MINERAL ECONOMICS AND BUSINESS

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Week 9

Lecture 44 : Depreciation - I

Hello, welcome everybody. Today, I will talk about another important topic: depreciation and how it relates to cost accounting in business. So, the concept I will cover today is depreciation—the definition, the basic concept we have. We will apply it through different examples, show its applications, and explain the concept of salvage value and its implications in depreciation calculations, as well as different methods of depreciation. We will also discuss how to calculate depreciation using those different methods today.

To start with, I must say that depreciation is an integral part of cost accounting because it directly affects the cost structure of the business. We can begin here and then try to understand that depreciation spreads the cost of fixed assets over their useful life. Say we have purchased something worth, say, 10 crore. Now, if we record this as an expenditure

in the first year itself—the year it is purchased—then what happens is we show it as a huge cost. But its utilization and output do not match the expenses.

So, the idea is to capitalize this asset over its useful life. That is why depreciation spreads the cost of that 10-crore fixed asset over its useful life. That means it may be spread as, say, 1 crore, 1 crore, 1 crore, or 2 crores, 2 crores, and so on, over the useful life. The question of how it is spread or distributed over the useful life is the topic where we discuss different methods of cost allocation. So, why do we do this?

By doing this, we ensure that the expense is distributed systematically rather than affecting the profitability in a single period. If I show it in a particular year, even then, when there is a business running and you acquire an asset and show it in that year, it will severely affect the profitability. Not only that, sometimes the balance will show negative—totally negative—because of the huge investment. So, as we know, cost accounting will focus on tracking, analyzing, and managing the costs associated with all production and operations. Depreciation, that is why, will play a crucial role in this process by showing these expenses or distributing these expenses systematically and maintaining a proper cost accounting system. In product costing, especially in manufacturing and production, depreciation is included in the cost of production.

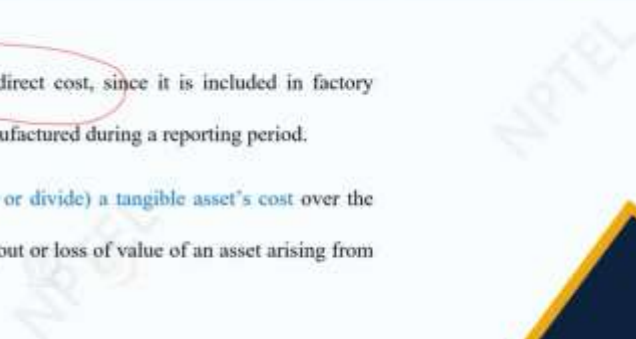So, it will affect product pricing and profitability analysis. If we use that or show the entire cost in one year, then it will be difficult even for pricing the product because the

huge amount shows as an expenditure in one year. So, this depreciation is considered an indirect cost since it is included in the factory overhead and then allocated to the units manufactured during a reporting period—financial period, for example. And depreciation refers to the prorating—that means distributing or dividing a tangible asset's cost over the asset's life. So, it is basically an indirect measure of its wearing out, as if we are utilizing it and then wearing out the machine.

So, it is losing value. So, from there, we are utilizing the asset. So, we just show that much value which we are utilizing. So, I have spent 100 crore—how much I am utilizing in a particular year. And then it loses the capacity to work further, and slowly it becomes obsolete rather than that.

And the use of this asset over a period—say, the estimated period of life—after that, it reduces to its salvage value, the estimated salvage value. So, the depreciation is to be allocated so as to charge a fair proportion, a fair proportion of the depreciable amount in each accounting period. For example, in a financial year or even the calendar year, as to be decided. So, we have to charge a fair proportion during the expected useful life of the asset. This expected useful life means basically we use an estimated useful life or estimated life of the asset.

Depreciation will definitely impact financial planning, investment decisions, and asset replacement strategy because it gives you insights into the asset and the expected cost of utilization. In tax and financial reporting, businesses also deduct the depreciation as an expense in financial statements. So, this will help in tax planning and financial analysis. So, since depreciation represents the declining value of the assets used in business operations. So, this is essential in cost accounting for accurate cost control, financial reporting, and pricing strategy.

So, it will continue showing that the value of the asset is declining, and at the end, we are fully capitalizing the asset. Now, there is a concept of salvage value before we go for calculations or different methods of depreciation that we discussed. So, the salvage value of an asset is the expected amount—remember, that is not the real amount. It can be sold for when it reaches the end of its usable life.

So, what happens is this is too theoretical in the beginning to understand because we are thinking that this machine will run for 10 years, and after that, it will have a junk value of 10 lakhs. For example, something worth say 10 crores will be fully depreciated after full utilization, and it will be reduced to junk. Then, by weight, you sell it and get 10-20 lakhs, something like that. This is not always true, but for the purpose of the concept of depreciation and utilization of this amount over the estimated life of the asset, this is very essential. This can vary, of course. It can vary, and even after the estimated usable life, it

can be of further use. But we can depreciate it over a period of time and then we can—Assume that or estimate that this will be the expected value—that if you sell this asset after its useful life, you will get this money. That will be called the salvage value, whether you can further utilize it or whether it becomes complete junk.

Salvage value

- The salvage value of an asset is the expected amount it can be sold for when it reaches the end of its usable life. This estimate is made at the time of purchase.
- To determine how long an asset will remain useful, the following factors should be considered:
    - **Wear and tear:** Regular use causes physical deterioration over time.
    - **Obsolescence:** Advances in technology or changes in industry standards may make the asset outdated.
    - **Legal or usage restrictions:** Certain regulations or company policies may limit how long the asset can be used.

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So, to determine how long this asset will remain useful, the factors that are considered are wear and tear—number one. The regular use of this asset will definitely cause physical deterioration over time. And then again, obsolescence is important. When you are using it for a long time, you will see that new machines are coming which are more useful, more efficient, and if you replace these old machines, you are benefited. So, obsolescence is one of the important factors. So, the assets get easily outdated. And then there are legal or usage restrictions.

Methods to calculate depreciation

- Many methods are available for determining the annual charge for depreciation.
  - Straight-line method of depreciation ✓
  - Written Down Value method (WDV) / Declining balance method of depreciation
  - Sum of the years digits method of depreciation
  - Units of production depreciation
  - Sinking fund method of depreciation

Each of these method has unique features, which is followed by different management philosophies.

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So, certain regulations or company policies may limit how long the asset can be used. We cannot say that it can be used indefinitely. Now, what are the different methods of calculating depreciation? There are many methods available for determining the annual charge for depreciation. For example, a very well-known method is the straight-line method of depreciation. And there is the written-down value method or declining balance method of depreciation.

Then we come to the sum-of-the-years'-digits method of depreciation. Then we have units-of-production depreciation, and there is also the sinking fund method of depreciation. All these methods have their unique features, and we have arguments to support or deny the utility of a particular method, but all these methods are in practice; they are used in reality. And all of them are actually utilized in specific situations, specific cases, and also there are regulatory guidelines—which I have also seen—where you have to follow a particular method of depreciation in the books of accounts. Let us now see how to choose a method in that case: the type of asset.

So, different assets wear out and lose value at different rates, which will also guide us as to which method will be sufficient. That means the style or the way it wears out will dictate the use of a particular method. Now, how you are using the asset will also affect its depreciation or the method of depreciating in the books of accounts. And also business conditions—the financial and operational situation of the company—that if you are in a very... I mean, if you want to depreciate something in 7 years, you can do it depending on

the business or financial situation. So, the commonly preferred approach is one that allows for a faster recovery of the investment.

That means, as quickly as possible, if we are making enough profit, then we show that it is fully depreciated over a limited period because this is one preferred approach. So, this is a good financial strategy—that we show these things in the beginning itself, at the beginning of the company, and then we become free of this additional liability of showing this depreciation in the books of accounts. This ensures capital recovery when we have already incurred the capital expenses; this helps in gradually recovering the investment instead of instant recovery, which is not feasible. So, the investment that we have made in the asset—it should be simple to use, meaning you must understand why you are doing this—so it should be easy to calculate and apply. It must be acceptable under tax regulations; you should not use a certain method and show in the books of accounts that the tax regulations deny or refuse to accept. Now, among the various methods that I have shown in the previous slide, the straight-line method and the declining-balance method are the most commonly used in financial accounting for industrial businesses.

The straight-line method and the declining balance method. We will start with the straight-line depreciation method, which is very simple to calculate. It is the simplest method for calculating depreciation. What do we do? It involves subtracting the salvage value from the initial cost.

Subtract the salvage value from the initial cost of the asset, and then we divide the result by the useful life. So, we determine the fixed annual depreciation amount. For example, we have:

Let,

P = Cost of a machine

S = Salvage value

n = Life of the asset

D = Depreciation charge per annum

Then, $D = \frac{(P-S)}{n}$

That means every year you are depreciating the same amount, meaning the depreciation amount is constant.

Straight-line depreciation method

- Under this approach, depreciation amount is constant. The main disadvantage of this method is that the charges made during the later periods are high as compared to the services rendered by the asset.

- Here, for calculating book value of the asset in year t, we use the following formula:

  $B_t = B_{t-1} - D_t$ [Book value at the end of the year = Book value at the end of the previous year − Depreciation charged in the current financial year]

  where, B_t is book value at the end of period t.

- **Schedule format:**

Year	0	1	2	3	4	5
Depreciation						
Book Value						

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The main disadvantage of this method is that the charges made during the later periods are very high as compared to the services rendered by the asset because see as it is wearing out every year. So, in the beginning we have say for example, some depreciation amount D. So, it is performing even better, but the depreciation amount is less, but as you are going towards the end of the life of the asset, then you are seeing that its performance

or its services is low, but you are depreciating the same amount, this is contradictory. So, the even then it is also used in many cases and say for calculating this book value of any asset of the for example, at the year t, we use the following formula. What formula we use?

This is the: $B_t = B_{t-1} - D_t$

So, just to explain these things I have written on the side that the book value at the end of the year of that asset book value equals to the book value at the end of the previous year minus the depreciation charge in the current financial year. For example, now if that B_t is the book value at the end of year of the end of period t, B_t, then this B_t is the book value at the end of the year t which is equal to the previous the book value of the previous year that is t minus 1 and then I have depreciated the amount say d t in that year. So, we get this relation and we are simply we make a schedule like that say in year 0, then year 1, year 2, year 3, year 4 and year 5 for example, 5 years here. So, we have the depreciation in the first year, we will depreciate at 0, then in first year we have a depreciation value and when you when you depreciate this amount, then the big book value will remain the same, will be the price of the or the cost of the machine minus the depreciation amount, the book value will reduce.

Again you calculate the depreciation here then you deduct this depreciation from the last year's book value you get this book value at the end of year 2 for example, B 2. Now, the book value at the end of year B 3 will be calculated by B 2 minus this D 3 depreciation at the year at the end of the year in the year 3. Similarly, we have D4 and D5, so here you get D4 book value in the at the end of the year 4 and this book value at the end of the year 5. Ideally, this should be equal to the salvage value, ideally this should be equal to the salvage value.

Example 1: A mining company purchases machinery for $50,000 with an estimated useful life of 10 years and a salvage value of $5,000. Calculate depreciation amount using straight line method.

Solution:

The formula for straight-line depreciation is: $D = (P - S)/n$

Substituting the values:

$D = (50,000 - 5,000)/10$

$D = \$ 4,500$

This means the machinery will depreciate by $4,500 annually for 10 years. At the end of its useful life, the book value will equal the residual (salvage) value of $5,000.

We can see in certain cases like straight-line depreciation it is possible, but in all the methods the last book value of the asset may not be equal to the salvage value. Now, let us see a mining company purchases machinery for, say, 50,000 dollars with an estimated useful life of 10 years. That means, n equals 10 and the salvage value is 5,000 dollars. We calculate the depreciation amount using the straight-line method. So, the formula for straight-line was simple: d equals p minus s divided by n.

So, we substitute these values in the formula: D equals 50,000 dollars, the cost of the machinery, minus 5,000 dollars, the salvage value, all divided by 10, the estimated useful life of the machines or assets. So, from here we get that every year the depreciation will be 4,500 rupees. So, 4,500 dollars will be charged as depreciation. So, the machinery in the books of accounts will depreciate by 4,500 dollars annually for 10 years. So, if we depreciate this for 10 years, 4,500 dollars for 10 years, then it becomes 45,000.

So, at the end of the 10th year, the residual value, which is also known as the salvage value we estimated, will be reached. That means the book value at the end of the 10th year will equal 5,000 dollars. We had purchased it for 50,000, and we have depreciated it over 10 years by 45,000 dollars. So, the remaining value is 5,000 dollars. So, this will be equal to our salvage value; here it is matching.

Written Down Value method (WDV)

- The Written Down Value (WDV) method applies a fixed depreciation rate to the asset's book value each year. This results in higher depreciation in the early years and lower depreciation in later years, reflecting the asset's actual usage pattern.

- In simple terms, this method ensures that depreciation expenses are front-loaded, meaning businesses recognize a larger portion of the asset's cost in the initial years and gradually lower amounts over time.

- This approach is also called the Diminishing Balance Method or Declining Balance Method and is widely used for assets that lose value quickly in their early years.

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Now, we come to the second method, or the written-down value method. This written-down value method applies a fixed depreciation rate—remember, not the depreciation charge, it is the depreciation rate which is fixed. So, you apply a fixed depreciation rate—for example, a percentage—to the asset's book value each year. So, this will result in higher depreciation in the beginning, and then, as the book value decreases, what will happen? The depreciation charge per year in the later years will

will be lesser and lesser. So, this ideally follows its usage pattern because, in the beginning, we have higher utility—better services from the machine. So, we depreciate more in the beginning, and then we slowly reduce the depreciation charge, depending on the performance of the machine. So, we actually try to follow the real usage of the machine in industries, and we devise this written-down value method, which is widely used, especially for machinery.

Written Down Value method (WDV)

- Under this method, *depreciation is charged at a fixed percentage on the reducing balances of the assets*. This is a realistic approach, since the depreciation charges decrease with the life of the asset.

- In this method, depreciation is calculated on the asset's **remaining book value** after accounting for previous depreciation. This ensures that **depreciation decreases over time**, reflecting the asset's actual decline in value.

- However, the book value at the end of the life of the asset, may not be equal to the salvage value of the asset and the salvage value must be greater than zero.

So, it ensures that the depreciation expenses are front-loaded—that means, in the beginning, they are high. The business recognizes a larger portion of the asset's cost in the initial years and gradually lowers the amounts over time towards the end of the machine's life. This approach is also called the diminishing balance or declining balance method and is widely used for assets that lose value quickly in their early years. So, this is also called the declining balance method, a very well-known method. Now, in this matter, what do we do?

Depreciation is charged at a fixed percentage on the reducing balance of the asset. So, this is a realistic approach, as I was telling, since the depreciation charges decrease with the life of the asset. So, as you go on increasing—as you just go on using the machine over the years—then its utility or the service will be reducing, and accordingly, we will be reducing our depreciation charge. So, in this method, the depreciation is calculated on the asset's remaining book value—remaining book value after accounting for previous depreciation. So, you can understand that if I apply, say, for example, 10 percent—I am just giving the example with 10 percent.

In the beginning, we have, say, 1 crore, then we have used 10 percent. So, the effective value will be going down—the book value—but you are not decreasing the depreciation percentage. So, that percentage reduction will again apply on the reduced value. So, what will happen is, actually, the depreciation charge will go on decreasing. In the beginning,

the depreciation charges will be high because the book values are high. So, if you go on calculating the depreciation and go on charging this.

Remember that the book value at the end of the life of the asset may not be exactly equal to the salvage value of the asset, and this salvage value, of course, must be greater than 0. It cannot be negative in the book of accounts. Let us say, what is this declining balance method? How do we utilize this? So, depreciation rate—remember, that is the rate, not the amount—is the rate:

Depreciation rate $= 1 - (S/P)^{1/n}$

Declining balance method

Depreciation charge is calculated from the following relation:

Depreciation rate $= 1 - (S/P)^{1/n}$

Book value at the end of year $N = P (1 - depreciation)^N$

$\quad\quad = P[1 - \{1 - (S/P)^{1/n}\}]^N$

$\quad\quad = P (S/P)^{N/n}$

Where,

N = year in which book value is to be found

N = total life of equipment

P = price of equipment

S = salvage value of equipment

Annual depreciation charge $=$ **Book value at (N-1) $\times$ [1 - (S/P)$^{1/n}$]**

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So, this is the amount—this is the depreciation rate at which we will depreciate the asset. So, the book value at the end of the year will be:

Book value at the end of year $N = P (1 - depreciation)^N$

$$= P [1 - \{1 - (S/P)^{1/n}\}]^N$$

$$= P (S/P)^{N/n}$$

Where,

N = year in which book value is to be found

N = total life of equipment

P = Price of equipment
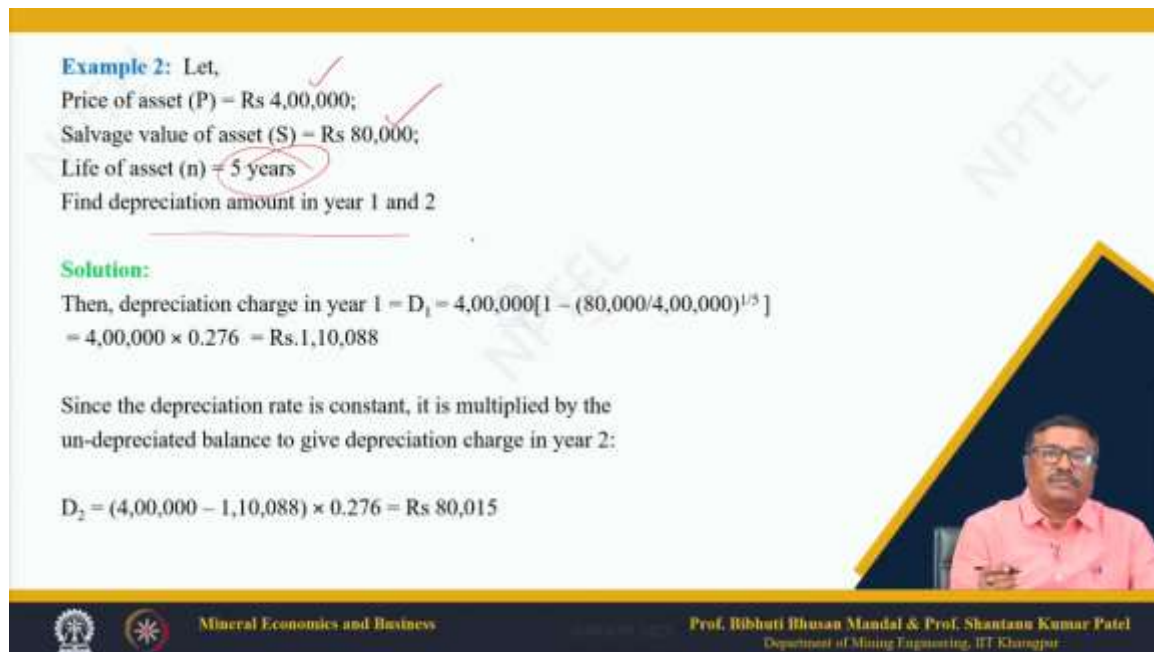
S = salvage value of equipment

The book value should ideally be S, the salvage value. S is the estimated salvage value of the equipment.

So, at the end of the year, as we can see from this calculation, it will become equal to the salvage value. Now, the annual depreciation charge equals the book value at n minus 1 multiplied by the depreciation rate at which we are depreciating. That means, say, in this year, we are trying to calculate the depreciation amount. So, the book value in the previous year multiplied by the depreciation rate will give us the depreciation charge.

Example 2: Let,
Price of asset (P) = Rs 4,00,000;
Salvage value of asset (S) = Rs 80,000;
Life of asset (n) = 5 years
Find depreciation amount in year 1 and 2

Solution:
Then, depreciation charge in year 1 = D_1 = $4,00,000[1 - (80,000/4,00,000)^{1/5}]$
= $4,00,000 \times 0.276$ = Rs.1,10,088

Since the depreciation rate is constant, it is multiplied by the un-depreciated balance to give depreciation charge in year 2:

$D_2 = (4,00,000 - 1,10,088) \times 0.276$ = Rs 80,015

Now, this depreciation charge will be deducted from the book value of the previous year, and we get the net book value for this year. For example, let us take this example: the price of the asset is, for example, 400,000 or 4 lakhs a year, and the salvage value is estimated as 80,000—not bad. The life of the asset is 5 years. So, the depreciation amount in year 1 and year 2—just for example—we will try to find out the depreciation amount in year 1 and year 2. So, the depreciation charge in year 1 will be D1. For example, if it is D1, then it is $1 - (S/P)^{1/n}$, for first year.

So from here we find that the first year the depreciation charge will be 1,10,088 rupees. So now what will we do? For finding out the depreciation in the second year. For

example, denoted by D2, we have the cost price in the beginning was 4 lakhs minus the depreciation charge, this is given and then multiplied by the depreciation rate which is constant.

You can easily find out the value of this, for example, 80,000 whole divided by 4,400,000, whole raised to the power 1 by 5, whole raised to the power 1 by 5. So, if you can find out these things, then you will find that the multiplication of 1 minus this will be coming as 0.276, 0.276 that will come. So, 1 minus this, you can find out that the value will be 0.276. Since the depreciation rate is the same, you can use this factor every year. And, you will see that this value is decreasing every year, that means the balance is declining, which is why it is called declining balance.

Sum of the Year - digits Depreciation Method

- This method allows for a faster depreciation write-off in the initial years. Instead of applying a fixed rate, it assigns a different depreciation rate each year based on a remaining life of the equipment

- If n is the estimated life of the asset, the rate is calculated each period as a function in which the denominator is always the sum of the series 1, 2, 3,...., n and the numerator for the first period is n, for the second (n-1) and so on.

- Ex: For 1st year, depreciation rate = $(P - S) \times n/(sum\ of\ all\ the\ years\ till\ end)$

- The sum of year's digits can readily be calculated from the formula n(n+1)/2, where, n is depreciable life in years.

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And, you are using the same multiplication factor irrespective of whatever the balance is on the left side. So, you get this value continuously declining every year; it will be reducing. Now, we will have a special lecture also in a class when we will solve more problems to illustrate the use of the method that we are showing today. For the time being, let us only show one or two examples; we will have separate classes for this. Now, there is an interesting method called the sum-of-the-year's-digits depreciation method.

This method allows for a faster depreciation write-off in the initial years. It was faster, definitely, in the declining balance method, but here you see that it is even faster in some of the year-digit methods. So, instead of applying a fixed rate, which was true for the

double declining balance method, it assigns a different depreciation rate each year based on the remaining life of the equipment. So, in the beginning, we will be charging first at a higher rate and then slowly cooling down. So, for example, if n is the estimated life of the asset, then the rate is calculated each period as a function in which the denominator will be the sum of the series 1 to n, right?
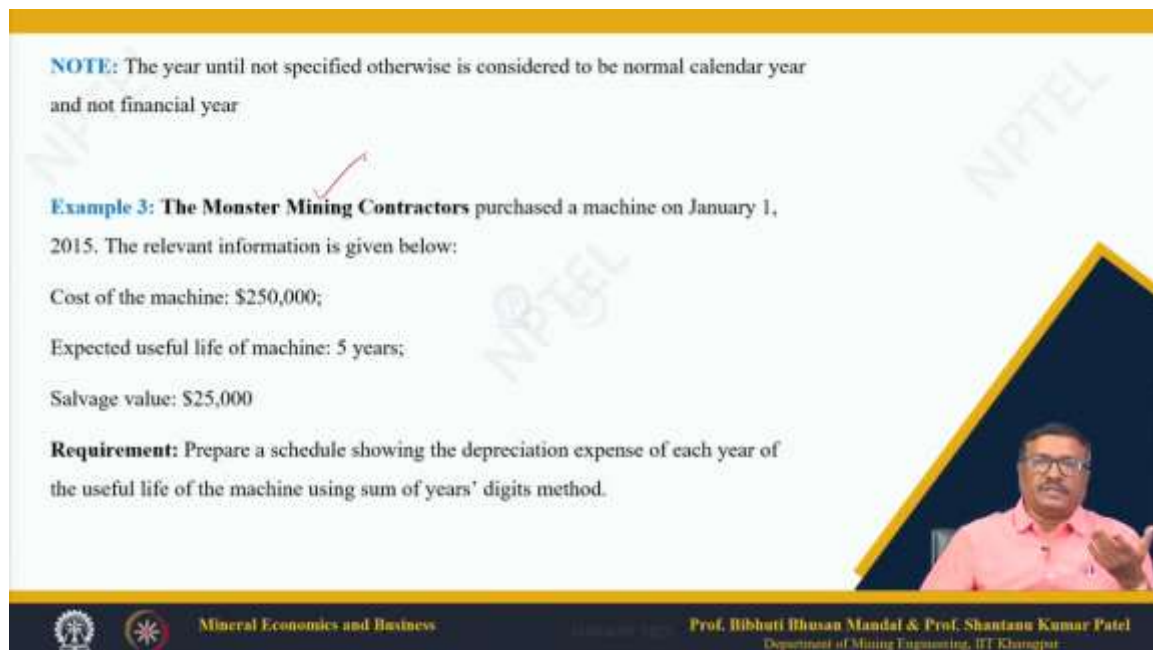
And the numerator for the first period is n, for the second n minus 1, and so on. So, I will just tell you the fact of how it is calculated. For example, we have a life. So, 1, 2, 3, 4, 5, and it goes up to n. Then the sum of the years will be: $n(n+1)/2$. This will be the sum of the years, and this will be the denominator. And in the first year, what we will do is depreciate as n divided by $n(n+1)/2$. This will be the highest value. So, the depreciation charge will be highest in the beginning. Next year, what we will do is change the numerator to n minus 1, divided again by $n(n+1)/2$

NOTE: The year until not specified otherwise is considered to be normal calendar year and not financial year

Example 3: **The Monster Mining Contractors** purchased a machine on January 1, 2015. The relevant information is given below:

Cost of the machine: $250,000;

Expected useful life of machine: 5 years;

Salvage value: $25,000

Requirement: Prepare a schedule showing the depreciation expense of each year of the useful life of the machine using sum of years' digits method.

So, this will reduce, and in the next year again, n minus 2, n minus 3, n minus 4, until we go to the end of the life of the equipment. For example, for the first year, the depreciation rate P minus S multiplied by N divided by the sum of all the years till end N, because in the beginning, I said in the first year we will use the highest value N divided by the sum of all the years till end. So, P minus S, P is the cost, and S is the salvage value, then you multiply with this fraction. So, you get a depreciation amount.

So, the sum of the years' digits can readily be calculated from the formula n into n plus 1 by 2, which I have shown, where n is the depreciable life in years. So, now, if it is not specified, then we should take it as a calendar year, which I have noted in this slide. For example, I will give an example so it becomes very easy for you to understand. For example, the Monster Mining contractor purchased a machine on January 1, 2015. So, the relevant information is: the cost of the machine is $250,000, the expected useful life is 5 years, and the salvage value is $25,000.

Solution:

Depreciable cost (depreciable base): $250,000 – $25,000 = $225,000

Depreciation expense at the end of the first year: $225,000 × (5/15) = $75,000

Book value at the end of the first year: $250,000 – $75,000 = $175,000

Notice that as the remaining life of the machine decreases, the depreciation expense also decreases.

Year	Depreciation base ($)	Remaining life of machine	Depreciation fraction	Depreciation expense ($)	Book value ($)
1	225,000	5	5/15*	75,000	175,000
2	225,000	4	4/15	60,000	115,000
3	225,000	3	3/15	45,000	70,000
4	225,000	2	2/15	30,000	40,000
5	225,000	1	1/15	15,000	25,000
				225,000	

*1 + 2 + 3 + 4 + 5 = 15

We have to prepare a schedule showing the depreciation expense of each year of the useful life of the machine using the sum of the years' digits method. These are the basic data that we have. Now, the depreciable cost, that means the depreciable base, is $250,000 minus $25,000, which is the salvage value. So, we have $225,000 as the depreciable amount that will depreciate over the life of the asset. So, at the end of the first year, we have n divided by the sum of the digits 1, 2, 3, 4, 5.

So, that is 15. So, 5 by 15 will be multiplied with the $225,000. It is giving you $75,000. So, what is becoming the book value? That $250,000 was the cost or the price.

75,000 is the depreciation. So, the book value is 1,75,000. Notice that as the remaining life of the machine decreases, the depreciation expense also decreases, as you can see. So, the remaining life of the machine in the beginning is 5 years, then 4 years, 3 years, 2 years, and finally 1 year.

So, the first depreciation fraction multiplier will be 5/15, then 4/15, 3/15, 2/15, and in the last year, it is 1/15. So, the depreciation expenses are scheduled here as 75,000, which we have calculated. Similarly, we go on multiplying with the book value and reach up to the value of 15,000. So, the book value, when calculated, becomes 1,75,000. In the beginning, after 1 year, it gradually reduces, reduces, and comes down to 25,000 dollars, which is equal to the salvage value at the end of the fifth year.

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- *Corporate depreciation accounting by* Subrata Kar. SBS Publishers. Delhi

So, this is the complete depreciation schedule for 5 years. We have decided that we will depreciate these items over 5 years. And this is how the book values will appear in our accounts, and this will be the depreciation expense shown in the accounts, using the sum-of-the-years'-digits method. We will continue this discussion in the second lecture. If you want to read more, you can use these books and internet resources. In the next class, we will continue with the topic of depreciation, Part 2, in which the remaining methods and some other topics will be discussed. Thank you very much.