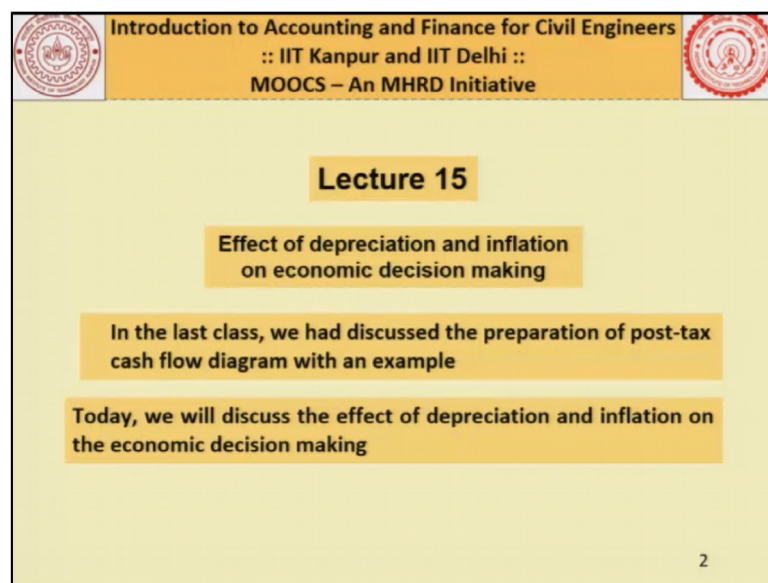**Introduction to Accounting and Finance for Civil Engineers**
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Module No. #03
Lecture No. #15
Effect of Depreciation and Inflation on Economic Decision-Making

Good morning, Namaskar, and welcome back to this course. In the previous lecture, if you remember, we discussed, different ways of computing, the Post-tax cash flow diagram. I give you a small example, and I told you to draw, the Post-tax cash flow diagram.

So, there we found that, depending on the depreciation, our Post-tax cash flow diagram, is slightly different from the, Pre-tax cash flow diagram. There was no change, in the initial, and the end of life, Pre-tax cash flow, and Post-tax cash flow diagram. The difference was noticed, only during the, intermediate periods.

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Now, in this class, we are going to learn, how to rather find out, the effect of Depreciation and Inflation, on the Economic Decision Making. For this, we take one small example.

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We assume that, some equipment has been purchased for, Rupees 3.50 Lakhs. And, its accounting life and service life happens to be, 5 years. The predicted salvage value is, nil. The gross income for all the 5 years, is assumed to be, Rupees 2.50 Lakhs. And, expenses are assumed to be, nil. So, what I am going to do is, I am going to give you 3 cases, for the same problem.

In the first case, I am giving you details, only on the income. In the second case, we will give you, some other data. And, in the third case, we will give you, some other data altogether, and we will see, how to take it for our analysis purpose. So here, what is happening is, I am able to purchase one equipment for, 3.50 Lakhs. And, this equipment is giving me, an income of 2.50 Lakhs, every year. My expenses are nil. This is, to start with, I am assuming that, my expenses are nil, life is 5 years.

Now, I am also going to tell you, depending on the method of depreciation, there are differences that you are going to get, in the cash flow diagram. Although, the total tax, that you will be paying, whether you are using, Straight Line Method of depreciation, or Sum of Years, or Double Declining Balance Method, they are going to be the same, but their timings are going to be different. In fact, that is why, you will always find, the taxpayer is given a choice, will like to go for a, different type of depreciation method, than a tax collector.

So, we will see, which one will be adopted, by which agency, and why? That is also, we will see, in this particular example, itself. So, if you calculate the depreciation, using Straight Line Method for this, so 3.50 Lakhs – 0, because there is no salvage value, divided by 5, because

life is 5. So, you find, 0.7 Lakhs every year, is your depreciation, using Straight Line Method. Using Sum of Years, it is going to be different. We will see, what it will be.

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And, for your benefit, I have drawn this particular table. And, this table gives me, the values of depreciation, using all the three methods. So, as I told you, Straight Line Method, I am getting same depreciation, 0.7, 0.7, 0.7, 0.7, and 0.7, every year, for 5 years. How, do I calculate, Double Declining Balance Method. You can see, the depreciation every year is changing, unlike your Straight Line Method of depreciation. Even in, Sum of Years Digits Method, the depreciation, every year is changing.

Let us do with, Sum of Years. Sum of Years, life is 5 years. So, Sum of Years is going to be, 5 into 6 by 2, which is 15. So, the first year, my asset is going to depreciate by, 5 by 15. Next year, it is going to be, 4 by 15, 3 by 15, 2 by 15, and 1 by 15. So, first year, the depreciation is going to be, 5 by 15 of 3.50 Lakhs - 0, of course because, we do not have any salvage value. This year, it is going to be, 4 by 15 of 3.5, 3 by 15 of 3.5, 2 by 15 of 3.5, and 1 by 15 of 3.5.

So, I have already calculated it, for you. It is going to be, 1.17 for the first year, 0.93 for the second year, 0.7 for the third year, 0.47 and 0.23 for the fifth year. When it comes to Double Declining Balance Method, the rate of depreciation is going to be, 2 by n. So, first year, it will depreciate by, 2 by 5, and multiplied by 3.5. So, we will find, first year itself, depreciation is going to be, 1.40 Lakhs. So, for the next year, the book value is going to be, 3.5 - 1.4, which is 2.10.

So, the next year, my depreciation is going to be, 2 by 5 of 2.10. And, this is coming to be, 0.84. Likewise, for the third year, it is going to be, 0.50. And, fourth and fifth year, if you see, very carefully here, I have switched it over to the Straight Line Method of depreciation. Because, otherwise, the depreciation for fourth year, was coming to be, lesser than Straight Line Method.

If, I would have gone in for, Double Declining Balance Method, even for fourth year, my depreciation in that year, would have been lesser than, Straight Line Method. So, tax authorities allow me, to make a switch. So, I have switched it over, at Year-4. And, you can see, that is the reason, this value is 0.38, and which is same as, 0.38 here. Now, if you sum, for all the 3 cases, they are going to be the same. So, this is also 3.5, this is also 3.5, and this is also 3.5.

Now, gross income, which is annual value given to us, in this particular problem is, 2.50 Lakhs, 2.50 Lakhs, 2.50 Lakhs, 2.50 Lakhs every year, for next 5 years. As I told you, in this particular example, we are dealing only with income, so expense is given to be, nil here. Now, we will see, how to go about it.

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So, when I calculate the net taxable income, first let me explain you, in the context of a straight line depreciation. So, you remember, your gross income is, 2.50 Lakhs. So, let us call this as, GI. Gross income is, 2.50 Lakhs. And, depreciation, which you remember now, is considered as an expense is, 0.70. So, my net taxable income is going to be, 2.5 - 0.7, which

is, 1.8. So, just look at this figure, very carefully, 1.8. This is my net taxable income, if I am using, Straight Line Method of depreciation.

Now, since depreciation is same, in the straight line, for all 5 years, this value is going to be the same. So, this is my net taxable income. Now, let us assume that, tax is at the rate of 40% of your income. So, my tax for this year is going to be, 1.8 multiplied by 0.4, which is 0.72. So, if you see here, this is the value, using straight line. So, that means, the tax that we will be paying, if I am going to go for Straight Line Method of depreciation, it is going to be 0.72.

So, in the next year also 0.72, third year also 0.72, fourth year also, fifth year also 0.72. So, if you sum it up, you will find that, we are getting, total tax implication of 3.60 Lakhs, using Straight Line Method of depreciation. And, every year, I am going to pay, 0.72 Lakhs. Now, let us move to, Sum of Years digit method, and see, how my tax calculations change. Now, as you know, in the Sum of Years digit method, my depreciation is changing, every year.

So, I will have to do, this calculation, for every year. So, my gross income is 2.5, as before. My depreciation, if you remember, in Sum of Years, for the first year was, 1.17. So, depreciation is 1.17. So, you can calculate this. This is going to be, 1.33, net taxable income. This is what, it is written here. So, if you are going in for, Sum of Years' digit method of depreciation calculation, the net taxable income is going to be, 1.33.

So, I multiply this by 0.4, to calculate my tax, for that year. So, it is going to be, 1.33 multiplied by 0.4, and this is going to be 0.53. Now, when I do it for the next year, next year if you remember, I mean, the depreciation is 0.93. So, what I do? 2.5, is my income. 0.93, is my depreciation expense. I deducted. And, I apply, 40% tax on that. So, I find that, the tax that I am paying is, 0.63. Right. So, when I calculate my net income, what will happen.

First, let me go with, Straight Line Method of the depreciation. So, you already found that, you have paid a tax of, 0.72. So, the net income, that you will have is, 2.5 - 0.72, which is going to be, 1.78. So, this is your net income, in Year-1, using Straight Line Method of depreciation. And, it is going to be the same, all 5 years, 1.78, 1.78, 1.78, 1.78, and 1.78. So, if we have to draw a cash flow diagram, Post-Tax Cash Flow, using the Straight Line Method of depreciation, it is going to be like this.

3.5, here. And then, your post-tax income is going to be, 1.78, 1.78, 1.78, all 5 years. On the other hand, if you do using, Sum of Years digit method, you will get, 1.97 in first year, 1.87 in second year, 1.78 in third year, 1.69 and 1.59, in fourth and fifth year, respectively. Now, in all these things, what is of interest to you is, to note that, irrespective of the method that we have used, the total taxes that we are paying, the value remains the same.

So, you can see here, 3.6 in, straight line, in double declining also, and in Sum of Years also. So, what is the difference? What is the point of contention, then? Why there is a dispute between, taxpayers and tax collector? It is because of the timing. So, you can see here. If you would have gone in for a, Straight Line Method of depreciation, first year itself, you would have earned an income of 1.78, second year 1.78, third year 1.78, fourth year-fifth year. This is using, straight line. All same, in 5 years.

But, if you would have gone in for, Double Declining Balance Method, in the first year itself, your net income is 2.06, second year 1.84. If you would have gone in for, Sum of Years, in the first year itself, you are getting 1.97, second year 1.87. So, you find that, higher income is realised, by faster method of depreciation. So, which are the faster methods of depreciation? Obviously, your Double Declining Balance Method, is the faster method of depreciation, compared to straight line, and the Sum of Years digit method.
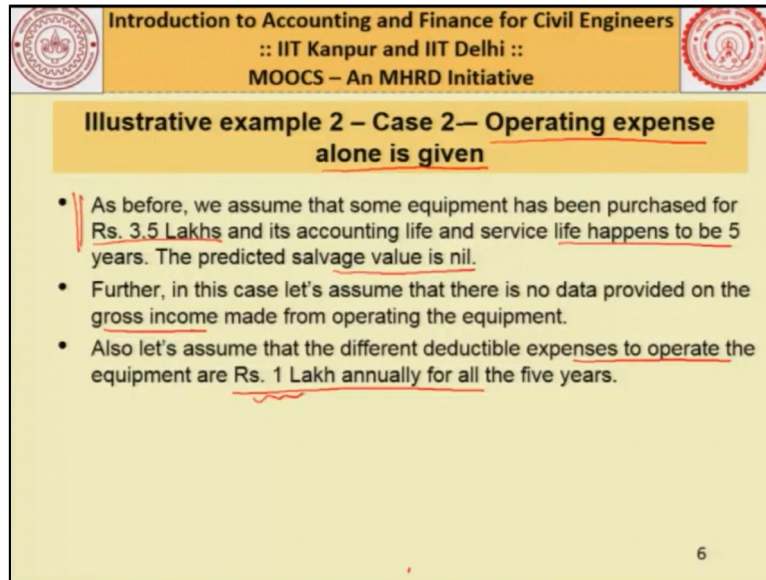
So, naturally, in the income that you get, in initial years, using faster method of depreciation, is more. So, that is why, all taxpayers, would like to use, a faster method of depreciation, if they are allowed. Whereas, the tax collectors would like you, as a taxpayer, to go with slower method of depreciation. Right. So, that is the reason, there is always a dispute between, taxpayers and tax collector. Now, in order to avoid this dispute, what most of the governments have done is, they have classified all assets, in different categories.

So, you have, Asset Category-1, Category-2, Category-3, Category-4, and so on. Now, for each of these Asset categories, they have specified, by how much, there will be depreciation, every year. So, Asset Category-1, they will say, okay, first year, the depreciation is going to be 25%, second year, it is going to be 20%.

So, they have specified, the depreciation percentage, for each of these Asset categories. Not only this, they have also specified you, the salvage value, so that, there is no dispute at all.

So, that is how, in modern days, there is no dispute between, tax collectors and taxpayers, as far as, the method of selection of depreciation is concerned. Now, we move to the next case, for the same example.

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And, in this case, we are given, operating expense alone. So, if you remember, similar type of problem, we did it in the previous lecture, where we discussed about, the expense part alone. So, if you remember, you had two options, of Equipment-A, and Equipment-B. And, for both of them, you are given the, only operating expenses. Now, in this case, let us assume that, the equipment is purchased for 3.50 Lakhs, life is 5 years, salvage value is nil. So, this is, as before.

Now, we assume that, there is no data on gross income, given to me. And, it is given that, we are incurring, 1 Lakh Rupees annually, as part of its operating expense. And, it is also given that, this whole of 1 Lakh, is admissible for tax rebate. So, what is happening? I am purchasing the equipment, for 3.50 Lakhs. Life is, 5 years. Salvage value is nil. No information on income. But, I am told that, I am incurring an expense of, 1 Lakh, every year. And, this 1 Lakh, is all admissible for, giving me tax benefit.

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So, I go with the similar calculation, once again. So, you are already familiar with the depreciation, now. So, I calculate the depreciation of, 3.50 Lakhs, using the three methods. In the first case, it is going to be, 0.7, 0.7, every year, for next 5 years. This is using, Straight Line Method of depreciation. If you go for, Double Declining, first year, it is very large depreciation, 1.4, second year 0.84, third year 0.5.

And, fourth and fifth, I switched it to straight line, and I am getting, 0.38, 0.38. Likewise, Sum of Years, I am getting, very high depreciation in initial years, 1.17 here, 0.93 here, 0.7 here, 0.47, and 0.23 here. Gross Income, as I told you, this is nil, in this particular example. Expense, every year, it is 1 Lakh. And, as I told you, these are all, admissible for tax rebates.
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Illustrative example 2 – Case 2— Operating expense alone is given

Year	Net taxable income			Tax			Post-tax net expense		
	SLD	DDB	SOY	SLD	DDB	SOY	SLD	DDB	SOY
1	-1.70	-2.40	-2.17	-0.68	-0.96	-0.87	0.32	0.04	0.13
2	-1.70	-1.84	-1.93	-0.68	-0.74	-0.77	0.32	0.26	0.23
3	-1.70	-1.50	-1.70	-0.68	-0.60	-0.68	0.32	0.40	0.32
4	-1.70	-1.38	-1.47	-0.68	-0.55	-0.59	0.32	0.45	0.41
5	-1.70	-1.38	-1.23	-0.68	-0.55	-0.49	0.32	0.45	0.51
			Total	-3.40	-3.40	-3.40			

Handwritten annotations:
S.L.D.
Income = 0
Dep. = 0.7
Exp. = 1.0
Net taxable income = -1.7
Tax @ 40% = -0.68
Net expense = 1 - 0.68 = 0.32

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So, now, how I perform the calculation would be, like this. Let us take the case, for a straight line. Because, this calculation will remain same, for all 5 years. So, income is, 0 here. Depreciation expense is, 0.7. Other expense is, 1.0. So, my total expense becomes, 1.7. So, if you subtract this, from zero, you can as well say that, my net taxable income is, –1.7 Lakhs.

Now, just look at this, – sign. That means, you have not earned, any money. So, if you have not earned, no question of paying taxes. So, what is happening here is, in another way, if you look, when you are charged tax at 50%, or let us say, 40%, in our case, in this example, so 1.7 multiplied by 4, I am getting a tax implication of, 0.68, in minus. What does this mean. That means, I am getting a benefit of, 0.68 Lakhs. In earlier case, when my income was given, I was getting, positive tax implication. So, I had to pay, taxes.

Now here, in this case, since government is giving me, tax rebate. And, when I am getting a tax of –0.68, it is as good as, I am getting a rebate of, 68,000. So, this is what, it is written. So, Straight Line Method, all 5 years, you are getting a tax rebate of, 0.68. So, what will be your post-tax net expense? So, you were spending, 1 Lakh. And, now you are getting a rebate of, 0.68 Lakhs. So, net expense, after taxes is, 1 – 0.68, which is 0.32.

So, this is what, you find here. 0.32, in the case of a straight line, in Year-1. 0.32 in Year-2, Year-3, Year-4, and Year-5. Now, if you look at the total tax liability, it is 3.40, in the straight line. Double declining also, same. And, Sum of Years digit method also, same. So, what you find here is that, the total tax liability, remains same. It is only the timing, that matters.

Now, similar analysis, you can do it using, Double Declining Balance Method. As you can see here, the depreciation in year one, using double declining was, 1.4 Lakhs. So, the net taxable income becomes, 2.4. So, when you are paying tax, you are getting a tax rebate of, 96,000. And, so your post-tax net expense, becomes very less, 0.04, in double declining. 0.26, in next year. 0.4, in next year.

And, when you have switched it to, straight line, you are getting a net expense of, 0.45 in Year-4, and 0.45 in Year-5 also. Likewise, if you go for Sum of Years, you are going to get, 0.13 as post-tax net expense, 0.23 here, 0.32 here, 0.41, and 0.51, respectively. So, you have seen here, how you are getting a tax rebate, even though, you did not have any income. Because of your expenses, you are getting, some tax benefit. And, that is getting reflected, in reducing your net expense.

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Now, we will see the last case here, in which, we are assuming that, income and expense, both are given. And, this is what is, most practical. Because, in most of the cases, you will be knowing, what is the income that you are getting, and what is the expense you are getting. So, let us assume, as before, we are purchasing equipment for 3.50 Lakhs, salvage value is nil, life is 5 years.

Let us, further assume that, the gross income is 2.50 Lakhs, and expense is 1 Lakh. And, let us further assume that, this whole of 1 Lakh is, admissible for taxes. That means, you are going to get benefit, on this particular expense. So, let us do the calculation, again.

We calculate, the depreciation. So, there is nothing new here. 0.7, every year, for next 5 years, using straight line. Double declining, 1.4, 0.84, 0.5. And, in Year-4, I am switching over to straight line. So I am getting, 0.38 and 0.38. Sum of Years, we have already seen, nothing new here. Now, in this column, you can see, I am having, 2.50 Lakhs. So, I am getting, 2.50 Lakhs income, every year, for next 5 years. Expense, 1 Lakh, for every 5 years. Now, let us see, how do we perform, further calculation.

So, your gross income is, 2.50 Lakhs. Your depreciation, which is expense for accounting purpose, is coming to be, 0.7, using straight line. Your other expenses, and remember, these expenses, are admissible for taxes. So, 1.0. So, my net taxable income is, how much? 2.5
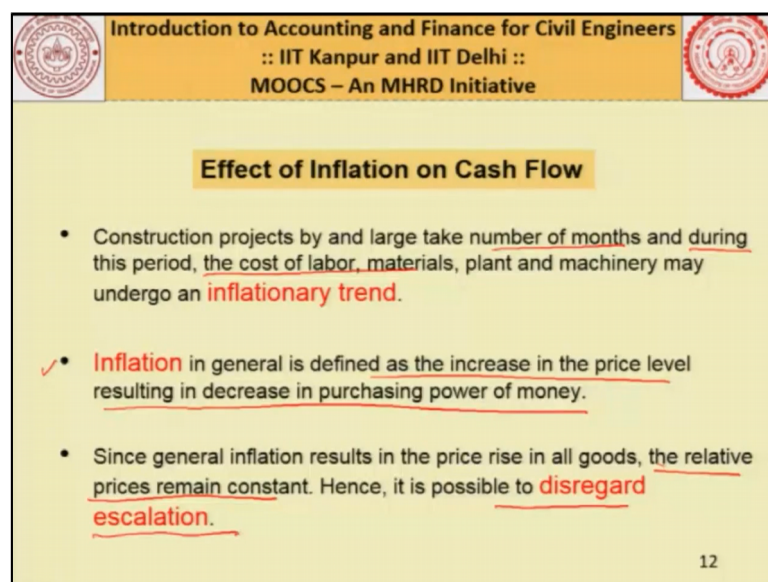
here. You subtract, this, and this. So, total expense is, 1.7. So, 2.5 - 1.7 is, 0.8. Now, we are paying taxes, at a rate of 40%. So, 0.8, 40% of that is, 0.32.

So, my gross income is going to be, rather net income is going to be, 2.5 minus the taxes, and minus, remember 1 Lakh, is your expense. So, this is going to be, my net income. If you forget about this personal expense, if you want to keep this separate, so your net income is coming to be, 2.18. This is what it is, shown here. You can see here. Net income, is coming to be, 2.18, every year, for all 5 years.

If you do, similar calculation for, Double Declining Balance Method, you will find, in the first year itself, you are getting a net income of 2.46, second year 2.24, third year 2.10, 2.05, 2.05. And, if you are going in with net income, you are getting 2.37 here, 2.27, and these 3 values. So, we have discussed, all three methods. And now, you are in a position to find, how to take care of different scenarios.

So, this is, as far as, our discussion on, impact of method of depreciation on economic evaluation was concerned. Now, we will quickly see, the impact of inflation. If you remember, in one of the assumptions earlier, we made that, we said that, the cash flows do not have, any impact on inflation. Or rather, in our market, we do not have any inflation.

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But, that is again, not the case. Depending on the market conditions, you will find, there are certain amount of inflation. Now, as you know, any construction project, for that matter, take a large number of months. The time period could be, very large, 25 months, 30 months. Even,

5 years, 6 years, is quite common for, construction projects. And, during this project, it is not unlikely that, the cost of labour and material, and for that matter, plant and machinery, remain static.

They are not. You will find that, every now and then, there is increase in the prices, of these materials. When it comes to inflation, it is generally defined as, the increase in the price level, resulting in, decrease in purchasing power of money. Now, when we see general inflation, you will find that, the price rise is more or less uniform. So, the difference, when you see, the relative prices, remain constant. So, sometimes, it is quite logical to disregard, escalation. Right.

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However, if you look at the Indian practices, specially the one, which is recommended in IRC: SP:61-2004, they say that, when there is a large difference between, the rate of inflation, and the rate of interest, you should calculate, the modified discount rate. In fact, they have also suggested, one formula. We will see, this formula. But, as long as, the inflation is small, we need not even worry about this.
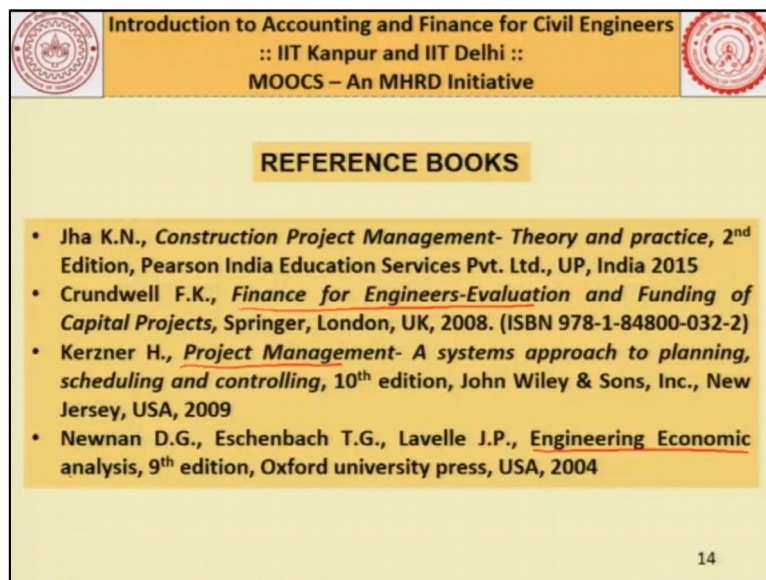
But, let us say, for example, if your rate of inflation is high, we should go in for, modifying our discount rates. So, for one small example, I have assumed that, the difference between, the rate of interest, and rate of inflation, is not large. They are comparable. And so, I can calculate this modified discount rate, using this formula. It is given, in this particular code. It says, 1 + interest rate percentage, divided by 1 + inflation rate percentage, - 1 multiplied by 100%.

So, this is how, you calculate the modified discount rate. Now, in general, for evaluation of alternatives, we take 12% as discount rate. Now, suppose, for our illustration, we assume that, rate of inflation is 8%. So, we can very well calculate, what is the modified discount rate. So, this would be, 1 + 12%, divided by 1 + 8%, - 1 multiplied by 100. So, you will find, this coming to be, 3.70%.

So, what you have to do is, you have to find out, the modified discount rate. And then, using this modified discount rate, you carry out the same analysis, which we have been carrying out so far, using any one of the methods, which we have learned so far. Either, it could be Present Worth Method, Future Worth Method, or Rate of Return Method.

So, just to summarise, in case, you find that, inflation rate is negligible, may be of the order of 1 to 2%, 3%, no need to worry about that. But, if you find that, there is a large difference between, rate of inflation, and interest rate, then you can use this formula, to calculate the modified discount rate. And thereafter, you can perform, similar analysis. Just to give you, the list of references again, you can have a look at, these textbooks.

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One by, me itself. And then, there are others. For example, this book on, Finance for Engineers - Evaluation and Funding of Capital Projects. Then, there is a book on, Project Management by Kerzner. And, there are, many such books. This title, Engineering Economic

Analysis by Newnan and Eschenbackh, they are quite good books. And, you will find, plenty of examples, for your practice.

So, just to summarise, in this lecture, I told you, the impact of depreciation, on our Post-tax cash flow analysis, and the impact of inflation. As I told you, as long as, inflation is under check, you can neglect that. If they are substantial, you can change the modified discount rate, and carry out the analysis, in a similar manner. So, we stop at this point. Thank you, very much, and see you, next time.