Geosynthetics Testing Laboratory
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Lecture – 08
Puncture Resistance Test and Burst Strength Test

Well, I will give one example.

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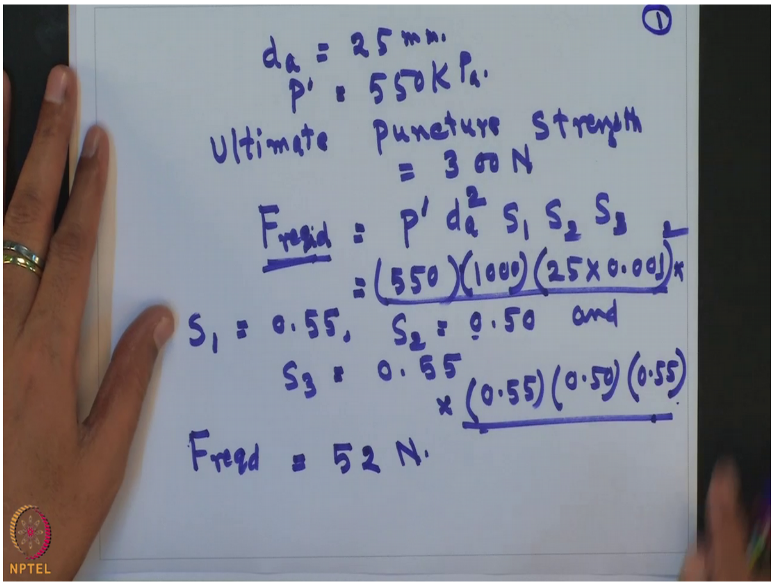

Let us say what will be the factor of safety against the puncture of geotextile material from a sub grounded, this diameter is 25 millimeter stone on the ground surface mobilized by a loaded truck with a implantation pressure implantation pressure P is equal to 550 kilo Pascal and travelling on the surface of the base course. So, you have to determine what will be the factor of the safety and geotextile has the ultimate puncture strength is 300 Newton this is as for ASTM D4833. So, you have to calculate what will be the factor of safety.

So, you can use this equation what is F required? F required it is (Refer Time: 02:06) P dash into d a square into S 1 into S 2 into S 3. So, what is that P dash is 550 kilo Pascal. So, this is 550 kilo Pascal. So, this into d a is 25 millimeter. So, this is kilo Pascal I put into in terms of the Newton. So, this will be the 1000 and d a, d a is 25 millimeter. So, d a we can write 25 into 0.001 this square. So, P into d a is what? S 1, S 2 and S 3 value.

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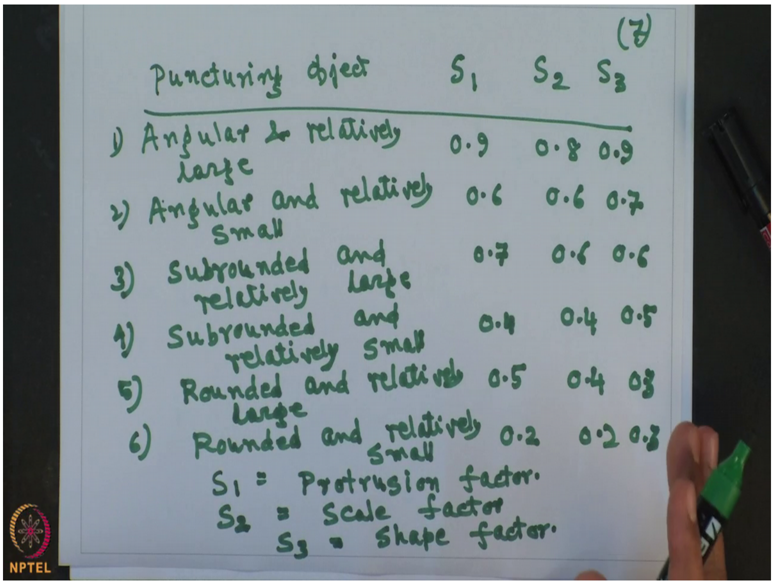

This value we have to choose from this table depending upon the type of the puncturing object. For example, some value we can say it is a subrounded and relatively large. So, you have to add of some S 1 value, S 2 value and some S 3 value from this table. So, let us say that S 1 value is 0.55 and S 2 value is 0.50 and S 3 value is 0.5 and 5.

So, knowing this value S 1, S 2 and S 3 you have to substitute here. So, this if you multiply this. So, this will be 0.55 that is for S 1, 0.50 that is for S 2 and 0.55 that is for S of 3. So, from this we can calculate F required this into this into this. So, this you will have that what will be the F required. So, this F required if you multiply this then you can have the value of 52 Newton, ok. So, you can determine what is F required.

Now, here you have to calculate that what will be the cumulative reduction factor cumulative reduction factor.

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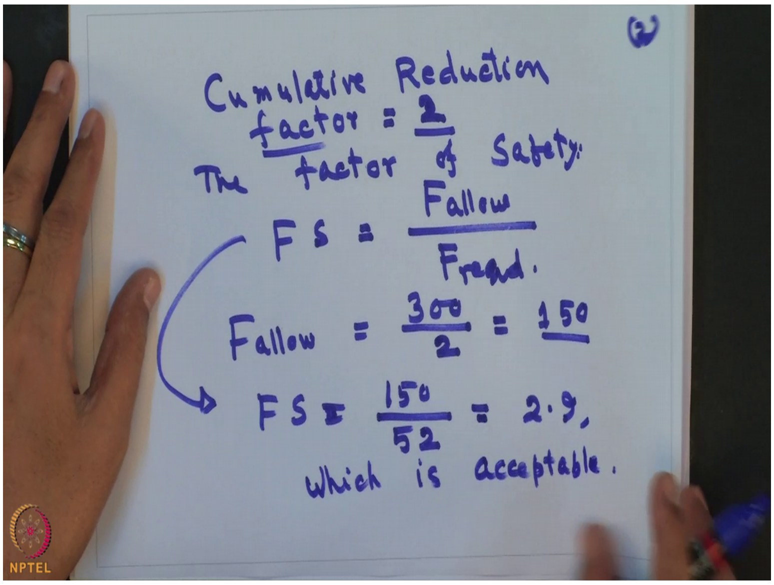

So, let us say that cumulative reduction factor is equal to 2 equal to 2. So, the factor of safety factor of safety FS will be equal to F of allow divided by value is F of required. So, in the problem it is given that 300 ports. So, F allow will be equal to 300 this divided by factor of safety is 2, this is factor of reduction factor is 2. So, this F allow will be 150.

Now, you can determine that FS. FS will be equal to 150. This 150 this divided by while you determine that F required is 52 Newton. So, F required is 52 Newton. So, F S will be equal to 2.9, which is which is acceptable. So, this is the puncture resistance I will talk you detail about this.

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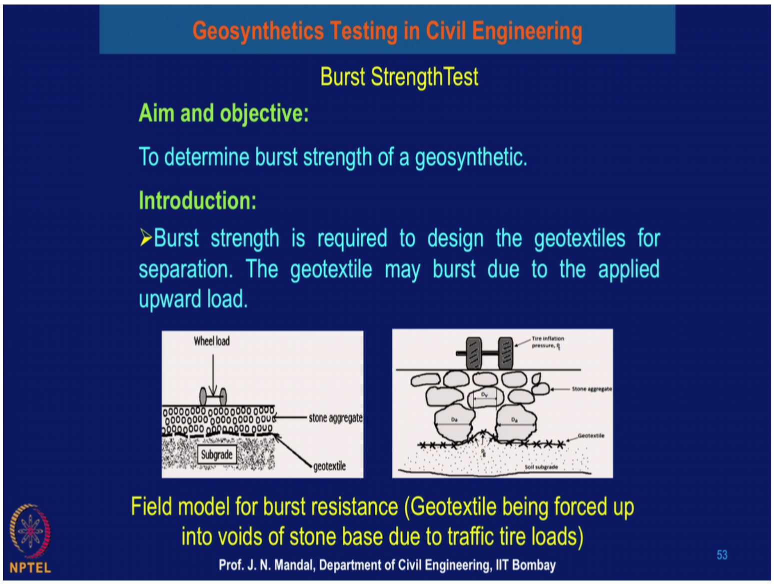

Now, we will perform the burst strength test. So, main objective of this test to determine what will be the burst strength of a geosynthetic material and burst strength is required to design the geosynthetics for separation. The geotextile may burst due to the applied upward load.

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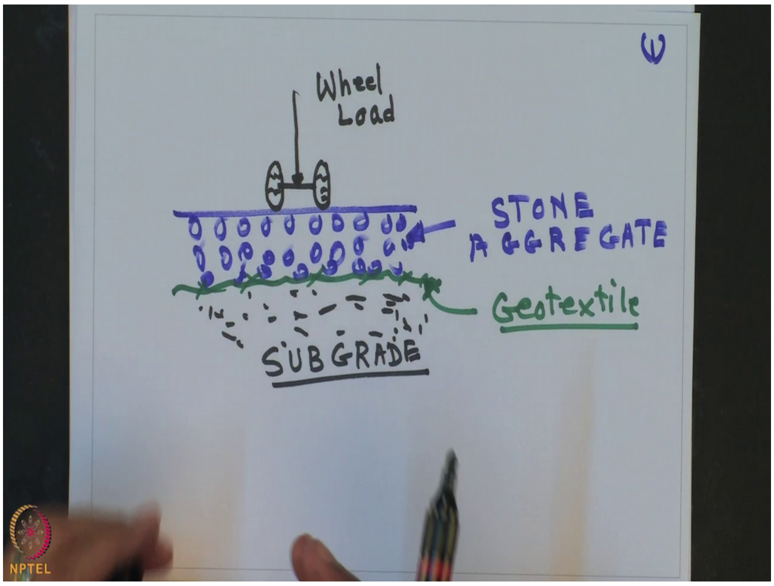

For an example this is the road and this the stone aggregate, this is the stone, this is the stone aggregate, this is the stone aggregate and you place the geotextile material. So, this is the geotextile material. So, this is geotextile materials you are placing here, and this is the subgrade subgrades soil. So, this is the subgrade.

And, when you apply the wheel load here this is the wheel load you are applying on the road wheel load, ok. So, there is a tire. So, there is a tire inflation pressure and this stone aggregate let us say some diameter of the stone aggregate d a, d b like this then when you apply the load then it to the sub subgrade so, geotextile may push in the upward direction that mean there will be the pressure on the geotextile and that pressure let us say it is a P of g. For example, I am showing that this is a tier inflation pressure, this is the pressure, this is the geotextile material and this is the subgrade and this is the P g is acting in the upward direction due to tire in inflation pressure P of a and this is the d b and this is the d of a either stone diameter.

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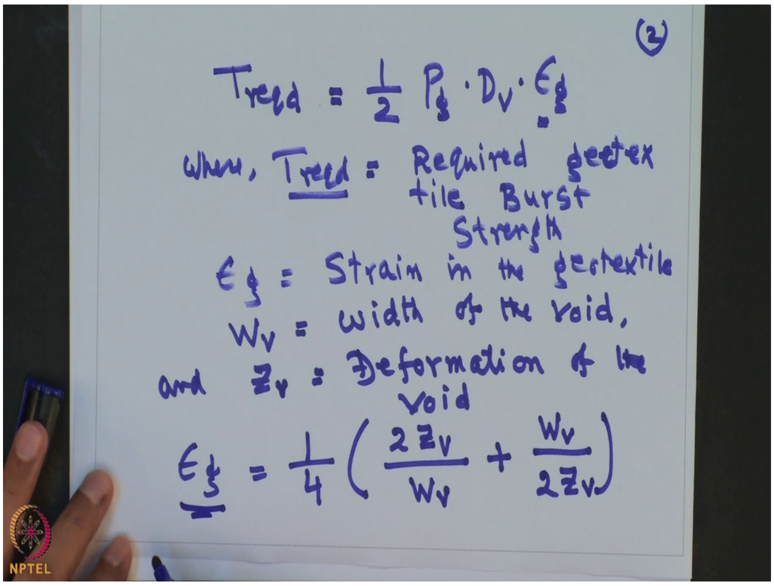

Now, from this theoretically from the concept (Refer Time: 12:30), 1984 developed a formula recall for the geotextile burst strength and this equation. For geotextile burst strength is as follow this is T of required is equal to half into P g into D v into epsilon g half into P g into D v epsilon g. So, this is the required geotextile burst strength, where T required is required geotextile burst strength burst strength. So, this is the equation you have to remember determine the burst strength of the geotextile material.

Now, this epsilon g is strain in the geotextile epsilon g is strain in the geotextile strain in the geotextile and it depend on the width of the void and also deformation of the void.

Now, as because epsilon g is the strain in the geotextile it depend on the width of the void let us say W v is the width of the void width of the void, and Z of v is a deformation of the void deformation of the void.

So, you can determine what is epsilon g; that means, strain in the geotextile material. So, epsilon g strain in the geotextile material can be written as 1 by 4 into 2 of Z of v divided by W by v plus W by v this divided by 2 of Z of v. So, you can determine what should be the strain of the geotextile material.

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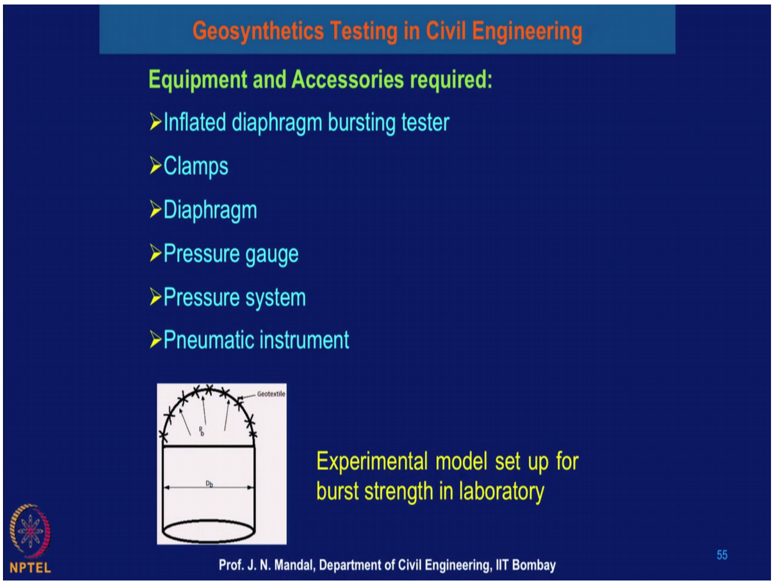

So, now what are the type of the equipment and accessory required for this test? So, you required the inflated diaphragm of the bursting tester, you require clamp and diaphragm, you require pressure gauge pressure system and pneumatic instrumentation. So, this is a kind of experimental model I can just show you.

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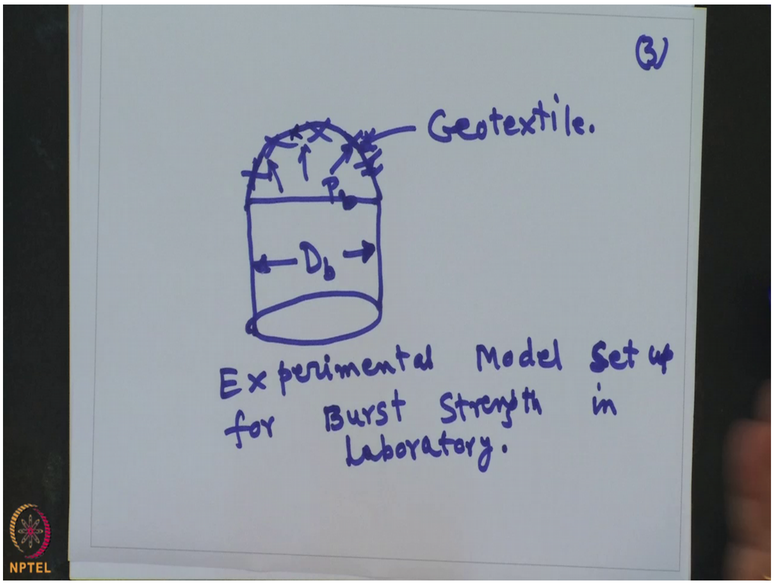

So, this is the equipment let us say and due to the burst this geotextile material is like this is the geotextile material and there is a pressure P of b and this is D of b. So, this is the experimental model setup for burst strength this is experimental model setup model setup for burst strength in laboratory. So, this is the model setup. So, there will be the pressure from the bottom and this geotextile material may onetime burst and by the pressure you can measure at what is strength this geotextile material is passed this is very important. And also this is very important in case of the geomembrane material that what should be their burst strength of the geomembrane material.

And, most of the time particularly the geomembrane is exclusively used for the landfill system and if there is a gas and then there is a possibility of the bursting of the geomembrane material it may be looks like a balloon it puts in upward it burst. So, one has to be careful that what will be the bursting strength of the geomembrane material.

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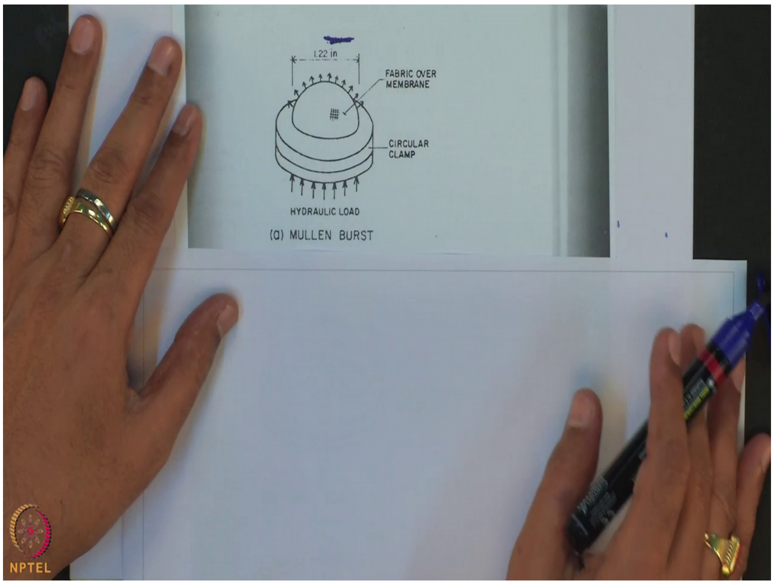

So, different types of the test also can be performed for the geomembrane material I am just showing some of the type of the material that one we can use. So, for example, that the different types of the test and let us say that this is the Mullen burst strength and you can see here it the circular clamp and here is the geotextile over the geomembrane and it has a dimension 1.2 range. And then, from the Mullen burst test apply the hydraulic load from the bottom and this geotextile membrane may passed. So, this is what you call the Mullen burst test.

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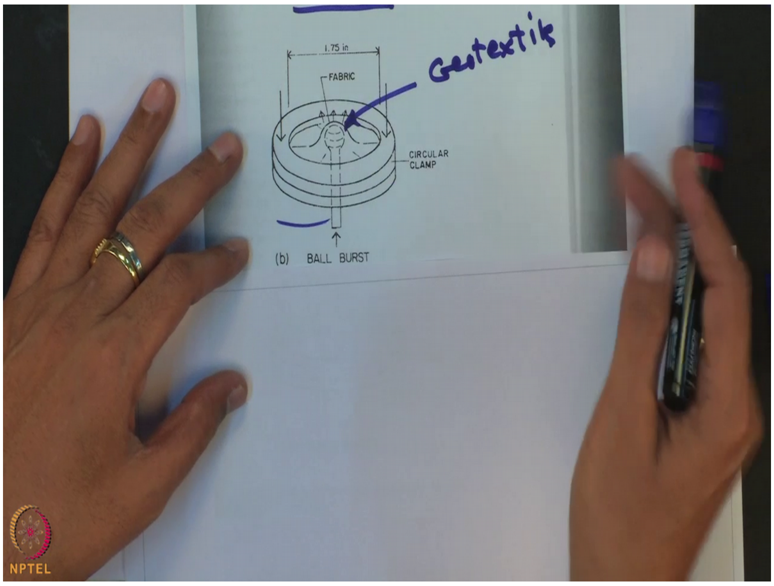

Then second another type of the test that what is called the ball burst. So, this is the kind of circular clamp and this looks like a ball the geotextile or the geomembrane material is clamped and this diameter about 1.75 inch. And, this is the geotextile material, this is geotextile material, this is a circular clamp and then ball burst and you determine what will be the burst strength of the geosynthetics material.

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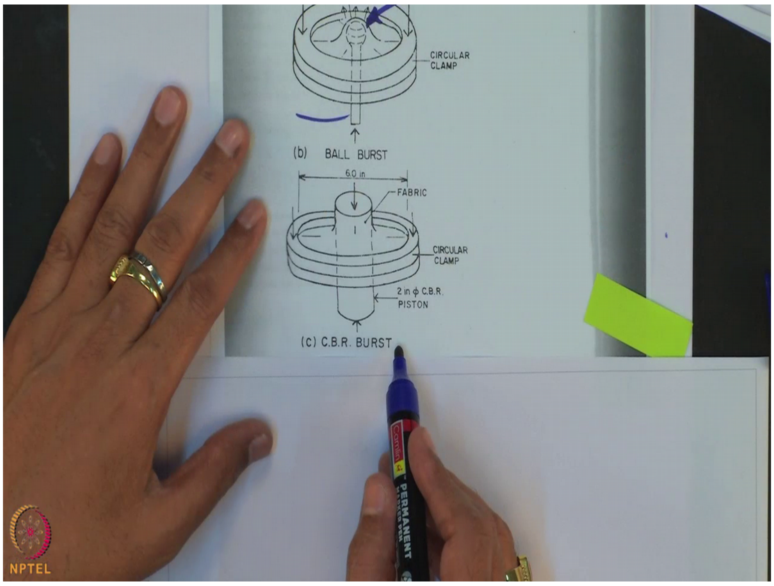

Then another type of geosynthetics material which you call the C.B.R. C.B.R burst. So, this is the same what I mentioned this is the circular clamp and this is the 2 inch diameter C.B.R piston and this piston is applied on the top of the geotextile material geotextile material here would diameter about of this model is 16 and this way also you can determine what should be the burst strength of the geosynthetics material.

So, there are different types of the geosynthetics material is available, but C.B.R burst also widely used for the burst strength of to measure the burst strength of the geotextile material.

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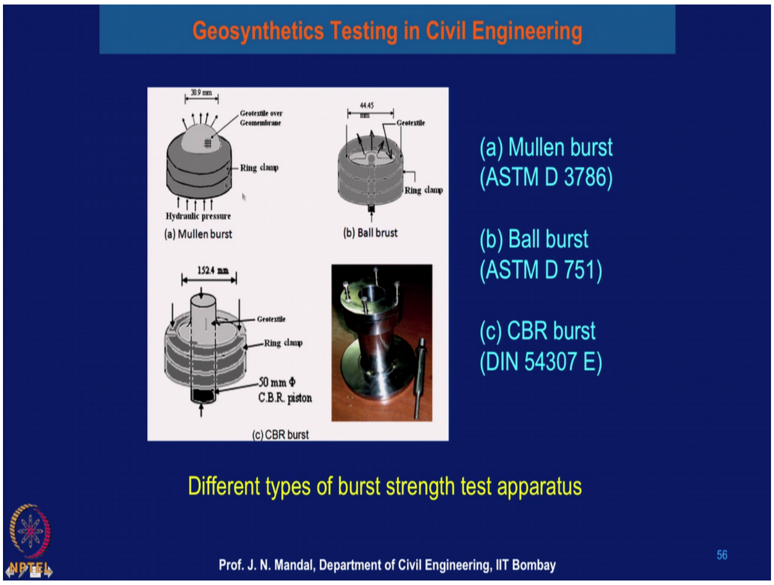

So, here also the that some also the similar type equipment has been shown here, what I shown you also this and this is the C.B.R burst strength, this is the Mullen busrt strength as for ASTM D 3786 that is this one Mullen burst strength and this is the ball burst which is as for ASTM D 751 and this is the C.B.R burst strength which we have developed in our laboratory and C.B.R burst is as for the DIN 54307. So, this is different types of the burst strength test apparatus.

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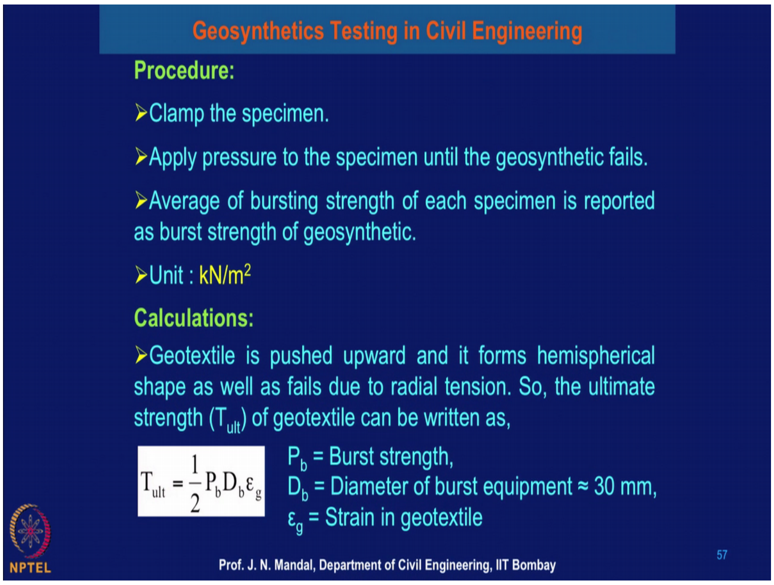

Now, this procedure for this you have clamp the specimen, then you have to apply the pressure to the specimen until the geosynthetic fail. Average of bursting strength of each specimen is reported as burst strength of geosynthetic and the unit of burst strength is kilo Newton per miter square. So, one of the calculation we are showing here that when the geotextile is pushed up kN I showing you that one calculation or to measure. So, geotextile is pushed upward and these form the hemispherical shape as well as fail due to the radial tension.

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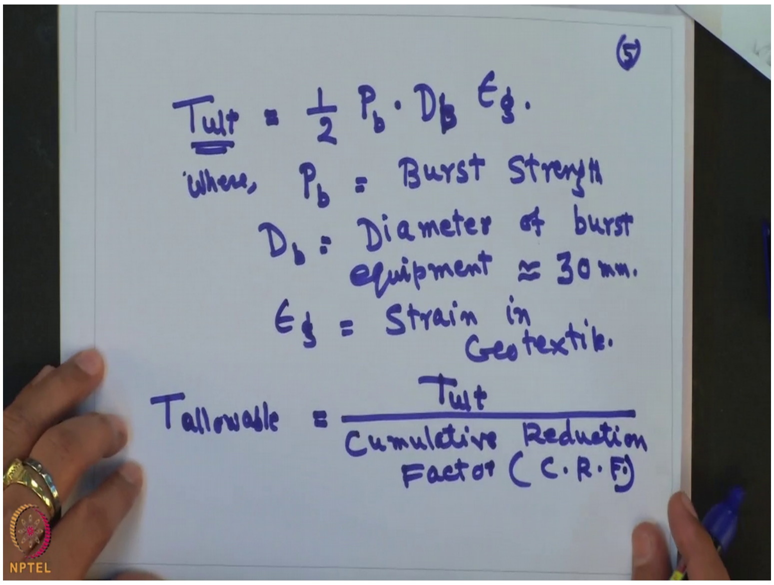

So, the ultimate strength of the geotextile can be written as T of ultimate is equal to half into P of b into D of B into epsilon g. You know that where P of b is burst strength P of b is your burst strength, and D of b; this is D of b, and D of b is the diameter of burst equipment diameter of burst equipment and that is approximately 30 millimeter which I shown you that that burst strength which you have developed and epsilon g is the strain in geotextile.

So, have strain in geotextile. So, you know what will be the ultimate strength. So, you have to determine that what will be the allowable. So, this is the ultimate. So, you can determine t allowable T allowable is equal to T of ultimate this divided by cumulative reduction factor this you remember cumulative reduction factor or you can say that CRF, ok. You have to determine what is T allowable.

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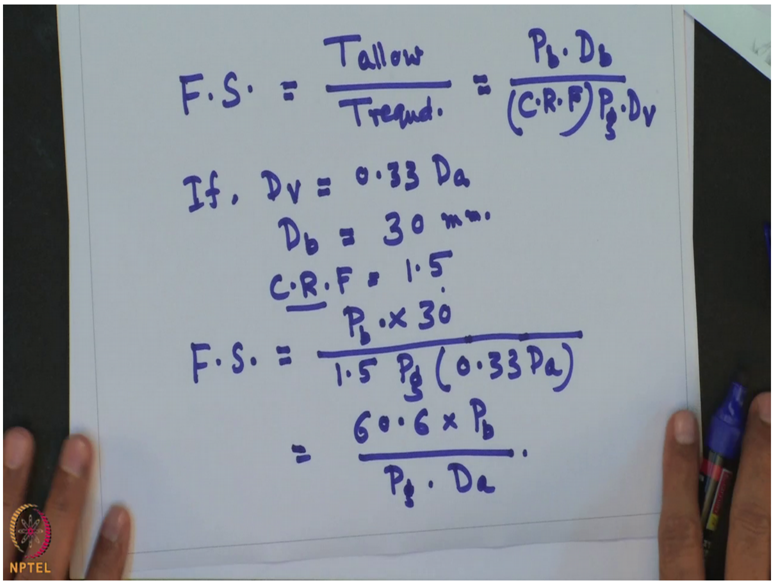

Now, you can calculate the factor of safety. So, factor of safety let us say FS will be equal to T of allow divided by what is T required that is T required. So, T allow is P of b into D of b into cumulative reduction factor into P g into D v ok. So, factor of safety T allowable by T required form the earlier equation. For example, that if the D b the diameter of the burst equipment is known, so, I mentioned you that if D v is equal to 0.33 times of D of a and D of b is equal to 30 millimeter that is the diameter of the burst equipment D b and CRF that is cumulative reduction factor is equal to 1.5.

So, there is a relation between the D v and D a that is 0.33 times of the D a. So, you can determine what will be the factor of safety. So, factor of safety will be equal to P of b into D of b is 30, this divided by cumulative reduction factor. So, this cumulative reduction factor is 1.5. So, you can write 1.5. So, this into P g and then into D v; D v has a relation with the D a, that is 0.33 D of a. So, if you calculate this you can have 60.6 into P of b this divided by P of g into D of a.

So, you can have this factor of safety in this format and from this you can make the design chart.

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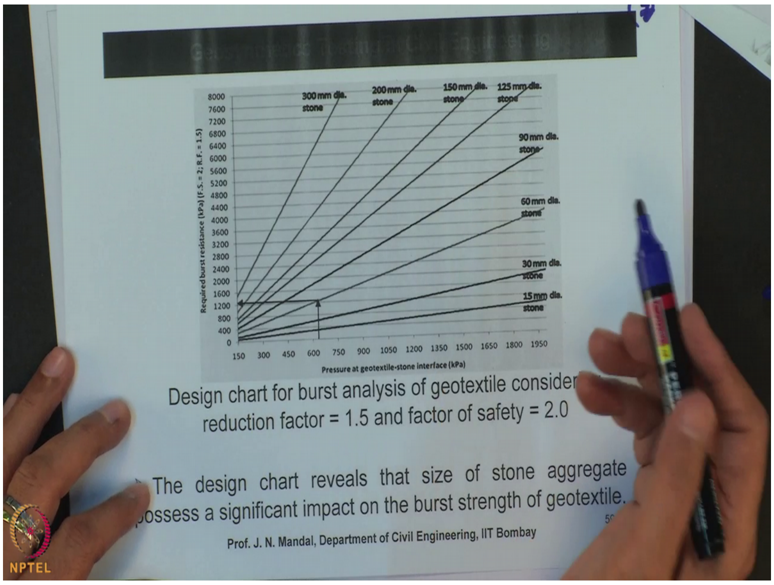

This is the design chart for burst analysis of geotextile considering the reduction factor 1.5 and the factor of safety 2. So, here this x axis is the pressure on geotextile stone interface in kilo Pascal this from 150 to 1950 kilo Pascal and this is required burst resistance kilo Pascal with the factor of safety 2 and reduction factor is 1.5. So, you can have the various line for the different diameter of the aggregate or stone it maybe 15 millimeter, 30 millimeter, 60 millimeter, 90, 125 millimeter, 150 millimeter, 200 millimeter and 300 millimeter.

So, if you know that what will be the pressure of the geotextile stone interface so, then you can calculate what will be the required burst strength. So, these designs are reveal that size of the stone aggregate what I say is significant impact on the burst strength of the geotextile material. So, from this laboratory you can determine that what will be the pressure on the geotextile material and what kind of the aggregate on stone diameter you want to use and then you can determine what will be the burst strength of the geotextile.

Thank you.