The cost of owning and operating construction machinery: -

There are several ways to find the cost of owning and operating construction machinery, but all of them do not give the real cost under different working conditions. Keeping detailed and accurate records of previously used construction machines helps a lot in using them as evidence for the machine under study, but there is no guarantee that

Similar machines will cost the same, especially if they are used in different conditions.

- There are many factors that affect the cost of owning and operating a particular machine, the most important of which is:
  1. The original cost of the machine.
  2. The working conditions under which the machine will operate.
  3. The number of operating hours per year.
  4. The number of operating years.
  5. The amount of care in maintenance and spare parts.
  6. The amount of demand for a similar used machine.

⇒ When the cost of owning and operating a particular machine is to be estimated before purchasing it and there are no previous records to benefit from it, the following factors must be taken into account:

- Depreciation
- Maintenance
- Spare parts
- Investing amounts
- The cost of lubrication and fuel required for its operation.

***To calculate the cost of owning and operating any machine, the following must be calculated:

1. Fixed cost: It is annual costs, i.e. calculated during the year, and these costs are considered fixed for any machine, the fixed annual costs include calculating the following costs:

A) The annual depreciation cost of the machine (Deprecation): depreciation means the loss of the value of the machine.

The original over time and the cost of depreciation can be expressed as a cost per unit of time or a cost per unit of production of the machine, and the annual depreciation of any machine can be calculated by the following law:

Annual depreciation = (original cost of the machine − recovery cost) / useful life of the machine

2. The original cost of the machine: - It includes its original price from the factory, in addition to the cost of loading, transporting, unloading, and installing the machine if necessary.

* Recoverable cost of the machine: It means the price at which the machine is sold after the expiry of its useful life.

* The useful life of the machine: It refers to the age during which the machine operates without the occurrence of major malfunctions.

B) The cost of maintenance and repair: The cost of maintaining and repairing any machine depends on (its type, the nature of its work, and the quality and amount of care for it during its working period). If any machine is given the necessary care according to the instructions of the producing company, then there is no doubt that this will reduce the cost of the annual maintenance and repair of that machine, and the annual cost of maintaining and repairing a

particular machine is estimated as a percentage of the annual depreciation value:

Maintenance and repair cost = (80 - 120)% * annual depreciation

****It is often taken (100%), in other words:

⇒ Maintenance and repair cost = annual depreciation cost.

- A- Investment cost: Owning any machine costs certain expenses, regardless of whether that machine is used or not, and includes bank interest, as well as the cost of insurance, taxes, and storage costs. All these costs and expenses are called investment, which change from one machine to another.
- The investment cost of any machine is calculated as a percentage of the average value of the machine. In other words:

  Investment cost = (10 - 12)% * average value of the machine

  The average value of the machine can be calculated from the following equation:

$$\acute{P} = \frac{P\,(n+1)}{2n}$$ ← عندما تكون القيمة الاستردادية تساوي (صفر)

$$\acute{P} = \frac{P\,(n+1)+s(n-1)}{2n}$$ ← عندما تكون هناك قيمة الاستردادية

where :

Ṕ: the rate of the machine value.

P: the original value of the machine.

n: useful life of the machine in years.

s: the recovery value of the machine.

2- Non-fixed cost: It is a cost that is calculated in hours, i.e. during the hour, and includes operating costs. Internal combustion construction machines need fuel for operation, as well as oil for lubrication. The value of these two paragraphs is considered the operating cost. The amount spent by one machine and the unit value of fuel

A- The spent fuel cost: It is the amount of fuel consumed by the machine during its use for an hour. The cost of spent fuel = the amount of fuel consumed * the price of one liter

The amount of fuel consumed per hour can be calculated through the following relationship:

The amount of fuel consumed = the horsepower of the engine of the machine * the operating coefficient of the machine * a special coefficient

For the private operator:

(0.15) if the engine of the machine is diesel.

(0.23) if the engine of the machine is petrol.

Note: The horsepower and operating factor of the machine are mentioned in the machine catalog.

B- The cost of lubricating oil for the engine of the machine: It is the amount of oil consumed by the machine within an hour of its operation. The amount of lubricating oil for any machine depends on:

1. The size of the engine
2. The capacity of the engine compartment

3. The condition of the pistons
4. The number of operating hours.

The cost of motor oil = the amount of oil consumed per hour* the price of one liter

The amount of oil consumed per hour can be calculated from the following equation:

$$g = \frac{c}{t} + \frac{0.0027 * F * hp}{0.89}$$

g: the amount of oil consumed per hour.

C: machine capacity in liters.

t: the number of hours between one oil change and another.

hp: (horse power)

F:(operation factor).

Note: Sometimes the wages of the workers (the machine operator and the rest of the staff of the machine from the maintenance officer and others) are given here. The wages here must be added and calculated within the cost of owning and operating the machine.

**The cost of owning and operating the machine = annual costs + hourly costs

Note: The cost of owning and operating the machine at any time is calculated in other words per year. By the month or by the hour?

The special and applicable context is calculating the cost of owning and operating a truck per hour. If all the calculated costs must be converted to the hour, and the

annual costs are converted to hourly costs by dividing them by the number of operating hours per year, which are given.

Example: Find the expected cost of owning and operating (15) m^3 tracked mechanical shovel if you know:

The diesel engine has a capacity of 160 hp. Engine sump capacity = 2271 liters Number of hours between an oil change and another = 100 hours. Operating coefficient = 60% The useful life of the machine is 6 years. The number of operating hours per year = 2000 hours. The value of the machine in the factory = is 82,260 dollars. Machine shipping fees = 2448 dollars. Unloading and installation fees = 220 dollars. The price of one liter of fuel = is $0.053. The price of one liter of oil is $0.32.

Solution: First we calculate the total cost of the machine

The total cost of the machine = the value of the machine in the factory + the unloading and installation fees + the shipping fees

= 82260 + 220 + 2448 = 84928 dollars.

Cost of owning and operating a shovel = annual fixed costs + hourly costs

*Fixed annual costs: they include

1- Annual depreciation of shovel = (84928-0)/6 = 14154.67$/yr

2- The cost of maintenance and repair = 100% x annual depreciation (100% is imposed if it is not given in the question)= 14,154.67 $/year.

3- Annual investment = 12% x average value of the machine (12% is imposed in case it was not given in the question

$\acute{P} = P(n+1)/ 2n.$

$$\acute{P} = \frac{84928\ (6+1)}{2*6} = 49541.33\$$$

For annual investment = 0.12 * 49541.33 = 5945$/year

Total annual fixed costs = 14154.67 + 14154.67 + 5945 = 34254.24 $ / year

Fixed annual costs calculated in hours = 34254.24 = 17.13$/hour.

Unfixed costs in hours

1- The spent fuel cost = the horsepower of the engine of the machine x the operating coefficient of the machine x a special coefficient × price per liter

= 160 x 0.6 x 0.15 x 0.053 = 0.7632 dollars / hour

2- The cost of spent oil = the amount of oil consumed per hour x the price of one liter

g =(c /t + 0.0027$*F*$hp/ 0.89)* 0.32= {22.71/100 + (0.0027*0.6* 160)/0.8}*0.32= 0.166 $ / hr.

Hourly cost of owning and operating a shovel = Total hourly costs= 17.13 + 0.7632 + 0.166 = $18.06/hour

Department of Building and Construction.

Material: estimation, specifications and contracts

Class: 4 th