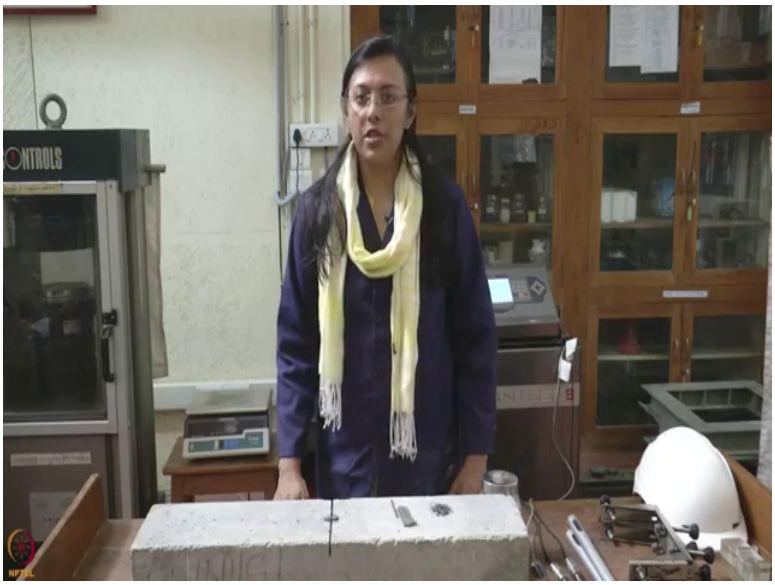
Advanced Topics in the Science and Technology of Concrete
Sujata Jose
Indian Institute of Technology Madras, Chennai
Fiber Reinforced Concrete Notched Beam Flexural Test

(Refer Slide Time: 0:11)



Welcome you all for these lab sessions of flexural toughness characterisation of fiber reinforced concrete, I am Sujata Jose, Dr Research scholar, working in the area of fiber reinforced concrete in building technology and conception management division in IIT Madras.

So first of all the main disadvantage of using plain concrete is brittle failure, so the advantage of fiber reinforced concrete over plain concrete is, it is enhanced ductility, post crack load carrying capacity etc. So this post crack load carrying capacity is captured by the post peak response which can be derived from this test of flexural toughness characterisation, objective of this test is to make sure the effectiveness of fibres and to obtain a post peak response.

(Refer Slide Time: 1:06)

So this is a specimen of fiber reinforced concrete, so there are different types of fibres in a market like steel, polymer which is used for many applications like flooring, pavements, slabs on grade, tunnel linings etc, so these are some steel fibres and recently new materials are being introduced in the market and this is an amorphous metallic fibre, so all these different types of fibers are used in for different applications.

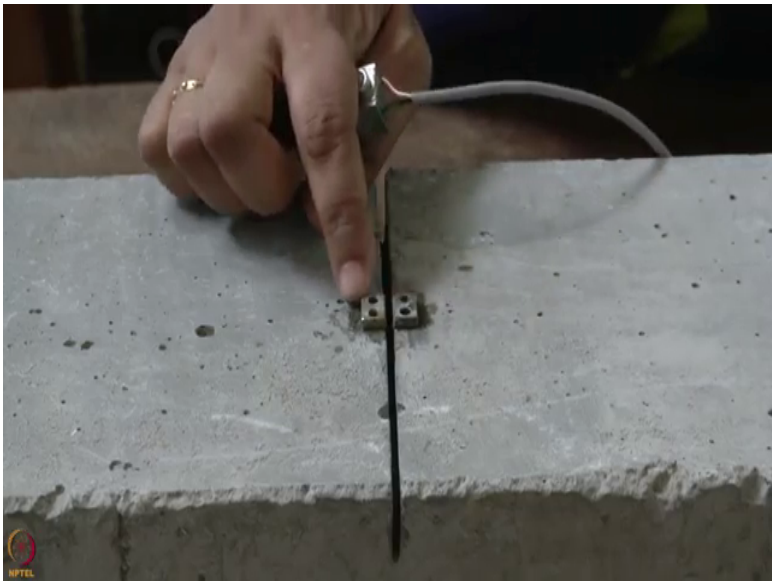
(Refer Slide Time: 1:41)

So now regarding the characterisation of fiber reinforced concrete there are two typical test notched and un-notched being test, so this is a specimen cast on fiber reinforced concrete, so this testing is based on an EN 14651 and Rilem TC 162, so in this notched test we are actually cutting a notched in the mid width of the test specimen, why do we need to cut the notch is, to the forcing, a weak plain in that area so that a crack happens in that area, so this is a specimen and the notch is cut using a saw cutter and what sawing is done and again drawing is done for another three days to avoid any thermal cracks.

(Refer Slide Time: 2:28)

So now typical depth and width of a notch is 25 MM and 3 MM and the specimen dimensions are 150 x 150 x 700 and the span 500 MM, so now as I told you before this is a closed-loop testing system, which is a displacement controlled test, closed-loop testing system works on a feedback control, feedback system. Unlike an open loop which is only an input and an output, so now this is a displacement control test in order to get the post peak response, so here is the displacement para meter is crack opening which is control with the clip gauge, so this is a clip gauge through which we controlled the test.

(Refer Slide Time: 3:11)

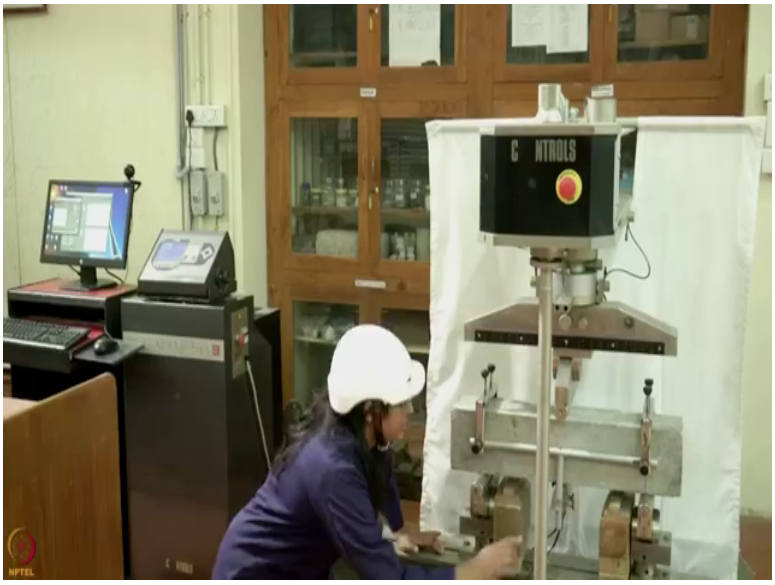


This clip gauge is fixed on to the specimen on a knife edge, which is fixed on either side of the notch at the mid span but along with a crack opening we are even measuring deflection, so deflection is measured by two LVDTs which is mounted on either side of the specimen using this frame and this frame is fixed on to the specimen by means of a C shape collar, so although we are measuring deflection and crack opening, the control para meter as this is a displacement control test, the control para meter is a clip gauge, CMOD which is measured by the clip gauge.

(Refer Slide Time: 3:54)

So now this test is continued until a crack opening of 4 MM, one more important thing to be noticed is that, the notch is bit, is cut at mid-width in the direction which is perpendicular to the casting face, so this is the casting face of the specimen and the notch is cut in a direction which is perpendicular to the casting surface and the loading direction is also perpendicular to the casting face, so loading on top, notch on the bottom and casting will be perpendicular to it.

(Refer Slide Time: 4:32)


NPTEL


NPTEL


NPTEL


C NTROLS

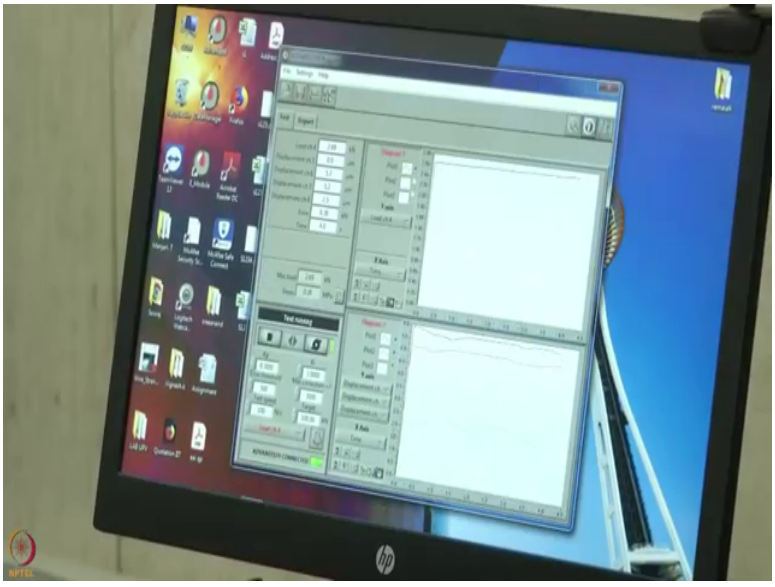

C NTROLS

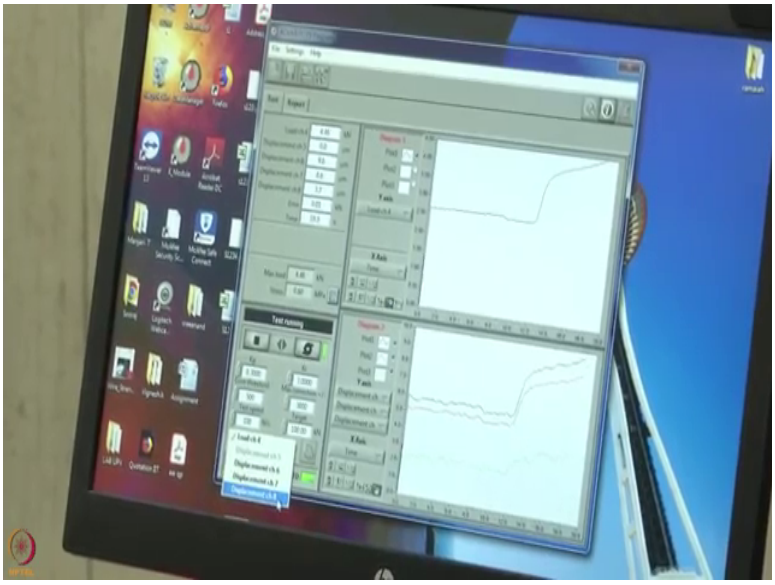

C NTROLS

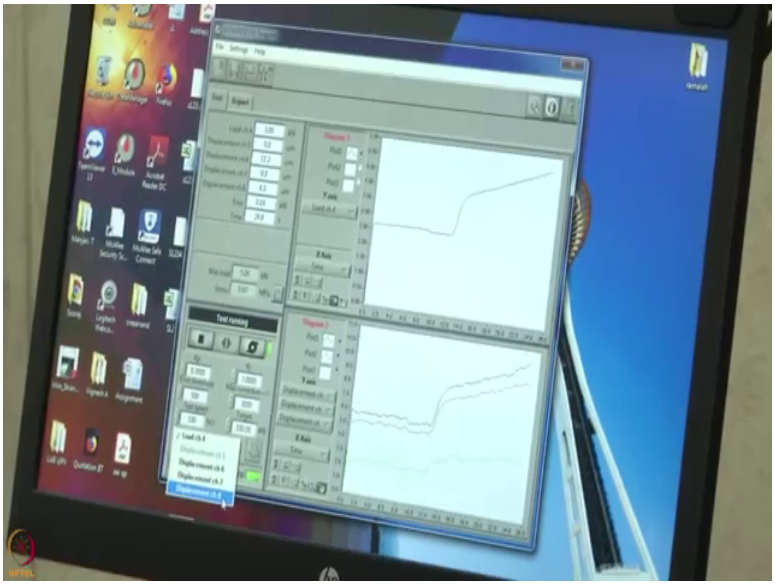
So now let us move on to see how we are going to mount to the specimen onto the testing frame, so this is the setup in which we have mounted or a fiber reinforced concrete specimen onto the testing system, so this is controlled closed-loop testing system and we have mounted here three senses are as I have explained before that is the clip gauge in which we controls the test that is here and LVDTs is which is fixed on either side of the specimen onto the rigid frame which is fixed to the specimen by means of a C shape collar and the deflection of the specimen we consider by taking an average of the LVDT reading of the two LVDTs on either side.

But the control is done with the clip gauge see a mode which is mounted onto the knife edge at the mid width; these sensors are connected to the data acquisition system through which we acquire data through a advantage interface.

(Refer Slide Time: 7:20)





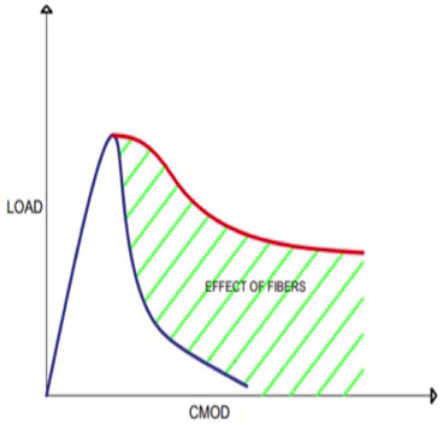


Now let us move on to see how we do the testing, so initially will start the test with load control till about around 40% of the peak load is reached and then will shift onto the CMOD or crack mouth opening displacement controller, now let us move on to the test, now the test is running, the peak load is achieved in 2 to 3 minutes time and the complete duration of the test that is for a CMOD or crack mouth opening of around 4 MM it takes to around 45 minutes for steel fiber reinforced concrete.

The test is completed as you can see that although there is a crack which is developed, there was no brittle or a catastrophic failure, that is because of the presence of fiber reinforced concrete but at the same time we have got the post peak response, there is the performance of fibers after peak, so what is a low carrying capacity at different crack openings, we can be able to derive from this test.

So now our test is complete we got two responses, the load crack opening response and load deflection response, so from these responses we derive the flexural toughness para meters, from the load crack opening response we calculate the regicidal flexural strength, which is the flexural strength at different crack openings of 0.5, 1.5, 2.5 and 3.5 MM, whereas from the load deflection response we calculate the equivalent flexural strength, which is based on the average load at different deflection limits, so these parameters are used in the design of FRC elements.

(Refer Slide Time: 9:43)



Now this is a typical load crack opening response of plain concrete and fiber reinforced concrete, as you can see in the case of plain concrete, there is a sudden drop after the peak which shows are brittle failure whereas in the case of fiber reinforced concrete there is an enhanced post peak load carrying capacity which is due to stress transfer by the fibers across the crack which was captured in a test that we show now, so this testing of characterisation of fiber reinforced concrete was done using the closed-loop testing system with displacement control and thank you for watching.