Port and Harbour Structures

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Pile Load Test

This pile or test mandatory, mandatory means it is compulsory to carry out pile test.

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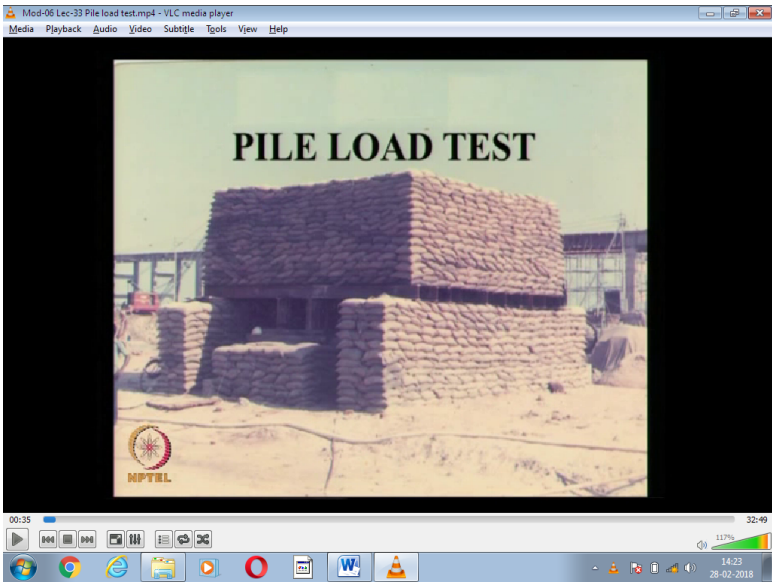

Some percentage is given there are two type of test one is initial pile load test and another is working pile load test, so this initial pile means this pile will (())(1:00) separately it is part of the structure you catch the pile do the test and forget about the pile till not be used for part of the construction. Working pile load test means you will do the test and continue to use the pile for further improvement.

What you are see here is call as a Kent Ledge, here some eye sections your test pile is somewhere in the middle of this you are loading it by a jack using sand bags for loads. Then use other piles there may be four more piles here at four corners that will give the reaction.

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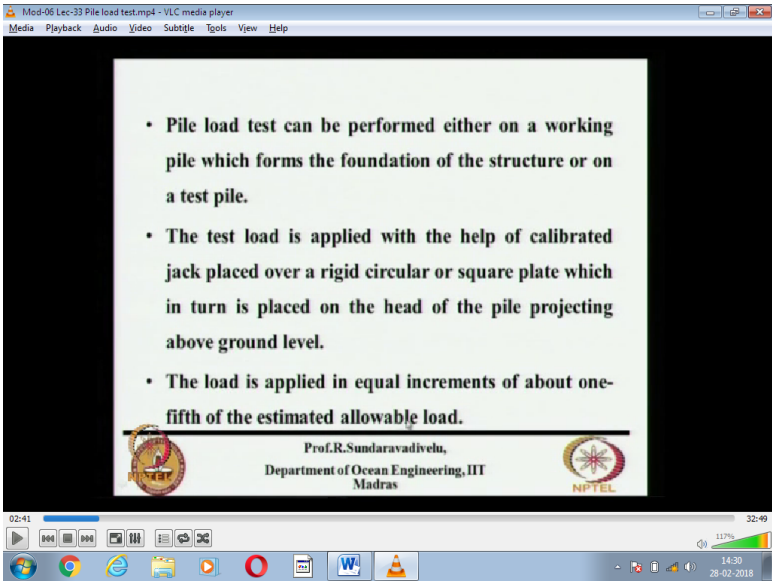

So this can performed either on a working pile which form the foundation of the structure or on a test pile test pile is a initial load test pile. This test pile is applied with the help of calibrated jack, at jack will be having a load corresponding to the pressure this has to place or a rigid circular or square plate this plate is placed on top of the pile on this pile should be projecting above the ground level.

So you have the pile which is projecting above the ground level put a plate then you put a jack then apply the load, and when you apply the load you have to apply an equal increments about one fifth of the estimate allowable load. Suppose estimate load is about thousand tons increment as two hundred, four hundred, six hundred, eight hundred and thousand. Sometime they use one tenth hundred two hundred three hundred like that.

The point here is you apply a load of hundred tons do not take the reading and go to the next increment you keep it for some time for it to be stabilise. So you have to load it than unload it also.What we record is the load that is from the jack the also you have to record the settlement's. You surely you use three dial gauges.

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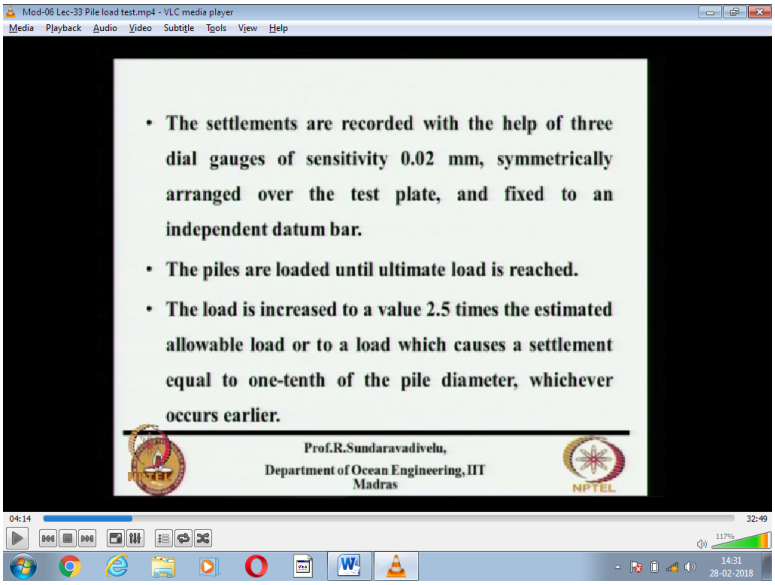

The sensitivity is pie not mm that means it can measure minimum of zero point zero two mm, and these three gauges should be symmetrically over the test plate and fixed train independent datum bar. So there is a independent datum bar which you fix the dial gauges so that will be the pile going down you can measure the settlement of the pile. The initial test piles you load until the ultimate load is reach sometimes you may not be able to reach the ultimate load. In such a case we apply the load up to two point five times estimated allowable load.

Suppose two four hundred tons is the capacity of the pile you need then you load it up to one thousand tons four hundred into two point five, or we have to apply the load which causes a settlement equal to one tenth of the pile diameter suppose pile diameter is thousand two hundred mili meters, settlement you have to measure up to one twenty mili meters. Whichever occurs earlier suppose a one twenty mili meters occurs earlier suppose let us say eight hundred tons you have to stop at that point of time.

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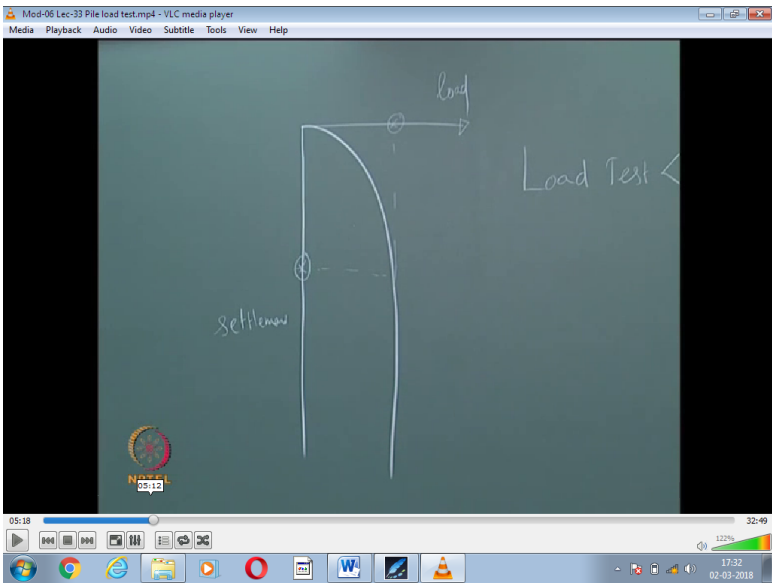

So you have to plot the load settlement curve the ultimate load is indicated by load settlement curve approaching vertical. You will get load settlement curve like this so when it became vertical so this settlement this load, this you are test load this is you settlement. There are other categories also two thirds of the final load which causes of settlement of twelve mili meter or two thirds of the final load which causes a net settlement of six mm. So this is some advance options that I am not teaching now.

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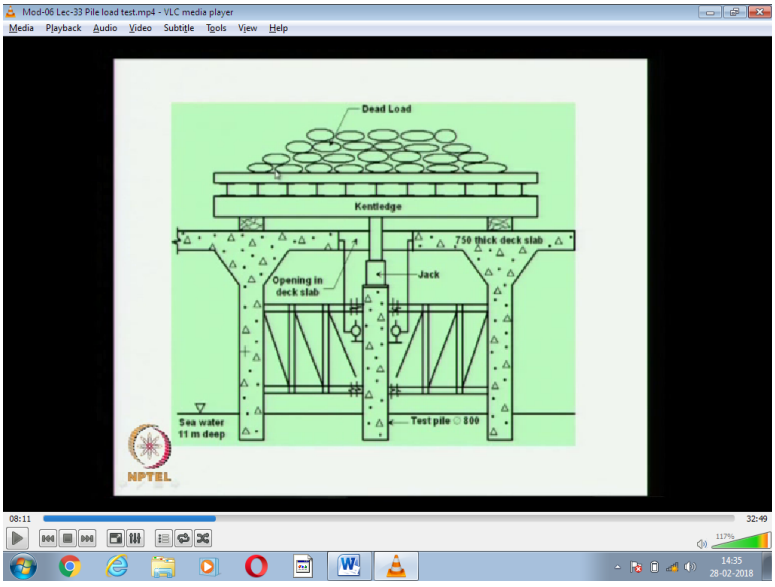

So this you are load test arrangement details are given here, this is called a Kent ledge this is a dead load, dead load means you can use anything normally they use the sand bags, bags filled with sand. This are the points which supports the Kent ledge, there is a truss which is connecting down. This is your pile you are toing about a plate, plate will be somewhere here, this is you jack this is a piston of the jack, suppose you want to make deck slab you make the deck slab but leave a opening here so the jack will go open down and this frame is attached to the this and you can measure the I am sorry this frame is not attached this is connected only this two piles. You have two dial gauges not here to the test pile than this is connected to the rigid based that is a slab permanent bench mark through which you can raise the settlement.

So this test pile is done in off sure condition where we have a sea water for board lawn meter deep below this, this is a water level so you raise the pile above the water level then put the Kent ledge and load it. Now I will explain the test procedure, test procedure what you do is first you cached there may be four pile at four corners the middle you will have the test pile on the four corners you put some pats or supporting the reaction put some steel graders like this this are the e sections what you are see this are the e sections other directions and one more e section is here on top perfect this called grill ledge foundation. And this grill ledge foundation for thousand tons you put the sand bags.

Where the load will go, where will the load go, yes it will go to the four corners piles. Then what you do is, you apply the jack then the piston will go and touch it. Then you apply hundred tons this total weight is thousand tons you apply hundred tons here. What will be the load coming on to this hundred tons. What will be the load going on the four corners thousand minus hundred nine hundred tons will go; it is clear, initially all the load when the jack is not touching will go to the four corner piles. Subsequently you apply the load when you apply hundred tons hundred tons will go here reaction the balance nine hundred will be shade here,then two hundred three hundred like this.

Finally all the thousand tons will go here and if the load is not thousand tons whole Kent ledge can be fall down ok, or only if you want to test for thousand tons report twenty percent extra thousand two hundred tons.So that, your thousand tons is applied here and two hundred tons going as reaction. Is a time consuming process but it most commonly used method.

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This shows the photograph where you are seeing these two frames attached some bench mark then there is one plate which is connected to this test pile where you measure the deflection this is a jack the piston then you have this Grill Ledge then eye section with a web stiffener so the load is transfer, the purely temporary arrangement butthis has to be done. Minimum on initial load and three working pile load is require to be done.

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So you can see the Grill Ledge and see the sand bags inside if you want to full lose sand also no problem. Suppose you want to apply thousand tons and you are staking for about five tons five meters then what you need is thousand by five that is two hundred square meter. Two

hundred means it will above fourteen meter by fifteen meter you have to stake the load, any doubts in this. .

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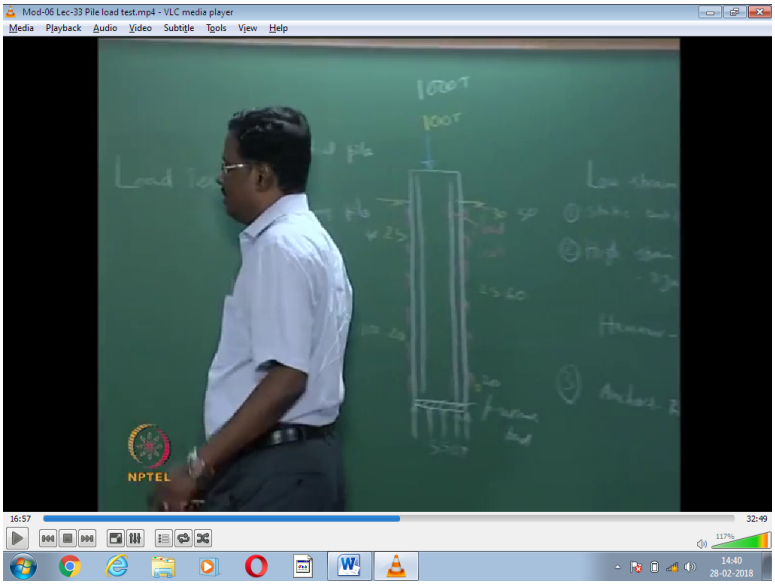

See this method is very compressive very difficult and all those things, so yesterday we have seen some integrated test this called as low strain integrated test, we also have another test called as high strain integrated test this also called as dynamic load test. So what you have seen in the earlier presentation is static pile load test, you apply a static load then applied.

So in a dynamic pile load test or in high strain test you have to use one hammer this hammer is about one percent of the test load capacity but it is four tons four hundred tons you have to use a four ton hammer and there is dwarf may very prompt point five meter to three meters. It is clear the low strain integrated test which you have discus in the last class you say hammer and tap it here what you do is you take a that is a hand held hammer here it is a heavy hammer which four ton you cannot lift four ton and done you need a separate rick to test it to lower it the dwarf of one and half three meter then measure the record base on the record you can get the pile load capacity pile capacity ok so this is the static pile load test.

The second one first one is static using this Kent Ledge, then the static Kent Ledge also we have two types one type is to measure only settlement the another type is measure skin friction and end bearing see what do we do in this case, so what we do is we have the pile, bottom of the pile you put a pressure pad along with the rein enforcements you attached load

cells, attached load cells then you apply the load so earlier you are only measuring the settlement now you measure the load in the load cell as well as the pressure pad.

So suppose this is your soil level there is two methods by which the load is transferred one of the method is by skin friction which will act on the side another one is end bearing it will take place on the bottom suppose you apply hundred tons load, let us see that you apply hundred tons and this may take eighty may take twenty five and this fifty what I am telling is out of hundred tons this will be twenty five plus twenty five fifty plus eighty, eighty plus twenty hundred, hundred tons will go.

But suppose this goes to thousand tons let us say at the end it goes to thousand tons this may go to fifty this may go to forty may go to sixty, go to hundred, go to two hundred balance will go three hundred three sixty four hundred four fifty balance will go to five fifty tons so depending on the layer the distribution randomly place the distribution load taken by skin friction depend on the strength of each layer.But when you apply hundred ton there may not be any unbarring going to the bottom of the pile because soil itself will take the pressure.

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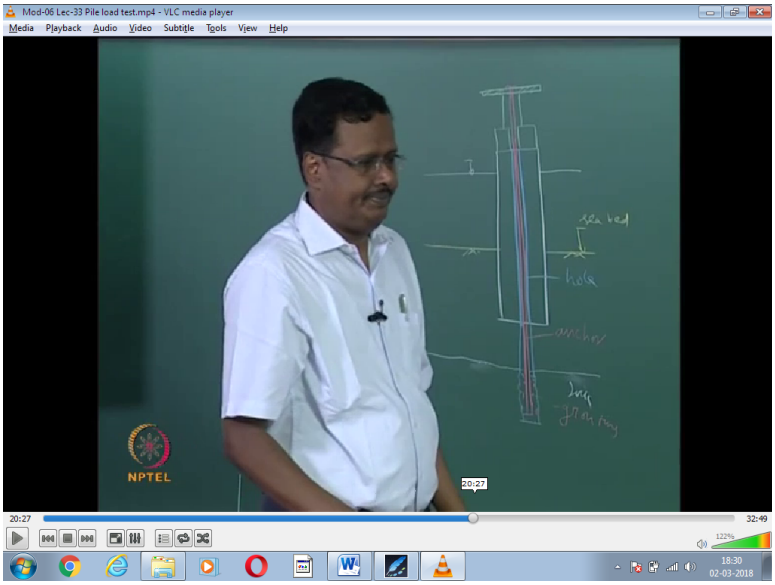

Then you can also do the test you seen what is known as anchors you call as a rock anchor. This test is most commonly use for marine structures where rock is available, so in this method what we do is we have the water level here we have the, this is your see bed level, so in this particular method what will do is we will have a hole which will be made inside through this hole we will be inserting one anchor, the anchor will short from put this like this

suppose this layer is a rock let us say so this go like this then will penetrate through the rock there will be any tube then will be grow ting this portion, this is the grow ting this is your anchor this is your hole.

So here will place one jack there will be a jack will be hollow jack, narrow opening here through which you can take the anchor then will have the piston going tab piston also will have a hole then will have the plate, so this anchor will be connected to the act like this bolt and nut arrangement. So you seeing the jack just apply the load what you trying to do is, you are trying to pull the anchor right. You want to pull the something there should be a reaction that reaction will go to the pile, right. This anchor should be of having sufficient capacity only rock is available you can do the, this method this is another most commonly used method.

So we have three methods only you seeing the static pile out test there we have two variations of measurement one is settlement another is confriction and end bearing second one is high strain integrated test which call as dynamic pile out test where you have to use the hammer which is capacity one percent of the test load that is to be done then we need some anchors if rock is available and do the test something like this.

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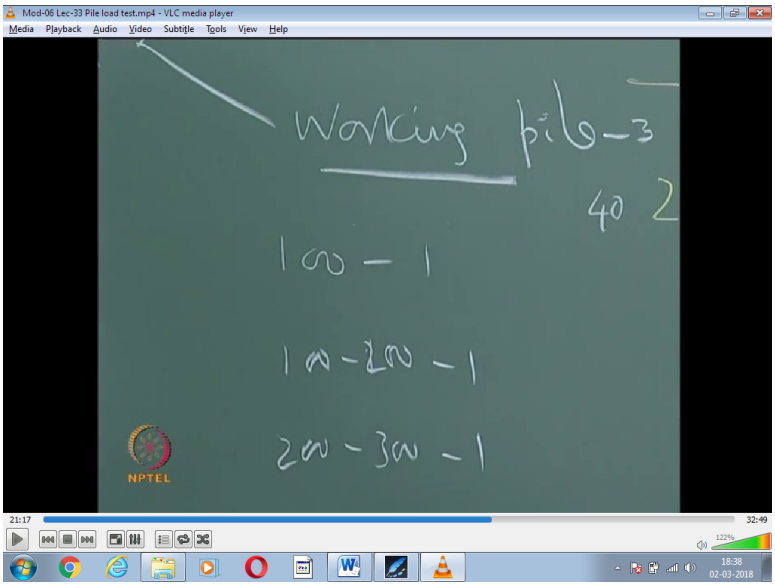

Another important aspect is this initial pile load test suppose there are about three hundred piles we have to do, is preferable that initial pile load test is done before starting the three hundred piles, you cached it separately do the test separately then do it. This working pile, you should not complete all the hundred piles suppose you have to do three working pile after

hundred piles you do first test after another hundred two hundred we need to do test one more pile, two hundred to three hundred test one more pile. Do not do it after everything is over they have done for flyover and they find lot of problem after completing all the piles you cannot do.

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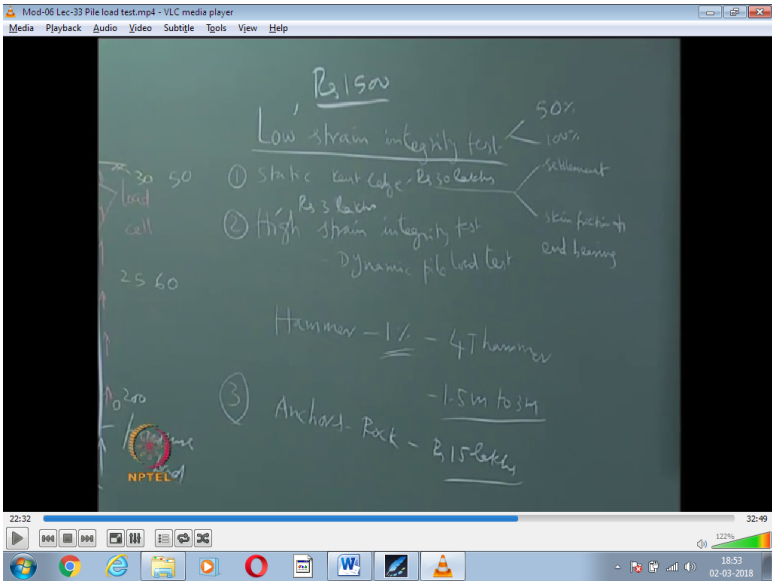

So you have to do the initial pile load test, initial means before driving any working pile you have to do the initial pile load test. Then this low strain integrated test is people say fifty percent of the piles and people say hundred percent of the pile that means one fifty pile you have to do the low strain integrated test, or nothingyou have to do, some people say hundred percent the cost is not very high the low strain integrated test if you are doing in large number they will cost what about thousand five hundred.

This high strain may cost about rupees three to five lacs, three lacs only, three lacs this static pile load test is very expensive it may cost as much as thirty lacs, this rock anchor is little bit less may be fifteen lacs will be able to do depends on the load type of soil and things like this.

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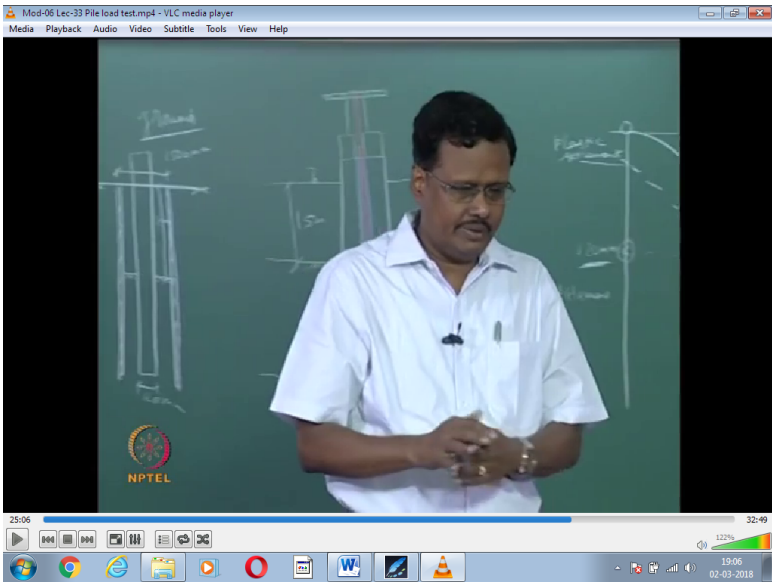

When you unload this curve will go something like this at zero load you may not have zero displacement this is zero as say this is your thousand tons to say this is your one twenty millimetres. Giving the limit case suppose the diameter of the pile is one point two meter one percent of the T ten percent of the T is one twenty millimetre so this is what is called as a plastic settlement.

This initial pile load test when you do they for a correct exact for doing this type of test you will go to the see bed suppose there water depth is about fifteen meters you have to have a gantry to do all these things, so initial test pile in exact condition cannot be done. So what you do is the initial test pile how to do it in the ground, ground means land see what you do is there will have the cured level here, no water here, then you drive one casing pipe this casing pipe is larger diameter then your test pile, as assume this diameter is about thousand five hundred mm, then you act your N pile diameter is thousand two hundred millimetre.

Then you remove the soil to this level suppose this free standing length is fifteen meter you remove the soil up to fifteen meter you want por water you can por water also to do the test because you want to simulate similar condition provided at the ground as well as the off sure location the soil properties are same we do not want the skin friction go into this area that is why we do this. So this is the three methods that is most commonly use for pile load test.

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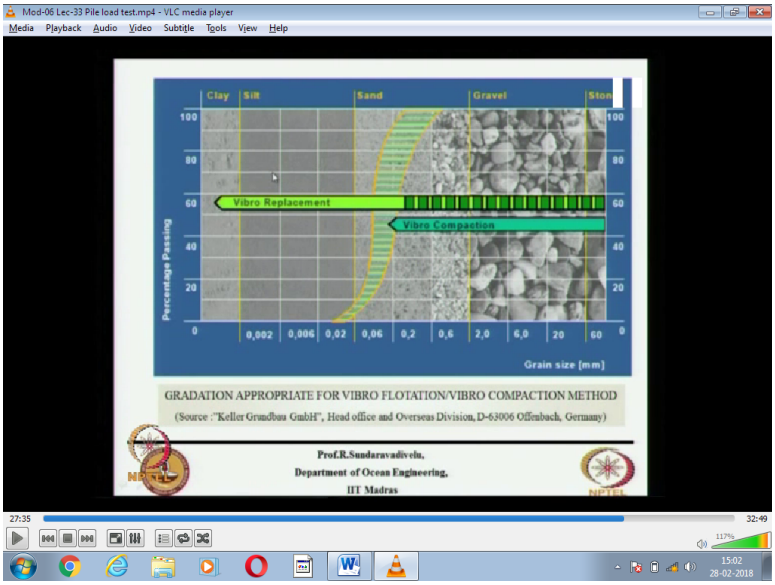

So we will discuss about this ground improvement in the next class but this figure you please understand what is given is percentage of passing to receive, there are two methods are given vibro replacement and vibro compaction this will study in the next class. What is given in this X axis bottom is grain size, grain size means this particle size of the material so this particle size is six millimetres this is twenty millimetres, this is sixty millimetres.

Here the particle size is zero point zero zero two millimetres, here it will be less than zero point zero zero two, if it is less than zero point zero zero two then you will have a clay layer. The particle size is between zero point zero zero two to about zero point not two than it is called as silt. It is bigger up to point four mm it is called as sand, than I think the glass wade up to this may be one millimetre they will called as a sand beyond that it is called as a gravel then more than forty mm they called as a sand stone wizard is strict this boundaries can change so in principle the smallest size is clay the biggest size is stone so we have sand bigger about a millimetre is gravel and less then about point not two mm is the silt.

So if you want to improve the ground the method will be different for different types of soil layers it is what is given here so here it is the ulta this side is smaller side clay this side is silt and this side is sand, if you have a stone under you do not need any compaction any ground improvement so if it is any other type of soil you have to do ground improvement. These are the various methods vibro compaction, blasting, chemical grouting, compaction grouting, dynamic deep compaction, soil mixing, jet grouting. Jet grouting can be adopted for any type

of soil where as vibro compaction and blasting generally recommended for sand not for silt and clay.

For clay generally soil mixing is used, so these are the methods by which you improve the ground. Why I discussing the ground improvement is suppose you have a very poor soil you want to transfer the load without improving the soil only by piles the cost of the project is three hundred crores. Suppose you do ground improvement then you install the pile then you do the constructions cost can come down to even hundred crores is it clear, you cannot simply going for structural piles for the test for taking the load the soil is very bad it is preferable to do all these things but another important method that is used apart from this, are in combination with these, this what is called as pre loading the time consuming method.

This method what we do is you go to the place just like Kent Ledge you stack six meter height of soil, leave it for one year then remove the soil since you are loaded the ground with the six meter of the height that is may be about ten tons per meter square load it is kept for longer time, the settlement what has to take place what have already taken place. See the pile load test, it is not the load this is final thing which you should remember, it is not the load what the pile can carry it is a load which it can carry with permissible settlement, settlement we have two types of settlements one is call as permanent settlement another is called as differential settlement so this load test what we want to find out is the settlement, settlement means how much the pile goes down so we have two types of settlement one is permanent settlement and another is differential settlement or we can call permanent or total settlement also.

Differential means when we have two piles at this two ends this pile is settling more and settling less the difference between them that is very critical. Suppose both the pile settle one twenty millimetre there is no problem suppose one pile settle by ten milimetre another pile settle by hundred millimetres different settlement is ninety millimetre that is not permitted so clear.

I have given one twenty millimetre one percent of the pile diameter is a permissible total settlement, all the piles goes down by one twenty no problem one pile goes by ten another goes by ninety both are less than one twenty but the difference is about eighty millimetre that is not acceptable so in civil engineering practice you should know what is the acceptance criteria, it is there for all behaviours crack weight what is the permissible crack weight zero

point zero zero four times that curve, the curve you sound a millimetre you can permit point three mm, the curve is fifty meter you can permit only point two mm.

Similarly settlement what is the total settlement what is the differential settlement similarly the stress level also, so every case you should know what is actual stress that is occurring on the structure, what is the acceptable stress or acceptable value it depends on the material what you are using ok see in the next class.