Geosynthetics Testing Laboratory
Prof. Jnanendra Nath Mandal
Department of Civil Engineering
Indian Institute of Technology, Bombay

Lecture – 12
Pullout Test

So, you know that how to calculate the Interaction coefficient, I will give you one also example or some specimen calculation for the determination of the Interaction coefficient. Before that I am just showing very simple way that how you can derive the equation.

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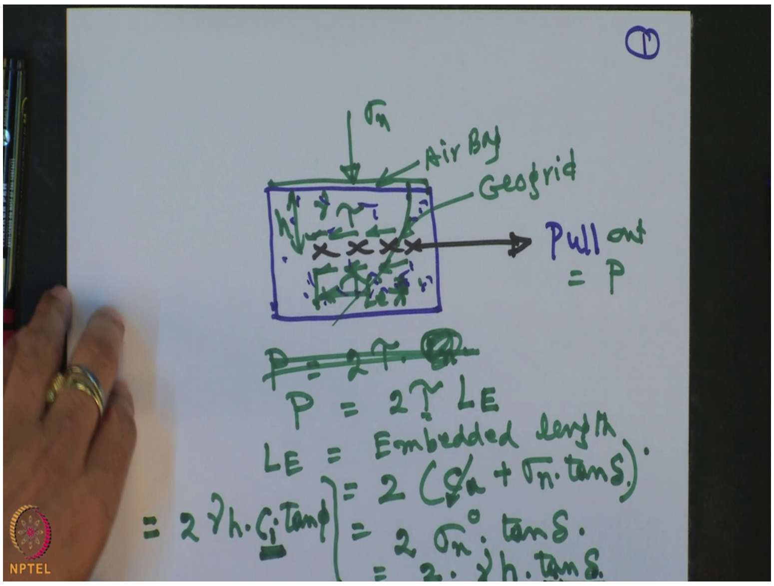

So, for example, that if this is the Pullout; pullout scene and this is the Geogrid material and you are pulling this Geogrid material and this is the soil sand let us say top and the bottom and you are pulling pull this. So, what will happen when you will pull? And then, you are applying some air bag is there air bag and then, you put some load on the here. So, there will be a development of the friction between the soil and this let us say this is Geogrid material; there will be development of friction between soil and Geogrid material

So, if this is the tau and this is the tau so, this pull pullout let us say this pullout is equal to P. So, P will be equal to 2 into tau, top and bottom 2 into tau and then, this is the normal load 2 tau into sigma of n. So, sorry, 2 tau into what is the bond length? Suppose this bond length is this that is what you call L of e.

So, this sample may fail like this. So, this is the bond length which is important to us. So, we can we can rewrite like this that P is equal to 2 into tau into L of L of E. So, this one of E is the embedded length, embedded length. So, again this tau is equal to 2 into this is C of a, you know tau equals to shear strength of the soil C plus sigma n into tan phi.

So, C plus sigma n into tan of is the internal friction between the soil and Geosynthetic is delta. So, this P will be embedded length. So, P will be equal to this. So, if there is no adhesion. So, C a will be the 0. So, this part will be the 0. So, you can write 2 into sigma n into tan of delta or you can write sigma n equal to gamma into h at any depth h and if gamma is the unit weight of the soil. So, 2 into sigma into gamma into h into tan of delta.

Now, if you can express this, tan delta in terms of the phi. So, you can write 2 into gamma of h into that is C of i into tan of phi this phi is equal to friction angle of the soil to soil and this tan delta is equal to friction angle between the soil and Geogrid material.

So, this is almost two-third times of the tan phi will give you the value of the tan delta; that means, Ci you can consider almost two-third this approximate value of two-third. But this interaction coefficient Ci is very important and that we have determined that how to calculate the Ci value. So, I will give you one of the I will give you one of the example for this to determine the Interaction coefficient value.

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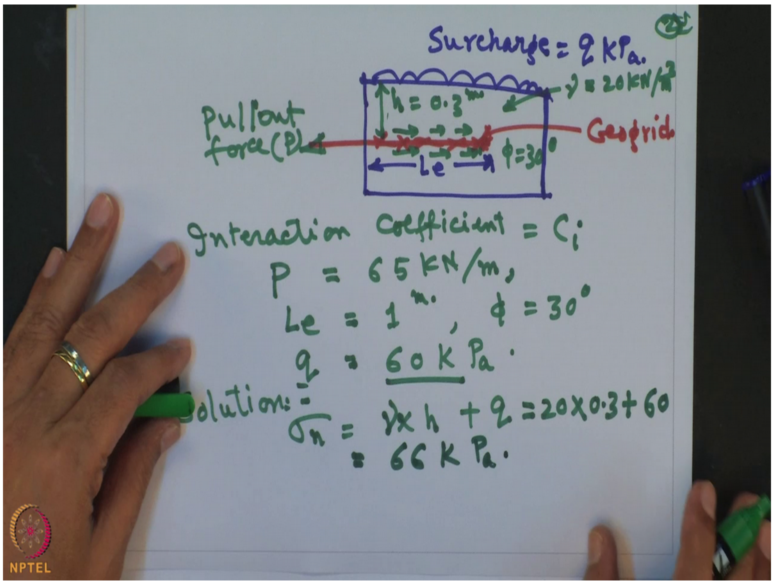

So, let us say that it is the pullout and there should be a some Surcharge and this surcharge is going to q this is in Kilopascal. Now this is the Geogrid material. Let us say this is Geogrid material and this distance embedded length distance let us say this distance equals to L of e ok.

So, there is a development or mobilization of the friction between the soil and the Geogrid material and it is located at a distance of h; h equals to let us say 0.3 meter and this soil has a gamma is equal to 20 kilo newton per meter cube and phi value is equal to 30 degree. So, you have to determine that what should be the interaction coefficient; interaction coefficient that is C of i.

So, here this is pulling. So, this is Pullout force. So, this is P. So, this let us say from this test you determine that P value is equals to 65 kilo newton per meter and embedded length that is L of e is equal to 1 meter and phi is given is equal to 30 degree and there is a surcharge that is q; q is equal to 60 kilopascal. So, you have to solve this problem.

So, for solution, you know sigma of n will be this is a gamma into height into plus the surcharge value. So, this sigma n will be this gamma into h plus the surcharge load is equals to q. So, what is gamma? Gamma is 20. So, this is 20 into what is h? h is 0.3. So, this is 0.3 plus q, q is the surcharge load that is q and that q value is given here 60. So, this will be equals to 60.

So, if you can calculate. So, then you can calculate the sigma of n value. So, this sigma n value will be 66 kilo pascal. Now you know the equation.

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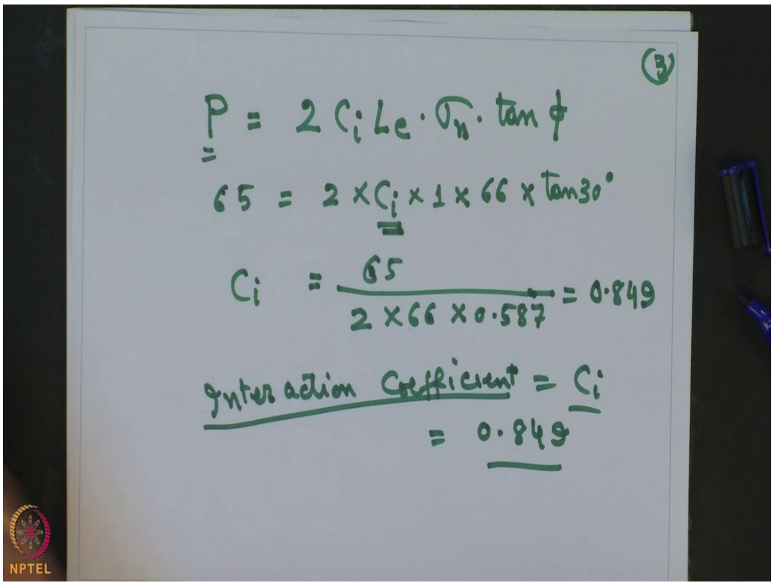

That is P is equals to 2 into Ci into L e into sigma of n into tan of tan of phi. So, you know what is P value? P value already I have mentioned here that 65. So, you can write 60, 66 phi value. So, P is equals to the total load; yes, that is will be equal to the 65 is equal to 2. You have to determine C of pi. So, this is Ci and L e is given, this L e embedded length is 1 meter.

So, you can write L e equal to 1 meter into that is sigma n. You have to determine sigma n. Sigma n is equals to the you know gamma into h plus q. So, here sigma n is equal to gamma h plus q. So, this will the 66. So, this will be equal to the 66, this into tan phi. So, phi value is also given here is 30 degree. So, this will be tan of tan of 30 degree ok. So, from this we have to calculate that what is C i.

So, then C i will be equal to that is 60 of phi. This divided by 2 into 66 into 0.587 tan 30 degree. So, this will be equal to 0.849. So, you can say that inter action coefficient, inter action coefficient that C of i will be equal to 0.849. So, this is very important and now you know how to calculate the inter action coefficient of the Geogrid material or any Geosynthetic's material.

Now, I will give you another example for the Pullout test for the Geogrid material.

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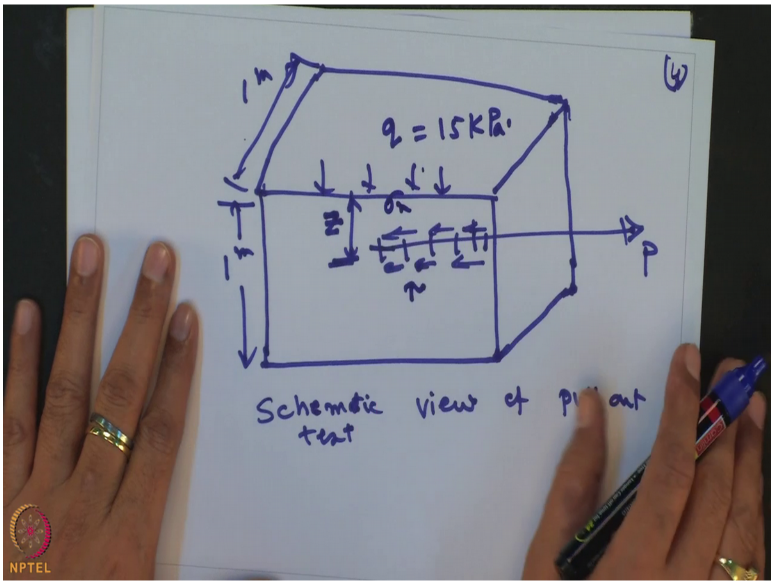

So, for example, this is I am showing you some schematic view of the Geogrid material and you are pulling this, this is schematic view of pullout test, of pullout test that is cyclic. And here is the Geogrid material this is the Geogrid material. So, there will be a development of friction mobilization between soil and Geogrid material.

And this let us say is located as a depth of z and let us say this is 1 meter and this also let us say this is 1 meter and there is a surcharge load and that surcharge load is equal to 15 kilopascal and this is tau and this is normal this is sigma of n is acting.

I now show you 1 example for the pullout strength of the Geogrid material. Now you know that Geogrid material has a longitudinal.

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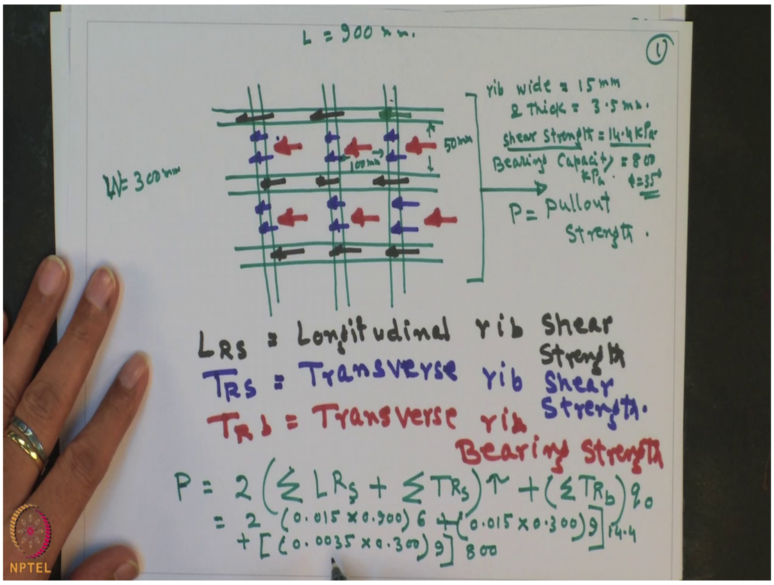

So, let us say this is the Geogrid sample. These are all Geogrid in the which call longitudinal rib and these are the transverse rib. So, this is longitudinal rib and this is longitudinal rib this is transverse rib and this transverse rib, transverse rib, transverse rib; there means 3 longitudinal rib and 3 transverse ribs. It is length let us say it is 900 millimeter and this tied with is equal to 300 millimeter.

Now, here how this Geogrid material, what is that doing? You are pulling; that means total anchorage or you can say it is pullout. So, you have to determine P is equal to pullout strength; pullout strength. So, in this longitudinal rib there is a shear strength. So, this is longitudinal rib shear strength. So, you can so like this, this is longitudinal rib shear strength.

So, this is this is longitudinal rib shear strength. This is longitudinal rib shear strength. This is longitudinal rib shear strength. If the longitudinal rib shear strength is expressed as L R S that means, this is longitudinal rib shear strength ok. This is longitudinal rib shear strength.

And here also these are the transverse, transverse rib. So, these transverse rib shear strength is also acting when you are pulling. So, when you are pulling, there is a transverse rib. So, transverse rib is this one, this one, this one and this one, this one and this one is the transverse rib ok.

This is transverse rib, this is transverse rib, this is transcribe rib, this is transverse rib because when you are pulling the Geogrid material; that means, longitudinal rib shear strength in this direction. But transverse rib shear strength is this direction. So, if I designated at T of R S; that means, transverse, transverse rib shear strength. This is transverse rib shear strength ok.

Now, apart from the longitudinal rib shear strength and the transverse rib shear strength, there is a transverse rib bearing strength; transverse rib bearing strength. This part, this part and I am just showing (Refer Time: 18:49) this part. This is transverse rib bearings. This is transverse rib bearing ok. This is transverse rib bearing. This is transverse rib bearing. This is transverse rib bearing. This is transverse rib bearing. That means, this are T R b is transverse rib bearing strength, bearing strength. So, we wanted to see that when this Geogrid material is pulling?

So, there is a development of shear strength along the longitudinal rib as well as the transverse rib here and apart from longitudinal and the transverse rib, there is a transverse rib bearing strength and we wanted to see that what of the Geogrid material bear the maximum strength; whether the longitudinal rib, whether the transverse rib or whether the bearing transverse rib bearing capacity?

So, for the pullout strength or anchorage pullout strength so we can write that P; P is equal to 2 of summation of L R S. L R S longitudinal rib shear strength to bottom and up to. So, 2 summation of L R S plus summation of T of R S that means, T to transverse rib top and bottom T of R S this into tau ok.

So, this is for the longitudinal and the transverse rib and for this transverse rib that is for the bearing strength. So, you can write this is summation of T R b. This is T R b here into q of 0; that means, this value also will be the given what will be the bearing capacity. So, then you can determine what should be the pullout strength or what should be the total anchorage strength or the pullout strength? I will give you one of the example and to show that which part it stay the maximum pullout strength. Whether it is a longitudinal, whether it is a transverse or whether it is a bearing?

So, for an example, for an example that when the anchorage capacity of here, anchorage capacity of each of the that strength component and percentage contribution due to the bearing capacity and as I said let us say that arbitrary dimension this length is about 900 millimeter and this strength is about or with about let us say with about 300 millimeter and the longitudinal rib are 50 millimeters spacing.

So, these longitudinal ribs are 50 millimeter spacing. So, this longitudinal rib spacing is 50 millimeter. So, this is 50 millimeter ok, longitudinal rib this spacing one to one spacing is 50 millimeter and the transverse rib, this to this spacing is 100 millimeter. So, this is 100 millimeter. So, this spacing is 50 millimeter and this spacing is 100 millimeter ok.

And all the ribs, all ribs all ribs are 15 millimeter wide by 3.5 millimeter thickness ok. So, rib wide, you can say that rib wide is about 15 millimeter and the thick of the rib is about 3.5 millimeter and in the analysis you find the shear strength is about 14.4 kilo pascal. So, shear strength also given shear strength is 14.4 kilo pascal. Then, this is about 55 into tan of 30 degree and the bearing capacity, bearing capacity is 800 kilo pascal; 800 kilopascal that is based on the soil friction angle is based on the soil friction angle is 35 degree.

So, this is the problem given and you have to find out what should be the total anchorage or pullout strength. So now, this P is equal to 2 into a summation of L R S. So, what is L R S longitudinal rib shear strength? So, here this rib wide about 15 millimeter. So, we can write here. So, this will be equal to 2 into 0.015 into this is 0.900.

Because this length is 900 millimeter 0.900 into this width of this is 300 millimeter and the spacing is 50 millimeter; that means, 300 by 50. So, 300 by 50; this is 300 by spacing is 50. 300 by 50 will be equal to 6. So, this into 6 plus this is for longitudinal rib shear strength.

Now, next for tau T R S; that means transverse shear strength. For the transverse rib shear strength; that means, this. So here again, that why is this 0.015? So, 0.015 this into and again this is 0.300, 0.300 into this is 900; this is 900 and this spacing is about 100. So, this 900 by 100; that means, it should be a 9. So, these are the data due to the longitudinal rib shear strength and transverse rib shear strength. This into because this is the ah this into tau.

So, tau value is given; that means, shear strength value is 14.4. So, this into 14.4 plus due to the bearing, that means, T R b. T R b is this one. T R b that means, transverse rib or the bearing strength. So, transverse rib bearing strength will be because the thick rib of the thick is 3.5 millimeter.

So, you can write this will be equal to 0.0035. This is the thickness into this is 300 millimeter. So, 0.300, this into and this length is about you can see 9, it will be the nine; that means, 900 by 100; that means, this is will be equal to 9. This total into that what will be the bearing capacity that is q 0. So, this is P 0 bearing capacity that is 800 kilopascal. So, this will give the 800 kilopascal.

So, these parts for the longitudinal rib shear strength. This part or the transverse rib shear strength and this part is the transverse rib bearing strength ok; so now, if you calculate the first part and the second part and the third part.

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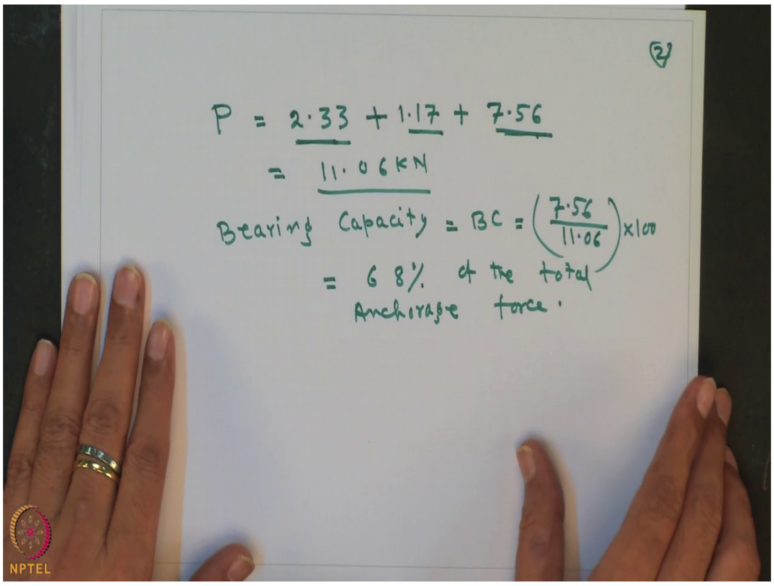

So, you can obtain P, that means total anchorage or pullout strength will be equal to first part is 2.33; second this is for the transverse rib and second is or sorry longitudinal rib and second is for the transverse rib transverse rib is 1.17 plus for the transverse rib bearing strength and that is 7.56.

So, this part is the longitudinal rib and this part is the transverse rib shear strength and this part is the transverse rib bearing strength. So, total P will be equal to 11.06 kilo newton. Now, you want to see the percentage contribution of the bearing capacity. So, bearing capacity that is B of C will be equal to 7.56. This divided by 11.06 this into 100.

So, this bearing capacity will be about 68 percentage of the total anchorage force. So, note that degree of mobilization of these 3 component of the anchorage resistance during the pull out at the function of load extension properties of the longitudinal rib and the flexibility and load extension property of the transverse rib. So here, you find that bearing capacity is giving more 68 percent of the total anchorage force with respect to the either the longitudinal rib shear strength or the transverse rib shear strength. So, bearing capacity is giving always on the bar value.

Thank you.