a containment. Geopipe you know it act as a drainage. Geofoam material it act as a separation and geocomposite means it acts as a separation reinforcement, filtration, drainage and containment. So, these are the different types of the function for the different types of the geosynthetics material.

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Now, I will just briefly explain what do you mean by the separation. You can see here that the rate one is the geosynthetics material. It may be woven, non woven geotextile, it may be geogrid material and top one is the coarser material and bottom one is the finer material.

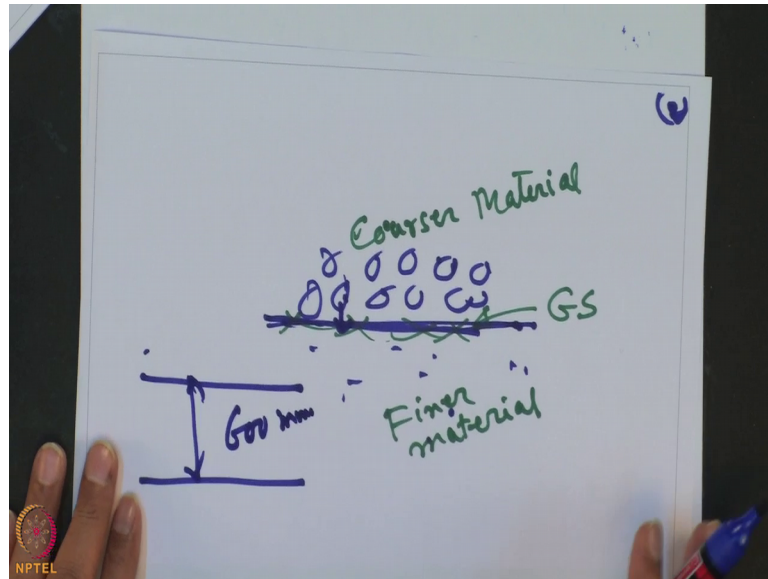
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So, if you can think about design for any kind of the pavement, so what will happen? The coarser material is a aggregate final material is the very soft clay for example, that if you if this is the soil and if this is the subgrade that means, this is the finer material and you place the aggregate on the top of the top of the subgrade. So, when there is no geotextile material and due to the application of the load or (Refer Time: 04:18) load the all the aggregate will penetrated into the subgrade or into the soft soil.

So, if you design for a road the majority of the aggregate will penetrated in to the into the finer material and if you draw a latency between the california bearing ratio and percentage of aggregate loss. So, you can have a curve bend like this. CBR is less 1 2 3 CBR is less percentage of the aggregate is lost CBR is 2 percentage again is reduced to 60 percent. So, like that you can think for the construction of the road you are losing about like 50 or 60, sometime 100 percentage of the good quality of the aggregate, but these are conventional method with design the pavement and for the ISE code specification and let us say for the thickness of the pavement as per design let us say 1200 millimeter in the conventional method, then you go for the sub base, base course and reinforce etcetera this is the conventional method.

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But if you adopt the geosynthetics material, then what will happen? Now, if you adopt the geosynthetics material. Let us say that this is the geosynthetics material please designated as GS and this is the finer material and top one is the courser material. So, these the courser material and this is finer material when geosynthetics material is there between the courser and the finer material these good quality of aggregate cannot penetrated into the finer material that means, you are saving good quality of the aggregate or across the road because here geosynthetics material act as a separation. So, this is the function of the geosynthetics material.

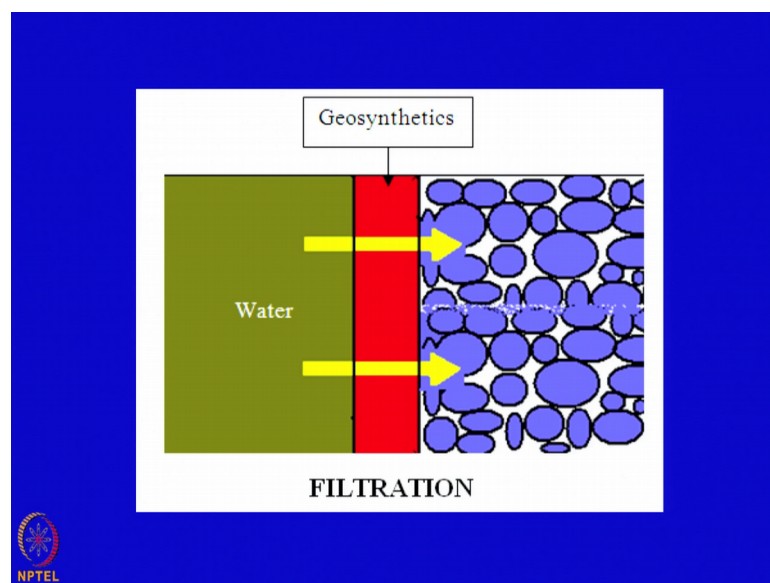
And now if you can design then thickness of the pavement reduced to 1200 millimeter in the conventional method it reduced to 600 millimeter. So, you can save the money, you can save the time for the construction of the pavement. So, here geosynthetic material act as a separation.

Now, what is the role of the courser material? You see that every material is good and bad. Here aggregate is very good because aggregate as a very good strength material, but aggregate is good for denis, aggregate is good for strength, but when this aggregate will penetrated into the finer material or the subsoil then this good quality of aggregate lose its strength. On the other hand if you can think the finer material or clay, clay material is good and clay material also bad. When you say that clay material is good, when you can use for the land field as a compacted clay liner it act as a impermeable material it is

good, but when this clay material it is very difficult to construct the any kind of the structure when it is very soft clay so that is bad. So, each and every material has a good and also the bad.

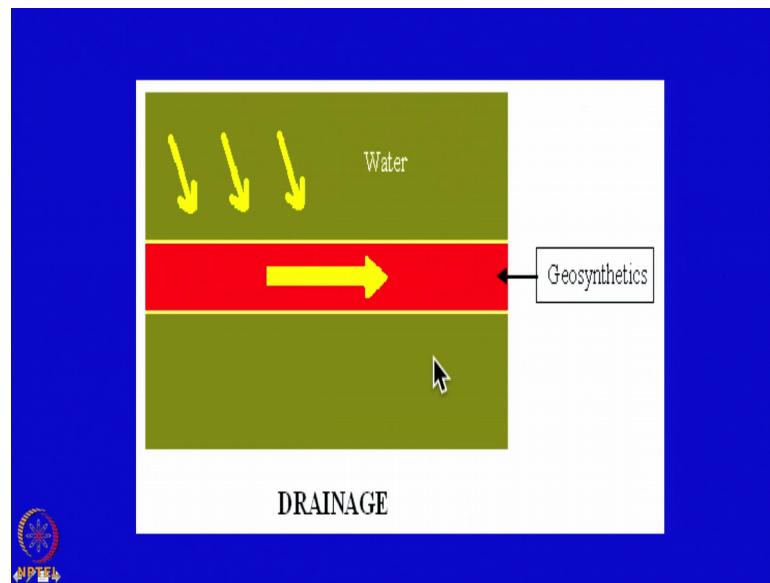
So, here I want to focus that how the geosynthetics material act as a separation between the courser and the finer material. So, these one of the main function is the separation, you should know but the design that what are the function of the geosynthetics material here separation is the function.

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Now, next we will also study about the filtration and how we will perform the test for the filtration. So, here water can pass along the plane of the geosynthetics material. So, it called the filtration when water pass across the plane of the geosynthetics material it is called the filtration. So, here geosynthetics material acts as a filter and in geosynthetics engineering term we will perform the test which you call the permeability or permittivity. So, we will perform test on the right edge with the filtration material. Majority of the structure around the wall fail due to the filtration and drainage because most of the cases we do not design proper kind of the filtration drainage. So, it is very important to know how to perform the filtration and the drainage test.

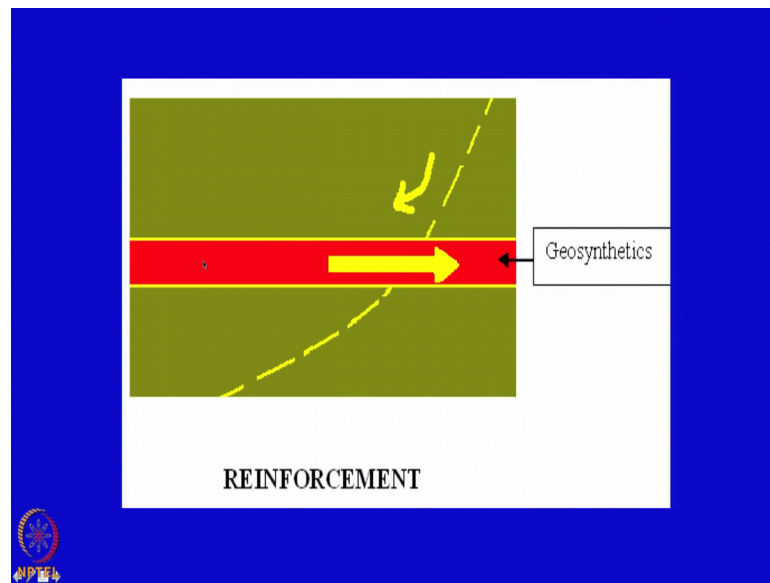
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Now, here this is the geosynthetic material and when the water or liquid or gaseous when the water or the liquid or gaseous passed along the plane of the geosynthetic along the plane of the geosynthetic material is called the drainage. So, this we will call the transmittivity. So, do not confuse with the filtration and drainage; filtration means if this is the geosynthetic material water can pass across the plane of the geosynthetics is called the filtration and when the water pass along the plane of the geosynthetic material is called the drainage or the transmittivity. So, we talked about the separation function, filtration function and the drainage function.

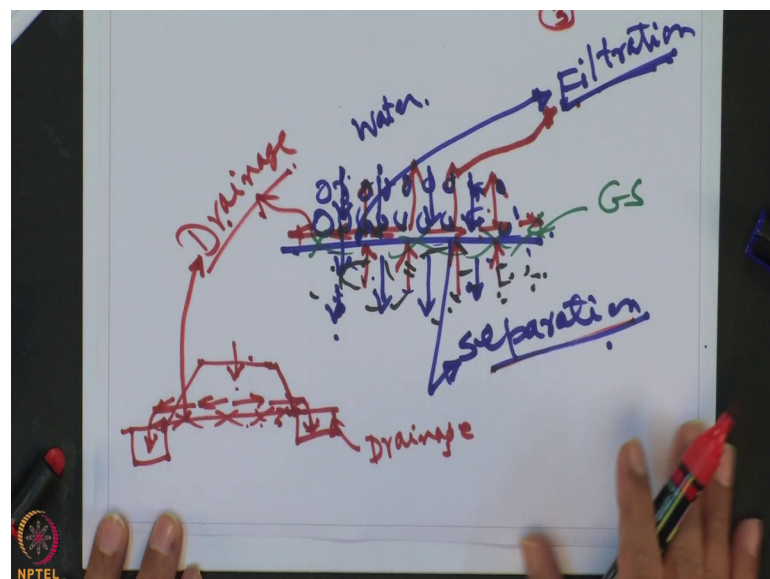
Now, here geosynthetics act as a reinforcement function.

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For example, this is a slope this slope can fail like this then you can place the geosynthetic material between the (Refer Time: 12:19) foundation to increase the factor of safety. So, here geosynthetic material act as a reinforcement. So, the beauty of this geosynthetics material for a particular application is not only act as a separation filtration or drainage, but also act as a reinforcement for an example that for the road construction.

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So, if this is the geosynthetics material. So, let us say this is the geosynthetics material and this is the courser material, and this is the finer material, this is the finer material. So,

this is the good quality of aggregate and this is the finer material. So, here geosynthetic material act as a separation which can separate the coarser and the finer material.

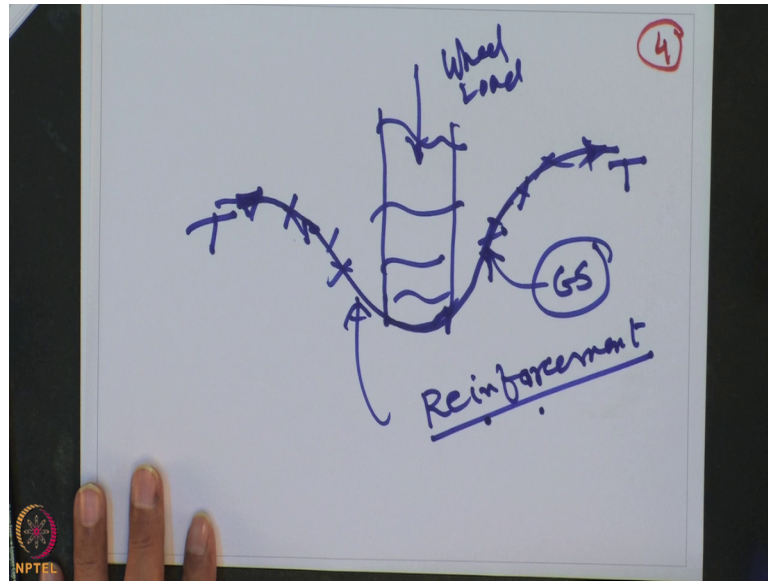
Now, when there is a rain. So, water can percolate like this from top to the bottom. So, water can pass from top to the bottom. So, it act as a filtration so geosynthetic material act as a filtration. So, initially this geosynthetic material act as a separation, here geosynthetic material acts as a filtration because water is plane water is passing across the plane of the geosynthetic that is why it is a filtration.

Now, if the finer soil there is a excess 4 order phase and development is there. So, in that case the water can flow from the bottom to the top, from the bottom to the top. So, it can flow like this also. So, that means these geosynthetic material is also act as a filtration, but you can think a kind of the capillary reaction. So, for the capillary reaction also you can use the geosynthetic material which can act as a filtration.

Now, water can pass along the plane of the geosynthetic material like this water can pass. For example, that if I draw a manning like this and if this is the drainage here there is here, these are the drainage, path is here and geotextile material is here. So, water can pass along the plain of the geosynthetic due to the application of load and then tending out. So, here geosynthetic material act as a drainage it act as a drainage here geosynthetic material act as a, because I say that water will pass along the plane of the geosynthetic material that is the reason here geosynthetic act as a drainage. For the same material that means, it act as a separation it act as a filtration and also it act as a drainage.

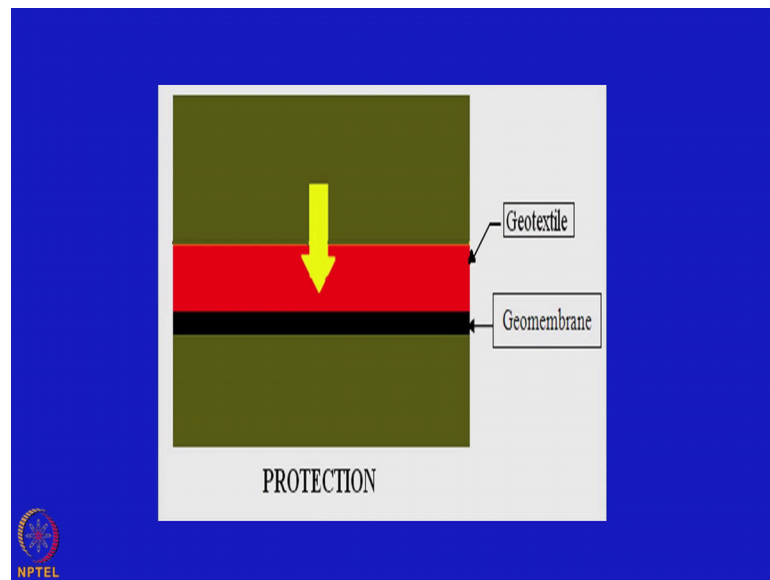
So, now, when you will apply the wheel load on the top of the road or the top of the aggregate then what will happen?

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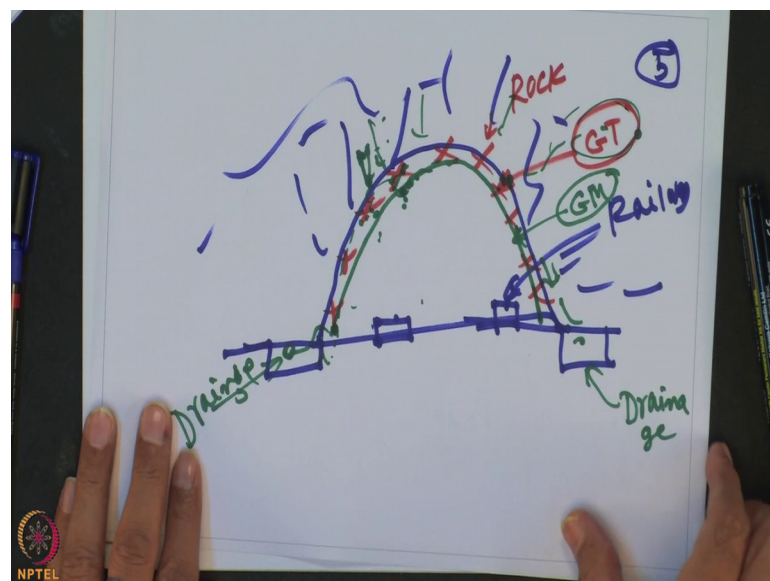
So, if you apply the load full load, then you can see the shape of the geotextile will be like this due to the due to the wheel load, this is the wheel, this is the wheel load due to the wheel load the shape of the geosynthetics material will be like this is the geosynthetics material. So, here they are in the development of tensile membrane that means, these geosynthetics material will act as a reinforcement these geosynthetics material will act as a reinforcement. So, that is why I am trying to say that geosynthetics material is not only act as a separation, filtration and drainage, but also act as a reinforcement. So, this acts as a multifunction that was the beauty of the use of geosynthetics material. And you can also use for the protection this black one is the geomembrane material and this is the geotextile material.

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So, here the geotextile material act as cushion.

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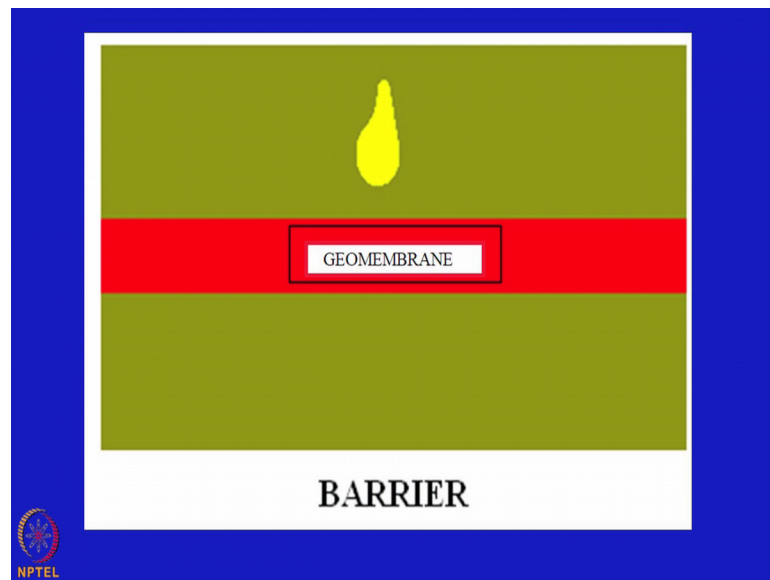
For example, that for the construction of the tunnel if you want to construct a tunnel, let us say this is the tunnel this is the drainage, this is the drainage and you are constructing a tunnel rock surrounding is there and you can go for the railway or the road whatever it may be railway. So, what will happen that because for the rock here is a rock or there is a fracture. So, water can percolate and water can enter into the tunnel. So, this will be a get this problem. Even then for any tunnel wall, even then metro railway what they are been

construction of the tunnel so you need open kind or to control the sewage this is very important to control the sewage. So, what is the role of the geosynthetics material. So, you can place that one layer of the nonwoven geotextile material this is geotextile material GT.

You can place the another layer of the geomembrane material here below this is geomembrane material. So, when there is a rain ok, then what will happen when there is a rain or any water. So, this geotextile material will act as a filtration and drainage and drainage out this is the drainage it will be drainage out or from this side also it can be, this is the drainage so it can be drainage out for geotextile material water can be drainage out. Now, this is the geomembrane material it is impermeable material. So, water cannot penetrated into the tunnel. So, these geomembrane will act as a barrier because this is the impermeable material.

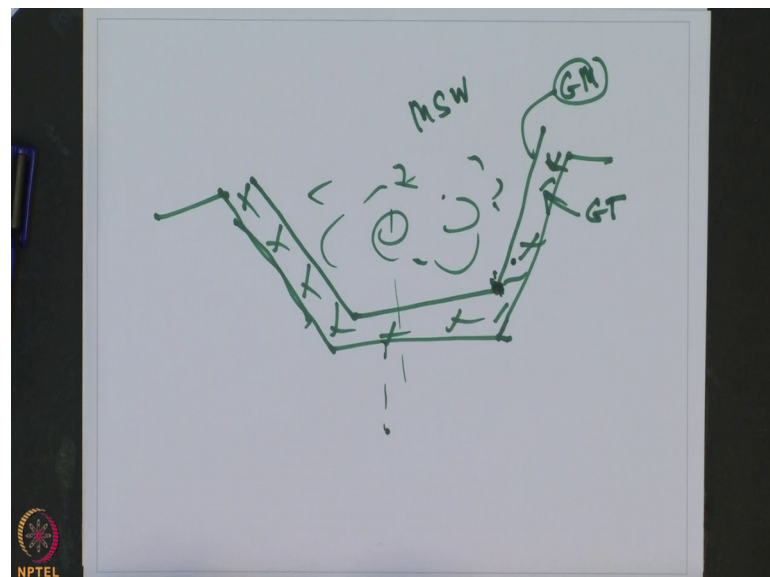
Now, sometimes if there is any angular rock which can penetrated into the geotextile material and there is a possibility for the damage of the geotextile material, but it will not damage the geomembrane material directly. So, here these geotextile material act as a cushion or it put it. So, no water then can be penetrated into the tunnel and tunnel is safe. So, you need for the design of the tunnel that proper kind of the testing for the selection of the geotextile material as well as geomembrane material geotextile material which is permeable geomembrane material which is impermeable material. So, here geosynthetics material acts as a protection or the cushion.

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And this is geomembrane you know for the land field you can use as a barrier, that is impermeable material and it cannot be contaminated the water cannot be passes through and it can control. For example, the land fields if you want to construct a land field, so there are different types of the land field.

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So, if you want to construct a land field like this conventional system you know, but alternative system you place the different types of the geotextile material which will act

as a filtration drainage you can use the geomembrane material which will act as an impermeable material.

So, all kinds of municipal solid waste or industrial waste can be protected. So, there should not be any formation of contamination in the ground which is a conventional method which will use as a compacted clay liner. So, here the geomembrane material will act as a barrier. So, you need proper kind of testing, proper kind of thickness of the geomembrane, proper kind of the properties of the geomembrane to select for use as a landfill liner. So, here geosynthetic material acts as a barrier.

So, all these geosynthetic materials I mention here what can they be used. They can be used in the national highway and widening of the highway road about beach urban and rural road, you know there are a lot of roads coming up widening of the highway also, a lot of roads about beach projected coming up for you can make use of the geosynthetic material. Then input soil wall or mechanically stabilized earth wall, steep slope, road about beach and apartment you can improve the ground by the use of the prefabricated particle drain instead of the sand drain because sand drain it may take so much time, but with the help of the prefabricated particle drain, then time will be less construction will be very fast. So, you can construct that very fast and it is a money saving, it is a time saving.

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WHERE CAN IT BE USED?

- National Highways and/or widening of highways, ROB, Urban and Rural Roads
- Reinforced Soil Walls and Steep Slopes, Road Over Bridge and Abutment
- Ground Improvement
- Embankment on Soft Soil
- Indian Railways and Airport
- Solid Waste Management (Landfills)
- Reflection Cracking/ Potholes
- Drainage, Filtration and Erosion Control
- Buildings
- Dewatering, Sewage Treatment Plant, Coastal Protection

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You can construct the embankment of the soft soil you know there are many good quality of aggregate is not available you can make of use the alternative new light geo material which we have developed you can make use for that material, and which only to be placed on the embankment on the concos like that the embankment on the soft soil. Can use for the Indian railway and the airport solid waste management the landfills reflects and cracking potholes I will shown you some slides also earlier. Drainage, filtration, erosion control this is one of the most important and you can make use of this geosynthetics material you can use for the building, for greenery, dewatering, sewage treatment plant and also the coastal protection.

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WHY USE IT?

- ❑ Significant savings (Cost competitiveness against other construction material)
- ❑ Faster rate of construction
- ❑ Sustainable development and lower carbon footprint
- ❑ Reduce land requirement and difficult site restrictions
- ❑ Employment opportunities and human capital (Commercial and business potential)
- ❑ Less periodical maintenance, increase lifetime of roads
- ❑ Green Technology

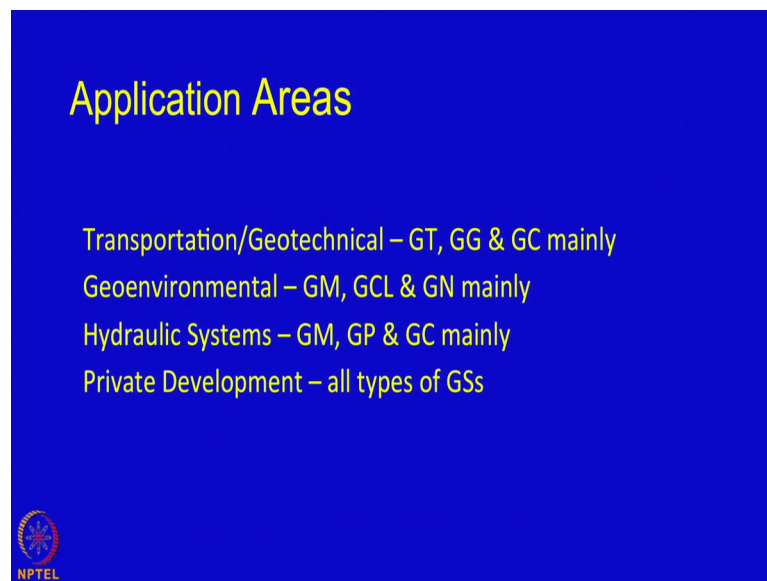
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Why use it? Significant savings cost competitiveness against the other constructive material, faster rate of construction, sustainable development and lower carbon footprint. Reduce the land requirement and difficult site restrictions. Why there is a difficult site cannot be constructed? You can make use of the geosynthetics material. For example, that any railway suppose if there is a soft soil earlier they had to diverted the railway some other direction you do not need it you can use make use of the geosynthetics material and you can straight railway line can be constructed with the use of geosynthetics material.

With this you can have employment opportunity, even capital, commercial and the business potential. Road you construct both side of the road you can provide with the

different types of the plantation, different types of the flower, you can sell it export import it and also you can earn the money, you can give the employment to the people. So, there is a lot of employment opportunity are there. Less periodical maintenance earlier suppose we had to with the conventional method you require lot of time for maintaining the existing road, but here you do not need it because it is clogging free. Increase the life time of the road and it is a green technology.

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So, major application of this area as a nation transportation geotechnical engineering for you can welly use geotextile material, geogrid material and geocomposite material and geoenvironmental engineering. Like a landfill, earthling dam, cannel these are for or you can use geomembrane material, geosynthetic clay liner and the geonet (Refer Time: 28:13).

And there are two related problem one is the strength related problem another is the flow related problem. So, strength related problem like the mechanically stabilized input soil wall road and the input soil steep slope. And other flow related problem that is hydraulic systems or you can use the geomembrane and geocomposite, geopolestral mainly, and the private development you can use all type of geosynthetics material.

So, what is that most important that you should know what should be the different types of the function and what will be the different types of the application when you will design? So, it is when you go for the any design. So, you require design by the cost,

design by the availability of the material and design by the specification. So, if you know what properties are required for all these all type of the application and their function then you can design it.

Thank you very much.