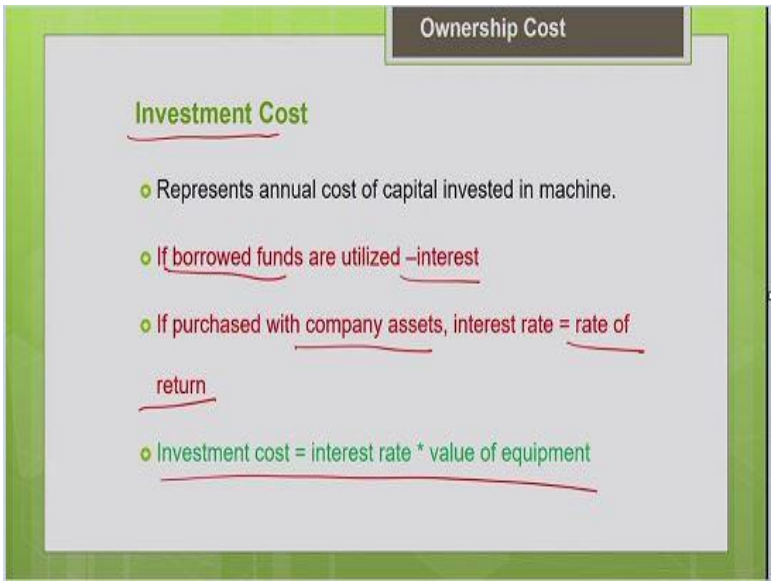

Now, let us move on to the next important component of the ownership cost and that is your cost of investment. So, investment cost it represents the annual cost of capital invested in the machine? So, it is similar to the cost of acquiring the ownership of the machine. So, you may have to purchase a machine or the equipment, either through borrowed funds, or you might have purchased either with your company assets, so in both the cases, you have to go for the cost of an investment.

Say if you are going for the borrowed funds, say for example, if you are going for the loan, so, the interest rate for to pay for the loan that will be considered as the cost of the interest. So, if you are going for the company assets, in that case, also you have to take the interest rate as the rate of return. So, for example, instead of investing this money in the purchase of machine, if you invested this particular money in something else, you might have achieved some rate of return.

So, that rate of return should be taken as the cost of investment. So, in this case, we are purchasing equipment with your own company assets. So, you have to take the interest rate equal to the rate of return. So in both cases, whether you are going for borrowed funds or your purchase from your own companies, it is in both cases, you have to take the cost of investment. So, either in this case, the interest will be the interest for the loan what you are paying in this case.

The interest rate will be the rate of return you might have achieved by investing the money in something else instead of buying the equipment. So, basically, investment costs is nothing but your

interest rate multiplied by the value of your equipment. So, you can see that interest rate multiplied by the value of equipment gives you the investment cost.

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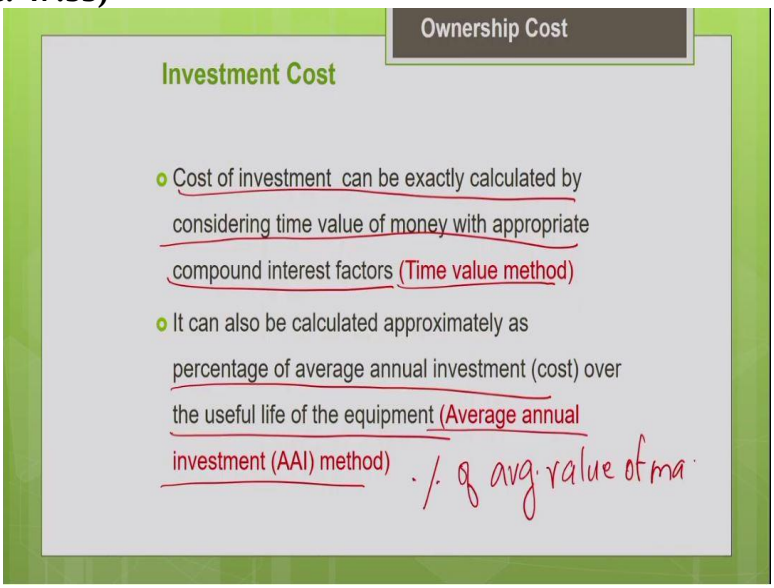

So, the cost of investment can be calculated by 2 different methods, as I told you earlier, one is a time value method other one is an average annual investment method. So, time value method is going to be very accurate method. Actually, there will be a separate lecture dedicated on this topic, I will just introduce to you what is this time value method as of now, so, basically you know that the cash flows are occurring at different time intervals in any construction form before we can see inflows and outflows will be occurring at a different period of time.

So, when you are making some analysis. So, we have to convert all the cash flows, which are occurring at different time period to a particular time period, you have to convert it into an equivalent value at a particular time period and then make the comparison of the analysis. So, that will be more rational. So, that is where we are considering the timing of cash flows in the time value method, which is more accurate. So, the cost of investment can be exactly calculated the considering the time value of money.

So, you will be using some appropriate compound interest factors in this method to convert the cash flows, which are occurring at different time interval to a particular time period, I need to use a compounding interest factors. So, you will be making use of debt in the time value method which

is more accurate, there is another method which is going to be approximate it is called as average annual investment method.

So, in this method, you are going to calculate the thing approximately as a percentage of average annual investment over the useful life of the machine that means, your cost of investment will be expressed as a percentage of average value of machine. So, you know that your machine is going to depreciate gradually over a period of time over its useful life, it is going to depreciate. So, in order to make our calculations convenient, as you know that all the components of the ownership costs which are expressed as a percentage of the value of the machine.

It will also depreciate according to the value of the machine. To make our calculations easier. Let us approximate or fix up the average value of the machine and express all the components of the ownership costs as a percentage of the average value of the machine, so this is what we do in the average annual investment method. So, here we will calculate the cost of investment as a percentage of average value of machine over its useful life, how to calculate the average value of the machine, we are going to see in the upcoming slides. The next important components of the ownership cost are the insurance costs, taxes and the storage cost.

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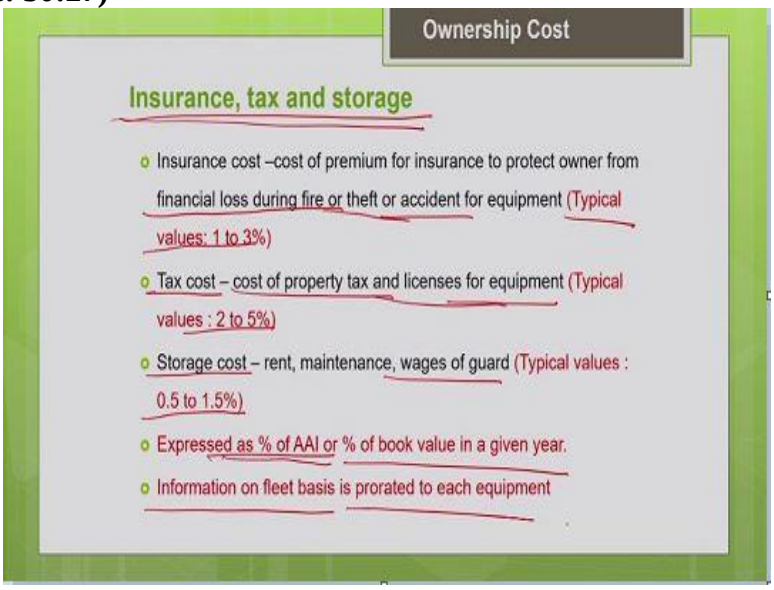

So, insurance costs just like the insurance premium, which would pay for our cars and other equipments. So, we need to pay the insurance premium also for the construction equipment to protect the owner from the financial loss in case of fire or theft or accident or whatever case, so to

protect the owner from the financial loss, so, we pay some insurance premium. So, that is a part of the ownership cost.

So, this insurance costs will be usually expressed as a percentage of the value of your machine. So, a typical value may range from 1 to 3 percentage of the value of the machine. So, it depends upon the value of the machine, it depends upon the location, it will vary depending upon the location. And another thing is if tax cost, say it is the property is it is a asset, so, you have to pay the property tax for the equipment you have to pay the property tax to the government.

So, the cost of the property tax and the licenses for the equipment will come under this tax cost. So, the typical values as reported in the literature, it varies from 2 to 5% of the value of your machine, this will also vary according to the location vary from place to place. So, then storage cost see, when the equipment is not operating, we have to store it in the storage yard. So, the rental charges what to pay for the storage yard and the maintenance charges for the storage yard.

And the wages what you pay for the security guard, all these are considered under the storage cost. So, the rental charges and the maintenance charges for the storage facility. And then for the security guard for the storage facility, we have to pay the wages, all these things comes into the storage cost. So, the typical values will vary from 0.5 to 1.5 percentage of the value of the machine. So, all these components of the ownership cost are expressed as a percentage of average annual investment or the average value of the machine.

Just now in the previous slide we have discussed what is the average value of the machine? So, these components of the ownership costs or express as a percentage of the average annual investment or the average value of the machine or the percentage of the book value in a given year. So, this information, we may be getting it on a fleet basis entire equipment fleet basis, then you can prorate it to the individual or each one according to your requirement. So, the entire information will be available for the entire equipment fleet. So, this we have to prorate it to each equipment.

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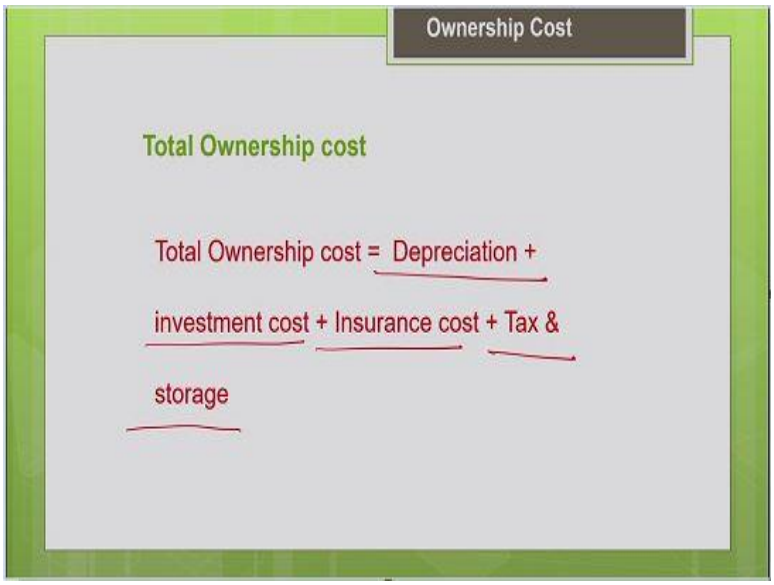

So, let us summarize what are all the components ownership costs we have discussed so far. So, the components of the ownership costs are the depreciation, the cost of investment, insurance cost, the property taxes and the storage cost, all these sums up to the ownership cost.

Total Ownership cost = Depreciation + investment cost + Insurance cost + Tax & storage

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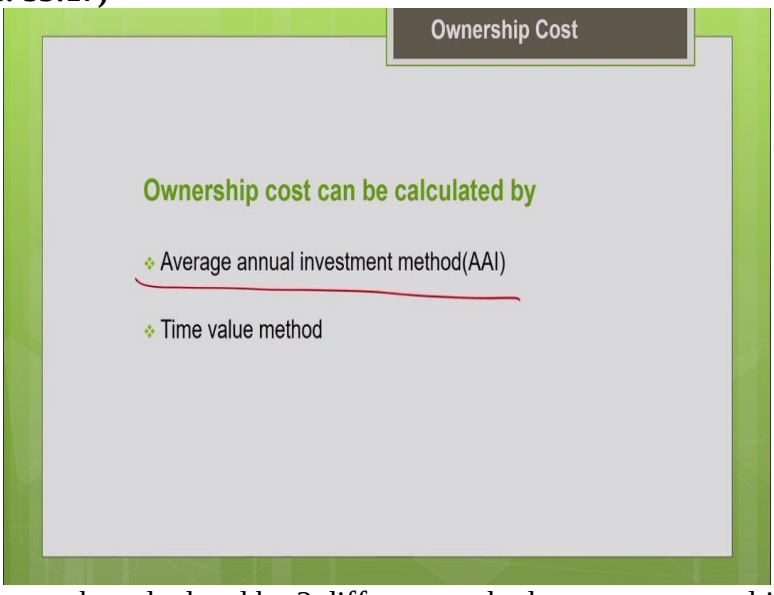

So, ownership costs can be calculated by 2 different methods, average annual investment method and time value method. So, in today's lecture, we are going to discuss about the average annual investment method which is an approximate method of estimation of the cost of investment.

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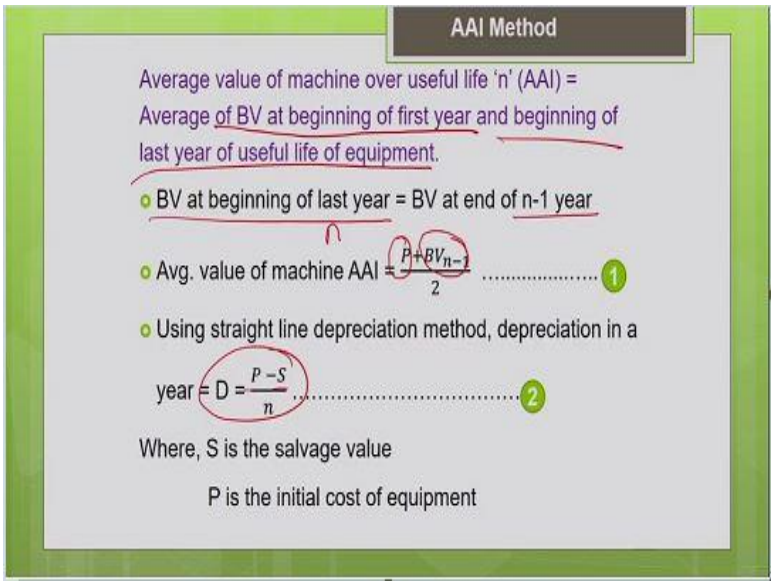

So, average annual investment method, how to estimate this average annual investment over the useful life of the machine or how to find the average value of the machine over its useful life. So, that is what we are going to discuss now, average value of the machine over the useful life is equal to the average value of the book value at the beginning of the first year and beginning of the last year of the useful life of the equipment, when you take the average of these 2 values, you will get the average value of the machine over its useful life.

$$AAI = \frac{P + BV_{n-1}}{2}$$

So, the first year what is happening that is your purchase. So, the average of book value at the beginning of first year is nothing but your purchase price purchase cost and beginning of the last year of the useful life of the equipment. So, that book value you have to take both the book values if you find the average you will get the average value of the machine. So, one more important thing which I told you earlier also.

So, book value at the beginning of a particular year is equal to the book value at the end of the previous year. So that is why book value at the end of the last year say n the total number of years is n book value at the beginning of last year n is equal to book value the end of the previous year previous is nothing but n minus 1 year. So this guideline you should remember now how to find the average value of the machine.

Just now I told you, you take the average of the initial book value that is nothing but your purchase price and the book value at the beginning of the last year of the life of the machine last year nothing but the end of the previous end of n minus 1 year. So, book value at the beginning of the last year n is same as the book value at the end of n minus 1 year. So, that is what we are written here book value at the beginning of last year n is same as book value at the end of n minus 1 year. So, we have taken that into this and we are finding the average year divided by 2.

Now, I hope you remember what we discussed for the straight line depreciation method. So, how to calculate the annual depreciation using straight line accounting method it is nothing but the difference between your purchase price and the salvage value divided by the number of years in the useful life of the machine that will give you the annual depreciation using straight line method. So, difference between the initial cost of the machine minus the salvage value divided by the n it gives you the annual depreciation which is occurring every year, which is going to be same for every year in this straight line method of depreciation.

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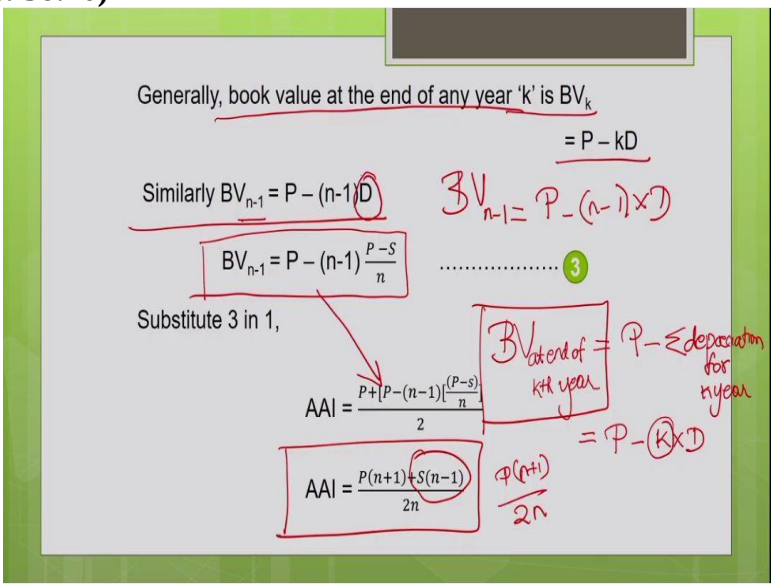

Now, another important thing you have to keep in your mind how to find the book value at the end of a particular year. So, this thing I have discussed in the earlier lecture. So, book value for a particular period book value at the end of a particular period at the end of k^{th} year, I just wanted to find a book value at the end of k^{th} year. So, I how will you find that? If you know the initial cost of the machine purchase price of the machine minus the accumulated depreciation for the k years. So, what is the accumulated depreciation for k years?

So, that will give you the current book value at the end of the kth year. So, when you follow the straight line depreciation, the depreciation is going to be same for every year. So, in that case how to find that P - k into D, D is a depreciation for every year using straight line method. So, number of years is k k into d. So, this will give me the book value at the end of the kth year. So, that is what is written here book value the end of any year k is nothing but P - k into D the initial cost minus the accumulated depreciation for the k number of years.

Similarly, for book value at the end of n minus 1 year I need to calculate book value at the end of n minus 1 year I need to calculate. So, the initial cost is nothing but P - n - 1 years multiplied by the depreciation if we go by straight line method P - n - 1 into D that is what is written here book value at the end of n - 1 here is nothing but initial cost minus n - 1 years multiply by the depreciation for every year now substitute the value of depreciation from the earlier thing whatever you got D = P - s / n substitute that in this equation.

$$BV_{n-1} = P - (n-1)\frac{P-S}{n}$$

Now, you will get P - n - 1 into P - s / n. Now, what do you substitute this equation 3 in the first equation, your first equation is nothing but your average value of the machine instead of BV n - 1, whatever your direct you substitute is BV n - 1, it can express everything in terms of P - s n. So that is what we are doing. Now so, you will get this P plus instead of this BV n - 1 we have substituted this one here.

$$AAI = \frac{P + [P - (n-1)[\frac{(P-s)}{n}]}{2}$$

So, P - n - 1 into P - s / n divided by 2 simplify it will get the average value of the machine as this. So we have to remember this formula P into n + 1 + s into n - 1 divided by 2n to get the average value of the mission over its useful life n, say if the salvage value of the mission is 0, then this will disappear, your formula will become P into n + 1 divided by 2n that will give you the average value of the mission in case salvage value is 0 at the end of the useful life of the machine. So, this formula you are going to remember.

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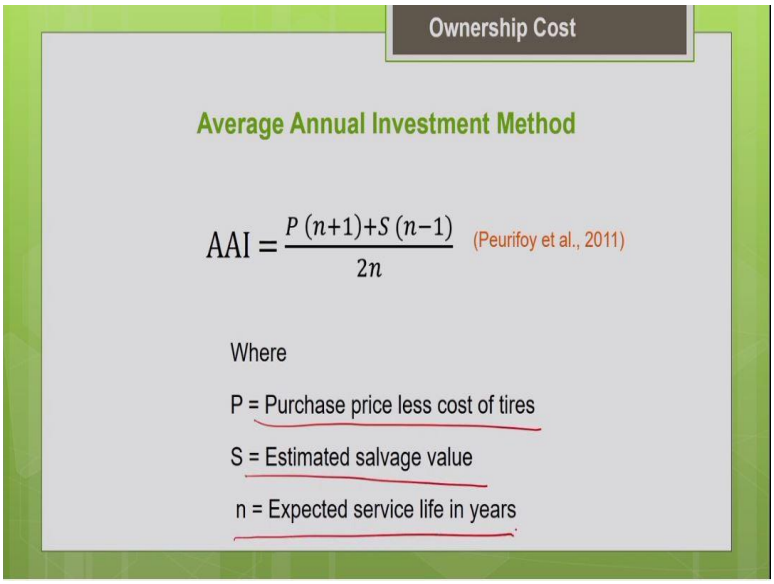

$$\text{AAI} = \frac{P\,(n+1) + S\,(n-1)}{2n}$$

Where

P = Purchase price less cost of tires

S = Estimated salvage value

n = Expected service life in years

And all the components of the ownership cost, we are going to express as a percentage of the average value of the machine when you follow this methodology for the estimation of the ownership cost. So P is a purchase price obviously you deduct the cost of tires, because tire costs will be considered under the operating cost. Then s is the estimated salvage value and n is the service life of the machine.

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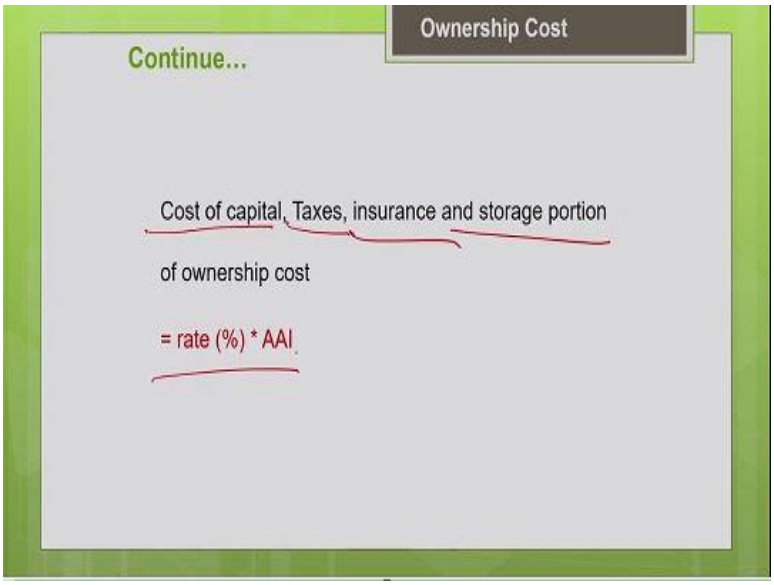

So other components of the ownership cost there is a cost of capital investment costs, your taxes, insurance, storage costs, everything is expressed as a percentage of the average value of the machine that is nothing but average annual investment over the life of the machine.

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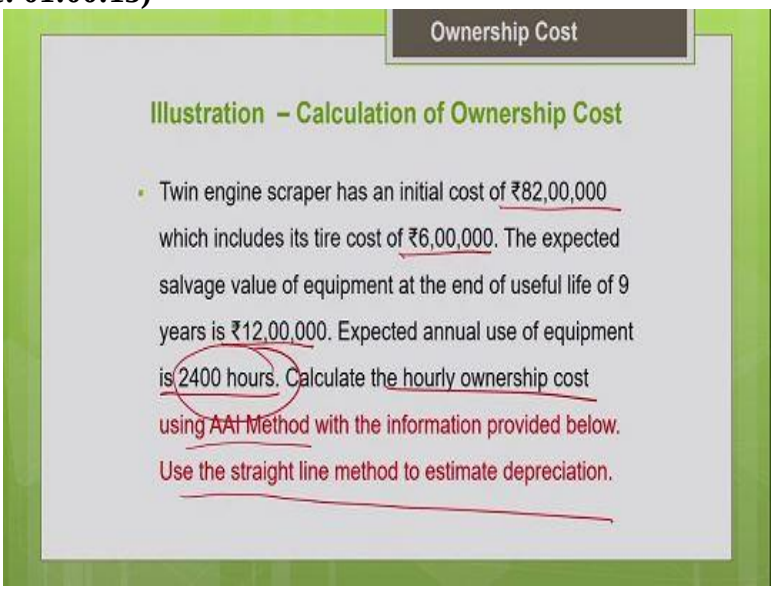

Now, let us work out an example on how to estimate the ownership cost of the machine using average annual investment method a twin engine scraper machine as an initial cost of 82 lakhs. So, this includes its tire cost of 6 lakh, the expected salvage value of the equipment at the end of the useful life of 9 years is 12 lakh. So, the useful life of the machine is 9 years, at the end of the 9 years I will be able to sell the machine at a price of 12 lakh.

Now, the annual use of the equipment is 2400 hours. So, it depends upon every day, how many hours or equipment is going to be operated, and how many days are going to work in a year. Depending upon that you can find what is the annual use of the equipment is 2400 hours. Calculate the hourly ownership cost. So, we always prefer to estimate the equipment cost in on hourly basis so, we are going to calculate it using AAI method average annual investment method and we are going to follow the straight line method to estimate the depreciation to make it more easier.

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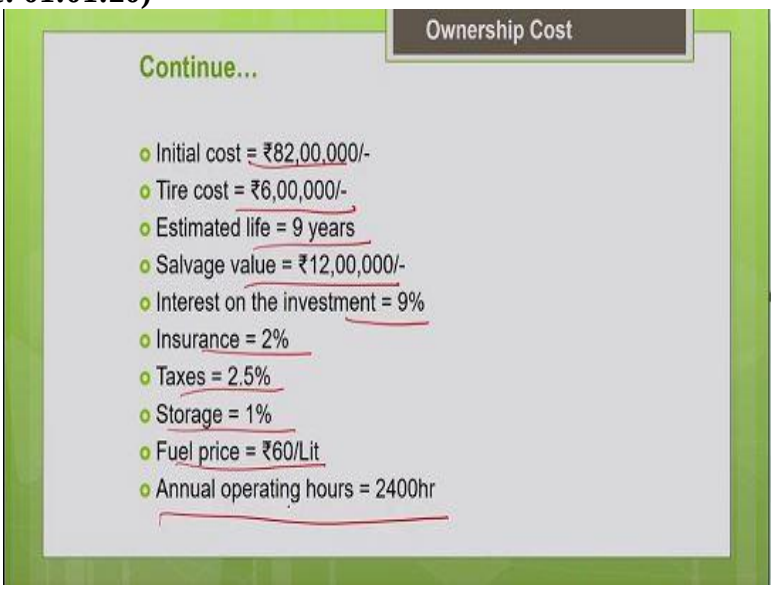

So, this is a summary of the input data given initial cost your tire cost life of the machine the salvage value interest the cost of investment interest on investment is 9% insurance costs 2% taxes 2.5% storage cost is 1% your fuel prices given will be useful operating costs estimation basically, then annual operating hours is 2,400 hours. So, with this is the input data, now, we are going to estimate the ownership cost for this particular machine using AAI method.

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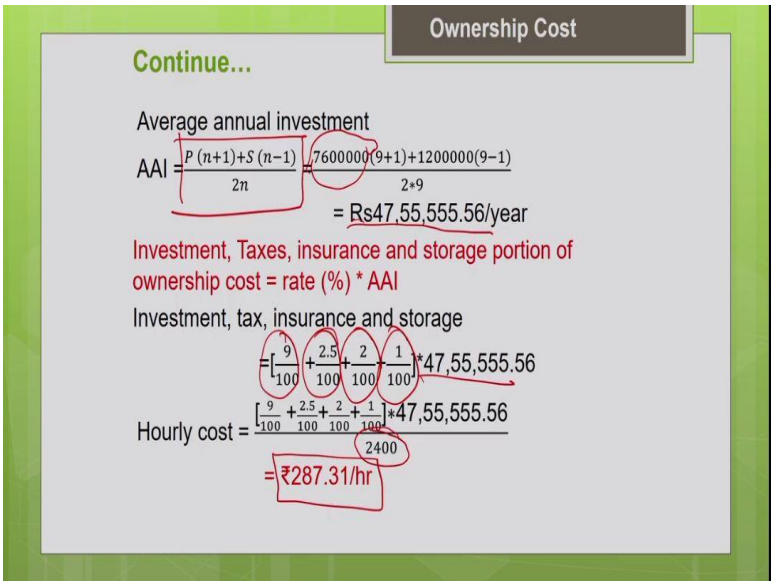

So, how to find this AAI average annual investment; we know the formula P into n + 1 + s into n - 1 / 2n.

$$AAI = \frac{P\,(n+1) + S\,(n-1)}{2n}$$

$$AAI = \frac{7600000(9+1) + 1200000(9-1)}{2*9} = ₹\,47{,}55{,}555.56/year$$

So, we are going to use this formula to determine so, you know P, P is nothing but 76 lakhs hope you know how to determine this 76 lakhs. So, the purchase price of the initial cost of the machine is 82 lakh the tire cost is 6 lakhs. So, 82 lakhs minus 6 lakhs gives you 76 lakhs into n is 9.

So, 9 + 1 plus salvage value is 12 lakh, 12 lakh into n - 1 that is 9 - 1 divided by 2 into 9 this gives you the average value of the machine. It is nothing but 47,55,555.56 per year. Now, estimate your investment, taxes, insurance and storage as a percentage of the average value of the machine how to estimate it you know the investment cost is 9% tax is 2.5 insurance 2% storage is 1% add everything find the percentage of the average annual investment and we wanted the hourly costs so divided by number of hours of usage of machine in a year.

$$Hourly\ cost = \frac{\left[\frac{9}{100} + \frac{2.5}{100} + \frac{2}{100} + \frac{1}{100}\right]*47,55,555.56}{2400} = ₹287.31/hr$$

So, annual usage of the machine in hours 2400 hours divided you will get the hourly cost of all these components of the ownership cost. Now, we are ready to determine the depreciation costs which is also an important component of the ownership cost.

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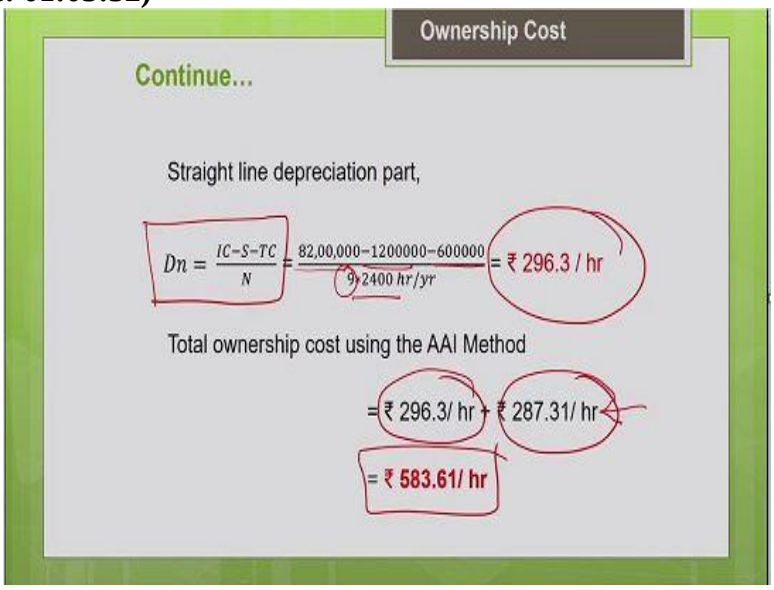

So, depreciation we are going to follow straight line method as it was asked to follow the straight line method in this problem you know how to find the straight line depreciation it is nothing but initial cost minus salvage value minus your tire cost divided by your so, initial cost 82 lakh salvage value 12 lakh and your tire cost is 6 lakh divided by number of years is 9 you multiply by the 2400 hours.

$$Dn = \frac{IC - S - TC}{N} = \frac{82,00,000 - 1200000 - 600000}{9 * 2400\ hr/yr} = ₹\ 296.3\ /\ hr$$

So, that you can get hourly costs directly you will get the hourly cost of depreciation now add up all the ownership cost. So, this is your depreciation costs and these are other ownership components, your insurance, taxes, storage, cost of investment everything add up you will get the total hourly ownership cost using the average annual investment method. So, this is how we estimate the ownership cost using the AAI method.

Total ownership cost using the AAI Method = ₹296.3/ hr + ₹287.31/ hr = ***₹ 583.61/ hr***

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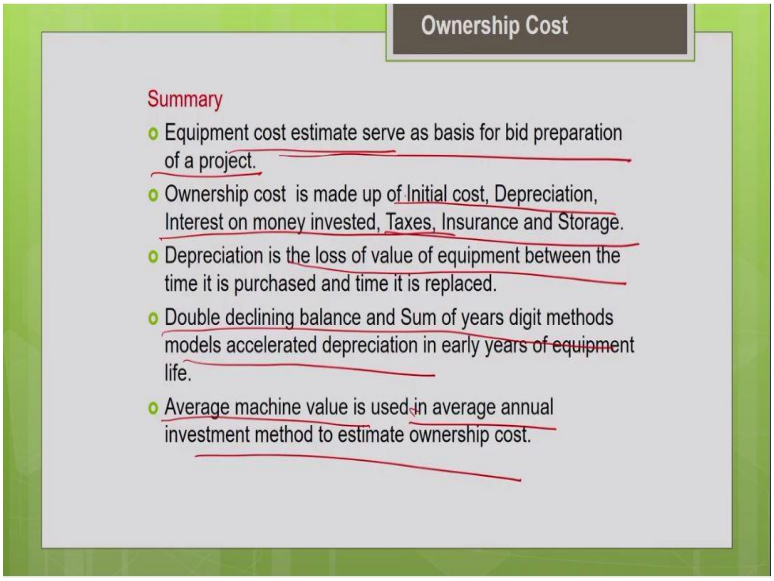

So, let me know summarize. So, what are all the points we have discussed so far. So, basically introduced to you what is the significance of the estimation of the equipment costs because equipment costs will serve as a basis for the bid preparation of the project? Your equipment costs need to be accurate if you have a thorough knowledge of how to estimate the cost of the equipment, then only you will be able to plan your bid properly because your equipment corresponds a part of the project costs.

So, if you underestimated equipment cost; you may overestimate a profit in paper and finally, you may end up in problem. So you should have knowledge and how to estimate the equipment cost. And what are the components of ownership costs we have seen it is made up of the initial purchase price costs of depreciation, cost of investment, taxes, insurance and storage. So, then we discuss what is depreciation, it is nothing but the loss of value of the machine between the time it is purchased and time it is replaced.

So, there will be gradual loss in any asset with time the loss value of the asset as depreciation then there are different methods and we found the double declining balance method and sum of the years digit method models accelerated depreciation in the early age of the machine and people prefer accelerated depreciation because it gives you tax benefits and we have to determine the average machine value over the useful life of the machine. If you are going to use average annual investment method to estimate the ownership cost and how to derive the average machine value, we have discussed just now.

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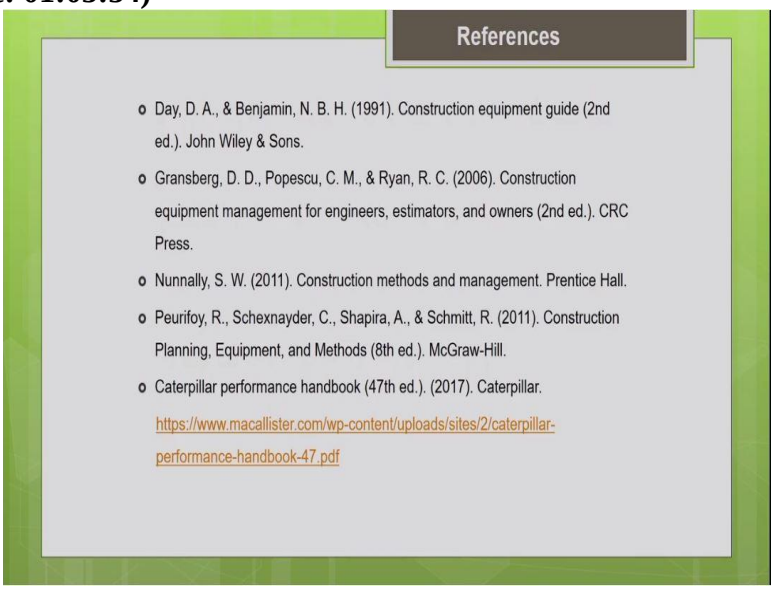

So, these are the textbooks to which I have referred for this particular lecture. So, you can try to procure these textbooks for the future reference. So, with this I would like to end up the lecture to. Thank you.