Geosynthetics Testing Laboratory
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Lecture – 09
Grab Tensile Test

Well, I now show you some specimen calculation for burst strength.

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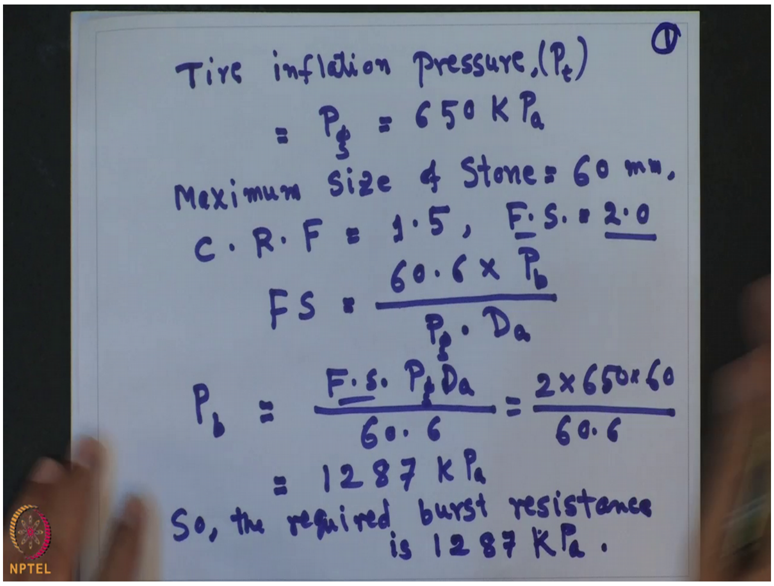

Let us say that tire inflation pressure that is P of t is equal to P of g is equal to 650 kilo Pascal, and maximum size of stone size of stone is equal to 60 millimeter. Then cumulative reduction factor is equal to 1.5 and factor of safety let us say 2.0. So, you know the equation factor of safety is equal to 60.6 into P of b this divided by P of g into D of a.

So, P b is equal to F of S, P of g into D of a this divided by 60.6. So, this will be equal to because factor of safety is 2, this factor of safety is equal to 2, this is 2 into P of g, P g is 650, 650 into D of a, D of a is maximum size stone 60 millimeter. So, this is 60 this is divided by 60.6. So, this will give you that 1287 kilo Pascal. So, the required burst resistance required burst resistance is 1287 kilo Pascal. So, this also you can determine from figure.

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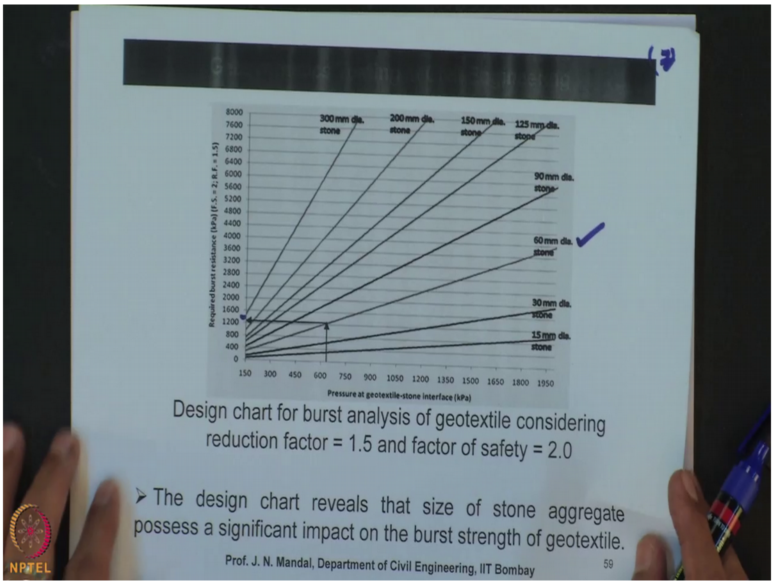

You can see here that pressure geotextile stone aggregate in the problem it is given 650 kilo Pascal this is 650 kilo Pascal, and stone diameter is 60 millimeter we can see considering this as a stone diameter 60 millimeter. So, knowing the pressure on the geotextile 650 stone diameter 60, so you can determine what should be the required burst resistance.

So, the required burst resistance is a about 1287. So, this is required burst resistance 1.827 kilo Pascal. So, from this design chart for burst analysis of geotextile we can make use of this design chart for the determination of required burst strength of geotextile material.

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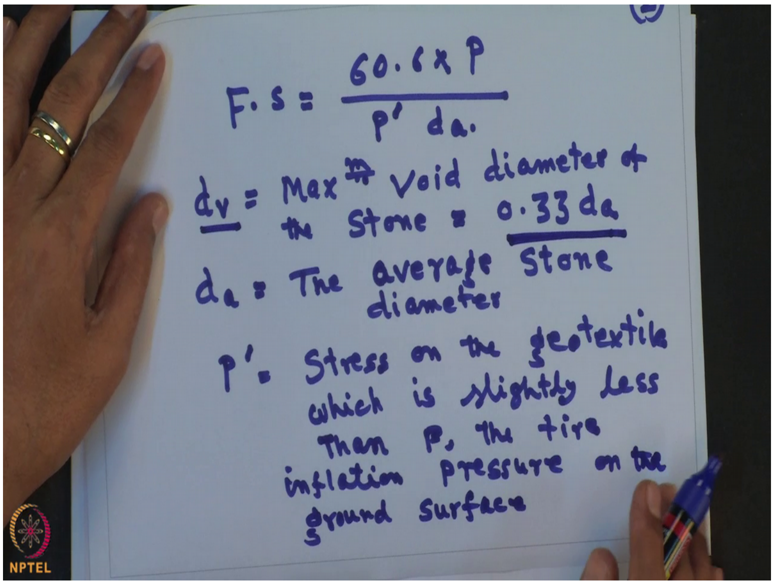

I am giving another example you know that let us say factor of safety is equal to 60.6 into P this divided by, let us say that stone on the geotextile let us say this is P dash into d of a. So, you know that dba has a relationship with the d of a. So, I am telling about what is d v I will explain this one later on that is maximum void diameter of the stone, this will be equal to 0.33 d of a, where d of a is the average stone diameter, average stone diameter.

And this P dash you can stress on the geotextile, P dash is stress on the geotextile which is slightly less than P that is star inflation pressure inflation pressure on the ground surface. I will explain later about the maximum void diameter of the stone equal to 0.3 times of d of a, d a is equal to average stone diameter. So, let us give another example that given tire that pressure is 700 kilo Pascal, the 700 kilo Pascal.

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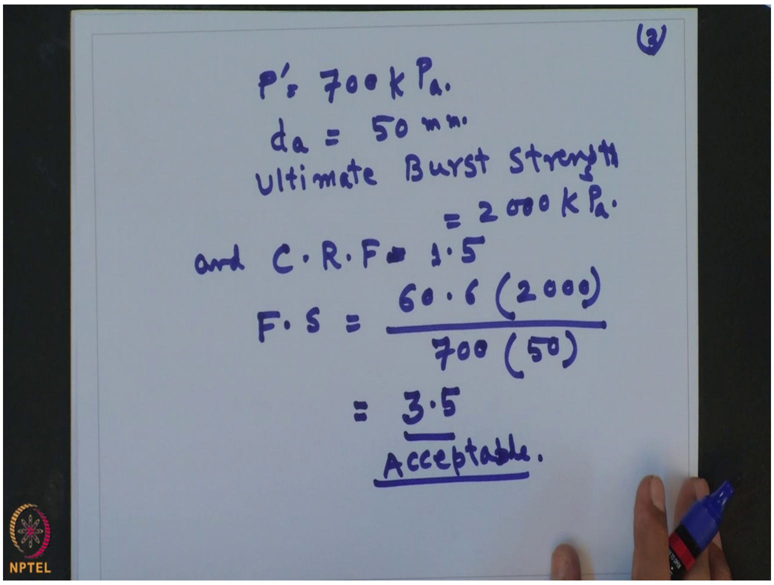

Now, this is let us say here about P dash is equal to 700 kilo Pascal and this is raised that tire inflation paper of poorly get it aggregate layer and consisting 50 millimeter maximum size of the stone. So, stone size is 50 millimeter, ok, that mean d a is 50 millimeter. And you have to determine what is the factor of safety using the geotextile beneath the aggregate having the ultimate burst strength ultimate burst strength is given burst strength is 2000 kilo Pascal ok, and cumulative reduction factor is given cumulative reduction factor this is equal to 1.5.

So, you have to calculate that factor of safety. So, factor of safety you know 60.6 into ultimate burst strength value, that is 2000 this divided by you know P dash value is given 700 into that diameter D a, D a is equal to average stone diameter; that means, this is 50. So, if you calculate you can find this factor of safety will be 3.5. So, the reduction factor 1.5 is already mean included. So, resulting factor of safety is acceptable. So, this is acceptable, ok. So, this factor of safety is acceptable.

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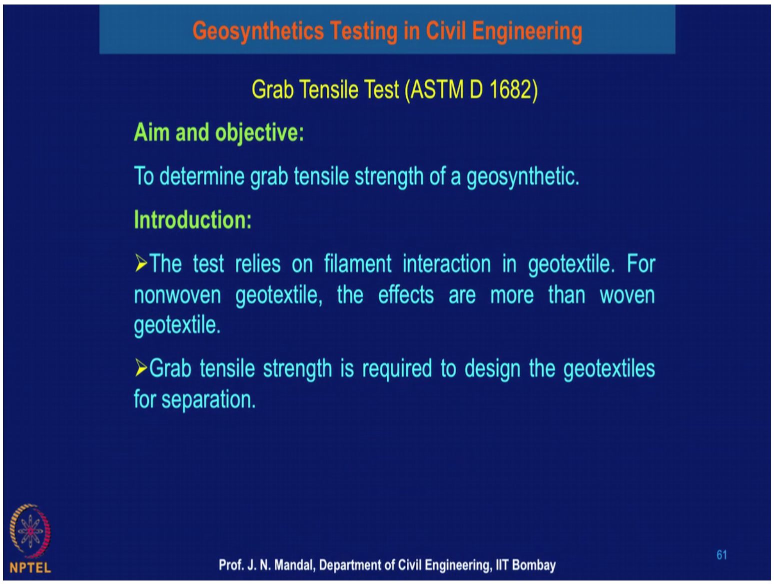

Now, I will discuss the grab tensile test. So, grab tensile test is performed as per ASTM D 1682. The main objective of this test to determine the grab tensile strength of geosynthetics material, an introduction the test rely on filament interaction in geotextile for nonwoven geotextile material the effect are more than the woven geotextile material and grab strength is required to design the geotextile for separation, you know what is the separation.

Now, when the pressure is applied on the upper surface of the stone for an example and how it spread on the lower surface of the stone. Let us say this is a one layer of the geotextile material.

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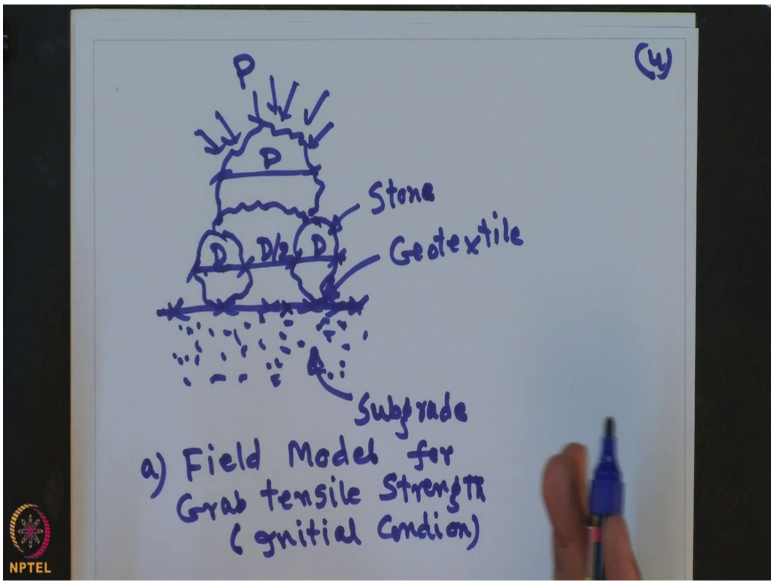

So, this is geotextile material, and these are the sub grade, these are sub grade. And these are the stone these are also a stone and this diameter of the stone let us say this is D by 2 and this distance is D, this distance is D and the top of this there is a another stone material and with diameter let us say D, and this is the pressure is acting on this that is designated at P.

So, these are the stone. So, this I am showing that field, field model, this is field model for grab tensile strength, this is the initial condition initial condition. So, when the pressure is applied to the upper stone and its spread the two lower stone laterally as a result there is a tensile is mobilized in this geotextile. It is analogue to the grab tensile strength test now how it can be analyze in the grab tensile strength material.

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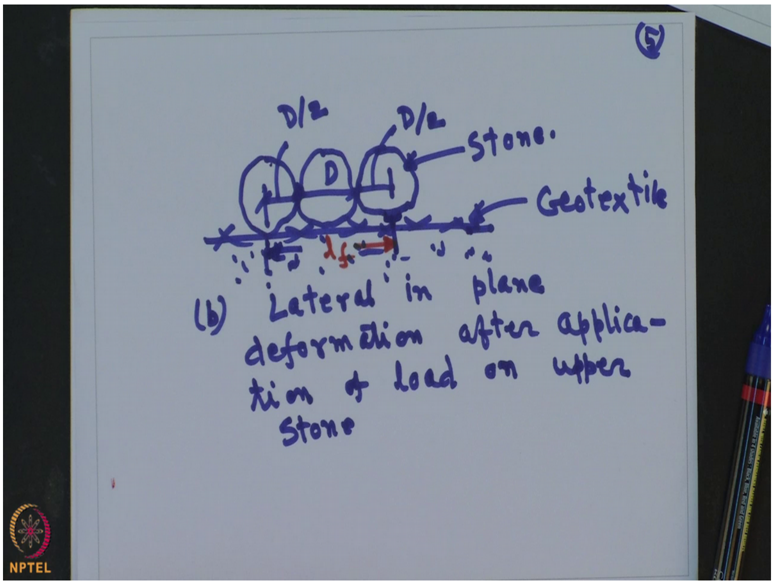

So, so if this is the geotextile material, this is geotextile and you know after applying the load and this is D this person is D by 2 and this person is D by 2. So, this is the stone and this is geotextile material, and this is sub grade. So, when you load applied in the initial stage and then there will be a lateral, lateral in plane deformation lateral in plane deformation after application of load on upper stone upper stone.

So, after application the load on the upper stone as you have seen earlier then this will be the position. So, this is the final position, so final position will be this to this. So, this and will be equal to let us say l of, l of f, ok. So, this can be this can be analogue to the grab strength test. So, how it can be analogue to grab tensile test? So, this is the let us say this is the sample of geotextile material and he had to performs the test. So, this is moving along this direction.

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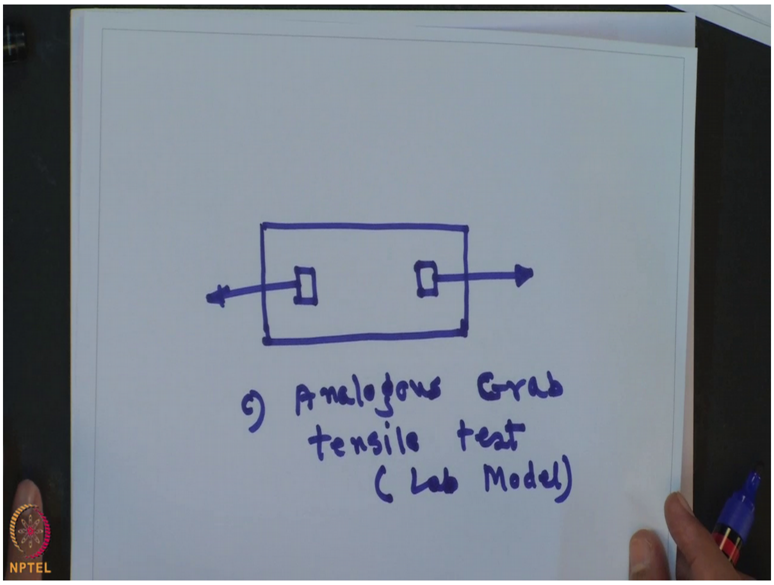

So, this you can say analogous grab tensile test this is the lab model. So, you have seen that what is that um the field model and how you can; so it in the laboratory model. Now, now from this let us say that D is the diameter of stone, ok, D is the diameter of stone.

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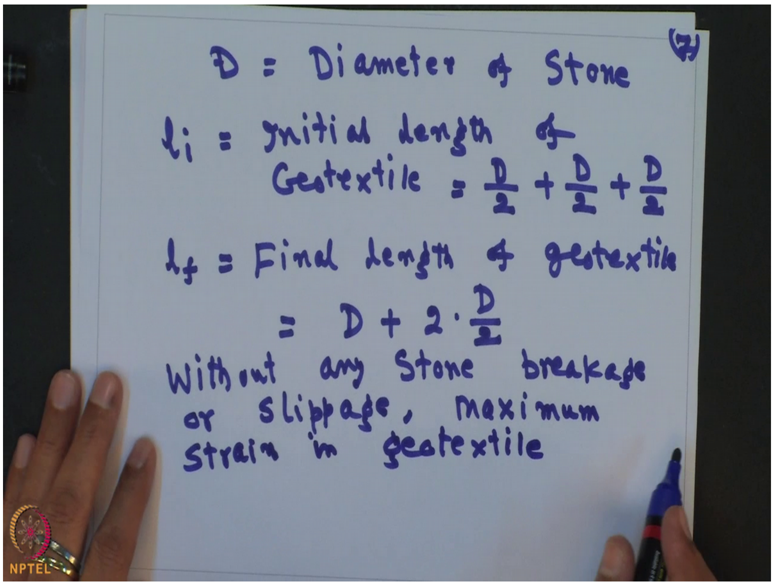

So, initial length, initial length of geotextile is equal to D by 2 plus D by 2 plus D by 2. So, if you can look here that initial length D by 2 and this is D by 2 and this is D by 2 so; that means, 3 D, D by 2. And after applying load that final length of geotextile will be equal to D plus 2 to D by 2. So, if you can see that after that final that when you apply the load. So, this is D by 2 this is D by 2 and this is D, so D plus D by 2, D by 2. So, that is a two D by 2.

So, without any stones breakage or slippage the maximum strain, maximum strain in geotextile can be expressed as let that you know maximum strain will be epsilon is equal to final length minus initial length this divided by the initial length.

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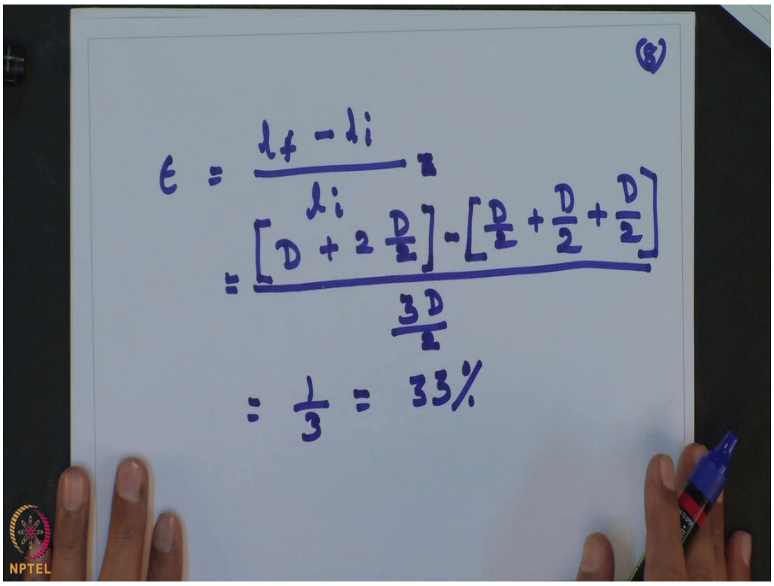

So, final length you know that is that here that is D plus 2 D by 2. So, this is the final length you know D to D by 2. This minus the initial length initial length was you know li is equal to D by 2, D by 2, D by 2. So, you can write initial length is D by 2 plus D by 2 plus D by 2 and this divided by the initial length mean you can write 3 of D by 2.

So, if you calculate you can have one tire and that is equal to 33 percentage, that is why this epsilon strain value is 33 percentage. Now, from this you can determine what will be the tensile strength T require of the geotextile material. So, T require will be equal to A of p into D v square into epsilon.

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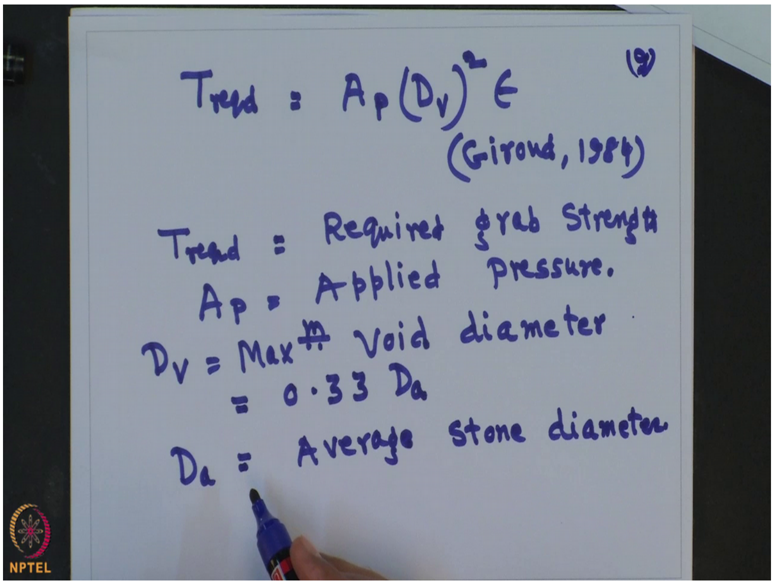

So, this is given by ground in 1984. So, where T require t require is equal to required grab strength required grab strength and A of p, this A p is applied pressure, A p is applied pressure and this is D of v, this D v maximum void diameter. So, this is maximum void diameter maximum void diameter. So, this will be equal to 0.33 times of D of a, where D of a is equal to average stone diameter this is average stone diameter, D a is equal to average stone diameter.

So, you can knowing the value of the applied pressure and the maximum void of the diameter or the average diameter of the stone and strength so you can determine that what will be the require grab strength of the geotextile material. Now, so what kind of the equipment or accessories required to perform the grab tensile strength, you require the tensile testing machine and you required the clamp.

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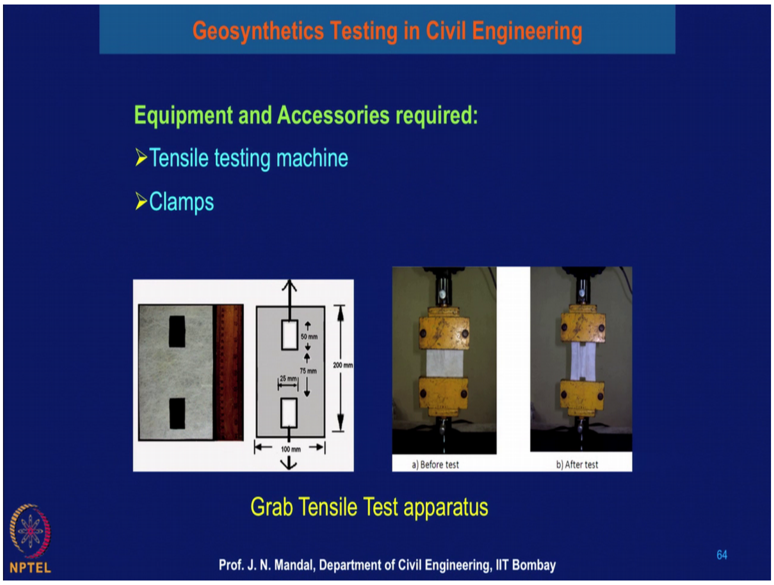

You can here the tensile testing machine and this is the clamp and this is the geotextile material and this geotextile material is before the test and this is the grab tensile test after the test. So, initially this is geotextile and this geotextile is grab with this.

So, it has a certain dimension that is this will be about 50, 60, 50 millimeter and from here to here about 70 75 millimeter, and the sample size is hundred millimeter into 200 100 millimeter into 200 millimeter. So, this is a grab tensile test apparatus. So, the procedure for this grab tensile test is that you have to mount the specimen centrally in the camp and start the tensile testing machine.

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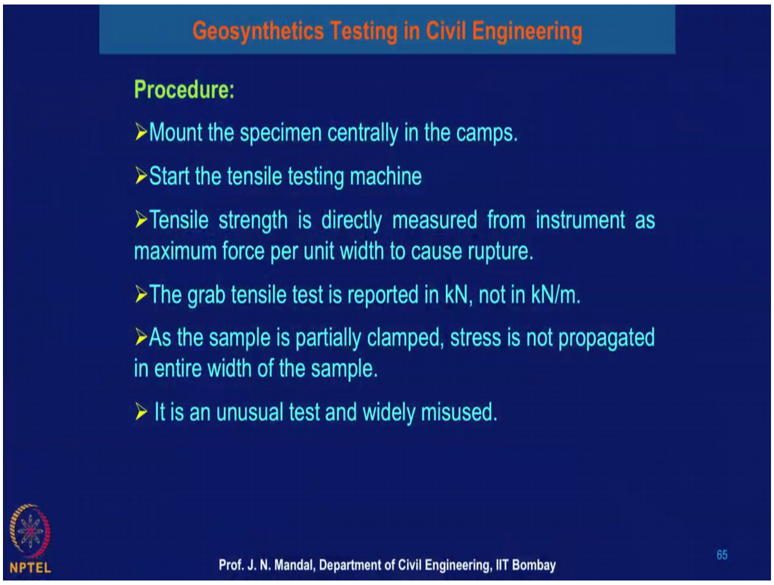

The tensile strength is directly measure from instrument as maximum force per unit width to cause the rapture. So, grab tensile strength is reported at kilo Newton, not as a kilo Newton per meter. I the sample is partially clamp the stress is not propagated in the entire width of the sample. So, it is unusual test and widely misused.

So, I am giving one of the example for this test. So, you know that what will be the required grab strength equation T required is equal to P dash into d v square into epsilon or this is A p, we have considered A p into d v square into epsilon.

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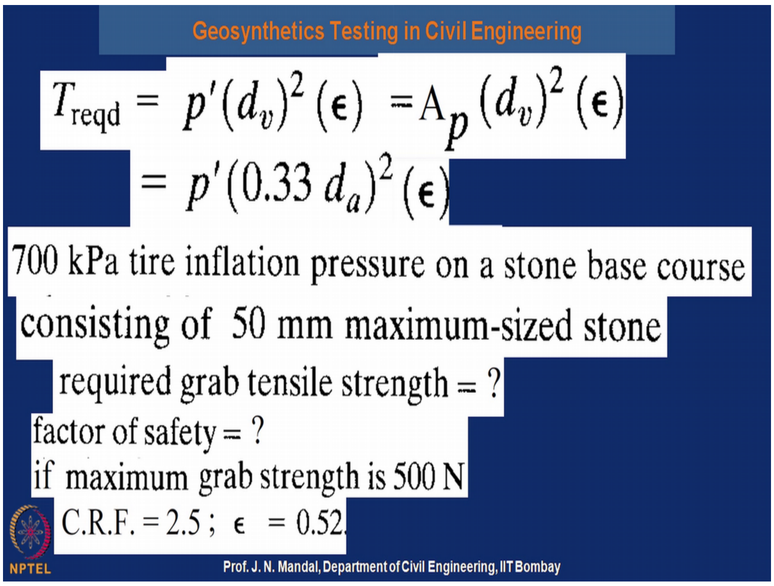

Here you know d v means, 0.33 times d a. So, this into 0.33 d a this whole square into epsilon. So, let us say given tire of 700 kilo Pascal tire inflation pressure, on the stone base crushed and 50 millimeter diameter of the, 50 millimeter diameter of the stone. So, size is 50 millimeter.

So, you have to calculate the what will be the required grab tensile strength of the geotextile material and what will be the factor of safety whose maximum grab strength suppose is given 500 Newton, with that cumulative reduction factor is equal to 2.5 and strain value is given let us say 0.52. So, T required you can determine you know the what is epsilon is 0.52. So, and T also is known to you.

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$$T_{reqd} = p'(d_v)^2(\epsilon) = A_p(d_v)^2(\epsilon)$$

$$= p'(0.33\,d_a)^2(0.52)$$

$$= 0.057\,p'd_a^2$$

$$= 0.057(700)(1000)(0.050)^2$$

$$T_{reqd} = 100\ N \qquad d_a = 50\text{ mm}$$

grab strength is 500 N; C.R.F. = 2.5

$$FS = \frac{T_{allow}}{T_{reqd}} = \frac{500/2.5}{100} = 2.0, \text{ which is acceptable.}$$

So, if you can calculate then you can have this equation this will be this will be like this 0.057 into A p into the d a square. So, this will be 0.057 this into A p is 700 inflation pressure into 1000 into 0.050 square ok. This is d a, d a is 50 millimeter size because d a we have considered 50 millimeter, so this will be this. So, T required will be equal to 100 Newton.

And factor for the 500 Newton grab tensile strength when it is given that 500 Newton grab tensile strength is given and factor is given is 2.5 this is here what I mention in second case. So, you can determine what will be the factor of safety; that means, this is T allow this divided by what is T require. So, T allow will be equal to 500 divided by 2.5, 500 is this and 2.5, so this will be allow and T required is the 100, which you determine 100. So, this will give you the value of 2.0 which is acceptable.

Thank you.