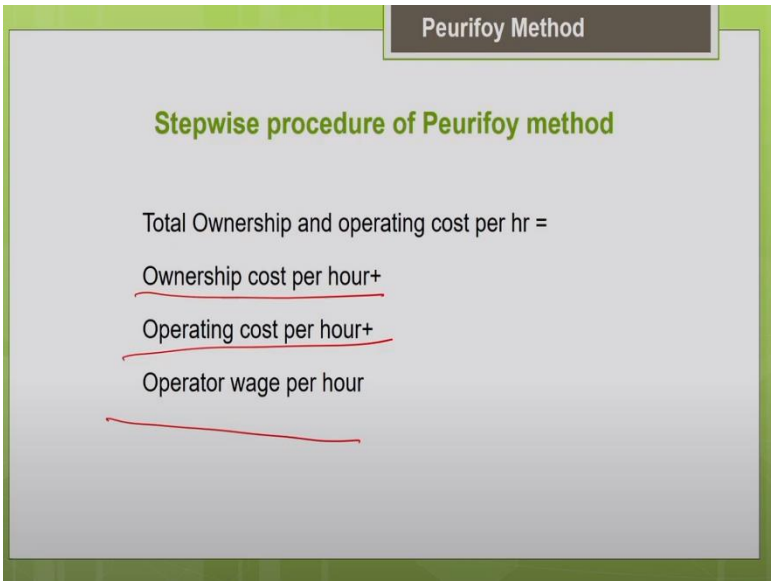

So just add up everything the ownership cost all the operating cost and operating wages also you will get the total ownership and the operating cost following the Peurifoy guidelines. Now let us workout from examples on how to estimate the equipment cost using these 2 methods.

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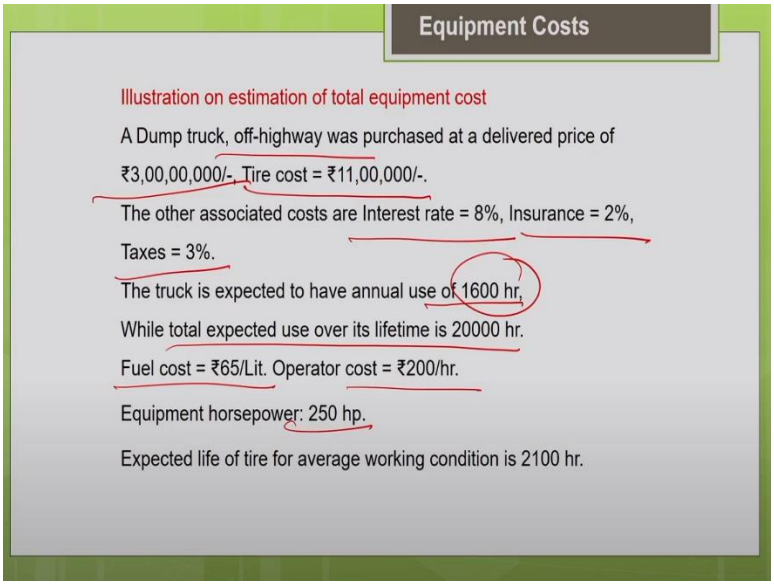

So you can see this problem in this problem you can estimate the cost for the dump truck. It is off highway truck, why we call it as off highway? This truck is not permitted on the public highways. It is an; heavy equipment high end equipment you can see that these trucks will be operated only in the project sites. You can also see some quarry truck. So those heavy machines are not permitted on the public highways. That is why we call it as off highway trucks. The initial cost is given so it was purchased with the deliver price of 3 crores.

So you can imagine it is already high end equipment with special features like you can see it will be kind of articulate machine with any additional features are there with this dump truck that is why you can justify its cost. And the tire cost of this machine is 11 lakhs. Also many of this number I have just made some approximate assumption. So let us not go deep in to this number, the main objective of this illustration is just to show you the methodology of how to estimate the economic cost.

The requirements are according to the type of the machine for which you are going to estimate. You can choose the appropriate estimation handbooks and choose the values estimated accurately. These numbers are just approximate assumptions just to show the methodology of how to estimate the economic cost. So the other associated cost are the interest rate which is nothing but 8% insurance 2% and taxes 3%. So other component of the ownership is also given.

And the truck is expected to have annual use of 1600 hours. So every year the truck is operating for 1600 hours. It depends upon every day how many hours it is operating and how many days it is operating in a particular year. So, according to that we can calculate this 1600 hour. Similarly, throughout this entire life its useful lifetime the hourly usages 20000 hours, and the local cost of the fuel in the particular space is 65 rupees per liter and the operating cost the wages per hour is 200 rupees per hour.

And the horsepower of the engine is 250 and the expected life of tire, this data is given to you directly you can take it from the handbook according to your requirement. But I have given you some approximate number for average working condition nothing but 2100 hours for this particular tire.

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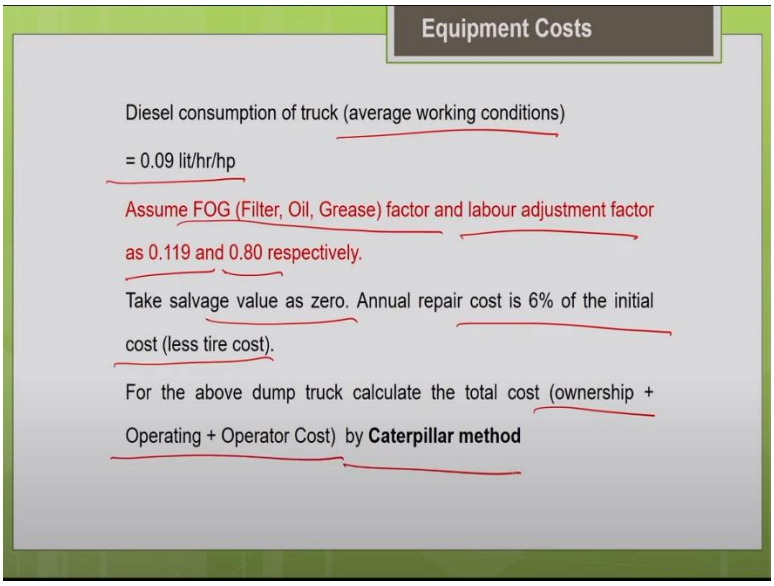

Then the diesel consumption of the truck for average working condition is 0.09 liters per hour per horsepower. So this value also I have assumed it approximately, you can look into the literature for the particular type of the machine in the particular work condition and you can get the value accurately for the particular model of machine from the equipment handbook. And similarly filter oil grease I have given the factor 0.119 and the labor adjustment factor I have used it as 0.8 approximately, the assumption for the particular region.

Take the salvage value 0 for this particular problem and the annual repair cost is 6% of the initial cost excluding the tire cost. The repair factor is also given to you directly. So for the above truck above dump truck you calculate the total cost your ownership plus operating plus ownership cost by the Caterpillar method first. We are going to estimate by the Caterpillar method first.

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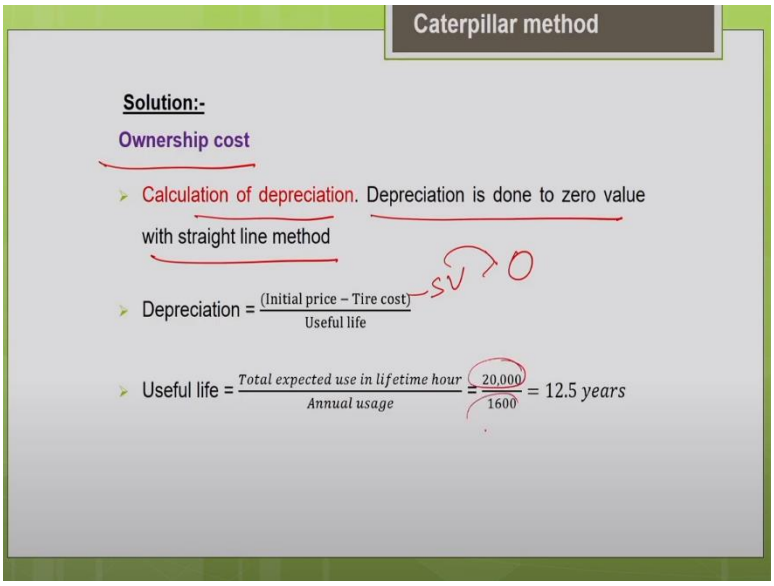

So under the ownership cost let us calculate the depreciation first.

$$Depreciation = \frac{(Initial\ price - Tire\ cost)}{Useful\ life}$$

So we are going to further straight line method since the salvage value 0 here in this problem. So the depreciation is done to 0 value you can say that it is nothing but initial price minus tire cost minus salvage value, salvage value is 0 divided by the useful life of the machine. How to find the useful life of the machine? So they have given you the total expected use of the machine in life time.

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It is given in the equation you can recollect the total expected use of the machine over its life time is. So you can see the total expected the use of the machine of over its lifetime is 20000 hours so it is given to you. And the annual use of the machine every year in hours is 1600 hour. So if you divide both you will get the 20000 hours it is the total lifetime use of hours every year it is used for 1600 hours.

$$Useful\ life = \frac{Total\ expected\ use\ in\ lifetime\ hour}{Annual\ usage} = \frac{20{,}000}{1600} = 12.5\ years$$

This will give you the useful life of a machine in years. That is what we calculating here. 20000 divided by 1600 gives you the useful life of the machine in years 12.5 years.

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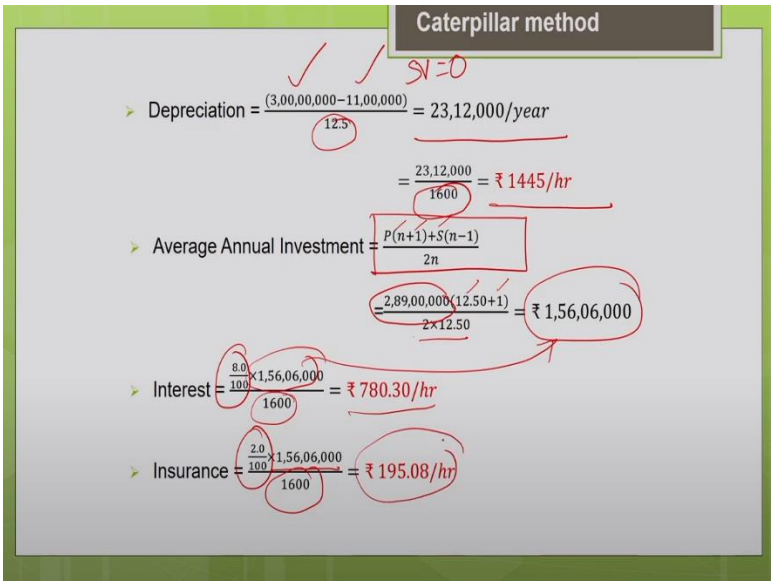

Now we shall calculate the depreciation. So depreciation is nothing but your initial price minus the tire cost minus the salvage value divided by the useful life of the machine. So initial price is 3 crore's minus the tire cost is 11 lakhs obviously your salvage value is 0 in the given equation and the useful life of the machine is 12.5 years. So now you can get your annual depreciation like this.

$$Depreciation = \frac{(3,00,00,000 - 11,00,000)}{12.5} = 23,12,000/year$$

It is nothing but 23,12,000 per year.

$$= \frac{23,12,000}{1600} = ₹\,1445/hr$$

So now just divided by the annual usage of the machine in hours you can get the hourly depreciation as rupees 1,445 per hour. So this is how we estimate the hourly depreciation. So this is approximate estimation because we are not considering the timing of the cash flow here. So another thing what we do in the Caterpillar method is we estimate the average annual investment.

Hope you remember the formula.

$$Average\ Annual\ Investment = \frac{P(n+1) + S(n-1)}{2n}$$

$$= \frac{2,89,00,000(12.50+1)}{2 \times 12.50} = ₹\,1,56,06,000$$

P is nothing but your purchase price minus your tire cost. It is nothing but your 3 crore - 11 lakh, 11 lakh is your tire cost that gives you 2 crores 89 lakhs, so multiplied by n + 1 ok, n is 12.5 + 1,

salvage value is 0. So divided by 2 into n, 2 into 12.5 so this gives you the average value of the machine over its useful life as you can say 1,56,06,000.

So over its useful life the average the value of the machine is 1,56,06,000. So now all the other components of the ownership cost you are going to estimate it as the percentage of the average of the machine. So your cost of investment interest is 8% multiply by the average this is your average value you can say. So this is the average value of the machine divided by the annual usage of machine in hours.

$$Interest = \frac{\frac{8.0}{100} \times 1{,}56{,}06{,}000}{1600} = ₹\,780.30/hr$$

So that you can get the interest hourly interest it is nothing but rupees 780.3 per hour. Similarly, insurance is nothing but 2% of the average value of the machine. 2% of the average value divided by the annual usage of the machine in hours that gives you hourly insurance cost is rupees 195.08 per hour insurance charges.

$$Insurance = \frac{\frac{2.0}{100} \times 1{,}56{,}06{,}000}{1600} = \frac{₹\,195.08}{hr}$$

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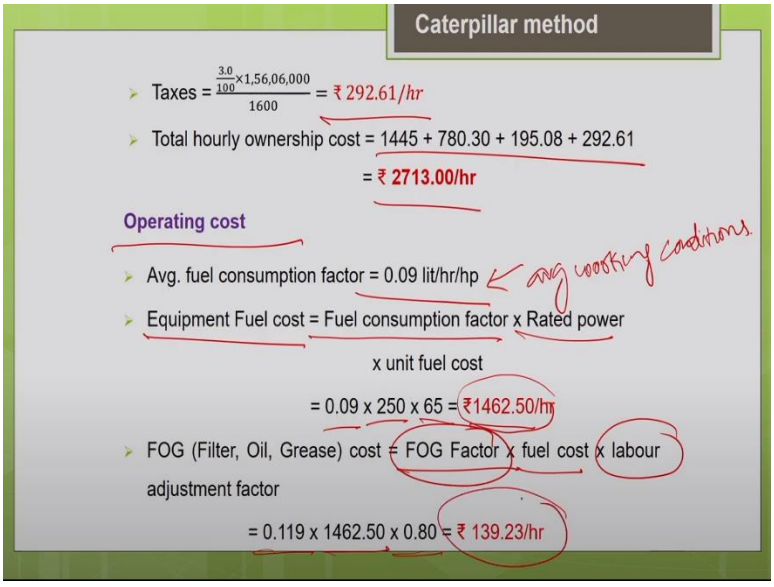

Similarly, your taxes it is taken as 3% of the average value of the machine / hourly usage of the machine in a year. It is nothing but 1600 that give you the hourly taxes cost as rupees 292.61 per hour.

$$Taxes = \frac{\frac{3.0}{100} \times 1{,}56{,}06{,}000}{1600} = ₹\ 292.61/hr$$

Now you calculate all the total ownership cost components. So it is nothing but so total ownership cost component you can see that one is your hourly depreciation, so other is your hour interest and hourly insurance charges and hourly taxes. So all these things if you add you will get your total hourly ownership cost as rupees 2713 per hour.

Total hourly ownership cost = 1445 + 780.30 + 195.08 + 292.61

= ₹ 2713.00/hr

Now let us move on to the operating cost estimation. So I have given you the question the average fuel consumption factor is 0.09 liters per hour per horse power. So based upon that you can calculate the equipment fuel cost so, this fuel consumption factor is derived from the particular average working condition from the handbook.

According to this question it should be for average working condition and it is derived. So I have assumed some figures here you can determine the values accurately from the appropriate equipment handbook or the manufacture guidelines. So the fuel consumption factor point 09 multiplied by the horse power engine it is nothing but 250 and the local unit fuel cost is 65 rupees per liter.

Equipment Fuel cost = Fuel consumption factor x Rated power x unit fuel cost

= 0.09 x 250 x 65 = ₹1462.50/hr

So that will give me the hourly equipment fuel cost as rupees 1462.5 similarly filter oil grease here I have given you FOG factor. So FOG factor is you are calculating the FOG factor as a percentage of your fuel cost. So the FOG factors for different types of machines are available in the equipment handbook for different operating condition. You can take it directly multiply the fuel cost.

Your fuel cost is nothing but 1462.5 multiply by the labor adjustment factor which I told you according to the region the labor skills may vary. So we have to account for those variation by using the labor adjustment factor for the particular region it is available in some of the handbooks.

FOG (Filter, Oil, Grease) cost = FOG Factor x fuel cost x labour adjustment factor

$$= 0.119 \times 1462.50 \times 0.80 = ₹\ 139.23/hr$$

So FOG factor is given 0.119 fuel cost we have estimated already and the labor adjustment factor is 0.8 this gives you FOG cost as rupees 139.23 per hour.

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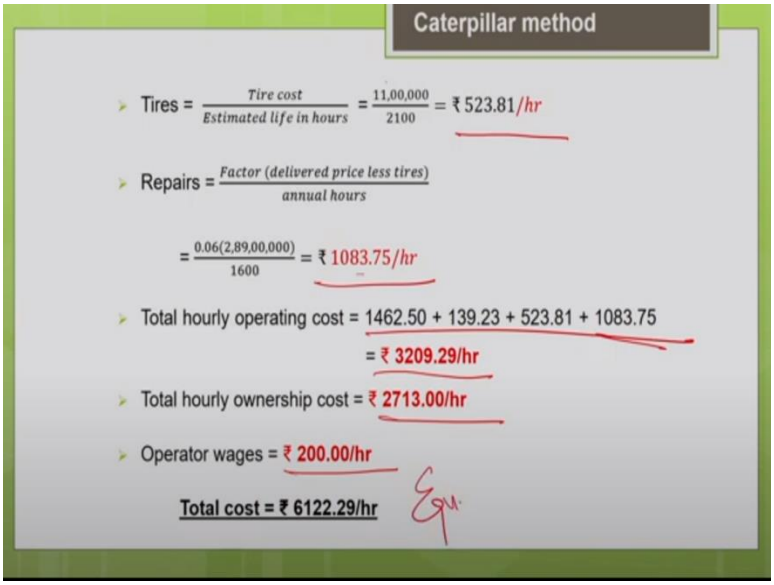

Now let us estimate the tire cost. So tire cost is nothing but the cost of the tire divided by the estimated life of the tires in hours. Cost of the tire is given to you in the problem 11 lakh divided by the estimated life of the tire. So depends upon the project working condition, you can get from the equipment manufacturer or from your past record in the question it is given as 2100 hours. Ok you can divide and get the hourly tire cost as rupees 523.81.

$$Tires = \frac{Tire\ cost}{Estimated\ life\ in\ hours} = \frac{11,00,000}{2100} = ₹\ 523.81/hr$$

Similarly, your repair factor for the machine so the repair factor is given as, 0.06 multiplied by the initial price of the machine. Initial price of the machine excluding the tire cost. So it is nothing but your 3 crores - 11 lakh that give you 2,89,00,000 multiplied by the repair factor. So divided by; the annual usage of the machine per hour that will give you the repair cost hourly repair cost as 1083.75.

$$Repairs = \frac{Factor\ (delivered\ price\ less\ tires)}{annual\ hours}$$

$$= \frac{0.06(2,89,00,000)}{1600} = ₹\ 1083.75/hr$$

So now add all your operating cost components. So what are all the different operating cost components we have estimated so far. So you can see that the equipment fuel cost we have estimated the FOG cost we have estimated we are going to add that. Then the tire cost we have estimated 523.81 and the repair cost we have estimated 1083.75. Add everything, you will get the total operating cost as rupees 3209.29 per hour.

Total hourly operating cost = 1462.50 + 139.23 + 523.81 + 1083.75

*= ₹ **3209.29/hr***

*Total hourly ownership cost = ₹ **2713.00/hr***

*Operator wages = ₹ **200.00/hr***

Total cost = ₹ 6122.29/hr

So you know that the total hourly ownership cost, you know the operator wages, you know the total hourly operating cost. Add all this 3 you will get the total equipment cost. So this gives your total equipment cost as rupees 6122.29 per hour. So let us continue with the same problem with the Peurifoy approach.

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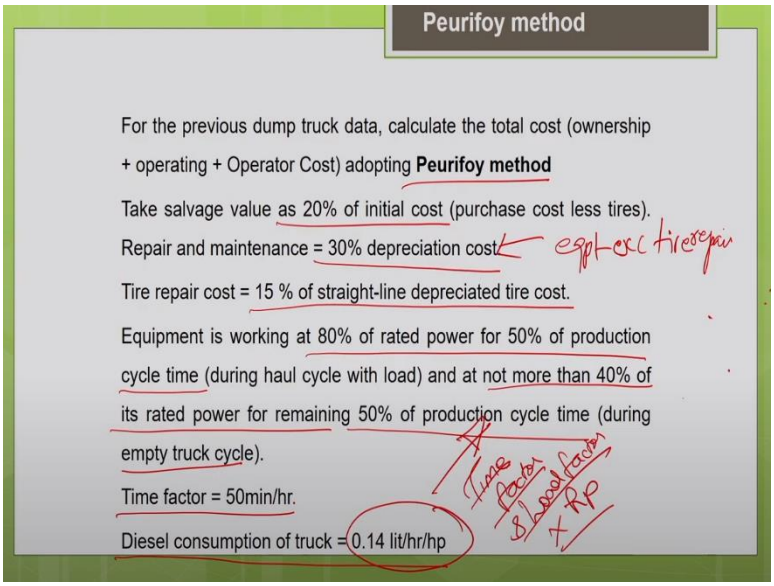

So as I mentioned earlier Peurifoy is considered as the father of the modern construction engineering. His contribution towards equipment management, equipment cost estimation guidelines are really appreciated a lot. So let us continue with the same problem now for the

previous dump truck data it is calculated by the total cost that is the ownership plus operating plus operator cost adopting the Peurifoy method. So in this way of some more assumptions like we are taking this salvage value as 20% of the initial cost.

So initial cost the excluding the tire cost. So hope you remember the initial cost, the initial cost for this machine was 3 crores and the tire cost was 11 lakhs. So we have to take the salvage value as 0.2 into salvage value as 0.2 into initial cost minus tire cost. So that will give you the salvage value. So now the repair and the maintenance it is taken as the percentage of the depreciation cost here.

So repair and maintenance is equal to 30% of depreciation cost and this repair; and maintenance the entire equipment excluding the tires repair. So tire repair is considered separately here it is nothing but the 15% of straight line depreciated tire cost. And another important thing here the operating conditions are defined clearly like the equipment is working at 80% of the rated power, 50% of production cycle time.

That is the truck is using 80% of the power consumption for during this haul cycle when it is traveling with the load. So that haul cycle will contribute to 50% of the total production cycle. So during this haul cycle when it is carrying the load it works as 80% of the rated power. The power consumption is 80%. But during the empty return cycle when there is no load in the truck that cycle time will be 50 % of the total production cycle time.

So during that cycle it is functioning at not more than 40% of the rated power. So during the haul cycle with the load it carries it is working at 80% of the rated power and the cycle time is almost 50% of the total production cycle. So that means 0.8 into 0.5. Similarly, during the return empty cycle which is 50% of the production cycle time it is working at the power of not more than 40% that is 0.4. So with this we can calculate our load factor and the time factor is also given.

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Time factor is nothing but the working efficiency of the machine. How long the machine is working say 50 minutes per hour that is what, is the time factor? So this fuel consumption factor is given from the literature where it is where the machine is working at standard condition. That is it is working at maximum output rate. So you have to adjust this fuel consumption factor according to this operating condition you have to adjust this according to the time factor and the load factor

and according to your horse power of the machine. So all these things you have to consider and adjust these fuel consumption factor.

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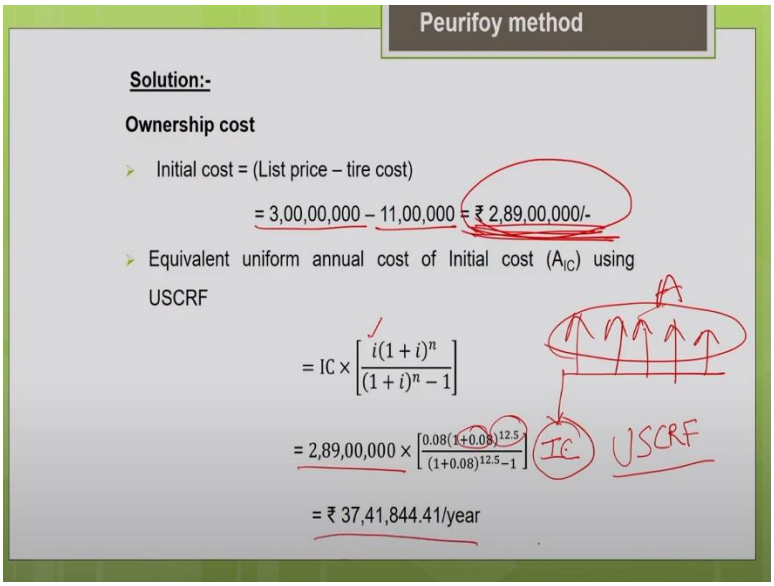

Now let us workout the ownership cost starting with the depreciation estimation. Peurifoy has given 2 different approaches. One is the approximate approach of average annual investment method AAI average annual investment method where we considered the average value of the machine over the life of the machine. So that is in approximate approach this I have discussed in the Caterpillar method just now.

So another method what he has discussed is about the time value method where we considered the timing of cash flow. And we convert the cash flow which are occurring at different point of time different period of time into equivalent cash flow at a particular period using the compounding factor which is more accurate to measure it. So in this problem we are going to assume the time value method one of the time value method so that we can look for a accurate estimate.

So first let us estimate the initial cost deduct the tire cost from the initial cost. So the initial cost is 3 crores minus the tire cost is 11 lakh, deduct it we will get 2,89,00,000 ok as the initial cost the after deducting the tire cost. Now you convert this initial cost into equivalent uniform annual cost using the compounding factor. So remember which compounding factor we are supposed to use say this is the initial cost ok, this initial cost we are converting into equivalent uniform annual cost A.