

CHAPTER – III

METHODS OF DEPRECIATION

Depreciation is a allowable expenses in general accounting purposes and income tax accounting purposes. But it differ categorically from other conventional expenses because depreciation charge does not occur any outflow of business fund. This chapter deals with the different methods of depreciation with their merits and demerits so that a firm is in a position to choose the best method.

The periodical amount of depreciation is affected by the following factors¹.

1. the cost of the asset;
2. the life of the asset;
3. the expected residual value of the asset;
4. and, by the method of depreciation selected for amortisation of the asset which must be systematic and rational.

Cost of asset means the basic acquisition cost of the asset plus all incidental expenses which are required to the asset into use. The incidental expenses like freight, import duty, Brokerage, legal expenses and installation charges are also form a part of cost of asset. There are some controversies regarding repairs and maintenance cost. In general, heavy repairs and maintenance cost which increases the life of the asset or keep the asset in its usable state² are also to be capitalised.

The useful life of an asset is the period of time during which the firm expects to use the asset for earning revenue³. It is not an easy task to estimate an accurate life of the asset. The useful service life of an asset may come to an end whether as a result of physical causes or as a result of changing economic significance or both⁴. Ronald Ma observed that “the life of the asset is the shorter of the life determined by (a) physical wear and tear, taking the maintenance policy of the firm into account, (b) obsolescence, and (c) where a machine has been installed to exploit a wasting asset,

the period of exploitation or in the case of a machine with a specialised function the period determined by the effective and sufficient demand for its products.”⁵ The physical, engineering life of the asset can be determined with a fair degree of accuracy, but technological obsolescence and demand for a product cannot be determined easily. So, instead of exact working life only the probable useful period may be assumed through rational approach like, past experience, quality of asset, expert’s opinion, consulting asset’s manual, statistical tools for forecasting etc.

Salvage value of an asset refers to the amount that can be expected to realise from disposal of the asset at the ends of its useful life. That means it is the difference between the cost of the asset and the total depreciation during its life. Expecting a few cases, salvage values of retired assets are not of any great significance. Still an incorrect estimate of the salvage value, however small it may be cannot but result incorrect measure of the periodical depreciation⁶.

Once the cost of the asset, useful lives and the salvage value are determined the problem of depreciation is reduced to one of finding a suitable basis of allocation of the cost of the asset less salvage value over the periods that use services of the asset. In general accounting practice, the choice of method of allocating the cost of a tangible fixed asset over its effective life i.e. depreciation should depend upon the patterns of expected benefits obtainable in each period from its use. The main problem of this approach is that there is no dependable way to measure the quantum of service that can be received from the asset over its expected service life. In actual practice what happen is that the accountant selects a method to be used as the basis for allocating the depreciable cost.

Sometimes, accountant are guided by a management’s policy relating to the allocation of cost of fixed asset. In all the cases, however, the problem boils down to the question of selecting a method which has to be systematic and rational⁷.

An interim report on an AICPA accounting research study on depreciation by Charles W. Lamden⁸, reported that the focus of much of the dissatisfaction is on the variety of cost allocation methods admissible under generally accepted accounting

principles. The only requirement is that the allocation method be 'systematic and rational'.

There is a wide variety of depreciation method in use and all these methods are based upon certain implicit assumptions though they all seek to distribute the cost of the asset over its useful life. These methods can be classified under the following groups⁹ :

i) Constant Charge Method

This method is based on the assumption that depreciation is a function of time and the service potential which is assumed to decline by an equal amount in each period. Straight line method falls under this category.

ii) Variable Charge Method

It is based on the assumption that depreciation is a variable charge rather than a fixed cost. Under this method, it is assumed that the value of an asset declines as a function of use rather than through the passage of time¹⁰. Usage method e.g. service-hours method, output method fall under this group.

iii) Declining Charge Method

Depreciation under this method assumes that the amount of service potential of an asset declines each year. This method is called accelerated method of depreciation¹¹. Here the pattern of allocation of cost is such that higher amount of depreciation is charged in the initial years and lower amount of depreciation in the later years. This is based on the assumption that there is larger cash inflows in the earlier years than it is in later years. Higher depreciation in the initial years has a plus point in it. Since it acts as a greater tax shield. Diminishing balance method, sum-of-years'-digits method, double declining balance method are all fall under this category.

iv) Increasing Charge Method

This method is based on present value of future cash flow taking into account the time value of money¹². This method is characterised by the compound interest on

the investment of the amount charged for depreciation for ensuring cash flow to meet the replacement cost of the asset. Another assumption under this method is the maintenance of capital. Annuity method, sinking fund method are included under this group.

v) Miscellaneous Method

This method comprises those which do not fall within the ambit of the above stated categories. It depends on arbitrary methods of allocation or any combination of time or use basis. Group or composite method, replacement method, revaluation method are included in this group.

Charles W. Lamden¹³ indicated that the systematic and rational criteria might have allowed a wide variety of methods. In practice, however, four basic approaches have been followed :

- i) Straight – line apportionment overtime, that is a uniform amount of amortised cost for each period in the estimated life of the property unit.
- ii) Reducing charge methods which produce decreasing amount of amortised cost over the life of the property unit.
- iii) Production and revenue methods which amounts of amortised cost that vary directly with the volume of production or the amount of revenue.
- iv) Compound interest methods which produce increasing amounts of amortised cost over the life of the property unit.

Accountants' Encyclopaedia¹⁴ classified depreciation method under the following categories :

1. Methods producing a uniform charge in each final year
 - a) Straight line method
 - b) Annuity method
2. Methods producing a decreasing charge in each fiscal year (accelerated methods)
 - a) Fixed percentage on declining balance – scientific methods

- b) Fixed percentage on declining balance – unscientific method (Income tax method)
- c) Sum-of-years'-digits method or Reducing fraction method

3. Methods producing a fluctuating charge in each fiscal year viz.

- a) Unit or production method
- b) Working hours method
- c) Inventory or Revolution Method

4. Method producing on increasing charge each fiscal year

- a) Sinking fund method

Grant and Norton classified the depreciation accounting method other than straight line method in the following categories :¹⁵

1. Consistent methods based on time

(a) Methods giving smaller writes-off than straight line in early years of life.

- (i) Sinking fund or present worth method
- (ii) Retirement method
- (iii) Replacement method

(b) Methods giving larger write-off than straight line in early years of life.

- (i) Declining balance method
- (ii) Sum-of-years' digits method
- (iii) Multiple straight-line method

2. Consistent methods based on use

- (a) Production method
- (b) Combination of the production and straight line method

3. Irregular methods

- (a) Retirement reserve method

- (b) Arbitrary write-offs determined annually by management
- (c) Per cent of revenue methods
- (d) Periodic appraisals.

Thus in the accounting literature several methods of allocation of cost (depreciation) have been suggested. In actual practice however, the following methods are in use¹⁶.

1. Straight line method
2. Usage method
 - a) Output method
 - b) Working-hours method
 - c) Mileage method
3. Decreasing charge method
 - a) Diminishing balance method
 - b) Double declining balance method
 - c) Sum-of-the-years'-digits method
4. Interest methods
 - a) Annuity method
 - b) Sinking fund method
5. Other methods
 - a) Revaluation method
 - b) Group or composite method
 - c) Discounted cash flow method
 - d) Replacement method.

Some of the well known methods of depreciation accounting are briefly explained in the discussion that follows :

STRAIGHT LINE METHOD

Under this method, an equal amount is provided each year for depreciation of each asset until the asset has been written down to nil or its scrap value at the end of the estimated life of the asset¹⁷. The name of this method is derived from the fact if the successive annual depreciation over the life of the asset are plotted on a graph, the result will be a straight line with a slope equal to the annual depreciation. This method is also called 'Fixed Installment Method' because a uniform amount of depreciation is charge each year¹⁸. The formula of the annual depreciation under the method is :

$$D = \frac{C - S}{n}$$

Where,

D = Annual depreciation.

C = Cost of the asset

S = Salvage or scrap value

n = Estimated life of years.

This method can be recommended only when the following conditions are satisfied.

- a) The asset is expected to render an uniform service through out its estimated useful hfe¹⁹.
- b) Annual repairs and maintenance costs are assumed to remain constant over its life²⁰.
- c) The asset is expected to earn an equal amount of revenue each year throughout its life.
- d) The amount of depreciation is a function of time only.

Repair Cost²¹

To mulify, the higher shut down and repair costs in the later part of the asset's life, a partial rectification of this method is possible by estimating the total amount of repair cost over the life of the asset. The depreciation and repairs are accounted for as a unit. The annual cost would then be :

$$\frac{\text{Cost} - \text{Estimated salvage value} + \text{Repair cost}}{\text{Estimated Life in Years.}}$$

Merits

There are several merits of the method

- a) This method is not only simple to understand but also easy to calculate.
- b) The book value of an asset can be fully written off.
- c) The life of the certain assets sometimes depend on contracts like leasehold property, patents, trade marks etc. In such case this method is very much appropriate.
- d) Effective life of an assets, scrap value, repairs and maintenance cost, rate of interest etc. cannot be measured with certainty. So, no single method can weight all the factors at a time with equal importance for fixing the amount of depreciation. From this view point, this method appears most reasonable as some favourable impact of some factors are offset by unfavourable effects of others.

Demerits

As against the advantages enumerated above, the straight-line method has some disadvantages also. Some of the disadvantages are :

- a) This method does not take into account the interest on capital invested on the assets²².
- b) Under this method the amount of depreciation can never be equal to the value of services rendered from the asset. An asset is expected to render

more effective services during earlier period than later period of its useful life as it's efficiency decreases over times.

- c) The charge for depreciation remains constant year to year but the repair and maintenance expenses may go up with the asset growing older and older.
- d) The recovery of 'Real Capital' is not possible under this method as the amount of depreciation remains the same year after year. Only the historical cost is recovered.
- e) This methods ignores the time value of money²³ and inflation factor.

DIMINISHING BALANCE METHOD

In this method, depreciation is charged at a fixed percentage each year to the net asset balance (i.e. cost less accumulated depreciation). The depreciation charges is higher at the early stages than the later stages i.e. the amount of depreciation decreases gradually although the depreciation rate is fixed. This method is also known as 'Declining Balance Method', 'Written Down Value Method'²⁴ etc.

Formula

Let,

C = Original cost of the asset.

D = Depreciable value i.e. total depreciation during the service life of asset.

S = Scrap value or residual value ($S = C - D$).

n = Estimated life of the asset.

r = Rate of depreciation in decimal term

V = Book value (i.e. cost less depreciation) (i.e. $V_1, V_2, V_3 \dots V_n$ be respectively, the book value at the end of the period 1, 2, 3.....n)

$d_1, d_2, d_3 \dots d_n$ be respectively the amount of depreciation at the end of period 1, 2, 3,n

Thus in the first year

$$d_1 = C \cdot r \quad \dots\dots\dots(1)$$

$$V_1 = C - d_1 \quad \dots\dots\dots(2)$$

From (1) & (2) we get,

$$V_1 = C - C \cdot r$$

$$\text{or, } V_1 = C (1 - r) \quad \dots\dots\dots(3)$$

In the second year,

$$d_2 = V_1 \cdot r \quad \dots\dots\dots(4)$$

From (3) & (4) we get,

$$d_2 = C (1 - r) \cdot r$$

$$\text{or, } d_2 = C \cdot r (1 - r) \quad \dots\dots\dots(5)$$

$$\text{And, } V_2 = V_1 - d_2 \quad \dots\dots\dots(6)$$

From (3), (5) and (6) we get,

$$V_2 = C (1 - r) - C r (1 - r)$$

$$\text{or, } V_2 = C (1 - r) (1 - r)$$

$$\text{or, } V_2 = C (1 - r)^2 \quad \dots\dots\dots(7)$$

In the third year,

$$d_3 = V_2 \cdot r \quad \dots\dots\dots(8)$$

From (7) and (8) we get,

$$d_3 = C (1 - r)^2 \cdot r$$

$$\text{or, } d_3 = C r ((1 - r)^2) \quad \dots\dots\dots(9)$$

$$\text{And, } V_3 = V_2 - d_3 \quad \dots\dots\dots(10)$$

From (7), (9) and (10) we get,

$$V_3 = C(1 - r)^2 - dr(1 - r)^2$$

$$\text{Or, } V_3 = C(1 - r)^2(1 - r)$$

$$\text{Or, } V_3 = C(1 - r)^3 \quad \dots\dots\dots(11)$$

If we follow the equation no. (1), (5) and (9) we can easily determine d_4 , d_5 and so on
i.e.

$$d_1 = Cr.$$

$$d_2 = Cr(1 - r)$$

$$d_3 = Cr(1 - r)^2$$

$$d_4 = Cr(1 - r)^3$$

.....

$$d_n = Cr(1 - r)^{n-1}$$

Similarly, if we follow the equation no.(3) (7) and (11) we can easily determine the
value of V_4 , V_5 and soon i.e.

$$V_1 = C(1 - r)$$

$$V_2 = C(1 - r)^2$$

$$V_3 = C(1 - r)^3$$

$$V_4 = C(1 - r)^4$$

.....

$$V_n = C(1 - r)^n$$

It appears from the above, both depreciation and the book value of the asset are
reducing at a constant rate.

$$d_n = Cr(1 - r)^{n-1}$$

$$\text{and } V_n = C(1 - r)^n$$

In general terms,

$$\text{and } d_t = Cr (1 - r)^{t-1}$$

$$\text{and } V_t = C (1 - r)^t$$

Where t ranging from 0 to n

Adding periodic depreciation we get

$$D = d_1 + d_2 + d_3 + \dots + d_n \quad \dots\dots\dots(12)$$

By substituting the value d_1, d_2, d_3 etc.

$$D = Cr + Cr (1-r) + Cr (1 - r)^2 + \dots + Cr. (1 - r)^{n-1} \quad \dots\dots\dots(13)$$

Multiplying both side of the equation by $(1 - r)$, we get

$$D (1 - r) = Cr (1 - r) + Cr (1 - r)^3 + \dots + Cr (1 - r)^n \quad \dots\dots\dots(14)$$

Subtracting (13) from (14), we get

$$-Dr = -Cr + Cr(1 - r)^n$$

Dividing both side by '-r'

$$D = C - C (1 - r)^n$$

$$\text{or, } D = C [1 - (1 - r)^n]$$

$$\text{or, } \frac{D}{C} = 1 - (1 - r)^n$$

$$\text{or, } (1 - r)^n = 1 - \frac{D}{C}$$

$$\text{or, } 1 - r = \sqrt[n]{1 - \frac{D}{C}}$$

$$\text{or, } 1 - r = \sqrt[n]{\frac{(C - D)}{C}}$$

$$\text{or, } 1 - r = \sqrt[n]{\frac{S}{C}} \quad (\text{As, } S = C - D)$$

$$\text{or, } r = 1 - \sqrt[n]{\frac{S}{C}} \quad \dots\dots\dots(15)$$

To find out the value of d_1, d_2, d_3 etc. directly, we have already shown in terms of general equation i.e.

$$d_t = Cr (1 - r)^{t-1}$$

Where t = Estimated life of the asset which is ranging from 0 to n

It may be written either as $d_t = [r (1 - r)^{t-1}] \cdot C$

Thus instead of applying a fixed rate on the diminishing balances of the asset, it is also possible to compute depreciation by applying fluctuating rates on the original cost of the asset.²⁵

Diminishing balance method is characterised generally by predetermined fixed rate say 20%, 15% or 10% on the diminishing balance to charged depreciation in each year. But the same result may be obtained under this method by charging depreciation on variable rate on the initial cost of asset. What is needed for the purpose is some mathematical adjustment.

It is observed from the above that a negative acceleration²⁶ is achieved under diminishing balance method.

Merits :

The diminishing balance method of depreciation has some advantages. These are mentioned below :

- a) Under this method, depreciation is calculated according to the service yielding capacity of the asset. As amount of depreciation decreases gradually with the decrease in service potential of asset.
- b) This method can be proved very helpful in adopting the better matching of revenue and expenses as in the first few years depreciation being heavy and repairs light and in the last few years repairs being heavy and depreciation light. The combination of depreciation with the cost of

repairs and maintenance is resulted more or less even charge against revenue over the whole life time of the asset.

- c) There is no danger that asset will be over-depreciated since no matter how high the rate of depreciation is taken (less than 100%) there is always something left in the relative ledger account to which the rate would be applied in the next year.²⁷
- d) This method is consistent with the principle that book value of an asset should be considered equal to the present value of its remaining service potentials because asset value decrease at higher rate in the earlier parts than in the later parts of the life.

Demerits :

There are certain objections to the use of this method. The main objections are as follows :

- a) There is no certainty that the service yielding ability of depreciable assets will always reduce by a constant rate.
- b) This method puts too much emphasis on the historical cost. Proper emphasis is not given on the recovery of capital invested on the asset. Similarly interest on capital invested is also ignored here.
- c) The use of this method mitigates against accurate costing. It has been observed in practice that sometimes the assets can earn more or less the same amount of revenue for a long period of time. In that case, different amount are charged for the use of same assets in different periods cannot be justified.
- d) This method does not give acceptable depreciation charges in either practice or theory where disposal costs of an asset are taken into account for purposes of determining the periodic rate.²⁸

- e) If the salvage value is relatively small the methods demands a very high rate of depreciation per annum. Again if the salvage value of the asset becomes zero or negative in that case, the formula has no applicability.
- f) This method requires a good deal of mathematical calculation.

SUM-OF-THE-YEARS'-DIGITS METHOD

This is another accelerated depreciation method which was introduced by the US Internal Revenue Code of 1954²⁹. Under this method the cost less salvage value is charged to different years in the ratio of capital blocked in the asset in the year concerned to the total blockage over its life. This method assumes that depreciation of the first year should be the highest as no portion of the capital has been recovered till then and the depreciation of the last year should be the least of all years because a major portion of the invested capital has been already recovered.

Since depreciation is measured according to the volume of blocked investment, its magnitude is expressed by means of a fraction. The denominator of the fraction, which remains constant is the total of the digits representing the useful life of the asset. The numerator, on the other hand, measuring the blockage of capital in the reverse weighted digits of each year.

Formula³⁰

Let,

D_t = Depreciation in period t

C = Cost of the asset

S = Estimated salvage value of the asset

n = Estimated life of the asset in years

t = The year of life of the asset (i.e. 1 is the first year, 2 is the second year and so on)

$$\sum_{i=1}^n Y_i = \text{The sum of the digits from 1 to n} = \frac{n(1+n)}{2}$$

The formula for measuring depreciation for a particular year is :

$$D_t = (C - S) \times \frac{n+1-t}{\sum_{i=1}^n Y_i}$$

Merits :

The merits of the method are as follows :

- a) In this method, the quantum of depreciation is greater in the earlier years in comparison with the later years because the benefits received from the use of the asset are greater in the early years than in the later years.
- b) In the earlier year repairs are light but depreciation is heavy but in the later year, as the asset gets older the repairs are heavy but depreciation is light. So depreciation plus repairs will more or less constant every year and the charge to Profit and Loss Account should be uniform.
- c) If the asset is retired earlier than anticipated as result of unforeseen obsolescence, the loss upon retirement will be less than if straight line depreciation were used, because, asset are recovered at a higher rate in the earlier years where as only a small fraction remains left for recovering them in the later years.
- d) For tax accounting purposes, these methods have a clear advantage over the straight line method. The larger deductions in the early years mean that at the very least tax payments are postponed for a considerable period. On the other hand, this method gives a tax postponement with the greatest present value.
- e) In this method nearly three-fourth of total depreciation is charged within half of its life. That means three-fourth of blocked investment recovered within short span.
- f) This method is very simple to understand and simple to calculate.

- g) This method is preferable for assets with services lives of eight years or more.

Demerits :

Although this method is considered to be a great innovation in the field of depreciation accounting but it has some disadvantages which are given below :

- a) This method also ignored the cost of capital on invested fund.
- b) In the earlier year greater depreciation is charged at a result less profit is available for declaring dividend in the earlier year. This may created serious problem for organisation to attract new investor. As dividend is one of the motivating factors for investment. Again more depreciation in the earlier year may resultant the high cost of production in the competitive market.

DOUBLE DECLINING BALANCE METHOD

In the USA the Internal Revenue Code of 1954³¹ permitted the tax payers who were using a declining balance method to charge depreciation for tax purpose a maximum of double the rate allowed under straight line method. This method of calculating depreciation was called double declining balance method. This method may be identified as a combination of straight line and diminishing balance method. Like diminishing balance method here the depreciation is charged on the opening written down value of the fixed asset. Like straight line method a fixed rate of depreciation is charged in this method. But the rate used is twice the straight line rate.

It is important to mention here that under this method an over depreciated cost of the asset at the end of the life of asset than its anticipated salvage value. In that case there may be two options to deal with the problem. Depreciation charge for the last year may be adjusted to make salvage value equal to its anticipated salvage value. Alternatively, in the last year the firm may opt out for straight line depreciation for written off the over depreciated salvage value. Again, under most circumstances, the entire depreciation would not be allocated during the life of the asset i.e. the amount

of the asset would exceed the salvage value. So that at a point some where near the mid point of the life of the asset, a change is made to the straight line method. If salvage value is zero and the life is an odd digit, the years of change will be $n/2 + 1\frac{1}{2}$; if the life is a even digit, the year of change will be $n/2 + 2$. If the salvage is greater than zero, the year of change will be later than this.³²

Merits :

The advantages of this method are as follows;

- a) In the earlier year more depreciation is charged than later years, so by adopting this method a firm can save tax by lowering its tax liability.
- b) In the initial year high depreciation accompanied with low repairs and maintenance cost and in the later part of asset's life low depreciation accompanied with high repairs and maintenance cost will be tend to make a uniform equitable year after year during the asset's life.
- c) A firm will generate more interest if it invest the depreciation outside the firm. It helps to create more fund at the time of replacement of asset.
- d) The firm will face minimum loss at the time of disposal of asset due to innovation as a large part has already changed to profit and loss account by way of depreciation.

Demerits

Every methods has its own limitation. The main objections against adopting the method are as follows :

- a) This method shows lower profit in the earlier year as high depreciation is charged. It will depict poor performance in the initial year.
- b) The investors are unhappy as they get low dividend in the earlier year for generating lower profit by the firm.
- c) Though it is popular among tax payer but sometimes they face high cost of production due to higher depreciation.

- d) Under this method the asset value can never be reduced to zero.

SINKING FUND METHOD

Under this method, depreciation is a provision by charging out of revenue for replacement of an asset and a means of maintaining capital. This method is based on the assumption that a fund is to be built up and that the amount of this fund should equal the total amount of the depreciation at the end of the useful life of the depreciable asset. An equal amount by way of depreciation is set aside by charging to the profit and Loss Account at the end of every accounting period, so that, all such equal installments if allowed to accumulate at a compound interest³³ would equal to the depreciable cost of the asset at the expiry of its useful life. Under all other methods of depreciation liquid cash may not be available to the firm at the time of replacement of asset because in those cases the amount of depreciation is retained in the business. In this method annual equal installment set off as depreciation is regularly invested outside the business in interest bearing easily marketable securities. Interest yielded on such securities is compounded or reinvested in each year. When the life of the asset expires, investments are disposed off and the proceeds are utilised for replacing the old asset. This method is also known as 'Depreciation Fund Method' or 'Redemption Fund Method'.³⁴

Formula :

Let,

d = Sinking Fund Depreciation.

C = Cost of the asset.

S = Salvage value

i = Rate of interest in decimal term

n = Years

Let it be assumed that the salvage value equal to zero. The accumulated amounts should then be equal to the cost of the existing asset. The accumulated amount can be obtained from the following :

$$C = d (1+i)^{n-1} + d (1+i)^{n-2} + d (1+i)^{n-3} + \dots + d (1+i)^{n-(n-1)} + d (1+i)^{n-n}$$

$$\text{or, } C = d (1+i)^{n-1} + d (1+i)^{n-2} + d (1+i)^{n-3} + \dots + d (1+i) + d \dots \dots \dots (1)$$

Multiplying both side of the equation by (1+i)

$$C (1+i) = d (1+i)^n + d (1+i)^{n-1} + d (1+i)^{n-2} + \dots + d (1+i)^2 + d (1+i) \dots \dots \dots (2)$$

Subtracting equation (1) from equation (2), we get,

$$C.i = d (1+i)^n - d$$

$$\text{or, } C.i = d [(1+i)^n - 1]$$

$$\text{or, } d = \frac{C.i}{(1+i)^n - 1} \dots \dots \dots (3)$$

Merits :

The main advantages of this method are as follows :

- a) Under this method, at the end of the specified time, a definite sum is available in cash to replace the old asset.
- b) Since the amount is invested outside the business there is no need to drawn money from the business for replacement purpose at the end of the life of the asset. This helps to avoid pressure on working capital.

Demerits

There are some weaknesses of this method and these are as follows :

- a) From the management view point the method is inefficient. Generally the internal rate of return of the firm is higher than the return on investment. As a result this causes substantial loss to the firm.
- b) There is always a risk factor about the loss on realisation of investments. That means if the market price of the investment in which depreciation is

invested fluctuate in that case the amount realised may be less than cost of the asset.

- c) The firm may face the difficulty of finding suitable investments which provide the desired rate of return per annum.
- d) It is difficult to estimate the exact working life of the asset which will be replaced.
- e) The effect of price level change is not considered at all. Since the amount of available fund at the end of the asset does not exceed the historical cost of the asset, the claim that fund invested outside the business will effectively replace the asset, remains doubtful.
- f) Under this method, the amount of depreciation charge does not bear any relation to the intensity of the use of the asset.
- g) This method does not consider the salvage value of an asset, at the end of its working life. It is truly unjustified.

ANNUITY METHOD

The principle underlying this method is that in calculating depreciation regard should be held, not only to the cost of an asset but also to the interest³⁵ which the capital blocked in that asset would have earned had it been invested outside the business. So under this method, a fixed installment of depreciation is charged against revenue for each year of the life of the asset in such a way that at a given rate of interest the present value of the sum of all those installments equals to the cost of the asset. Stated otherwise, depreciation for each year is made to include an interest on unrecovered capital outlay but the interest which is credited annually to Profit and Loss Account, gradually diminishes. On the other hand, depreciation excluding interest i.e. net depreciation goes on increasing. It may also be noted that Annuity Method of depreciation recovers more than the original cost of the asset. The excess being interest on investment.

Formula

Let,

A = Annuity depreciation

C = Cost of the asset

S = Salvage value

i = Rate of interest in decimal term

n = Estimated life of the asset

It also assume that salvage value is equal to zero.

Then, the present value of A due in 1 year = $\frac{A}{(1+i)}$

the present value of A due in 2 years = $\frac{A}{(1+i)^2}$

So, the present value of A in n year = $\frac{A}{(1+i)^n}$

The sum of the present value of future annuity depreciation is to be equal to the cost of the asset.

Then, $C = \frac{A}{(1+i)} + \frac{A}{(1+i)^2} + \frac{A}{(1+i)^3} + \dots + \frac{A}{(1+i)^n}$ (1)

Multiplying both side of the equation by (1+i)

$C(1+i) = A + \frac{A}{(1+i)} + \frac{A}{(1+i)^2} + \frac{A}{(1+i)^3} + \dots + \frac{A}{(1+i)^{n-1}}$ (2)

Subtracting equation (1) from equation (2), we get,

$C.i = A - \frac{A}{(1+i)^n}$

or, $C.i = A \left[1 - \frac{1}{(1+i)^n} \right]$

$$\text{or, } C.i = A \left[\frac{(1+i)^n - 1}{(1+i)^n} \right]$$

$$\text{or, } A = \frac{C.i.(1+i)^n}{(1+i)^n - 1} \dots\dots\dots(3)$$

Merits :

A number of merits can be claimed for this method :

- a) In this method depreciation includes not only the recovery of invested capital but also the interest on capital outlay. So this is more logical and realistic than other methods.
- b) At the time of inflation, it is possible for the firm to replace the asset as total depreciation charged is more than cost of the asset.
- c) This method is most appropriate for the intangible such as leasehold rights, patents etc. In this cases depreciation varies with the passing of time rather than with the intensity of use.

Demerits

The method has some demerits and these demerits are as follows :

- a) The use of the asset or its service rendering capacity is not at all considered for measuring depreciation. The cost of waiting time rather than the cost of physical deterioration is given more importance in such a case.
- b) In this method, it is assume that the rate of interest on unrecovered capital outlay is equal to its cost of capital but in real world it is hardly happen.
- c) The scrap value of the asset is not considered which is not justified.
- d) Annual repairs and maintenance cost are assumed to remain constant throughout the life of an asset, but it is not so happen.

- e) This method creates difficulty in measuring depreciation if replacement of old asset with new asset occurs during the life of old asset.

INSURANCE POLICY METHOD

This method is similar to the sinking fund method except that instead of investing the money in securities an insurance policy³⁶ is taken to produce the amount required at the end of asset's life. Here a fixed amount is charged each year to the Profit and Loss Account, but unlike the sinking fund method, the amount is paid to the insurance company as premium at the beginning of each year. As the Insurance Company requires to be paid for the risk it undertakes and it follows that the insurance policy method is a little more expensive than the sinking fund method, but it provides a definite amount at the end of the asset's life.

Merits

The merits of this method are as follows :

- a) In this method, there is a certainty that the guaranteed amount will be received from the insurance company. There is no such risk due to fluctuation in the market price of securities.
- b) There is no need to judge the merit of different securities for investment. Fund is made by paying the premium on insurance policy.

Demerits

Some of the demerits of this method are as follows :

- a) As the insurance company takes the risk and it also makes some profit naturally the interest on insurance policy is less than the rate of interest prevailing in the market. So depreciation charge in this method becomes more expensive.
- b) If new asset is acquired during the life of the old asset this method cannot be used effectively because the contract with the insurance company cannot be changed.

DISCOUNTED CASH FLOW METHOD OF DEPRECIATION³⁷

Under this method the value of an asset is computed by discounting the future cash flows attributable to the asset. Here depreciation is a measure of change in the discounted value of the asset. This means depreciation is measured the difference between the value of the asset based on the discounted future cash flow at the beginning of the period and the discounted future cash flow at the end of the period. This method is widely used in the field of economics.

Formula

Let,

V = Present value of future cash flows

D = Periodic depreciation

R = Periodic Cash Flows (i.e. $R_1, R_2, R_3, \dots, R_n$ be respectively the cash flow at the end of the period 1, 2, 3, ..., n).

i = Rate of interest in decimal term

n = Life of the assets in years

This the value of the asset at the beginning

$$V_0 = \frac{R_1}{(1+i)} + \frac{R_2}{(1+i)^2} + \frac{R_3}{(1+i)^3} + \dots + \frac{R_n}{(1+i)^n}$$

$$\text{or, } V_0 = \sum_{j=1}^n \frac{R_j}{(1+i)^j} \dots \dots \dots (1)$$

Then, the value of the asset at the end of 1st year

$$V_1 = \frac{R_2}{(1+i)} + \frac{R_3}{(1+i)^2} + \frac{R_4}{(1+i)^3} + \dots + \frac{R_n}{(1+i)^{n-1}}$$

$$\text{or, } V_1 = \sum_{j=2}^n \frac{R_j}{(1+i)^{j-1}} \dots \dots \dots (2)$$

∴ Depreciation in year 1

$$D_1 = V_0 - V_1$$

$$\text{or, } D_1 = \sum_{j=1}^n \frac{R_j}{(1+i)^j} - \sum_{j=2}^n \frac{R_j}{(1+i)^{j-1}}$$

Similarly, depreciation in year 2

$$D_2 = V_1 - V_2$$

$$\text{or, } D_2 = \sum_{j=2}^n \frac{R_j}{(1+i)^{j-1}} - \sum_{j=3}^n \frac{R_j}{(1+i)^{j-2}}$$

And, depreciation in year 3

$$D_3 = V_2 - V_3$$

$$\text{or, } D_3 = \sum_{j=3}^n \frac{R_j}{(1+i)^{j-2}} - \sum_{j=4}^n \frac{R_j}{(1+i)^{j-3}}$$

In this way we can calculate the depreciation in respect of any period. In general term the period is denoted as D_t .

$$\therefore D_t = V_{t-1} - V_t$$

$$\text{or } D_t = \sum_{j=1}^n \frac{R_j}{(1+i)^{j-t+1}} - \sum_{j=t+1}^n \frac{R_j}{(1+i)^{j-t}}$$

$$\text{Again, } V_t = \sum_{j=t+1}^n \frac{R_j}{(1+i)^{j-t}}$$

$$\text{or, } V_t = \frac{R_{t+1}}{(1+i)} + \frac{R_{t+2}}{(1+i)^2} + \frac{R_{t+3}}{(1+i)^3} + \dots + \frac{R_n}{(1+i)^{n-t}} \quad \dots\dots\dots(3)$$

$$\text{And, } V_{t-1} = \sum_{j=t}^n \frac{R_j}{(1+i)^{j-t+1}}$$

$$\text{or, } V_{t-1} = \frac{R_t}{(1+i)} + \frac{R_{t+1}}{(1+i)^2} + \frac{R_{t+2}}{(1+i)^3} + \dots + \frac{R_n}{(1+i)^{n-t+1}} \quad \dots\dots\dots(4)$$

Multiplying both side of the equation (4) by $(1+i)$, we get,

$$V_{t-1} (1+i) = R_t + \frac{R_{t+1}}{(1+i)} + \frac{R_{t+2}}{(1+i)^2} + \dots + \frac{R_n}{(1+i)^{n-t}} \quad \dots\dots\dots(5)$$

Subtracting equation no (3) from equation (5), we get

$$V_{t-1} (1+i) - V_t = R_t$$

$$\text{or, } V_{t-1} + i.V_{t-1} - V_t = R_t$$

$$\text{or, } V_{t-1} - V_t = R_t - i.V_{t-1}$$

$$\text{or, } D_t = R_t - i.V_{t-1} \quad [\text{As, } D_t = V_{t-1} - V_t]$$

So, the new formula for getting the depreciation at 't'th period :

$$D_t = R_t - i.V_{t-1} \quad \dots\dots\dots(6)$$

Putting the value t (1, 2, 3.....n) we can easily determine the depreciation for period 1, 2, 3..... and so on.

$$D_1 = R_1 - i.V_0$$

$$D_2 = R_2 - i.V_1$$

$$D_3 = R_3 - i.V_2$$

.....

$$D_n = R_n - i.V_{n-1}$$

Merits :

The merits of this method are as follows :

- a) Under this method depreciation is based on the service potentiality of an asset. So this method is the ideal method for charging depreciation.
- b) This method is widely used in the field of economics.
- c) This method may be used effectively where the firm depends on single asset.

Demerits

Weaknesses of this method are as follows :

- a) Future cash flow may not be correctly known from previous. So this method depends on the expected cash flow.
- b) Forecasted cash flow and actual cash flow may differ, in that case this method gives some unrealistic picture of business.
- c) Cash flow of a business is a joint product of many factors. So, it is difficult to find out the separate cash flow generated by individual asset.
- d) Under this method, it is difficult to forecast the future services of the asset; to value those future services and to determine the appropriate rate (or rates) of discount.³⁸
- e) This method needs a good deal of mathematical calculation.

USE-BASE METHOD

Under this method depreciation charge is made a function of usage rather than a function of time. The basic assumption of this method is that with every unit of product the value of the asset reduces proportionately. So depreciation under this method becomes a true variable cost of the product. This method is suitable where individual output can easily be identified, the rate of usage varies from period to period and total usage of the asset over its life can be established reliably.

There are three methods based on this concept :

(i) Output method (ii) Working hours method, and (iii) Mileage method.

i) OUTPUT METHOD

Under this method depreciation charge for the year is made to vary with the number of units produced during the years. To find out depreciation, the cost less salvage value of the asset is divided by the number of units expected to be produced by the asset during its service life.

$$\text{So, Depreciation cost per unit} = \frac{\text{Cost of asset} - \text{Salvage value}}{\text{Estimated number of units}}$$

Periodic depreciation = Number of units produced during the period X Depreciation cost per unit.

ii) WORKING HOURS METHOD

This method is suitable where the life of asset is measured by its service hours rather than units produced. To find out depreciation, under this method cost of asset less salvage value is divided by the total working hours during its life.

$$\text{So, Depreciation cost per hour} = \frac{\text{Cost of asset} - \text{Salvage value}}{\text{Total working hours of the asset}}$$

Period depreciation = Number of hours worked during the period X Depreciation cost per hour.

iii) MILEAGE METHOD

This method is used in transport industries. The working life of the vehicles like asset is expressed in mileage or kilometers. Depreciation per kilometer is calculated by dividing the cost of the vehicle by the estimated running kilometers it can travel in its life time.

$$\text{So, Depreciation cost per mile / kilometer} =$$

$$\frac{\text{Cost less salvage value}}{\text{Estimated miles / kilometres run during the service life.}}$$

Periodic depreciation = Actual miles or kilometres run by the vehicle during the period X depreciation cost per mile or kilometre.

OTHER METHODS OF DEPRECIATION

DEPLETION METHOD

This method is generally applied in case of wasting assets e.g, mines, quarries and natural resources. Here the rate of production is measured by the rate of

exhaustion of the asset. Under this method the total reserve of asset is measured by an expert valuer. After that the cost per unit of reserve asset is ascertained by dividing the cost of acquisition of the asset by the total reserve of that asset. Periodic depreciation is calculated by multiplying the reserve of assets exhausted during the period by the cost per unit of reserve asset. The asset reduced to zero at ends of the total exhaustion, so the method is known as depletion method.

REVALUATION METHOD

This method is generally applied to assets like small tools, container, crockery etc. which are not material significance to the business. This method depends solely on the market value of the asset. The basic assumption of this method is that reduction in value of the asset in particular year is its depreciation. Depreciation is calculated here as the difference between the book value as at the beginning of the period and the reappraised value as obtained at the end of the period.³⁹ In any year, if closing market value exceeds the opening value of the asset, the excess amount is not taken into account.

GROUP OR COMPOSITE METHOD

This method is applied where assets having relatively lower values and keeping separate account is expensive and laborious job. Under this method, depreciation is not calculated individually on different items of asset belonging to the same group or different group of different rates, rather than a average group or composite rate of depreciation is preferred. When the asset are of same characteristic, the method is called group depreciation method and when the asset are of different characteristic the process is called composite depreciation method.³⁶ The rate of depreciation is calculated by dividing the sum of each assets annual depreciation by the cost of the entire group. For this purpose the average working life of all the assets of group is taken as the base. The disadvantages of this method are that the rate of depreciation is to be changed frequently with the addition of asset and it does not consider the intensity of use of the assets.

SELECTION OF A BEST DEPRECIATION METHOD

Charles W.Lamden⁴⁰, on his study, pointed out that 'systematic and rational' ultimately permits almost any method. Fortunately, in practice only a relatively few methods have been used. The choice among even these few methods, however, can have a significant effect on reported income. Without criteria for choosing among the alternatives, companies are almost completely unrestricted in their choice of method and they do choose different methods under apparently similar circumstances. It is also not uncommon for companies to change methods and thereby significantly change reported net income which also affects comparisons between periods.

He again asserted that neither the original choice nor subsequent changes in methods are motivated predominantly by any real effort to report underlying economic circumstances. The proponents of unrestricted choice recognise that such freedom is sometimes abused, but they deny that such abuse is typical. They contended that management most often makes a sincere effort to choose methods which best reported economic reality. To date, this controversy has not been resolved.

It is important that the method selected reflects economic reality. It is also important that the criteria for the choice be clearly understood so that the method be the same in all cases where the circumstances are the same. Most important, arbitrary shifts between methods should be eliminated.

His study also observed that the end objective is to confine variations in methods of accounting for depreciable assets to those justified by substantial differences in circumstances. Further, it could be argued that reducing the acceptable alternatives may not improve the usefulness and comparability of financial statements. There is a substantial group that feels that diversity of practices is needed if depreciation accounting is to reflect the existing diversity to economic circumstances in a truly comparable and useful way, even if a variety of practices is desirable, it does not necessarily follow that the decision to use given methods must be unrestricted. Rather, sufficient criteria should be established so that the choices among alternatives will be based on valid differences in relevant circumstances.

Depreciation is a mandatory charge. The management of a firm must select a depreciation method for income tax purposes and for financial accounting purposes. The firm needs not, however choose the same depreciation method for both income tax purposes and financial reporting purposes. In both cases, the selection is subject to constraints. For income tax purposes, the method must be one of these that are approved by Income Tax Rules. For financial accounting purposes, the method must be one that falls within the purview of generally accepted accounting principles (GAAP). Specially for Indian Company, for financial accounting purposes, the method is guided by the Companies Act 1956. So in both the cases, the selection of a suitable method is limited by law.

If the firm selects same method of depreciation both for income tax accounting purposes and for financial accounting purposes, only one set of depreciation records need to be maintained and hence the cost of the accounting process will be lower. Despite this fact, some firms select to use approved depreciation method for income tax purposes and other method for financial accounting purposes.

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