Evaluation of Textile Materials
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Lecture-24
Evaluation of Tensile Properties of Textile Materials (contd…)

Hello everyone, now we will start the tensile testing of fabric, so the strip test which is very common for fabric tensile testing.

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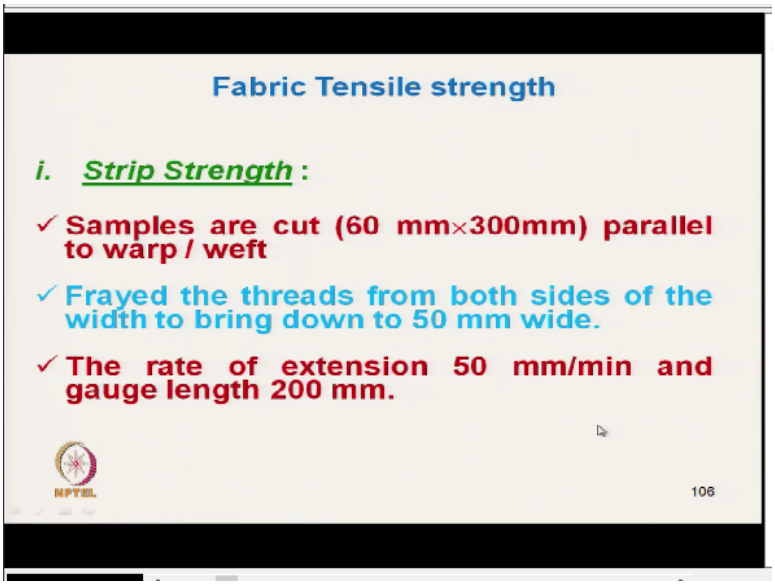

So, here the samples are cut in 60 millimeter by 300 millimeter parallel to wrap or weft ok.

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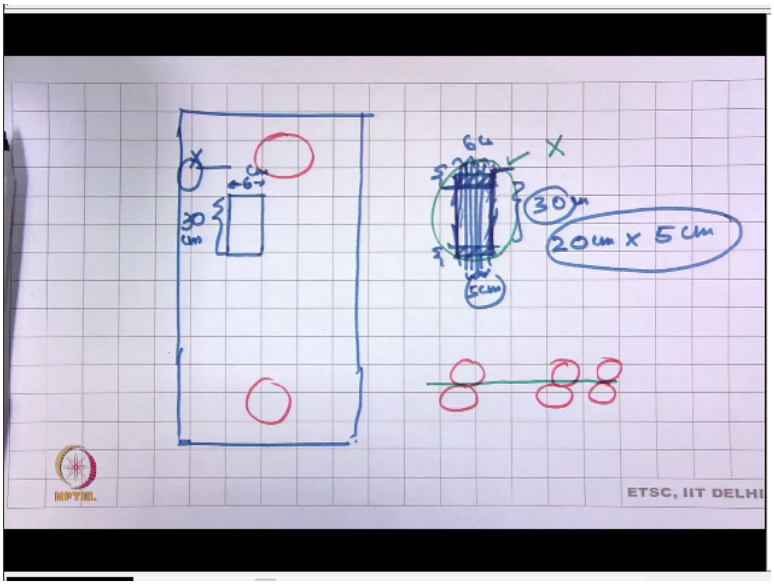

Suppose this is a fabric as we have discussed in the sampling section. So we cannot use the sample close to the (()) (01:06). So you will select sample from here, the sample is cut suppose you want to test the wrap strength, this is the sample we are cutting the length is 30 centimeter and here it is a 6 centimeter this is the length ok. Now and after that what we do this sample it is a 30 centimeter and it is a 6 centimeter.

And we start fraying out the yarn because you are cut the end here fabric, so it may so happen that the same work due to its some angle same path may not be continuing. But actually we want the continuity in the work. Because we are trying to test the end, so there during cutting it may so happen this one end its cut in between it goes in between, in between it is ending. So, in that, so we try to fray out the edge ends. Edge ends were fraying out to keep it to bring it down to 5 centimeter.

So, here fraying out from both the sides to bring it the ultimately up to 5 centimeter and also it is a 30 centimeter. So 5 centimeter from top and 5 centimeter from bottom will go and at the jaw. So, effectively it will become 20 centimeter length and 5 centimeter of width this is the effective specimen size between the jaws ok. So, fraying the threads from both sides of the width of width to bring down width of effective width is that is of 50 millimeter ok.

So 5 centimeter bringing down and rate of extension is 50 millimeter per minute and the gauge length is 20 centimeter. So, as we have already mention, so this is the effective specimen size and the rate is 50 millimeter per minute.

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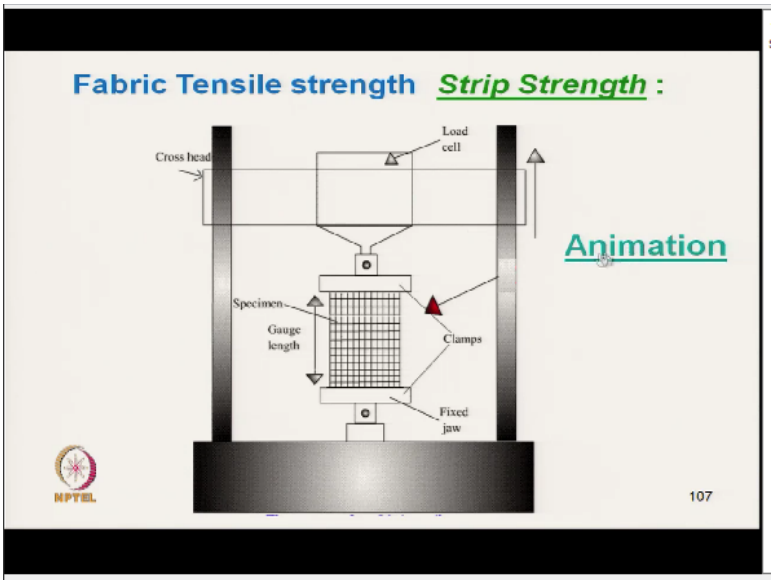

And this is the instruments, so then after that we just put in the jaw this fabric and this constant rate of extension type of machine here it is a bottom jaw is fixed. And top jaw is moving and fabric gets extended ok stressed and we measured the breaking load.

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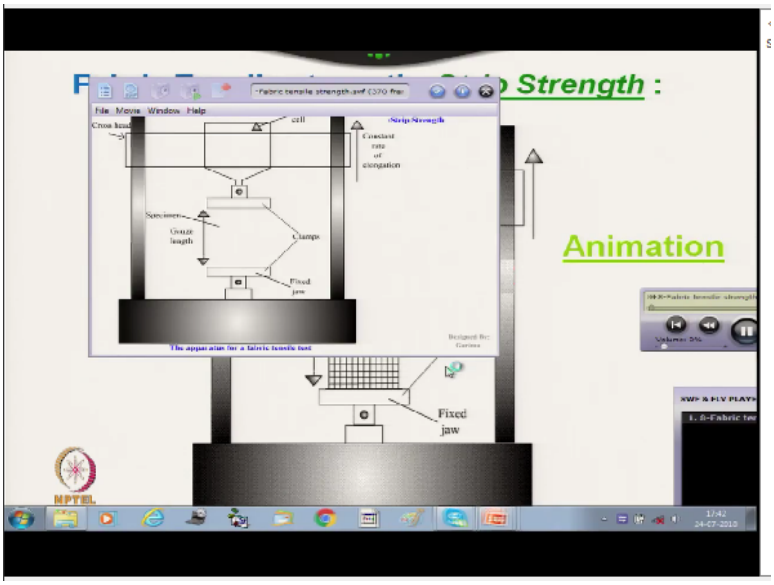

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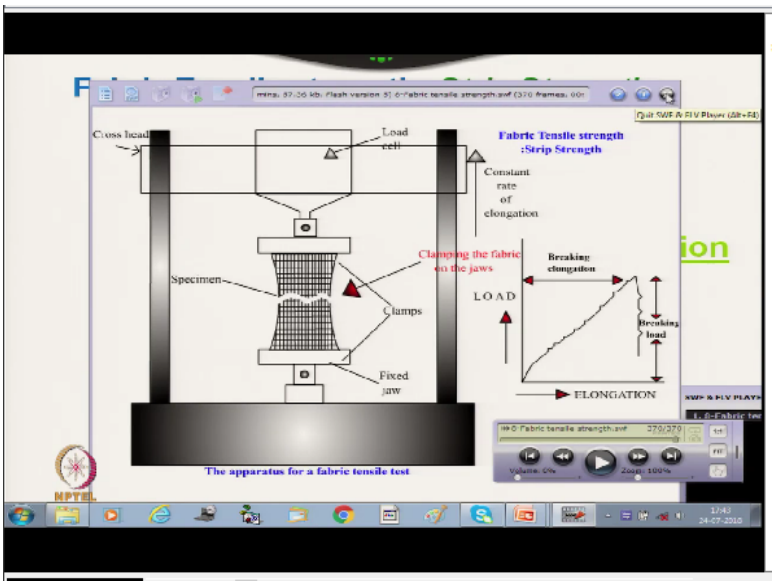

You see the animation here, now this started moving ok the upper clamping it is clamped gauge length is there. Now it is not started moving, so it is then now it is started moving and this going effect is there and then it is breaks. So stress strength cork we can get from this ok, this is the stress strength from there we can get the breaking load. This is the breaking load and this is a breaking tensile.

So in this way we can calculate the energy required everything we can calculate here it simply stress strength loading elongation cork of everything.

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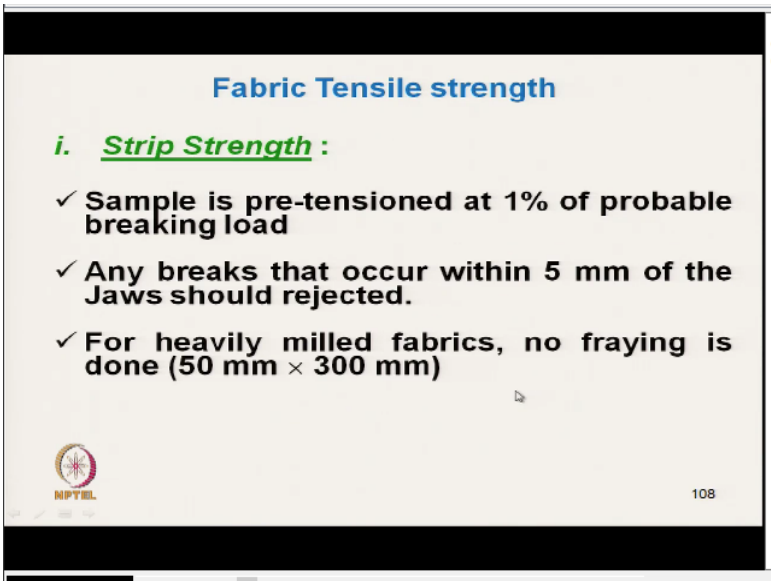

And the sample is pre-tensioned at 1% of probable breaking load. So you know the if you know the breaking load it is probable breaking load expected breaking load. We have to have some pre-tension why do you need pre-tension just to remove any crimp or any other fold any crimp effect, so we have some pre-tension. And in case of any improper jawing, so suppose jaw pressure is very high.

In that case there may be some jaw breakage, so that those fabrics we have to reject ok either there may be jaw breakage or may be jaw slippage also. So in that case, so the any breaks that occur within 5 millimeter of jaw should be rejected that means that within 5 millimeter means that has occurred within the jaw, after that it has come out ok due to extension. And for heavily milled, so fabric like where it is not possible to take out the threads.

So you do not need to fray out, so in that case we do not take the initial width of the sample 60 millimeter with directly take 50 millimeter. So, directly if the our samples effective samples are we will take ok and 30 millimeter that is the size take, heavily milled fabric like wollen fabric some felted fabric. This type of fabric you can use 50 millimeter by 300 millimeter gauge length.

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And similar to the tensile test another simple tested is a simple testing element which is called grab test. And grab test basically it is in for most of the practical purpose practical application the strip test, strip tensile test the result does not actually reflect the actual performance. Because the

any practical application we do not use as a strip as a sample may be in on apparel or may be in any technical textile like in jio textile if we see a fabric is placed under the soil where the stones are there ok.

It is not in the form of strip, it is the total fabric width and the griping point is somewhere else at in between. So that is the in even in the apparel suppose it is being loaded. It is I want to a have some stressed value on the fabric, the fabric here it is not in the form of strip, here actually it is a grabbed, grabbed in between. So it is fundamentally it is different from the strip test. Jaw faces are considerably narrower than fabric length, no need to fray the fabric.

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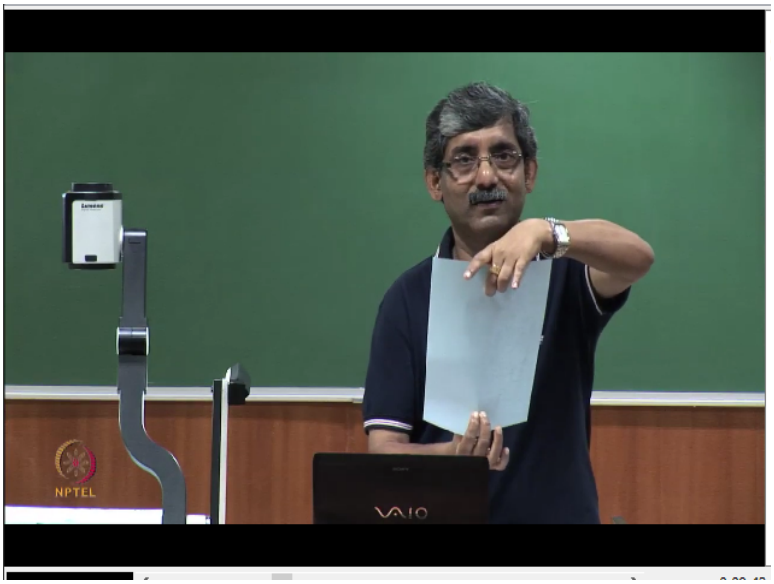

Because we are actually griping suppose this is the fabric and we are not griping like strip test throughout this width we are griping at the midpoint ok. So, we do not need to fray out the threads actual sample is ok and it is a quicker we do not have to fraying fray we do not have to jaw it properly you simply put it cut the fabric and put under the this jaw ok and its quicker method and speed is adjusted. So, that the sample breaks at 20 +– 3 second it is a same as the strip test also.

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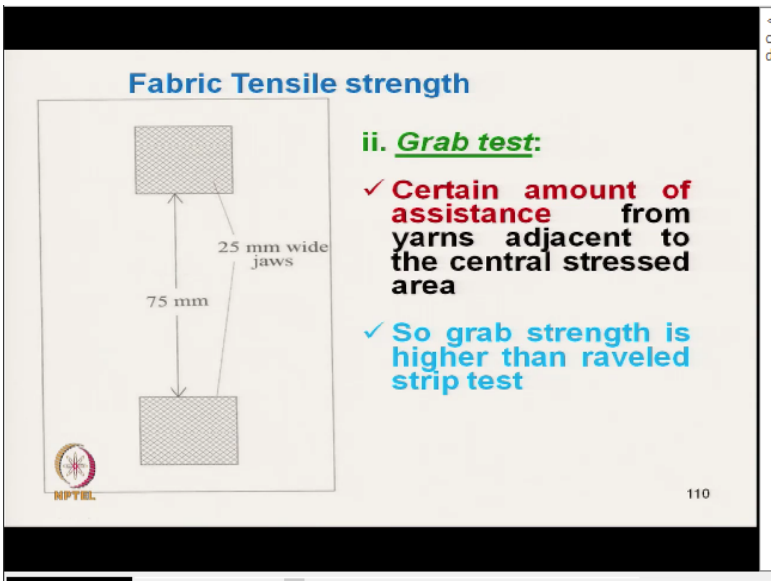

Now this is the grab, this is total width full width of the fabric and here it is being grabbed. It is a jaws are much smaller in dimension ok width wise. So, basic if you here is that it is a it gets assistance from the adjacent end ok adjacent ends beyond the reach of the this jaw ok that means it gets help. So it adds to the strength of the fabric, so effectively though grab strength is higher than the strip strength when strip strength only the ends under the this jaw under the grip of the jaw or coming into picture**.**

But here in addition to this adjacent fabric is also helping but this grab strength result is actually it is very close to the practical value.

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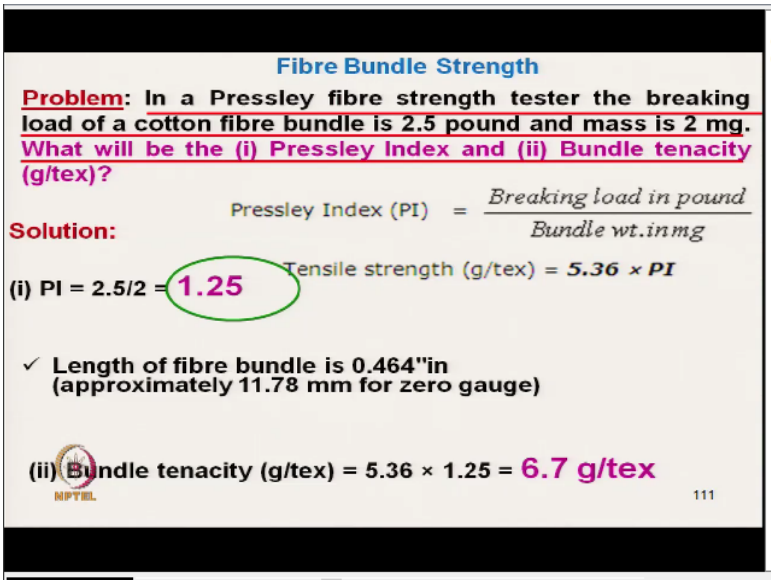

Now we will try to solve different numericals ok related to the strength, strength of may be bundle strength will try to solve numerical of fabric strength. First let us see the Pressley strength ok it is a bundle strength, in a Pressley fibre strength tester the breaking load of cotton fibre bundle is 2.5 pound and mass is, so in Pressley strength tester or in stelometer what we have to the as you have mention the jaw size of jaw or dimension of jaw is are exactly same**.**

They are interchangeable ok and after breaking, so if you want to get the gram/tex value we must know the mass of the bundle. So in this test always after testing we take the mass of the bundle ok. So, the cotton bundle is the breaking load is 2.5 pound and the mass of the bundle is 2 milligram what is the Pressley index? And bundle tenacity in gram/tex. So this is the question now it is a simple direct formula Pressley index is breaking load in pound and bundle weight in milligram.

And if you want to convert the Pressley index as we have seen earlier for zero gauge length it is a value is 5.3 here it is given it is a this is the zero gauge length, in a pound with it is a in zero gauge length form ok. So, this is the Pressley index, so 2.5/2 1.25 is the Pressley index and the length of the fibre bundle here in Pressley for zero gauge length it is a approximately 11.78 millimeter approximately you can say 12 millimeter gauge length.

And bundle tenacity in gram/tex if we multiply it by 5.36 for zero gauge length, it is a 6.7 gram/tex (()) (13:42). So, bundle strength and this value in it is in for zero gauge length ok. So, why what is the zero gauge length here? So you must know the concept of zero gauge length here.

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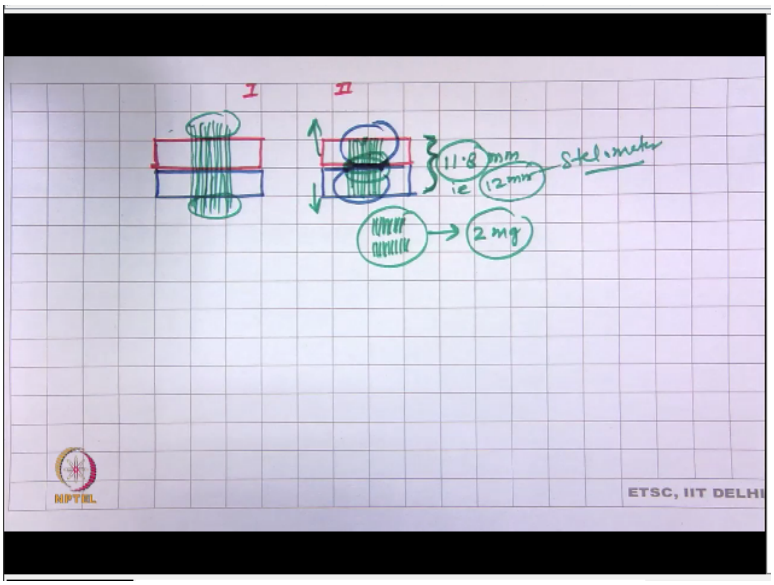

So, in if you see the Pressley tester this is the jaw one jaw another jaw is this one is another jaw ok. And if we have if you see the fibre, fibre bundle this is in almost parallel fibre bundle and after that what we do we cut this fabric we cut the this fabric by knife ok. Now this is situation 1 and after the cutting ok and this is the fibres, ok. Now this length why zero gauge length there is no space between the fabric fibre this is jaw.

So there is the gauge length there is a there in contact ok this 2 jaws this length is typically around say 11.8 millimeter okay 11.78 millimeter or approximately say it is 12 millimeter it is for 12millimeter in stelometer ok. Now this is the gauge length and after that after breakage what happen this will get descendible and the fibres will be under the grip of the top jaw and bottom jaw.

Then we have to open this fibres and then this is from top jaw bundle and this is from say bottom jaw and this total we have to take the mass and as per this numerical it is a 2 milligram and during and when in the machine in the instrument this will be loaded and the load will be measured here separative load. So, that is the situation here, so this is the bundle strength here it is coming out to be, so 6.7 it is a directly we can use this formula ok.

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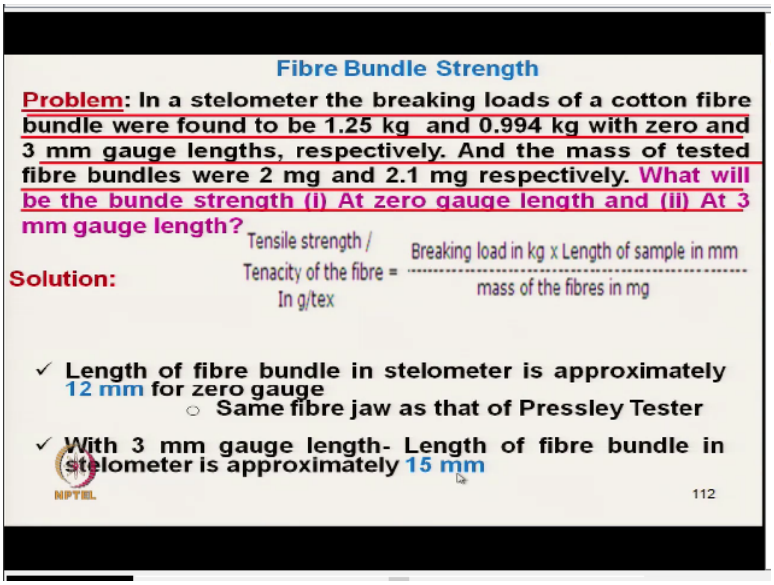

Next numerical is that stelometer, in stelometer in addition to the zero gauge length there is a provision we can increase the gauge length to 3 millimeter. We can add one strip metal strip which will which his having 3milimeter length width 3 millimeter thickness that we can insert. So, that means the gauge length will be 3 millimeter but effective length of the fibre bundle will be 12 millimeter+3 millimeter it will become 15 millimeter ok.

So, that is the thing that situation, so next problem is on stelometer, in a stelometer the breaking load of cotton of a cotton fibre bundle was found to be 1.5kg and 0.994kg with zero and 3millimeter gauge length respectively ok. And the mass of tester fibre bundles were 2 millimeter and 2.1 millimeter respectively ok. So, fibre bundles milligram 2 milligram and 2.1 milligram respectively what will be the bundle strength at zero gauge length and at 3 millimeter gauge length that is the question.

Now try to see the solution stepwise the bundle tenacity is the breaking load in kg*length of the sample in millimeter/mass of the fibre in milligram. So, fibre bundle this is the standard formula to get the tenacity in terms of gram/tex ok same formula we can use for yarn gram/tex only that the length of the yawn and the mass is required ok. So, this is the gram/tex now the values are given okay what which value is give, so let us see the length of the fibre bundle in stelometer is approximately 12 millimeter with zero gauge length.

And with 15 millimeter width 3 millimeter gauge length sample fibre jaw ok same fibre jaw is used as a Pressley tester with 3millimeter gauge length the length of the fibre bundle will become 15 millimeter this data we know that means the length of the sample is known here ok. And mass is known and breaking load is known then we can simply calculate ok.

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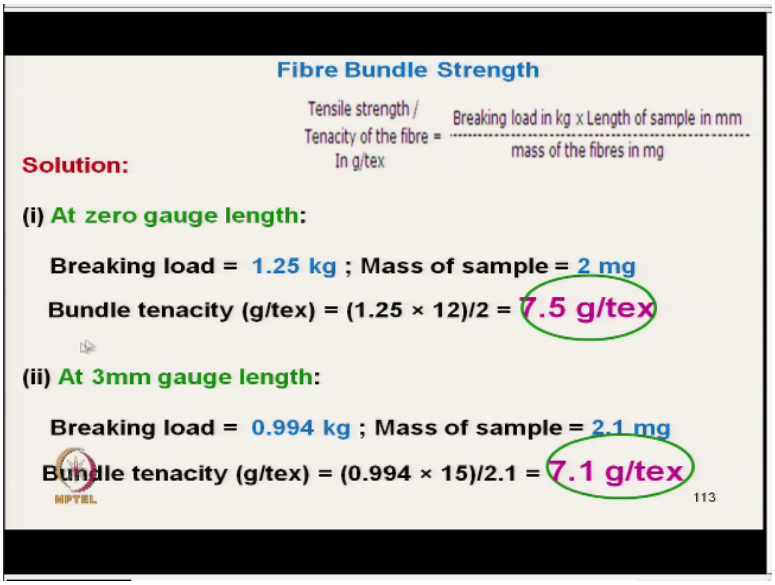

So, at zero gauge length the breaking load is given 1.25kg mass of sample 2 milligram and the bundle tenacity is come out to be 1.25*12, 12 is the length/mass in milligram. So, it is coming out to be 7.5 gram/tex ok, now if we increase the same cotton if we increase the this gauge length. So we will get the value which will be lower than the zero gauge length because same factors like quickling effect similar quickling effect will be there in bundle strength even other gauge length as increased typically we should get the value lower than that.

And one important thing is here one has to mention it we cannot always have bundle even if the gauge length is constant like zero gauge length. We cannot have the same bundle mass ok suppose for same zero gauge length we test the second sample it may not be 2 milligram it may it will be different may be little bit higher or lower. But accordingly it is expected that the breaking load will change ok if it mass is more that means breaking load will be proportionally higher.

But ultimately the breaking bundle strength should be closed to that okay this is the value and 3millimeter gauge length. The breaking load is given, mass of sample is given and bundle

tenacity is here it was 12 millimeter and here in 3 millimeter gauge length it will become 15 and its coming out to be 7.1gram/tex value ok. So, that means what we are getting we are getting little bit lower gram/tex for same cotton with higher gauge, gauge length ok.

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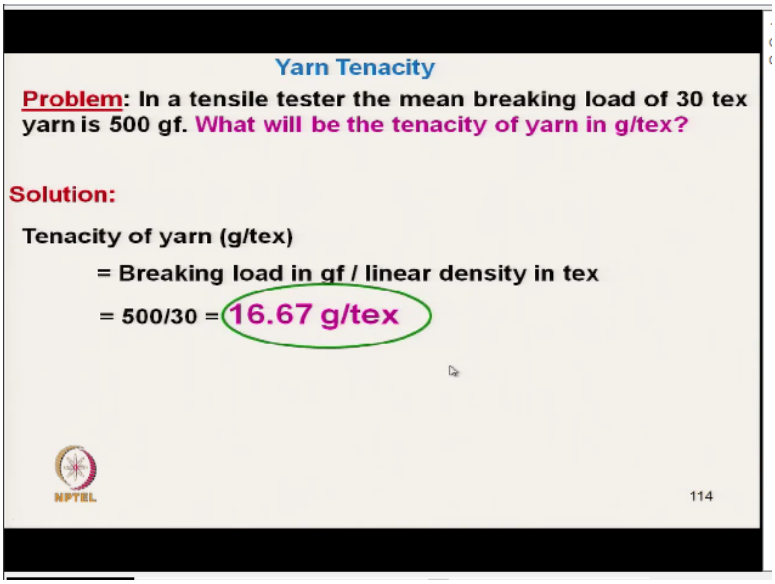

Next is the in a tensile tester the yarn tensile yarn tenacity, in a tensile tester the mean breaking load is of 30 tex yarn is 500 gram force. What is the tenacity of the yarn? it is very simple simply divide it okay it is a breaking load in gram force/linear density in tex ok. So, we can simply divide the gram force/tex and it will give as the value of 500/30 it is 16.67 gram/tex ok this is the result.

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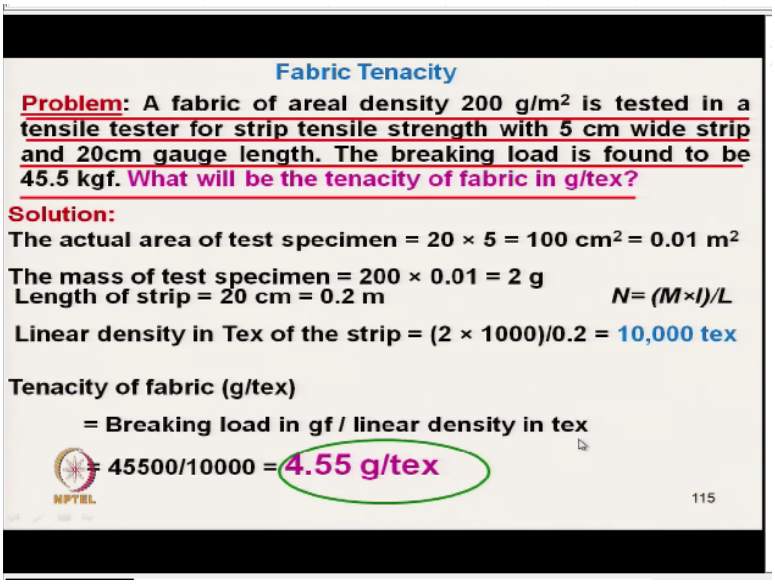

Now next numerical is that it is a fabric tenacity okay now normally in strip test we get the value in terms of kg or newton or something different, it is in terms of load value here. But here it is asked that tenacity what will be the tenacity of fabric in gram/tex if we see the fabric tenacity it is normally not expressed in terms of load. It is expressed in terms of gram/tex because the if the width of the fabric changes or if the say mass/unit area just to compare the fabric of different mass/ unit area the tenacity value.

It is expressed in terms of gram/tex suppose for same fabric same similar if I use instead of 200 gram per square meter if I use 300 gram per square meter. The breaking load value will definitely increase but we have to see whether the tenacity value is increased or not. In that case to compare the tenacity of fabric actual the strength of the fabric we have to compare in terms of gram/tex not in terms of the breaking load.

Breaking load will definitely be higher for quicker fabric ok. So, a fabric of areal density 200 gram per square meter is tested in a tensile tester that is strip tester with 5 centimeter wide strip and 20 centimeter gauge length ok. So, what are the data has been taken it is a simple calculation you can take ok. The breaking load is found to be 45.5kgf ok. What will be the tenacity of fabric in gram/tex ok.

Now this is the condition here now that actual area of the fabric is 100 square centimeter that means 0.01 square meter and the mass of the test specimen is 2 gram. Because 200 gram per square meter and 200* 01 it is a 2gram length of the strip is 0.2 meter 20 centimeter and we want to measure here the tex value. Tex of the fabric under the test under test and you know the tex value it is a mass of the sample, by the length of the sample and mass of the specimen, length of the specimen* l is the in that particular unit tex unit the l is the it is a 1000.

So we can use this value here, so mass of the specimen 2 gram, length of the l is the 1000 meter and the length of the specimen is 0.2meter. So, it is coming out to be 10,000 tex ok and then what we can do when the tenacity of the fabric you can calculate here it is a breaking load in gram force/linear density in tex. It is coming out to be 4.55 gram/tex now the idea of using gram/tex in

place of the breaking load it is that suppose it what we are doing we are taking a fabric of say 300 gram/tex.

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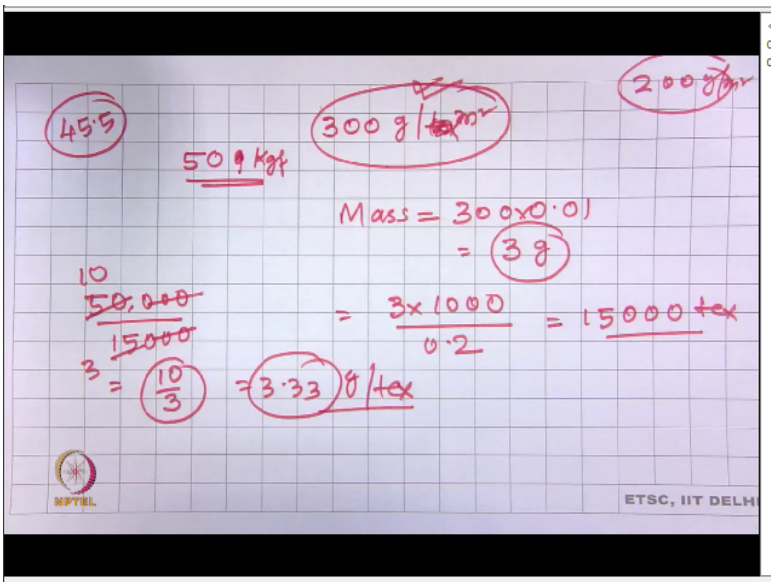

And what we have found that the strength has become say **50** 50 strength 50 gram per sorry 50 kg kgforce. Now can you tell this fabric is stronger than earlier fabric, earlier fabric it was 45.5. So, you cannot compare we because our sorry this fabric is gram/square meter. This is areal density of the fabric will be 300gram/square meter earlier it was 200gram/square meter. So, this 300gram/square meter fabric, so if we try to see if we can if we get the mass of the fabric the skipping all other consonant.

The mass of the fabric will be 300*0.01 it is becoming 3gram and the tex will be what will be the tex? 3*1000/0.2 that means it will become 15000tex ok 15000tex and the it is a 50kg. So, 50kg 50,000gram/15000 it will become say 10/3 okay, 10/3 ok, 10/3. So, it will be 3.33gram/tex ok that means earlier with the lower even with the lower value of breaking load. The tenacity was 4.55 it is higher than this tenacity 3.33 that means the breaking load with we cannot compare the breaking load by breaking load of different types of fabric ok.

So, to compare the 10 breaking tenacity to the strength of the fabric we should compare in terms of tenacity of fabric in terms of gram/tex. So here the idea is first you have to get the value of tex of the strip ok then you can calculate.

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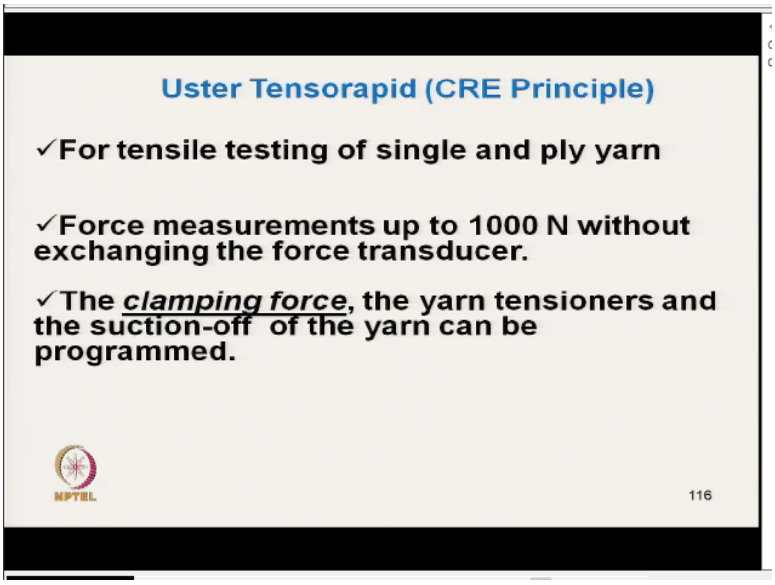

So, next the last segment we have reached here it is basically gives as the another set of instrument one is toward which is which works in CRE principle. The principle is same as that of single yarn strength testing but this is fully automatic in UTM test the single yarn testing we put in the jaw manually. But here (()) (30:42) gives the automatic the gripping and automatic breaking.

So, it is a or tensile testing of single yarn and ply yarn, so we have to feed the yarn in the form of the package ok for measurement of up to 1000 newton 1kilo newton without exchanging the force transducer ok. So, it is a wide range of tensile testing range of yarn we can test here. The clamping force the yarn tensioners and the suction-off of the yarn can be programmed.

We can actually programmed depending on the yarn type of yarn we can programmed the clamping force we can programmed the yarn tensioner what how much tension it has to put and also the suction-off of the yarn okay that how quickly the test will be done and that we can programme here.

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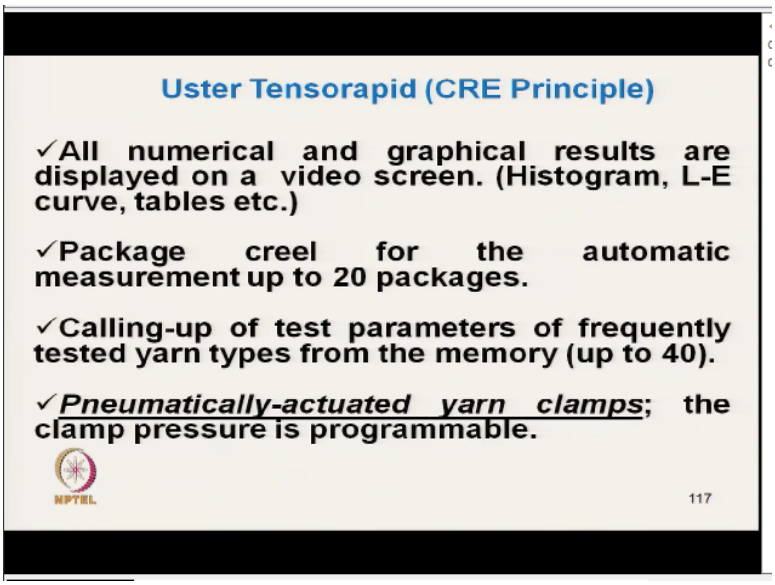

All numerical and graphical results are displayed on a video screen okay **in a** on a video screen we can display all everything ok in the form of histogram load elongation curve and table form we can get. So, **it** it is totally automatic we get we have to only feed the cone or bobbin mainly typically bobbin ring bobbin you just put there. And it will automatically test data large number of sample and give the histogram and everything it will give.

In packages are up to 20 packages are actually put we can in a in the creel we can put and then it is automatically it is measures the value. And as that it is a programme it is a all the data are in kept in the memory we can recalling. We can for analysis for future reference we can recall this, so calling-up of test parameters of frequently tested yarn type from the memory. You can just the memory it is old version there are 40.

But now it has improved a lot a pneumatically actuated yarn clamps. So it is a there is no physical pressure it is a pneumatic pressure is there and no sling nothing is there ok. And **you can** we can control the pressure the clamping pressure is programmed, so depending on the type of yarn we can programme this clamping pressure.

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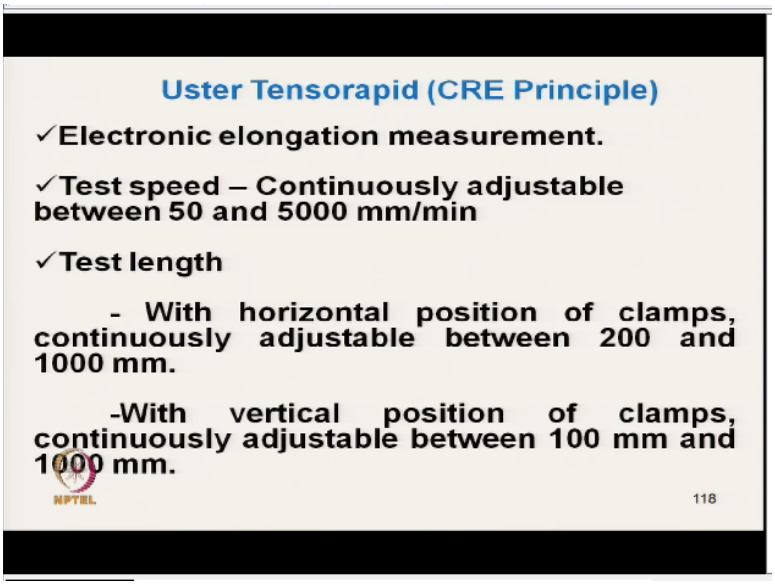

And electronic elongation measurement it is a elongation we can measure electronically and test speed it is continuously you can adjust automatically it can changed it can be adjusted from 50 millimeter/ minute to, so 5000 millimeter/minute. So, within that wide range we can change the test speed test length can be changed and this instrument work in 2 modes in vertical mode and in also in horizontal mode.

In if it works in horizontal mode continuously adjusted between 20centimeter to 1meter okay within that range 20 centimeter to 1meter range that we can adjust the length okay it is a wide range. But in vertical mode it is a more ranges here it is a say 10centimeter to 1meter, so that within that range continuously we can adjust okay. This are the simple parameters of the particular machine but the working principle is exactly same that we have discussed it is basically it works in the principle of (()) (35:11) principle.

We have reached at the end of the tensile tester, here we have discussed all the tensile related parameters, we have discussed the different methods for measurement of tensile characteristics of textile material in the form of fibre bundle, in the form of single yarn in a fabric. And also instrument for dynamic measurement that constant rewinding tester and we have also seen that the instruments work in different principles that is constant rate of travers, constant rate of elongation and constant rate of loading.

And also you have seen the there are various factors which affect the test result like rate of elongation the gauge length. So, if we want to have perfect result, so we have to follow the standard procedure and also the test result can vary by improper jaw improper placing of sample in the jaw. So, we must be very careful putting the fabric in the jaw, so this I think with this that we will get oral idea over the tensile characteristics of textile material.

We have also discussed various numerical which will enhance the better understanding of the principle and hope this section will help in better understanding on the tensile characteristics. And also in a application one can this total this segment will help now till then will stop here and we will next class we will start with new topic till then thank you.