LECTURE EIGHT: PLANT AND EQUIPMENT MANAGEMENT

The selection of the appropriate type and size of construction equipment often affects the required amount of time and effort and thus the job-site productivity of a project.

Choice of Equipment

Typically, construction equipment is used to perform essentially repetitive operations, and can be broadly classified according to two basic functions: (1) operators such as cranes, graders, etc. which stay within the confines of the construction site, and (2) haulers such as dump trucks, ready mixed concrete truck, etc. which transport materials to and from the site. In both cases, the cycle of a piece of equipment is a sequence of tasks which is repeated to produce a unit of output. In order to increase job-site productivity, it is beneficial to select equipment with proper characteristics and a size most suitable for the work conditions at a construction site.

In excavation for building construction factors that could affect the selection of ***excavators*** include:

1. **Size of the job:** Larger volumes of excavation will require larger excavators, or smaller excavators in greater number.
2. **Activity time constraints:** Shortage of time for excavation may force contractors to increase the size or numbers of equipment for activities related to excavation.
3. **Availability of equipment:** Productivity of excavation activities will diminish if the equipment used to perform them is available but not the most adequate.
4. **Cost of transportation of equipment:** This cost depends on the size of the job, the distance of transportation, and the means of transportation.
5. **Type of excavation:** Principal types of excavation in building projects are cut and/or fill, excavation massive, and excavation for the elements of foundation. The most adequate equipment to perform one of these activities is not the most adequate to perform the others.
6. **Soil characteristics:** The type and condition of the soil is important when choosing the most adequate equipment since each piece of equipment has different outputs for different soils. Moreover, one excavation pit could have different soils at different stratums.

7. **Geometric characteristics of elements to be excavated:** Functional characteristics of different types of equipment makes such considerations necessary.
8. **Space constraints:** The performance of equipment is influenced by the spatial limitations for the movement of excavators.
9. **Characteristics of haul units:** The size of an excavator will depend on the haul units if there is a constraint on the size and/or number of these units.
10. **Location of dumping areas:** The distance between the construction site and dumping areas could be relevant not only for selecting the type and number of haulers, but also the type of excavators.
11. **Weather and temperature:** Rain, snow and severe temperature conditions affect the job-site productivity of labor and equipment.

By comparing various types of machines for excavation, power shovels are generally found to be the most suitable for excavating from a level surface and for attacking an existing digging surface or one created by the power shovel; furthermore, they have the capability of placing the excavated material directly onto the haulers. Another alternative is to use bulldozers for excavation.

The choice of the type and size of ***haulers*** is based on the consideration that the number of haulers selected must be capable of disposing of the excavated materials expeditiously. Factors which affect this selection include:

1. **Output of excavators:** The size and characteristics of the excavators selected will determine the output volume excavated per day.
2. **Distance to dump site:** Sometimes part of the excavated materials may be piled up in a corner at the job-site for use as backfill.
3. **Probable average speed:** The average speed of the haulers to and from the dumping site will determine the cycle time for each hauling trip.
4. **Volume of excavated materials:** The volume of excavated materials including the part to be piled up should be hauled away as soon as possible.
5. **Spatial and weight constraints:** The size and weight of the haulers must be feasible at the job site and over the route from the construction site to the dumping area.

Dump trucks are usually used as haulers for excavated materials as they can move freely with relatively high speeds on city streets as well as on highways.

Equipment Selection Considerations:

Factors to be considered in selection of construction equipment are as follows

1. Task considerations
   - Nature of task and specifications
   - Daily or hourly forecast of planned production
   - Quantity of time and time allowed for completion
   - Distribution of work at site
   - Interference expected and interdependence with other operations.
2. Site constraints
   - Accessibility to location
   - Working space restrictions
   - Altitude and weather conditions
   - Working season and working hours
   - Availability of local resources of manpower, material and equipment.
   - Availability of land, power supply and water supply for workshop
   - Availability of equipment hiring, repair and maintenance facilities
   - Availability of fuel, oil and lubricants.
3. Equipment suitability
   - Type of equipment considered suitable for task
   - Production capability, serviceability condition and delivery time of each equipment available.
4. Operating Reliability
   - Manufacturers reputation
   - Equipment component
   - Use of standard component
   - Warranties and guarantees
   - Structural design
   - Safety features
   - Preventive maintenance programme.
5. Maintainability
   - Ease of repair or maintenance
   - Vendor's after sale service, repairs ,spares and maintenance
   - Availability of spare parts

- Standardization consideration.

6. Economic Considerations
   - Owning costs
   - Operating costs
   - Re sale value
   - Replacement cost of existing equipment
7. Commercial considerations
   - Buy second-hand or new equipment
   - Rent equipment
   - Hire-purchase equipment
   - Purchase on lease

Equipment Acquisition Options:

1. Purchasing plant
2. Renting plant
3. Leasing and hire purchase of plant
4. Replacing old plant

Types of Construction Equipment:

The various types of construction equipment are

1. Earthwork equipments
2. Concreting equipments
3. Hoisting equipments

Types of Earthwork Equipments:

1. Backhoe
2. Front shovel
3. Dragline
4. Clamshell
5. Dozers
6. Roller compactor
7. Scraper
8. Dumper

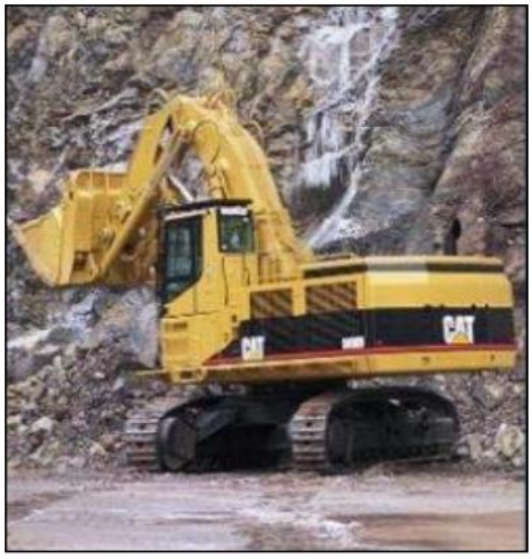
9. Grader

Backhoe

It is mainly used to clean up construction areas, to dig holes in the ground, to smooth uneven ground and to remove deep root from trees

Front Shovel

It is mainly used for excavation purposes above its own track or wheel level. It is used for heavy cutting in all types of dry soil.



Dragline

They are used for bulk excavation below in track level in loose soils, marshy lands and areas containing water.

Clamshell

It consists of a hydraulically controlled bucket supported by a lifting arm. It is mainly used for deep confined cutting in pits and trenches.

Dozers

They are used for moving earth upto distance of about 100m and act as a towing tractor and pusher to scraper machines. They can be track mounted or wheel mounted.

Roller Compactor

It is used for compaction of earth and other materials in large work of highways, canals and airports.

Scarper

They are used for site leveling, loading ,hauling over distances between 150m-900m.

Dumper

It is used for horizontal transportation of materials on and off sites.

Grader

It is used for grading and finishing the upper surface of earthen formations and embankments.

Types of concreting equipments

1. Concrete batching and mixing plant
2. Concrete mixers
3. Concrete transit mixers
4. Concrete pumps

Concrete batching and mixing plant

It is mainly used for weighing and mixing large quantity of concrete constituents.

Concrete Mixers

It is used for mixing small quantity of concrete constituents

Concrete Transit Mixers

It is used in case of ready mix concreting

Concrete Pumps

It is used for horizontal and vertical transportation of concrete in large quantities.

Types of Hoisting Equipments

1. Hoists
    a. Boom hoists
    b. Chain hoists
    c. Electric hoists
    d. Tractor hoists
2. Cranes
    a. Derrick crane
    b. Mobile crane
    c. Tower crane

Hoists

Boom Hoists

It is used for lifting weights on the hooks which is attached to special metal ropes designed to bear maximum loads.

Chain Hoists

It consists of chain rope and pulley that is used to move the load from up to down

Electric Hoists

It is modernized form of chain and boom hoists used in industries for fast working.

Tractor Hoists

It consists of a boom which is attached with base of a tractor and a hook with rope is installed on this boom that can be operated through driver controls.

Cranes

Mobile Cranes

It is suitable for all types of structure. It can operate in muddy terrain but requires good ground conditions. It needs adequate operating clearance.

Tower Cranes

It is used for high rise structures. It is considered to be safe due to presence of limit switches.

Derrick Cranes

It is preferred for high rise and apartment building. It is cheaper than mobile and tower cranes.