MODULE - 3

CONSTRUCTION EQUIPMENTS

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- In the case of huge construction projects;
- Proper use of the appropriate equipment contributes to economy, quality, safety, speed and timely completion of a project.
- Equipment are use for highway projects, irrigation, buildings, power projects etc.
- 15-30% of total project cost has been accounted towards equipment and machinery

Classification of Construction Equipment

- Earth-moving equipment
- Hauling equipment
- Hoisting equipment
- Conveying equipment
- Aggregate and concrete production equipment
- Pile-driving equipment
- Tunneling and rock drilling equipment
- Pumping and dewatering equipment

Operations involved in construction of any project

- Excavation
- Digging of large quantities of earth
- Moving them to distances which are sometimes fairly long
- Placement
- Compacting
- Levelling
- Dozing
- Grading
- Hauling

EXCAVATING AND EARTH MOVING EQUIPMENT

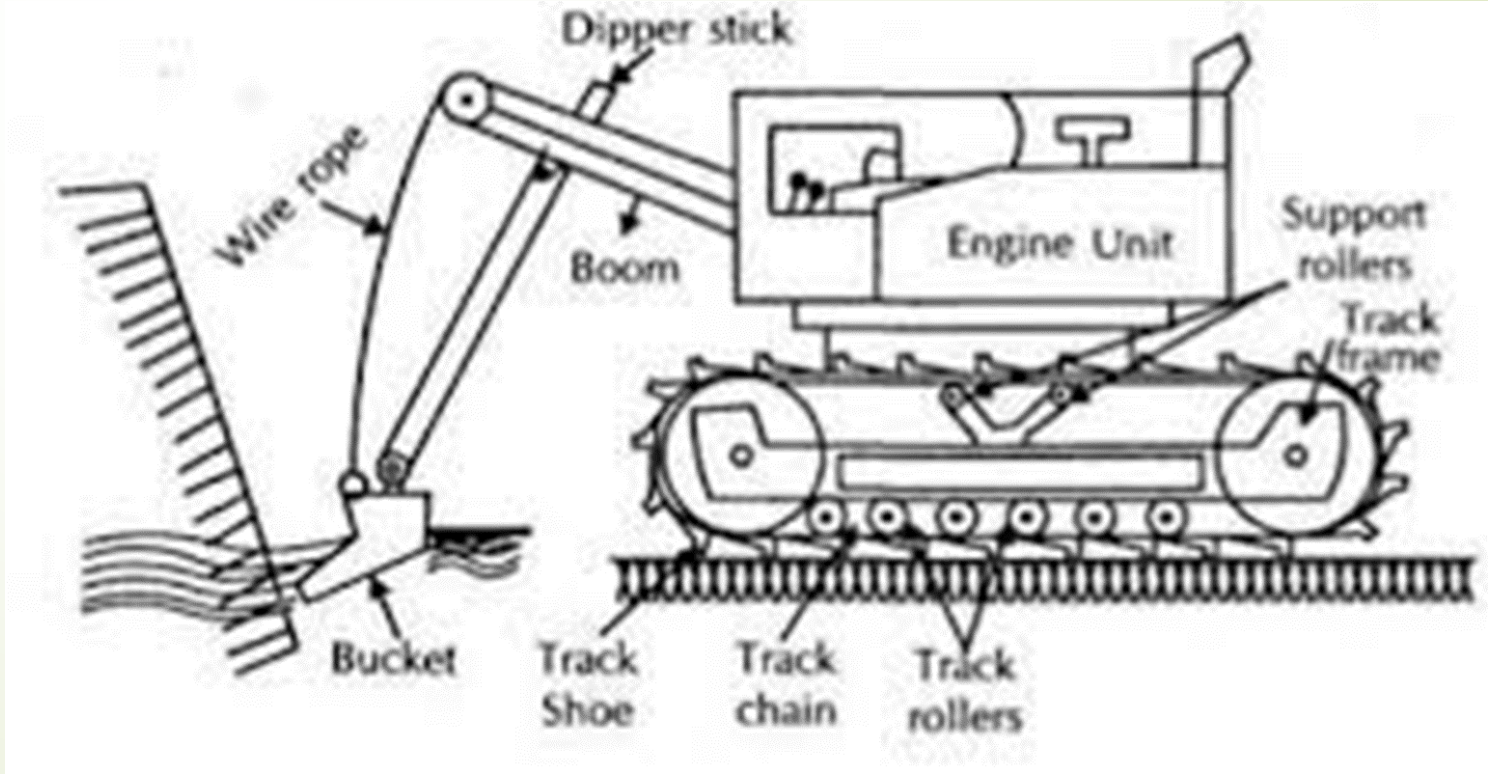
- Power shovel
- Back hoe
- Drag line
- Clam shell
- Scrapers
- Bull dozer
- Angle dozer
- Excavator

POWER SHOVEL

- To excavate the earth and to load the trucks
- capable of excavating all types of earth except hard rock
- size varies from 0.375m3 to 5m3 .
- Basics parts of power shovel including the track system, cabin, cables, rack, stick, boom foot-pin, saddle block, boom, boom point sheaves and bucket

Applications

- Suitable for close range of work
- Capable of digging very hard materials,
- can remove big sized boulders.
- It is used in various types of jobs such as digging in gravel banks, clay pits, digging cuts
- in road works, road-side berms



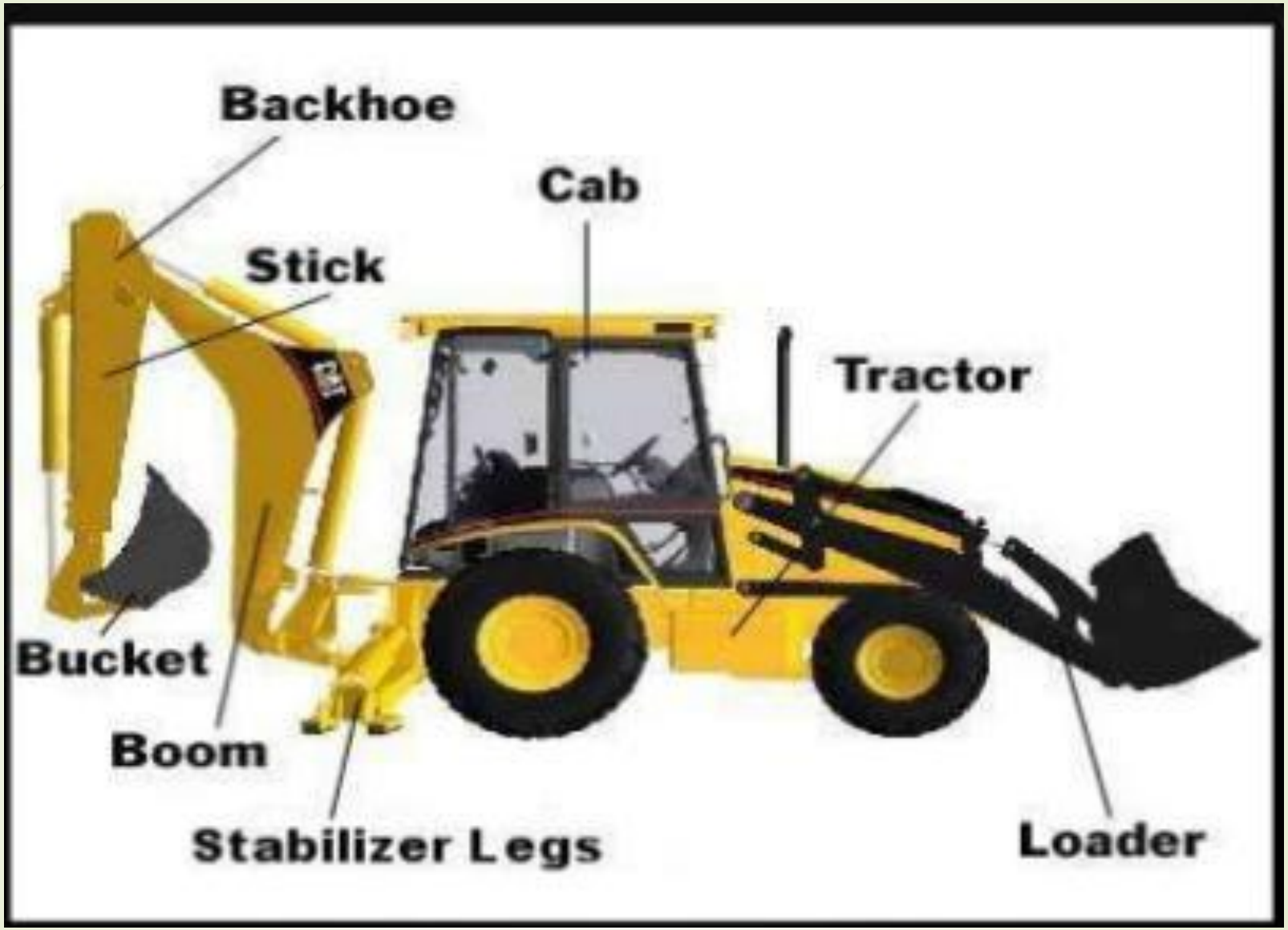
OLD → NEW

BACK HOE

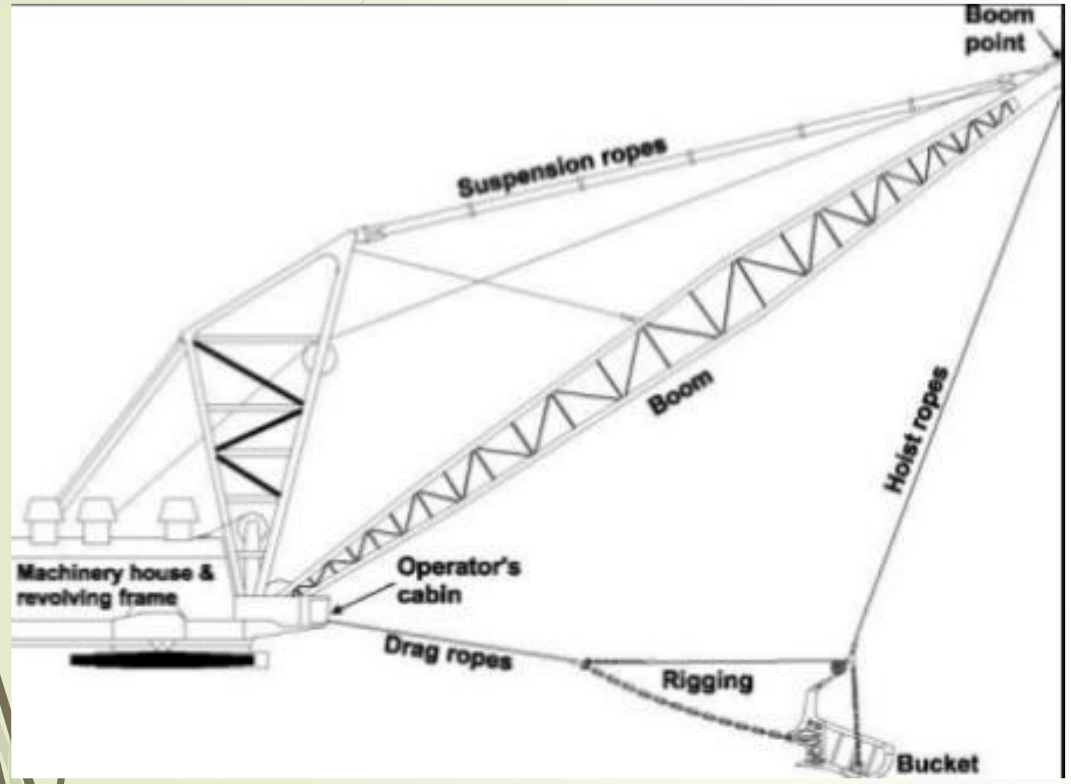
- Also known as hoe, back shovel and pull shovel
- It is used to excavate below the natural surface on which it rests.
- Generally used to excavate trenches, pits for basements and also for grading works, which requires precise control of depths.
- The basic parts are boom, Jack boom, Boom foot drum, Boom sheave, Stick sheave, Stick, Bucket and Bucket sheave

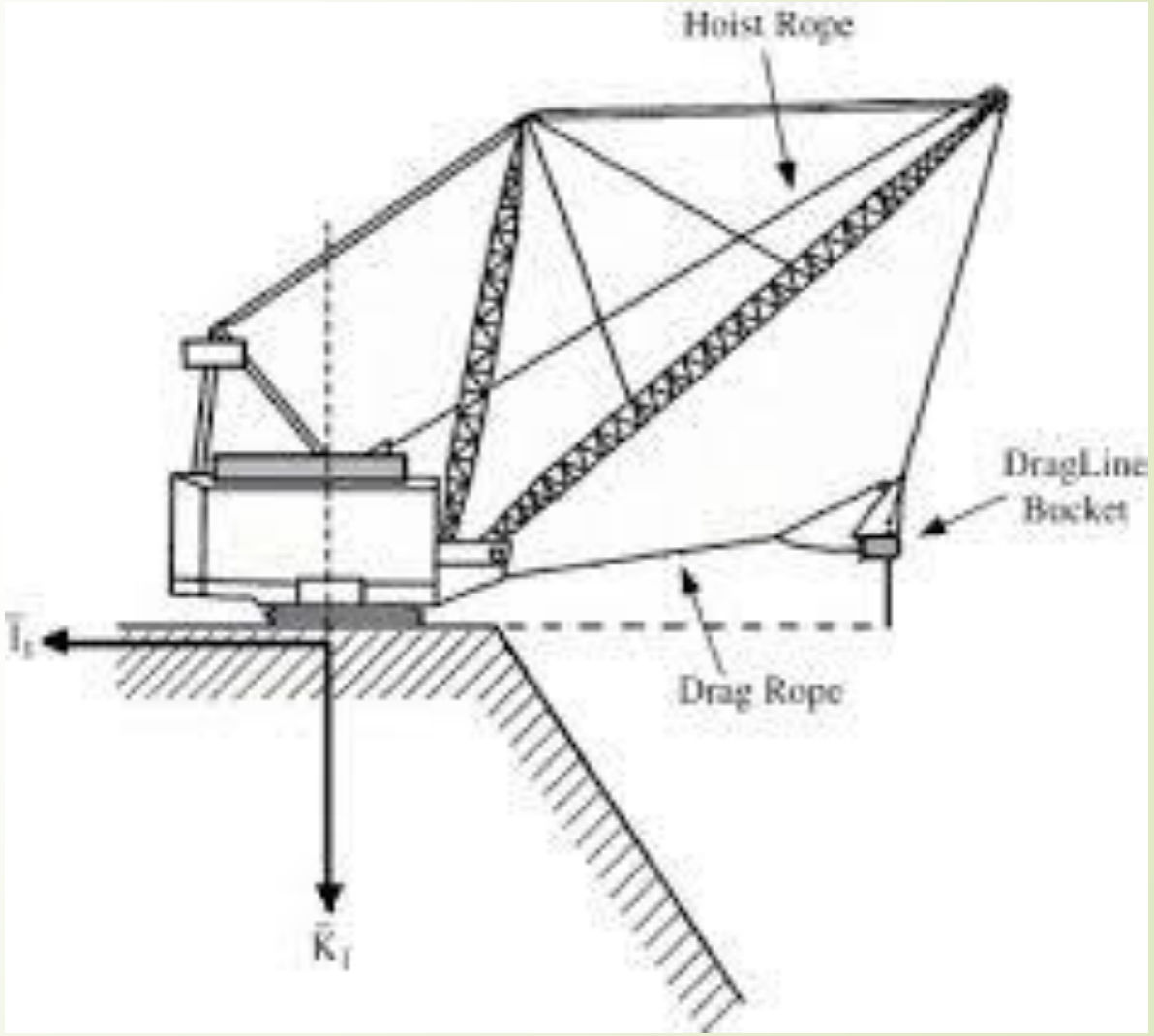
Application

- It is the most suitable machine for digging below the machine level, such as, trenches, footings, basements etc.
- It can be efficiently used to dress or trim the surface avoiding the use of manual effort for dressing the excavated the surface


Backhoe
Cab
Stick
Tractor
Bucket
Boom
Stabilizer Legs
Loader

Drag line


Boom point
Suspension ropes
Boom
Hoist ropes
Machinery house & revolving frame
Operator's cabin
Drag ropes
Rigging
Bucket


Hoist Rope
DragLine Bucket
Drag Rope

- The drag line is so name because of its prominent operation of dragging the bucket against the material to be dug.
- Unlike the shovel, it has a long light crane boom and the bucket is loosely attached to the boom through cables.
- Because of this construction, a dragline can dig and dump over larger distances than a shovel can do.
- Drag lines are useful for digging below its track level and handling softer materials.
- The basic parts of a drag line including the boom, hoist cable, drag cable, hoist chain, drag chain and bucket

Applications

- It is the most suitable machine for dragging softer material and below its track level
- It is very useful for excavating trenches when the sides are permitted to establish their angle of repose without shoring.
- It has long reaches.
- It is mostly used in the excavation for canals and depositing on the embankment without hauling units

Clam shell

- This is so named due to resemblance of its bucket to a clam which is like a shell-fish with hinged double shell.
- The front end is essentially a crane boom with a specially designed bucket loosely attached at the end through cables as in a drag line.
- The capacity of a clam shell bucket is usually given in cubic meters.
- The basic parts of clam shell bucket are the closing line, hoist line, sheaves, brackets, tagline, shell and hinge.

Application

- Used for handling loose material such as crushed stone, sand, gravel, coal etc.
- Main feature is vertical lifting of material from one location to another.
- Mainly used for removing material from coffer dam, sewer main holes, well foundations etc

Scrapers

- Unique machine for digging and long-distance hauling of plough able materials.
- self-operating machine
- It is not dependent on other equipment.
- Wheels of machine cause some compaction.
- The basic parts of scrapers are the bowl, apron and tail gate or ejector

Bull dozer

- The heavy blade attached to the tractor pushes the material from one place to another.
- The tractor can be of the crawler or the wheeled type.

Classification of bull dozer

- **1. Position of blades**

– a) Bull dozers in which the blade perpendicular to the direction of movement

– b) Angle dozers in which the blade is set at an angle with the direction of movement

- **2. Based on mountings**

– a) Wheel mounted

– b)Crawler mounted

- **3. Based on the control**

– a) Cable controlled

– b)Hydraulically controlled

Applications

Bull dozers are mainly used for the following operations

- For spreading the earth fill
- For opening up pilot roads through mountainous and rocky terrains.
- Clearing construction sites.
- Maintaining haul roads
- Clearing land from the trees and stumps
- Back-filling trenches at construction sites by dragging the earth from one place to another

Earth compaction equipment

- Smooth-wheel rollers.
- Sheep-foot rollers
  - a)Ordinary sheep-foot roller
  - b)Convertible roller
  - c)Turn foot roller
- Pneumatic-tyred rollers

Smooth-wheel rollers

- Plain steel rollers
- Self-propelled type
- Weighing from 5 to 15 tonnes
- Used for ordinary rolling work where deep compaction is not required
- These rollers may have one front and two rear wheels
- The rear wheels being usually larger in diameter and the front one being winder
- Weight of rollers may be increased by filling water or sand ballast in hollow cylinder.
- These rollers are effective in compacting granular soils, such as sand, gravel and crushed stone.

Sheep-foot rollers

- For compacting earth work in embankments and canals (where compaction deep into the layer of the earth is required)
- These gives best result in compaction when the soil is clay or predominantly cohesive and impervious.
- The sheep foot rollers may weigh upto 15 tonnes or more
- Travel at a speed of 25 kmph
- As roller moves over the surface, the feet penetrate the soil to produce a kneading action and a pressure to mix and compact the soil from bottom to top layer.
- With repeated passages of the roller, the penetration of feet decreases


BOMAG

Pneumatic-tyred rollers

- It consists a base or a platform mounted between two axles.
- The rear of which has one more wheel than the front.
- Most suitable for compacting fine-grained soil and well graded sands.
- Ballasting is done using either water, sand or pig iron in order to increase the self weight
- Pneumatic-tyred rollers
- Major advantages are the ability to control the ground contact pressure by:
  - a) Altering the weights of machines,
  - b) Increasing the number of wheels,
  - c) Increasing the tyre width
  - d) Changing the contact area of the tyre by altering the contact pressure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Hauling equipment

- The equipment used for transportation of material are known as hauling equipment or simply haulers.
- Haulers may operate on the roadways or railways
- It involves
  - transportation of building materials,
  - carriage and disposal of excavated earth
  - haulage of heavy construction equipment
- These are classified on the basis of method of dumping the load
- 1. Dump trucks
  - *a) Side or rear dump trucks*
  - *b) Bottom dump trucks*
- 2. Dumpers

Dump trucks

- These are used for earth moving purpose.
- The selection of the type of dump trucks for a specific job depend on the soil condition.
- (a) Side or rear dump trucks-
  - These are heavy duty trucks with strongly built body which is hinged on the truck chassis at the rear end and one side respectively, and can be fitted to the rear in the case of rear dump and to the hinged side in case of the side dump, through the action of hydraulic jacks.
  - These trucks are suitable for use in hauling wet clay, sand, gravel, quarry rocks etc.

Side dump truck

Rear dump truck

- Bottom dump trucks
- These are similar to semi-trailers in which their front is supported on the rear of the hauling tractor and their rear is resting on their own wheels.
- The body of the truck remains in the same position and the discharge of the material takes place through its bottom after opening of two longitudinal gates.
- The gates are hinged to the side of the body.
- These trucks are suitable for use in hauling free flowing material, such as, sand, gravel, dry earth, hard clay etc.

Dumpers

- High speed pneumatic wheeled trucks
- Short chasis
- Strong bodies
- Loading, hauling and dumping is done very fast as compared to other equipment
- Suitable for short hauls on rough roads
- Specially where a shuttle movement is required

Hoisting equipment

- Hoisting is the lifting a weight from one location and moving it to another location which is at a reasonable distance.
- Big projects such as, construction of dams, industrial buildings etc. require hoisting equipment.
- Hoisting equipment includes jacks, winches, chain hoists and cranes.
- Crane is the only single machine which, as a single piece, is capable of providing three-dimensional movement of a weight.
- Cranes are broadly classified as :
  - i. Stationary or derrick cranes
  - ii. Mobile cranes
  - iii. Overhead or gantry cranes
  - iv. Traveller cranes
  - v. Tower cranes

Derrick cranes-

- Derrick cranes consist of a mast, a boom and a bull wheel on which the boom rotates about a vertical axis and guys or supporting members.
- Electrically operated, diesel operated or diesel-electrically operated.
- The boom can revolve through 360º.
- This crane is used for heavy loads upto 200 tons.

Mobile cranes-

- These cranes are mounted on mobile units which is either crawler type or wheel type
- Truck cranes have high mobility while the crawler mounted cranes move slowly.
- Crawler mounted cranes are capable of moving on rough terrain.

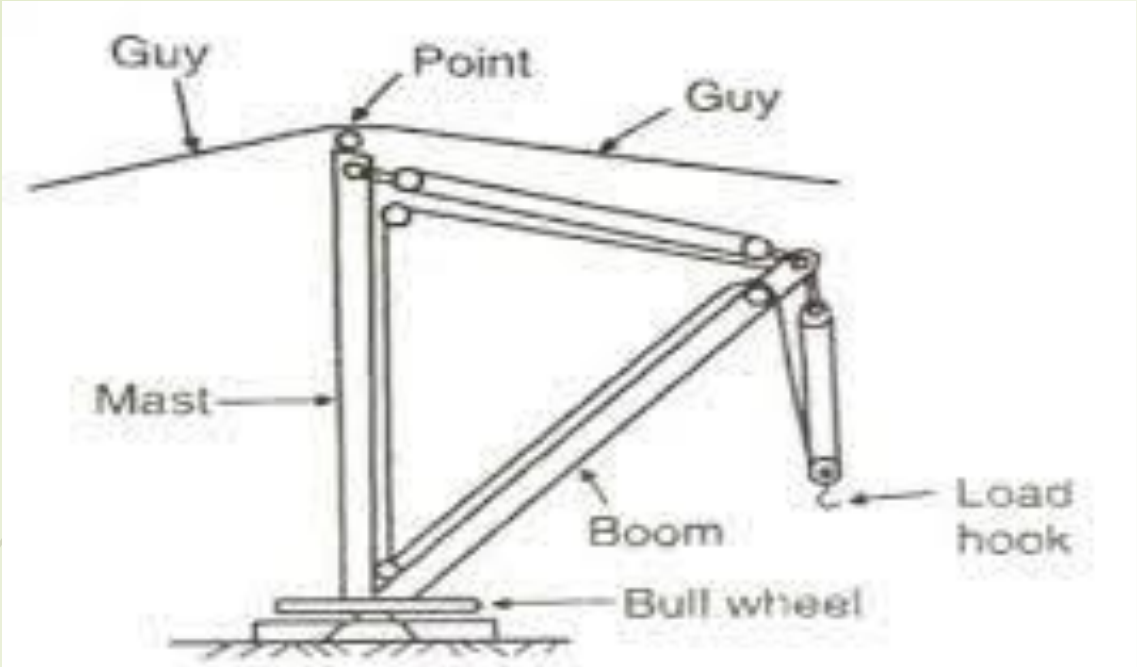


Fig. 2.14. Derrick Crane.

Overhead or gantry cranes-

- large service area,
- freedom from floor obstructions
- and three-way mobility
- Widely used in erection, foundry, steel plants, storage yards and different types of industrial works
- These type of cranes consist of two main parts i.e., the bridge and the crab.
- The bridge consists of two main girders fixed at their end to end and capable of moving on gantry rails
- The crab consists of the hoisting gear mounted on a frame.
- The frame itself is mounted on another set of wheels and capable of travelling across the main girder

TRAVELLER CRANES

- Travelling or bridge cranes have their crabs moving on girders which are supported on legs instead of on overhead gantry track as used in overhead cranes.
- The legs are capable of moving on tracks laid on the floo

Tower cranes

- Tower cranes are actually a derrick crane mounted on a steel tower.
- Tower cranes are usually used for industrial and residential high-rise buildings.
- These are commonly used for assembly of industrial plants with steel structures.
- The main parts of tower crane are under carriage, slewing platform, tower with operator's cabin and jibs.
- The tower has a truss structure welded from steel bars and channels

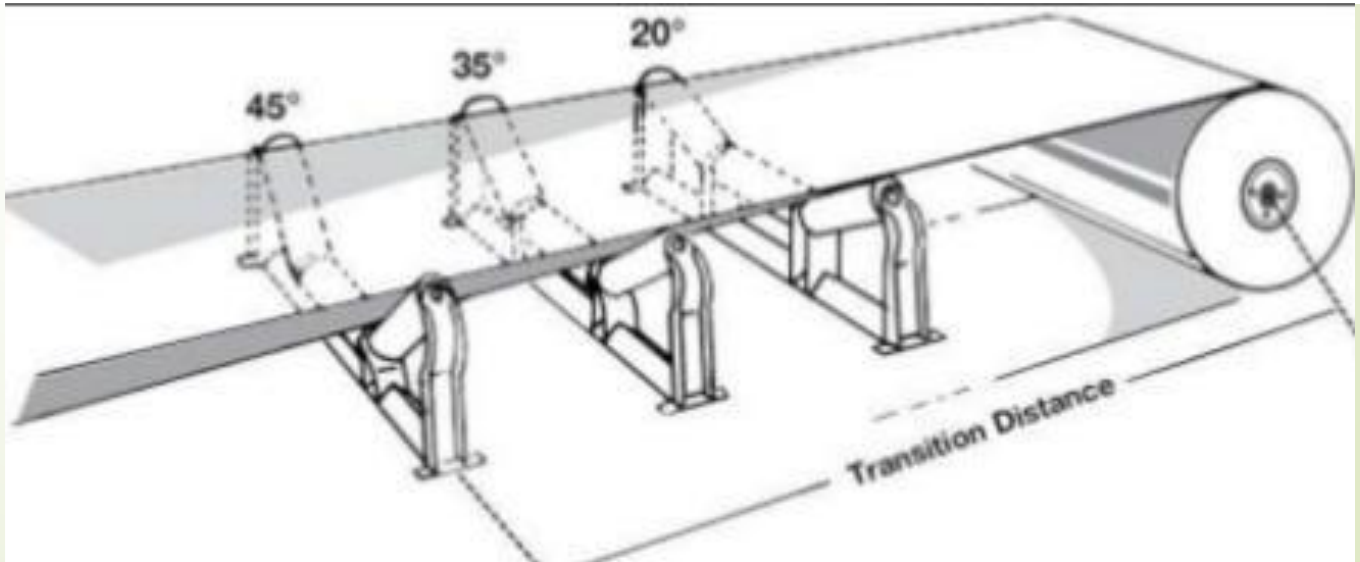
Conveying equipment

- Transporting material from one place to another over a stationary structure.
- Caries material in continuous stream with its distinct feature such as endless chain or belt.
- Can be done horizontally, vertically or inclined.
- When the equipment does horizontal conveying, it is known as conveyor and when it does vertical, it is known as elevator.
- Conveying are mainly used in mining, construction and in some of the industries.
- In construction industry, conveyors are mainly used for concreting purpose

- The Advantage of using conveyors are as follows:-
  - 1. It increases the output.
  - 2. It facilitates continuity in operation.
  - 3. It results in time saving.
  - 4. There are no waiting periods.
- Some of the popular conveyors are as follows:-
  - 1. Belt conveyor
  - 2. Screw conveyor
  - 3. Bucket conveyor
  - 4. Aerial transport

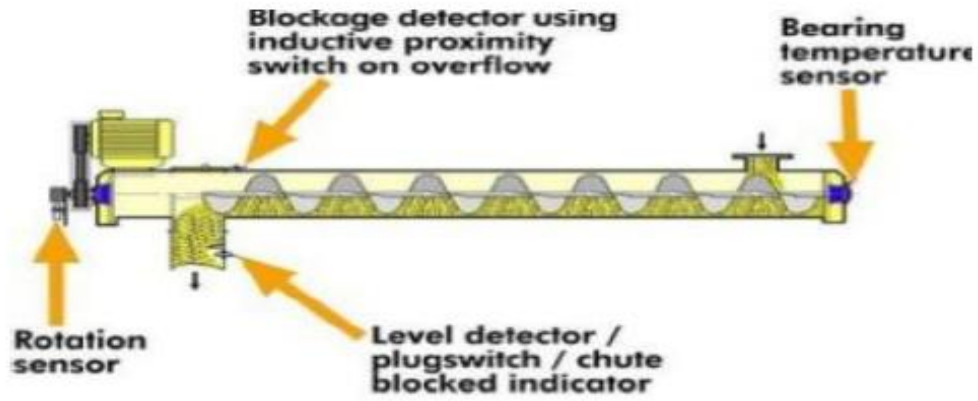
Belt conveyor

- Used when large quantities of materials have to be conveyed over long distances at fast speed.
- It consists of a belt running over a pair of end drums or pulleys and supported at regular intervals by a series of rollers called idlers.
- These idlers are supported on a conveyor frame.
- The middle sag provided in the belt prevent the spilling of material.
- Generally, rubber is most commonly used as conveyor belt.
- Belt conveyor



SCREW CONVEYOR

- Widely used for handling granular or pulverized material.
- The quantity of material conveyed is less compared to the conveyor, but at the same time the cost is also less.
- A screw conveyor consists of a helix mounted on a bearing at the ends and at intermediate points and is driven by a motor from one end.
- The material enters the through at one end is carried to the other end by screwing action of helix.
- The length of the conveyor is about 65m. with an inclination up to a maximum of 350

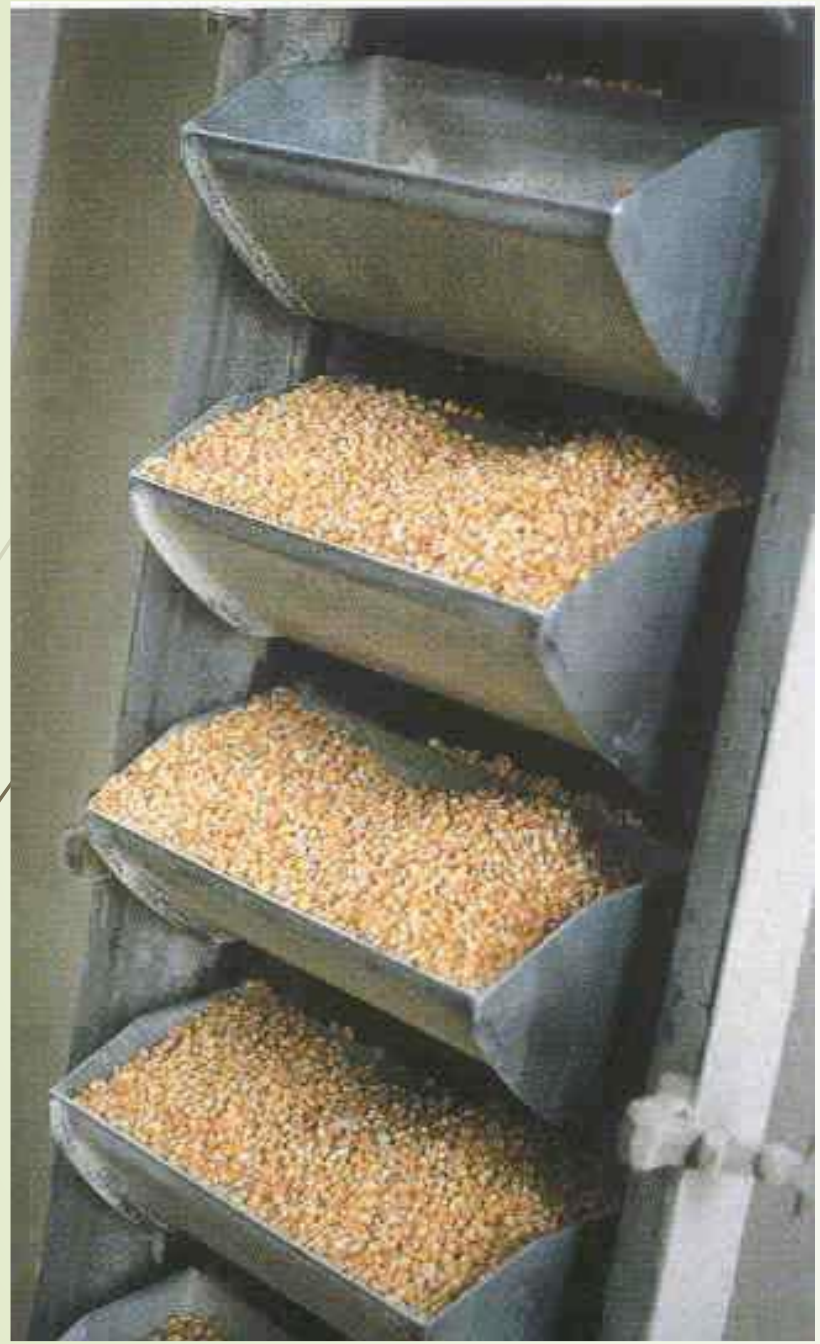


Bucket conveyor

- It has buckets in the shape of 'V' which are open at the top.
- They may be feeder loaded or may drag in a vertical movement or along an incline.
- The length of these type of conveyors are generally limited to 25 m. (due to weight of the conveyor and strength of the chains.)
- This type of conveyer is mainly used in coal handling where bucket elevators carry the material vertically

Aerial transport

- Aerial transportation through cableways, rope-ways and tram ways
- Often used with advantage for transportation of material in hilly regions.
- Reducing the distance of transportation as well as cost of transportation
- The load being passed over intermediate towers or stations for long distances



Grader

- A grader is a construction machine with a long blade used to create a flat surface. It is commonly called in names such as road grader, a blade, a maintainer and motor grader,
- Graders are mostly been used in road construction for construction and maintenance of dirt roads and gravel roads.The grader typically consist of three axles, with the engine and cab situated top, the rear axles at one end of the vehicle and a third axle at the front end of the vehicle, with the blade in between.
- In the construction of paved roads they are used to prepare the base course to create a wide flat surface for the asphalt to be placed on.
- They are also used to set native soil foundation pads to finish grade prior to the construction of large buildings.Many countries use grader for the flatting process that is done before the placing of Asphalt.
  Graders too have various types; some consist a large fork front, and some consist of a flat blade front, which vary from different sizes.

Forklift

- Forklift is a small industrial vehicle, having a power operated forked platform attached at the front that can be raised and lowered for insertion under a cargo to lift or move it.
- Forklifts serve the needs of various industries including warehouses and other large storage facilities.
- Forklifts are powered by electric battery or combustion engines.
- Some Forklifts allow the operators to sit while driving and operating the machine while others require the operator to stand.
- It is being extensively used throughout the industry for transporting materials and goods.

Factors Affecting Selection of Construction Equipment

1. **Ease of Operation:** Faster operation, less fatigue, and fewer errors go with ease of operations.

2. **Flexibility:** Unless there is enough work to keep a highly specialized machine busy, it is better to select one which can be used for different types of work. In absence of flexibility, the purchase of the machine is not at all justified.

3. **Durability:** A machine is used by different people under varying conditions. Unless, it is strong and durable, it would be a poor investment.

4. **Portability:** A machine is frequently moved from user to user or from one place to another place in the same work area.

Compactness and ease of handling saves time and energy and increase the use of the machine. Modern machine have been reduced in size and weight without the sacrifice of the quality.

5. **Adaptability:** If a machine can be used without disrupting an existing system, it would be better to do so than go in for one which necessitates a considerable rearrangement of the forms and records involved in extensive recopying of information and of adjustments in procedures.

6. Service: Reliable and continuous performance demands quick repairs and proper maintenance. The machine which can be serviced promptly has advantage over one which cannot be serviced.

7. Operating cost: This includes such things as supplies, the space occupied, the special equipment and forms required, repairs, etc.

8. Reputation of the Supplier: Few people have the expertise to judge the mechanical qualities of a machine so one has to depend upon the integrity of the manufacturer and dealer to furnish a good machine and to backup claims and guarantees.