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Geotechnical Engineering Laboratory

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Lecture No – 12

Permeability

Welcome I am professor J. N. Mandal department of civil engineering Indian institute of technology Bombay. Now I will talk about the different apparatus and assessory require for the permeability test.

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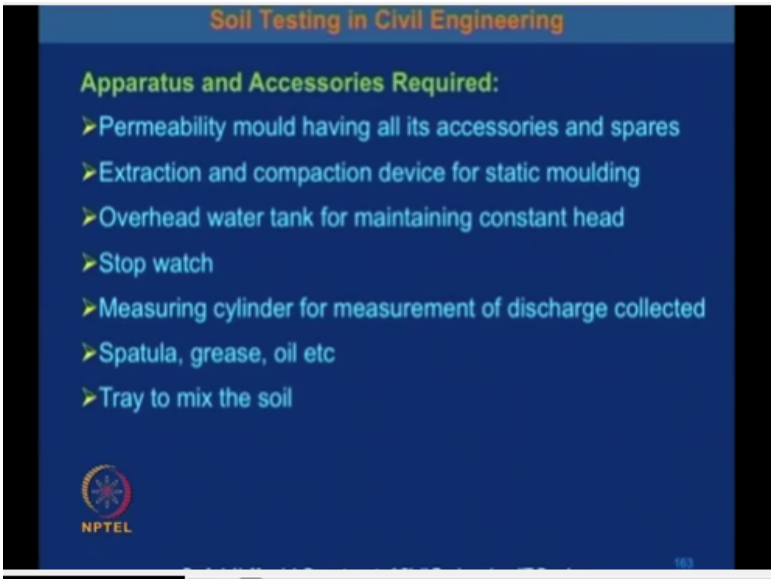

Permeability mould having all its assessory and spare. Extraction and compaction device or static moulding. Overhead water tank for maintaining the constant head, stop watch, measuring the cylinder for measurement of discharge collected. Spatula, grease oil etc. Tray to mix the soil.

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This is the defined types of the assessory required for the permeability test. So this is the permeability mould and this is the extraction device from where the permeability sample are to be extracted using this equipment. And this is the overhead water tank, this is the tank this is the water is inside so this is the overhead water tank and this is the stop watch we have to measure at a particular time the flow of water through the soil.

And this is the measuring cylinder and this is the oil and this one is the spatula. So these are some of the equipment what you require for testing the permeability of the soil.

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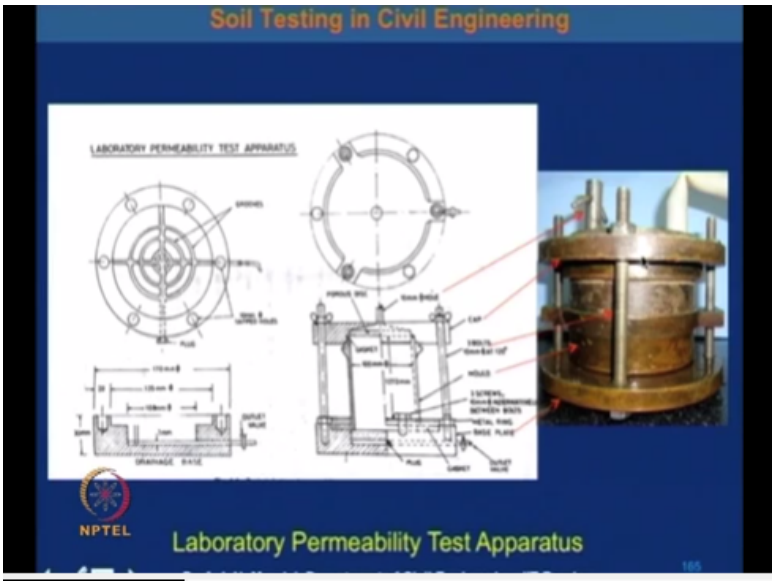

This is the laboratory permeability test apparatus and detail also given here, this is the plate and this is the gasket, this is duex valve, this is the metal ring, and these are the mould, mould is here, and it has a particular size is 100mm diameter and 1-73mm is the length and this one is the cap.

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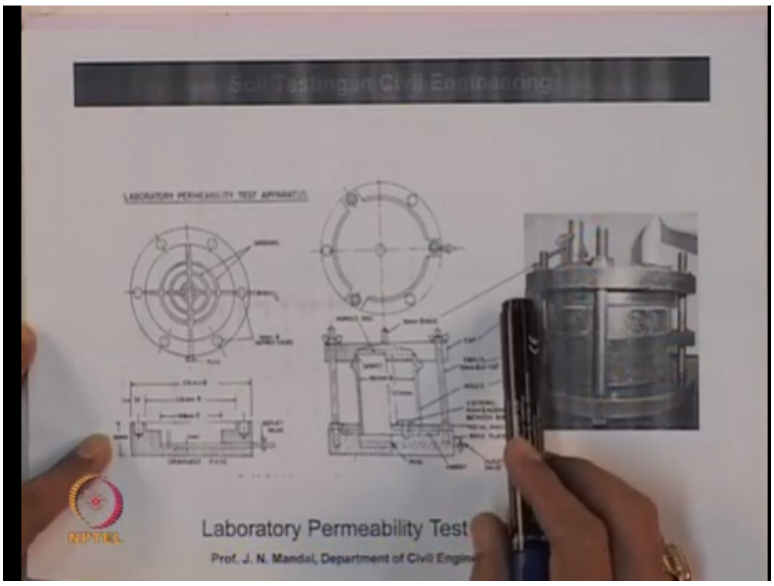

And this is the porous disk here and this is the metal ring at the bottom and this is the base plate and this is the outlet valve, and this is the plug. So all these drainage base also it is given here and this is the outlet valve. So from this equipment we determine that coefficient of the permeability.

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This is the permeability test setup and this is constant head permeability test, this one is the constant heat permeability test and this one is the variable plate permeability test. So we can perform the two kind of the test one is the constant heat permeability and another is the variable heat permeability. This is for the constant heat permeability test and this is for the variable heat permeability test. So you can use both the apparatus for the determination of the permeability of the soil.

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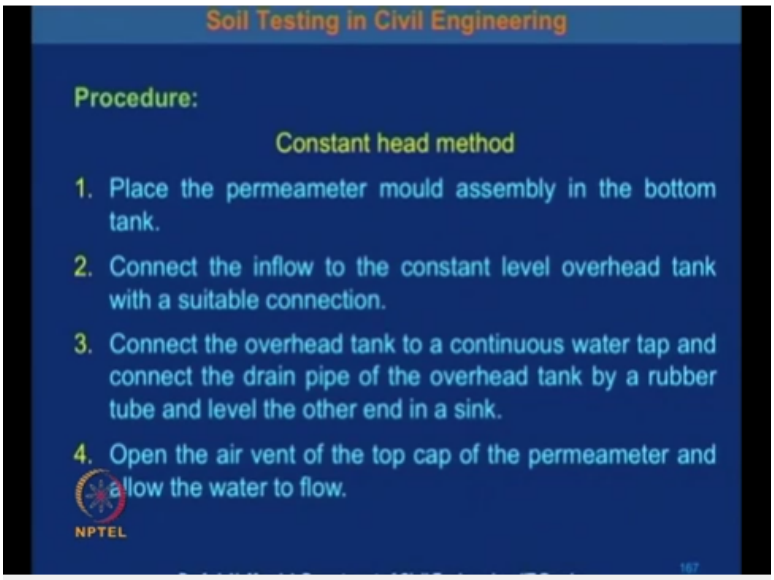

Now let us talk about what will be the procedure for the constant heat method. First of all place the permeameter mould assembly in the bottom tank and then collect the inflow to the constant level over a tank with a suitable connection. Now connect the overhead tank to a continuous water tap and collect the drain pipe of the overhead tank by a rubber tube and level the other end in a sink. Open the air vent of the top cap of the permeameter and allow the water to flow.

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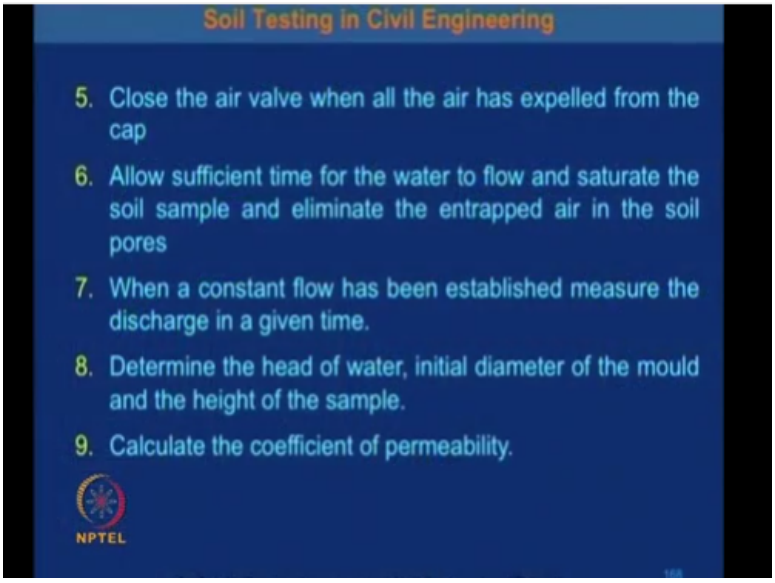

Next close the air valve when all the air has expelled from the cap. Allow sufficient time for the water to flow and saturate the soil sample and eliminate the entrapped air in the soil pores. When a constant flow has been established whether the discharge in a given time. Then determine the head of water, then initial diameter of the mould, and the height of the sample. And then you can calculate that what would be the coefficient of permeability of the soil.

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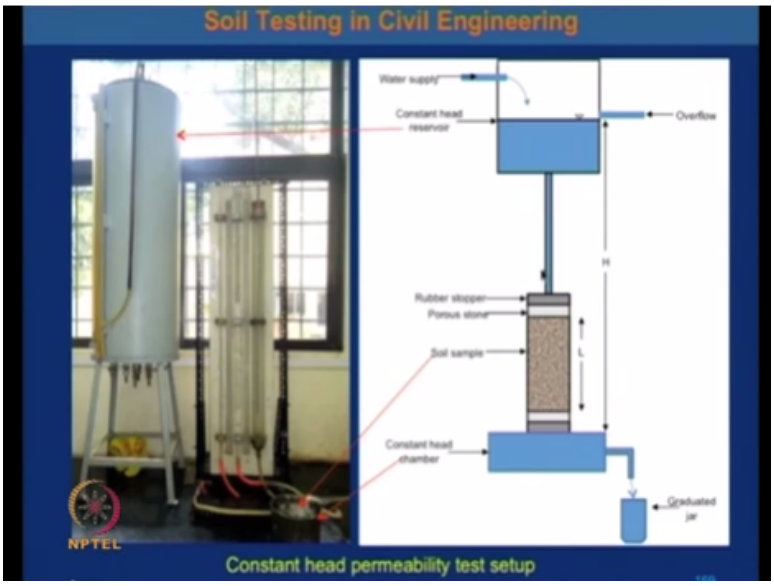

So this is the equipment for the constant head permeability test apparatus you can see here head water rate this is the sample so here I can.

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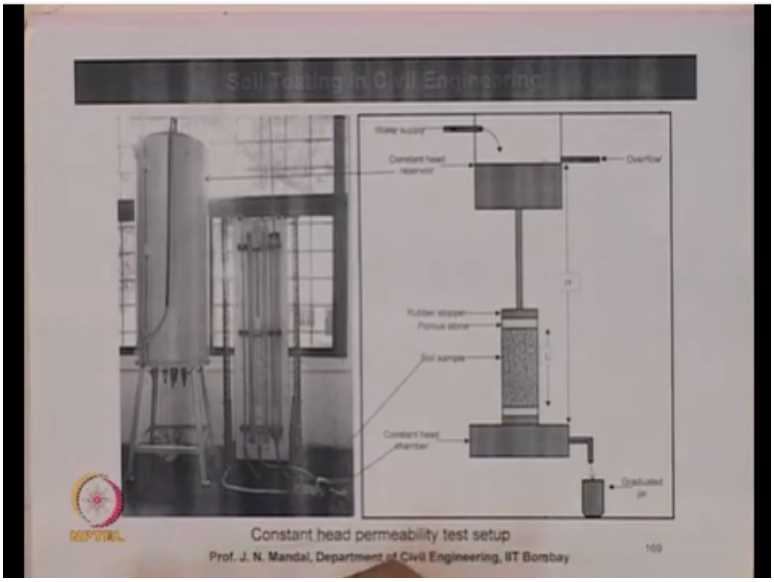

So that this is the soil sample is here and this is the constant head chamber, and this is the soil sample its length is L, and this is the porous tool the top, bottom and this one is the rubber stopper. And this water is supplying at reservoir and that is constant heat water is supplying at a constant heat and then water is overflow from here. So this height from here to here is H, and length of the sample is the L.

And then at a constant heat water can pass through the soil sample at a particular time and then you have a gear graduated jar, so you can determine what would be the balloon of water collected into this graduated jar at a particular time okay. Then from this you can calculate that what would be the coefficient of permeability of the soil. So how to calculate this coefficient of permeability for constant heat, here I will show you there are some calculation.

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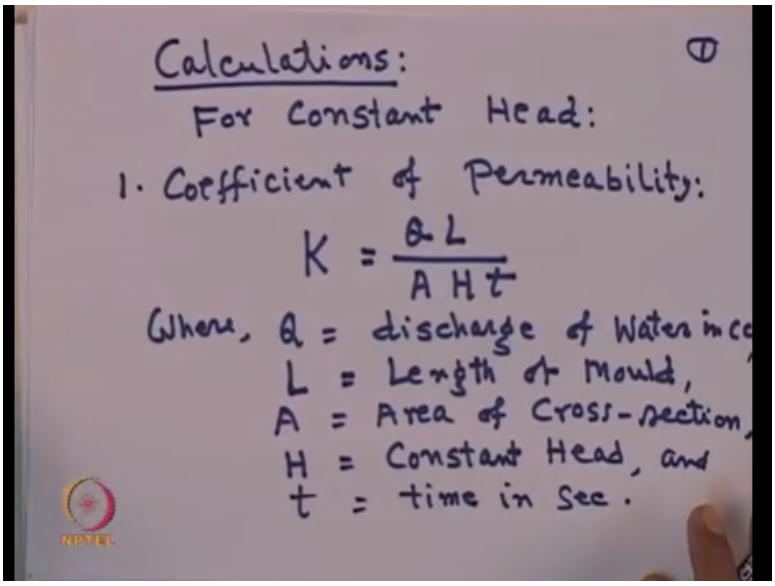

To determine the coefficient of permeability. Now we are discussing for constant head okay, constant head permeability. Now first of all you know what would be the coefficient of permeability. And that integrated at K, K=QL/AHt where Q, this Q is the discharge of water in CC, and L is the length of the sample L is length of the mould and A is area of cross-section. And H is constant head, and then t is time that is in second.

So you should know that what will be the coefficient of permeability that this is the equation for coefficient of permeability that is K=QL/AHt Q is discharge of water in CC, L length of the mould, A area of cross-section, H is equal to constant head, and t is equal to time in second. So from this equation you can calculate that coefficient of permeability.

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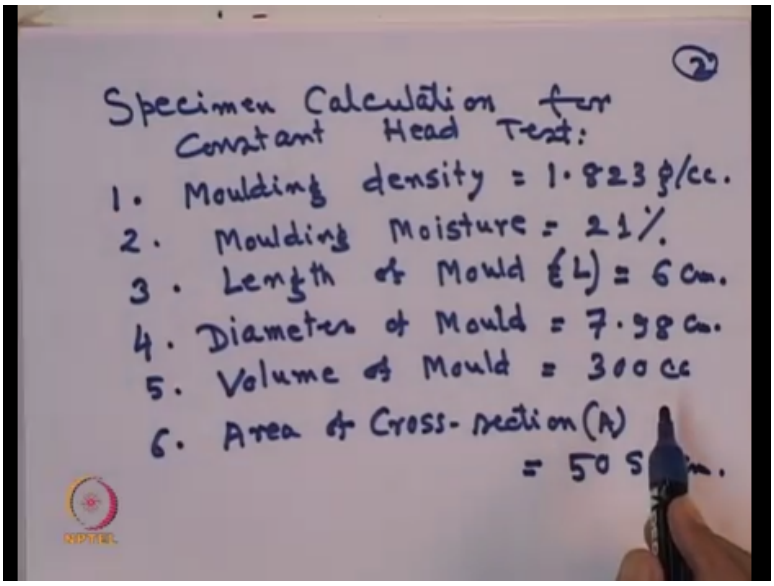

Now I can show you some specimen calculation for constant head test okay. So you know that moulding density of sample is 1.823g/cc so we have calculated that what would be the density of the sample. Then what would be the moulding moisture, let us say 21%, you know how to determine the density and also how to determine the moisture content of the sample. Then length of the mould and let us say this dignity at L is equal to 6cm.

And then diameter of mould is 7.98cm, next volume of the mould is 300cc, and next area of cross-section and it designated at A is equal to 50^2cm. So you know that what is density, moisture, mould, length, what will be the diameter of the mould and volume of the mould and area of the cross-section. So we know all this parameter, now how to calculate the coefficient of permeability.

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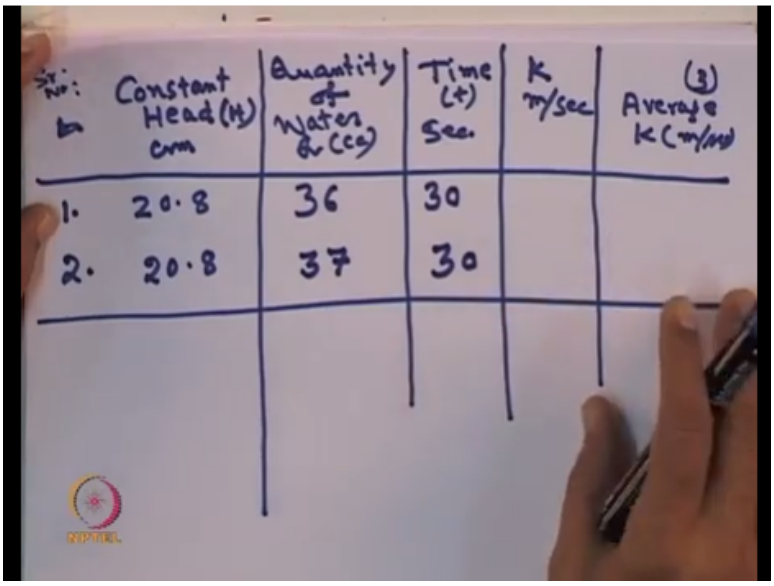

Let us say one serial number you are taking that constant head and that is H that is cm. And then we have to, what will be the quantity of water that is Q in CC. Then what should be the time required that is t in second. And then you can calculate coefficient of permeability K m^2/sec and then you take the average K that is m^2/sec. So let us say this is serial number 1, and let us say that constant heat is about 20.8cm, and then you are measuring what will be the quantity of the water you are collecting here.

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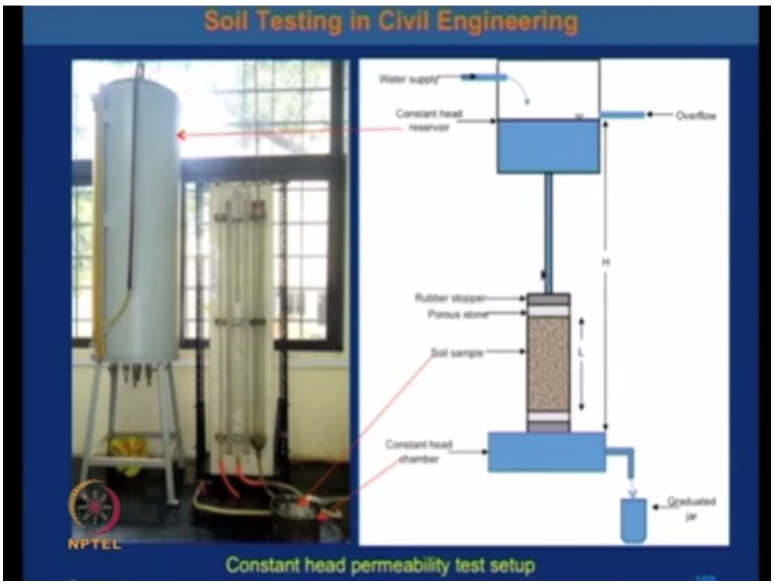

So it pass through the, this is constant heat and let us say this height is about 20.8cm and water which pass through the soil sample and then you collect it here in this jar at a particular time. And then from the jar you will be knowing how much quantity of water you are collecting at a particular time, so let us say that quantity of water collected in this jar is about 36CC for a time let us say in 30 second.

Then from this you can calculate what will be the coefficient of permeability, let us say that another experiment this head is constant 20.8 and quantity of water let us say 37CC and time second is equal to 30. And from these two data we can calculate what would be the coefficient of permeability for number one test what would be the coefficient of permeability number two test and then you can calculate the average coefficient of permeability. Now I will show how you can calculate this K value okay.

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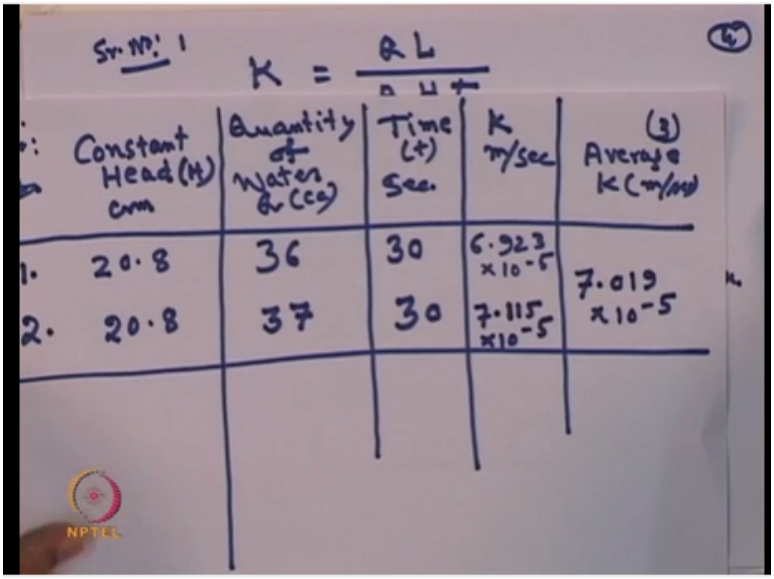

So this K value you can calculate using this equation, you know K = QL/AHt. Now in serial number 1 what is Q, Q= 36 okay, so this is 36, this into what is the length of the sample, length of the sample I told you earlier length of the sample is 6cm, so this is 36 x 6/ the area cross-section area, this area of cross-section is 50. So this A will be equal to 50, this into what is the height of the circle, so height of this about 20 H= that is 20.8, this is 20.8 this height is 20.8, so this will be 20.8, this into time t, so t require 30, so this will be 30 okay.

So if you calculate this then you can have the 6.923 x 10^{-3}cm.sec. So this is from the first serial number 1 you are having the coefficient of permeability that is K=6.923 so we can write here that K value from serial number 1 is 6.923 x 10^{-5} then from the serial number 2 test we can write this quantity of water from second serial number is 37, so this will be K = 37 x the length is the same this is the 6 and this divided by area is also same, that is 50 this area is 50 and it is constant height also second case 20.8, so this will be 20.8 into that time required, time also 30 this time is this is 30.

So if you calculate this so you can have this value is equal to 7.115 x 10^{-3}cm/sec, so if you can convert it into meters, then it will be the 7.115 x 10^{-5} m/sec and this also if you can convert then this will be 6.923 x 10^{-5} m/sec. So because here we have K remains in terms of m.sec so in the first is we are having that coefficient of permeability is 6.923 x 10^{-5} and the second serial for the serial number 2 we are having that coefficient of permeability is 7.115 x 10^{-5} m.sec, so you can write 7.115 x 10^{-5} m.sec.

Now you take the average value of these two test, so you can have the average value 7.019×10^{-5} m/sec. So you can calculate the coefficient of permeability of the soil and this coefficient of permeability of this side of 7.019×10^{-5}. So you know how to calculate the coefficient of permeability of the soil. This is for constant head permeability, so constant head permeability of the soil can be determined using this constant head permeability apparatus.

Because this permeability is very important for type of the soil whether it is a constant gain soil or the finite gain soil. So once you know what will be the quantity of, what will be the coefficient of permeability of the soil and what will be the type of the flow of the soil. So it may be the permeable soil, it may be the impermeable soil, so if there are say gravel and sign this could be sent and permeability will be on the hard side while at in case of the clay coefficient of permeability on the bad side.

So it is almost act like a impermeable material. So we so far discussed about the constant heat permeability and how we can calculate the coefficient of permeability or the constant heat permeability. Now we can discuss that variable head permeability.

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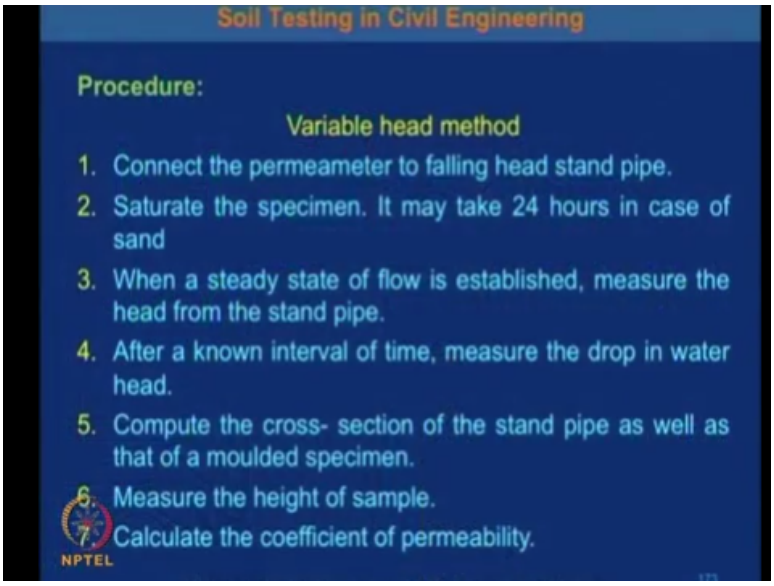

So what are the procedures for the variable head permeability? They connect the permeameter to falling head stand pipe. Saturate the specimen; it may be 24 hour in case of sand. When a steady state of flow is established then measure the head from the stand pipe. After a known interval of time, whether the drop in water head. Compute the cross-section of the stand pipe as well as that of moulded specimen. Then measure the height of the sample and then you calculate the coefficient of permeability.

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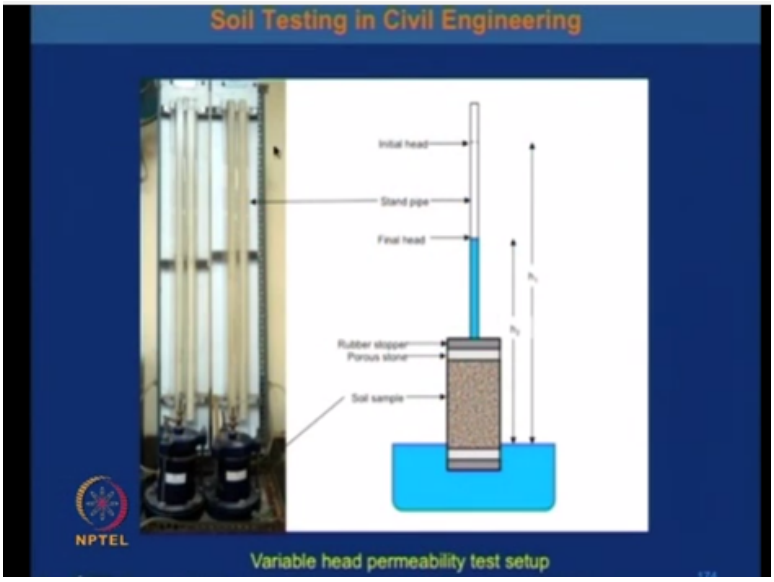

Now this is the variable head permeability test okay. So here the swing that this is the soil sample for variable head permeability and this is the porous stone here, porous stone and this is the rubber stopper.

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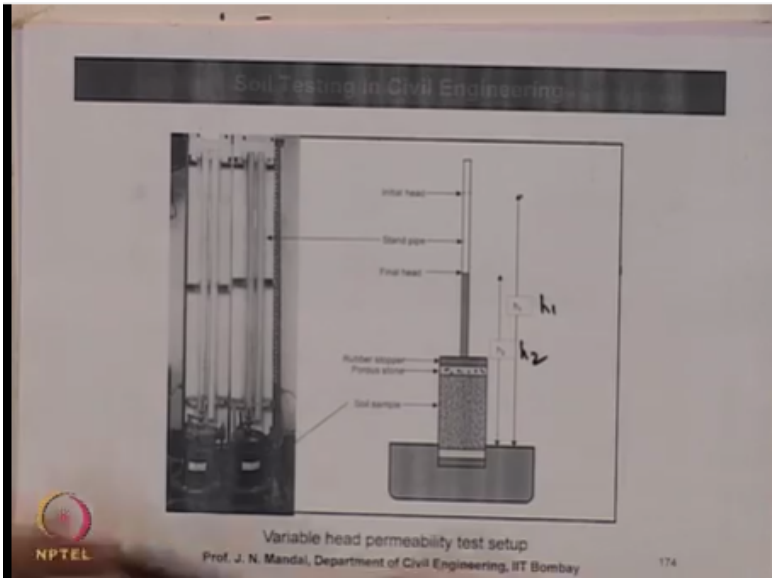

And these are the stand pipe, this is stand pipe and because it is a variable head so initial head here that is let us say H1 and then the final head from here to here is H2. So this is H1 and this is H2, so water can pass through this soil sample for the variable head and you can calculate that what would be the coefficient of permeability for the variable head test. So now I will show you that, so how to calculate the variable head permeability test with this equipment. And next I will show how to calculate the coefficient of permeability for the variable head permeameter, thank you.

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