Advanced Topics in the Science and Technology of Concrete
Prof. Prabha Mohandas
Indian Institute of Technology Madras, Chennai
Bond Characteristic of Prestressing Strand

(Refer Slide Time: 0:11)

Welcome you all for relaxation of bond characteristics of prestressing strand; I am Prabha Mohandas looking in the area of bond performance of prestressing concrete system, in building technology and construction management at IIT Madras, nowadays we use lot of patents in concrete members in bridges in the form of gutters, high-rise buildings in the form of slabs and railway sleepers etc, for any systems that involves two materials it is important to evaluate and understand its bond behaviour to ensure its structural performance.

(Refer Slide Time: 0:43)

This test method is based on the standard ASTMA1081 with a slight modification required for pretension in concrete systems because the ASTMA1081 is just the use of uncertain strands in cement grout, just typically for the post tensioning scenario with just the use of 450 MM long cylindrical specimen with 125 MM diameter, in the case of patents in concrete system you need to transfer the stress from the strand to the concrete, to transfer the stress from the strand to the concrete you need to have strand machine lengths from both ends.

So for a particular strength of concrete and the stress applied you need to determine the strand machine lengths required and depending on that you need to choose the embedment length of the specimen, so by considering the transmission length for this particular grade concrete used here, we used M 50 grade just typically use for used to sleeper, railway sleepers in India and so we have chosen 1 m long specimen for this particular grade and the stress applied.

Now let us see the significance and use of this test method, say that is we use prestressing strand in both, pre-tension concrete systems and post tension concrete systems, so especially in pretension concrete systems the bond plays a major role, we expect this strand to transfer this stress from the strand to the concrete by the bond, doing the manufacturing process and handling from this industry, manufacturing industry to the site, the surface of the strand could be altered which will be influencing the bond also, as I mention due to these reasons we need to ensure the strand is an good shape to bond with a surrounding concrete.

So let me explain the significance a use of this method, so we use prestressing strands early in pretension concrete applications as well as in post tension concrete applications, especially in pretension concrete system, the strand is expected to transfer this stress by bond to the surrounding concrete, however the bond ability of the strand can be influenced during manufacturing processes, subsequent handling and storage conditions and it is important to evaluate the bond between the strand and concrete as a qualifying test to ensure its structural performance.

So this is all about the testing, so let me explain the specimen replacement for this test, we are taking the strand samples as a received condition and we have placed a 50 MM a long PVC pipe at the live end as a bond breaker to prevent the contact between this strand and concrete which will help us to reduce the stress concentration during the pull out test, then stress will be applied on the strand using the hydraulic jack but the required initial place trust, typically it will be 70 to 80 percentage of its ultimate, tense is strength of the strand, once it is strand or

stress you put the prepared concrete on the mould then after 24 hours the specimen are de-moulded and allowed to gain its design strength.

The stress from the strand to the concrete will be transferred, was the concrete has attended sufficient strength to take the transfer stressed typically when the concrete attends its 60% of target strength, stress will be transferred, once the stress is transfer specimen will be cutted the end and allow to cure for 28 days then you will take the specimen for bond testing.

(Refer Slide Time: 4:06)

Let me explain the bond test setup that we have here for this testing, here you have 1.5 m long pull out frame, specially designed and fabricated for bond testing of pretension strand in concrete at IIT Madras, we have mounted this pull out frame on the MTS universal testing machine, so we have gripped the top portion of the pull out frame on the top crossed it and it is gripped here using the hanging rod and at end of the hanging rod we has given the shavel kind of arrangement which will enable the frame to rotate during the testing if there is any torsion to release it.

(Refer Slide Time: 4:39)

Then we will mounting pull out specimen here, so we are now going to place this specimen on the frame, you have this 350 MM expose the strand at this end and 150 MM expose the strand at the other end, so this end will be placed at the bottom and it will be gripped and that

will be on the top which will be kept free and we have two LVDTs to be placed one at the bottom of the strand or the live end another at the free end of the strand at the top to measure the slipped of the strand with respect to the concrete and these LVDTs will be fixed using the LVDT holder.

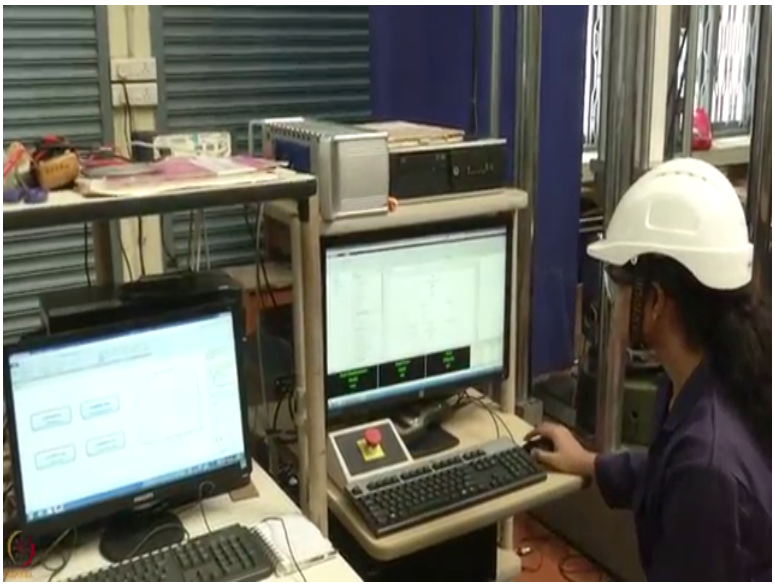
(Refer Slide Time: 5:27)

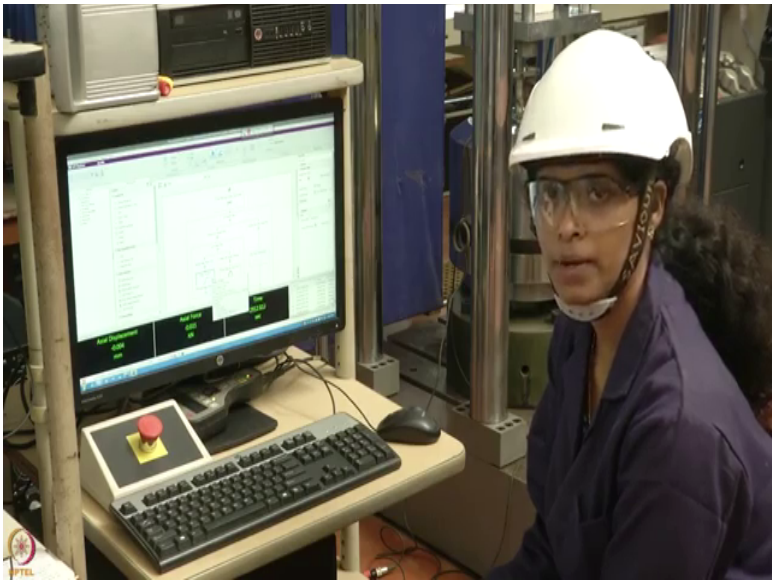
Now we have fixed the pull out test specimen on the frame and place the one LVDT at the load at end, it is called live end where load will be applied and another LVDT at the top, free end and the specimens are whitewashed using a Plaster of Paris to absorb any crack developing during the pull out test and it is move on the testing.

(Refer Slide Time: 7:29)

So we have connected the LVDT to, two LVDTs and the load cell of the testing machine, actuator of the testing machine to the external data logging system where the data will be recorded during the testing.

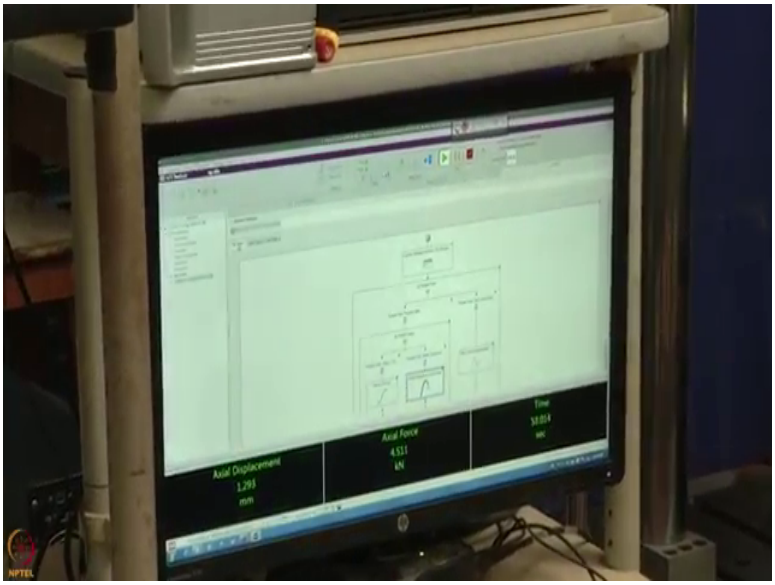
(Refer Slide Time: 7:45)

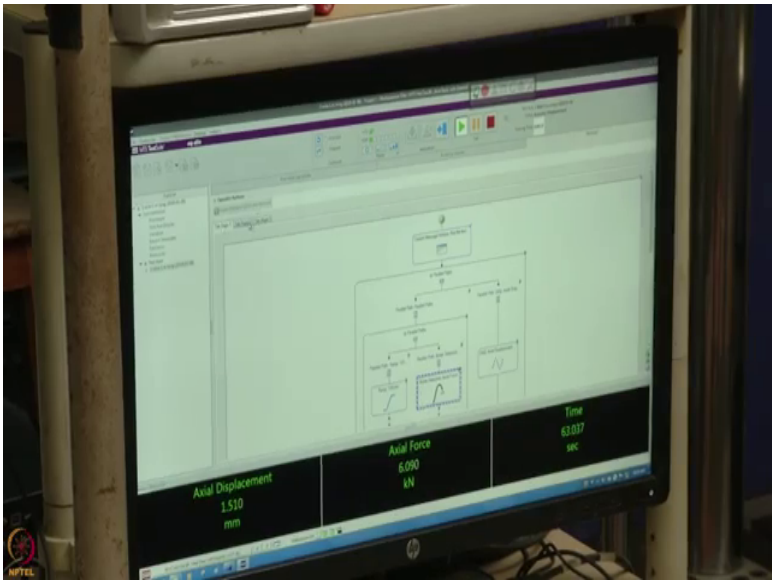


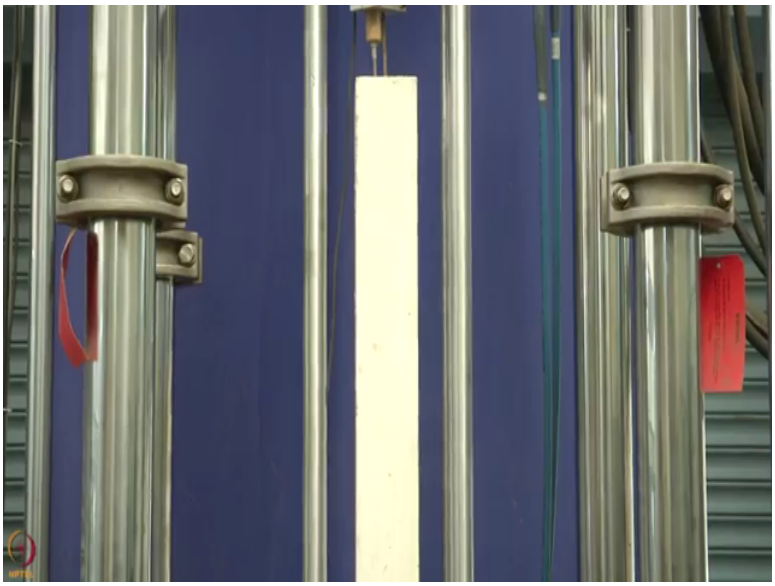


So onces those setups are done, we have a customised test program for running the pull out test for prestressing strands, so these are the procedure for the test program and before starting the test ensure that LVDTs position are at zero if not offset the reading to make it zero, so this is the test program customised for pull out test for prestressing strands, so where this program is based on closed-loop testing where load will be applied at the rate of 2.5 MM per minute.

(Refer Slide Time: 8:33)

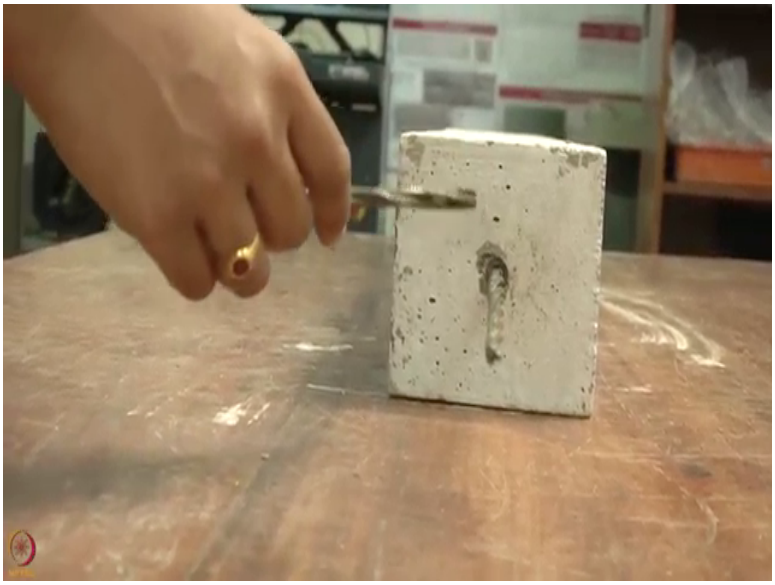


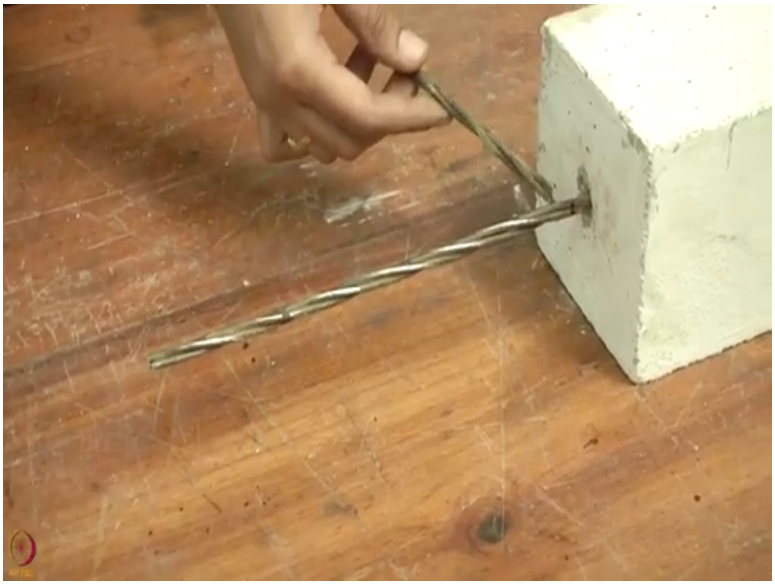

Axial Displacement
1.510
mm
Axial Force
6.090
kN
Time
63.037
sec



Now we have started the test, the test is running, so here you can see the load versus the displacement, now the pull out test is over, we have observed strand structure at the bottom because when we test this 1 m long pull out specimen, the load resistance to the slip will also increase, so the member will experience more load and it reaches, its ultimate strength hobot 35 to 40 kN, so once it is reaching its ultimate strength we will observe such strand rupture failure, now also we have observe almost 8 to 10 MM slip before it fails.

(Refer Slide Time: 9:44)





So now this region is the live end where we applied the load and here you can see the strand rupture, where the strand reaches to is maximum capacity it has broken and during the load testing we have observed concrete crushing or shortening at this region where we applied the load and here this region you can feel some amount of concrete crushing and slip and also you can see the bond breaker placed inside the PVC pipe and here we have observed almost 8 to 10 MM slip, so you can see the marker rod placed before placing the specimen for testing and after testing you can see almost 8 to 10 MM, it is almost 1 cm slip occur due to the pull out test.

From this test method we will obtain the low versus slip behaviour for the prestressing strands in concrete based on this we can determine the bond stress slip behaviour, bond stress can be computed by dividing the load by the embedded area of the strand inside the concrete, typically bond strength is computed as bond stress corresponding to 2.5 MM slip at the end of the member as suggested by ASTM 1081, also researches have use bonds stress value at the peak or peak bond stress value will be taken as bond strength of prestressing strand in the concrete.

(Refer Slide Time: 11:20)

That is all about the bond characteristic of prestressing strand in concrete when this test method we have learned how to obtain the bond stress slip behaviour for prestressing strands in concrete to determine its bond strength. Thank you.