Geosynthetics Testing Laboratory
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Lecture – 04
Tests for Physical Properties and tensile strength of geosysnthetics

Why do you need to study this course? The main aim and objective to be world class centre of excellency in geosynthetic testing and other related product for the benefit of the mankind around the world. Enhancing how elementary theoretical knowledge and the observation of engineering performance assist and inspire creativity in the rational application of geosynthetic testing. The test on geosynthetics are conducted in this course in two different ways.

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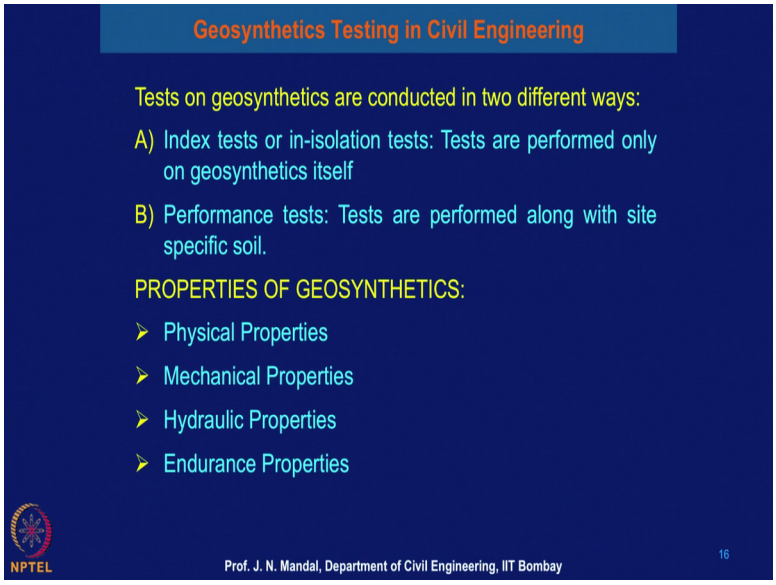

A index test or in-isolation test, test are performed only on geosynthetics itself, and B performance test, test are performed along with the site specific soil. If we can perform the geosynthetics material along with the site specific soil you can obtain some different value with respect to index tests or in isolation test. It is true that if you perform some time some of the test with the site specific soil then you can have much more realistic value.

Now, we will discuss properties of the geosynthetics physical property, mechanical properties, hydraulic properties, endurance properties. Now, what are the physical properties of the geosynthetics material mass per unit weight?

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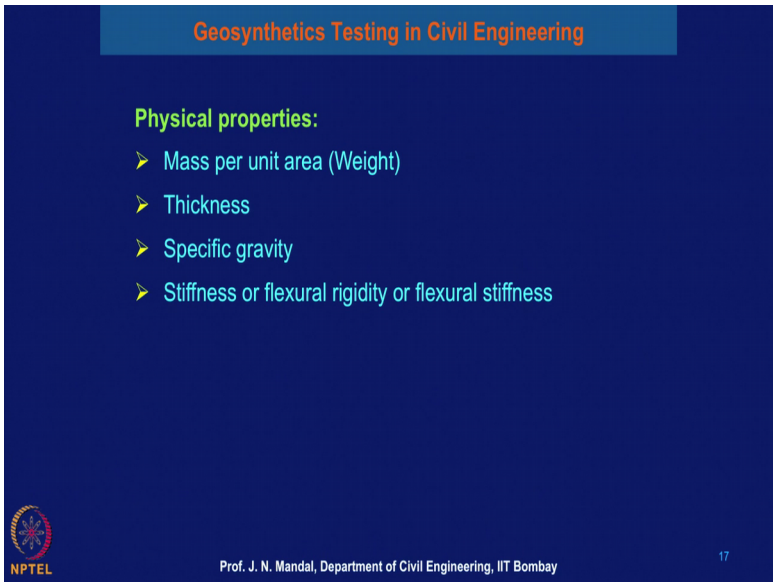

Second what will be the thickness of the geosynthetic material, what is the specific gravity of the geosynthetic material, what will be the stiffness on flexural rigidity or flexural stiffness? So, we will discuss one by one how we can perform the defined physical properties of the geosynthetics material.

Now, we begin the mass per unit area as per ASTM D 5261. What is our aim and objective for this test? To determine mass per unit area geosynthetic material.

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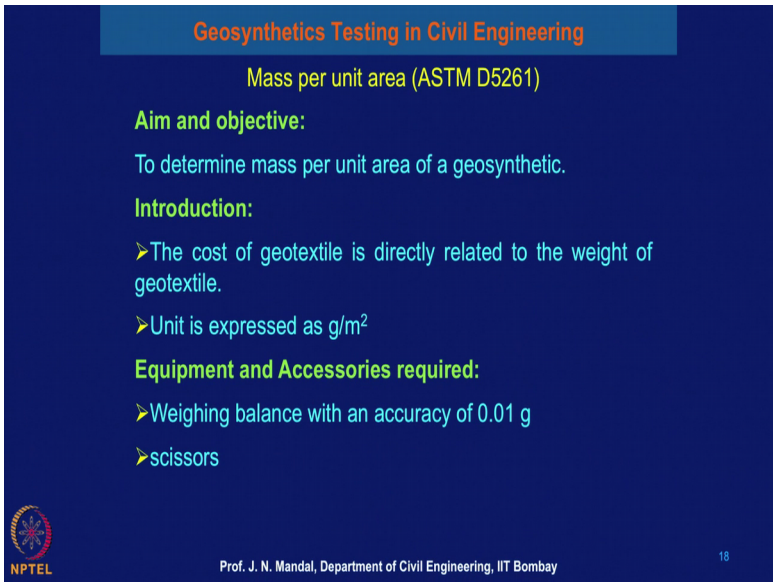

Because mass per unit area vary it may be 100 gram per meter square, 200 gram 300 gram, 400 gram per meter square, 500, 600 gram per meter square. So, if the gram per meter square is more the cost of the geosynthetic material also will be the more, but we have to select one gram per meter square geosynthetic material is required for the specific application and how you can perform the test.

Now, in introduction the cost of the geotextile is directly related to the weight of the geotextile weight of geotextile more mean cost of the geotextile will be the more and unit of the geotextile material is expressed as gram per meter square. One of the equipment and accessories required to perform the mass per unit area test. You require weighting balance with an accuracy of 0.01 gram and scissors.

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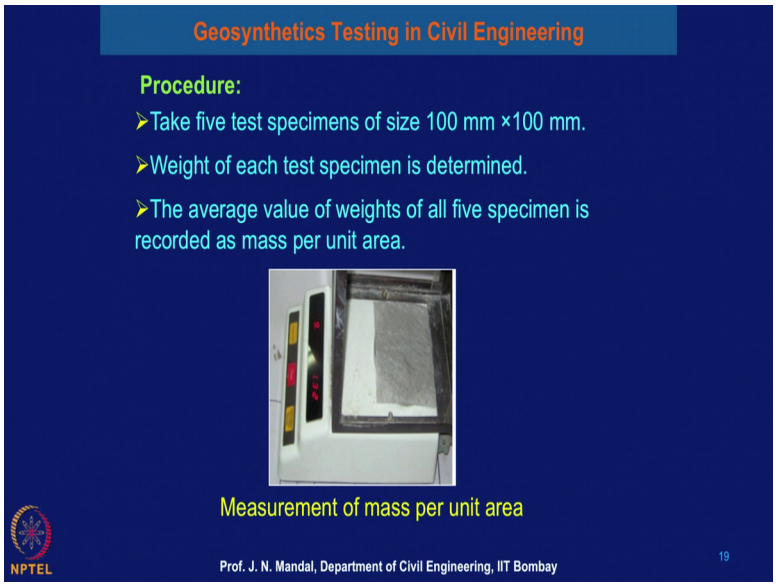

How will you?

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Proceed to perform the test. The procedure is like this you take 5 test specimen of geosynthetic and whose size is 100 millimeter by 100 millimeter. Then weight of each test specimen is determined and then take the average value of the weight of all 5 specimen is recorded as a mass per unit area. So, this is the measurement equipment for the mass of the geosynthetic material this is the equipment this is the geosynthetics material which size is 100 millimeter bar 100 meter, meter bar is placed in this equipment and you measure that what should be the weight and which is recorded as a gram per meter square.

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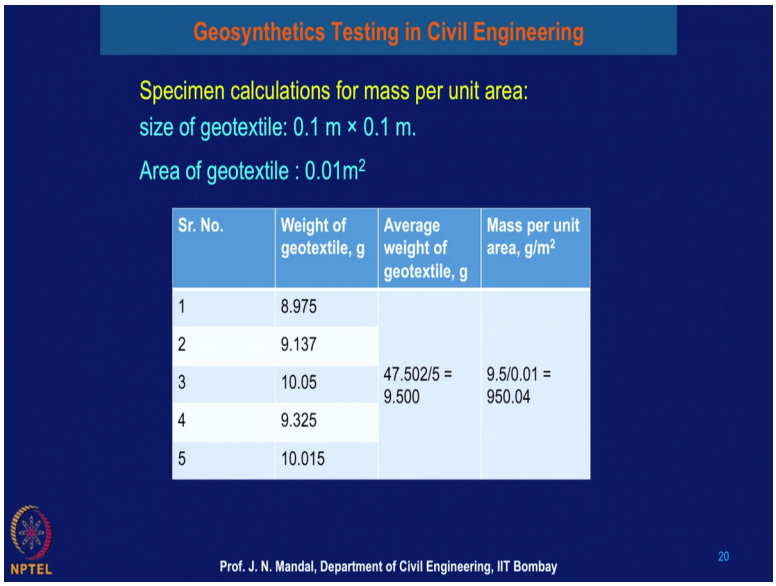

So, here some specimen calculation for the mass per unit area are given, you know the size of the sample is 0.1 meter into 0.1 meter and area of the geotextile will be the 0.01 meter square. So, if note down serial number 1 2 3 4 here to perform 5 6 test. So, we measure what will be the weight of the geotextile in terms of gram you can see here in the first test we have perform and measure the weight of the geotextile 8.975 gram.

Next test we perform it is 9.137 gram, next third we have perform the weight of the geotextile 10.05 gram and fourth test it give the result 9.325 gram and fifth test we are having 10.015. So, you take the average weight of the geotextile material. So, average weight is about 47.502 because there are total 5 test have been performed with 5 geosynthetics material so it is coming 9.500 gram.

So, mass per unit area in gram per meter square will be 950.04 gram per meter square. So, mass per unit area of geotextile 950 gram per meter square and gram per meter square is the unit or the mass per unit area geosynthetic material.

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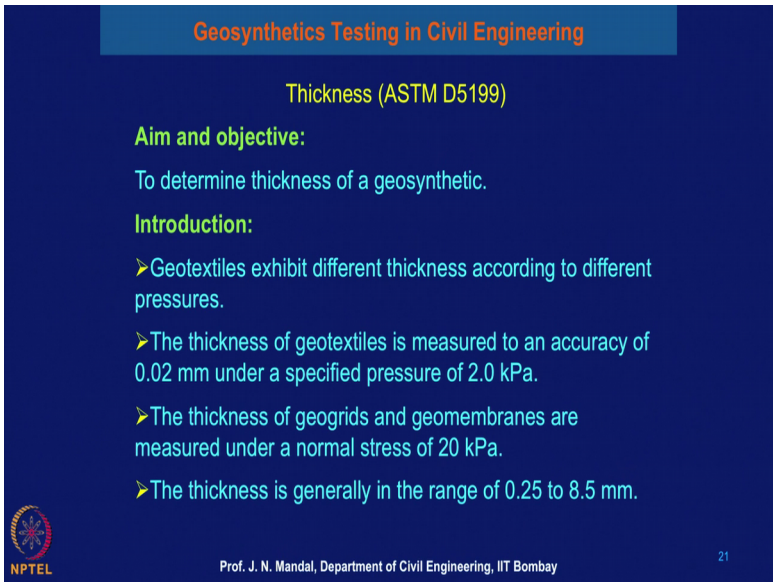

Now, next here to determine what will be the thickness of the geosynthetics material it varies thickness of the geotextile material it may be 0.25 or it may be 3 millimeter, 5 millimeter, 4 millimeter, 4.55 millimeter, 8 millimeter. So, different types of the thickness of the geosynthetic material will be available for particularly for woven and non woven geotextile material and this various application.

So, here for the thickness of the geosynthetics material we adopt the ASTM D 5199 and main aim and objective of this thickness test to determine what will be the thickness of a geosynthetic material. In the introduction you require geotextile exhibit different thickness according to the different pressure. So, if the thickness of the geotextile is measured to an accuracy of 0.02 millimeter under a specified pressure of 2.0 kilopascal as per standard. And thickness of the geogrid and the geomembrane are measured under a normal stress of 20 kilopascal and thickness is generally vary in the range of 0.25 to 8.5 millimeter.

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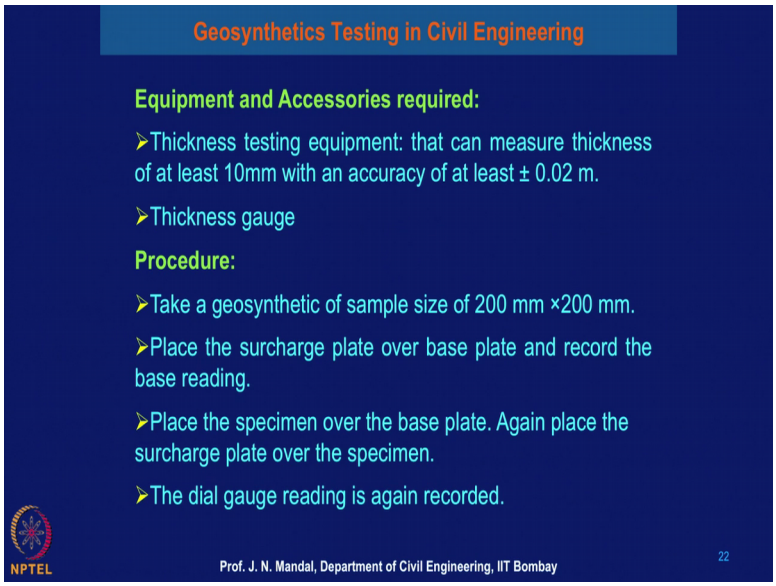

So, we need the equipment and accessories required thickness testing equipment that can measure the thickness of at least 10 millimeter with an accuracy of a least plus minus 0.02 meter. Need thickness of the gauge what is the procedure? Take a geosynthetics of sample size of 200 millimeter by 200 millimeter. Place the surcharge plate over the base plate and record the base reading place the specimen over the base plate and again. Place the surcharge plate over the specimen and you measure the dial gauge reading is recorded.

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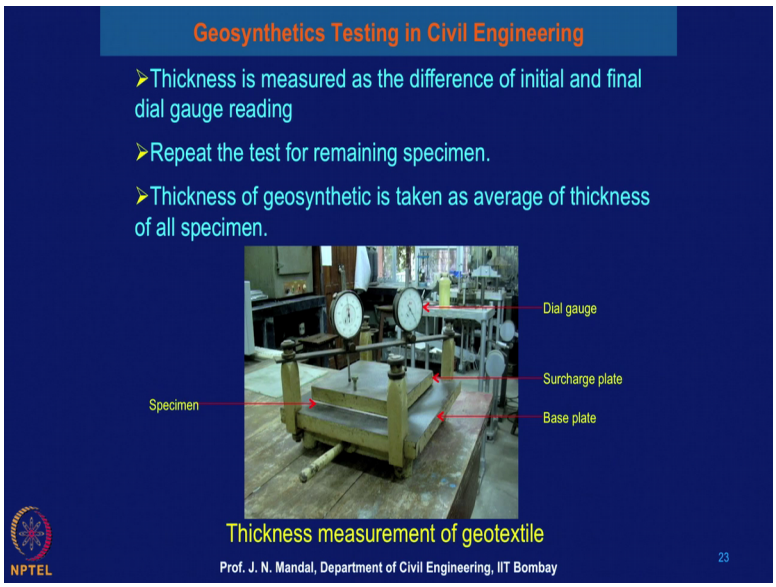

Here, is the equipment what you measure the thickness of the geotextile material. And thickness is measured as a different of initial and final dial gauge reading there here is a dial gauge you can say 2, also the 4 and you take the reading by the dial reading in the initial and the final stage due to application of the load and repeat the test for the remaining specimen. So, thickness of the geosynthetic material is taken as a average of the thickness of all specimen.

Here, as I said the thickness is measure of the geotextile material with the head of this equipment and this is the base plate and this white colour is the, this geotextile material and this stop one is the surcharge plate and this is the dial reading and this white one is the geosynthetic specimen. So, you can measure the thickness of the geosynthetic material with the help of this equipment.

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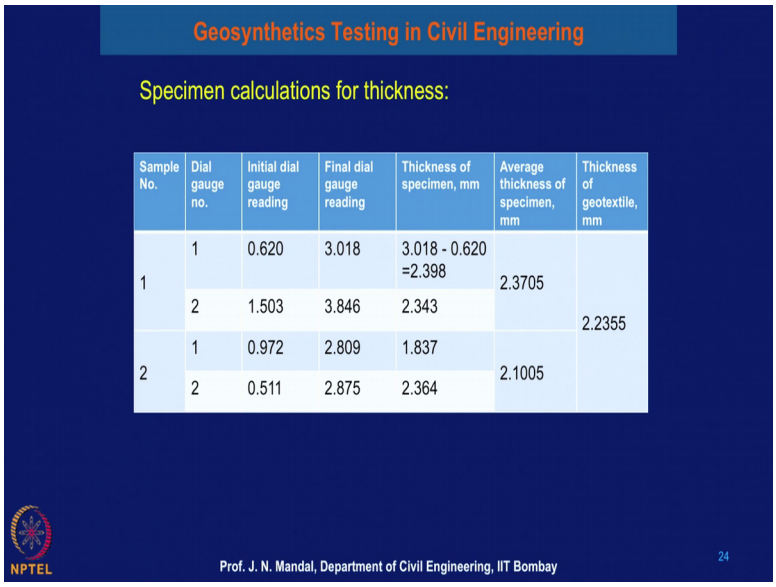

Now, this is some specimen calculation for thickness of the geosynthetic material is given. This is sample number 1 this is dial gauge reading for one is initial dial gauge reading 0.620 and final dial gauge reading 1.503 for a sample number 1. Similarly for the sample number 2, the initial dial gauge reading 0.972 and for the 2 the dial gauge reading is 0.511. So, you can determine we can determine that what will be the gauge reading final gauge.

Final reading this is 3.018, 2 for 3.846, 2.809, 2.875 and then you determine the thickness of the specimen, so this minus this is 2.398, this minus this is 2.343, this minus

this is 1.837 and this minus this is 2.365. So, average thickness of the geosynthetic material is 2.3705 and for this two sample the average thickness of the geosynthetics is 2.1005. So, we can have the thickness of the geotextile material 2.2355 millimeter. So, this is approximately 2.2 millimeter thickness of the geosynthetic material. So, you should know how to determine the thickness of the geosynthetics material.

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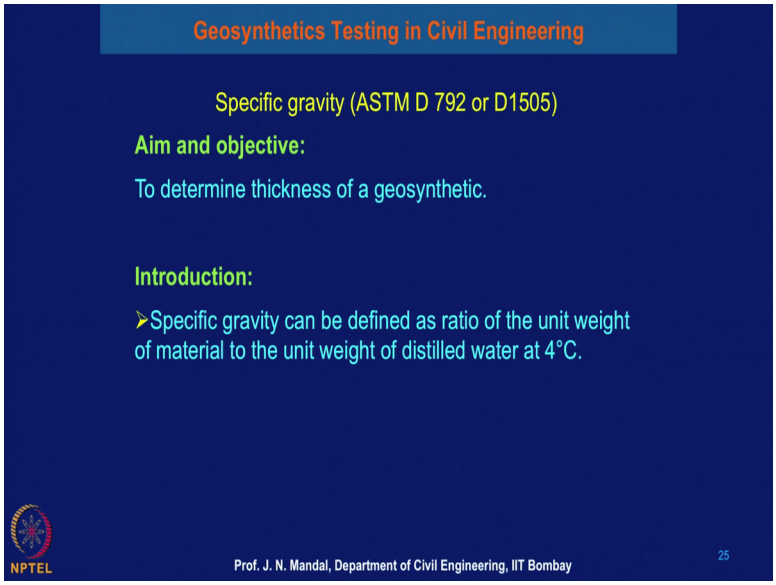

So, introduction specific gravity can be defined as the ratio of the unit weight of the material to the unit weight of the distilled water at 4 degree centigrade you know how to determine the specific gravity of many material. Here only we have presented the specific gravity of different geosynthetic material, if the material is polypropylene specific gravity is 0.91, if material is polyethylene then specific gravity is 0.9 to 0.96, if the material is polyester which is designated as pt then specific gravity is 1.22 to 1.38. If it is a polyvinyl chloride PVC is (Refer Time: 14:07) material specific gravity is 1.69, if it is a nylon the specific gravity lies between 1.05 to 1.14. You can have some idea about specific gravity of the defined geosynthetics material.

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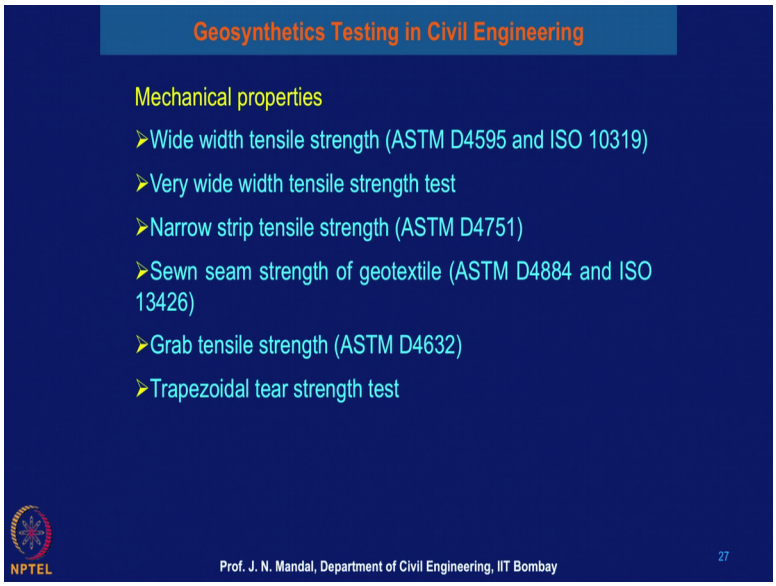

Next is the mechanical properties which is very important in civil engineering and how to perform the different types of the mechanical properties of the geosynthetics material. There are various types of the test are available.

So, one is the wide width tensile strength as why ASTM D 4595 and ISO Indian standard organization 10319. Now, those tensile studies recommended for the design for any infrastructure. Here the very wide width tensile strength test, narrow steel tensile strength as for ASTM D 4751. So, this should not adopted for the design and not recommended sewn seam strength of geotextile as for ASTM D 4884 and ISO 13426, and graph tensile strength ASTM D 4632 and trapezoidal tear strength test. So, we will discuss with; so we will perform different types of the test how to perform this test and what will be the unit of the tensile strength of the geosynthetics material which will focus in our course.

So, this is very important why do we tensile stress and various ASTM D 4595. The main aim and objective to determine why do it tensile strength of a geosynthetics material. In introduction basic difference between this test and other tensile strength test is the width of the specimen, remember width of the specimen the reason for the necessity of wide width specimen is that geotextile particularly the non woven geotextile achieve high poisons ratio value from the narrow tip test. Some geosynthetics have a tendency to contract under a force the greater width of the specimen specified in this test method minimizes the contraction effect of those fabric.

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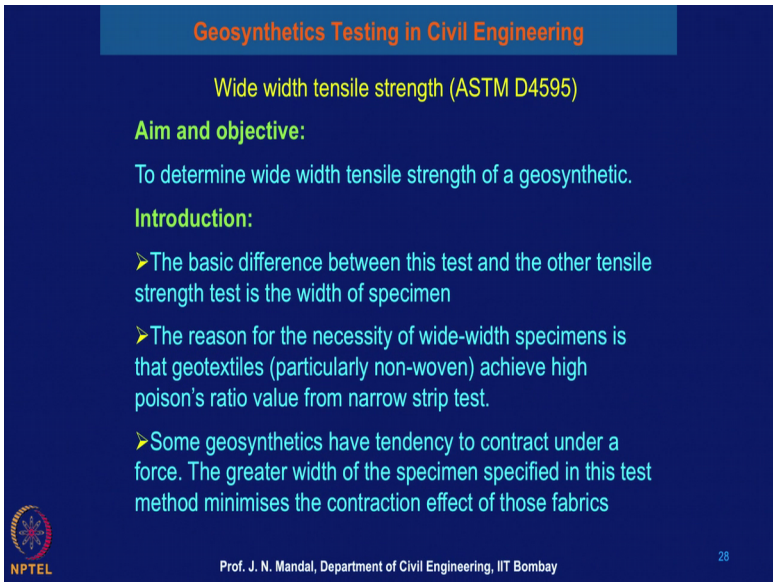

What are the equipment and accessories required? Tensile testing machine and strain rate is very important.

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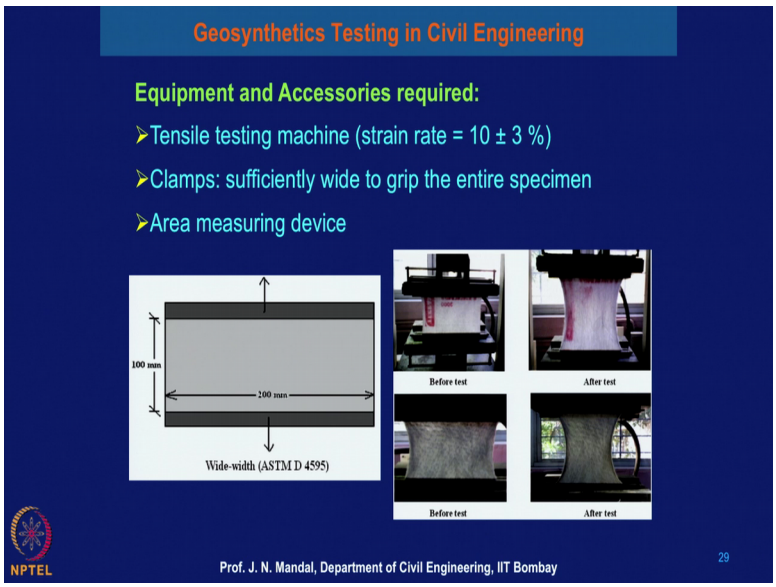

The strain rate for the wide width tensile strain will be 10 plus minus 3 percentage. If it is a ISO specification or international standard organization specification the tensile strain machine rate will be 20 plus minus 3 percentage, so strain rate is very important.

So, remember what will be the strain rate of the machine for to perform the wide width tensile strain of the geosynthetics material and that is 10 plus minus 3 percentage. In a

proper kind of the clamping arrangement and sufficient width to give the entire specimen, that is very important and area measuring device. So, you can see here this is the sample and size of the sample is 200 millimeter and 100 millimeter is the gauge length. And here perform the test in universal testing machine here is a clamp, so it should not be slip it should properly grip and before the test the sample has been loaded this is white colour is non woven geotextile material you can see after performing the test we can see there is a formation of the neck and sample may tear up. So, you can measure the tensile strength of the non woven geotextile material.

Similarly, the another non woven geotextile material before the test and after the test. So, it should be a proper kind of the testing proper kind of the failure of the geosynthetics is necessary. So, this way we perform the white width tensile test of geosynthetic material.

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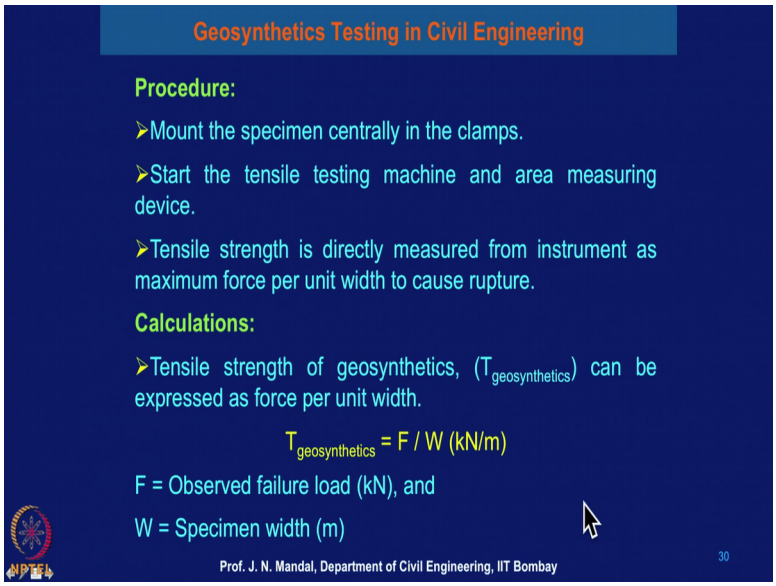

Now, procedure for first mount the specimen centrally in the clamp start the tensile testing machine and area measuring device tensile strength is directly measured from the instrument and maximum force per unit width to cause rapture.

Now, it is also very important that how you can calculate the tensile strength of the geosynthetics material. So, tensile strength of the geosynthetic material can be expressed as a force or unit width this is a very important. That mean T of geosynthetics will be equal to F divided by W and unit is kilonewton per meter, remember unit of the tensile strength of the geosynthetic material is kilonewton per meter, where F is observed failure

load in kilonewton and W is the specimen width is meter. That is why the unit of the tensile strength of the geosynthetic material is equal to F by W is kilonewton per meter but not the meter square.

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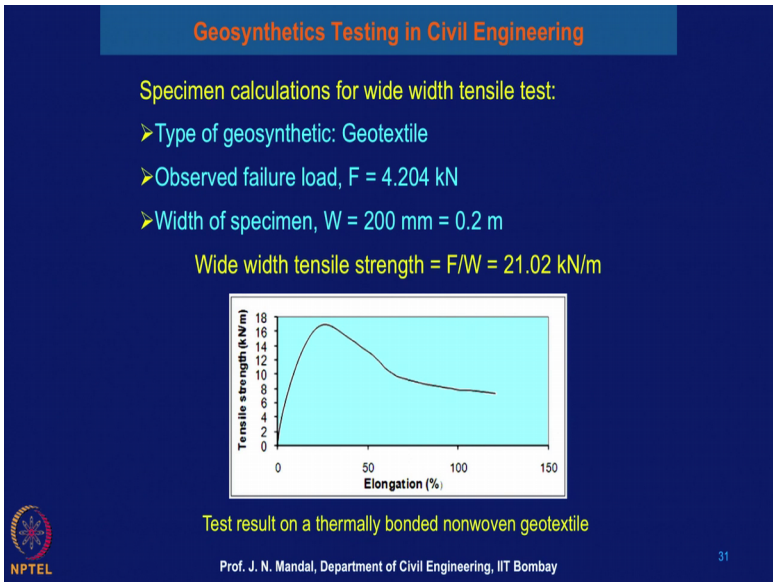

So, specimen calculation for a wide width tensile strength, so type of geosynthetics it may be geotextile, it may be geogrid, it maybe geomembrane. So, object failure load F is 4.20 kilonewton let us say and width of the specimen is 200 millimeter that means, 0.2 meter. So, while this tensile strength is equal to F by W is equal to 21.02 kilonewton per meter. So, you can draw the tensile strength what is its elongation you can measure what should be the tensile strength and the corresponding the elongation of the geosynthetic material.

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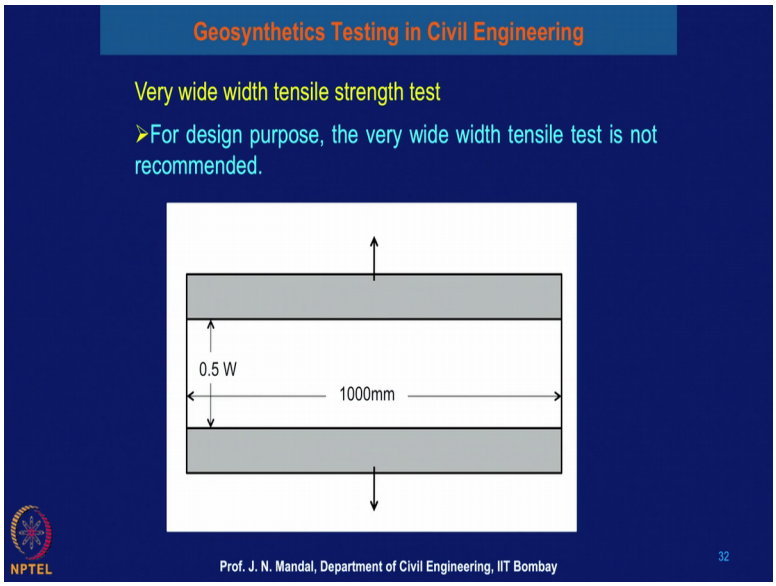

So, next is the very wide width tensile strength. So, here the size of the specimen is 1000 millimeter to 0.5 times of the W. For design purpose the very wide width tensile strength is not recommended, and generally this we do not perform any kind of the test for the wide width tensile test.

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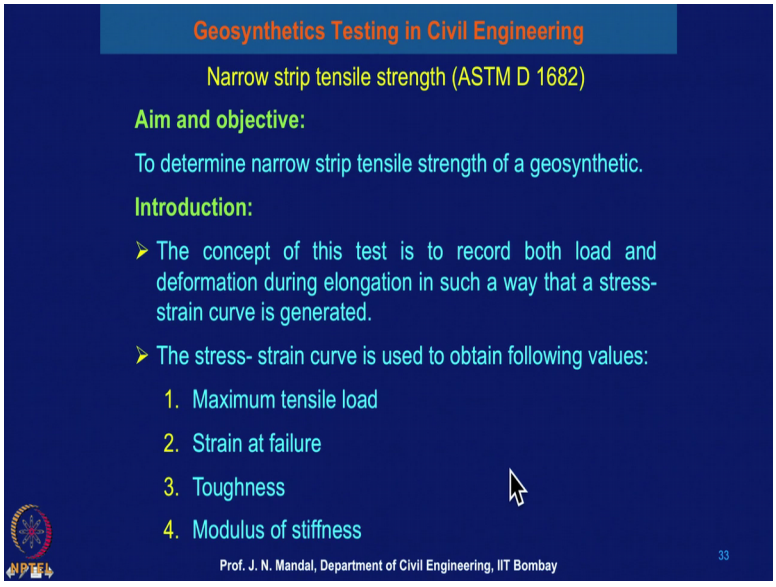

Narrow strip tensile test as for ASTM D 1682. The main aim and objective of this test to determine narrow strip tensile strength of a geosynthetic material. In introduction the concept of this test is to record both load and the deformation during elongation in such a

way that is stress strain curve is generated. This test strain curve is used to obtain the following value what will be the maximum tensile load, what will be the corresponding strain at failure, what will be the toughness, what will be the modulus of the stiffness.

So, from this test also you can perform all this test and you can perform all this value. So, testing procedure mount the specimen centrally in the clamp in a universal testing machine, start the tensile testing machine and area measuring the device and here is strain rate is about 300 millimeter per minute.

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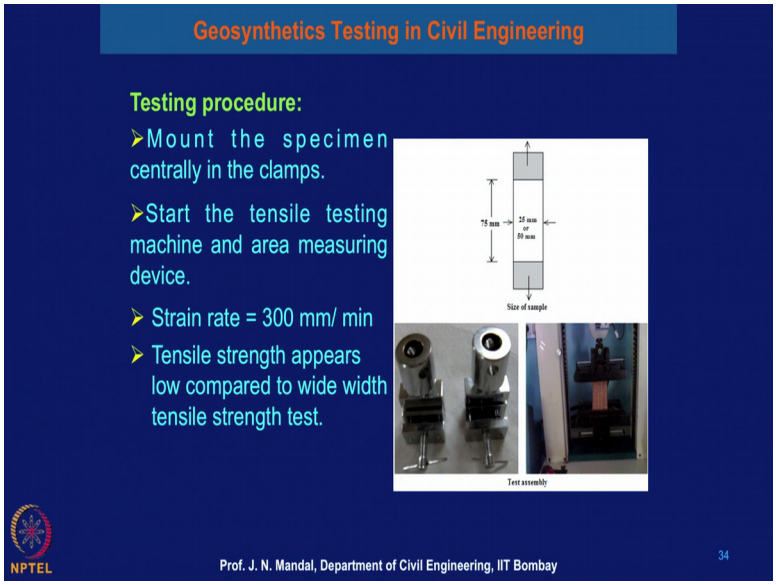

So, tensile strength appear low compared to wide width the tensile test. So, this you can this, this is the clamp and this is a part from the narrow tensile test.

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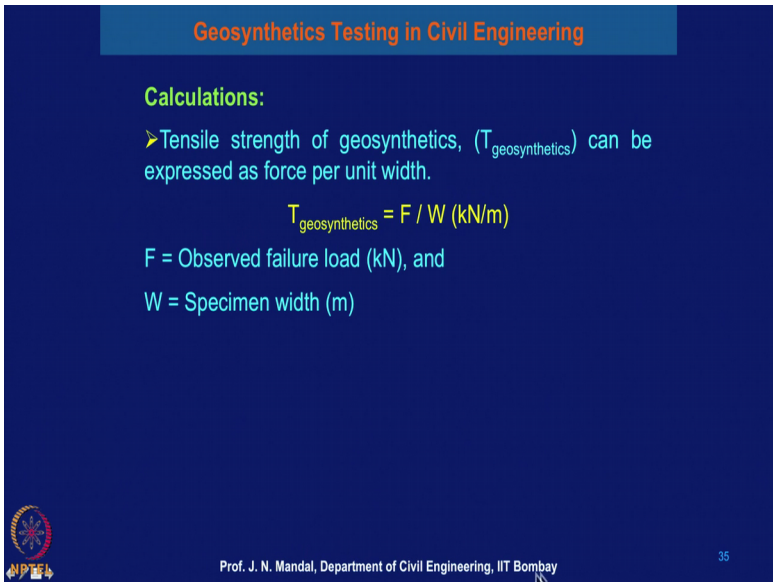

So, you have to calculate the tensile strength of the geosynthetic material and it can be expressed force per unit area that means you know what will be the object failure load and what to do the width of the specimen. So, you can calculate the tensile strength of the geosynthetic material.

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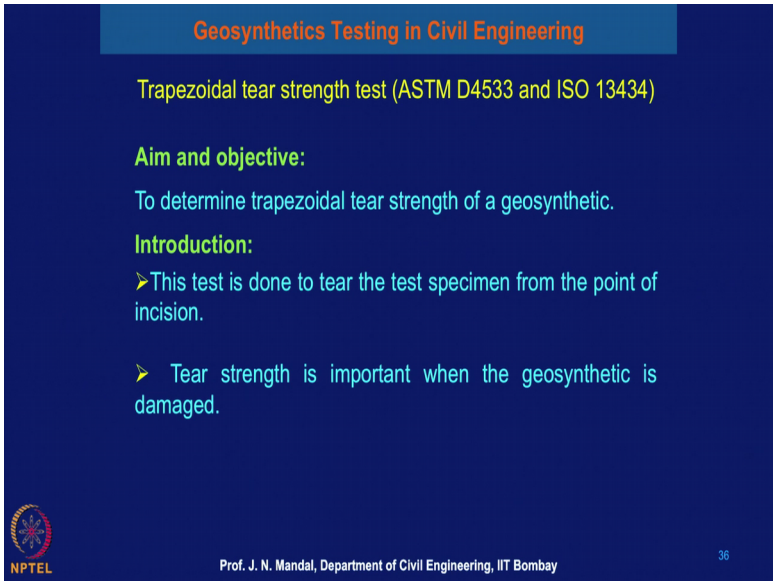

Next you know geosynthetic material may tear. So, we have to perform some kind of the test and which is called the trapezoidal tear test strength. When you dump these any kind of the material or gravel on to the top of the geosynthetic material, geosynthetic material

may be damaged or it may be tear the top. So, it is necessary that what will be the trapezoid tear strength of the geosynthetics material and this test are performed as for ASTM D 4533 and ISO 13434.

Here main aim and objective to determine the trapezoidal shear strength of a geotextile. In introduction this test is done to tear these specimen from the point of insulation and shear tear strength is important when the geosynthetics is damage. So, this is the instrument and accessories required tensile testing machine clamp and the trapezoidal template.

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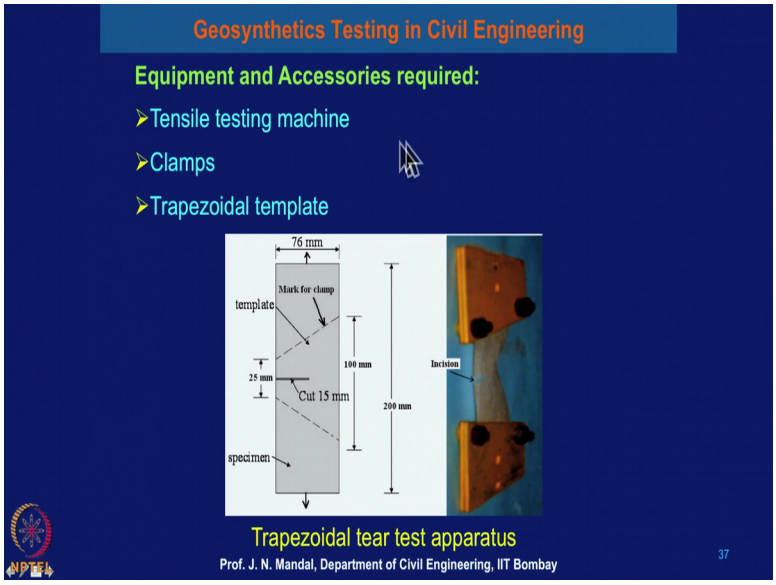

So, this is a trapezoidal tear test apparatus and this is the size of the sample and this is the trapezoidal in shape here you can see here and marked for the clamp here, this is the specimen and this initial portion is cut is 15 millimeter, this is 25 millimeter, these are template, these are template and this is 100 millimeter. And this specimen is clamped in this universal testing machine and you perform the trapezoidal tear test apparatus. This is very important you should perform the trapezoidal tear test.

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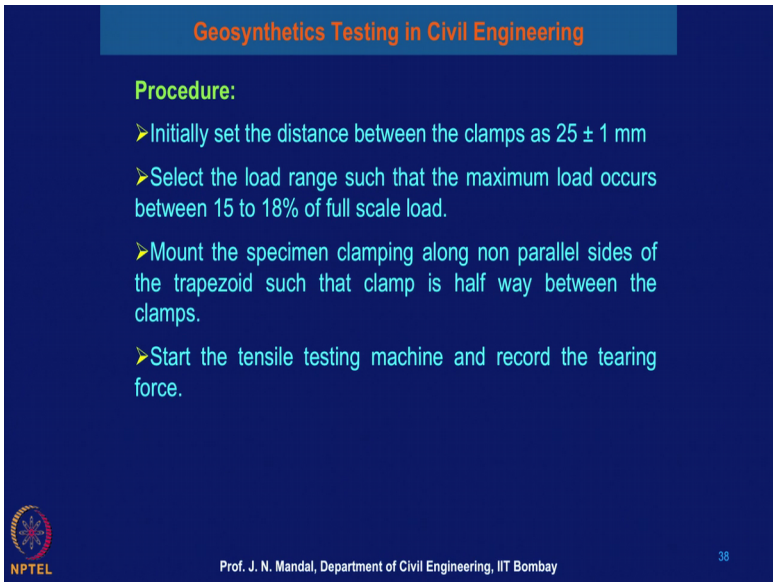

So, procedure initially said the distance between that clamp as 25 plus minus 1 millimeter select the load range such that maximum load occurs between 15 to 80 percent, 18 percent of the full scale load mount the specimen clamping along non parallel side of the trapezoid such that clamp is half way between the clamps. Start the tensile testing machine and record the tearing force.

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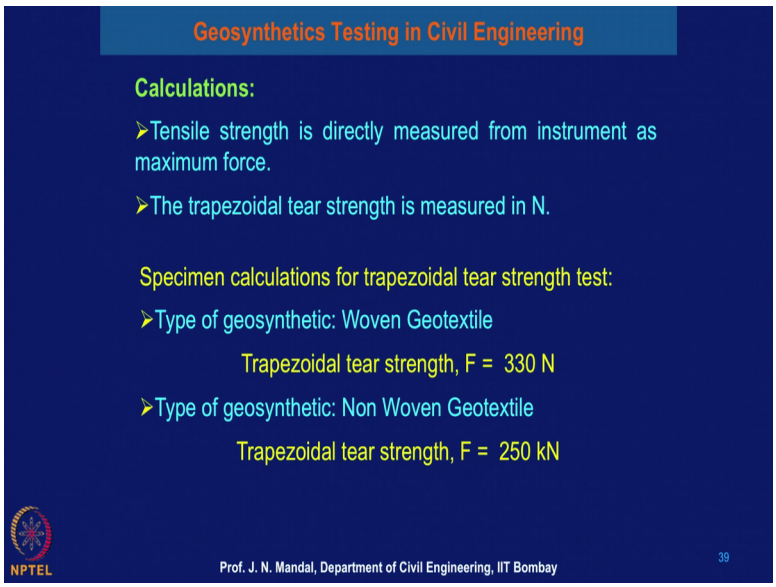

So, how to calculate the tensile strength, cafeteria trapezoidal tensile strength of the geosynthetic material? Tensile strength is directly measured from the instrument as a

maximum force trapezoidal tear strength is measured in Newton, N. Now, I am showing that some specimen calculation for the trapezoidal tear strength test.

Type of geosynthetics it may be the woven geotextile material it may be the non woven geotextile material. So, trapezoidal tear strength of woven geotextile material is 330 Newton and if the type of geosynthetic material, non woven geotextile material trapezoidal tear strength is 250 kilonewton. So, for different types of the geosynthetic material you can obtain the different types if the tear strength of the geosynthetic material.

So, this test is important because geotextile material should not be damage. So, we have to specify proper strength of the geosynthetics material. So, if you use for any kind of the infrastructure where we have to dump the aggregate on to the geosynthetic material either it may be woven and nonwoven geotextile material, you should know that at what height it should be dump onto the geosynthetic material in order that geosynthetic material should not be damage. Because trapezoidal tear strength is very important, if there is any damage also it can be rectified also it can be teach and there is a certain rules and regulation one has to follow. But if you perform proper kind of the testing trapezoidal tear testing of the geosynthetics material then it can be avoided.

So, all the testing what I explain today starting from your mass per unit area thickness of the geosynthetic material and particularly the wide width tensile strength of the geotextile is almost important for design of any geosynthetics structure, and narrow stream tensile strength and the trapezoidal tear strength of the geosynthetics material.

Thank you very much.