# CONSTRUCTION & EARTH MOVING EQUIPMENTS

## A-PLANNING & SELECTION OF CONSTUCTION EQUIPMENTS

**Construction equipment planning** aims at identifying **construction equipment** for executing project tasks, assessing **equipment** performance capability, forecasting date wise requirement of number and type of **equipment** and finally participating in the **selection** of **equipment** to be acquired.

## B-EARTH MOVING EQUIPMENTS

### 1. DRAGLINE

The basic character of the machine is dragging the bucket against the material to be dug. **Dragline** is used to excavate the earth and load it into hauling units such as trucks or tractor pulled wagons or to deposit it into dams/ embankments or spoil banks near the pit from which it is excavated.

### 2. TRACTOR

The durability and engine power of tractors made them very suitable for engineering tasks. Tractors can be fitted with engineering tools such as dozer blades, buckets, hoes, rippers, etc. The most common attachments for the front of a tractor are dozer blades or buckets. When attached to engineering tools, the tractor is called an engineering vehicle.

### 3. BULLDOZER

A bulldozer is a track-type tractor with a blade attached in the front and a rope-winch behind. Bulldozers are very powerful tractors and have excellent ground-hold, as their main tasks are to push or drag.

Bulldozers have been further modified over time to evolve into new machines which are capable of working in ways that the original bulldozer can not. One example is that loader tractors were created by removing the blade and substituting a large volume bucket and hydraulic arms which can raise and lower the bucket, thus making it useful for scooping up earth, rock and similar loose material to load it into trucks.

### 4. POWER SHOVEL

**Power shovel** is **construction** equipment whose value is to excavate the earth and load it into the trucks or other hauling equipment waiting nearby. They are capable of excavating all classes of earth, except the solid rock without prior loosening.

## C-USES OF COMPACTING EQUIPMENTS

### 1-TAMPING ROLLERS

A self-propelled or towed drum-like **roller** with projecting studs that penetrate the surface of the ground; used to obtain deep compaction of fill material

### 2-SMOOTH WHEEL ROLLER

**Smooth wheel rollers** are most suitable for consolidating stone soling, gravel, sand, hard core, ballast and surface dressings. Not suitable for consolidating embankments and **soft** sub-grades, but are better suited than any other plant for compacting silty and sandy soils and with fewer passes

### 3-PNEUMATIC TIRED ROLLERS

**Pneumatic tired roller** has a number of rubber **tires** at the front and at the rear end. **Pneumatic tired roller** can be used for highways, **construction** of dams and for both fine grained and non-cohesive soils. It is also used for smoothening of finishing bitumen layer on highways, roads, streets etc

### 4-VIBRATING COMPACTORS

The roller type **compactors** are used for compacting crushed rock as the base layer underneath concrete or stone foundations or slabs. ... Road **rollers** may also have **vibrating rollers**. In plates and **rollers** the **vibration** is provided by rapidly rotating eccentric masses.

## COST OF OWNING AND OPERATING CONSTRUCTION EQUIPMENT

1. Factors affecting the cost include:

- Cost of equipment delivered to the owner.
- The severity of the conditions under which it is used.
- The care with which it is maintained and repaired.
- The number of hours used.
- The demand for used equipment (salvage value = SV)

2. Estimate Cots: includes

a) Depreciation Costs.
b) Maintenance & Repair.
c) Investment cost

## a- Depreciation Costs:

Depreciation is the loss in value of equipment resulting from use or age (useful life). Assume a unit of equipment will decrease in value from its original total cost at a uniform rate. There are 3 three methods for influential the cost of depreciation.

i. Straight Line Method.
ii. Declining – Balance Method.
iii. Sum of the Years Digit Method.

For example:

| | |
|---|---|
| Original cost | $12,000 |
| Useful life per year "working due " | 2,000 hr / yr |
| Salvage Value after 5 yrs. | $2,0000 |

### 1-straight line method :

Total dep. = original cost – salvage value

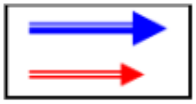
→ **12000 – 2000 = $ 10,000**

Annual dep. Cost = $ 10,000 / 5 yrs. = 2000 $/ yr.
Hourly dep. Cost = $ 2,000 / 2000 hr =$ 1 / hr

Widely used method.

## 2- Declining – Balance Method.

| end of year | %. Depreciation | Dep. For current yaer | $ Book Vlue |
|---|---|---|---|
| 0 | 0% | $0.00 | **$12,000.00** |
| 1 | 40% | $4,800.00 | $7,200.00 |
| 2 | 40% | $2,880.00 | $4,320.00 |
| 3 | 40% | $1,728.00 | $2,592.00 |
| 4 | 40% | $1,036.80 | $1,555.20 |
| 5 | 40% | $622.08 | $933.12 |
| | | | **2000** |



Blue for multiplication arithmetic
RED for subtraction arithmetic

As we see the final salvage value at end of 5th. Yr. doesn't match the expected or what must it be.

So this method is not recommended.

# 3-Sum of the Years Digit Method.

| End of year | % Depreciation | $ Total Dep. | Dep. For current year | Book Value $ |
|---|---|---|---|---|
| 0 | 0 | 10000.00 | 0.00 | 12000.00 |
| 1 | 0.33333 | 10000.00 | 3333.33 | 8666.67 |
| 2 | 0.26667 | 10000.00 | 2666.67 | 6000.00 |
| 3 | 0.2 | 10000.00 | 2000.00 | 4000.00 |
| 4 | 0.13333 | 10000.00 | 1333.33 | 2666.67 |
| 5 | 0.06667 | 0.00 | 666.67 | 2000.00 |

∑15

First we sum end of year digits, in the above example they sum to {15}, then we predict the depreciation via dividing in reverse way, in other words every year takes its due of depreciation that the first of the five years would come 5/15 and so do

Depreciation % = Dep. factor

| | 1 | 2 | 3 | 4 | 5 | ∑15 |
|---|---|---|---|---|---|---|
| Dep. factor | 5/15 | 4/15 | 3/15 | 2/15 | 1/15 | |

## b– Maintenance & Repair.

→ Vary with the type , the service and the care.
→ Expressed as a % of annual cost of depreciation
→ Experience records serve as a guide in estimating these costs.

## c– Investment cost.

Includes interest on the money invested, taxes of all types , insurance and storage as a % of ~ 15-25%.

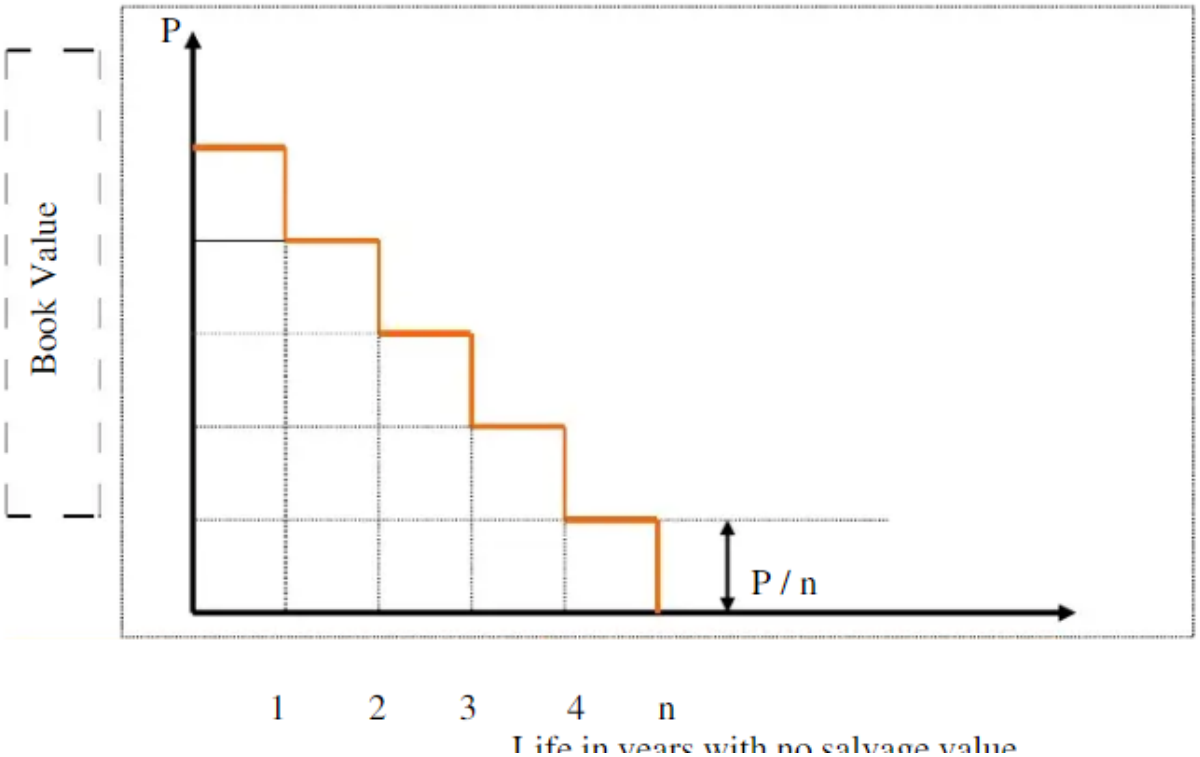
For example:

| | |
|---|---|
| Original cost | $ 25 , 000 |
| Useful life = age of equipment till being garbage | 5 yrs. |
| Salvage value after 5 yrs. | $ 0 |

| Beginning of Year | Cumulative depreciation. $ | Value of Equipment |
|---|---|---|
| 1 | 0 | 25,000 |
| 2 | 5,000 | 20,000 |
| 3 | 10,000 | 15,000 |
| 4 | 15,000 | 10,000 |
| 5 | 20,000 | 5,000 |
| 6 | 25,000 | 0 |

Total values of equipment = $ 75,000
Average value = 75,000 / 5 =$ 15,000
Average value as a % of original cost = (15,000)x1000 /25,000 = 60 %

WITHOUT SALVAGE VALUE



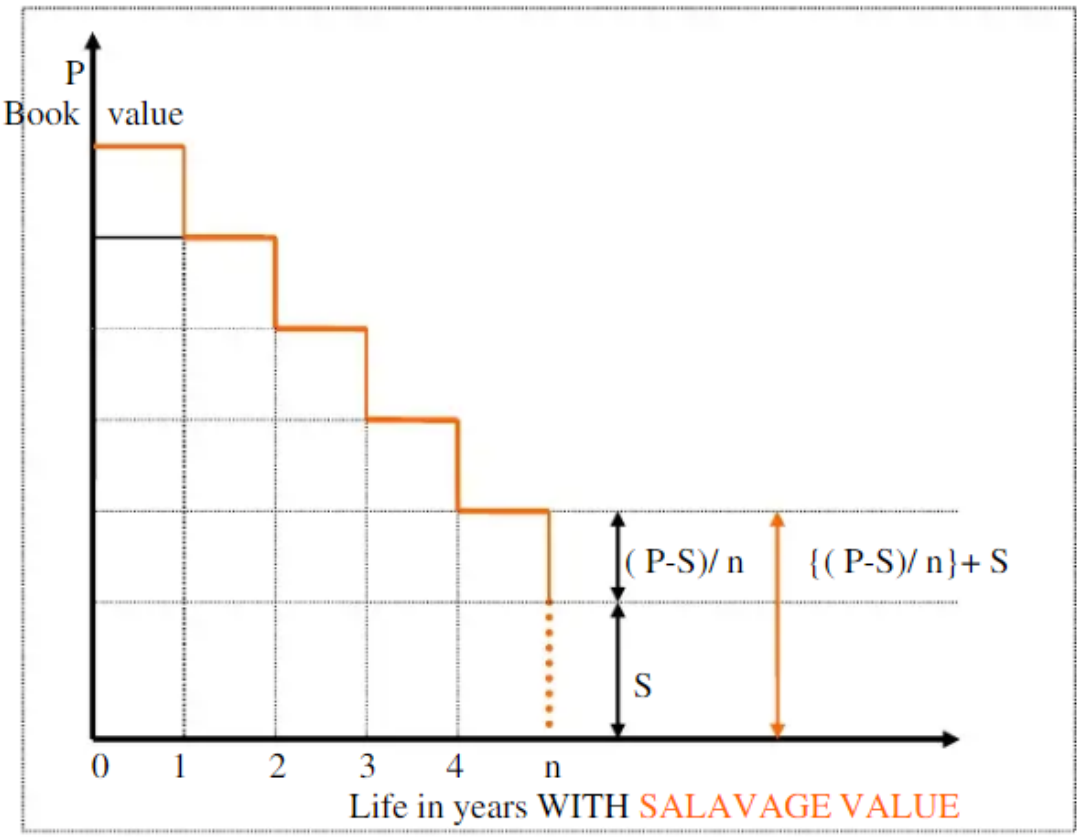

AVERAGE VALUE ( $P_{av.}$ )

$P_{av.} = P\,(n+1) / 2n$

Annual investment cost

Inv. Costs = $P_{av.}$ X inv. Rate (%)

SALVAGE VALUE CONSIDERED :




→ $P_{av.} = \{P(n+1) + S(n-1)\} / 2n$

→ average annual investment cost :

Inv. Costs = $P_{av.}$ X Inv. Rate (%)

NUMERICALS ⇨ 06 MARKS DATE

## TYPE-I- [Compulsary]

[Based on Calculate Depreciation By straight line method]

FORMULA:-

Annual Depreciation Amount in Year = $Dm = \frac{P-SV}{n}$

where, Dm = Depreciation in Rs
P = cost of construction equipment in Rs
SV = Salvage / scrap value in Rs
n = useful life in Years

01. The intial cost of a pieces of construction equipment is Rs. 3,50,000/-. It has useful life of 10 yrs. The estimated salvage value of the equipment at the end of useful life Rs. 5,00,000/- calculate the annual depreciation and book value of the construction equipment using straight line method.

Soln> Given data, P = 3,50,000/-
SV = 5,00,000/-
n = 10 years

To find (i) Dm = ?
(ii) BVm = ?

By straight line method, we get

$$Dm = \frac{P-SV}{n}$$

$$Dm = \frac{35,00,000 - 5,00,000}{10}$$

$$\therefore Dm = 3,00,000/-$$

7.0

# SOIL REINFORCING TECHNIQUE

## NECESSITY OF SOIL REINFORCING

**Soil reinforcement** is necessary in lands where chances of erosion are high. It is particularly useful in areas with soft **soil** as it cannot provide adequate support to any construction or building.

The principle of reinforced soil is that an introduced material provides a tensile restraining force that reduces the lateral stress required to maintain the equilibrium of a loaded soil. As and when the soil element is compressed under vertical stress, it undergoes lateral deformation.

When the reinforcement added to the soil in the form of horizontal layers the soil element will be restrained against lateral deformation as it is acted by a lateral force. It is important to note that the tensile force in the reinforcing element depends on there being lateral strain.

## USE WIRE MESH

Gabion is a welded **wire** cage or box filled with materials such as stone, concrete, sand, or **soil**. So, gabion is a partially flexible block **construction** used for slope stability and erosion protection in **construction**. Various types of gabions are constructed and used in different **engineering** constructions.

## USE GEO-SYNTHETICS

**Geosynthetics** are synthetic products **used** to stabilize terrain. They are generally polymeric products **used** to solve civil engineering problems. This includes eight main product categories: geotextiles, geogrids, geonets, geomembranes, **geosynthetic** clay liners, geofoam, geocells and geocomposites.

## STRENGTHEING OF EMBANKMENTS

An **embankment** refers to a volume of earthen material that is placed and compacted for the purpose of raising the grade of a roadway (or railway) above the level of the existing surrounding ground surface.

**Soil reinforcement** is performed by placing tensile elements in the **soil** to enhance its natural stability and strength. This is achieved by bringing **reinforcement** elements in contact with surfaces in the aggregate and sub-base of **soil** mass

# SLOPE STABILIZATION IN CUTTING AND EMBANKMENTS BY SOIL ENFORCING TECHNIQUES

There are many methods that could be used to help prevent or stop erosion on steep slopes, some of which are listed below.

- Plant Grass and Shrubs. Grass and shrubs are very effective at stopping soil erosion.
- Use Erosion Control Blankets to Add Vegetation to Slopes.
- Build Terraces.
- Create Diversions to Help Drainage.

In **cutting** means when road is constructed by **cutting** the land and removing soil for base course and wearing courses. **Embankment** means when road is constructed on raised surface filled with soil and sufficiently compacted.

**Embankments** – a construction that allows railway lines to pass at an acceptable level and **gradient** over low lying ground. ... Rock cuttings – an excavation that allows railway lines to pass at an acceptable level and **gradient** through the surrounding ground that is composed entirely or predominantly of rock.

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