Introduction to Accounting and Finance for Civil Engineers
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Module No. #02
Lecture No. #06
Economic Decision Making - II

Namaskar, and welcome to this course on, Accounting and Finance for Civil Engineers once again. And, this as you know, is being hosted together by, IIT Kanpur and IIT Delhi.

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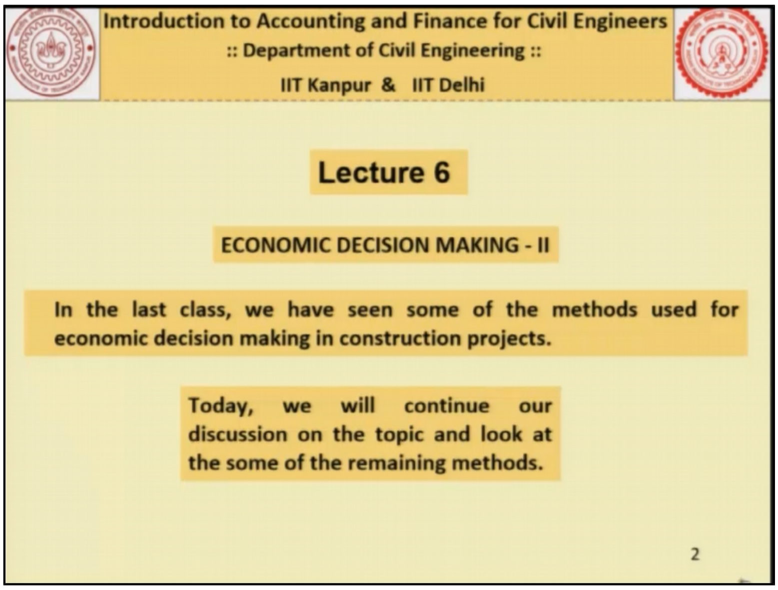

So, as far as the lecture today is concerned, this is the second in the series of economic decision-making. And, in the last class, we have seen, some of the methods used for this process, as far as, construction projects are concerned. So, we will continue the discussion today, and look at some of the methods that were remaining from the list, that I had shown you.

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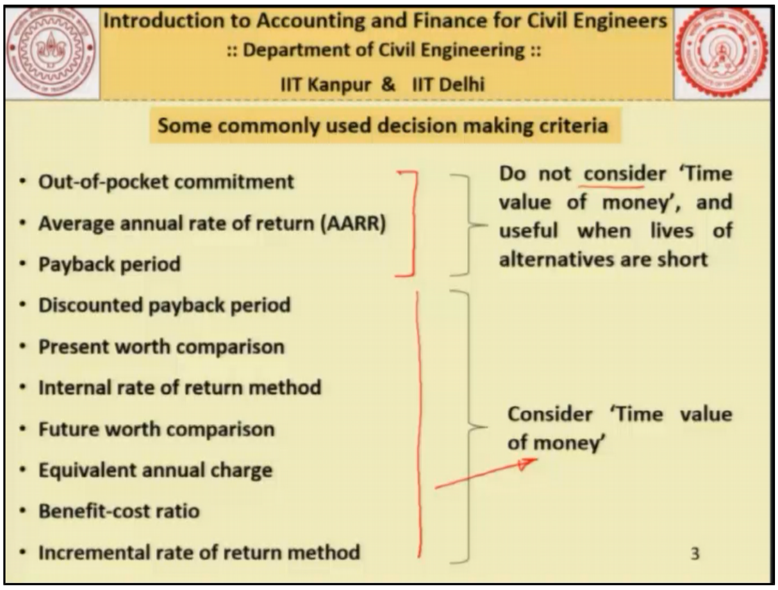

So, you would recall, that this was the list that were shown to you, out of pocket expenses, and annual rate of return, payback period, and so on, right down to the incremental rate of return method. And, we have said that, these 3 methods, do not consider the time value of money, whereas these methods here, they consider the time value of money also.

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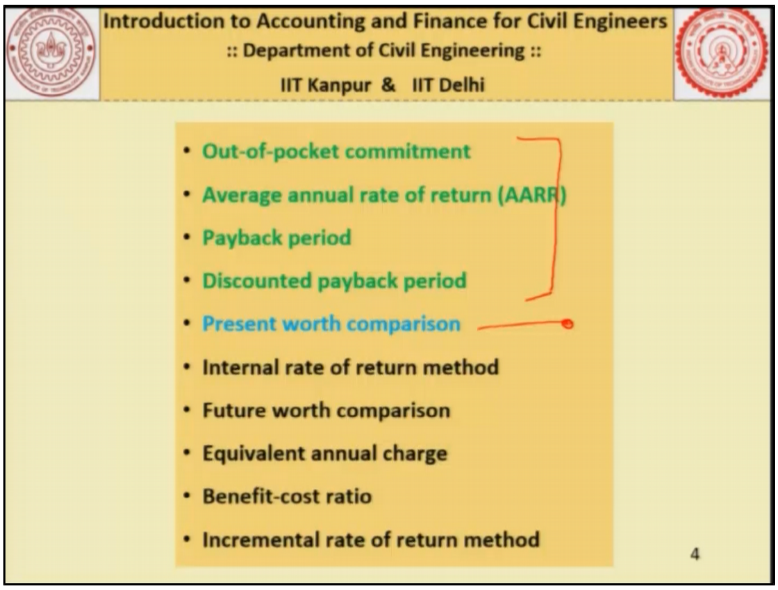

We have continued our discussion, and had completed, these 4 methods. And, what we were doing at that time was, a part of this discussion on, present worth comparisons.

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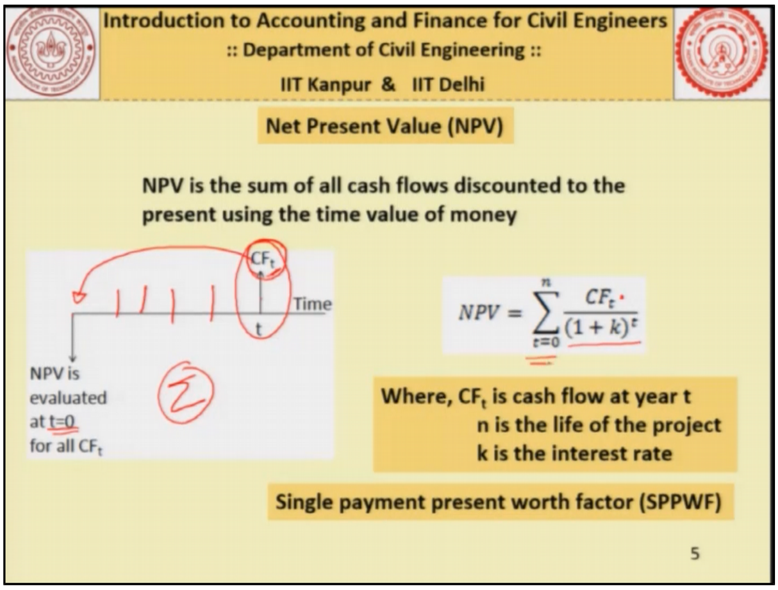

So, let us resume our discussion, from there. We were talking of NPV, which is the Net Present Value. And, that is the sum of all cash flows, discounted to the present, using the time value of money concept. So, what it effectively means is, that we have these different cash flows, at different points in time. And, we want to bring all of them back to, time T is equal to zero. And, at the end of it, sum this whole thing, if there are more than one cash flows.

So, that sum, is what is NPV. So, mathematically speaking, we had looked at this formula, that if we get all the CFT's at different points in time, we can use this, 1 + K to the power of T, and we will get NPV. In this equation, CFT is the cash flow at year T, or time T, N is the life of the project, and K is the rate of interest. We have been using I, but we could use K, or any other variable. And, this basically is an adaptation, of the single payment present work factor.

So, you can see that, a single payment here, is being transferred to this point. And, that is what we had talked about, when we had talked of SPPWF. That is, the Single Payment Present Worth Factor. Now, what we are doing in addition to that is, just creating this sum of the different single payments. So, that is what is the concept of NPV. And, we have gone over it, in the last class also.

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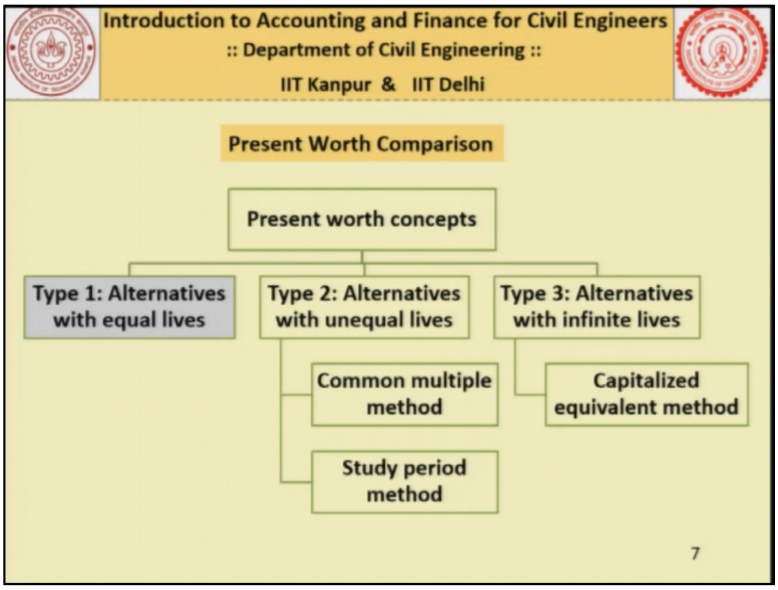

So, with this, you would also recall this particular chart, where we had said, that the present work concepts, can be used for type-1, type-2, and type-3 kind of situations, where type-1 deals with alternatives of equal lives, and type-2 deals with alternatives of unequal lives, and alternatives with infinite lives. So now, let us resume our discussion for, alternatives with unequal lives.

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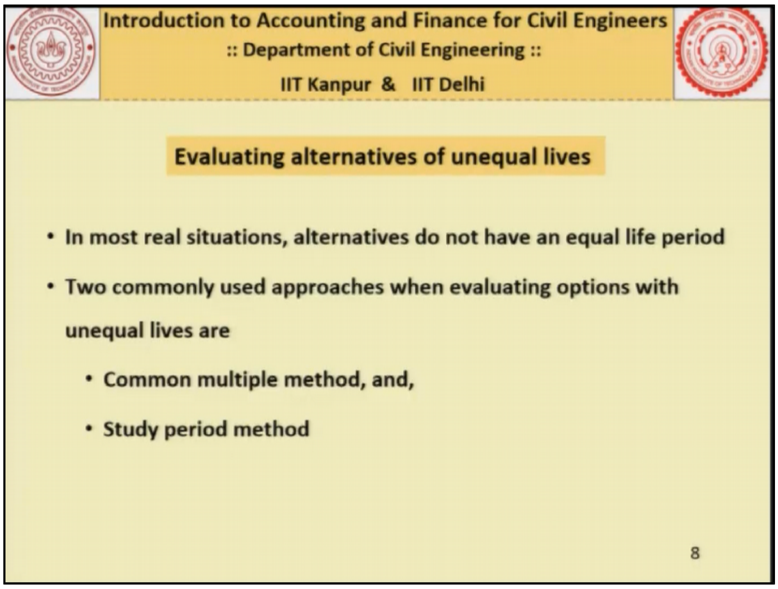

In most real situations, that is what it is. So, the alternatives may or may not have, equal lives. And, most of the time, you will find that, they do not have equal lives. One equipment may last 5 years, and other equipment may last 7 years. So, the 2 commonly used approaches, when evaluating options with unequal lives are, the Common Multiple Method, and Study Period Method. Now, what is the difference between these 2?

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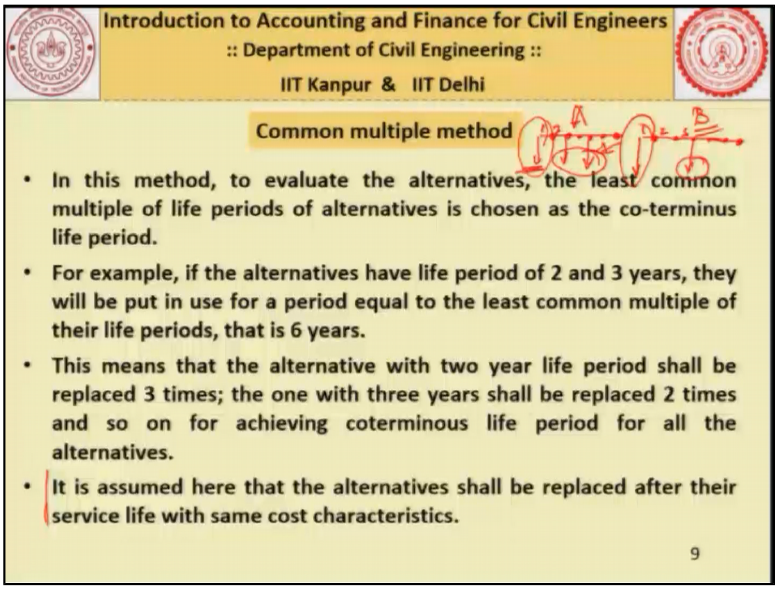

As far as, the Common Multiple Method is concerned, what we really do is, re-evaluate the alternatives, at the least common multiple of life periods of alternatives, as the coterminous life period. For example, if alternatives have a life period of 2 and 3 years, then they would be put to use for a period, which is equal to the LCM of these life periods. And therefore, 6 years. Which means, that the alternatives with 2-year life periods, shall be replaced 3 times, and the one with 3 years of life period, will be replaced twice.

It is assumed, that the alternatives shall be replaced, after their service life, with the same cost characteristics. Now, this is a simplifying assumption. What is being basically said is that, if we have an alternative, which has a service life of 2 years. And, another alternative, which has a service life of 3 years. 1, 2, and 3 here. And, 1 and 2 here. Now, what is being said is that, if we go to a period of 6 years, then we would need to replace this equipment here, go for another 2 years here, replace this here, and then we will come to 6.

Whereas, in this case, if you replace this equipment here, and then we go to a cycle, we will come to 6. So, what is being assumed, as far as this last assumption is concerned, that this replacement here, and this replacement here, which is twice in the case of, let us say Alternative-A, and once in the case of Alternative-B, that will happen at the same cost characteristics, as the original cost. That is, the original cost here, is what we are taking here.

Please remember that, it is not really necessary to do that. We can take any value, that we want. And, as long as we are making, the right kind of corrections for that, we can still make that comparison. But, in this particular method that we are using, we are not doing that. So, it is a simplifying assumption. And, under that simplifying assumption, we will go ahead and show, illustrative calculations.

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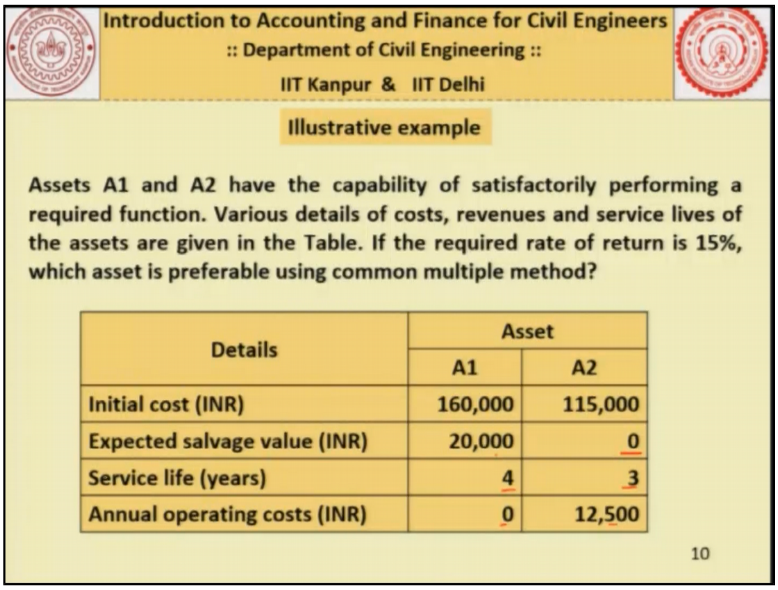

Details	Asset	
	A1	A2
Initial cost (INR)	160,000	115,000
Expected salvage value (INR)	20,000	0
Service life (years)	4	3
Annual operating costs (INR)	0	12,500

Now, coming to an example. Let, assets A-1 and A-2 have the capability of satisfactory performing, the required function. Various details of costs, revenues, and service lives, are given in the table. And, if the required rate of return is 15%, which asset is preferable using the Common Multiple Method. So now, this is the details of the 2 assets, A-1 and A-2.

So, we have the initial cost, which is a 160,000, and a 115,000. Expected salvage value is 20,000. And, we do not expect, any salvage value here. The service life, let us say, 4 years and 3 years. And, the annual operating cost is, zero here, and 12,500 here. So, how do we go about doing this example. Let us try to calculate the NPV. That is what, our brief is.

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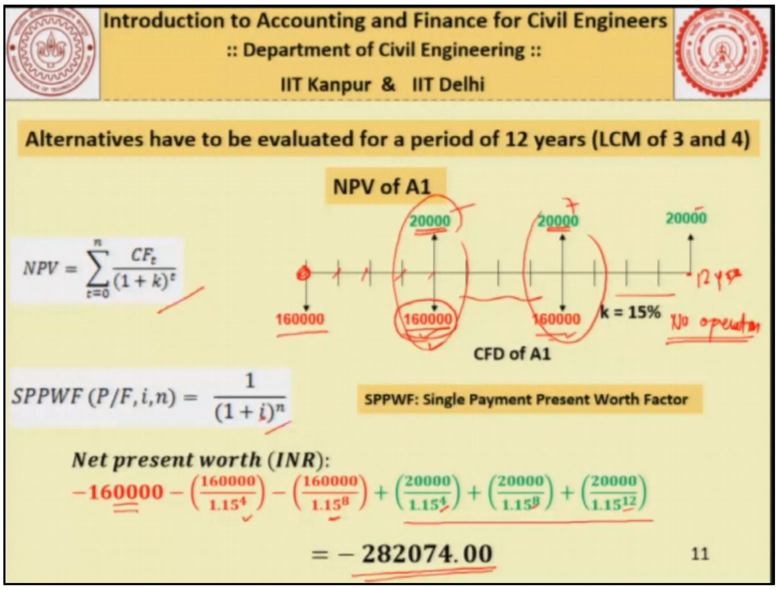

That, we want to calculate the NPV of both these options. And, they will be evaluated at a period of 12 years, which is the LCM of 3 and 4. So, for the Alternative A-1, this is our cash flow diagram. So, this is what the initial investment is. And, this has a life of 1, 2, 3, 4 years. And again, we will invest 1,60,000, or 160,000. Go for another 4 years here, invest here. And, go for this, and come to the coterminous value of 12 years.

While we are doing this, we remember that, whereas we will invest, or will be required to invest 160,000, in a new equipment, there will be a salvage value of 20,000, as far as the old equipment is concerned. And, please remember that, there is no operation cost, as for as Alternative A-1 is concerned. So, with this detail, if you want to calculate the NPV, this is the formula that we discussed in detail, and we know how to do this.

So, we transfer everything, all these values here, to the present value. Which is, this is my present value anyway. This is all negative. So, this 160, and 160, are both negative. This is being charged at 15% here. So, 1.15 to the power of 4, which is 4 years in this case, and 8 years in this case. So, this becomes, here. These 3 terms reflect, what is the present value of this salvage value.

So, one is to the power of 4, the other is to the power of 8, and third one is to the power of 12. So, if we do this arithmetic, we find that, this is our answer. So basically, as far as NPV of A-1 is concerned, which has an initial investment of 160,000, salvage value of 20,000, service life of 4 years, if we do this exercise thrice, that is, we get to 12 years, then, the NPV is, 282,074 Rupees. Now, let us try to do the same exercise, for asset A-2. And, that is much simpler, having done once.

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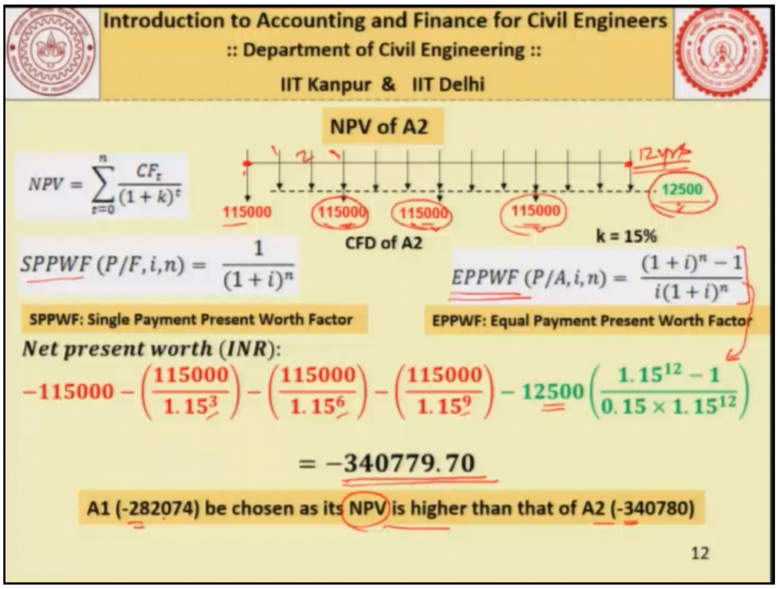

We have an initial investment of 115,000. And, this has to be repeated, 4 times. Because, we want to come to a, co-terminus period of 12 years. And, this has only a service life of 3 years. So, every 3 years, we will have to replace the equipment. And, in this case, there is an operating cost of 12,500, every year. So, what we need to do is, to get all these values. That is, this 115,000 here, and this 12,500 here, back to, the present value here.

Please also remember that, there is no salvage value involved here. So, there are no plus term, that we will get. And, as far as the formulae that we use are concerned, one will be a single payment present worth factor, which could be used, to reduce these 3 values, to the present worth, which has been done here. 1.15 to the power of 3, 6, and 9. And here, we will use, equal payment present worth factor, which is basically the 12,500 being spent, for the entire period of 12 years.

So, this is the value here, which is basically the formula, 1+ I to the power of N – 1. This is the formula we are using, to reduce this value, to the present value. And, if you do this calculation, we will find that, this turns out to be, 340,779.70. So, what really happens is, that since A-1 will be the chosen alternative, because it is higher, as far as the NPV is concerned, than A-2.

It is higher because, it is less negative. So, that is something, which you must keep in mind, because we were talking about, negative values. So, we are talking about negative values here. The lesser negative value, is actually more harmful to us. It is less profitable to us. So, in this case, this is a more negative value, less profitable, therefore choose Alternative A-1.

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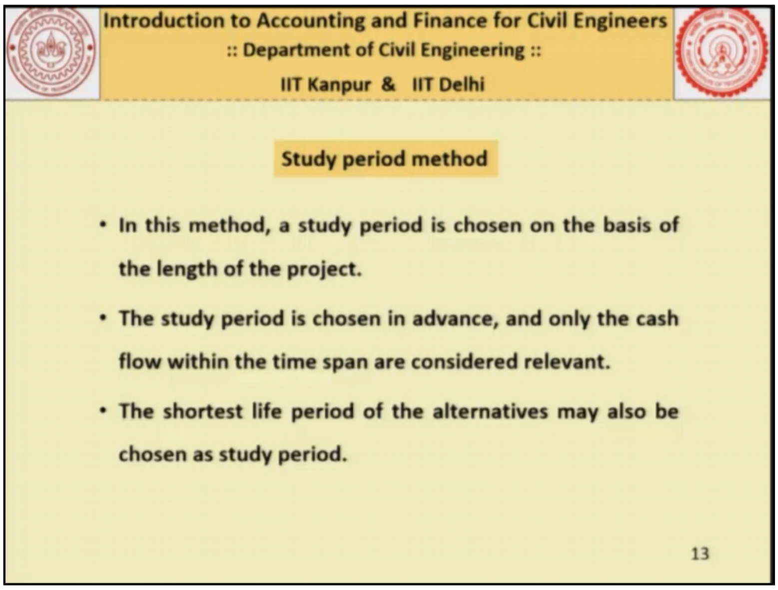

Now, let us come to the Study Period Method. So, instead of now trying to do the LCM, we will try to identify a study period, and then try to do similar analysis. So, in this method, a study period is chosen, on the basis of the length of the project. The period is chosen in advance. And, only the cash flow, within the timespan, are considered relevant. The shortest life of the alternatives, may also be chosen, as the study period.

So, there are different options, that we have. And, I said, right at the outset of this course, that in several places, we will talk about, what is the convention? What are the options that are available to us? And then, somebody, as an engineer, or as an accountant, or as a professional basically, has to take a decision, based on the input available to him. It is not really a matter of being, absolutely wrong, and absolutely right.

There are cases where, different methods may give you, different alternatives as profitable, or advisable. So, we have to take a call, and try to say that well, this method tells me this, that method tells me something else, now what is really applicable in our case. So, that is, what is the responsibility of an engineer, or a professional, as far as Construction Management is concerned.

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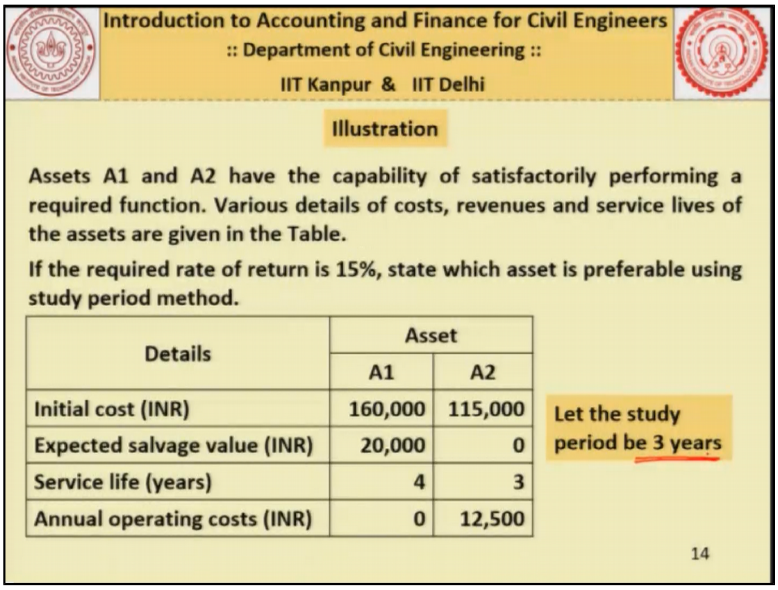

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So, moving forward, to an illustrative example, which is basically the same example, that we did just now, using the LCM method. So, here also, the table is exactly the same. And, we are considering the study period to be, 3 years.

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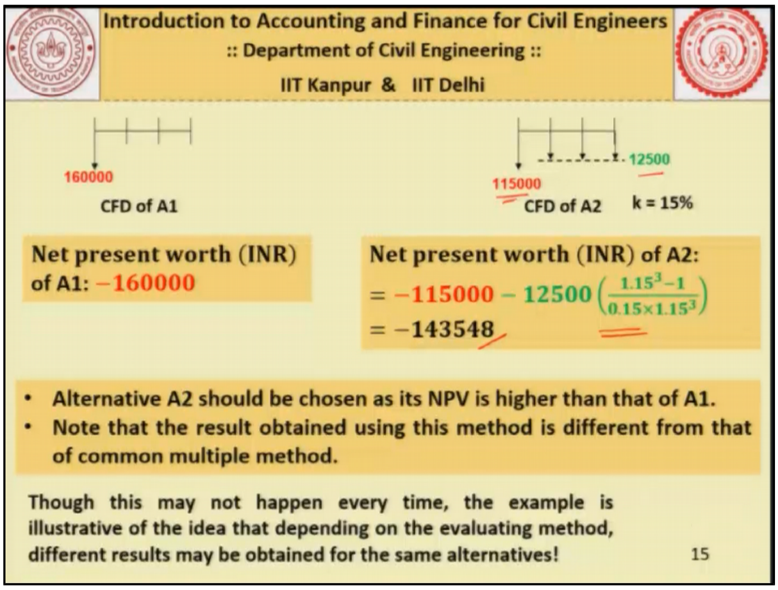

So, if we consider the study period to be 3 years, in that case, the relevant cash flow diagram as far as A-1 is concerned, is just as much. There are no operational expenditures. There is no salvage value. Because, the service life of this equipment is 4 years. So, and we have said that, only the cash flows, or transactions, or whatever it is happening, within the study life, is being considered. So, since the study life is only 3 years, this is all that matters, as far as we are concerned, for Alternative A-1.

So, the present worth of this alternative, obviously simply 160,000. And, when it comes to asset A-2, the cash flow diagram is 115,000, and an operating expense of 12,500 every year. So, this gives me a net present worth of, 115,000. And, the same old formula for EPPWF, and we get the net present worth of - 144,548.

So, now what happens. Alternative A-2 should be chosen, as its NPV is higher than that of A-1. Note that, the result in this case is different, then that obtained from the, Common Multiple Method. And, that is exactly, what I had mentioned just now, that these different methods may lead to, different recommendations. Because, each of them have inherent limitations and assumptions.

So, these methods, just give you different tools, which as an engineer, or as a professional, you have to use with judgement. And, that is exactly what is written here, that though this may not happen every time, the example is illustrative of the idea, that depending on the evaluating method, different results may be obtained, for the same set of alternatives, or the same set of data. And, professional judgement is required, when making a final decision.

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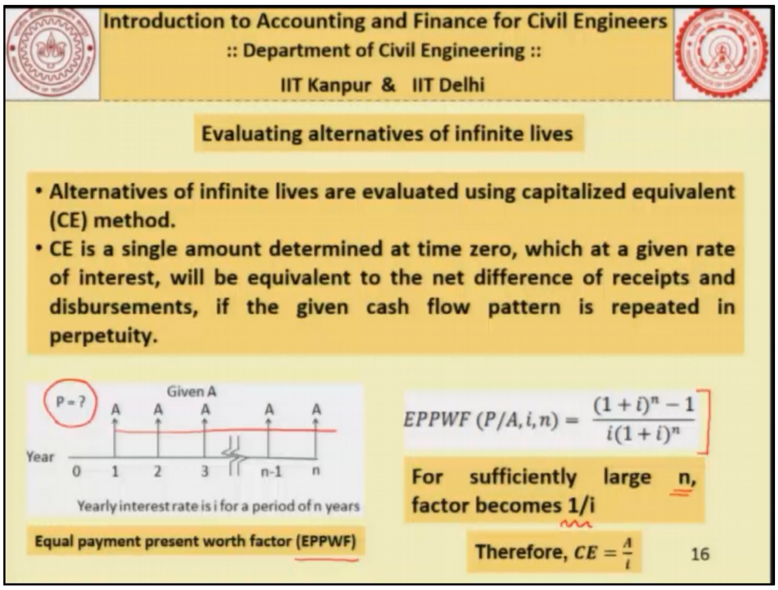

Moving forward, we go to alternatives with infinite lives. So, the alternative with infinite lives are evaluated using, what is called the Capitalised Equivalent Method. That is, the CE Method. Now, the CE, or the Capitalised Equivalent, is a single amount determined at time zero, which at a given rate of interest, will be equivalent to the net difference of receipts and disbursements, if the given cash flow pattern is repeated in perpetuity.

So basically, let us go back, and try to see, what we have already done. What we had done, when we consider the EPPWF, that is, Equal Payment Present Worth Factor, we were trying to find out, what is the p, if this a, which is an instalment kind of a payment, being repeated all the time, for a long period of time, in perpetuity. Then, what we had said was that, this is the formula that can be used, or this is the factor that can be used.

But, please remember that, if the N becomes very large, then this factor simply reduces to 1 upon I. Now, how that happens, I am going to show you. I would also like to draw your attention to the fact, that we use this formula just now, when we were trying to determine the NPV, for operating costs, 12,500 or whatever that number was, incurred every year, for a period of 3 years, for a period of 6 years, and so on, and we try to use precisely this formula.

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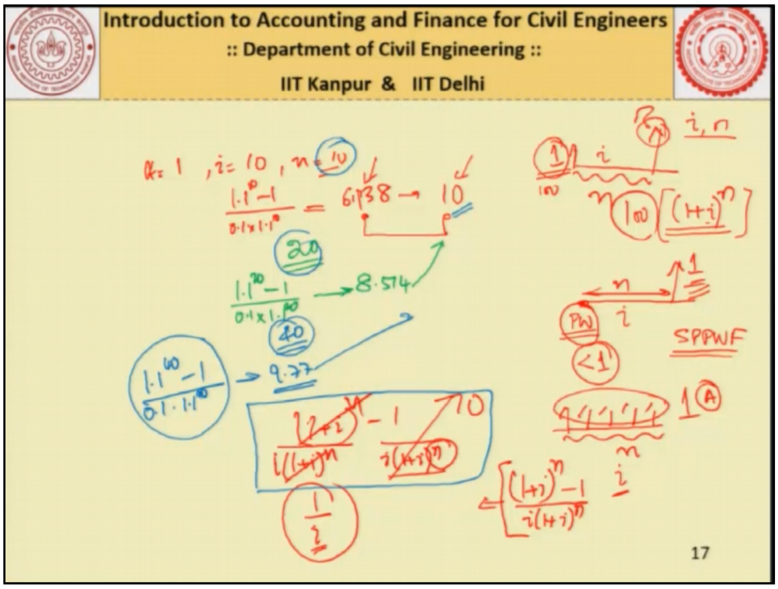

So now, this is something, which we must clearly understand. So, let us try to go back to the basics, and try to understand, that if we are considering the whole concept of interest rate, and a period which is N years, then the first thing that comes to mind is that, what happens if I have a unit value here, how much will it grow to, after a period of N years, if the rate of interest applicable is I. That, we know from the compounding interest formula, that this will be nothing but, 1 + I to the power of N.

So basically, if this was 1, this value will be higher than 1. That is, how we are normally assuming, given the fact that, I is positive. So, if I is positive, N is positive, then this 1 will grow to so much. If we have a different value than 1, we have a 100. We know that, this has to be simply multiplied by 100. So, this is basically just the factor that, we have already discussed earlier, the converse of this problem. If we have 1 here, at the end of N years, with a rate of interest applicable being I, then what is the present worth of this 1.

This is precisely, what we have been talking about as the, Single Payment Present Worth Factor. And, if you look at the tables, those will tell you that, this value will obviously be, always less than 1. So, if you want a certain value here, that can be simply multiplied by that factor, and we get the present worth. Now, coming to the EPPW kind of a model, this is what we are doing. So, if this was unit, what we are calling A.

If, A was a unit quantity, and this was happening N times, at a rate of interest of I, then the present worth factor is, 1 + I times to the power of N – 1, upon I times 1 + I to the power of N. Now, this is how these factors, are coming about. We have to understand, what is actually happening. Now, if simple arithmetic tells us that, if we break this up into 1 + I to the power of N – 1. And, this is going to be here, at both sides. 1 + I to the power of N, here. And, I times 1 + I to the power of N, here.

If N tends to be infinity very large, then the denominator goes to a large number, and this term goes to zero. And, in this case, as far as the first term is concerned, they cancel out, and your factor simply becomes, 1 upon I. And, this is what, we had mentioned in the previous slide. So, it simply becomes, 1 upon I. Let us try to do a simple simulation, and try to find out, that if my A was 1, the rate of interest was 10, and the N was also 10.

We try to find out, what is the present worth, or the present worth factor, as far as this is concerned. If we use the actual formula, we will find that, this is nothing but, 1 + 1 to the power of 10 - 1 divided by 0.1 times 1.1 to the power of 10. And, this will turn out to be 6.138. Now, if we were to use the formula that it is 1 upon I, then N is equal to 10, then 1 upon I is actually 10.

So, we have, this is the difference between, the rigorous analysis, and the approximate analysis, when we take, N is equal to 10, and taken it to be large number. So, now instead of 10, if this N was to be made, let us say 20, then what happens. The numbers become, 1.1 to the power of 20 - 1 upon 0.1 into 1.1 to the power of 20, and then the number turns out to be, 8.154

You can do this arithmetic and check, and you can see that, this is becoming closer to this value. Now, instead of 20, if we take this number to be 40. So, we see that, we are gradually increasing this N, to reach a large number. Then, what happens is that, this turns out to be, 1.1 to the power of 40 - 1 divided by 0.1 times 1.1 to the power of 40, and this will turn out to be 9.77.

So, gradually as N is being increased, we find that the final answer, as far as this is concerned is indeed, tending towards this 10 value. And, that is what, simple calculus tells us. This is what, this particular term, or this breakup of the terms, tells us. So, just keep that in mind that, these formulae, have their own limitations. If you want to use simple calculations, they will always be approximate. But yes, we can always use them as, first guesses. So now, having done that, let us try to look at an example, and try to see, how it works.

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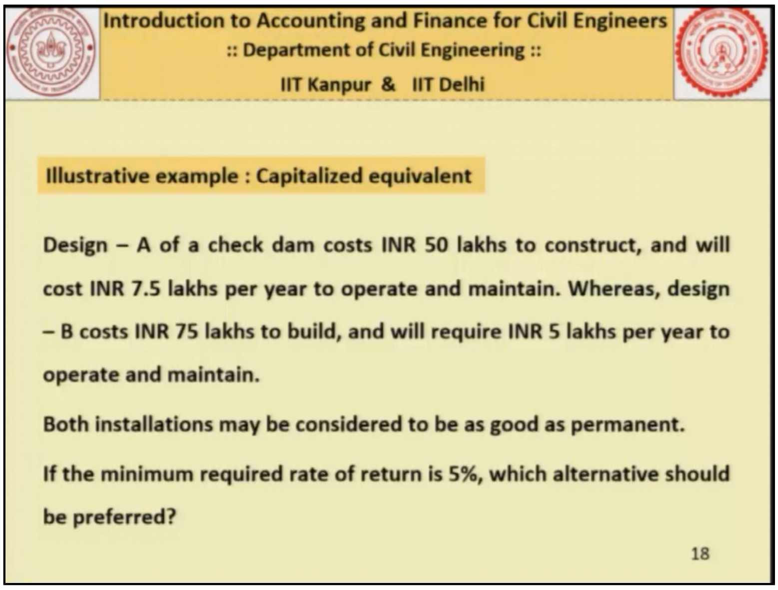

Let us consider, design A of a check dam, which costs 50 Lakhs to construct, and will cost Rupees 7.5 Lakhs per year, to operate and maintain. Whereas, design B costs 75 Lakhs to build, and will require 5 Lakhs per year, to operate and maintain. Now, both installations may be considered to be, as good as permanent. And, if the minimum required rate of return is 5%, which alternative should be preferred. So, let us see, how it works.

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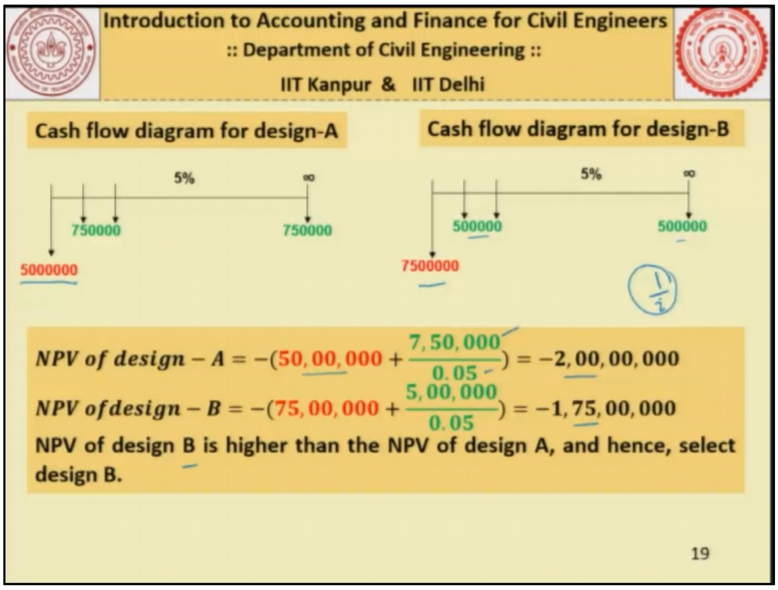

This basically is the cash flow diagram, as far as design A is concerned. Some kind of cost in the beginning, 50 Lakhs. And then, 7,50,000, 7.5 Lakhs, going on forever. Cash flow diagram for B is, 75 Lakhs. And, only 5 Lakhs, going on forever. Now, how do we compare the 2. NPV of design A is 50 Lakhs.

And, this 7.5 divided by 0.05, which is basically the factor of 1 over I. And, we get the NPV is 2 Crores. That is, 200 Lakhs. As far as design B is concerned, you do the same approach. And, we get the NPV to be, 1.75 Crores. So, the NPV of design B, is higher than that of design A. And hence, select design B. So, that is how it works, when we are talking of alternatives, which have a long life, or an infinite life.

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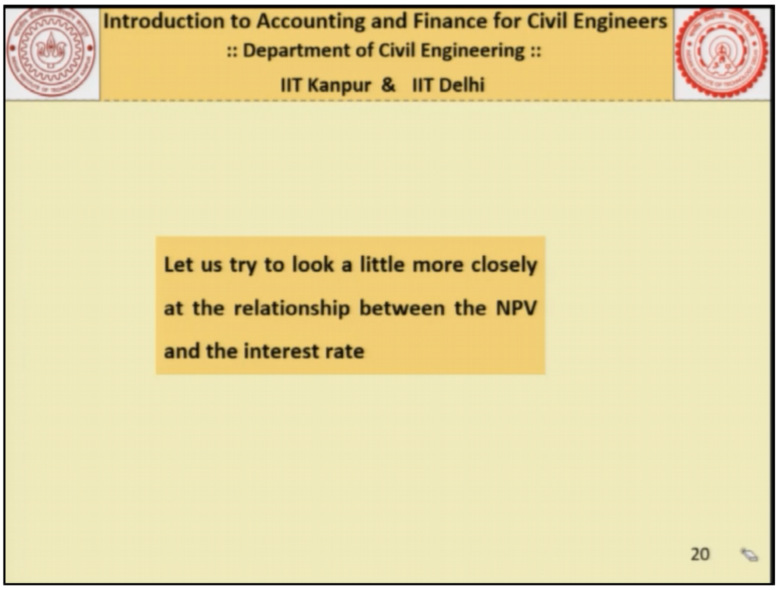

Now, coming to a very different discussion, let us try to understand, and look more closely at the relationship between, NPV and the rate of interest.

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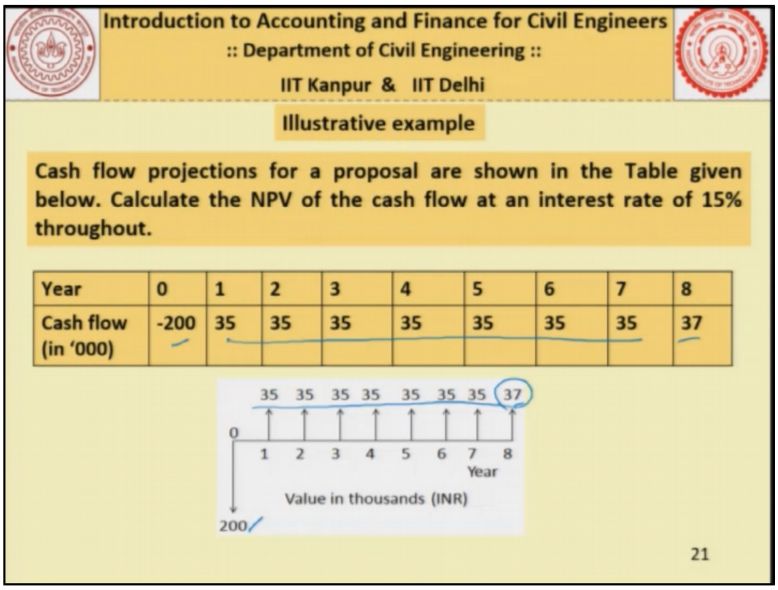

An illustrative example, which will make things clear. If we were looking at a cash flow diagram like this, you would recall that this is coming from one of the previous examples, that we have already done. Now, calculate the NPV of the cash flow, at an interest of 15% throughout. Now, if we were to do that, this is our cash flow diagram, from the table.

Our 200, coming from here. This is my 200 here. And, this 35's, are all over the place here. And, this 37 is coming here. We cannot use the, equal payment present worth factor, because of this 37 sitting here, instead of 35. So, we can do, any which way we want.

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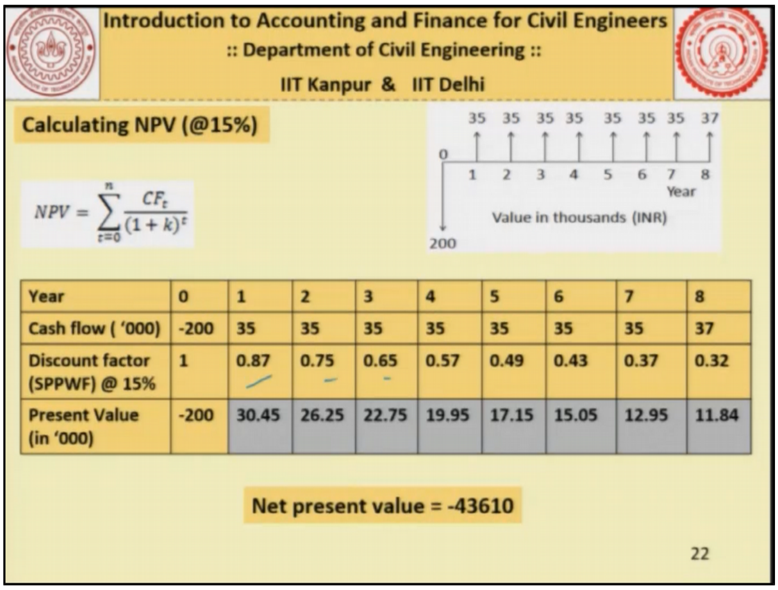

And, so long as we do this NPV calculation at 15%, what will happen is, that the present factors you have to calculate, or see from the table, and come to the present values, which we have already done in the previous example, when we were talking earlier. And, we will find that, the net present worth is, - 43,610.

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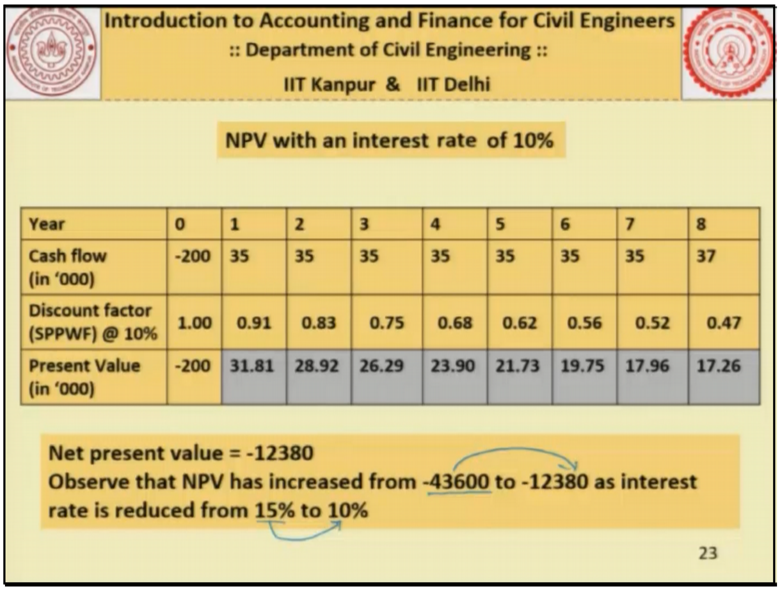

If we would repeat this exercise now, with an interest rate of 10%, the whole process remains the same. And, we will find that, the net present worth has now become - 12,380, different from - 43,600, when we use the interest rate of 15%. So, by changing the interest rate, from 15 to 10, the NPV has gone from - 43,600 to - 12,380, with the kind of data that we had.

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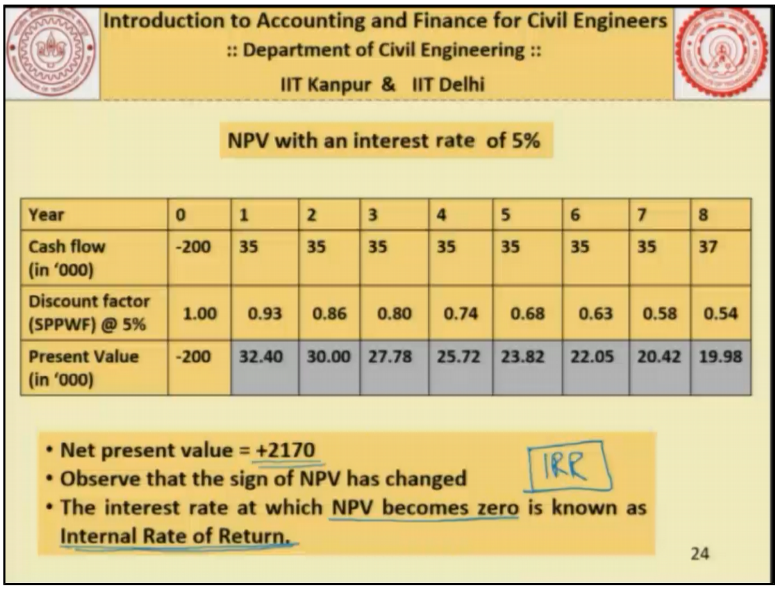

Now, if we were to further to do this exercise once again, at 5%, then what we will find is, that the present value has gone to a plus value. That is, + 2,170. And, this clearly shows that, the NPV is very strongly related to, the rate of interest that we use. And, depending on the interest rate, the values could be plus or minus.

So obviously, the interest rate at which the NPV becomes zero, is known as the, Internal Rate of Return. Now, this is a concept, which is used, very often in Construction Economics and Decision Making. And, that is why, we must be very clear about this. The Internal Rate of Return, is that rate of interest at which, the NPV is zero.

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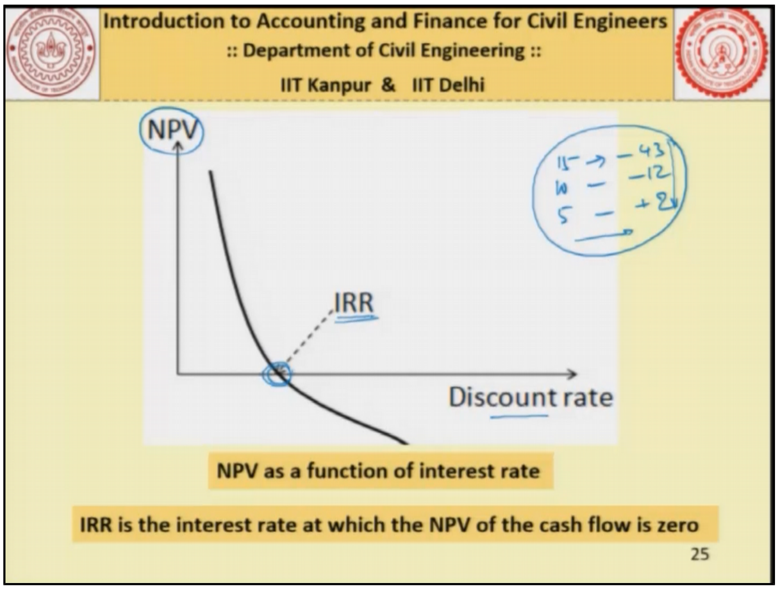

Geometrically speaking, this is what it is. So, you would remember that at 15%, our NPV was – 43. At 10%, it was – 12. At 5%, it became + 2, something of that nature. So basically, as we reduced the interest rate, the NPV moved in the positive direction. So, there is a negative relation between these 2.

So, if we plot the NPV, versus the discount rate, or the interest rate, there will be a point where, the NPV will be zero. And, that is precisely what is called the, Internal Rate of Return. So, I would encourage you to do more problems, by varying the interest rates, and try to determine the IRR's, for those cases as well.

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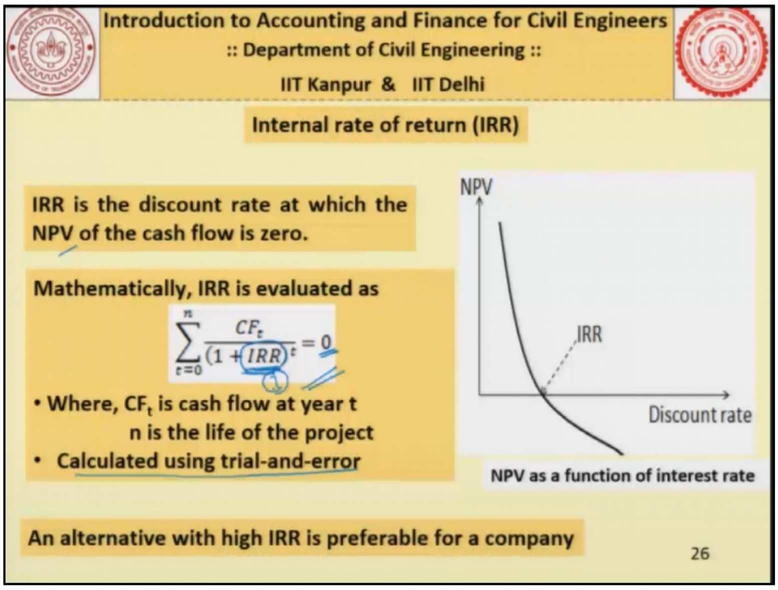

So, more formally, IRR is the discount rate at which, the NPV of the cash flow is zero. And, this is what, we have already done. And, how do we calculate the NPV? We already know that, this is how we are going to calculate the NPV. Except that, in NPV, we had said that, we will take this term here to be I, and calculate the NPV.

The zero was not coming to the picture. But, if this I get replaced by the IRR, then the NPV is zero. So, that is precisely, what the definition is. And, this is calculated using a, trial and error procedure. Obviously, an alternative with a higher IRR is preferable, as far as a company is concerned.

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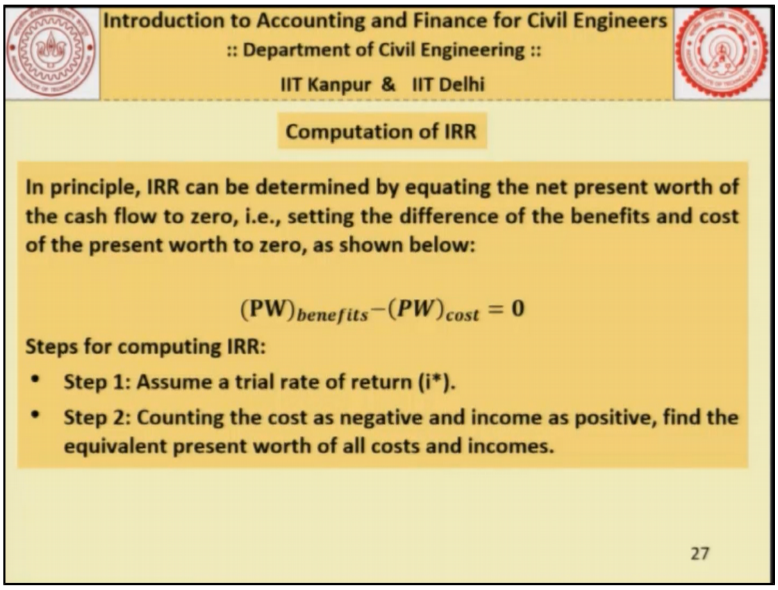

Now, beginning this point, there is a 4 or 5 step procedure, which tells you, how to calculate the IRR. Let us quickly, go through that. In principle, the IRR can be determined, by equating the net present worth of the cash flow to zero. That is, setting the difference of the benefits and cost of the present worth to zero, as shown in this equation here. And, the first step, is to assume a trial rate of return at I%, counting the cost to be negative, and the income to be positive, find the equivalent present worth of all costs and income.

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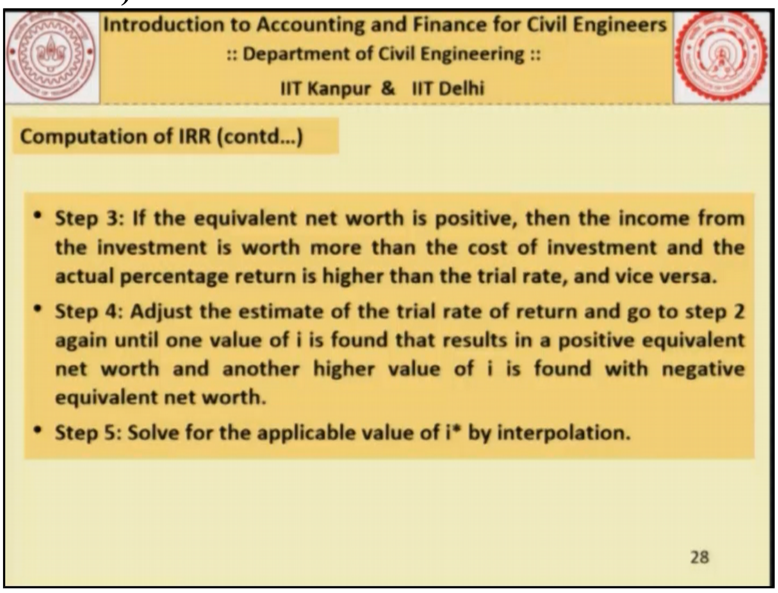

The third step would be, if the equivalent net worth is positive, then the income from the investment is worth, more than the cost of the investment, and the actual percentage of interest or return, is higher than the trial rate, and vice versa. So, adjust the rate, according to the result that you get in step 3, and go back to step 2, until one value of I is found, that results in a positive equivalent net worth, and the other higher value of I is found, with a negative equivalent net worth, and solve by interpolation.

So, that is what, we had actually done. From the previous example, we had 15, then 10, and then 5. And, we found that, when we transition from 10 to 5, there was the transition from, a negative value, to a positive value. So, we obviously know that, the IRR is somewhere between 5 and 10. We can do a closer iteration once again, and determine the actual IRR, which I am not really doing, as far as this particular class is concerned. But, we will do a very simple illustrative example of calculating the IRR, with this cash flow shown here.

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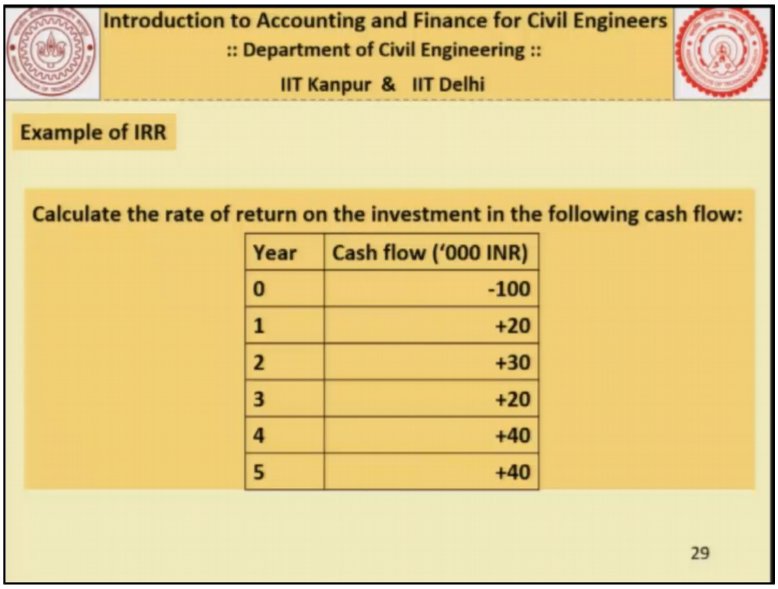

There is a – 100, to begin with. And then, + 20, 30, 20, 40, and 40, which is represented like this.

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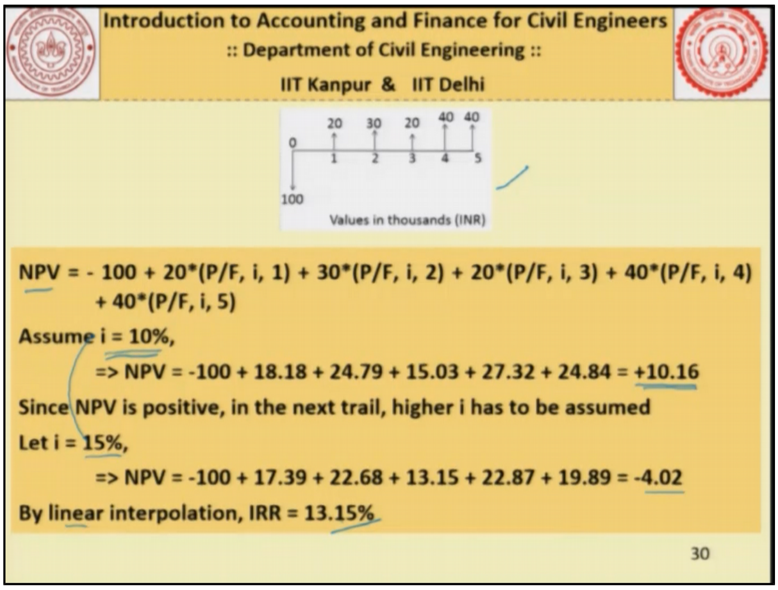

And now, if we try to calculate the NPV, at an I of 10%, we find that this + 10.16. If we increase the rate of interest to be 15%, we find that, it is - 4.02. And, if you are happy with that, we can do a linear interpolation, and find that the IRR is between 10 and 15, 13.15%.

If you want to be more accurate, than doing a linear interpolation between these 2 numbers, sure enough, go ahead and try to do it with 12%, 14%, and then try to get a number, which will possibly be slightly better approximation of the IRR. Now, this completes my discussion, as far as, IRR is concerned, the Internal Rate of Return is concerned. Let us move further, and try to discuss a little bit about, Future Worth Comparison.

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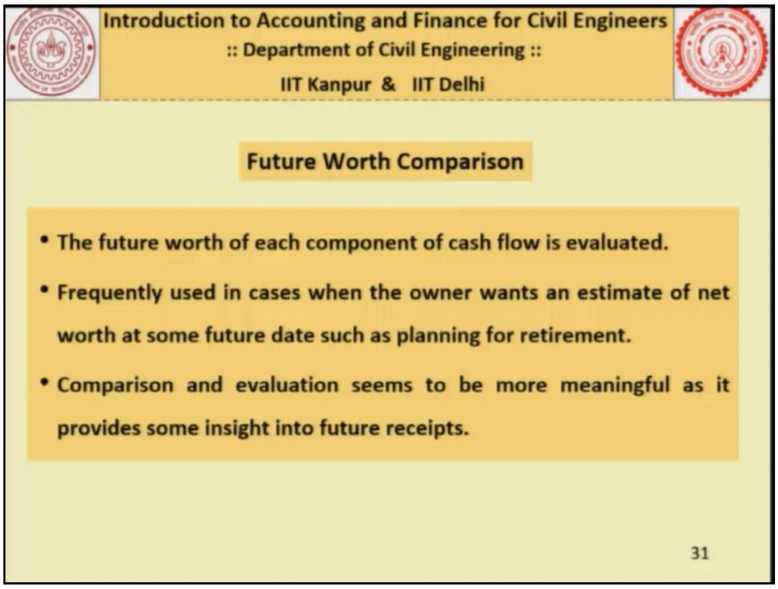

So far, what we had done was, the present worth. That is, all expenses were being brought to a present worth, discounting it, using the concept of interest rate. And then, coming up with a present worth, trying to do the analysis, based on present worth, what is the present worth, positive, negative, less negative, more negative, determining the IRR, and so on.

But now, what we will do is, do the future worth. The future worth is calculated, for each component once again. And, frequently used in cases, when the owner wants to estimate, the net worth at some future date, such as planning for retirement, and so on. And, comparison and evaluation seems to be more meaningful, as it provides some insight into the future receipts.

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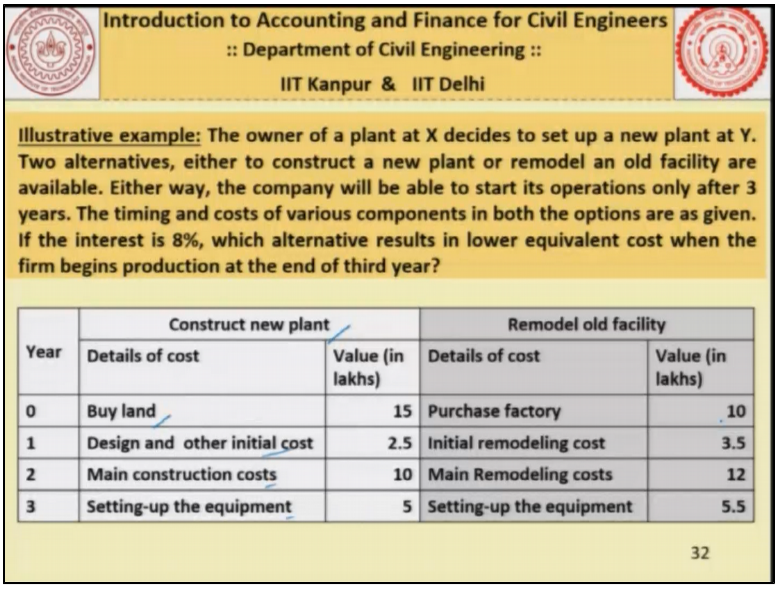

As an illustrative example, if you look at the data, that is given here. The owner of a plant at X, decides to set up a new plant, at another place Y, and he is considering 2 alternatives. Either to construct a new plant, or remodel an old facility, which is available. Either way, the company will be able to start its operations, only after 3 years. The timing and costs of various components in the 2 options, are as given in the table shown here.

If the interest rate is taken to be 8%, which alternative, setting up the new plant, or remodelling an existing plant, result in a lower equivalent cost, when the firm begins production, at the end of the third year. So, we will try to do this, with the future worth concept. So, this is the data, which is given to us.

As far as, constructing a new plant is concerned, there is buying the land, design, and the initial construction cost, and the main construction cost, and the setting up of equipment. When it comes to remodelling, purchase of factory, initial remodelling, the main remodelling and construction costs, and setting up the equipment. So, we can reduce both these alternatives, to cash flow diagrams.

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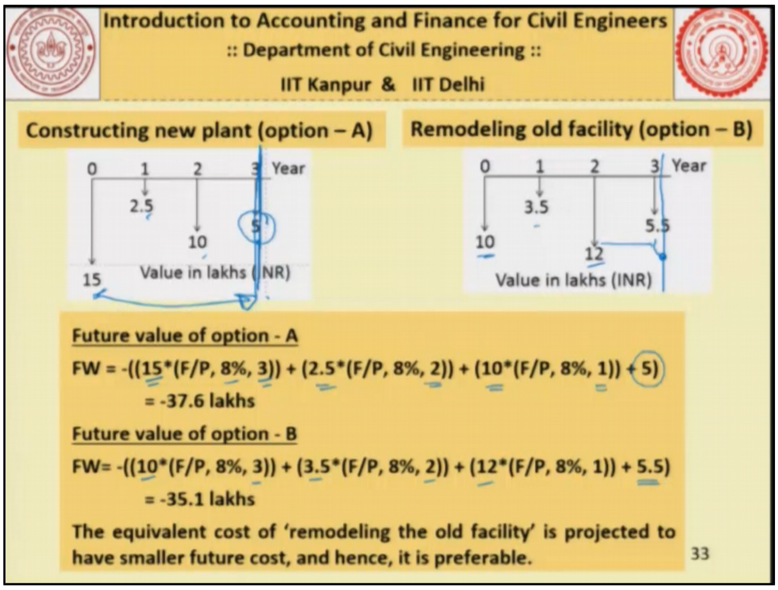

That is, this is my cash flow diagram, for option A. This is the 1st expenditure, the 2nd expenditure, the 3rd, and the 4th expenditure, in terms of purchase of land, initial construction and design, main construction, and finally the setting up of equipment. Similarly, for option B, this is the cash flow diagram. Now, we want to do this analysis using, future worth. Future worth of option A, is given like this. That is, we are talking of the future worth of, this 15, at an interest rate of 8%, after 3 years.

So, we are trying to reduce everything, to this point in time, which is, 3 years hence. So therefore, this 15, 3 years hence. This 2.5, 2 years hence. This 10, 1 year hence. And this 5, as it is. So, if we do this exercise, we will find that, the future worth is – 37.6. So, this is the total expenditure, in future worth terms.

Similarly, if you calculate the future worth of option B, which is 10, for a period of 3 years. That is, this 10, to a period of 3 years. This 3.5, for a period of 2 years. This 12 here, for a period of 1 year. And finally, this 5.5, as it is. So, if that is what we do, we find that, the future worth of option B, is - 35.10.

Now, which of these do we choose. The equivalent cost of remodelling the old facility is projected to be, having a smaller future cost. And hence, that is preferable. So, that is how we do, future worth kind of analysis, as far as, evaluation of options is concerned. So, now coming to the last concept of the day, the Equivalent Annual Charge, which is the EAC.

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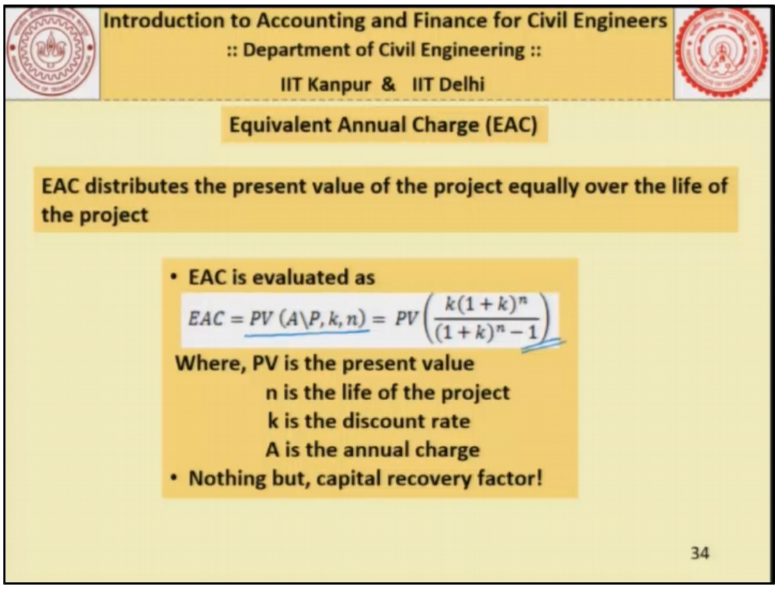

The EAC distributes, the present value of the project equally, over the life of the project. And, there we find, that we can use this formula. Now this, if you notice carefully, is just the converse of the EPPWF. That is, the Equal Payment Present Worth Factor. So, PV is the present value of the project. N is the life of the project.

K is the discount rate, or the interest rate, which we have been using I. And, K interchangeable. And, A is the annual charge. Nothing but, the Capital Recovery Factors. So, if you go back to those tables, which we showed you, and try to tell you, how those tables can be used, you will find that, sometimes it is referred to as the, Capital Recovery Factor.

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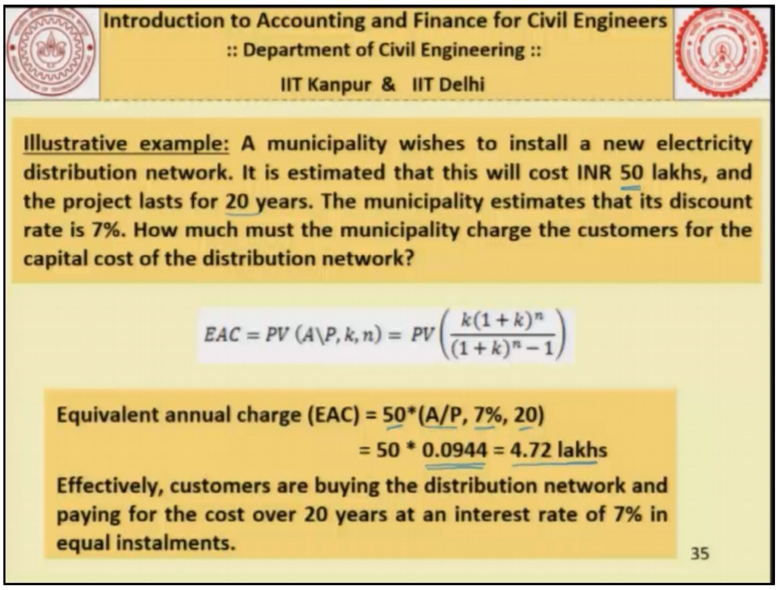

Now, as an illustrative example, let us try to see this. A municipality wishes to install, a new Electricity Distribution Network. And, it is estimated that, this will cost, 50 Lakhs. And, the project last, for 20 years. And, the municipality estimates, that its discount rate is 7%. How much must the municipality charge, the customers for the capital cost of the distribution network. Now, if you want to use this formula, how do we go about doing it.

The Equivalent Annual Charge, which is EAC, is 50 times, a by p, given 7% of interest, in 20 years of use, and the factor turns out to be, 0.0944. And therefore, the Equivalent Annual Charge is 4.72 Lakhs, for an investment which is being made for 50 Lakhs, to last for 20 years. Effectively, the customers are buying the distribution network, and paying the cost for 20 years, at an interest rate of 7%, in equal instalments. So, that is the interpretation of the EAC.

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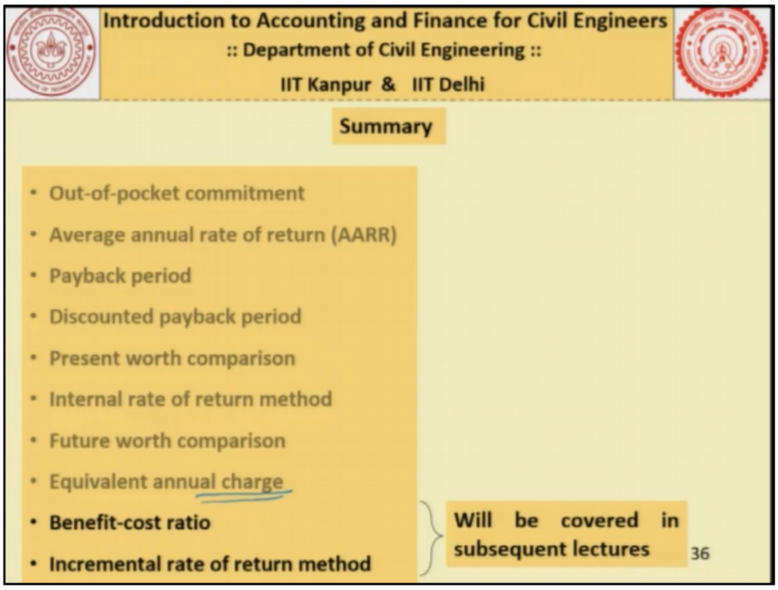

Now, going back to this table, that we started. We have completed our discussion up to the, Equivalent Annual Charge. And, these 2 methods, which is the Cost Benefit Ratio, or the Benefit Cost Ratio, and the Incremental Rate of Return Methods, these would be covered, in a lecture subsequently, possibly by Professor Jha, IIT Delhi. I look forward to seeing you once again, in another lecture. But, before that, let me give you some references.

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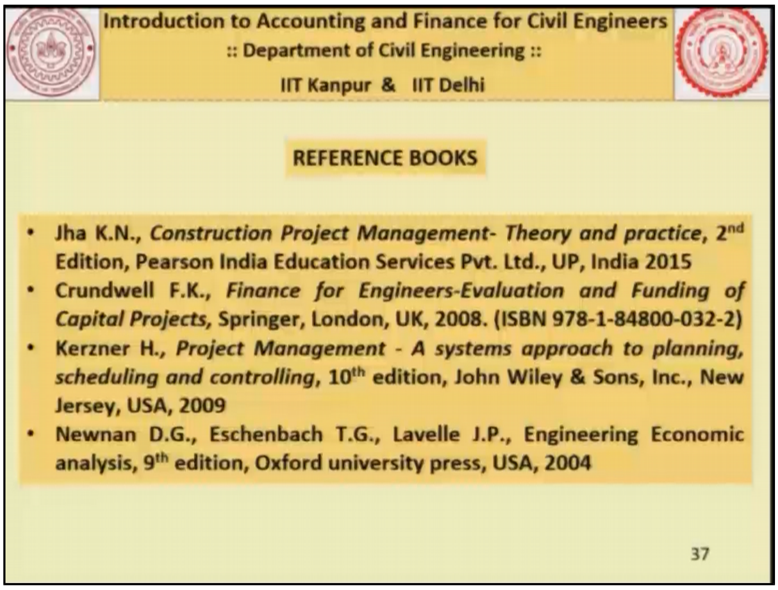

These are the books, which you could probably refer to, understand the subject more clearly. Thank you.