Geosynthetics Testing Laboratory
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Lecture - 10
Grab Tensile Test and Triaxial Test

Now, I will show you another example of a Grab Tensile Test.

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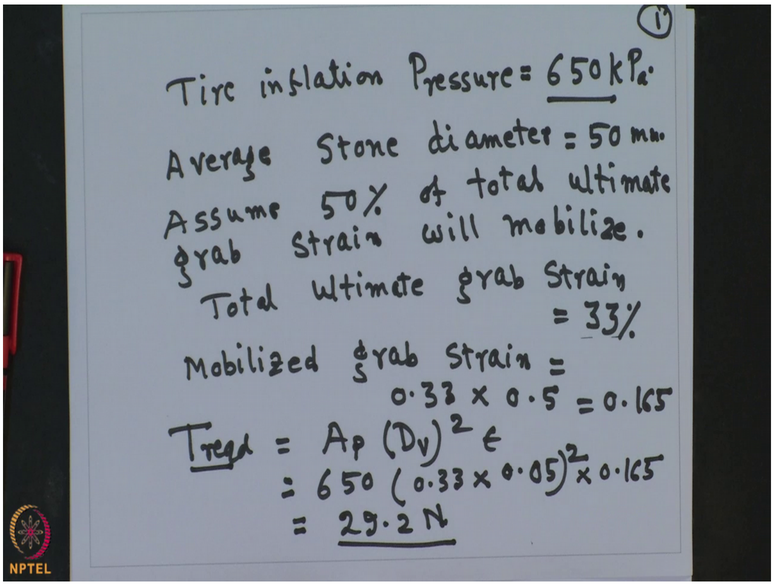

So, let us say that Tire inflation Pressure is equal to 650 kilo Pascal and average stone diameter is equal to 50 millimeter. Now, geotextile is to be placed beneath the stone base course. So, assume 50 percentage of total ultimate grabs strain will mobilize, will mobilize. So, we know that total ultimate grabs strain; so total ultimate grabs strain is equal to 33 percent as shown you earlier.

Now, what should be the Mobilized grab strain? So, Mobilized grab strain will be equal to 0.33 into 0.5 is equal to 0.165. So, you know the what is T required equation that is A of p into D v square into epsilon. So, Ap equal to tire inflation pressure is 650. So, this is 650 into D v is equal to your total ultimate grab strain value is 0.33. So, 0.33; that means, this is 0.33 into 0.05 whole square. Because the average stone diameter is 50 and mobilized grab strain is 33.33. So, this will be 0.33 into 0.05. This into the mobilized grab strain epsilon is 0.165.

So, this will give you 29.2 Newton. So, this is the calculation for the grab tensile stress. So, this is T required is equal to 29.2 Newton. So, here I have shown you some specimen calculation and theory based on the your burst strength and as well as for the grab strain. So, burst strength is very important for different types of the project for the geotextile or the material or the geomembrane material may burst. So, you should know what should be the burst strength required and what kind of the geosynthetic material, you should select for that specific application. As I told you in case of the land field, to you should perform the proper types of the burst strength of the geomembrane or geotextile material.

And secondly, that grab strength; it is just as an index test to quality control of this material and because in the grab these entire portion of the cramp is not fixed with the geotextile material. So, this test is not so much reliable. Now, I will talk about some Triaxial test of the geosynthetic material. Now geosynthetic material should placed in proper location; if we do not place in the proper location, we can observe, so what will happen. How the strength of the geosynthetic material can be improved by pressing the geosynthetic material at a particular layer?

So, you cannot place the geosynthetic material anywhere. So, location for placement of the geosynthetic material is more important and also you will be knowing that what will be the strength of the material; how much it increased; what kind of improvement of the shear strength of the soil due to the introduction of the geosynthetics material. Now, let us perform some triaxial test. You know the triaxial test and it is a cylindrical sample is a let us say this is the Triaxial.

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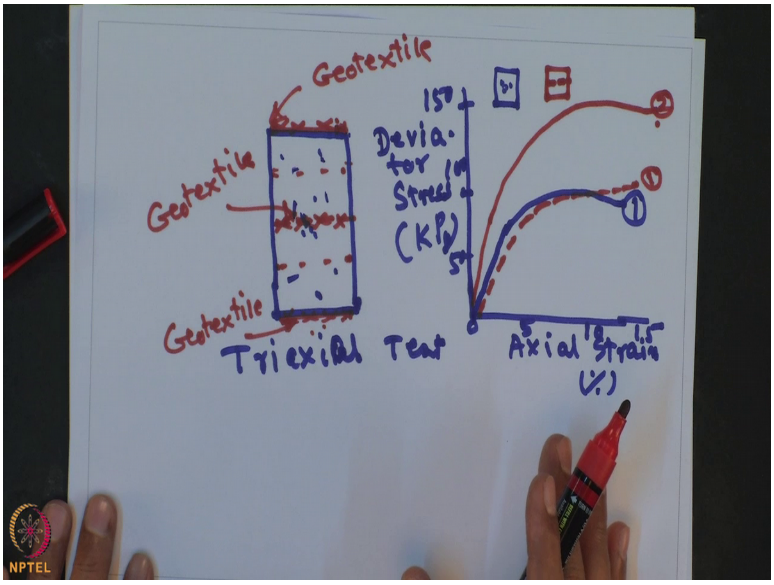

So, you will perform the tri Triaxial Test. So, these triaxial test are to be confirmed and there is a beneficial effect of geotextile when you place the geotextile material at the proper location. Now, you take some 2 or 3 test on the then, sand sample and at a confining pressure, you can give confining pressure 21 kilo Pascal or 210 kilo Pascal for different soil and geotextile configuration.

In from this, test in what test let us say for a particular confining pressure of 21 kilo Pascal. So, you can represent the baseline shear strength data of the sand itself. So, you can draw the curve for the gain soil sample. Let us say that this is the un (Refer Time: 08:48) case when geotextile material is not there into the sample. So, you can draw a correlation between the axial strain in percentage, let us say 0 5 10 15 and the deviator stress, deviator stress that is in kilo Pascal I just say 50 100 and let us say 150 kilo Pascal.

So, when there is no reinforcement, no geosynthetic material in the sample; so you are performing some test. So, you can draw from the triaxial test at a particular confining pressure, you can draw the stress strain curve. So, let us say the stress strain curve for unreinforced soil; let us say something like this. So, this is one let us say for unreinforced case sample. The sample where there is no geosynthetic material. So, this is only the sample. So, you know that in standard in unconventional method have to perform the triaxial test and can determine what will be the deviator stress and corresponding the strain value.

Now, if you place a layer of geosynthetics material at the top and bottom of the sample; let us say you place in a triaxial sample you are placing a one layer of the geotextile material at the top and the bottom. So, this is geotextile material at the top of the sample and this is geotextile material at the bottom of the sample.

So, you find if you can perform the test and if we can draw the curve, you find that it is almost the same. It is almost the same as an un input soil sample. So, placement of the top and bottom on the soil, he does not show improved shear strain behavior, since this location of the geotextile material are non acting dead zone. It is non-acting and dead zone in conventional triaxial test and this kind of the behavior is logical and instructive. It is instructing because it is teaching us that if the geotextile is placed at the wrong location, it will not any beneficial effect. So, that is why it is most important the placement of the geotextile material should be proper.

Now, if I place the geosynthetics material in the central portion of the triaxial sample. So, let us say now you place this geotextile material in the central portion of the sample, you can place also here, you can place also here one-third, two-third and you can perform the triaxial test and then, you can draw the stress strain curve and you can find any place the geotextile material for a particular confining pressure.

Then, you find there is a improvement of the textile curve. So, let us its two when we are place the geosynthetics material at the center. So, you can place also somewhere here; also you can place somewhere here, one layer, two layer, three layer and you can find this textile curve with increasing the number of the placement of the geosynthetics material. So, it is very important the placement of the geotextile for your place the geotextile material. It requires proper location of the placement of the geotextile material. Then, will be it will be the beneficial effect of geotextile material, you can perform under different confining pressure.

So, in general function of reinforcement in soil and this also particularly applicable in case of reinforce soil retaining wall and also that the inputs soil slow. What there will be a good interaction between the soil and the geotextile material? So, this is one of the basic concept and mechanism that how the strength of the geosynthetics material is increasing due to the interaction of the geosynthetics material. So, proper location of the geotextile is most important.

So, you cannot place anywhere of the geotextile material, as you see that when your place the geotextile on the top and bottom of the triaxial soil sample; there is no improvement; this act as a dead zone or non-active zone. Now, there are 3 different reinforcement mechanism; one is the Membrane type; another is the Shear type and another is the Angelus type. I will explain one by one.

So, membrane reinforcement occur when a vertical force is applied on the geotextile, on the deformable sub grade. Now depending upon the depth of the soil at which the geotextile is placed from the force applied and then, you can determine what should be the horizontal stress you can determine; what should be the horizontal stress at depth let us say z and angle is an angle let us say theta.

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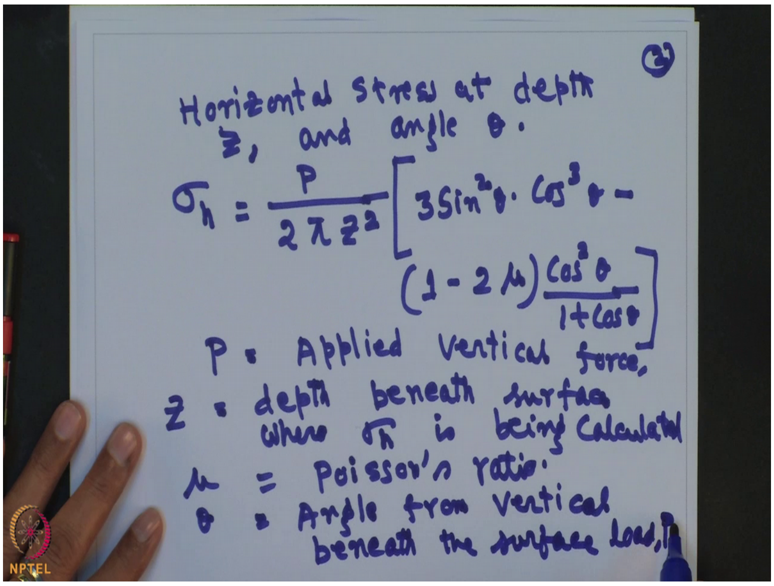

So, you can determine the horizontal stress sigma h is equal to P divided by 2 into pi into z square this into 3, this is sin square theta into cos cube theta minus 1 minus 2 of mu into cos square theta divided by 1 plus cos of theta; where, P is equal to applied vertical force, applied vertical force and z is the depth beneath surface, surface where sigma h is being calculated and mu is poisons ratio and theta is angle; angle from vertical beneath the surface load, the surface load that is P. Now, if you put the load directly beneath the load, where theta is equal to 0; if theta is equal to 0; then, when the theta is equal to 0.

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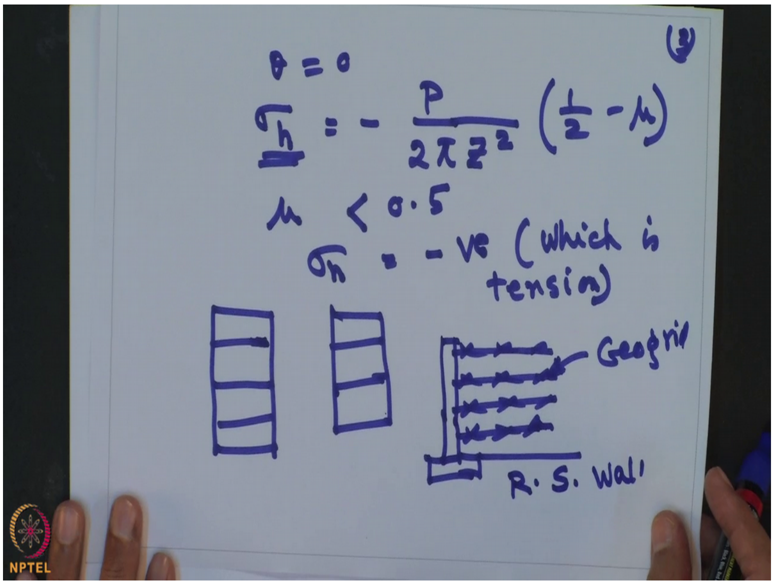

Because when you are placing the load directly, when theta 0; then you can have the equation sigma h is equal to minus P by 2 of pi into z square this half minus mu. So, if the mu value is less than 0.5, then what should be value of sigma h? Sigma h will be negative; that means, which is tension that is why the tension developed. When you apply the vertical load produce that tension in the horizontal plane beneath it. So, I will place the geotextile material closer and closer.

For example, this is the triaxial soil sample, if we place the geotextile material in closer and closer. So, what will be the load? Load will be the higher; then higher the tensile stress value; that means, higher the required tensile strength of the geotextile material. So, whether you are in putting on the very soft soil, there will be yielding situation of this particular reinforcement mechanism.

And if you can place the geotextile material in a distance in between there is a spacing is different between the two geotextile material, then you find the tensile strength is on the lower side. So, more the number of the reinforcement layer and there is a more improvement of the tensile strength of the geotextile material and this kind of application is mainly for the geosynthetics reinforce soil wall and geosynthetic reinforce soil slope for in where you have to place the number of the layer of the geosynthetics in the construction of the reinforcement soil wall.

For example, if this is the facing element and you are facing the geosynthetic material different number of the layer like this. So, this is the geogrid material here placing. So, this kind of mechanism applied in case of reinforce mechanically stabilized reinforce soil wall. Also this mechanism is applicable in case of the reinforce soil slope. For example, if you construct a steep slope steep slope.

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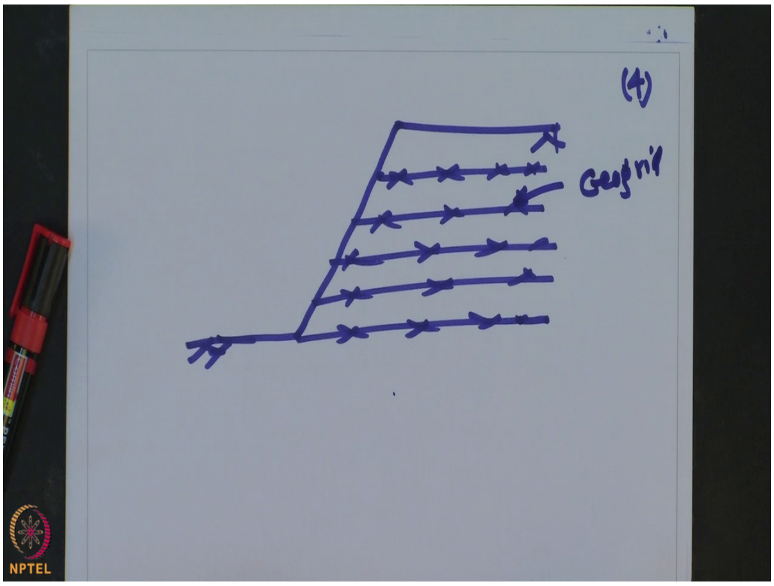

So, you can place the number of the layer of the geogrid material. So, these are all this geogrid material ok. You have place one layer in between the foundation and the embankment soil. So, this is the geogrid material. So, here geotextile material act as a tension or geotextile material act as a membrane type of the reinforcement.

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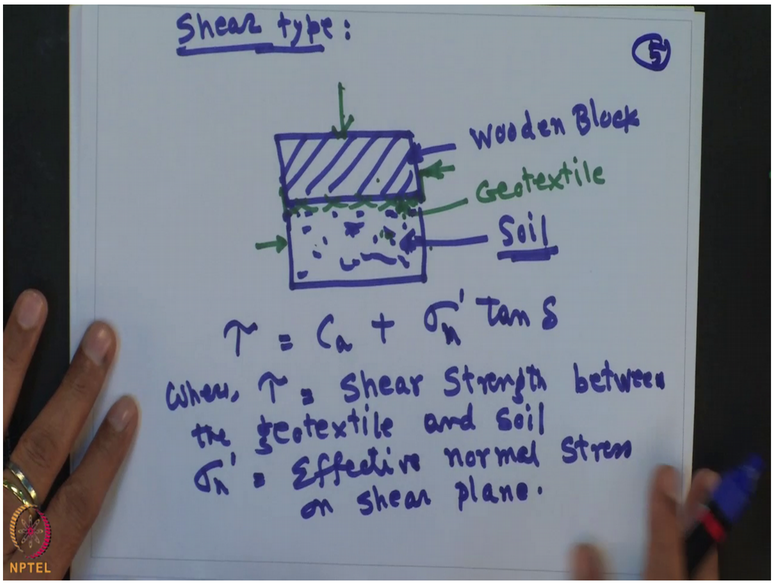

Now, geosynthetic material also acts as a shear type. So, far we mentioned about the reinforcement in membrane type, now we will discuss the shear type. Now, at shear we perform the test in a direct shear test. So, you can have a better visualization by the direct shear stress. You know what is direct shear test and you know how to perform this shear strength of the soil; then, we will perform how we can perform this shear strength of the geotextile material.

So, a geotextile material is placed and on the direct shear test and you have to perform the test. So, there will be the 2 material; shear as shear in the interface. So, resulting geotextile to soil shear strength parameter can be determined.

For an example that we wanted to perform some test. Geotextile interface between the soil and geotextile material. You know that what is direct shear test. So, let us say this is the direct shear test in the lower part and this is the upper part and this is let us say this upper part let us say it is wooden, wooden block and lower part is fill up with the soil. So, this is the soil ok.

And geotextile is placed with the wooden block. This is your geotextile, fixed with the wooden block. So, if you can perform the direct shear stress, we apply load and there should be a shear in between the soil and the geotextile material and the resulting geotextile to soil shear strength parameter can be determined.

So, shear strength parameters can be determined soil to (Refer Time: 26:44) because this is a foreign body and you can determine that from the traditional geotextile material using an adopted more coulomb failure criteria. So, from the more coulomb failure criteria you know tau is equal to C of a plus sigma of n into tan of tan of delta. So, where tau is equal to shear strength; tau is equal to shear strength between the geotextile and soil and sigma n dash is equal to effective normal stress normal stress on shear plane; effective normal stress on shear plane.

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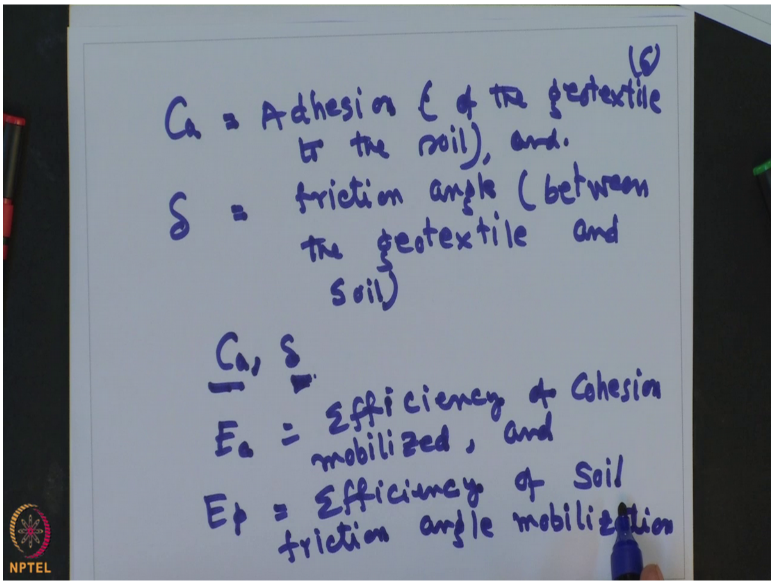

Now, this C a and this delta, C a is the adhesion. C a is equal to Adhesion. So, this is you can say of the geotextile to the soil and delta is the friction angle. This is friction angle between the geotextile and soil. So, shear strength parameter that is C a and delta, this can be compare with respect to the soil to soil geosynthetic material.

So, from this you can determine what should be the what should be the adhesion. This is important and what will be the friction angle and from this also you can determine E of c; that means, efficiency. Efficiency of cohesion mobilized and E of phi is efficiency of soil friction angle soil friction angle mobilization; soil friction angle mobilization.

You can also equally perform that soil to soil strength and you can determine the what should be the C and the phi. C you know that in case of soil to soil, you know the what is C that is cohesion and you know what is phi and that call the angle of friction. So, knowing the value of the soil to soil cohesion and the friction angle, you can determine what should be the efficiency of the geosynthetic material in terms of E c and also E phi.

So, these are the test tensile strength, you can determine the basic mechanism of the triaxial test of geosynthetics material. So, from this test we can learn that what kind of geotextile material, what you should be located or we should be placed on the geosynthetic material; you cannot place the geosynthetic material anywhere. As we observe that when you are placing the geosynthetic when the top and the bottom. So, there is no improvement.

On the other hand, if we can place the geosynthetic material in the middle of the triaxial sample or one-third and the two-third of the geosynthetic sample and you find there is a substantial improvement of the tensile strength of the geosynthetic material because there is a mobilization of the friction between the soil and the geosynthetics material. Similarly, you have also shown that direct shear stress; how it is the mobilization of friction between the soil and the geosynthetics material.

So, any type of the material you can perform the direct shear stress. It may be the concrete, it may be the geomembrane, it may be geogrid, it may be the woven and non woven geotextile material. So, you can determine that what should be the efficiency in terms of the cohesion and what will be the efficiency in terms of the angle of the internal friction. So, this is very important, this parameter to perform this kind of the test that is triaxial test and as well as the direct shear stress.

Thank you.