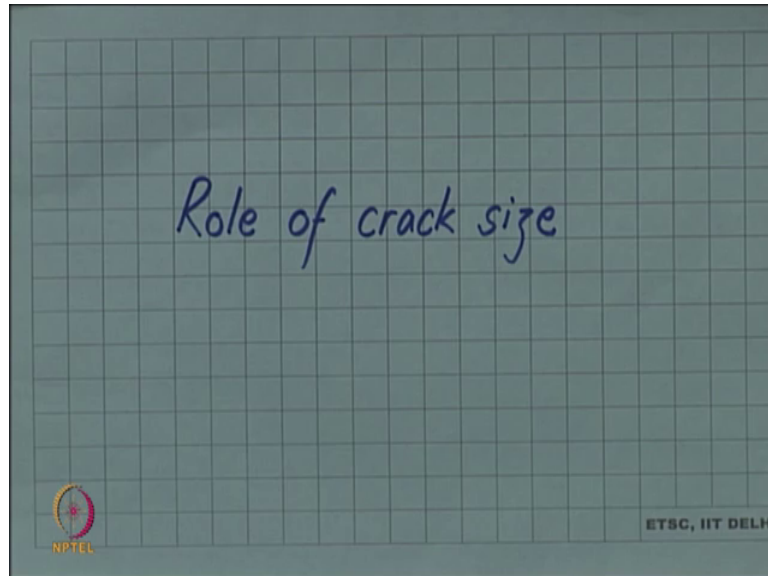


**Introduction to Materials Science and Engineering**  
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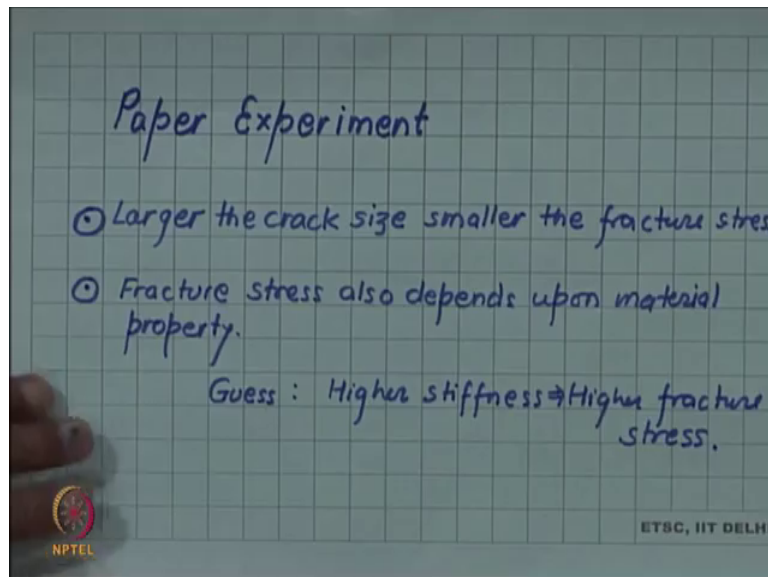
**Lecture - 139**  
**Role of crack size**

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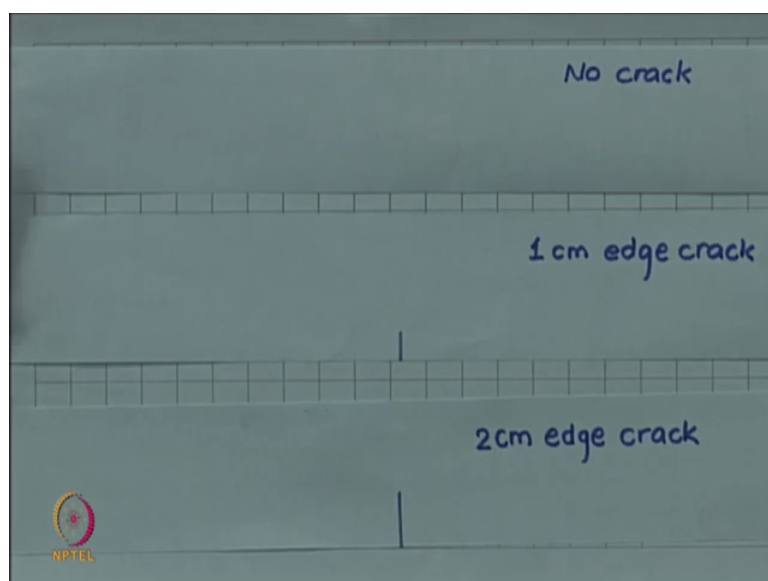
Fracture stress of a material, the stress at which any component or any material will fracture is not purely a material property. It also depends upon the size of crack which is present in the body. So, let us look at that, we will first look at it through experiment, which I call paper experiment.

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So, we will have I have made three specimens out of paper for testing.

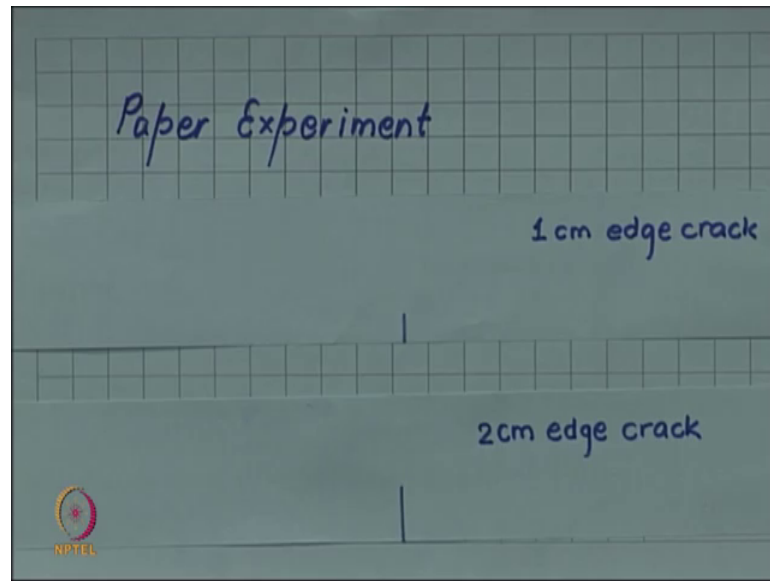
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These are rectangular rectangular strips made of the same paper on which I am writing.

So, I have made one and each of them all of them are of the same size, one I have introduced no crack. In the another one you can see here, I have written 1 cm edge crack. So, there is a crack here at this point is the length of the crack I introduced is 1 centimeter. And there is a third specimen in which the length of the crack is 2 centimeter, these three specimens I have and I will test them one by one. Let me begin with the no crack one.

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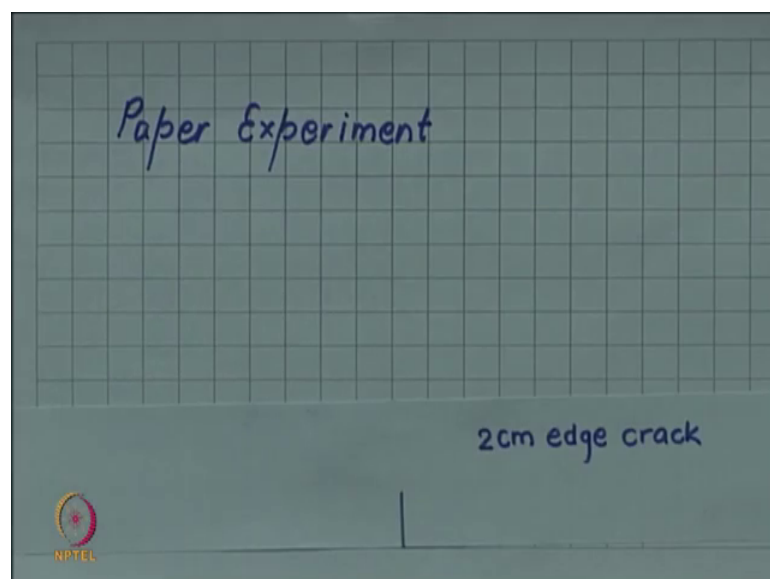


Of course, I do not have I do not have a mechanical load measurement system.

So, only by the feel of effort, which I am putting I will get an idea of how much stress is required. So, this is a no crack one and I am going to try to tear them all of them intension. So, I am trying to put a tensile stress, but I am not able to tear it at all. Finally, I have succeeded but the failure was more or less in the grip, where the stress concentration was probably much higher.

So, this was no crack.

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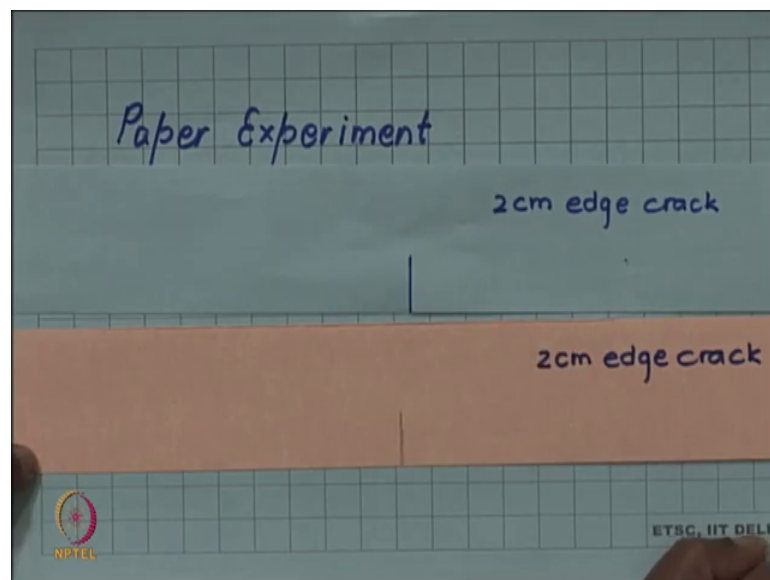


Now, I have a specimen with 1 centimeter crack. So, you can see in the bottom there is a crack of 1 centimeter. And now I try to pull it otherwise this sample is exactly the same in dimension and in material it is the same paper. But I have introduced a crack and now I grip it in the same way and, I tear it and it I have been able to tear it quite much more easily than the effort which I put for the strip without crack.

Now, the third specimen I take which is 2 centimeter edge crack. So, now, the crack is twice the length and I pull otherwise its again this identical specimen in terms of material and external dimensions, but it has a crack size which is two times the crack size which I had in the previous specimen. So, I try to pull it and it is a breaking, or tearing much much much more easily I can feel that, you have to take my word for that, but you need not take my word this is a very simple experiment and you can do it at home.

Now, so the conclusion is that if there is a larger crack size, the fracture is stress which smaller. So, the result of the experimental larger the crack size, it is smaller the fracture stress, this is one conclusion.

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Now, I have one more set of experiment in which, now I am changing the material. So, I have 2 strips again of the same external dimensions, they are of the same size, but and the crack size introduced is also the same both of them have 2 centimeter crack size, but one of them is of a floppier material than the other, you can see I am holding them in my hand.

So, this one this one is a very floppy because, it is a thin sheet and this one is of a stiff paper. So, a stiffness of this is much much more than this one. Now, I will again do identical experiments on the two, this is a 2 centimeter one which I had already done, I am repeating that and with very little effort I am able to a tear it. But now, I take this stiffer paper with the same dimension, same crack size, but of made up of stiffer material. So, now, I am trying to pull it, I am not able to tear it, I had to put enormous effort to tear it.

So, for the same crack size different material will have different fracture stress. So, fracture stress does depend upon material property also, also depends material property. And we did not we have not analyzed all the material property which may go into it, but at least we saw that the paper which was thicker or stiffer, I had a higher stress. So, maybe we make a guess, we are not sure, but guess higher stiffness higher fracture stress.