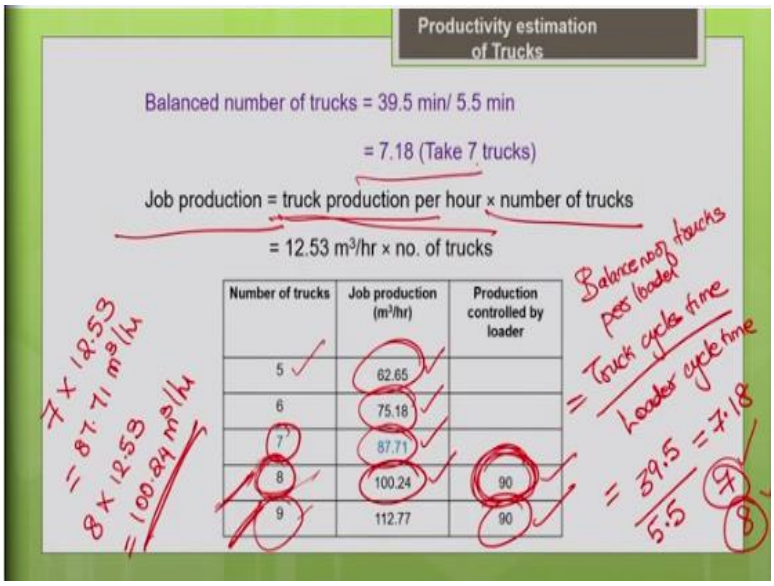

Now let us find the balance number of trucks needed for one loader. So, that depends upon your the balance number of trucks per loader going to be serve by one loader is equal to your truck cycle time divided by load of cycle time. So, you have estimated the truck cycle time earlier, so estimated it is 39.5**.**

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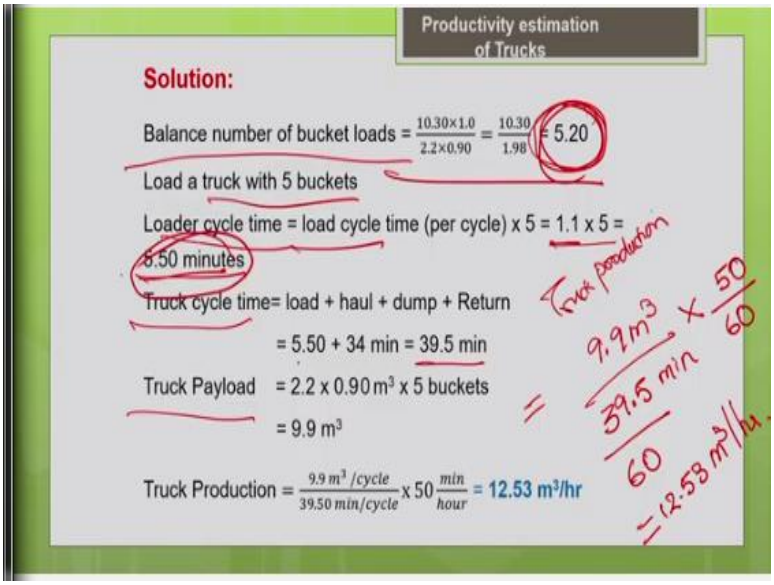

The truck cycle time is 39.5 and the loader cycle time is 5.5, we have calculated the loader cycle time as 5.5. So, this gives me the balance number of 7.18, here also I did not get the old number, so I have to do the rounding either I can round it to 7 or I can round it to 8. So, but the logical thing is you have to work with the economics of both the cases and then take the decision. So, here I am going to work out the economics of both the cases.

So, just to give you a better explanation I am just working out what will be the economics when I go for different number of trucks. Say if I go for 5 number of trucks 6, 7, 8 and 9**,** how the productivity will vary, how the unit production cost will vary? We will work it out and see, so that will get a clear picture on what is the effect of number of trucks, and what is the effect of increasing the number of trucks beyond the balance number on the unit production cost**.**

So, we will do in-depth analysis by working out for all the number of trucks. So, basically how to estimate the job production? So, it is nothing but your single truck productivity multiplied by number of trucks, that will give you the job production. So, provided the number of trucks are lesser than the balance number. In that case you can calculate by that, because when the trucks are lesser than the balance number or equal to balance number your truck cycle time will govern the productivity**.**

But when the number of trucks is your balance number say 7, so actual balance number is 7.18. So, when the numbers of trucks are lesser than the balance number say 5 trucks, 5 into productivity of your truck, individual truck productivity is 12.53-meter cube per hour. So, that gives me the value is 62.65-meter cube per hour**,** this is what you got. Similarly, when the number of trucks is 6, 6 into 12.53-meter cube per hour that will give me the answer is 75.18**.**

When the number of trucks equal to 7, 7 multiped 12.53 gives me the productivity as 87.71-meter cube per hour. When the number of trucks is 8, 8 into 12.53, I am getting the value as 100.24-meter cube per hour**.** But I cannot go by this productivity, this is because when the trucks are lesser than the balance number equal to balanced number your truck will be controlling the productivity of the system.

Beyond the balance number**,** so you can see that number of trucks are more so the truck will be waiting for the loader unless the loader is available your truck cannot do the job. So, the productivity here will be controlled by your loader. So, beyond the balance number you can see that you cannot go beyond the productivity of the loader because the load of cycle time will control the productivity of the system, for cases above the balance number.

You cannot go beyond the productivity of the loader beyond the balance number. Though the number of trucks or more you have 8 trucks, you have 9 trucks but the trucks will be simply waiting for the loader only. That is why it is not preferable to increase the number of trucks beyond the balance number. Because the trucks will be just waiting for the loader**,** so you cannot go beyond the productivity of the loader.

So, unnecessarily it will increase your production cost because of the increase in the cost of trucks. Even though I get the productivity as 100.24, if I go for 8 trucks but the actual productivity will be only 90-meter cube per hour. Because I cannot go beyond the productivity of the loader, loader will be controlling beyond the balance number.

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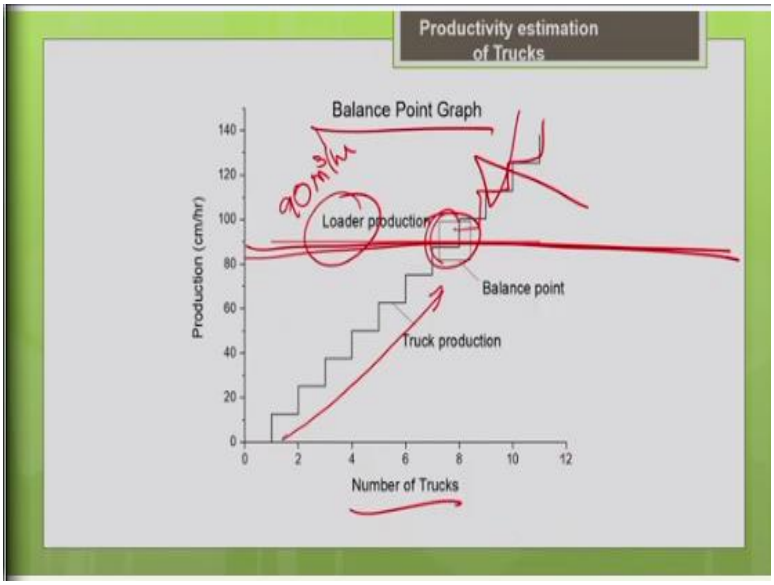

This picture the balance point graph clearly illustrates what is the significance of the balance point. So, as you keep increasing your truck number you can see that the productivity is significantly increasing. At the balance point you can see that the productivity of your truck and the productivity of the loader will be same**,** loader productivity is 90, the load of productivity is 90-meter cube per hour.

At the balance point both the machines are working at same productivity, but beyond the balance point even if you increase your trucks you cannot get this productivity, you cannot go beyond the

load of productivity level, that will be the limited value. Because you have only one loader whether you have 8 trucks or 9 trucks or 10 trucks, all these trucks are going to just wait for the loader**.**

So, it is not advisable to increase the number of trucks beyond the balance number because there is only one loader here that will be controlling the productivity of the system.

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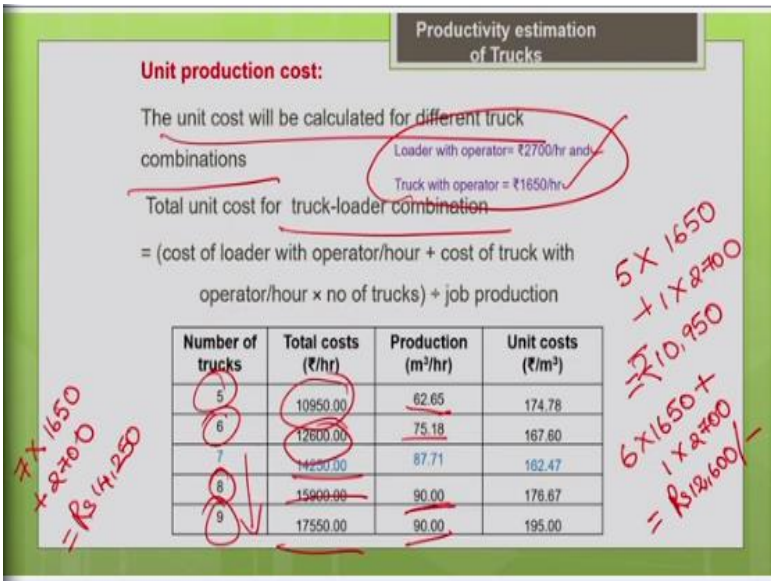

Now let us work out the economics because most of the decisions are based upon the economics. People are more concerned about the unit production cost associated with the machine. So, whichever combination gives you lesser unit production cost we will advise that combination**,** so that is how we are supposed to follow**.** The unit cost here will be calculated for the different combinations**.**

So, how to calculate the total unit cost for the truck loader combination I need the input data, so the input data is given to you what is the cost associated with the loader and the truck**.** The hourly cost data is already given to you as rupees 2700 per hour for the loader and rupees 1650 per hour for the truck. Now let us estimate the total unit cost for the truck loader combinations for different number of trucks**.**

Say for first for 5 number of trucks, how will you calculate the total cost? Total cost is nothing but 5 multiped what is the hourly cost of truck 1650 plus there is only one loader 1 multiplied by 2700.

So, this gives me the cost is 10950 rupees, this will be the cost associated with the 5 trucks. Similarly for the 6 trucks, 6 multiped 1650 + 1 multiped 2700, so this gives me the cost is rupees 12600, you can get this.

Similarly for the 7 trucks, 7 multiped 1650 + 2700, this gives me the cost is the rupees 14250 per hour**.** Like this you keep calculating for 8 trucks and 9 trucks you can calculate the cost, total cost per hour. Now your productivity already you have estimated the productivity in the earlier table 62.65, 75.18, 87.71, but you have to note that beyond the balance number the productivity will be only 90, I cannot go beyond 90.

Because beyond the balance number the productivity is controlled by loader whose productivity is 90-meter cube per hour**.** So, that is why you can say the productivity is only 90 beyond the balance number**.** Now you have to calculate the unit cost of production, how to estimate the unit cost of production?

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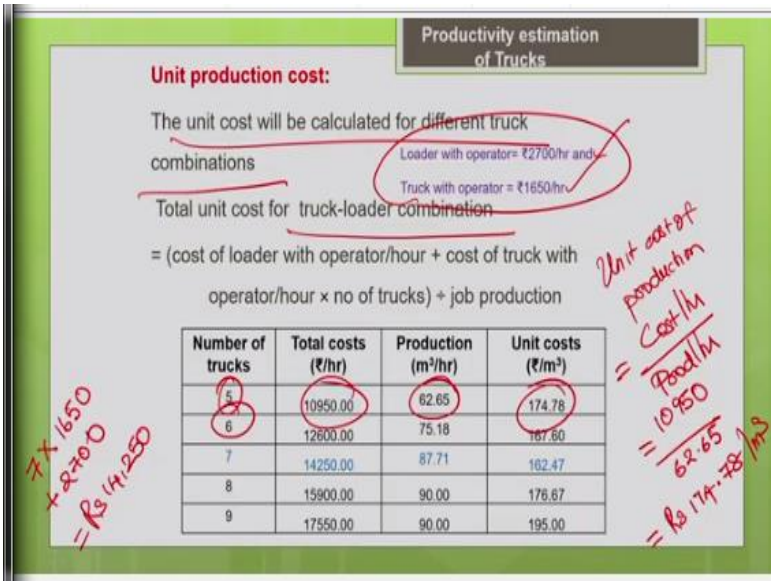

Unit cost of production is nothing but cost per hour divided by productivity per hour. So, for the number of trucks 5, so for 5 trucks what is the total cost 10950 divided by productivity is 62.65**.** So, this gives me the answer as rupees 174.78 per meter cube, this is the unit production cost associated with 5 trucks, similarly for 6 trucks you have to calculate, 6 trucks.

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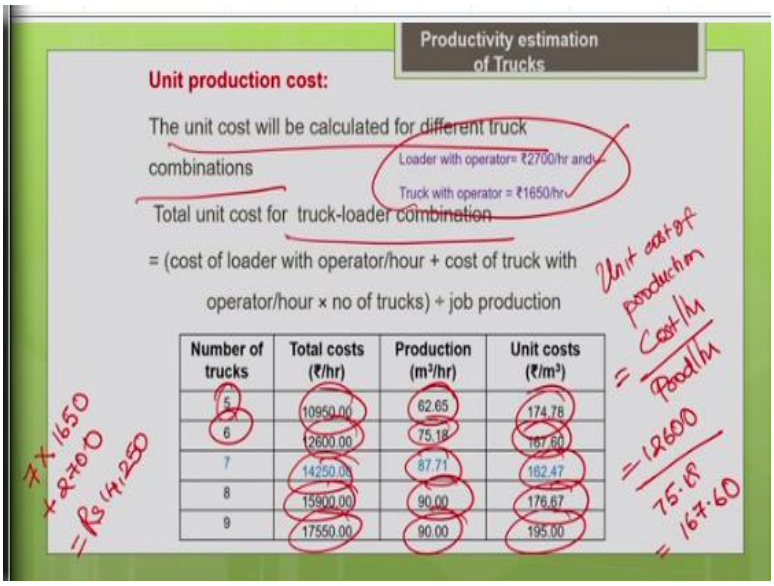

It is nothing but 12600 divided by 75.18 gives me the value is 167.60, you can see here. Similarly, you find the unit production cost by dividing total cost by productivity, you will get the unit production cost for all the cases you can just find it for all the cases 5 trucks, 6, 7, 8 and 9**.**

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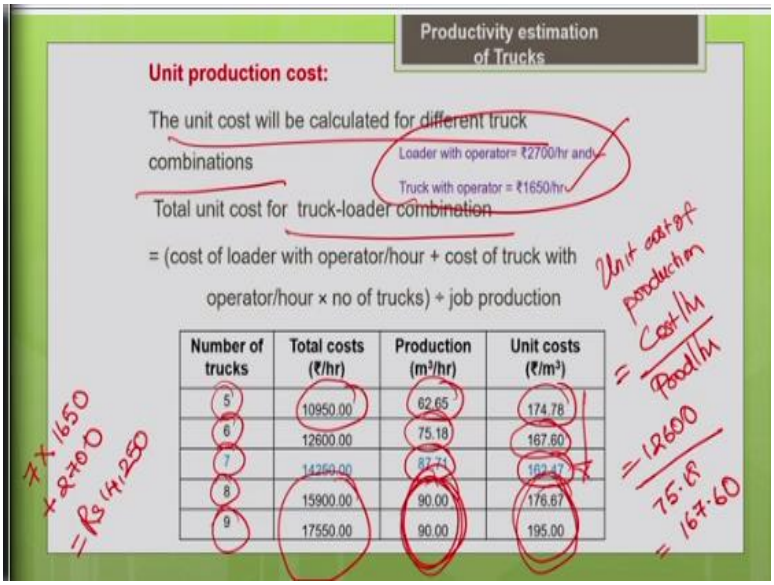

So, one important thing you have to note here is when the number of trucks is 5 though the total cost is less in this case, but the productivity is also less, that is why you can see that the unit cost is high. But as your number of trucks increases you can see that the productivity increases significantly, that is why your unit cost of production reduces**,** it is reducing. But beyond the balance number 7 when I try to increase the number of trucks, there is no increase in productivity.

Because the productivity is limited by loader, I cannot go beyond 90, but your truck causes unnecessarily increasing**.** So, because of that I can see that the unit cost increases significantly, unit production cost increases significantly, that is why it is not advisable to go beyond the balance number**.**

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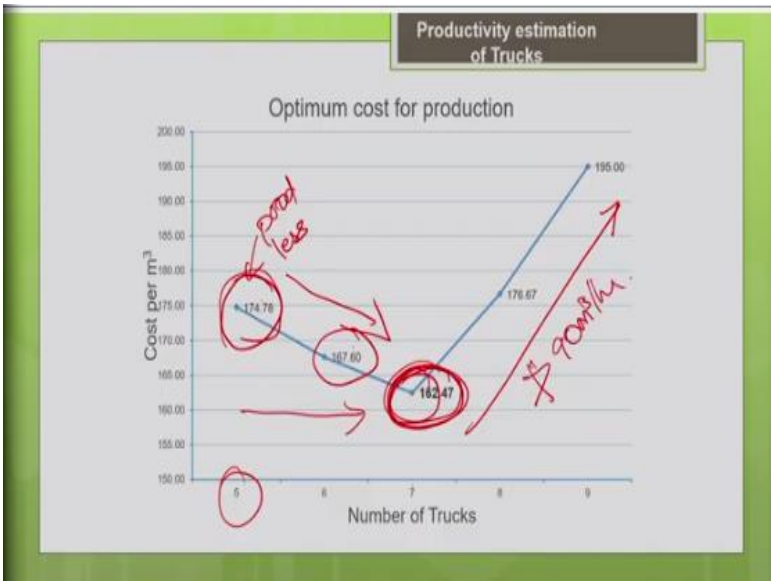

So, graphically you can see this**,** so when the number of trucks or less your unit protection cost is less when the number of trucks is 5, when the number of trucks is less the unit production cost is higher than the optimum value. You can see the optimum value for the number of trucks 7 the unit production cost is 162.47**.** But when you go for 5 trucks you can see that the unit production cost is higher than the optimum value, why it is higher than the optimum value?

Because here productivity is less in this case, but when you increase the number of trucks you can see that the productivity will increase significantly, so your unit production costs keep reducing**.** And when you reach the balance number you can see that you can have the minimum unit production cost. But when you try to increase number of trucks beyond the balance number, what is happening? There is no increase in productivity.

Beyond the balance number the productivity is limited by the loader, so I cannot go beyond 90 meter cube per hour that was the productivity of the loader I cannot go beyond 90 meter cube per hour.

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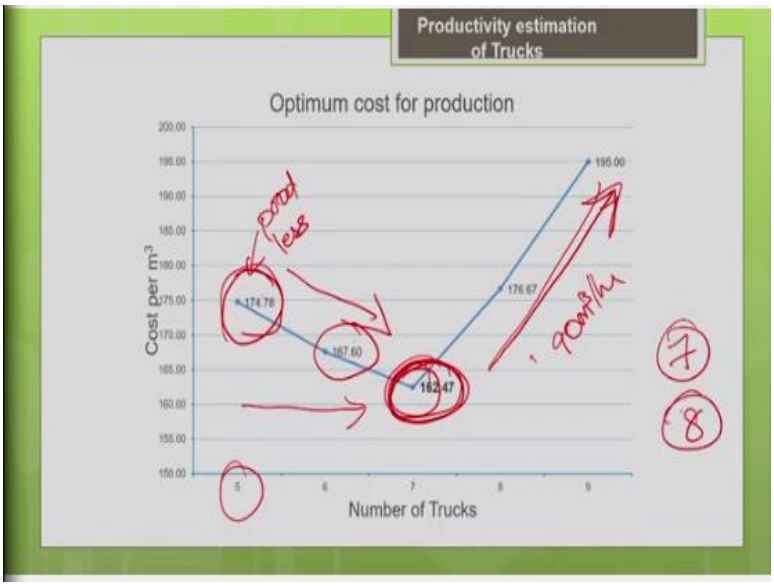

But and your cost of the truck is increasing that is why you can see that unit production cost significantly increases. So, it is always preferable to go by the balance number, but in this case our balance number was 7.18**,** it was 7.18. So, whether to round it to lower number or round it to higher number, whether I should go for 7 or whether I should go for 8. If I go for 7 my unit production cost is 162.47.

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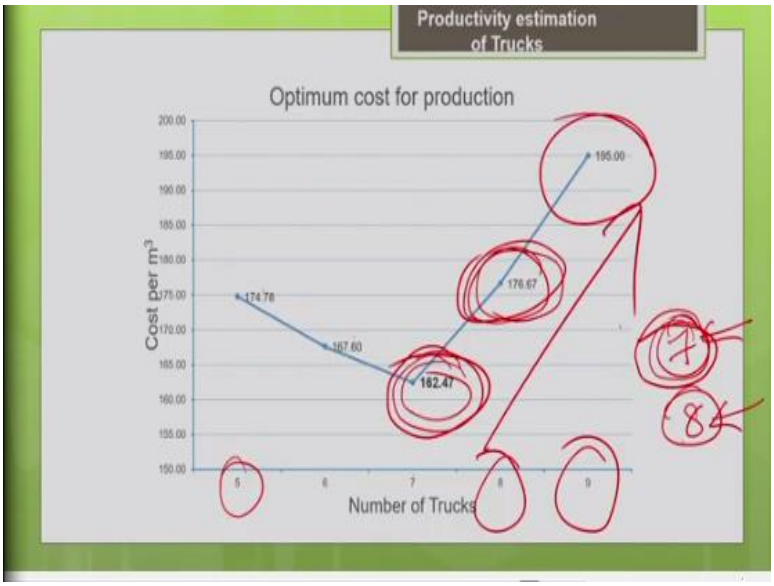

If I go for 8 trucks my unit production cost is 176.67, so it is preferable to round it to the lower number, rounding to lower number is preferable. As I told you this is what is commonly followed,

when you round it to lower number you can avoid you can give some break time for your loader**.** That is also one way good, the loader will help you in clearing the addressing the site as I told you**.**

The site as well as there will be some break time for the loader, and it will get ready to load the next truck. That is why people always prefer to round it to lower number, but anyway it is always preferable to work out the economics of both the cases, I have worked out and showed you. You can see that for lower number of trucks the unit production cost is very less for 7 in this case.

For when you go for 8 there is no significant increase in productivity that is why you can see that the unit production cost increases significantly**.** So, whether you go for 8 trucks or 9 trucks there will not be increase in productivity, there will be just increase in the truck cost, that is the reason which is significantly increasing.

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So, we have come to the end of this lecture, let me now summarize**.** We have discussed about the different types of trucks and I told you the importance of checking the payload the weight of load inside the truck against the rated gravimetric capacity. You should never overload the machine which will result in premature aging of your truck as well as the tires**.** And dumping time when you calculate, you should know that it depends upon the mode of dumping whether you are going for rear dump trucks or bottom dump trucks.

And the material type easy flowing or tough material and also it depends upon the congestion in the dump area, all these things are going to affect your dumping time. So, when you work in a team with machines, so basically the all the interdependent machines should be balanced in their size as well as it should be balanced in number. Excavator and truck should be of compatible capacities**.**

Based on studies they found that truck capacity should be 4 to 5 times the bucket capacity of the excavator, that is the ideal case. So, then the number of machines also to be balanced at the balance number of machines you can see that both the loading unit and the hauling unit will operate at the same production level**,** you will get your maximum efficiency at the balance number, the waiting time will be minimum.

And always whether you are going to round it to a lower number or round it to the higher number, work out the economics. Work out the unit production cost associated with both the cases and then evaluate the balance number and decide your selection**.** Estimation of job cost I have done it already by evaluating the equipment balance.

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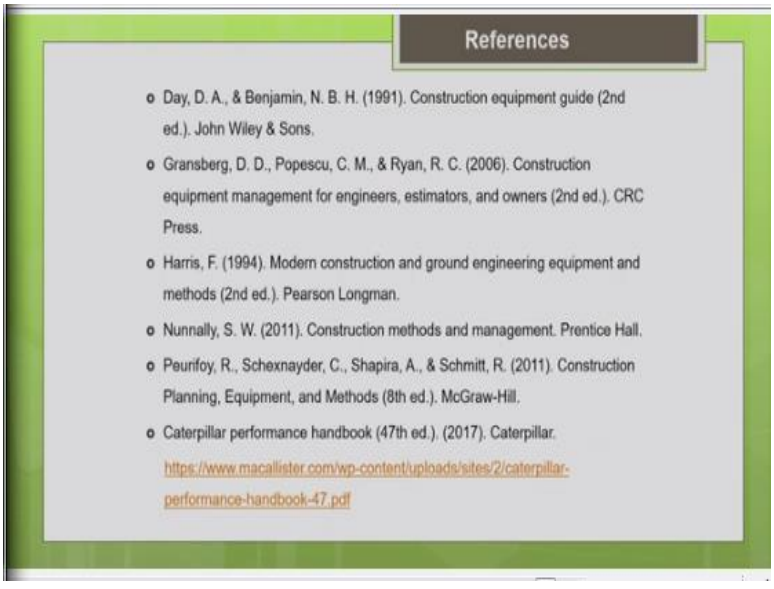

So, these are the references which I have referred for this lecture, you can try to procure these textbooks for preparation. In the next lecture we will be discussing about the piles and the pile driving methods, thank you.