Introduction to Accounting and Finance for Civil Engineers

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Lecture-25
Bidding (Part-4)

Good morning, namaskar and welcome to the course once again. In the last lecture we learnt how to prepare tender summary for a particular case project. We learnt how to identify those key objects which influences my bid price, in this lecture we are going to pursue further the tendering process and we will learn how to carry out rate analysis. We will like to see how to carryout the rate analysis for direct cost items, we will also like to see how to carryout rate analysis for indirect cost items.

Subsequently we will learn how to apply markup and then we will see how to prepare the total bid price, so we straightaway move to the problem.

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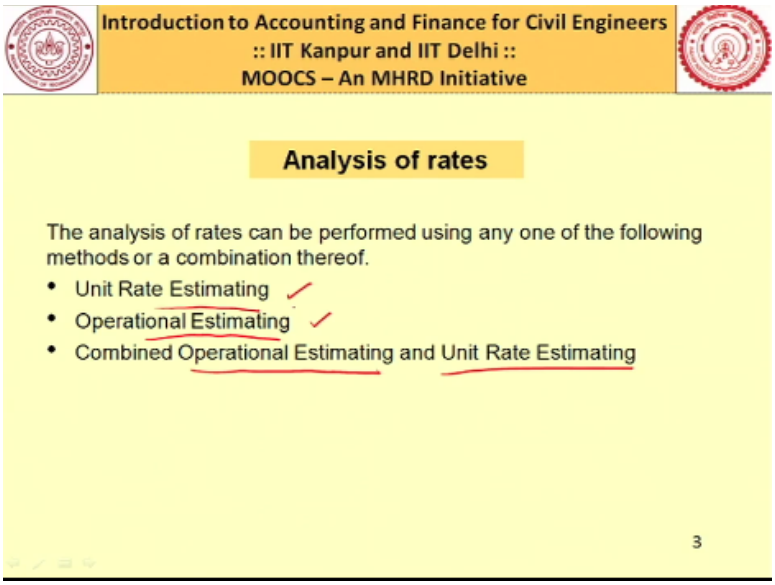

Now there are 3 ways in which we can carryout the rate analysis, the first one we call it as unit rate estimating and the second one we call it as operational estimating. In some cases we may

have to combine these 2 methods and we call this as combined operational estimating and unit rate estimating. We will try to take few examples for each of these methods and we will illustrate you how to carryout the rate analysis.

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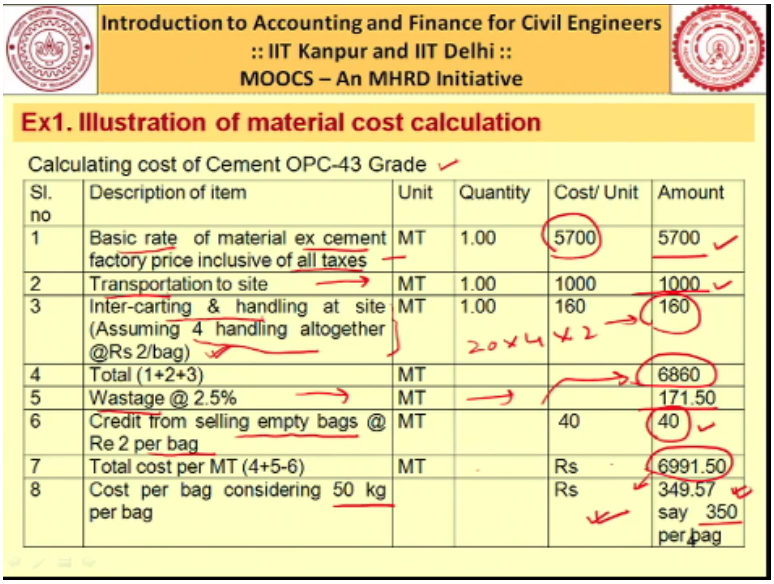

Now as far as unit rate analysis is concern we will apply this method in order to illustrate the costing of cement. Let us say the cement is OPC-43 grade and you would like to find out the unit cost of this particular material. Now if you remember in previous lecture I told you that when you calculate the cost of material you have to consider the basic rate, you have to consider the transportation cost, you have to consider some other cost such as that cost you incur in inter-carting and handling.

You also have to incorporate wastages if there are any and thereby you try to get the total cost. So, here I am trying to find the cost of cement 43 grade, the basic rate of this particular material X cement factory price which is inclusive of all taxes, I collected the quotation and I find that it is 5700 rupees per metric ton. So, this is the cost I have written here, then depending on the site location from the store you can add the transportation cost.

Here for this particular site I have added 1000/metric ton as transportation cost for this particular material. Then I am further assuming that at the site I will be roughly doing about 4 handling all together, so when the material comes to the store I will be unloading it. Then when the material

goes to a particular site location there it will be at unloaded. So in total I am assuming that I will do 4 handling and each handling let us say it is costing rupees 2/bag.

So that way I have calculated it to be 160 rupees/metric ton because in 1 metric ton you have got 20 bags, 4 handling 2 rupees/bag. So 20*4*2 that brings me 160 rupees/metric ton, so if you add all 3 you will get 6860 rupees. Now in cement it is usual to have a wastage of about 2.5%, so that cost also leads to be included. So, I have calculated the wastage 2.5% on 6860, now sometimes you sell the empty cement bags also.

Let us say the cost of selling that empty bags is coming to be rupees 2/bag, so I am detectying this cost from the total cost. So 20 bags in 1 ton of cement and if you are getting a credit of 2 rupees/bag I am getting a credit of 40 rupees. So this cost is getting subtracted from my total cost, so the total cost/metric ton is coming out to be 6991. Now each bag is consisting of 50 kg cement, so per kg cement you can calculate it by dividing it by 1000 or if you want to do it in per bag which is 50 kg you divide it by 20.

So you get 349.57 which is roughly about 350 rupees per bag, so this is how you calculate the cost of OPC-43 grade cement.

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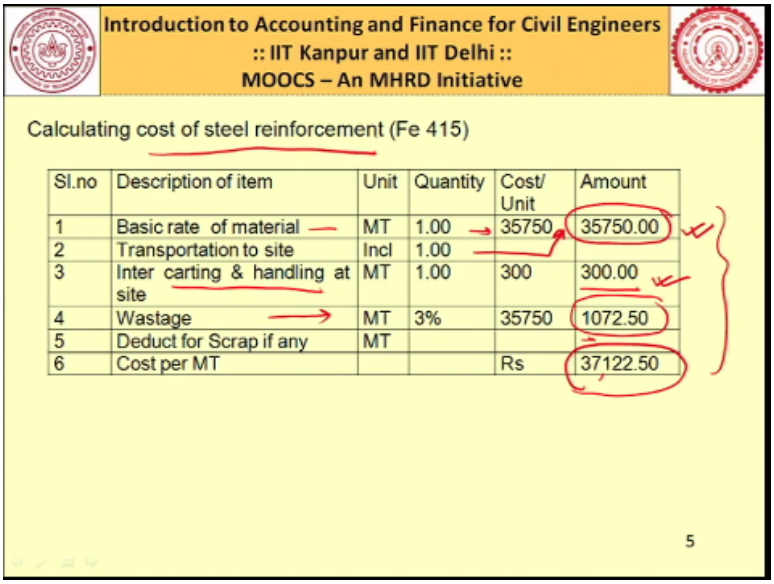

I will give you few more illustration, let us say I try to calculate the cost of steel reinforcement, so here I find the basic rate of material as let us say 35,750. Let us say this cost is include ship of transportation cost also that means this cost I am incurring at site. So, this is also sometimes called as landed cost, now at site I am incurring certain cost on inter carting and handling let us say it is coming to be about 300 rupees/metric ton, wastage in steel roughly it would be about 3%.

So I am getting 1072.50, so total I add it up if I am selling my scrap then that credit I should have got for this particular costing. But right now I am assuming no credits, so 0 here, so if you add all these values you are getting 37122.50. So this is how using unit rate method we are able to calculate the cost of steel reinforcement.

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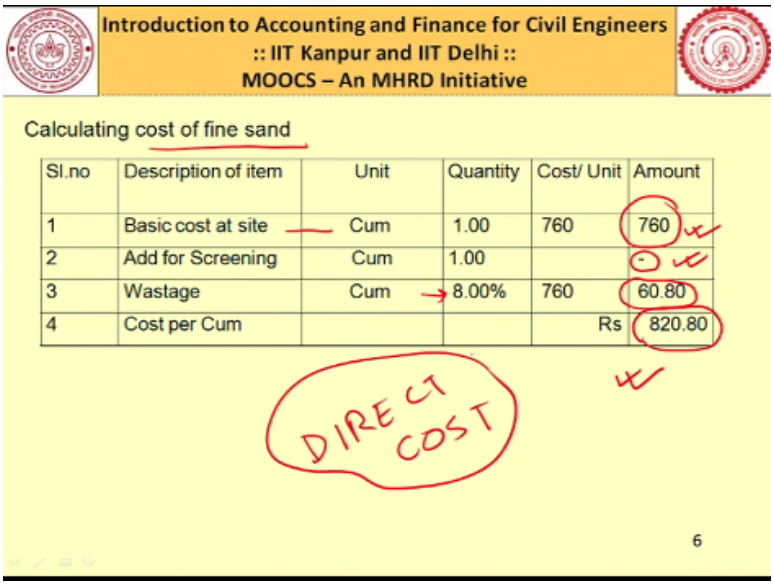

Let us try to do 1 more example that of calculating the cost of fine sand, here let us say I am finding that the basic cost at site is coming to be 760 rupees/cubic meter. So, this is from the quotation that I have collected from different suppliers of fine sand. Sometimes you add the cost for screening but right now I am assuming that I am not incurring any cost on screening, wastage roughly it would be about 8%.

So you can find this cost is coming to be 60.80, so if you add all of them together you are getting 820.80, remember these are all direct cost only, right now I am not at all bothered about finding

the indirect cost. But you know the total cost is the sum of direct cost+indirect cost, right now we are concern only about the direct cost.

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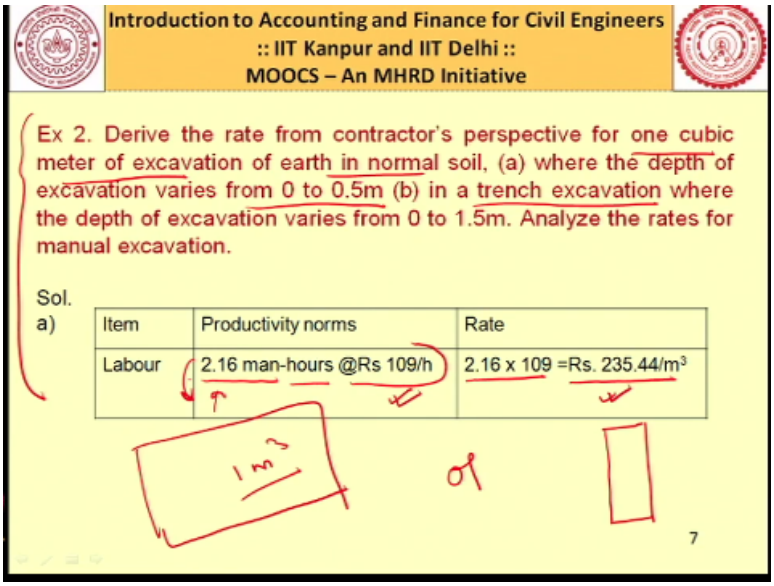

Now I will explain you another method of analysis which we are calling it as operational but before that we will show you the illustration of computing the labor cost. So let us say we try to understand this with the help of 1 small example again. I am trying to find the cost of 1 cubic meter of excavation of earth in normal soil. Now depth of excavation is varying from 0 to 0.5 meter and in the second case I will try to find out the cost of 1 cubic meter in a trench excavation.

So trench what you find the width would be correspondingly lesser compare to the open excavation. So here this is how a trench would look like but if you see the open excavation this could be the large area. Obviously the rate for trench excavation is going to be more in terms of cubic meter compare to open excavation. Now how do I do all such kind of analysis I have from my past experience productivity, rate for each of these items.

So, for example I know that if I have to do open excavation I will be incurring about let us say my productivity would be 2.16 man-hours/cubic meter. So, if I want to do 1 cubic meter of excavation my labor involvement would be roughly about 2.16 man-hours. Now I have already

calculated the cost of 1 man-hour for my organization it is coming to be 109/hour, I will show you how it has come.

So, I simply multiply this estimated productivity norm with the per hour rate or hourly rate and I am getting it like this, so I multiply 2.16 with 109 and I am getting 235.44 rupees/cubic meter. Now if I have to do the trench excavation my past experience source the value is going to be higher.

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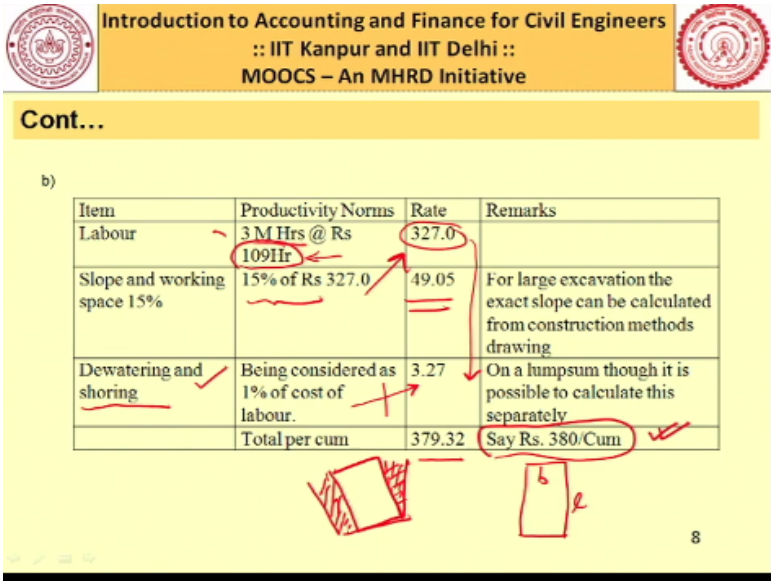

So, that means I need more man-hours for doing 1 cubic meter of excavation, if I am excavating a pit whereas I would require only 2.16 man-hour if I need to do open excavation. So, here what I have done I have taken 3 man-hours as the productivity norm and here again I am taking 109 rupees as hourly wages in the form of a direct cost. So, this when you multiply 3 with 109 you are getting 327.

Now what happens in a trench the client is going to pay you based on the actual width and length, so this length, this width. But you will find that at site you will not be able to maintain exact width like this in a vertical cut, so what you will do you might be doing this in some kind of a slope. But client is not going to give you payment for this extra excavation that you are doing, so this is the extra excavation you are doing.

Because you cannot have vertical cut in a given soil, so you would like to have some extra work done in the form of a slope. So, you will have to load the extra cost that you are incurring in maintaining this slope also in your rate. So, in general you can consider about 15% of your total cost for maintaining the slope and working space. But the client is going to pay you only for this area, so we have load for the extra work that we are doing on our per cubic meter rate.

So, I am taking 15% on this value, so this is coming to be 49.05, sometimes if you are going deeper you may have to carryout dewatering also and soaring also. So, you want to remove the water, you want to make sure that your slope does not collapse. So, in order to maintain that you have to perform dewatering operation also, now there are specialized agencies who can give you the rate that you would encounter for dewatering.

But for small jobs you can take it as 1% of the cost of labor, so in this example I have just taken 1% of the total cost of labor. So,1% of 327 I have loaded it in my per cubic meter cost, so when I add all of them I am getting 379.32 I have rounded it of to 380 rupees/cubic meter. So, if you remember for open excavation we are getting the rate as about 235 based on this assumed productivity now.

And for trench excavation I am considering a productivity of 3 man-hours and I am getting a rate of 380/cubic meter.

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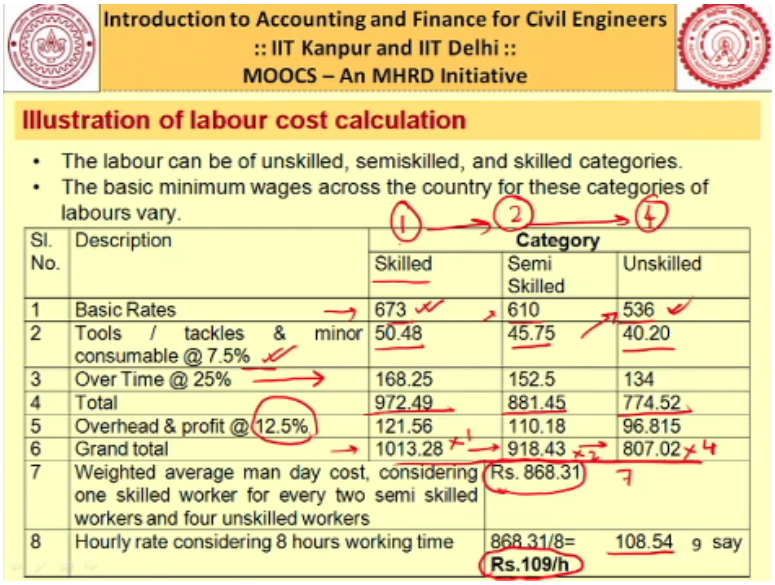

Now I will show you how did I get this 109, in all our calculation you remember I use this 109 as hourly wage, for doing this normally we calculate the weighted average of various labors. And the cost that I am incurring on that, so if you consider the daily rates daily wages for a skilled worker is currently about 673 for a semi skilled worker it is about 610 and for unskilled worker the basic rate is for 536.

Now for calculating the hourly rates what I do is I consider that for every 1 skilled worker I have 2 semi skilled worker and I have 4 unskilled worker. So, this is normally the combination of a particular gang for every skilled worker you have about 2 semi skilled worker and about 4 unskilled worker. Now what I can do is in the basic rates I will add some value to take care of my tools, tackles and minor consumables.

Because these workers are not bringing their own tools and tackles, so as a contractor you will have to provide it and roughly it would be costing about 7.5% of their wages. So you take the 7.5% of the 673, so it is coming to be 50.48 likewise 7.5% of 610 you are getting 45.75, 7.5% of this 536 you are getting this. Overtime for analysis purpose normally we consider 25%, if some worker is working in overtime you will have to give double the basic wages that they are suppose to be getting during normal times.

So, I am considering 25% extra on this, when you add it up you get these values 972.49, 881.45 and 774.52, overhead and profit depending on your organization policy it could be added 12.5% or 15% you can add it and then that way you will be able to get these values. Now as I told you have to consider the weighted average, so for this you multiply this value with 1, you multiply this value with 2, you multiply this value with 4 and divide the sum by 7.

If you do this you will find you are getting a weighted average of 868 for 8 hours working. So, hourly working you divide it by 8 and you are getting 108.54. So, roughly we are assuming it to be 109 rupees/hour, so this is what we used in our previous calculations when we consider the cost of 1 cubic meter of open excavation and 1 cubic meter in trench excavation.

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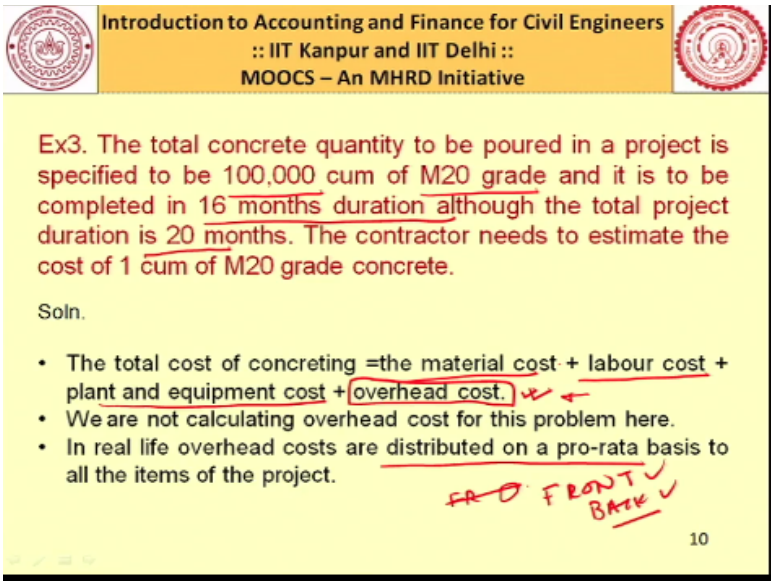

Now I will illustrate you some other method, so for you have studied how to carryout the unit rate analysis, now we will see how to carryout the operational estimation process. Now in operational estimation process all the time we have to consider the timeframe, what is the duration and what is the quantity in which it has to be performed. So in order to reflect these 2 aspects I have given you a small problem I am told that I have to estimate the rate of carrying out 100,000 cubic meter of M20 grade concrete.

And it is to be completed in 16 months time, total project duration is 20 months. So, although the total project is 20 months but my schedule shows that the concreting operation has to be carried

out only in 16 months time and the total quantity involved is 100,000 cubic meter. So, if I have to estimate this I have to separately find out the material, now you know how to calculate the material cost I have to separately find out the labor cost that also you know.

Plant and equipment cost I will tell you how to find it out and overhead cost in today's lecture we are not going to discuss this part. In some other lecture I will tell you how to calculate the overhead cost, normally these overhead cost are calculated separately and they are distributed either on a pro-rata basis or front loading if you remember in previous lecture I had told you about the concept of front loading and the concept of back loading.

So depending on the situation that you think is favorable to you, you can choose either the uniform loading or front loading or back loading. But as I told you we are not going to discuss this issue in this particular lecture.

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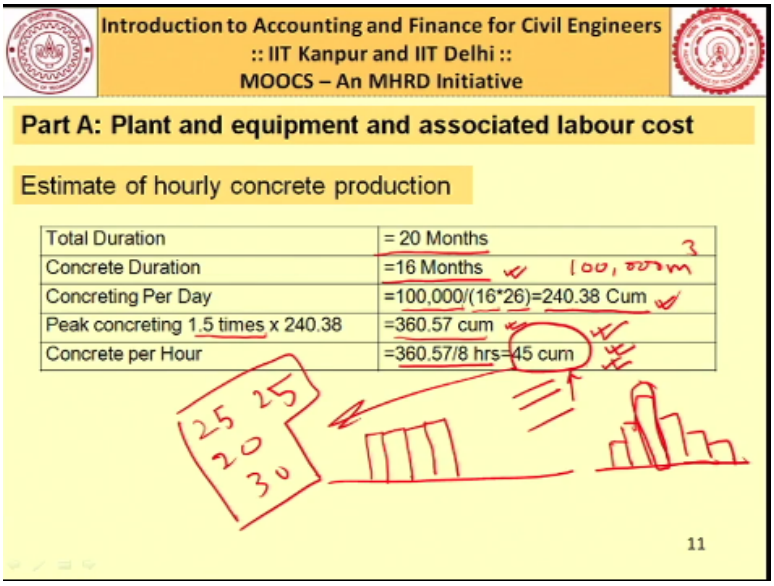

So, let us start working on this particular example, so first I try to estimate what is the concrete/hour production needed. So, let us say total duration is 20 months it is given but concrete duration is 16 months that means I have to complete all my concreting which is equal to 100,000 cubic meter in 16 months time. So, for analysis purpose I will assume it on a uniform basis, so I will calculate the concreting that is expected to be done on a daily basis.

So, it would be 100,000/16 months and we are assuming that every month has 26 days, so that means 4 non-working days. So, on Sundays we are assuming that we are not working, so out of 34 Sundays gone, so we are left with 26 days. So, that gives me 240.38 cubic meter, that means I am expected to do on an average 240.38 cubic meter but construction is not practiced in following manner today you come, you pour 240 cubic meter and go home, tomorrow you come do again 240 cubic meter and go home, it is never done like this.

So, you will find some day you will be doing less, some day you will be doing more, some day even more and so on. So, you will find this is how your distribution of daily concreting operation would be like. So, in order to make sure that your equipment is capable of giving you even this production which is the peak production I am multiplying it with the value called peak factor, in this case I am assuming it to be 1.5 times.

Now depending on your experience you can multiply it with 1.25, 1.3 or 1.4, so I am going to mobilize my plant and equipment which can give me a productivity of 360 cubic meter/day. So, in terms of hourly production rate I can divide it by 10, so that means I need a concrete production unit which can give me 45 cubic meter in an hourly basis. So, this calculation is done essentially to find out what kind of equipment is needed for my project.

So, now I will look for that particular equipment which can give me 45 cubic meter hourly. Now here again you have to make a choice whether you will go for a single equipment which can give you let us say 45 or 50 cubic meter or whether you would like to go for 2 equipment of let us say 25 **25** or maybe even 20 and 30. So, it depends, now both of them have got advantages, both of them have got disadvantages.

So, you have to take a call and then decide appropriately whether you would like to go for 1 equipment of this much capacity or 2 or 3 equipment are slightly lower capacity. Now once you have decided the equipment that I am going to have a batching plant, I am going to have so many concrete transit mixture, I am going to have so many pumps.

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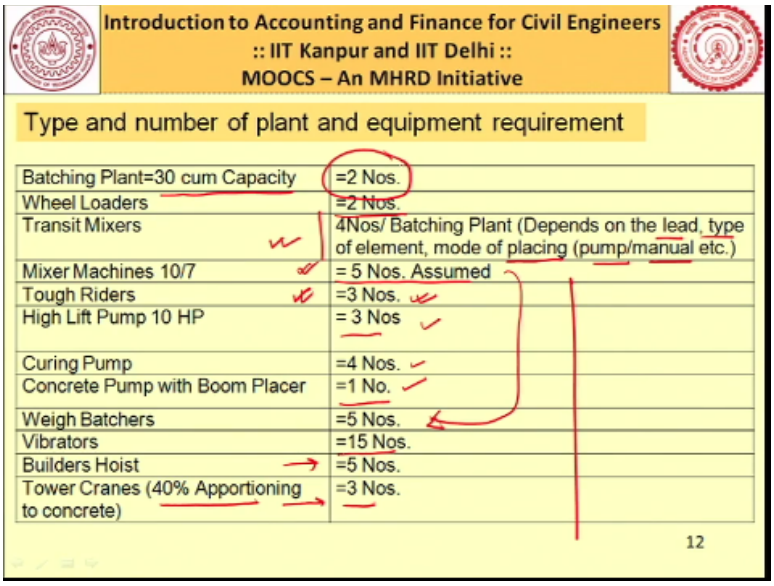

Then we are ready to calculate the cost, so here what I have done I have taken 2 batching plants of 30 cubic meter capacity. Because in case 1 batching plant fails I can carry on the work with the other batching part, accordingly I have taken 2 wheel loaders, transit mixers the number will be decided based on the lead type of element and mode of placing whether you are placing it through pump or manually that will tell you how many transit mixers are needed.

Mixer machines I am keeping as a emergency measure suppose sometimes my machine goes under breakdown I can carry on the concreting with these mixer machines. Tough riders, very handy equipment I am proposing to keep 3 numbers, high lift pump 10HP I am assuming 3 numbers, curing pump 4 numbers, concrete pump I am assuming with boom placer 1 number, weigh batchers corresponding to each of these 5 mixer machine I have taken 1.

So, 5 numbers, vibrators these are always small items 15 numbers I have assume, builders hoist 5 numbers and I am also assuming 3 tower cranes. Of course the only 40% cost will be a person to the concreting items, so these are the ways in which you calculate what type of equipment you need and how many numbers you need.

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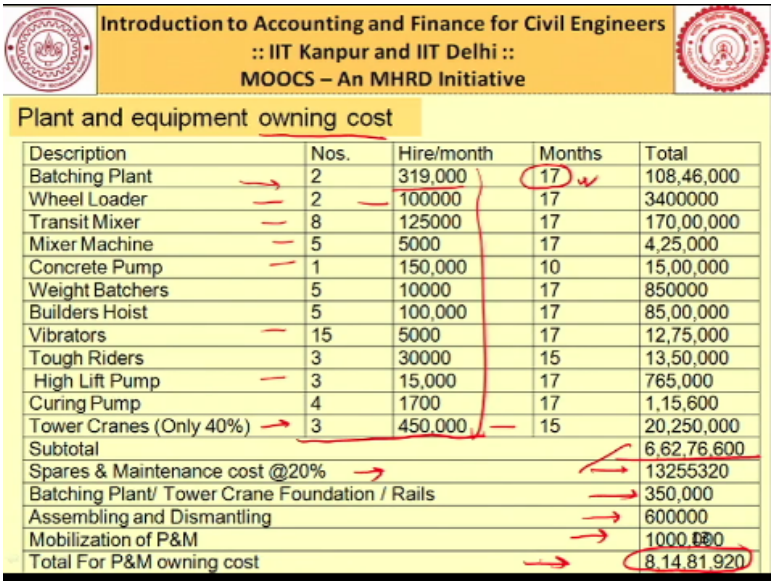

Now comes the costing part, so the first component of cost is plant and equipment owning cost how much exactly you need in order to own these plants. Now some companies they have their own plants, some of them they take it on hire. Now irrespective of whether you own it or lease it hire it you have to understand what is the hire charges on a monthly basis that you will be incurring.

So, I am taking these hire charges which are let us say the market values of the rental for each of this equipment. So, batching plant I have 2 numbers, hire charges/month is 319,000 these values you can crosscheck and maybe if you want you can change them. Now this will be required for 17 months why 17 although you know that concreting operation is going to last only for 16 month.

But 1 month I have kept for let us say mobilization, demobilization I am keeping some extra cushion. You can keep it 18 also I am not going to divide that but the idea is you have to have sufficient cushion. So, that in case you are suppose to be staying longer you do not make losses, likewise for wheel loader 2 numbers, hire charges, transit mixer, mixer machine, concrete pump, builders hoist, high lift pump, tower cranes only 40% of the cost I am booking in concreting operation, remaining 60% it could be either in formwork or it could be in reinforcement.

If you put all loads all the cost of tower crane here your cost of concreting is looking very odd, it will look very odd. So, it is better to put it this way, so I go on doing this I calculate it this value I am getting, normally about 20% extra I keep it towards spares and maintenance cost. So, 20% of this I have added it here now batching plant, tower crane they require foundation and for that also you need cost.

So, I am estimated this cost separately, assembling and dismantling also involves cost, so that also has been taken care of. Mobilization of each of these equipment also requires lot of money, so I have added that, so I add all of them and I get this value as the total for plant and machinery owning cost, so this is the cost implication if I am going to own these many equipment.

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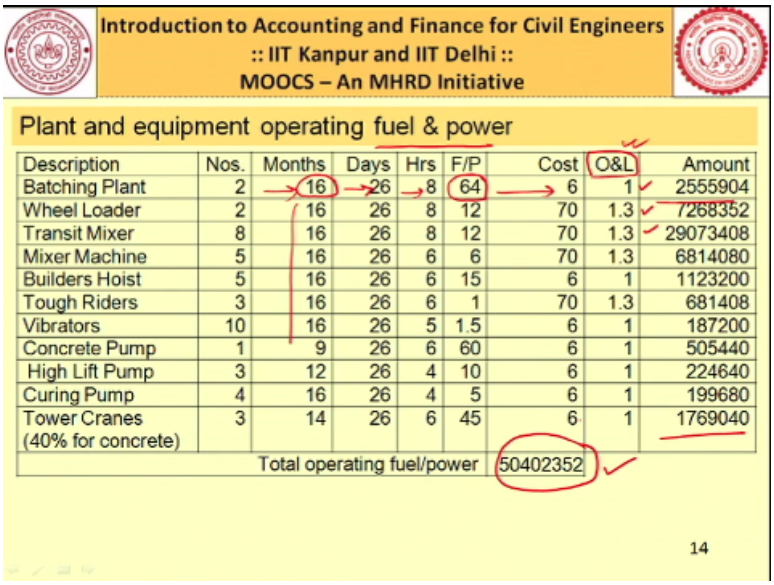

Now comes how much cost I have to incur towards their fuel and power, some of them they will run on electricity, some of them they will run on diesel. Accordingly I have taken the cost, so batching plant 2 numbers but here you can see I have consider them only for 16 months because irrespective of the time you will be keeping these equipment at site only 16 months would be the running time, so that is why I have kept only 16 for all of them you can see.

And every month 26 days working, 8 hours working everyday and batching plant let us say it is suppose to consume 64 units of power at a cost of 6 rupees/unit. Then you also have to cost add the cost oil and lubricant depending on the condition of equipment this factor could be varying

from 1 to 1.3, older the equipment you have hire values of this. So, you go on multiplying all of them and you get these values and you add it up total and that is way that is how you get this total operating fuel and power.

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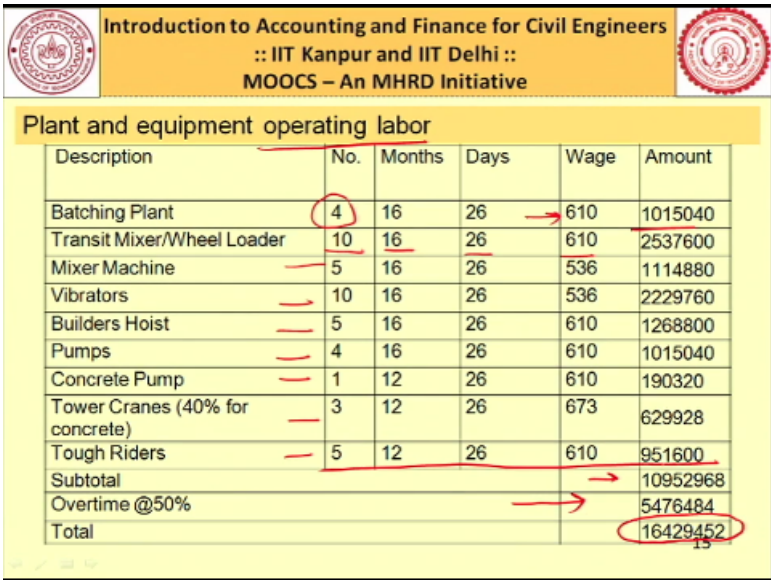

Then comes operating labor, so each of these equipment would require involvement of workers. So, for example batching plant I assuming 4 workers for 16 months, 26 days, wages 610 these are the kind of workers, kind of let us say semi skilled that we are getting transit mixer we have 10 workers for 16 month 26 days 610. Likewise for mixer machine, vibrators, builders hoist, pumps, concrete pump, tower crane, tough riders.

So, wherever there are involvement of workers you will write the number, you will write the number of months they will be staying there and number of days and you multiply it with their wages. So, that way you get now you can also add overtime wages about 50% here and you add it up you have this value as the plant and equipment operating labor.

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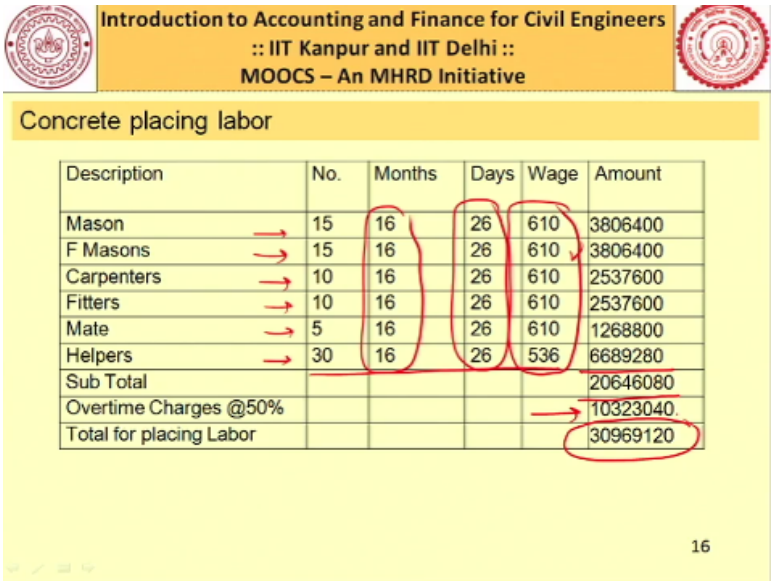

Now comes concrete placing labor, so for those laborers where involve with running of those equipment. Now here are the workers who will be responsible for placing the concrete, so I have assume 15 number machines, 15 finishing machines, 10 carpenters, 10 fitters, 5 mates and 30 unskilled workers. So you can calculate the cost in the same manner they are there for 16 months, 26 days in a month, the wages are varying for unskilled it is 536, for semi-skilled it is 610. Here also I am adding overtime charges of 50%, so this gives me total for my placing labor.

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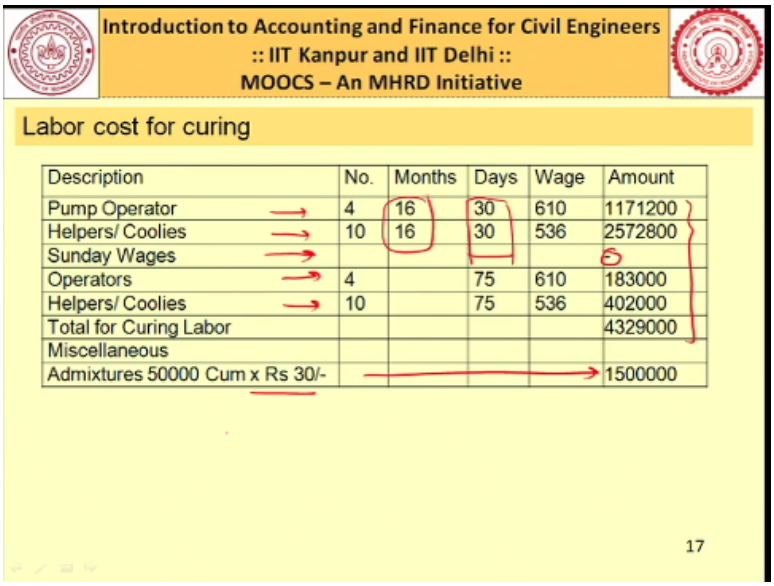

Now labor cost for curing that labor cost was involved in concreting operation, now we need to employ some workers for curing of concrete also. So, for this you need pump operator, you need helpers, you need further operators, helpers, coolies, sometimes if you are calling them on

Sunday you have to give them overtime wages. In our case I am not assume Sunday wages, so here also they are required for 16 months.

In this case we are assuming 30 days because curing you have to perform all 30 days right and depending on the wages you will get these amount. If you have to add at mixer that cost also can be added up I have added 30 rupees/cubic meter for a mixer.

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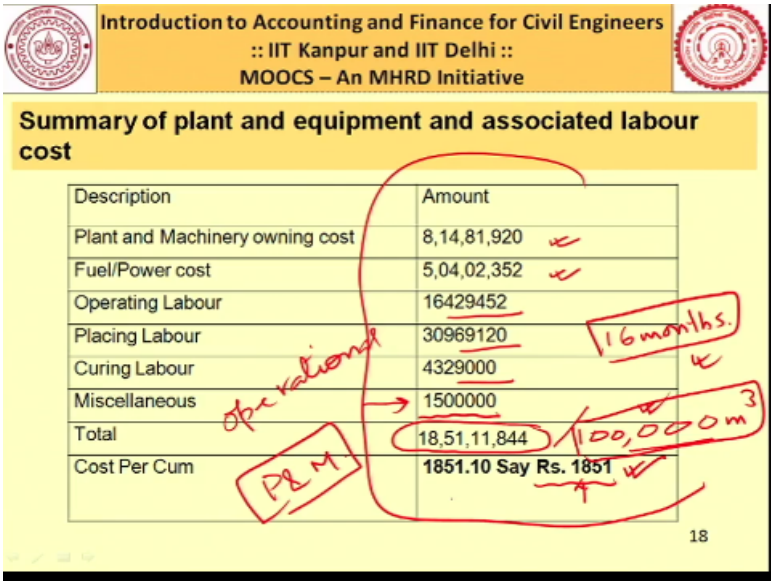

So, this is how it is done, so what I will do now this is the cost of owning, operating of my equipment right. So, plant and machinery owning cost you already know how from where it has come, fuel power cost from where it has come is known to you, operating labor, placing labor, curing labor and miscellaneous I am putting it for the at mixer part. I can add it up total and this I am dividing it by 100,000 what is 100,000 remember 100,000 cubic meter concrete is the total scope that we have to done in 16 months.

So, that gives me 1851 rupees/cubic meter as for as the plant and machinery cost itself is concern right.

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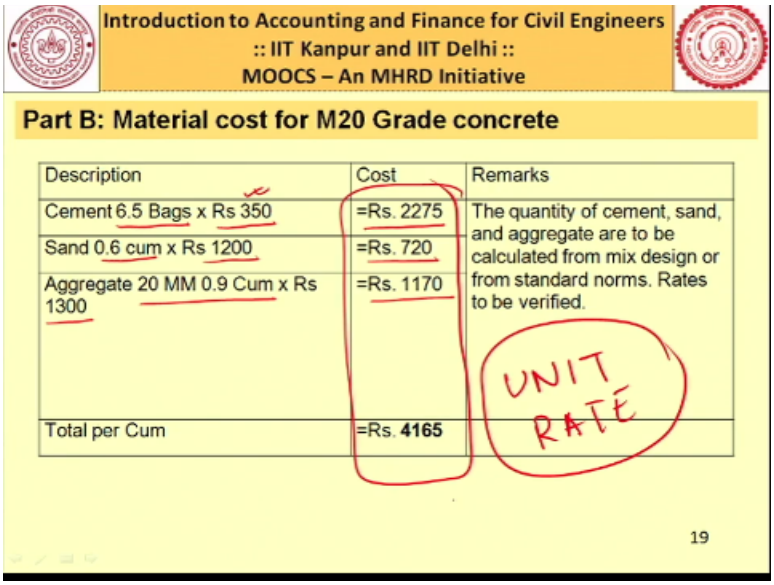

Now we will see the material cost, so how much cost we would require in order to produce 1 cubic meter of M20 grade concrete. Although exact quantity you will be able to get only after the mix design but for tendering purpose I can assume that I require 6.5 bag cement at a cost of 350 rupees from where this has come you already know this. So, this is 2275 sand roughly it would require 0.6 cubic meter at a rate of 1200 rupees/cubic meter, this is 720.

Aggregate I require 0.9 cubic meter at a rate of 1300 rupees/cubic meter, so total is 1170, so if you add I am getting 4165. Now if you look at material cost calculation this is what this is unit rate estimation method, nowhere I consider the time, nowhere I consider the quantity. But when it came to this computation of plant and equipment this is what is known as operational method, why?

Because you needed to know how much is the total quantity you needed to know what is the total duration. So, all these calculations are true for 16 months concrete duration and 100,000 cubic meter concrete quantity. So, that way you have been able to get this, if these values are changed you might land up in some other value of plant and equipment charges. So, while you are working on operational method of estimation you require to know the quantity and the duration.

But when it comes to unit rate method of estimation you do not need to know the quantity or the duration. Now sometimes as you can see in this particular example I used both.

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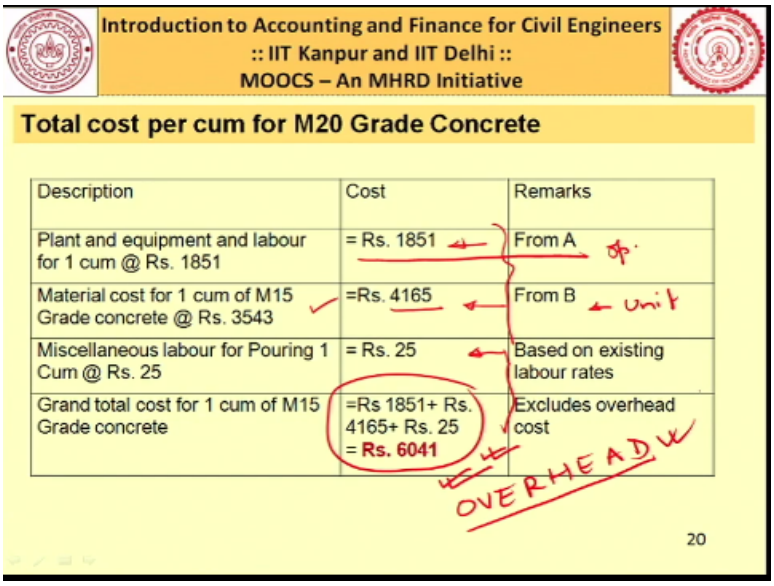

So, I combined both of them, so you can see from A we are getting this plant and equipment cost from the previous sheet I am getting this 4165 which is the material cost, miscellaneous labor for pouring I am just keeping this is from my past experience 25, I add all of them and I am getting rupees 6040. So, for plant and equipment I use operational method for evaluating material cost I use unit rate method and I added rather I combine these 2 methods to get this particular rate.

Now remember again this is without my overheads, so for I have not done any discussion on my overhead part. It will be done in some other lecture but to just make you more clear about this method again.

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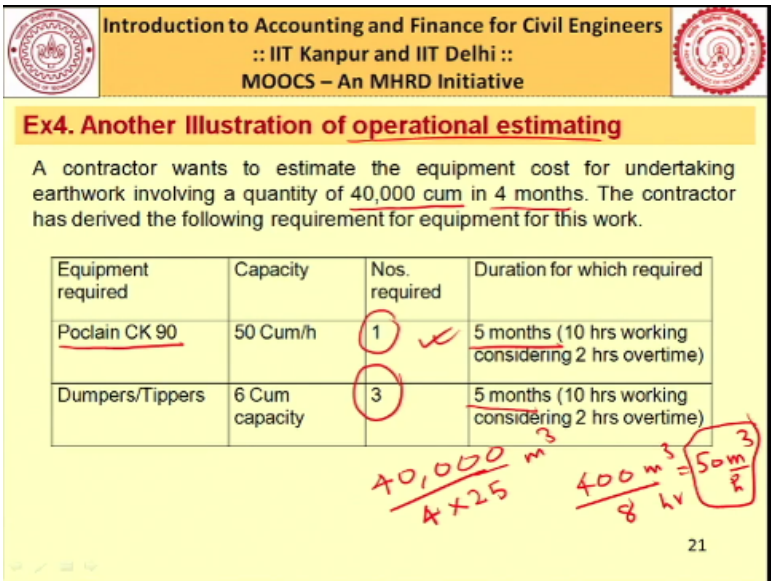

I have given you 1 small problem again, so you can see here in this particular problem I want to calculate the cost of 1 cubic meter of excavation using plant and machineries. So, I have to carry out 40,000 cubic meter of earthwork in 4 months time. So, here again I am going to use operational estimating method because I am giving the quantity, I am given the duration. So, how do I calculate this, so 40,000 cubic meter to be done in 4 months time.

So, divided by 4, even if you assume let us say 25 days in a month working days it will be like this. So, how many cubic meter on a daily basis we have to do it would be roughly about 400 cubic meter. If you are working for 8 hours, so divided by 8, so that means it will be about 50 cubic meter an hour. So, I am looking for a rate of 50 cubic meter/hour excavation and I know from my past experience and from my knowledge that this much productivity can be given to me by a Poclain CK90.

So, I require 1 number for this and I would require it to keep it with me for 5 months, here again although the actual duration is 4 months, I will take 1 month extra. Just in case some problem happens I will be making use of this for that additional month also. Now depending on the lead time depending on the distance of disposal of earth I will calculate how many dumpers or tippers would be needed. In this example I have assumed it to be 3, this also is needed for 5 months, 1 month extra.

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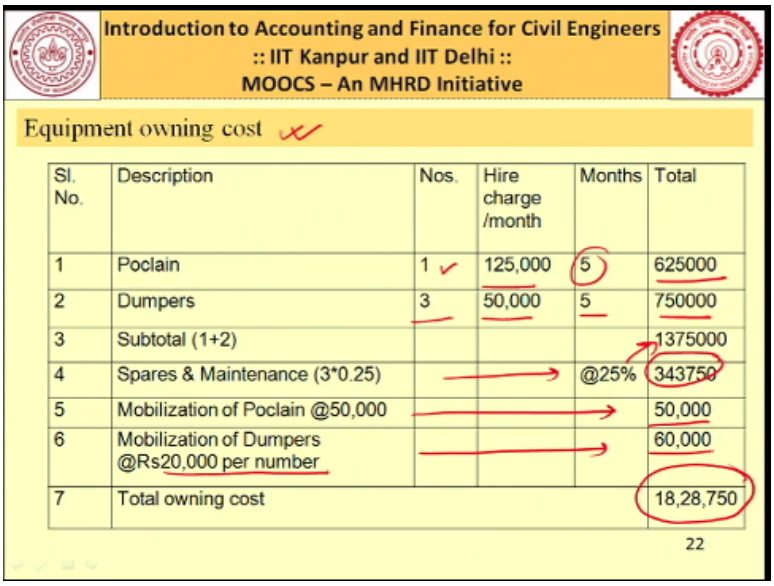

Now in the same manner I am going to calculate the equipment owning cost, so Poclain 1 number, hire charge/month for 5 months, this value 3 dumpers hire charge/month, 5 months this number. Spares and maintenance I am keeping 25% extra on this, so I get this value, mobilization of Poclain whatever cost you can forecast I have assumed 50,000, 3 dumpers to be mobilize at a rate of 20,000/number that also I have added, so this is my total owning cost.

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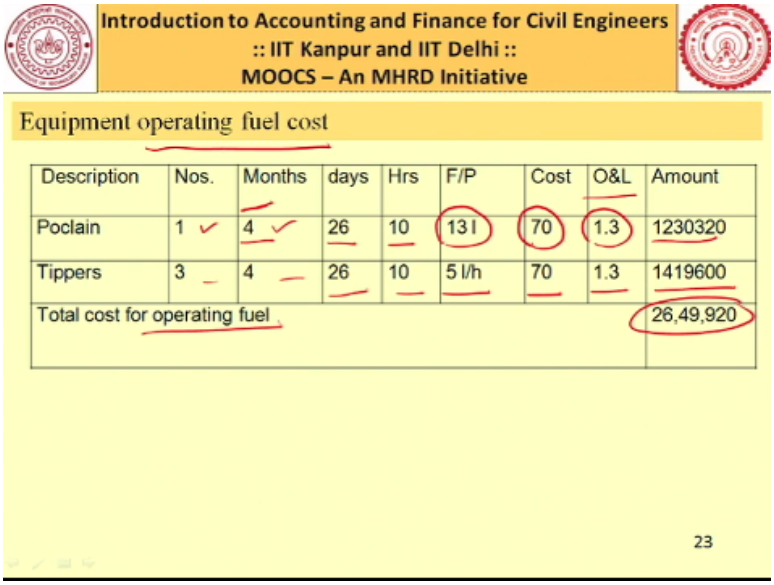

Now I will calculate the operating fuel cost, so Poclain 1 number 4 months, the actual running time is always 4 months although I kept the provision of 1 month extra as far as owning cost was concern, 26 days, 10 hours working I am assuming 13 liter on an hourly basis cost of diesel is 70 rupees. Oil and lubricant I am keeping 30% extra, so this is there, tippers 3 numbers, 4 months,

26 days, 10 hours 5 liter/hour, 70 rupees/liter, 1.3% I mean 1.3 is the multiplication factor to take care of oil and lubricant this value, so total is this, this is the cost for operating fuel.

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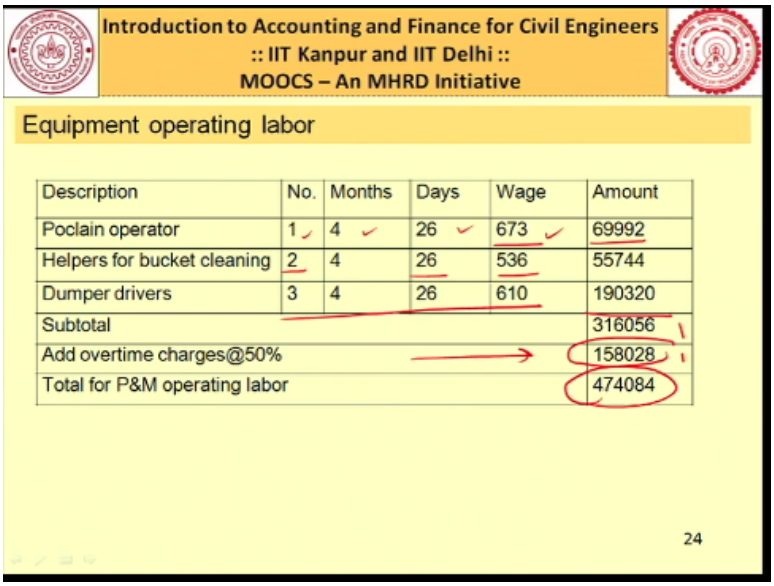

Then comes operating labor here also for each Poclain I have kept 1 number operator, 4 months, 26 days, 673. These are highly skilled worker, so I have taken the skilled workers rate this is their 2 numbers for bucket cleaning, 4 months 26 days 536. These are unskilled workers, dumper drivers from under semi-skilled, so this is the value. Here also I can consider 50% overtime, so I add this and this I am getting this value.

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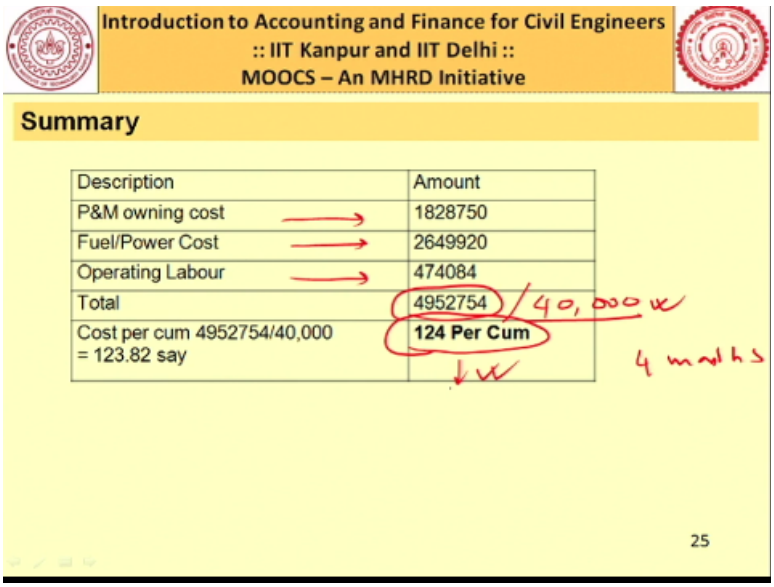

So, how do I calculate the total cost for keeping this plant and equipment, this will be the sum of owning cost, fuel and power cost, operating labor. I add it up and this I divide it by 40,000 because my scope of earthwork was 40,000 to be done in 4 months time. So, I find that I am getting this value as rupees 124/cubic meter, this value may change depending on your hire charges of different equipment and the consideration of petrol, diesel and other lubricants.

If your equipment are new you can find that this even goes down further. So, what we have done in this class is I have given you a glimpse of computing the direct cost and this has been explained with the help of few examples. I told you how to carry out the rate analysis using unit rate estimation method, I also told you how to carryout rate analysis using operational estimation method.

In one of the examples which I presented today I have also told you how to club these 2 values. So, we stop at this particular point, next class when we meet I will tell you how to carry out the rate analysis as for as indirect cost items are concern. We will see what are the items coming under indirect cost, for example the temporary structures, conveyance, salaries, labor benefits and many more thing and we will see how exactly we calculate the cost corresponding to each 1 of them.

And in subsequent lectures we will see how to decide the markup, once you have the direct cost information, the indirect cost information and the markup information you will be able to compute the bid price.

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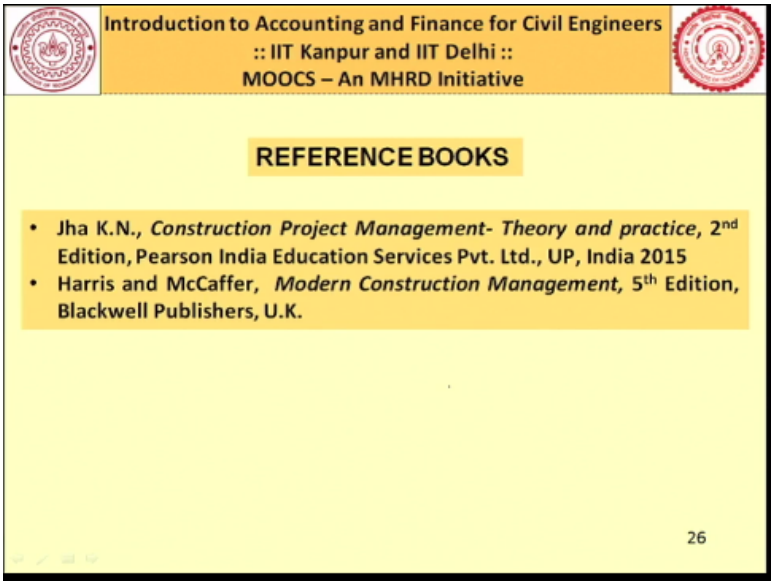

So, more on this we will see in the next class till then thank you and good bye.