

CONSTRUCTION MANAGEMENT & ENTREPRENEURSHIP BCV501

Presented By,

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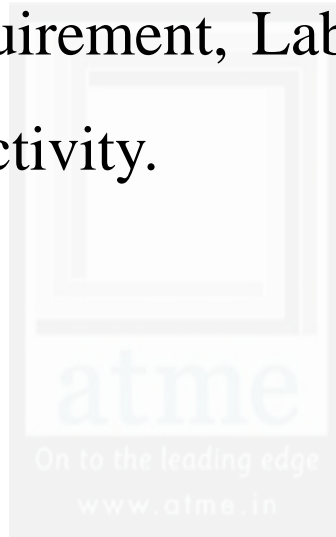
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SYLLABUS

MODULE 2:

Resource Management: Basic concepts of resource management, class of labour, Wages & statutory requirement, Labour Production rate or Productivity, Factors affecting labour output or productivity.



RESOURCE MANAGEMENT

- INTRODUCTION
- CLASS OF LABOUR
- WAGES & STATUTORY REQUIREMENT
- LABOUR PRODUCTION RATE
- FACTORS AFFECTING PRODUCTIVITY

INTRODUCTION

- Completion of construction project at maximum efficiency of time & cost requires judicious scheduling and allocation of resource.
- Manpower, Materials, Money & Machines require close management attention.
- **“Supply & support the field operations so that established time objectives can be met”.**

IMPORTANCE OF MANPOWER

- Discover talented and competent workers
- Greater production
- Avoid sudden disruption of an enterprise production
- Prevent under utilization of personnel through overmanning

MANPOWER PLANNING

1

- Schedule the work elements

2

- Describe the work elements

3

- Chart of manpower

4

- Avoid sudden and steep fluctuations

CLASS OF LABOUR

IS 10302:1982 – “Unified nomenclature of
workmen for civil engineering”

Approved by Civil Engineering Division Council

- Skilled/semiskilled
- Unskilled
- Managerial/Technical

WAGES & STATUTORY REQUIREMENTS

- Construction workers have no job security and are least trained.
- Construction labour leads a migratory life working in different sites.
- The economic conditions of construction labour are the worst due to poor bargaining power, illiteracy and the temporary nature of their employment.

WAGES & STATUTORY REQUIREMENTS

- Trade unions: AITUC(All India Trade Union Congress), INTUC(Indian National Trade Union Congress), BMS(Bharathiya Mazdoor Sangh)
- Trade union Act – 1926
- Labour Welfare Fund Act – 1965
- Payment of wages Act - 1936
- Workmen's Compensation Act - 1923

ESTABLISHING WORKERS PRODUCTIVITY STANDARDS

- CHALLENGING TASK

$$\text{Workers required} = \frac{\text{Work quantity} \times \text{Workers productivity standard}}{\text{Completion period}}$$

$$\text{Workers productivity standard} = \text{Worker output norms} \times \text{Production Efficiency factor}$$

- IDENTIFYING REQUISITE SKILLS
- WORKERS PRODUCTION PLANNING NORMS

LABOUR PRODUCTION RATE

- Rate of transformation of inputs into outputs in a productive operation.
- It requires resources in the form of men, machine, materials & money.
- Labour productivity may be defined as the ratio of output to labour input (Productivity analysis).
- The measurement varies organization to organization.

HUMAN FACTORS & PRODUCTIVITY IMPROVEMENT

- Motivation of workers can be enhanced through job enrichment.
- Workers are motivated by completing quality productive work, social relations at work.
- Goal setting, planning and communications improve the performance.

FACTORS AFFECTING LABOUR OUTPUT

- Overtime
- Morale & Attitude
- Work complexity
- Repetition of work
- Quality Control
- Equipment intensive task
- Supervision
- Dilution of supervision
- Labour Availability
- Stacking of trades
- Joint occupancy
- Mobilize/Demobilize
- Errors & omissions
- Start/stop
- Logistics
- Hazardous work area³

CONSTRUCTION EQUIPMENTS

- Earthwork Equipment
- Concreting Plant Equipment's
- Material Hoisting Equipment
- Heavy Construction Plant Equipment
- Support & Utility Services Equipment

EARTHWORK EQUIPMENT:

1. **Earth cutting and moving equipment:** Bulldozers, Scrapers, Front-end loaders, Motor graders.
2. **Excavation and lifting equipment:** Backhoes, Power Shovels, Draglines, Clamshells.
3. **Loading equipment:** Loaders, Shovels and Excavators.
4. **Transportation equipment:** Tippers, Dump Trucks, Scrapers, Conveyors.
5. **Compacting equipment:** Tamping Foot Rollers, Smooth Wheel Rollers, Pneumatic Rollers, Vibratory Rollers and Plate Compactors.

CONCRETING PLANT AND EQUIPMENT

1. **Production equipment:** Batching Plants, Concrete Mixer
2. **Transportation equipment:** Truck mixers, Concrete dumpers
3. **Placing equipment:** Concrete pumps, Conveyors, Hoist, Grouting equipment.
4. **Concrete vibrating equipment:** Needle vibrators, Plate compactors

MATERIAL HOISTING EQUIPMENT

1. **Hoists:** Fixed, Mobile, Fork-lifts.
2. **Mobile Cranes:** Crawler-mounted, self-propelled rubber-tired, truck mounted.
3. **Tower Cranes:** Stationary, Travelling type.

SPECIAL PURPOSE HEAVY CONSTRUCTION PLANT AND EQUIPMENT

1. **Aggregate production equipment:** Crushing plants, Rock blasting equipment, screening plants.
2. **Concrete paving equipment:** Concrete paver finishers.
3. **Pile driving equipment:** Pile driving hammers.
4. **Asphalt mix production and Placement equipment:** Asphalt plants, asphalt pavers.
5. **Tunneling equipment:** Drill jumbos, Muck-hauling equipment, Rock bolters, Tunnel boring machines.

ESTIMATION OF PRODUCTIVITY FOR CONSTRUCTION EQUIPMENTS

1. Earthmoving Equipment:

- $\text{Production} = (\text{Volume per cycle} * \text{Cycles per hour})$
- $\text{Cost per unit production} = (\text{Equipment cost})/(\text{Equipment production per hour})$

2. Excavating and Lifting Equipment: Face shovel, Backhoe, Dragline, Clamshell

3. Dozers

4. Compactors: Smooth wheeled Rollers, Sheeps foot Rollers, Pneumatic tyred Rollers, Tandom Compactors

5. Graders

6. Hauling Units

ESTIMATION OF OWNERSHIP

1. Initial capital cost
2. Depreciation
3. Investment cost
4. Insurance cost, taxes and storage cost

1. INITIAL CAPITAL COST

- It is about 25% of the total cost invested during the useful investment life.
- Initial cost consists of:-
 1. Price at extra + extra equipment + sales tax
 2. Cost of shipping
 3. Cost of assembly & erection

2. DEPRECIATION

- It represents the decline in market value of the equipment.
- Depreciation results from physical deterioration and economic decline.
- Methods of Depreciation:-
 1. Straight Line
 2. Declining balance
 3. Sum of the years – digit
 4. Sinking fund

STRAIGHT LINE DEPRECIATION

- Equipment will lose the same amount of value in every year.

$$\longrightarrow D_t = (P - F)/n$$

$$\longrightarrow B_t = (B_{t-1} - D_t)$$

DECLINING BALANCE METHOD

- Constant percentage of the book value of the previous period of the asset will be charged as the depreciation amount for the current period.

$$\longrightarrow D_t = K \times B_{t-1}$$

$$\longrightarrow B_t = (B_{t-1} - D_t)$$

SUM OF THE YEARS DIGITS METHOD

- It is assumed that the book value of the asset at a decreasing rate.

$$\longrightarrow D_t = Rate \times (P - F)$$

$$\longrightarrow B_t = (B_{t-1} - D_t)$$

- Rate is calculated by the following way:-
 - If the no. of years = 10
 - Sum of the years =
 - Rate of depreciation for 1 – 10 years are 10/55, 9/55, 8/55,
.....1/55

SINKING FUND METHOD

$$\longrightarrow A = (P - F) \times \frac{i}{(1 + i)^{n-1}}$$

$$\longrightarrow D_t = (P - F) \times \frac{i}{(1 + i)^n - 1} \times (1 + i)^{t-1}$$

$$\longrightarrow B_t = (B_{t-1} - D_t)$$

3. INVESTMENT COST

- It represents the annual cost (hourly cost) of capital invested in a machine.
- Average annual cost of interest is based on the average value of the equipment during its useful life.

$$C = \frac{P(n+1)}{2}$$

$$C = \frac{P(n+1) + F(n-1)}{2n}$$

4. INSURANCE, TAX & STORAGE COSTS

- Insurance cost represents the cost incurred due to fire, theft, accident for the equipment.
- Storage costs represents rent & maintenance of the storage yards.
- Insurance & tax costs are also known as fleet basis.

EQUIPMENTS COST

OWNERSHIP COST– It is the cumulative results of those cash flows an owner experiences whether (or) not the equipment is productively employed on the project. Significant cash flows affecting the ownership cost are,

- ☐ Purchase expenses
- ☐ Salvage value
- ☐ Tax savings from depreciation
- ☐ Major repairs
- ☐ Property taxes
- ☐ Insurance
- ☐ Storage

OPERATING COSTS – Typical expenses include,

- a) Minor (or) Normal Maintenance cost
- b) Repairs
- c) Fuel
- d) Lubricating oil
- e) Replacement cost – wear & tear items

EQUIPMENT SUITABILITY

The most important factor that determines the suitability of equipment for earthwork is the soil (or) the earth itself. The type of earth moving equipment required varies with the nature of the soil and task to be performed.

1) **Excavating and lifting soft earth**

- a) Deep pit excavation – Clamshell and dragline
- b) Shallow pit excavation – Back hoe
- c) Ground level excavation – Power shovels
- d) Shallow trenching – Back hoe (excavator)
- e) Wet soil excavation – Dragline

2. Cutting over areas

- a) Short hauls – Dozers
- b) Long hauls – Scrapers

3. Loading and transporting the excavated soil

- a) For loading soil – loaders, power shovels, excavators
- b) For transporting soil – tippers, dumpers, scrapers

The main ground characteristics which influence the performance of equipment are,

- 1) Suitability of an equipment
- 2) Digging effort
- 3) Volume conversion
- 4) Equipment output

Digging Effort – It depends upon the nature of the soil. The typical soil factors which determine comparative equipment efforts required in various types of soil are as follows:

Nature of soil	Digging effort	Soil factor
Loam, sand, gravel	Easy	1.0
Common earth	Medium	0.85
(ordinary soil)		
Stiff clay, soft rock	Hard	0.61

Volume Conversion – The volume of the soil in its place in natural state is referred to as bank volume. When it is in loose state, it is called as loose volume and when it is in compacted state, it is called compacted volume.

Nature of soil	Bank Volume	Loose Volume	Compacted Volume
Common earth	1	1.25	0.90
Sand	1	1.12	0.95
Clay	1	1.27	0.90
Rock (blasted)	1	1.50	1.30

PERFORMANCE EFFICIENCY FACTOR

Assessed equipment efficiency working (min/hr)	Performance efficiency factor
60	1.0
55	0.92
50	0.85
45	0.75
40	0.67

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CORRECTION FACTOR

1) Equipment Performance Comparison

Equipment	Factor multiplier
Power Shovel	1.0
Back Hoe	0.80
Dragline	0.75
Grab	0.40

2) Soil Digging Factor

Digging effort	Factor multiplier
Easy digging	1.0
Medium digging	0.85
Hard digging	0.67

3) Swing Factor

Angle of Swing	45°	60°	75°	90°	120°	150°	180°
Factor value	1.20	1.16	1.05	1.0	0.88	0.79	0.71

4) Load Casting Factor

Method of casting	Factor multiplier	
	Open area	Restricted area
Side casting	1.0	0.80
Loading in vehicle	0.80	0.60

DOZER PLANNING OUTPUT

- ❑ Bulldozers are versatile machines which is used for moving earth up to 100m, moving and grubbing the sites, used for pushing scrapers, spreading soil to level the surface, maintaining roads, etc.,
- ❑ The ideal output is measured in bulk volume (loose soil) assuming a forward dozing speed of 3km/hour, return speed of 6km/hour, maneuvering time of 0.15 minutes, easy going on general level ground and dozing of materials using straight S-blade.

Dozer output = Dozer ideal output * Correction factor * Performance factor (in LCM)

Correction Factors

1) Blade Factor Multiplier

Type of blade	Blade Factor
S-blade	1.0
A-blade	0.75
U-blade	1.25 (used only for loose soil)

2) Transmission Factor – Take **80% of the ideal output** if it is based on power shift system

3) Grade Factor

Nature of slope	Effect on output (%)
Downhill working	Increase $2.5 * \text{grade} (\%)$
Uphill working	Decrease $2 * \text{grade} (\%)$

4) Soil Factor

Digging effort	Soil Factor
Easy digging	1.0
Medium digging	0.85
Hard digging	0.67

5) Swell Factor

Type of soil	Swell factor
Common earth	1.2
Sand & Gravel	1.1
Dry clay	1.3
Rock	1.5

Scraper Planning Output

Scraper is equipment that is commonly used for scraping, loading, hauling and discharging. It also includes spreading large quantities of earth over long distances for around 3 km and in layers of 15 cm to 30 cm depth. There are two main categories of scrapers, namely,

- a) Towed scrapers – They are best suited for medium distances up to 400 m. It can operate in small areas and scrape in heavy soil areas.
- b) Motorized scrapers – These include single engine scraper, double engine scraper and elevating scraper.



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