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NATIOINAL PROGRAMME ON TECHNOLOGY ENHANCED LEARNING

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Geotechnical Engineering Laboratory

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Lecture No – 20

Consolidation

Now I will discuss the laboratory consolidation test, so how to perform the consolidate meter test using the video meter or consolidation meter in this test are primary object to determine the consolidation properties of a given soil sample, and this is very, very important parameter in geochemical engineering. So when a saturated mass of soil is loaded.

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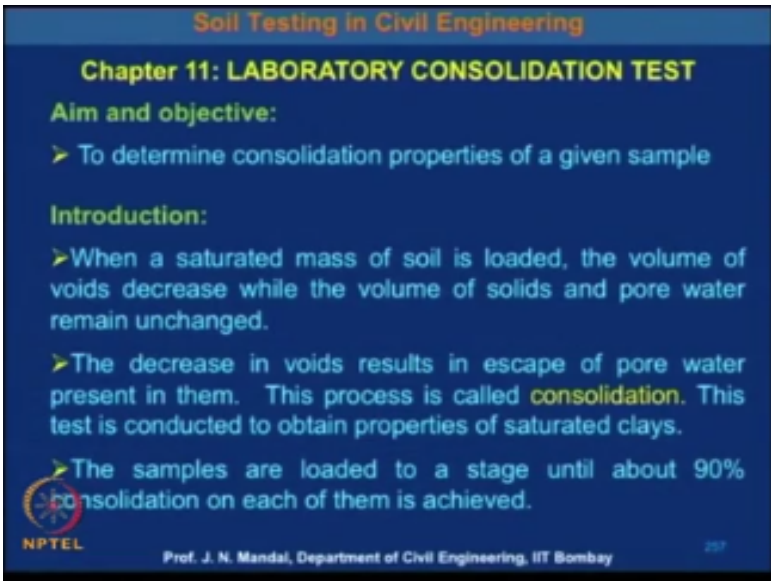

The volume of the void decreases while the volume of the solids and pore water remain unchanged. The decrease in the voids result in escape of pore water present in them the process is called consolidation. This test is conducted to obtain the properties of the saturated clay, the sample are loaded to a stage unit about 90% consolidation on each of them is achieved. Now some of the to understand this consolidation.

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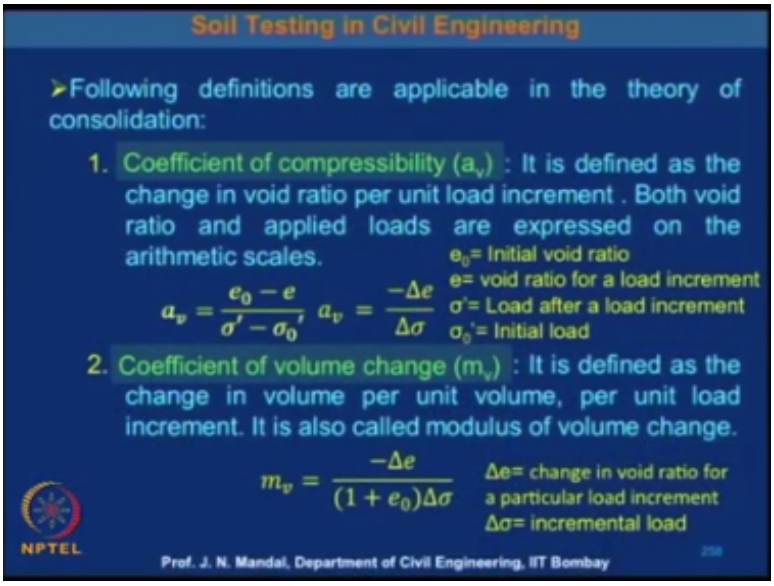

And you record some of the definition of application in theory of consolidation and how you can determine the some of the important parameter in consolidation that parameter.

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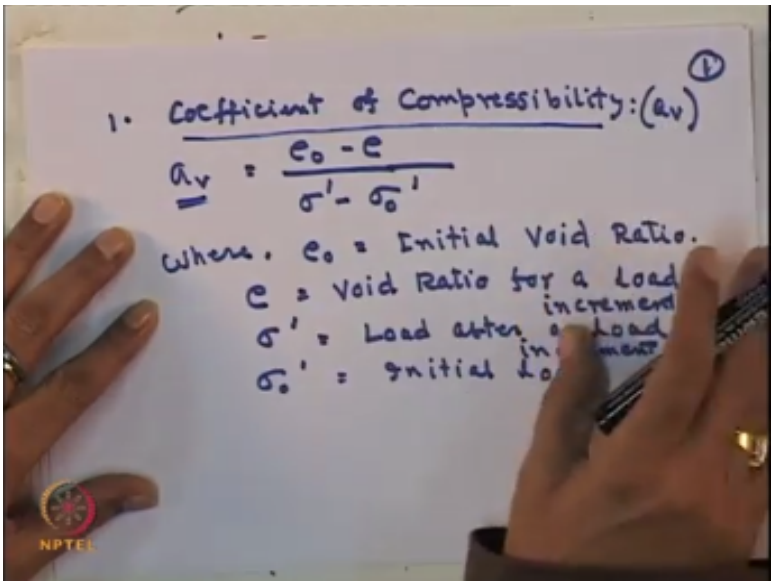

One is coefficient of compressibility when frequently use this term coefficient of compressibility which is reignited as a_v, so this coefficient of compressibility that is a_v is define as the change of void ratio part unit load increment and both the void ratio and the applied loads are express on the arithmetic scale. So this a_v we can write $e_0 - e / \sigma' - \sigma_0'$, where e0 is the initial void ratio and e is void ratio for a load increment.

And σ' is = load after a load increment and σ0' is the what is call initial load so if you this e_0 e and σ' and σ_0' so you can calculate the coefficient of compressibility is this one of the important parameter in coefficient of compressibility. So remember this coefficient of compressibility. A_v = 0-e/ σ' – σ_0'.

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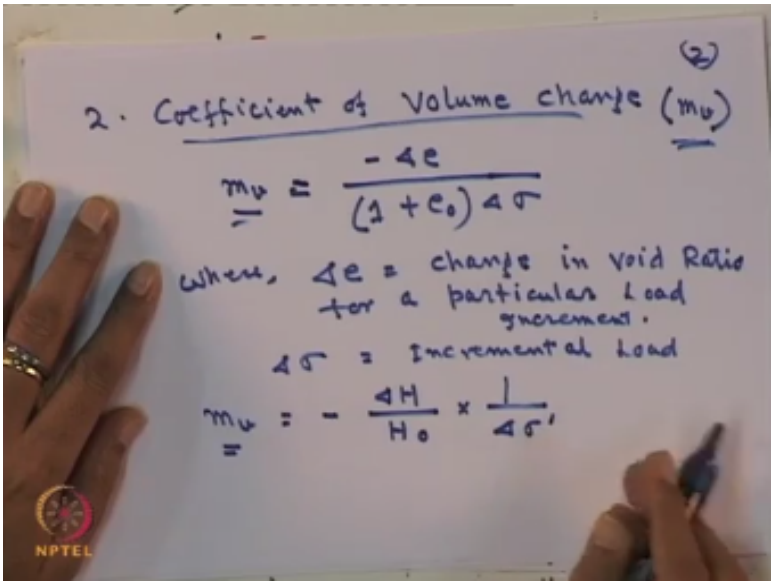

Next is coefficient of volume change and that is reignited ignited as m_b so what is m_b? Mb is define either change in volume or unit volume or unit load increment it is also call the modulus or volume change, so coefficient of volume change or Mb can be express as $\Delta_e / (1 + e_0) \times \Delta \sigma$. Where Δ e = change in void ratio for a particular load increment okay. And $\Delta \sigma$ = incremental load so this term coefficient of volume compressibility is very important so that is reignited at m_b and you should know what is the m_b.

For a latterly combine soil the change of the volume is proportional to the change in the thickness that is let us say change of the thickness is Δh and the initial volume is proportional to the initial thickness that is h0. So therefore this m_b can also express as Δ of h dependent by h 0 x 1 / $\Delta\sigma$', so this m_b also can be express Δh / h0 $1/\Delta\sigma$. So this is the coefficient of volume compressibility. Then another term also very important that is what you call.

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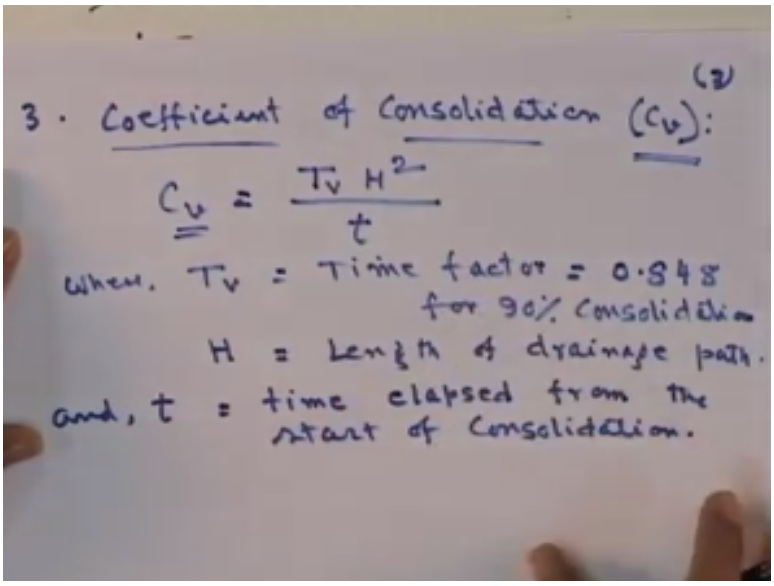

That coefficient of consolidation this is very important parameter and this is reignited as C_v, so this coefficient of consolidation is define as the amount of water dent out of the void ratio of clay preservative element in a unit time due to the consolidation. So C_v can be written as $T_v \times H^2 / t$, where Tv = time factor so this time factor let us say for 90% consolidation this Tv value will be 0.848 and this is for 90% consolidation okay.

And H = length of drainage path, drainage is very important and t =that is time elapsed from start of consolidation. So you know what is Tv time factor H = length of the drainage and t = time elapse from the star of the consolidation. This coefficient of consolidation is very important you have to remember this equation that $Cv = Tv\ H^2 / t$.

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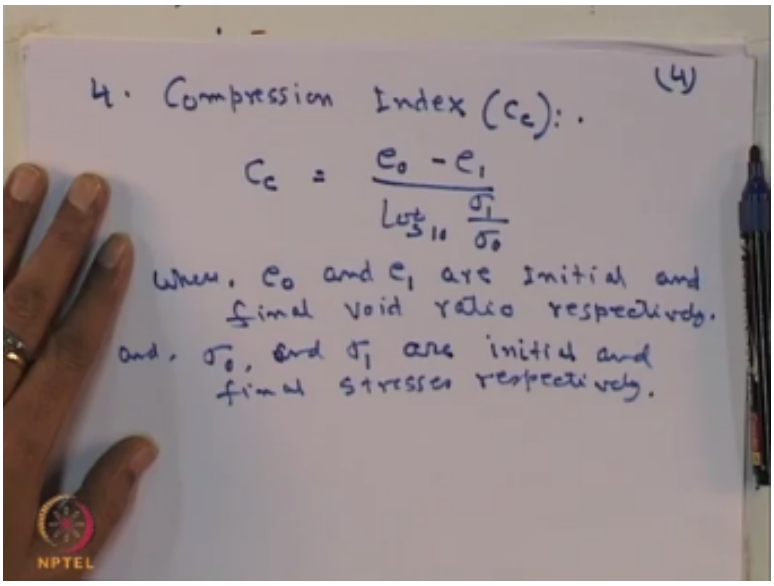

Next is compression index and that is reignited as C_c, so this C_c is a slope of a linear portion of e log σ' call and it is a dimensionless factor. So this Cc can be express as $e_0 - e_1$ / log of σ_1/σ_0, where e0 and the e1 are initial and final void ratio respectively. And σ_0 and σ_1 are initial and final stresses respectively. So here this compression index which is reignited as C_c.

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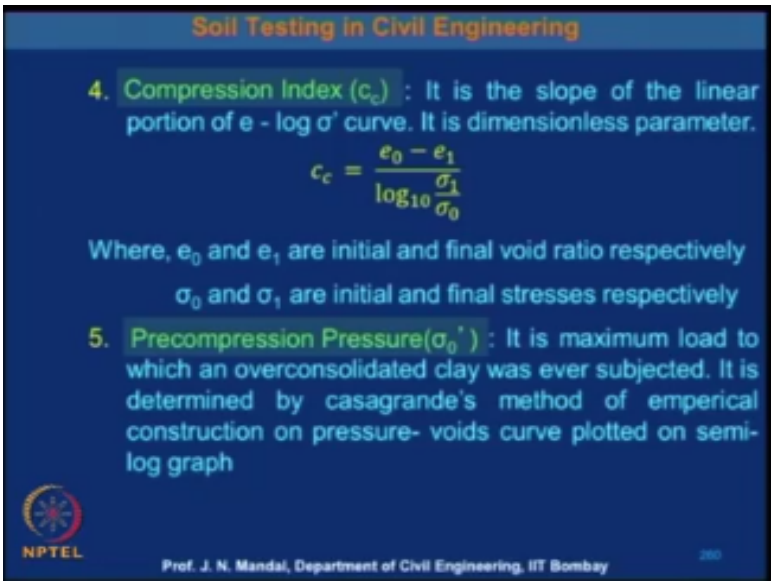

And then the C_c is express as $e_0 - e_i$ / log of based in σ_1/ σ_0. So this compression index you can determine form the linear portion of the log e and σ' called all log of p cart from this you can determine this compression index this is also another very important parameter. Then another term which you call the pre compression pressure.

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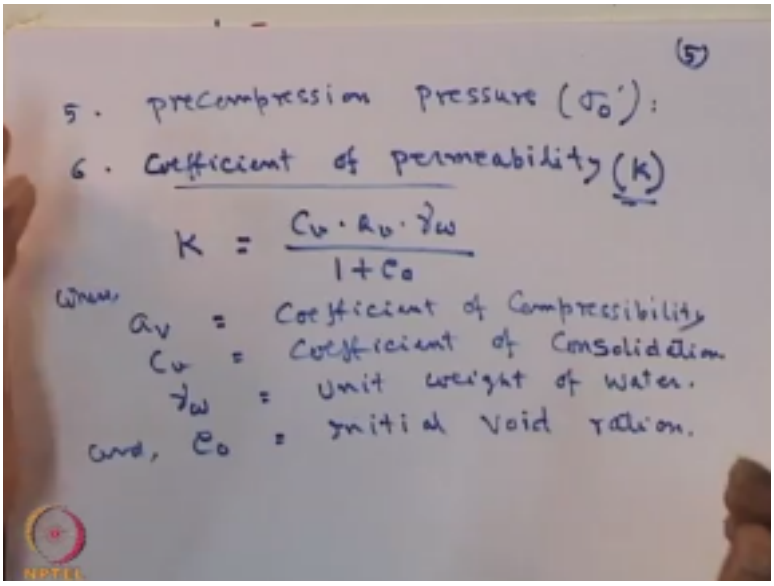

Pre compression pressure and that is σ0', so it is the maximum load to in the over consolidated clay was ever subjected. It is determine by the casagrande's method of experimental emperical construction on pressure and void ratio curve plotted on the semi log graph paper. So from the semi log graph paper you can determine the pre compression pressure, I will show you later that how we have to determine the pre consolidation vassal that is σ0'. So this pre consolidation pressure also is very important.

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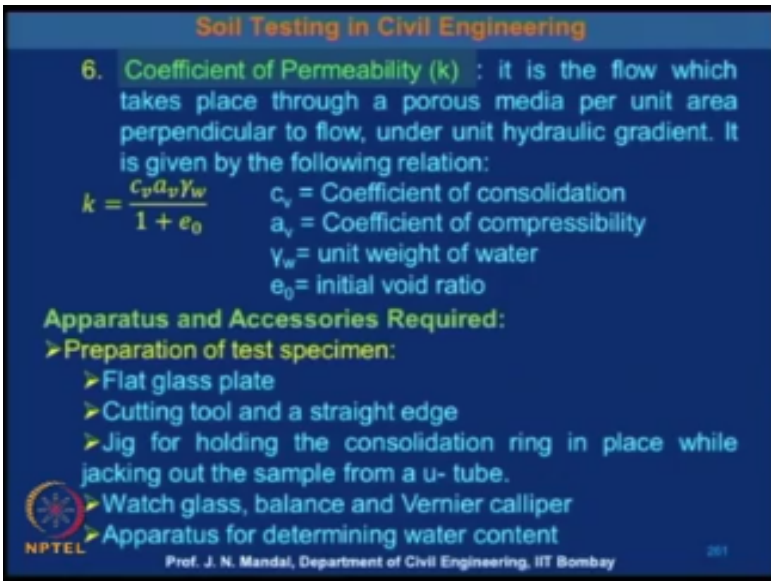

Now other term is the coefficient of permeability and that is denoted by K, and coefficient of permeability also you can determine from the consolidation test his is the indirect method to determine the coefficient of permeability. So coefficient of permeability is the flow which take place through a porous, media or unit area perpendicular to the flow under the unit hydraulic gradient.

So this coefficient of permeability k can be express as the Cv x Ab x γw/ 1 + e0. Where av is the coefficient of compressibility and Cv is the coefficient of consolidation and this is γ w, this unit weight of water and e0 is initial void ratio, so from the consolidation test if you know that coefficient of consolidation and the coefficient of compressibility γ w and the initial void ratio you can determine that what should be the coefficient of permeability of the soil.

This is the indirect method what we can determine the coefficient of permeability. Now will discuss about the apparatus and the accessories required to perform the consolidation test. So first of all that you need that how to repair the test specimen you need the flat glass plate then cutting tools and the straight edge jig for holding the consolidation ring in place while jacking out of the sample from a u tube.

Then what are glass balances and the vemier caliper apparatus are determined drink the water content. Now how to perform the consolidation test it is perform using an eodometer cell and this eodometer is consist of consolidation ring cutting ring.

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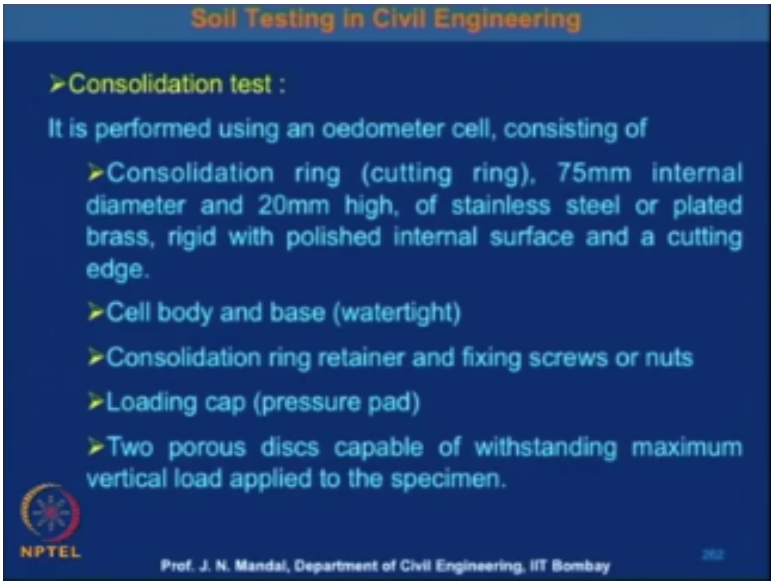

There 75mm internal diameter and 20mm high, of stainless steel or plated brass, rigid with the polish internal surface and the cutting edge. Cell body and base that is watertight and consolidation ring retainer and fix screw or nuts loading cap in pressure pad and two porous this is capable of withstanding the maximum vertical load applied to the soil specimen. Now how to measure the dial gauge and the stop watch we use the stopwatch take the reading time reading.

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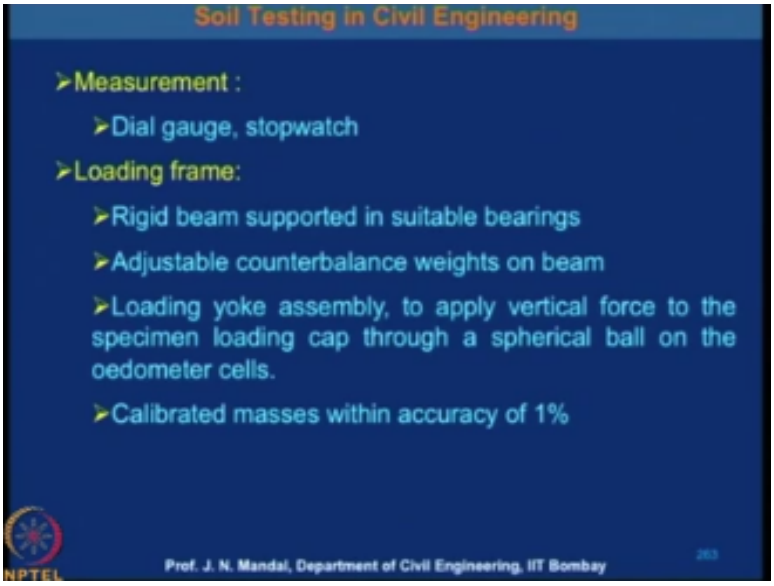

And correspondingly you measure what should be the dial gauge. For a specific time you take the dial gauge reading the loading frame rigid beam supported in suitable bearing, adjustable counterbalance weight on beam loading yoke assembly to apply vertical force to the specimen loading cap through a spherical ball on the eodometer cell. Calibrated masses within accuracy of 1% I will show you that equipment what we can use for the, what to perform the consolidation test.

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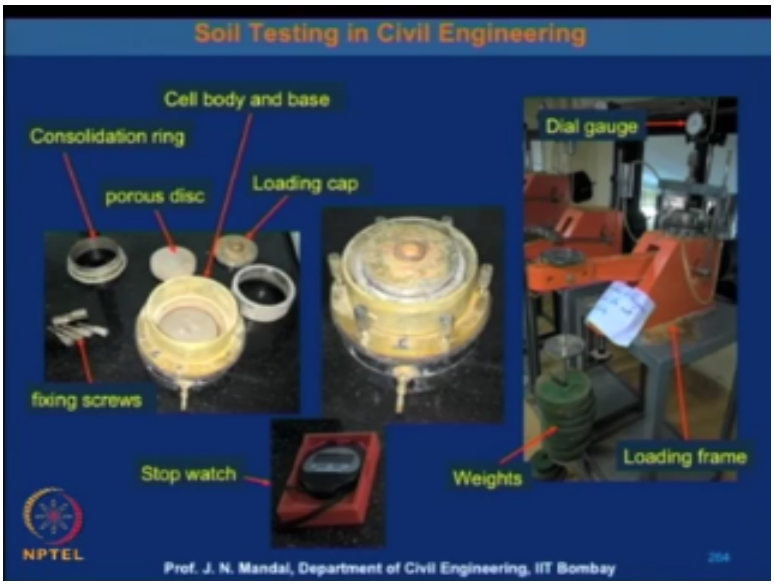

So here is shown that this is the consolidation the ring okay and this is the porous disc and this is the loading cap and this is the cell body and the base. So here is a fixing screw here is a stopwatch you have to take the reading of the dial gauge at a particular time and this is basically consolidated meter equipment, here this is here. And then we have to apply the loading term and here load is applied that weight different weight you have to apply 1, 2, 3, 4 kg load we are applying.

And at a particular time using the stopwatch you read the dial reading and continue for loaded time. So this is basically consolidated meter and then load is applied here then you take the weight at a particular weight you keep on take reading at a different time, so this is some assembly for the consolidator test.

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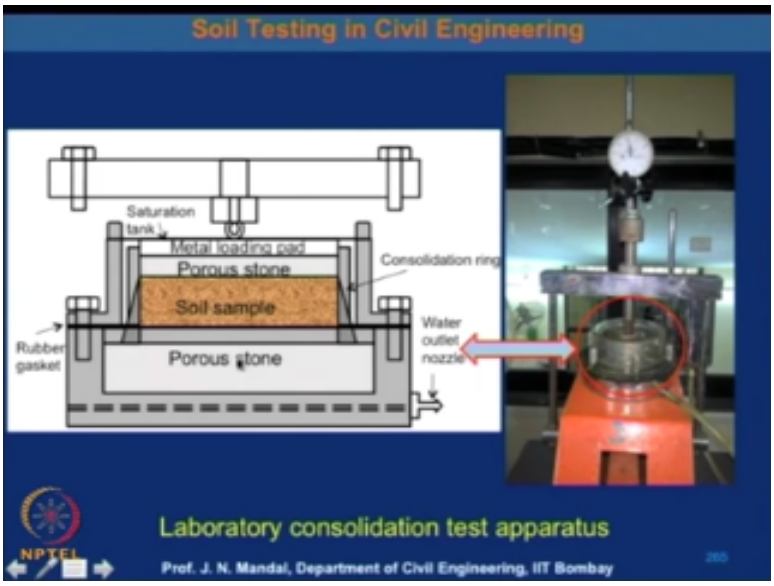

And solids on also the lines case here we can see here the consoled meter this is the soli specimen okay and this is what us told at the bottom and also at the top if the water is den both way then we have to place porous stone on the top and the bottom and then it is the metal loading pad okay and then you are applying the load and this is water is outlet and this is the consolidation meter ring and this is the rubber gasket and then the load is applied here, so it is here you can see that how you are applying the load.

So this is the laboratory consolidation test apparatus. So if the sample you know it is a circular sample if the sample is like this.

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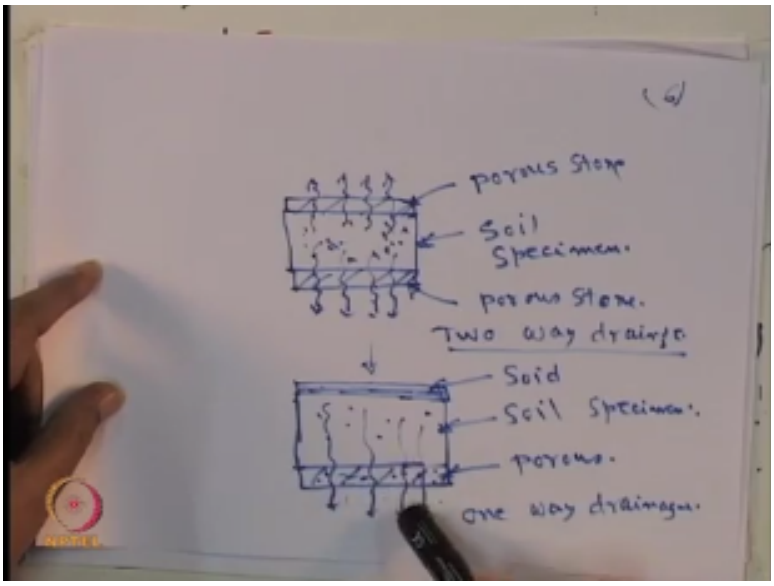

This is the soil, if it is the soil specimen and you can keep that what has told on the top and as well as at the bottom, so just say this is the porous stone okay. This is at the top and the bottom then because when we are keeping the porous stone on the top and the bottom so drainage will be on the top like this water will escape out from the sample and this water escape out of the sample so it is two way drainage when you apply the load then there will be dissipation of excess porous deposal from the sample.

When you keep the porous stone that the top and the bottom that means this is the both are drainage. And if you keep if this is the let us say this is the sample okay this the soil sample soil specimen and if you can keep solid plate on that and it will keep the bottom as a porous material. So if this is the porous but this is the solid and this is the sample okay, so gain will be one side it this is one way drainage here is a two way drainage here this is the one way drainage. So drainage can be done also the one way, so due to apply the load there will be dissipation of a excess porous result from the solid sample.

So soil sample may drain in the both way or each maybe the one way if it is the both way that to provide a porous stone at the top and the bottom or the soil specimen and if it is one way we have to keep the solid plate one side and the porous stone is the other side or as per cell. So this way you can perform the test and how to perform the test.

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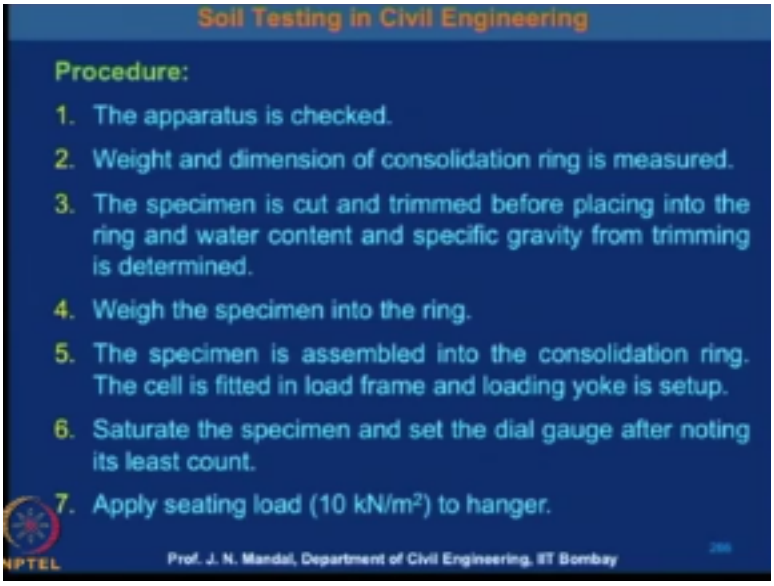

So here some procedure the apparatus is first checked, weight and dimension of the consolidation ring is measured the specimen is cut and trimmed before placing in to the ring I showed you the what is the ring and water content and specific gravity from the trimming is determine so we have to calculate what will be the water content and the specific gravity of the soil sample.

Weigh the specimen in to the ring the specimen is assemble in to the consolidation ring this cell is fitted in load frame and loading yoke is set up. Saturate the specimen and the dial gauge after noting its least count and apply the initially the seating load that is 10km/m^2 to the hanger. Adjust he beam to horizontal.

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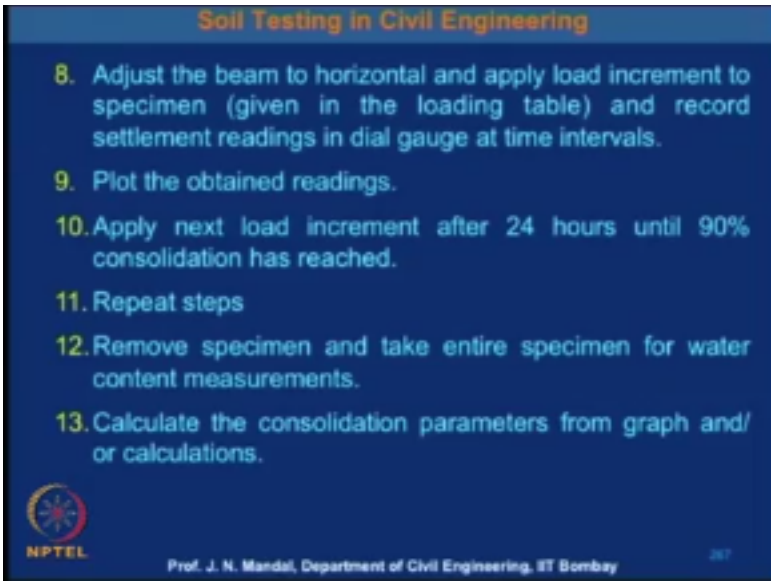

And apply load increment to the specimen I will show you how to the load increase in a loading table and record the settlement reading in dial gauge at the different time interval. Plot the obtained reading apply next load increment after 24 hour until the 90% consolidation has reached, then it repeat the step. Remove the specimen and take the inter specimen for water content measurements.

Calculate the consolidation parameter of the graph and you calculate that what are the other parameters required for the consolidation. So but you know that how to perform the test I will show you next that under the how at a defined interval of the time and how you can take the reading dial gauge reading and different kind which starting from let us say the 0 then 1 minute 2 minute 3 minute 5 minute then you increase the time interval 30 minutes 60 minute one hour two hour like that you continue 12 hour and next we also you continuing an up to 24 hour at a particular loading then up to 24 hour.

Then next again you increase the load and then again you continue to take the reading at different timing like that you keep on increasing the load at different time up to 24 hour and the from that reading we will calculate the different parameter what should be the void ratio how to calculate. So from that table we can determine all those parameter I will show you the next time that how we can form the table and how we can take the reading and how to calculate the other parameter how we calculate the coefficient of consolidation and how you will calculate the M_b e e_0 etc. thank you.

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