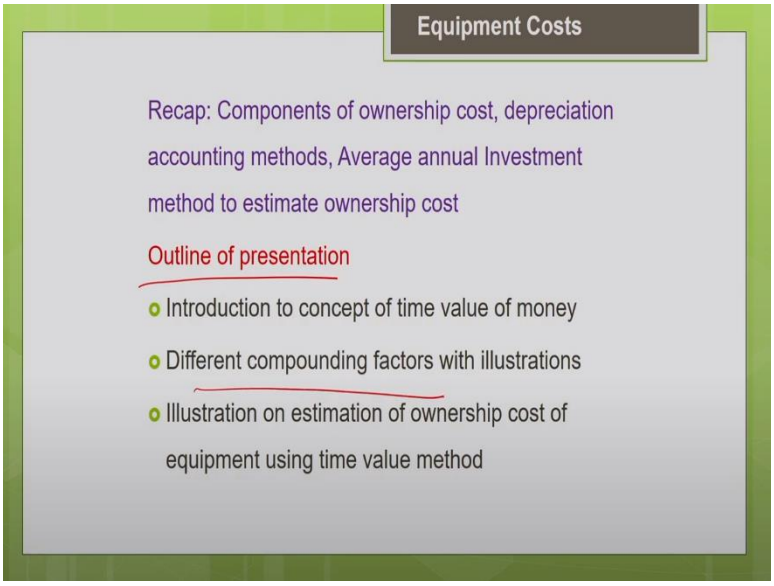
Construction Methods and Equipment Management

Dr.G. Indu Siva Ranjani
Department of Civil Engineering
Indian Institute of Technology, Guwahati

Module No # 01
Lecture No # 03
Equipment Cost – Ownership cost (Time Value Method)

Hello everyone. I welcome you all to the lecture 3 of this course construction methods and equipment management. So in this lecture we will be discussing about the equipment cost estimation specifically I will discuss about the ownership cost using time value method.

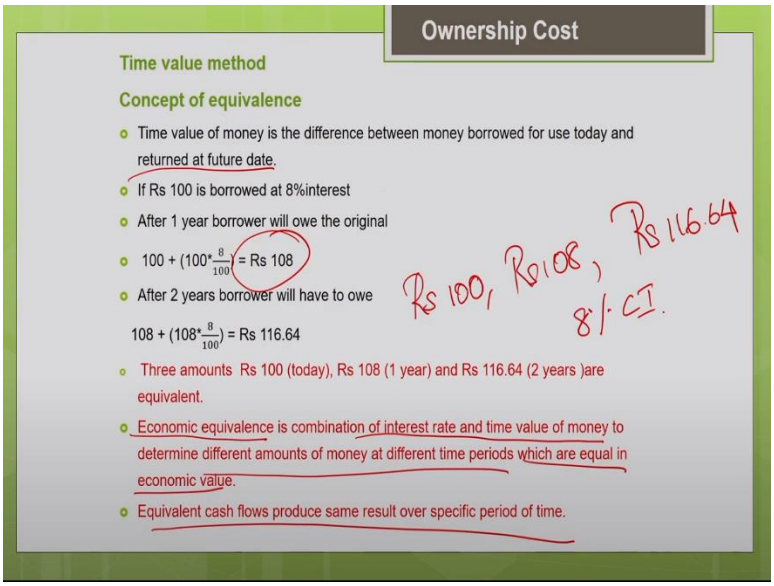
(Refer Slide Time: 00:42)



So let us have a recap of what we learnt in the previous lecture. So in the previous lecture I have introduced to you what are all the components of the ownership cost. We have discussed about the different depreciation accounting methods. Then we worked out a problem on how to estimate the ownership cost using average annual investment method. So this is the outline of today's presentation. In today's presentation I will just introduce to you what is the time value of money?

So as I told you earlier like the cash flows are occurring at different time period.. So we have to convert those cash flows with the occurring at the different time period into equivalent value at a particular time period using various compounding factors. So how to use those compounding factors we are going to discuss in this lecture with some illustrations. And we will also work out of an example on how to estimate the ownership cost using time value method in this lecture.

(Refer Slide Time: 01:35)



Let us see what is this time value of money? As everyone knows that value money changes with time, it is known concept for everyone. So basically if you borrow say 100 rupees from the bank today. So if I am going to return that 100 rupees after 1 year I cannot return the same 100 rupees I have to add some interest to the particular principle 100 rupees. And I have to return back the principle plus interest together at the end of one year.

So how much will be the interest rate that will be decided by the bank depends upon the compounding rate of interest that followed by the bank policy. So according to the bank policy it will vary. So basically the bank or any borrower is charging you the interest for the money whatever he is lending you. The reason why they charge the interest everyone knows it is because they are taking risk by lending you the money.

For this particular risk they are charging the interest so that they can get the profit. So the interest nothing but the earning power of the money. So in another perspective you can say by giving the 100 rupees to the person, the person who is lending is losing the freedom of using, that 100 rupees. To compromise it he is charging you this interest kind of rent. It is kind of rent what we pay for using his money.

So in different perspective you can define it in different way. But basically the interest is the earning power of the money. So basically time value of money is the difference between the money

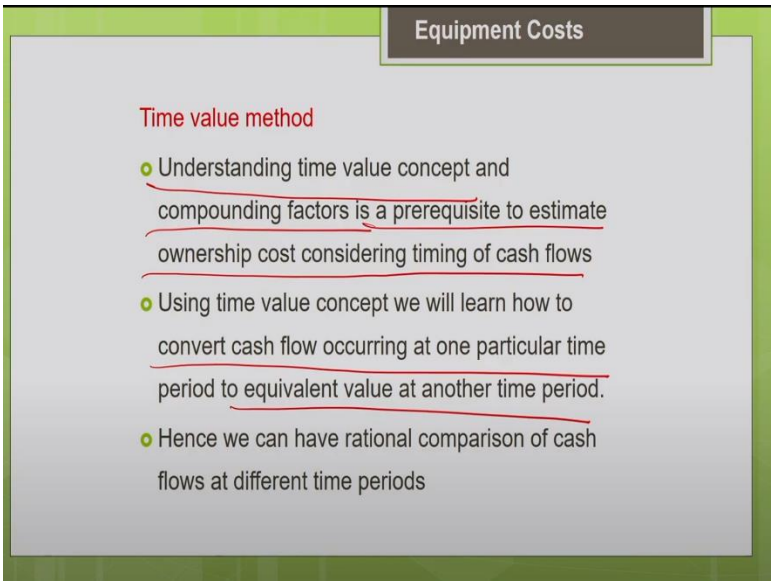
borrowed for use today and return at the future date. So when I borrow 100 rupees from the bank so if it is going to be compounded at the interest rate 8% then after 1 year I am supposed to return 100 + 8 by 100 into the principle amount. This is your interest.

So the total money which you have to return after 1 year will be rupees 108. Say if I want able to return the money after 1 year I am going to return it after 2 years then what happens? Your interest will be compounded. Now you have to calculated in interest for the new principle 108. So 108 + 8 by 100 into 108 so this is the amount which I have to return to the bank after 2 years. So it comes around 116.64. So the thing we have to keep in mind is all these three values are equivalent.

The 100 rupees today and rupees 108 after 1 year and rupees 116.64 after 2 years, all these are equivalent. They are not equal but economically they are equivalent. So this is called as economical equivalence. That is they are going to create the same effect only. So this is the concept of equivalence. They are made equivalent at the compounding interest say 8%. At 8 percent compounding interest they are made equivalent.

So, economic equivalent is the combination of the interest rate and; the time value of the money to determine different amounts of money at different time periods which are equal in the economic value. So basically, these equivalent cash flows will result in same result over a period of time. So the result is going to be same that is what we say here economically equivalent. Though they are not equal they are economically equivalent from economic perspective.

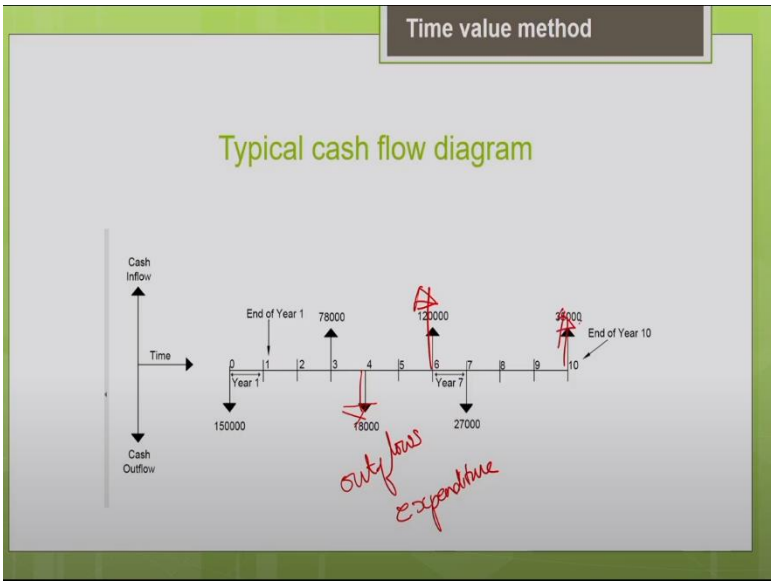
(Refer Slide Time: 05:07)



So in this time value method so basically you have to understand the time value concept and the compounding factors. So what are all the compounding factors which are generally adopted to convert the cash flows which are occurring at different time period to a particular time period to equivalent value or a particular period those compounding factors you should know. So this is a pre-request to estimate the ownership cost using time value method.

So that is it why we are going to learn what are the different compounding factors available and what are the application of this compounding factors and how to make use of them that is all we are going to discuss on the upcoming slides. Using time value concept, we will learn how to convert the cash flow occurring at one particular time period to equivalent value at another time period. So that is what the main purpose of this time value concept. So that we; can have a rational comparison of cash flows at different time periods which will be more sensible.

(Refer Slide Time: 06:02)

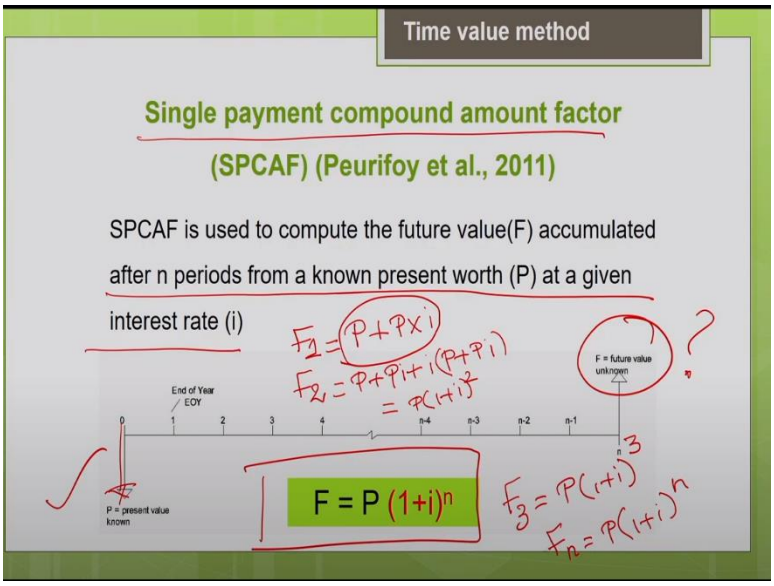


So this shows the typical cash flow diagram. Cash flow diagram is nothing but a graphical representation of the cash flows which are occurring at different point of time. So basically the horizontal line indicates the time period. The time 0, whatever the cash flow occurring at time 0 it indicates the present value. This is the present value year 1 2 3 4 everything indicated the end of the year. So you have remember, that year 1 2 3 means it indicates the end of the period.

And the cash flows which are pointing downward so they are cash outflows. So basically your expenditure is your cash out flow. So cash out flows expresses the arrow pointing downward. And cash inflows are represented as arrow pointing upward. So all your revenue, income your research so whatever is the cash inflow. Say for example if you are going to sell your equipment at the end of the useful life of the machine, the salvage value is your cash inflow.

So that will be represented as the arrow pointing upward. So these things you have to remember in mind. So we are going to use the cash flow diagram to discuss the compounding factors.

(Refer Slide Time: 07:20)



So now let us move on to the first important compounding factor which we need to learn that is single payment compound amount factor. It is given as: -

$$F = P\,(1+i)^n$$

Where,

F = Future value

P = Present value

I = Interest rate

n = period

So this single payment compound amount factor is used to compute the future value accumulated after n periods from a known present worth at a given interest rate i. That means if you know the present value of an asset we can find its future value.

So future value is unknown, you know the present value; you would like to estimate the future value of the particular asset. So you know that that the compounding rate of interest i and you know the n what is the life what is the period for which you are calculating. Then you can use this single payment compounding act factor to estimate the future value. So basically say for example if I am investing 1 lakh in bank.

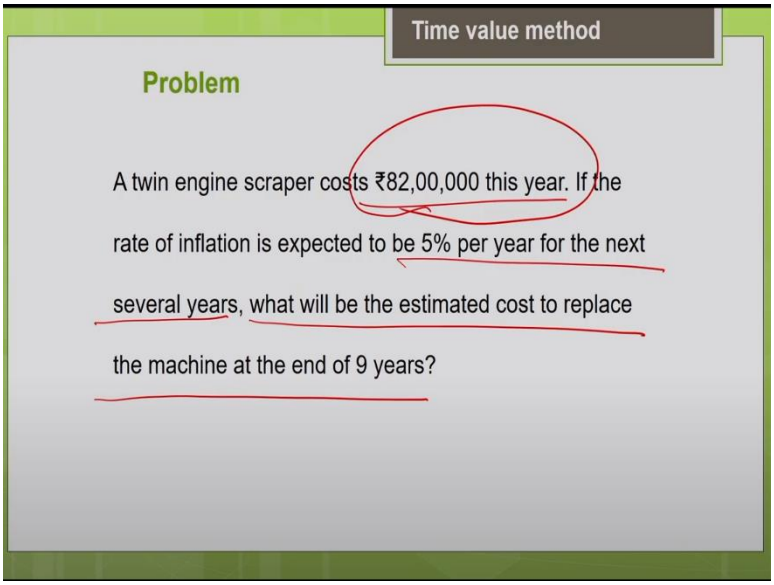
So it is going to be compounded at the interest rate of say 8% for 8 years. So after 8 years what will be future sum of this present 1 lakh that it can calculate using this single payment compound amount factors. Say how will, you calculate basically the future value of the end of the first year

is nothing but you know the principle value P, now you have to calculate the interest for the principle. P into i, i is the compounding rate of interest.

Now for the end of the second year you need to find the future value. How will you calculate now? P + P into i + you have to calculate interest for this entire new sum now. So i into P + Pi so if you simplify it will be P into 1 + i whole square. Similarly, if you want to calculate the future value at the end of the third year F3 you will get P into 1 + i the whole cube. So if you want to calculate the future value end of nth year it is P into 1 + i power n.

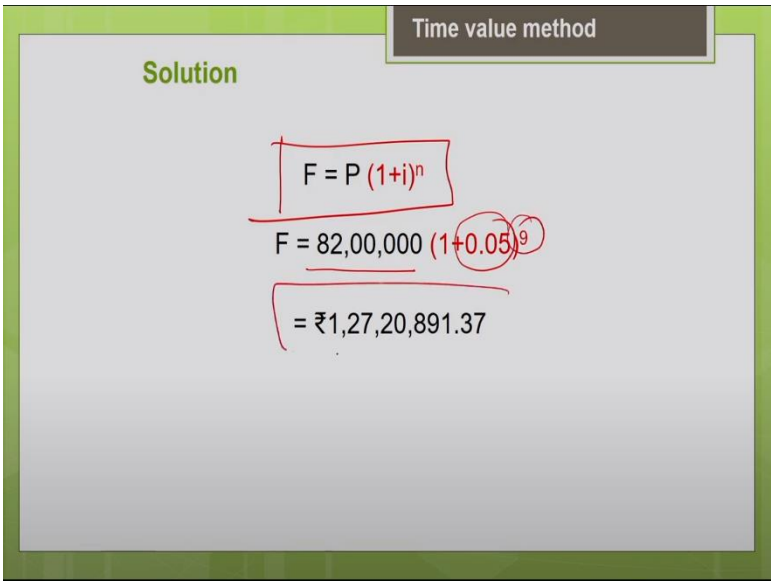
So this is how we get this formula. F is nothing but P into 1 + i power n. If I know the present value of a sum I can know its future value, at the end of n years, if n is known and the compound rate of interest i is known. So now from the equipment perspective we will see one example.

(Refer Slide Time: 09:49)



A twin engine scraper machine it is costing 82 lakh this year, if the rate of inflation is expecting to be 5% per year for the next to several year. I hope everyone knows what is inflation? So inflation refers to the loss in buying power of the currency. So the rate of inflation is 5% what will be the estimate cost to replace a machine at the end of 9 years. So I know the present value of this equipment, I need to know the future value of the equipment at the end of 9 year.

(Refer Slide Time: 10:29)



So I can use the same the single payment compounding amount factor.

$$F = P\,(1+i)^n$$

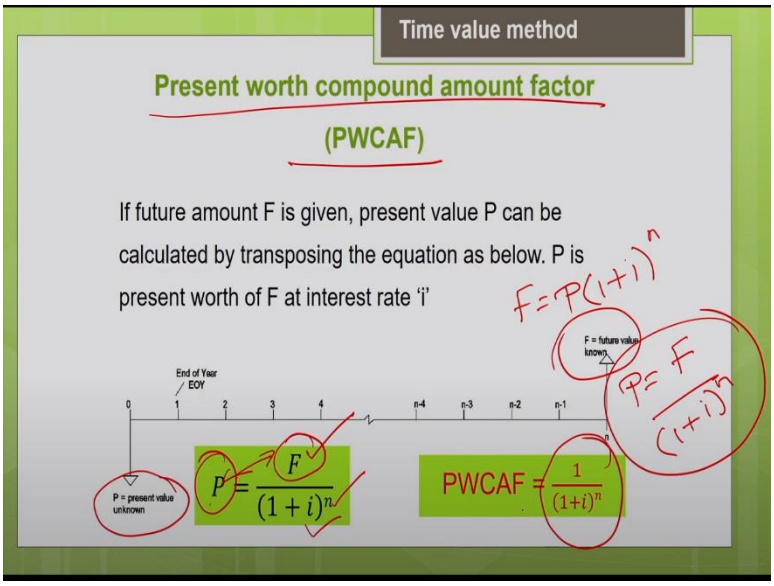
$$F = 82{,}00{,}000\ (1+0.05)^9$$

$$= ₹1{,}27{,}20{,}891.37$$

I need to know the future value of the scraper, I know the present value of the scraper, I know the rate of inflation instead of interest rate I am taking rate of inflation here the life of the machine is 9 years. So it helps you to calculate the future value of the machine. So this compounding factor is very useful because you can know say after 9 years, if I want to replace this old machine with a new machine, how much amount of money I may need.

So that accordingly I can save that money in the pool of funds reserve for the equipment purchase. So this way it will be helpful in the equipment economics.

(Refer Slide Time: 11:14)



Now the next important factor which we are going to discuss is present worth compound amount factor. It is just an inverse of what we discuss so far. So what is the single payment compound amount factor? F = P into 1 + i power n. So now to find the present value you just transpose equation. After transposing it becomes:-

$$P = \frac{F}{(1+i)^n}$$

This gives the present value. So in this case the present value is unknown but the future value is known. It is just an inverse of the earlier case.

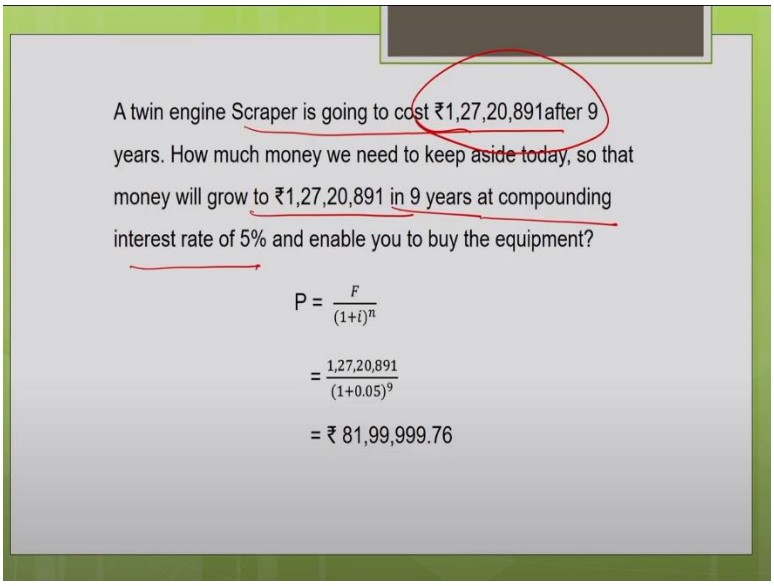
Say for example if I want 10 lakhs after 8 years the compounding interest rate of 8%. How much they should deposit now in the bank. How much amount they should deposit now in the bank? So that it will grow to 10 lakhs at the end of 8 years at the rate of interest of 8%. So I can calculate using this formula. So to calculate the present value, I need the future value, the future value is known, n is known, i is known I can find the present value.

So you should know that the P is made equivalent to F by this factor.

$$\text{PWAC} = \frac{1}{(1+\text{i})^n}$$

This factor is called present worth compounding amount factor.

(Refer Slide Time: 12:40)



So let us workout another example from equipment perspective. A twin engine scarper is going to cost the same numbers I have used again, so that it will be more easier to understand. It is going to cost 1,27,20,891 rupees after 9 years. So you know its future value after 9 years. How much money we need to keep aside today, so that money will grow to 1,27,20,891 rupees in 9 years at a compounding interest of 5% and so that you can buy this particular equipment. So you know the future value of equipment after 9 years.

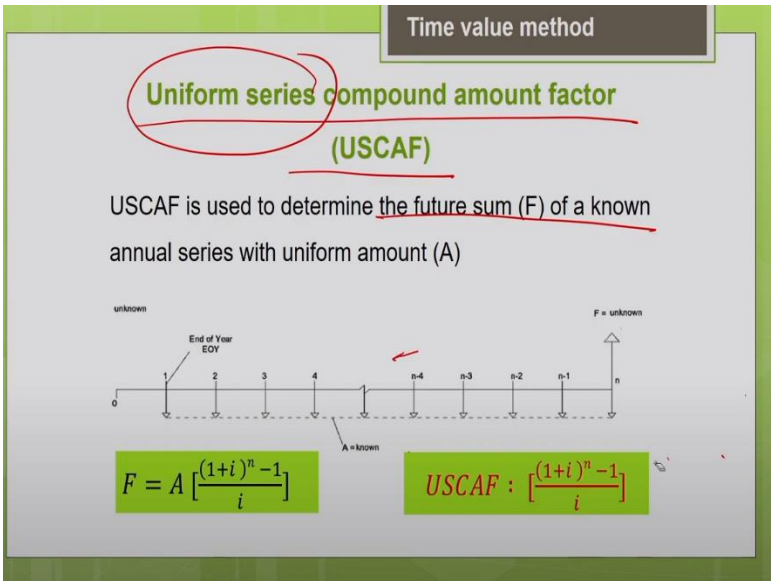
So how much money I should now deposit in the bank at the compounding interest rate of 5 % for 9 years. So that at the end of the ninth year I will, be able to buy this particular equipment. How to plan for that? So how much money I have to deposit now so that after 9 years I can buy this new equipment. So it is we are going to find out the present value. It is nothing but F divided by 1 + i power n. Future value is known compounding interest 5% number of years is 9, you can calculate.

$$P = \frac{F}{(1+i)^n}$$

$$P = \frac{1,27,20,891}{(1+0.05)^9} = ₹\,81,99,999.76$$

So it means now I have to deposit a amount of 81,99,999.76 rupees in the bank for 9 years at the interest rate of 5%. So that it will grow to 1,27,20,891 rupees so that at the end of ninth year I will be able to buy this particular machine.

(Refer Slide Time: 14:31)



Let us see the next important compounding amount factor it is nothing but uniform series compound amount factor. So basically the payments most of the companies you can see it will be occurring cash flows, payments or the receipts all these are occurring in the series. So for example if you are buying an equipment through loan so doing loan repayment, so that will be in series. Similarly your receipts or revenue all these things will be receiving it in series the period of time.

So here we are going to consider only uniform series. Uniform series means in this series of cash flow all the cash flows are equal in value. So I noted very carefully it is equal. All the individual cash flows are equal value. A refers to the individual cash flow of this series of the cash flow and A is equal. So now what is a purpose of this uniform series compound amount factor? It helps us to determine the future sum of the known annual series with uniform amount A. It is represented as follows: -

$$USCAF = \left[\frac{(1+i)^n - 1}{i}\right]$$

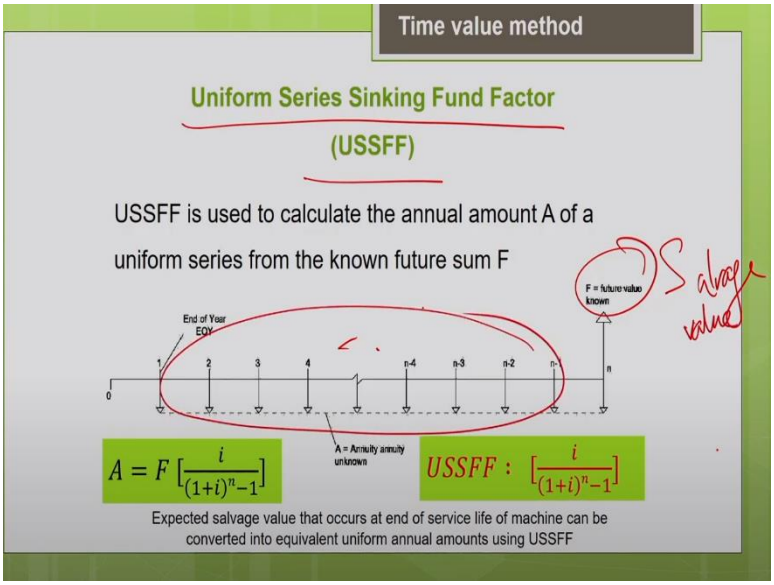
$$F = A\left[\frac{(1+i)^n - 1}{i}\right]$$

So you know the series. The series is known A is known. I need to find the future value of this A. F is unknown the future value is unknown. I need to find the future value of this A. Then I can make use of this uniform series compound amount factor. So basically say for example I am investing in bank let say at the end of every year I am investing 1 lakh in the bank for 8 years.

At the end of every year I am investing, I am depositing the same amount of 1 lakh, at the end of every year for 8 years at the rate of interest of say 8%. So at the end of 8 years how these series of cash flow grow into. So what is the future value this series of investments for the deposits for what you have made. That is what we are calculating here. So the series of investments or the deposits are known.

What is the future value of the series is unknown. So that is what they are calculated? So F is made equivalent to A by this factor. This is the factor called as uniform series compound amount factor.

(Refer Slide Time: 17:02)



So another important factor is uniform series sinking fund factor. So it is an inverse of the earlier case what we have discussed. It is represented as: -

$$USSFF = \left[\frac{i}{(1+i)^n - 1}\right]$$

$$A = F\left[\frac{i}{(1+i)^n - 1}\right]$$

In this the series of the cash flow that is unknown. The uniform series A is unknown but your F is known. So this is used to calculate the annual amount A of the uniform series from the known future sum F. So future sum F is known, I am going to find the equivalent A for it.

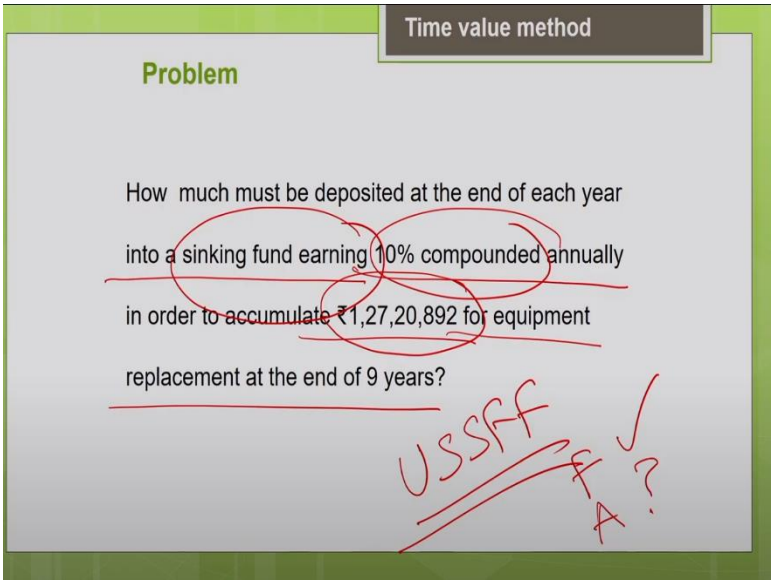
So it is just obtaining the transpose of the earlier equation. This equation if you transpose it you will get the A value. So you are going to find the A from F, i and n. All these are known this is unknown. So basically how much amount of money I should deposit in bank. Every year for 8 years same example 8 years, how much amount of money I should deposit for 8 years. Every year I should deposit same amount at the compounding interest rate of 8%.

So that at the end of the eighth year say I will be getting 10 lakhs this is known. So I need 10 lakhs at the end of eighth year. So every year how much I should deposit in the bank at the compounding interest of 8%. This A is unknown that is what we are calculating here. So from equipment percent if we see it helps you to calculate what is the equivalent value of the salvage value?

So you know that salvage value is one which is occurring at the end of the useful life of the machine it is a future value. So at the end of the useful life of the machine you are disposing the machine or selling it at the reasonable price that is what is your salvage value of the machine? Ok. So how to convert this salvage value which is occurring at the future into equivalent cash flows into equivalent uniform annual amounts.

So we can do that using this factor uniform series sinking fund factor. So this is one application in the equipment economics point of view. So we are converting the salvage value which is occurring in future into equivalent uniform annual amounts using uniform series sinking fund factor.

(Refer Slide Time: 19:31)



Now let us see an illustration from the equipment perspective. So much must be deposited at the end of each year into a sinking fund earning 10% compounded annually in order to accumulate 1,27,20,892 rupees for equipment replacement at the end of 9 years. So, basically say when we plan for the purchase of a equipment or replacement of old machine with a new machine. So generally we do not prefer to use the entire revenue of one complete year one particular year for the equipment purchase.

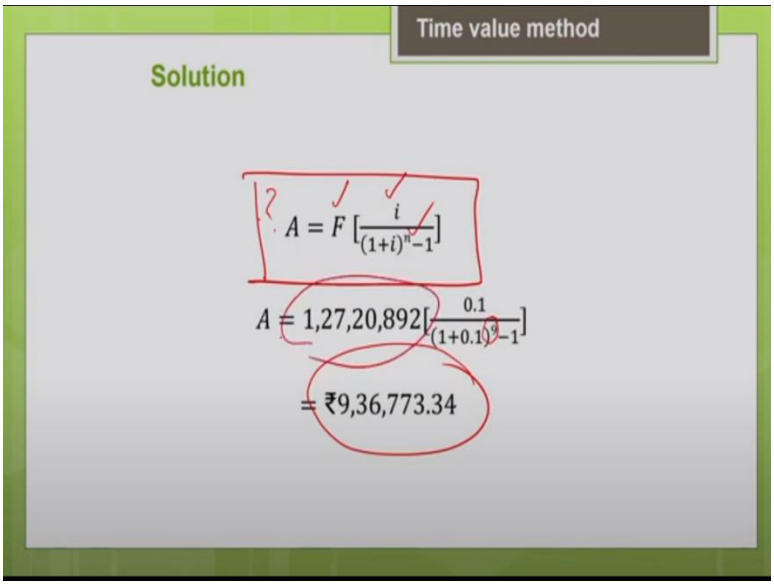
Generally most of the companies will not follow the particular policy because we cannot spend the entire revenue of the company of one year for the equipment purchase itself. There will be lot of other commitments so it may not be possible for us to do that way. And equipment cost may be very significant. So generally what they do is they plan for equipment purchase or equipment replacement in a systematic way.

So there will be particular pool of funds dedicated for the equipment purchase or equipment replacement, for this sinking fund. In the particular pool of fund is they will deposit money. So every year they will be depositing some amount of money. Say for n years this will be compounded at the particular rate of interest say i percentage. So it will help you to either buy a new machine or replace old machine with new machine at the end of the particular period.

So that is how we plan for this equipment purchase or equipment replacement. We deposit some amount of money in pool of funds called as sinking fund that is what is this problem about? How much must be deposited at the end of each year into a sinking fund earning. So how much we deposit into sinking fund earning. The rate of interest is 10% so that my future value is needed is 1,27,20,892.

So that at the end of 9 years I will, be able to replace my old machine with the new machine. So this I can go for uniform series sinking fund factor, with the help of this factor I can estimate this value. So you know the future value is known. You need to know what is the A, every year what should I deposit into the sinking fund. Using this compounding factor, I can estimate that.

(Refer Slide Time: 22:02)



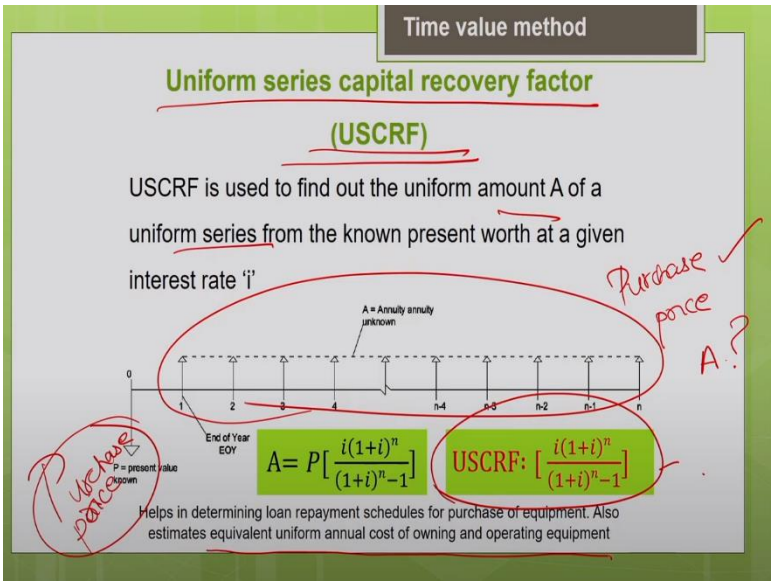
This is your uniform series sinking fund factor.

$$A = F\left[\frac{i}{(1+i)^n - 1}\right]$$

$$A = 1{,}27{,}20{,}892\left[\frac{0.1}{(1+0.1)9 - 1}\right] = ₹9{,}36{,}773.34$$

A is unknown, F is known, i is known, n is known using this we calculate. Now you know that every year I should deposit 9,36,773.34 rupees into the sinking fund. So that at the end of 9 years I will be able to generate an amount of 1,27,22,892 with that I will be able to replace my old machine with a new machine.

(Refer Slide Time: 22:35)



So the next important factor which we are going to discuss today is uniform series capital recovery factor. It is given as follows: -

$$USCRF = \left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

Basically this is used to find out the uniform amount A of a known series from the known present worth at a given interest rate i. So you know the present worth of a particular asset. The present value is known. How to convert it into a equivalent uniform series. P the present value is known. The present value is known. How to convert it into equivalent uniform series? That is possible using this uniform series capital recovery factor.

Say for example if I deposit 10 lakhs in bank now. So for a period of 9 years I have deposited at a interest rate of say 9%. For 9 years I have deposited at the interest rate of 9%. So what will be amount of money which I will get at the end of every year as a return. So that return is going to be in the form of equal amount of money. So that is what is A? That I can find it if I know that I am going to deposit 10 lakhs now at the end of every year how much amount of money I will get from the bank as a return in terms of equivalent amount.

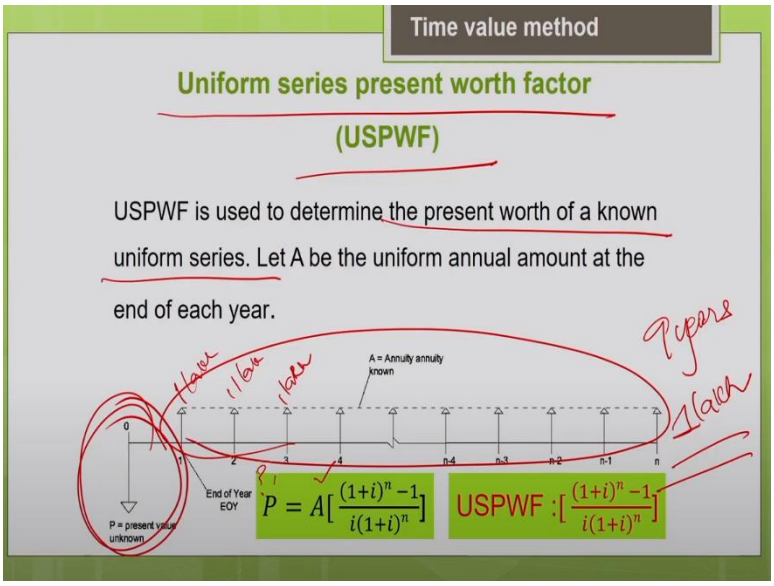
So that is what n calculating with this. So there are different applications for this uniform series capital recovery factor. It helps you in determining your known repayment schedule. Say for example if you have purchased equipment through loan. So you are lender will find out the loan repayment schedule using this uniform series capital recovery factor. See basically it tells you how to recover the capital invested. How to recover the loan which you have lent to your borrower?

So to find it I can make use of it uniform series the capital recovery factor. So one thing is a loan repayment schedule and another that is what we are recovering your, the capital cost. Say another important application in the equipment economics is you know the purchase price of the machine, what you make at the beginning. That is the present value purchase place of the machine is known to you. The present value is known. How to convert it into equivalent uniform cash flows?

How to convert the purchase place into equivalent uniform cash flows over the useful life of the machine? So how to; convert the purchase price into A? How to convert purchase price into A? So purchase price is known to you, A is unknown. So you can calculate using this uniform series capital recovery factor. So that is what is written here. It also estimates the equivalent uniform annual cost of owning and operating equipment.

You can convert the purchase price of the equipment into equivalent uniform annual cost of owning the operating machine using this formula. So this will help you in the equipment cost estimation. How to estimate the annual cost of the machine? And how to, estimate the hourly cost of a machine? Which; we are going to see in the upcoming slides.

(Refer Slide Time: 25:47)



So another important factor which we are going to discuss now is your uniform series present worth factor. It is an inverse of what we discussed earlier.

$$USPWF = \left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

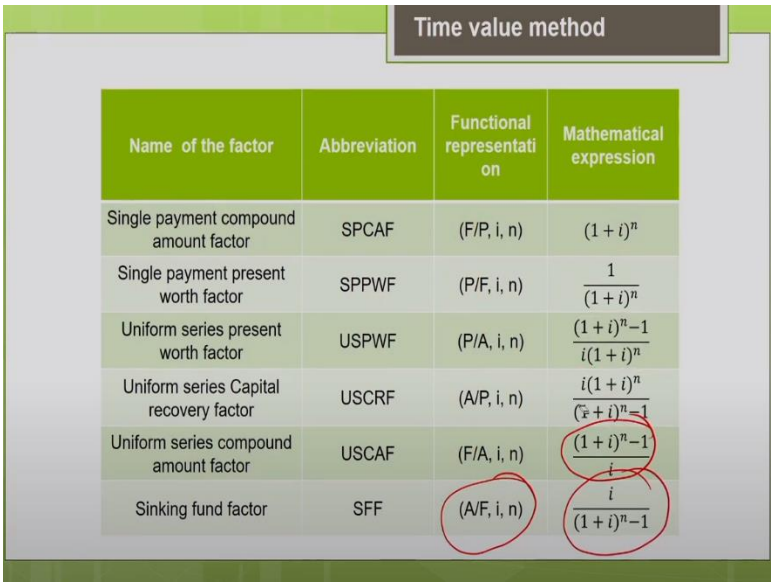
So there A is unknown, P is known. So here A is known P is unknown. So it is just by transposing this equation you can find this uniform series present worth factor. It is used to determine the present worth of a known uniform series. So the series is known, the series of cash flow is known. What is it present value? I can determine from this compounding factor.

Say for example for 9 years, my plan is for 9 years at the end of every year I need 1 lakh as a rate of return from the bank. So for that how much amount I should need to deposit in the bank. So that I can get the return of 1 lakh for 9 years at, the end of every period over the period of 9 years. So I need 1, lakh money. At the end of every year I need a return of 1 lakh for 9 years.

So how much should I need to invest now? Ok. So that is what I am calculating from here. So I can find the present worth of known series of cash flows using this uniform series present worth factor which is nothing but the transpose of the earlier formula whatever we discussed. It is a

transpose of uniform series capital recovery factor. So here you can see the P is made equivalent to A by this uniform series present worth factor.

(Refer Slide Time: 27:26)



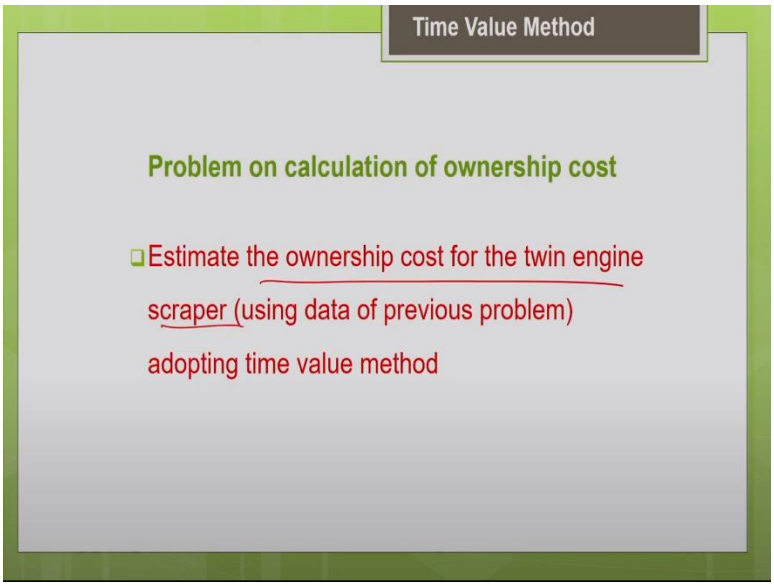
So let us now summarize what are all the different compounding factors which we have learnt single payment compounding amount factor you know that to determine F for known P, i and n. So F is made equivalent to P by using this factor. So, single payment present worth factor to determine P for the known F, i and n. P is made equivalent to F by this factor. For the uniform series payments, uniform series present worth factor determine P for the given A, i, n.

This is the factor which makes equivalent. So this is to determine A, the annual cash flow your determining the annual cash flow for the known P, i and n this is the factor. Then the uniform series compound amount factor to determine F for given A, i, n. So basically to know what is the current series to known. If you want to know the future value of the current series, then you can use this factor. Then sinking fund factor it is just an inverse.

So determine A for the known F, i and n. So they have made equivalent by this factor. So basically if you see that these two, are inverse of each other. Similarly, these two are inverse of each other. See if you know one you can calculate the other one. You need not remember all the compounding factors at least one of every important factors of this you should remember. So let me summarize what we have discussed so far.

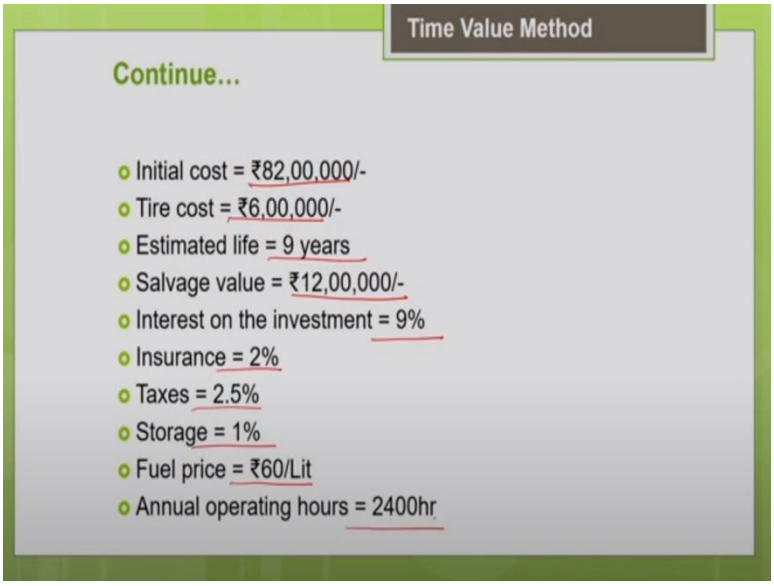
I introduced to you the importance of considering the timing of the cash flows. And how to use the various compounding factor to convert the cash flow which are occurring at different time period to equivalent cash flows at the particular time period.

(Refer Slide Time: 29:23)



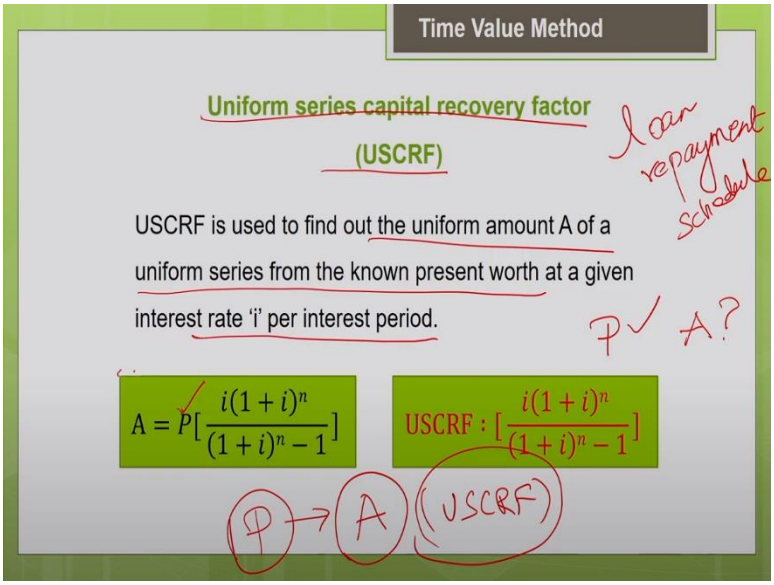
So now let us proceed on how to estimate the ownership cost using this time value concept. The same problem which we have worked out earlier but using the time value method. So estimate the ownership cost of the twin engine scraper machine, using the data previous problem what we have used earlier for the other method it is average annual investment method is the same data we are going to use here. But we are going to work out using the time value method here.

(Refer Slide Time: 29:52)



So let me summarizing the input data of the given in the problem. So the initial cost of the machine is 82 lakhs. The tire cost is 6 lakhs and the estimated life of the machine is 9 year. So at the end of 9 years we will be able to sell this machine at a salvage value 12 lakh. So the interest of the investment is 9%, insurance percent is 2%, tax is 2.5%, storage is 1% and fuel price is given as 60 rupees per liter which will be used for operating cost estimation. Then the annual operating hours equal to 2400 hours. So the use of machine in hours in years is 2400 hours.

(Refer Slide Time: 30:36)



Now let me recollect the important compounding factor which we discussed earlier which we are going to use again now in the ownership cost estimation using time value method. So the important factor which we are going to use now is uniform series capital recovery factor. So basically this factor is used to find out the uniform amount A of a uniform series from the known present worth at a given interest rate i per interest period.

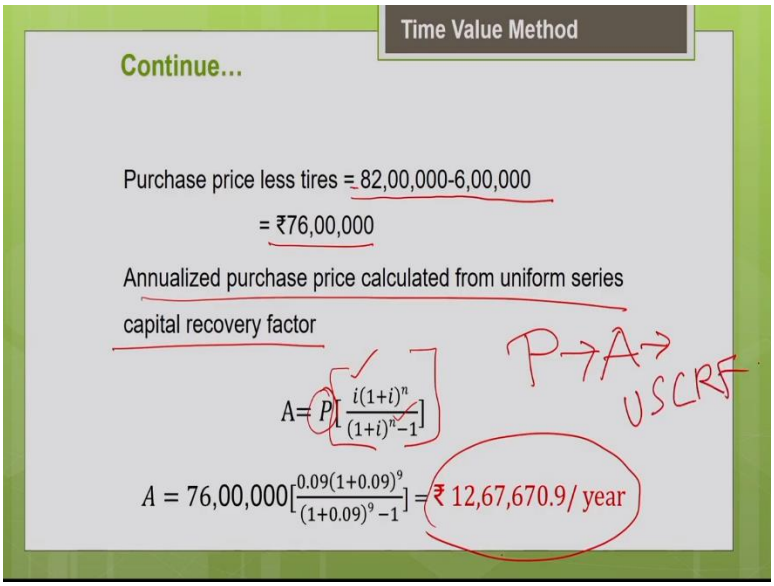
So in this case your present worth of your money is known. You are going to find the uniform amount A. So for a given P we are going to find A. So basically we discussed about this factor earlier. It helps you to determine at what rate your capital can be recovered. Using this factor we can also find what is the loan repayment schedule for the equipment. So the lender will fix the loan repayment schedule using this uniform series capital recovery factor.

So at what rate you can recover your loan. What will be your loan repayment and schedule? So that we can calculate using this so basically for the given P you can find the A. Say you know the

present purchase price of the machine P. So you can convert it into annualized purchase price or equivalent annual the uniform cost so using this uniform series capital recovering factor. So the purchase price of the machine can be converted into equivalent uniform annual cost over the useful life of the machine using uniform series capital recovery factor.

So we are going to determine A for the given P to know the present value. So this is given you are going to find the A. So this is your uniform series capital recovery factor. So the A is made equivalent to P by this factor.

(Refer Slide Time: 32:36)



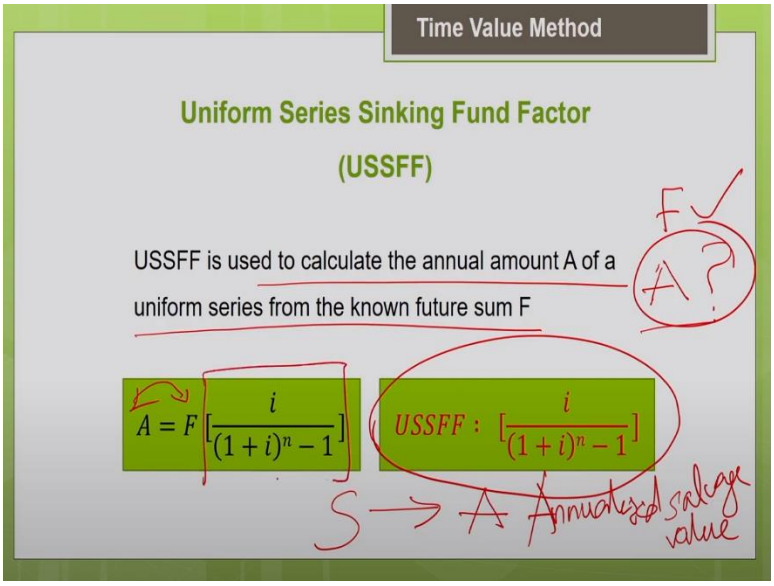
Let us see how to use this factor to find the annualized purchase price of the machine. So first let us calculate what is the purchase price of the machine less the tire cost? So 82 lakhs is the purchase price minus the tire cost because the tire will; be cost of the considered under the operating cost. Now the purchase price less the tire cost will be 76 lakhs. Now how to find the annualized purchase price from the uniform series capital recovery factor?

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

$$A = 76,00,000[\frac{0.09(1+0.09)9}{(1+0.09)9\ -1}]\ =\ ₹\ 12,67,670.9/\ year$$

So you know the P value purchase price less the tire cost that is 76 lakh multiply by this uniform series capital recovery factor. You know the i value, you know the n value. So you can substitute it and find the annualized purchase price of the machine. So now you have converted the present purchase price into annualized purchase price using this uniform series capital recovery factor. Now let us move on to the next part.

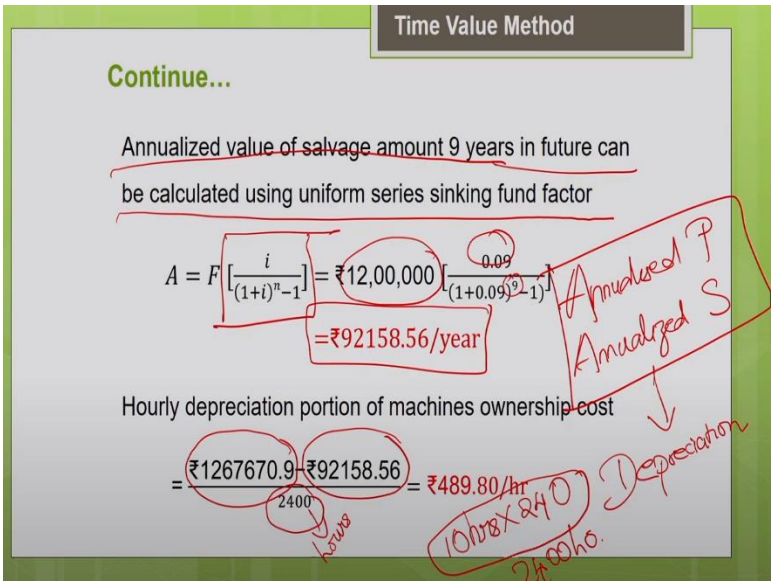
(Refer Slide Time: 33:32)



So now we are going to use this factor uniform series sinking factor. Let us recollect what is sinking factor? Ok. So basically it is used to calculate the annual amount A of a uniform series from a known future sum F. So if the future sum F is known then you can convert it into equal and uniform series A. So here you are calculating A for the given F. The future sum is known, the future value particular the money is known we are going to convert that future some into equivalent reform series A using this uniform series sinking fund factor.

So now how are you going to use this in the ownership cost estimation let us see. You know the future salvage value of machine, salvage value is nothing but at what price you are going to sell the machine at the end of the useful life. So the future salvage value is known you can convert it into equal and reform series A that is you can convert it into annualized salvage value using this uniform series sinking fund factor. So here the A is made equivalent to F by this uniform series sinking fund factor. Let us see how it is applied.

(Refer Slide Time: 34:55)



Now the annualized value of salvage amount 9 years in future can be calculated using uniform series sinking fund factor as below.

$$A = F\left[\frac{i}{(1+i)^n - 1}\right]$$

$$= \text{₹}12{,}00{,}000\left[\frac{0.09}{(1+0.09)9-1)}\right] = \text{₹}92158.56/year$$

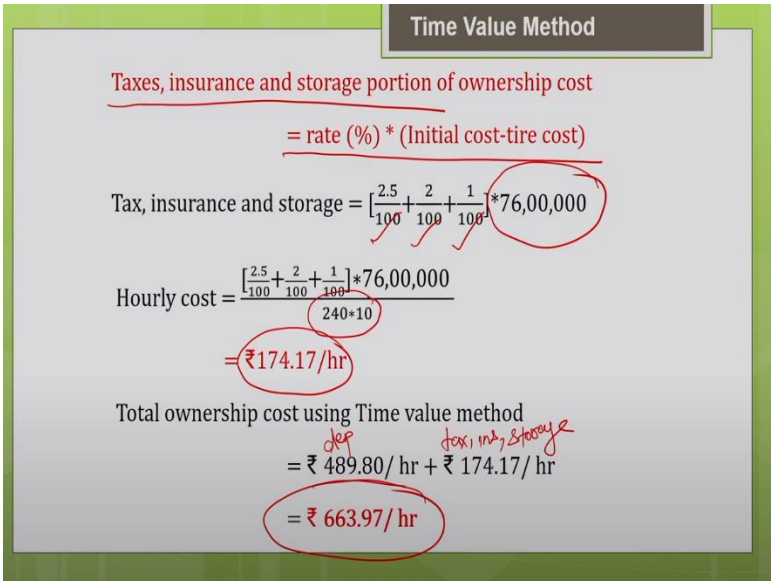
F is the future salvage value 12 lakh. You know the interest rate, you know the n. So this is your uniform series sinking fund factor. So you can multiply the sinking fund factor with the salvage value you will get the annualized salvage value as below. So now you know the annualized purchase price you know the annualized salvage value.

If you find the difference you will get your depreciation. So that is what is the straight line method says difference between the purchase price minus the salvage value. Here you are going to find the annualized value then we will convert it into hourly cost. So hourly depreciation portion of the machine ownership cost we are calculating with the straight line depreciation method. It is nothing but your annualized purchase price minus your annualize salvage value divided by the annual use of the machine in hours.

$$= \frac{₹1267670.9\text{-}₹92158.56}{2400} = ₹489.80/hr$$

So the total hourly usage of the machine. Say for example every day you are using the machine for 10 hours. So you are going to operate the machine for 240 days in a year. So the total annual usage of the machine, hourly usage of the machine in a year will be equal to 2400 hours. So this is how you calculate the hourly depreciation. Now let us calculate the other components of the ownership cost.

(Refer Slide Time: 36:43)



So the other components of the ownership cost taxes or insurance and storage. So they are express as a percentage or the initial cost minus the tire cost. So in this time value method instead of taking the average value of the machine we are calculating as a percentage of the initial cost of the machine, obviously after deduct the tire cost. So at the tax component, insurance component and the storage percentage so calculate the percentage of the initial cost minus tire cost divided by the total hourly usage of the machine in a year.

$$Tax, insurance\ and\ storage\ (hourly\ cost) = \frac{[\frac{2.5}{100} + \frac{2}{100} + \frac{1}{100}]*76,00,000}{240 * 10}$$

$$= ₹174.17/hr$$

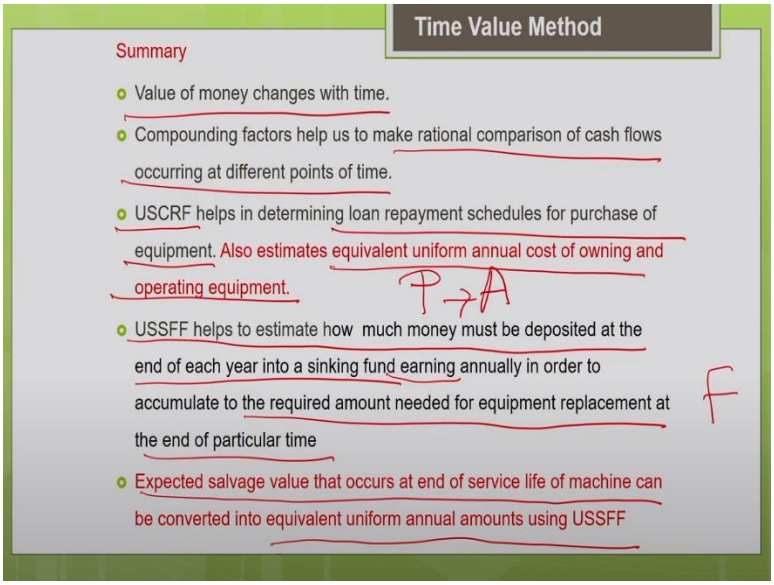
So that is divided by 2400. So you will get hourly cost at rupees 174.17 per hour. Now you are going to calculate the total ownership cost. So earlier whatever you are calculated the depreciation and now you have calculated your other part taxes, insurance and storage add both. This is your depreciation part, this is your taxes insurance and storage part, add everything you will get the total ownership cost using the time value method .

$$Total\ ownership\ cost\ using\ Time\ value\ method = ₹\,489.80/\,hr + ₹\,174.17/\,hr$$

$$= ₹\,\mathbf{663.97/\,hr}$$

So you have calculated hourly cost. So this is how the estimate the total ownership cost using time value method. Earlier I have calculated using average annual investment method which was a approximate without considering the timing of cash flows,. So this is what accurate method. You can compare the cost using both the methods.

(Refer Slide Time: 38:08)



Now let me summarize, so whatever we have discussed so far in this particular lecture on time value method. As everyone know the value of money is changing with time and we found that the compounding factors are very helpful to make the rational comparison of the cash flows occurring at different point of time. It helps you to convert the cash flows occurring at the different period into equivalent value at the particular period for making the analysis of comparison.

So then we saw the application of this uniform series capital recovery factor it helps in determining the loan repayment schedule for the purchase of the equipment. It helps you to determine at what rate you recover the capital invested. Also it estimates the equivalent uniform annual cost of owning and operating equipment. It helps you to convert the present purchase price into annualized purchase price.

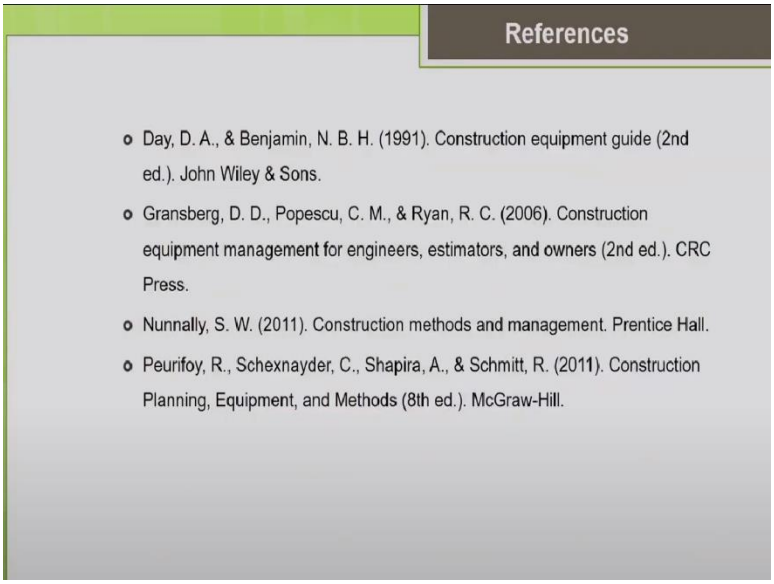
So that is how we estimated the depreciation in the time value method hope you remember. Similarly, this uniform series sinking fund factor helps to estimate how much money must be deposited at the end of each year into the sinking fund earning annually in order to accumulate to the required amount needed for the equipment replacement at the end of the particular time. Say I told you about the sinking fund.

Generally, when we plan for the purchase of a new equipment or replacement of the old equipment with new machine so what we do is? We deposit some amount of money into the pool of funds go to the sinking funds every year, planning for the purchase for the replacement. So that at the end of the particular period that money will grow into particular sum which will enable you to either purchase in new machine or replace old machine with the new machine.

So this sinking fund factor will help you to determine how much money I should deposit in the pool of funds every year. So that it will grow into the future value F at the end of the n years. Also with the help of the uniform series sinking fund factor I can convert the salvage value that occurs at the end of the service life of machine into equivalent uniform annual amounts. So that is what we found in the time value method estimation.

So we convert the future salvage value into annualize salvage value using uniform series sinking fund factor. So with this we have come to the end of the lecture 3.

(Refer Slide Time: 40:37)



So these are the important references which I have referred for this lecture preparation. You can refer these textbooks for the post preparation. So in the next lecture we will be discussing about how to estimate the equipment cost particularly the operating cost. How to estimate the operating cost we are going to discuss in the lecture 4. Thank you.