

# Production and Operation Management

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# Production and Operation Management (MEC250)

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# Content

- 1) Introduction
- 2) Production and Productivity
- 3) Production Planning and Control
- 4) Facility Location
- 5) Facility Layout
- 6) **Material Handling**
- 7) Repair and Maintenance

# Material Handling

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# Material Handling

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- 1) Concept, Objectives & Elements of Material Handling.
- 2) Principle of Economic Material Handling.
- 3) Relationship of Material Handling with Plant Layout.
- 4) MH Equipments



# Concept of Material Handling

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- Material Handling involves the movement, handling & storage of materials during different stages of manufacturing.
- It amounts to 15 to 25 percent of total cost of product.
- Material Handling does not add any value to the product.



# Objectives of Material Handling

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- Reduce the unit handling costs which includes total material handling costs, material handling labour costs.
- Reduction in manufacturing cycle time through faster movement of materials between work stations and by reducing the distance through which the materials are moved.
- Contribute towards better control of the flow of materials through manufacturing facility.

- Improved working conditions and increased safety.
- Contributes to better quality by avoiding damage to components by inefficient handling.
- Increased storage capacity by utilization of floor area.
- Increased productivity at lower manufacturing cost.
- Reduce work in process inventory.
- Improve customer service by more efficient shipping and receiving.
- Better personnel utilization.



# Benefits of Material Handling

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- Reducing idle time of workers and machines.
- Clean shop floor enables smooth and efficient functioning.
- Less wastage, spoilage and damages.
- Improve inventory control.
- Reduction in fatigue of workers leading to greater job satisfaction and more work with greater safety.

- Help the maintenance of quality standards.
- Reduced volume of work in progress.
- Promote greater industrial safety because it has been found out 30 to 40% accidents are due to bad material handling.
- Increased efficiency and higher production by providing an uninterrupted flow of material.
- Create a better working operating condition and environment through an improvement in house keeping conditions.



# Negative Aspects/Limitations of Material Handling System

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- Additional Capital Investment.
- Space and special building requirement.
- Auxiliary equipment cost.
- Maintenance.
- Loss of flexibility.
- It is very important to make careful evaluation of the total benefits and limitations, before one decides and go for any material handling project.

# PRINCIPLES OF ECONOMIC MATERIAL HANDLING

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- **Planning Principle:** All handling activities should be planned. Handling activities may account for 25 to 80% of all productive activity. Plan a system integrating as many handling activities as possible and coordinating the full scope of operations (receiving, storage, production, inspection, packing, warehousing, shipping and transportation).
- **Material Flow Principle:** Material handling and plant layout are intimately interrelated. This flow pattern is actually the backbone of most production facilities. One of the first steps in planning a material handling system is the design of material flow pattern. This may be largely determined operation by sequence, which in turn will determine the pattern of equipment arrangement.



- **Simplification Principle:** Reduce, combine or eliminate unnecessary movements of equipment's. It implies primarily the reduction or elimination of moves of equipment that is not being properly utilized.
- **Gravity Principle:** This is certainly a very obvious principle but one that is all frequently overlooked because of its simplicity. Many materials can be made efficiently by the proper application of the law of gravity. So, utilize gravity to move material whenever practicable.
- **Space Utilization Principle:** Make optimum utilization of building cube factory and ware house space because wasted space means wasted money. Inherent in this principle is that square feet and cubic feet as "dear" height will permit items to be stacked.
- **Unit Size Principle:** It is one of the keystones of modern, efficient material handling is increased quantity, size, weight of load handled. In general, the larger the load, the lower the cost per unit handled. Whenever practical individual items should be gathered and made up in unit loads.

- **Flexibility Principle:** Use method and equipment that can perform a variety of tasks and applications because these are more fully utilized than a single purpose one.
- **Safety Principle:** One of the objectives of material handling is to improve the working conditions by providing safer work situations. All handling activity in operations or being planned should be safe.
- **Equipment Selection Principle:** In selecting handling equipment consider all the aspects of the materials to be handled. Standardize methods as well as types and sizes of handling equipment should be used. It can have extreme value in increasing material handling efficiency.
- **Motion Principle:** This principle implies that mobile equipment should be kept moving, that is performing the function for which it is designed. It should be tied up for unduly/long periods of time for loading and unloading.
- **Capacity Principle:** Use handling equipment to achieve full production capacity.



- **Idle Time Principle:** Reduce idle or unproductive time of both handling equipment and manpower. Equipment and manpower are “making money” when fully utilized. Therefore every effort should be made to plan methods and schedule equipment to permit full use of both resources.
- **Maintenance Principle:** Plan for preventive maintenance and scheduled repair of all handling equipment's. If the equipment is in good working order it results in a lower cost per unit handled.
- **Control Principle:** Use of material handling equipment to improve production control, inventory control and order handling. Since material handling equipment is used to move materials through the plant and the production processes, its use can have a great effect on the control of the items being moved. In many cases, handling equipment provides a direct mechanical path for the movement thereby facilitates the control of the material.
- **Performance Principle:** Determine efficiency of handling performance in terms of expense per unit handled.

# Relationship of Material Handling with Plant Layout

- Plant layout and material handling go side by side, while working out details of plant layout, details of material handling for movement of men and material have to be worked out simultaneously.
- An effective layout involves least material handling and less costly material handling equipment.
- It permits material handling without any loss of time, with minimum delays and least back tracking.
- In a properly designed plant layout the total number of movements and distance moved in one direction are also considerably reduced.



- On the other hand an efficient material handling system helps building an effective plant layout around itself.
- Various departments are located in such a way that the material handling is minimized, space requirements are considerably reduced which make's material handling much faster and more economical.

# Selection of Material Handling Equipment

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The following factors may be considered while selecting material handling equipment:

**Type of Material to be moved:** Material can be divided into

- i) Bulk or unit
- ii) Bagged, large or small cartoons, boxes or drums
- iii) Light, medium or heavy



**Physical Properties and Possible Chemical Action:** The size of material, its shape, weight, nature (solid, liquid, gas) and its chances of getting damaged during handling and effect of dust, temperature, variations and moisture on the product decides the need for product protection and the selection of material handling equipment.

**Plant Building and Layout:** Plant building enters in the problem first in respect of number of floors, thus bringing the question of vertical transportation if the building is more than one story. Second plant building construction is concerned with the load that a floor can safely withstand and also with the possibility of attending certain type of conveying equipment to the structural members e.g. weak roofs limit the use of overhead conveyors and steps between two floors will not allow trucks to operate usually once a building has been erected it is not possible, at a reasonable cost to make too many changes in the construction merely for the purpose of installing material handling equipment. So; the plant building and layout effect to a great extent on the selection of material handling equipment.

**Type of Production System:** The selection of material handling equipment largely depend upon the type of production, conveyors are more suited for continuous production on fixed routes and power trucks for intermittent production. Conveyors though costly but can handle more volume of production per unit time as compared to trucks. Whereas a truck is more flexible equipment.

**Nature and Extent of Movement:** The selection of material handling equipment also depends upon nature and extent of movement. Whether a material is to be moved in horizontal, vertical or combination of both directions is to be decided. A vertical flow pattern will require elevators, conveyors, pipes etc. where as a horizontal flow pattern will need trucks, overhead bridge, cranes, conveyors etc.

**Path of Movement:** The path of movement can be classified as either fixed or variable and if variable as limited or unlimited. Certain materials go through the same sequence of operations and follow the exact path through a plant i.e. the path movement is fixed and roller conveyors, overhead chain drive monorail can be used over this path.



**Capacity of Equipment:** The equipment selected should have enough load carrying capacity to do the job effectively, yet should not be too large and result in excessive operating costs.

**Flexibility:** Flexibility of a material handling system refers to its adaptability to changes itself according to the operating conditions. These changing conditions involve different products of varying size, nature, shape and weight, changes in volume to be handled, new layouts, machinery and production process. The greater the possibility that these changes will occur the greater is the need for a flexible material handling system.

**Life of the Equipment:** The life of material handling equipment's should be maximum as possible. Because the downtime of equipment's increased cost of production so at the time of selection of material handling equipment. We must be ensured about the life of the equipment.

**Reliability and Maintainability:** Equipment should be chosen for its ease of maintenance (maintainability) at reasonable costs and for its reliability (maximum downtime). In addition equipment performance in these characteristics is dependent on part of the user's maintenance and operating policies.

**Cost of material handling equipment and handling costs:** Cost is the most important factor in equipment decisions. The company wants to minimize the cost of performing the materials handling function consistent with satisfactory performance.

In economic evaluation of various handling devices both the total capital outlay and operational handling costs should be taken into consideration. The capital outlay includes the cost of equipment, the cost of its transporting and constructional costs involved in its installation and operation. The difference in the cost of building and structures which can be serviced by alternative transporting facilities should be considered when comparing capital outlay.



### Operational handling costs include:

- Cost of electric power.
- Cost of lubricating, rigging and other material.
- Cost of repair and maintenance.
- Wages and salaries of personnel.

Moreover account should also be taken of losses due to depreciation. So in each case material handling equipment chosen should satisfy all the requirements of PPC and it should cut the handling cost/unit of load and reduce the term within the capital investment will pay.

# SAFETY REQUIRED WHILE USING MATERIAL HANDLING EQUIPMENT

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- To avoid premature fatigue of transport workers, full use should be made of mechanized material handling equipment.
- The transport workers should not be asked to lift more than the permissible load.
- During transport sharp material, sharp edged goods etc. should be covered and placed in stable holders.
- Containers or vessels employed to transport small parts or liquids



- Should not be too large to limit the range of vision
- Should be light and should not be defective or leaking.
- Depending upon the material to be lifted proper material handling equipment should be used.
- All material handling equipment's should be promptly repaired and adequately maintained on priority basis.
- Emergency stop buttons or a continuous stop card should be provided at all danger points.
- Follow traffic rules.
- Never allow unqualified person to operate your machine.
- Never use a naked flame to inspect battery or any leakage.

# Material Handling Equipment's

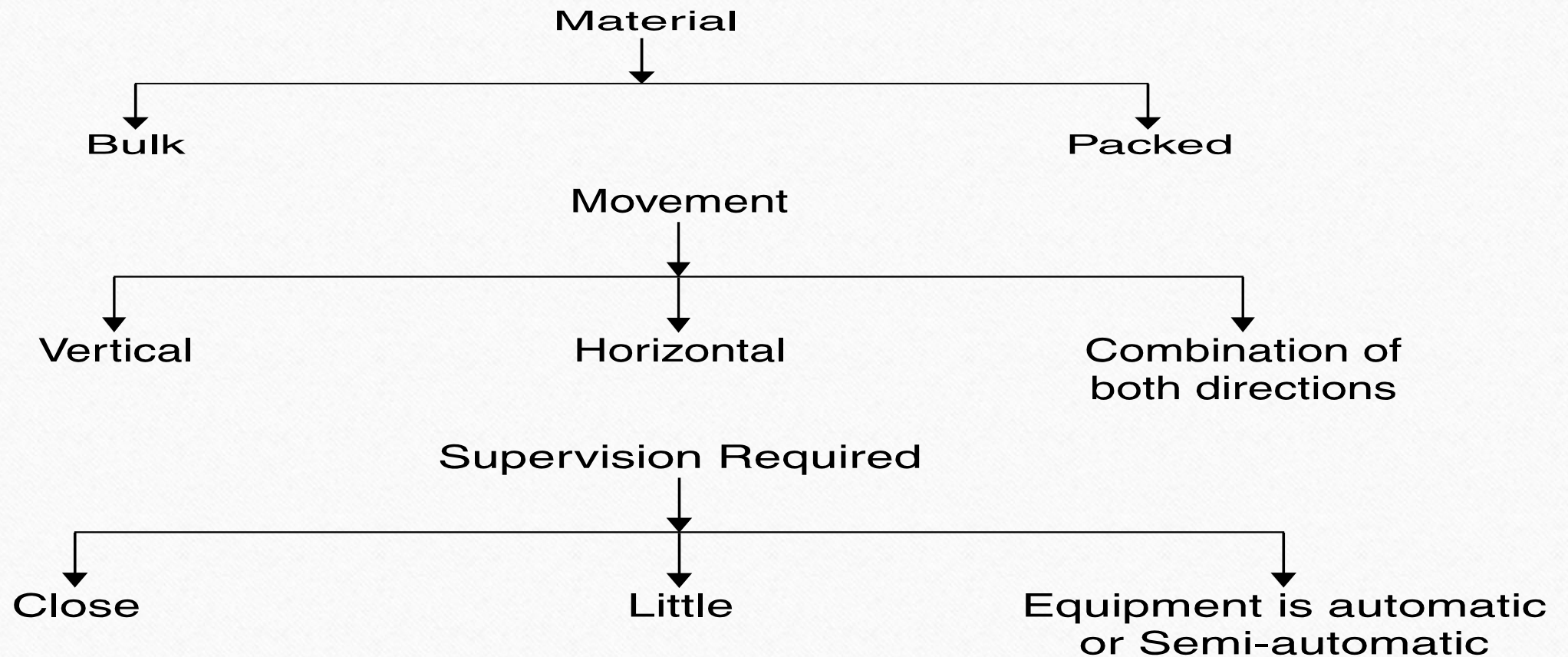
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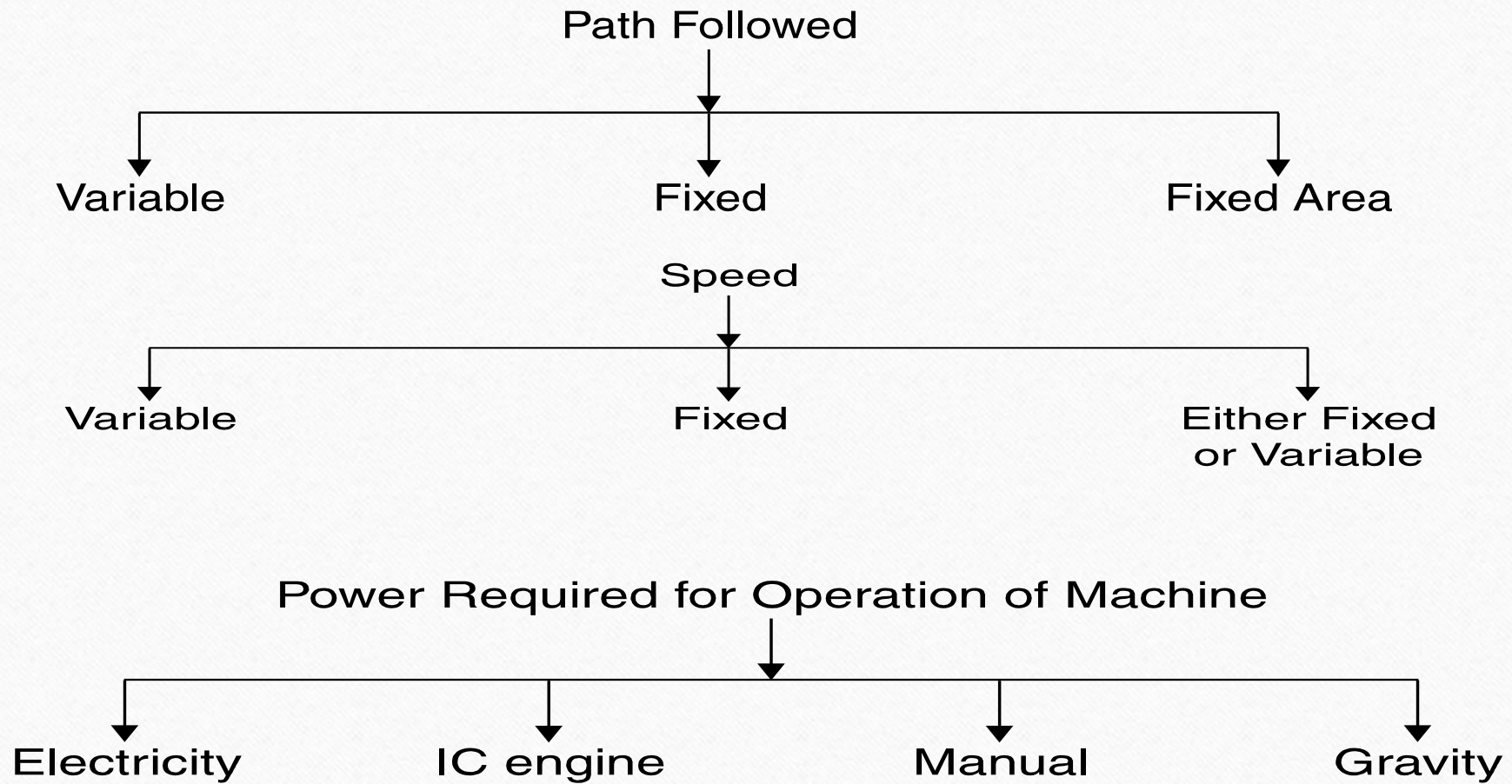
Types of MHEs (Material Handling Equipment's)





# Classification of Material Handling Equipments







# Categories of Material Handling Equipment's

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- Conveyors
- Cranes
- Hoists
- Trucks and Vehicles
- Auxiliary Equipment's

# CONVEYORS

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- Used where the path for the flow of material is **fixed**.
- Used for **horizontal as well as transportation along a slope**.
- Used for **Mass Production**
- Properly designed and installed conveyors are very reliable in operation, requiring a **minimum amount of downtime** for routine maintenance.



## (a) Belt Conveyors

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- The belt can be made from a variety of materials it may be rubber covered canvas, plain fabric etc.
  - Troughed Belt Conveyors
  - Metal Belt Conveyors

- Troughed belt used extensively for hauling coal, gravel, sand and similar material which are not too wet or sticky.
- The materials include carbon steel, galvanized steel, chromium stainless steel or other metal or alloys that are required for specific application and environment. Typical uses of metal belt conveyors include operation such as spray washing glass containers and moving hot forging from automatic die casting equipment.



# Troughed Belt Conveyors

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# Metal Belt Conveyors

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## **(b) Chain Conveyors**

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- Consists of one or more endless chains that travel the entire conveyor path.
  - Apron and Pan Conveyor
  - Slat Conveyor
  - Cross Conveyor
  - Car type Conveyor

# Chain Conveyors

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# Apron and Pan Conveyor Slat Conveyor

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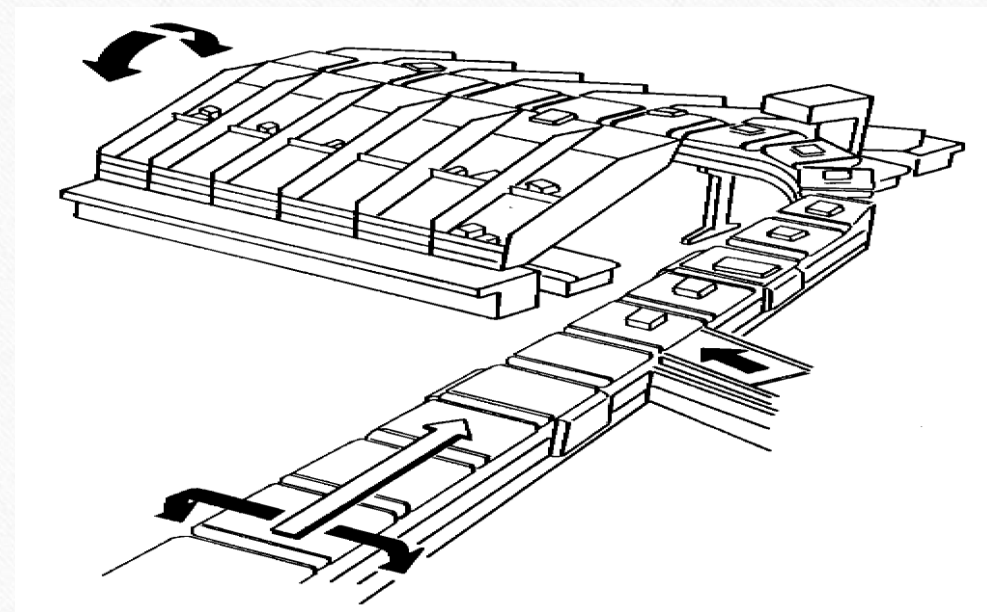
# Slat Conveyor

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- Unit being transported retains its position (like a belt conveyor)
- Orientation and placement of the load is controlled
- Used for heavy loads or loads that might damage a belt
- Bottling and canning plants use flat chain or slat conveyors because of wet conditions, temperature, and cleanliness requirements



# Cross Conveyor

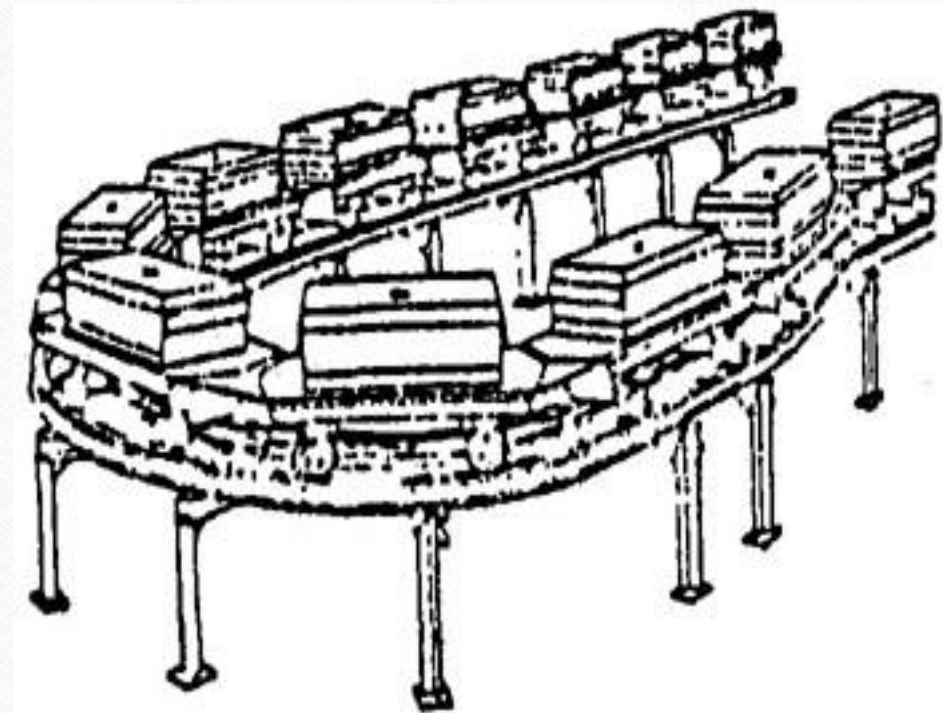


Either continuous loop, where individual carriages are linked together to form an endless loop, or train style (asynchronous), where a small number of carriers tied together with potential for several trains running track simultaneously.

Automatically separates single line of products into multiple in-line discharge lines.



# Car Type Conveyor





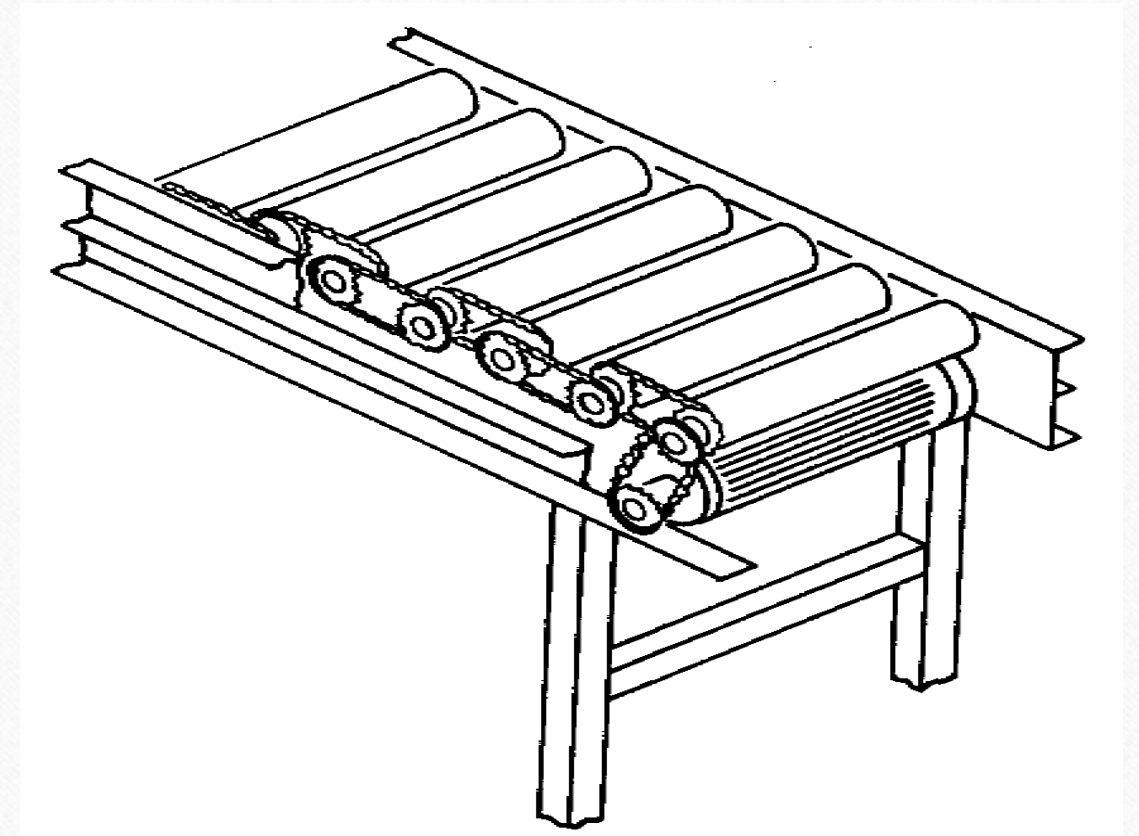
## (c) Roller Conveyors



- It consists of cylindrical rollers made of tubing's which revolve on free running bearings.
- Gravity aided or Powered
- Bigger jobs can be handled as they are, whereas small items put in boxes, tins or pallets before being transferred.
- The standard roller spacing is 3, 4 or 5 inch. If the weight handled is more than spacing should be closer. Generally the minimum spacing is one third of minimum package length. At any time there are three rollers under load.



# Gravity aided or Powered





## (d) Pneumatic Conveyor

- High volume of air flows through a tube, carrying materials along with the air flow.
- Not suitable for carrying Wet materials.



## (e) Gravity Bucket Conveyor

- In the bucket conveyors, freely swinging buckets are carried between a pair of parallel endless chain which can follow any path from vertical to horizontal.
- Any type of materials can be fed into bunkers not water.
- Few common types of bucket conveyors are:
  - Gravity discharge bucket conveyor
  - Pivoted Bucket Conveyors
  - Bucket Elevators.





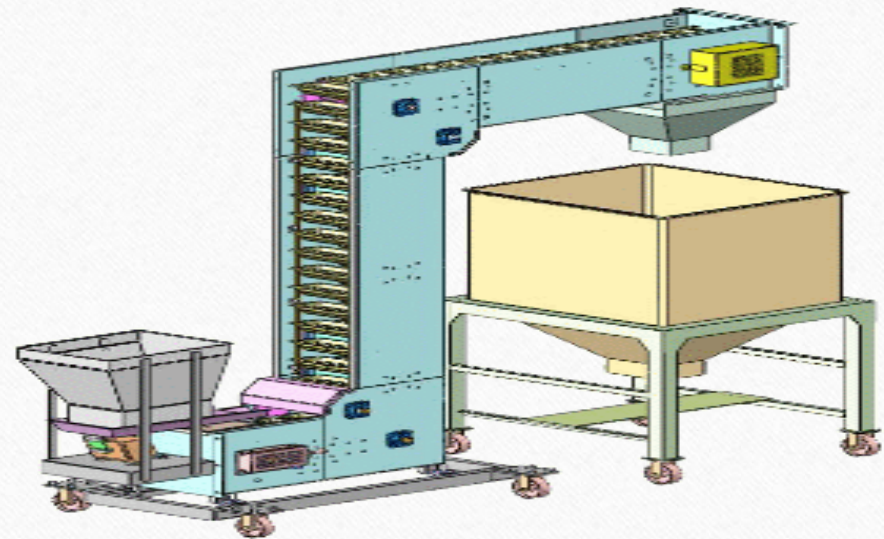
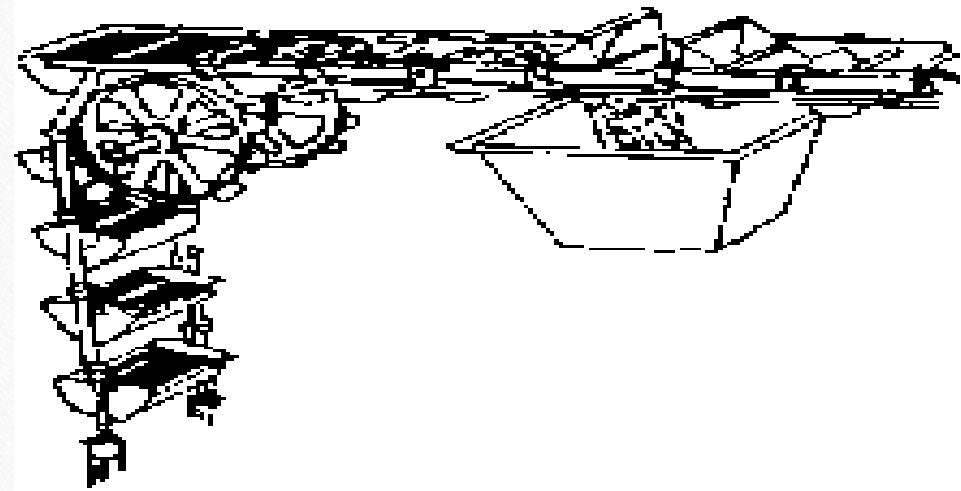
# Gravity Discharge Bucket Conveyor



These are simple and more suitable for bulk materials like coals, sands etc. The cost of operation is also relatively low and the degradation of material is minimum in this case.

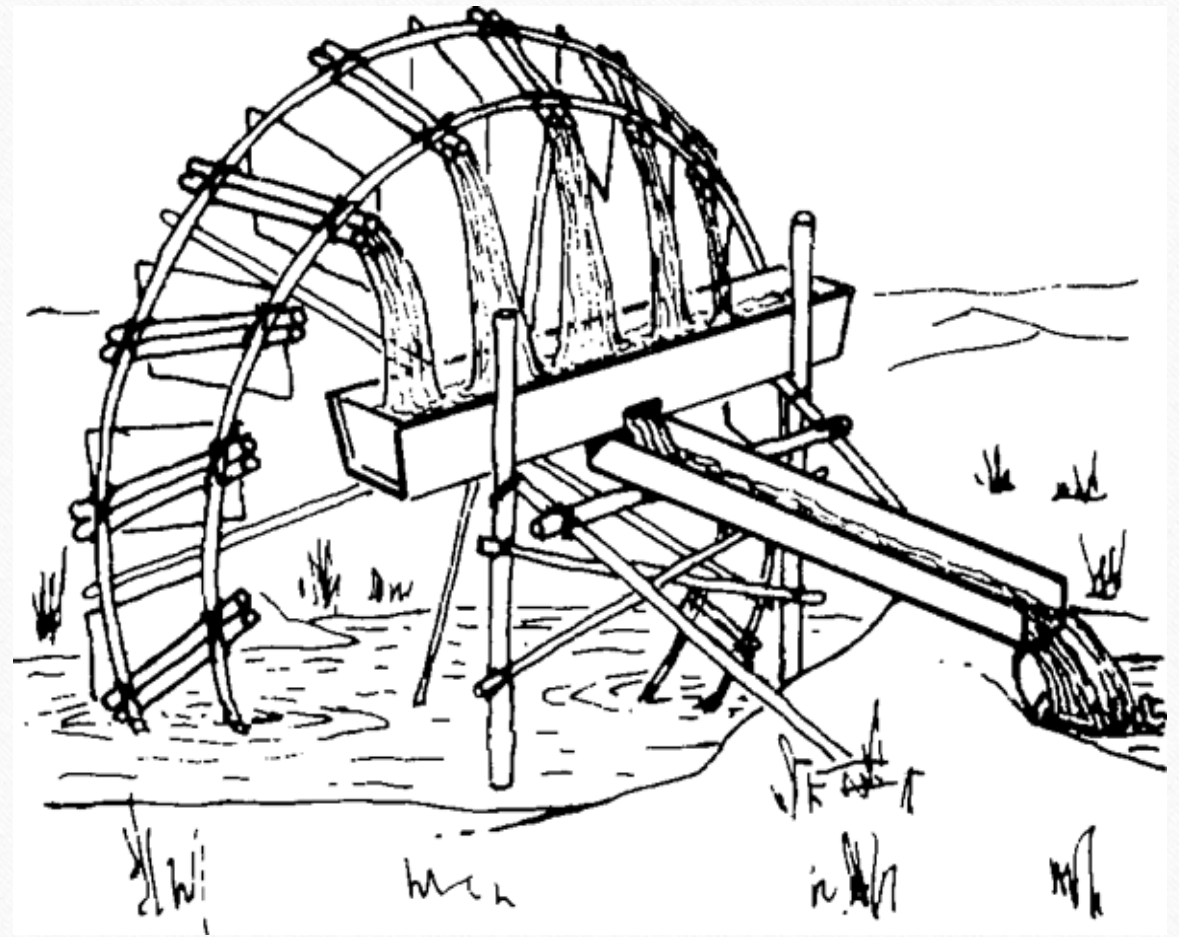
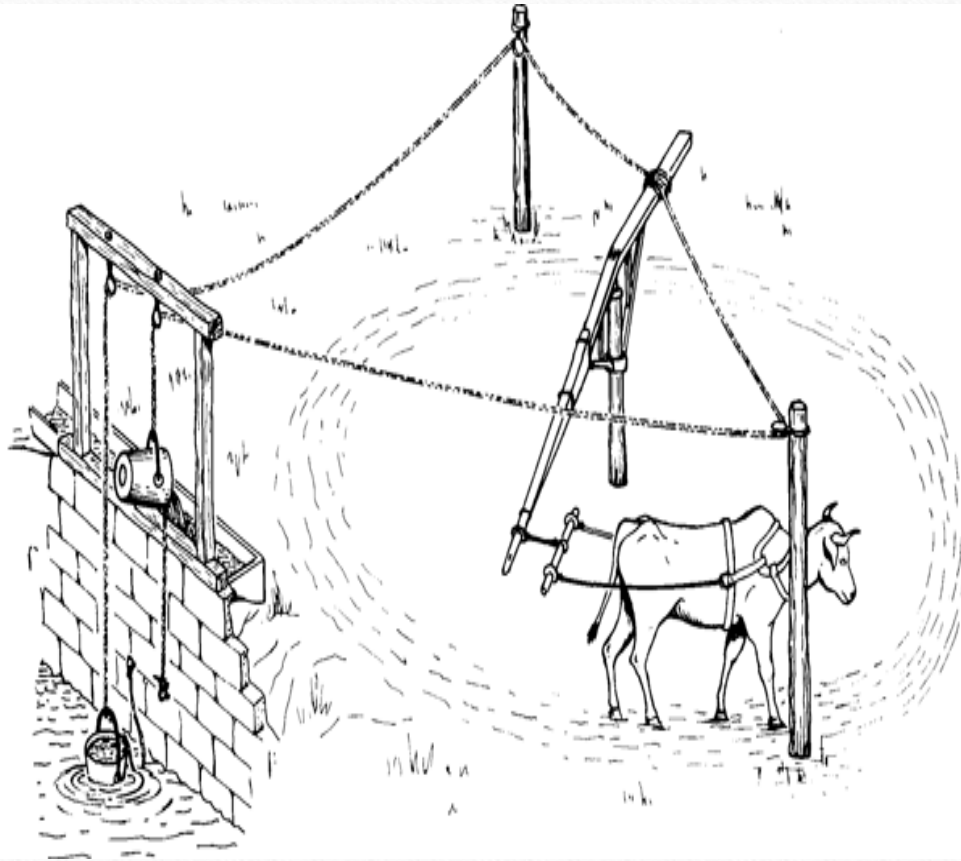
# Bucket Conveyors

- These are generally used in power plants for handling coal and ashes, in cement mills, in ceramic industries, in crushing plants etc.
- The capacity of conveyors ranges 200-300 tones/hr.
- The maintenance cost is low but higher than regular bucket conveyor.





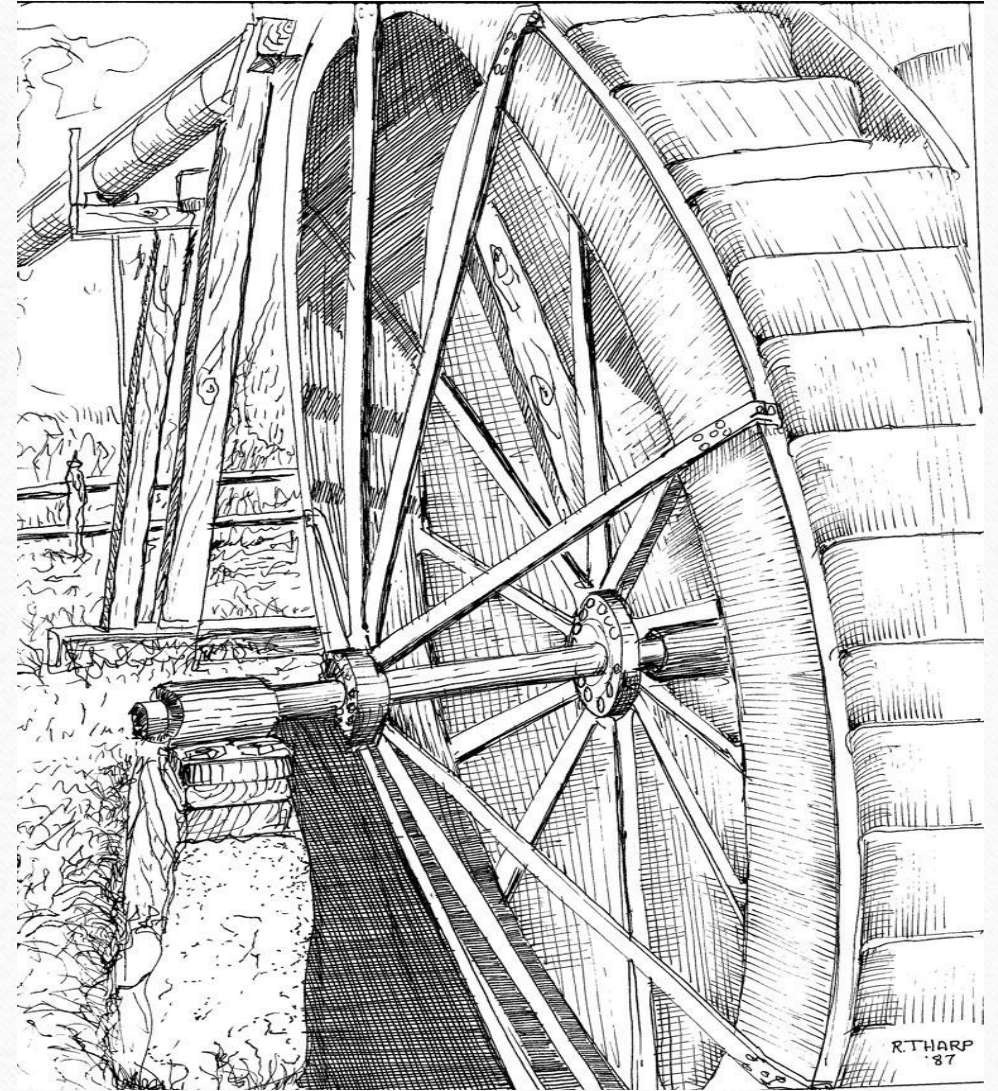
# Pivoted Bucket Conveyors





A short rod or shaft on which a related part rotates or swings.

A person or thing on which something depends or turns; the central or crucial factor





# CRANES

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- Cranes are amongst the oldest type of fixed path equipment.
- These are best used where consideration of space make other equipment in practicable.
- It lift; swing and transport wide range i.e. light to heavy loads of awkward shape.

# Types of Cranes

- Portable Hand powered crane
- Jib and Goose Neck Crane
- Revolving Jib crane
- Overhead Travelling Crane
- Top running crane
- Under Hung crane
- Derrick Crane
- Gantry Crane
- Stacker Crane
- Industrial Mobile Crane



# Portable Hand Powered Crane

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# Jib and Goose Neck Crane

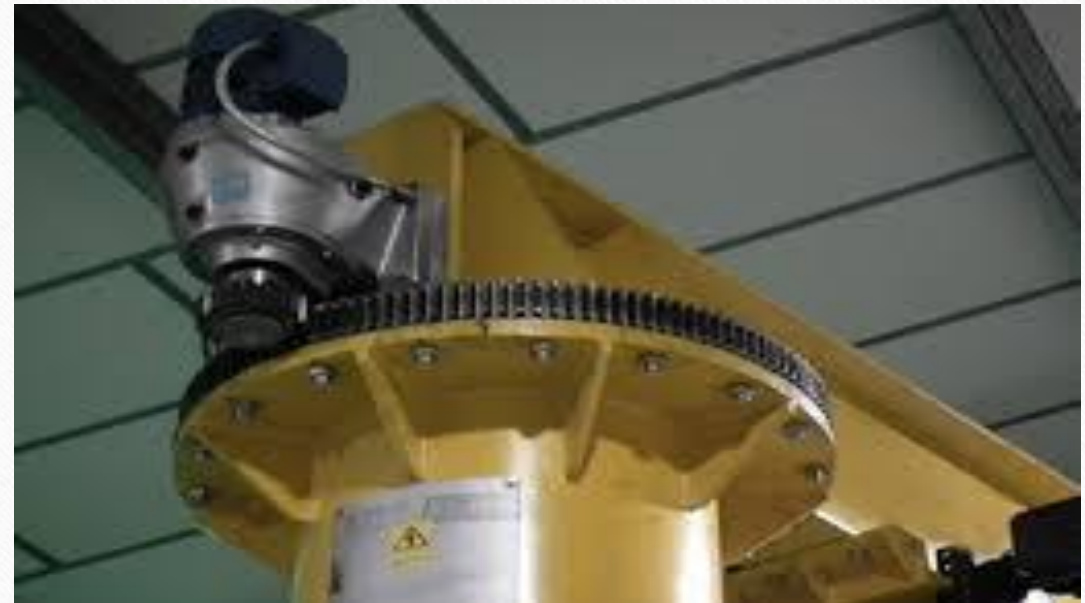
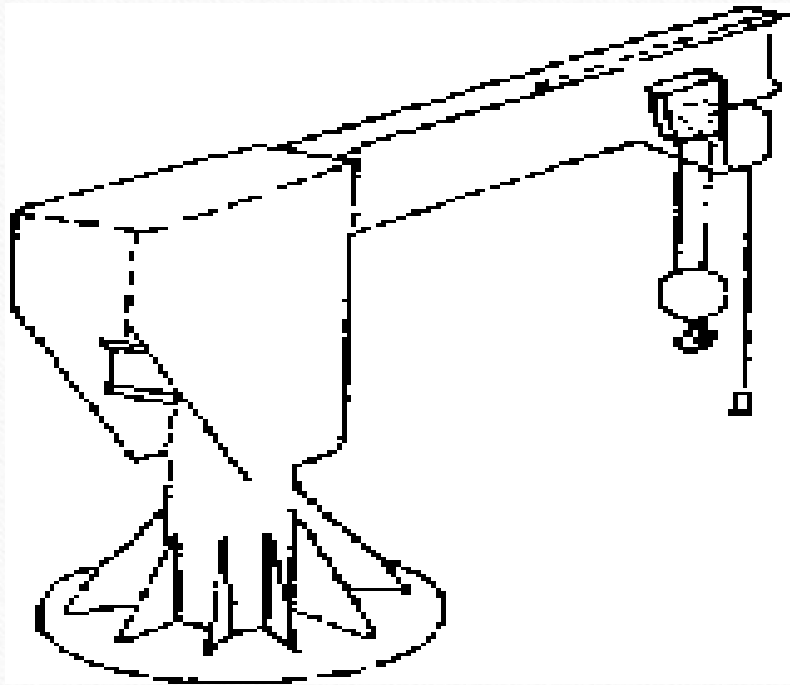
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# Revolving Jib Crane

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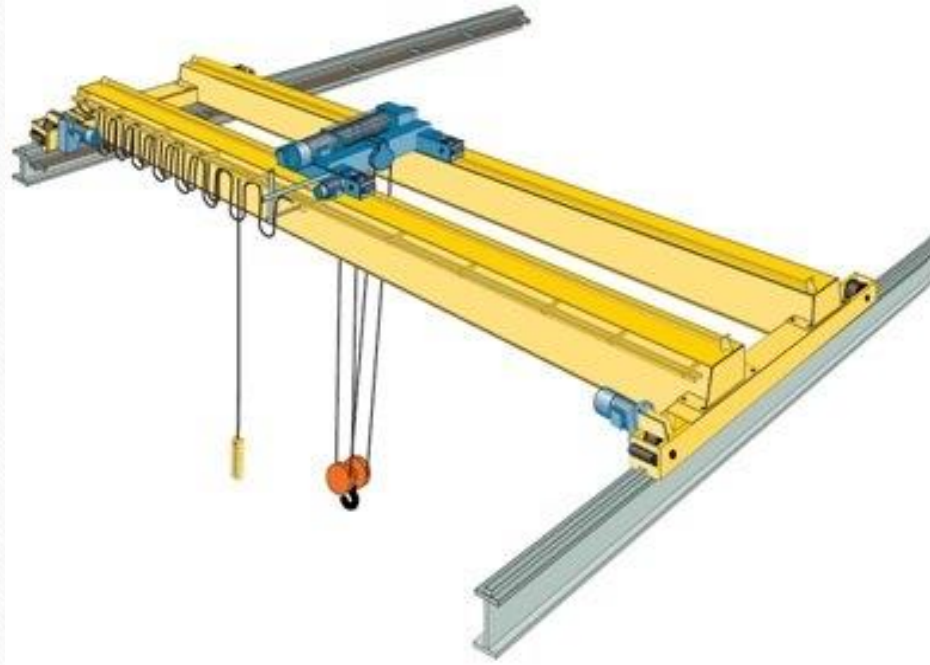


# Overhead Travelling Crane





# Top Running Crane and Under Hung Crane



# Derrick Crane

- A machine for hoisting and moving heavy objects, consisting of a movable boom equipped with cables and pulleys and connected to the base of an upright stationary beam.
- A tall framework over a drilled hole, especially an oil well, used to support boring equipment or hoist and lower lengths of pipe.





# Gantry Crane

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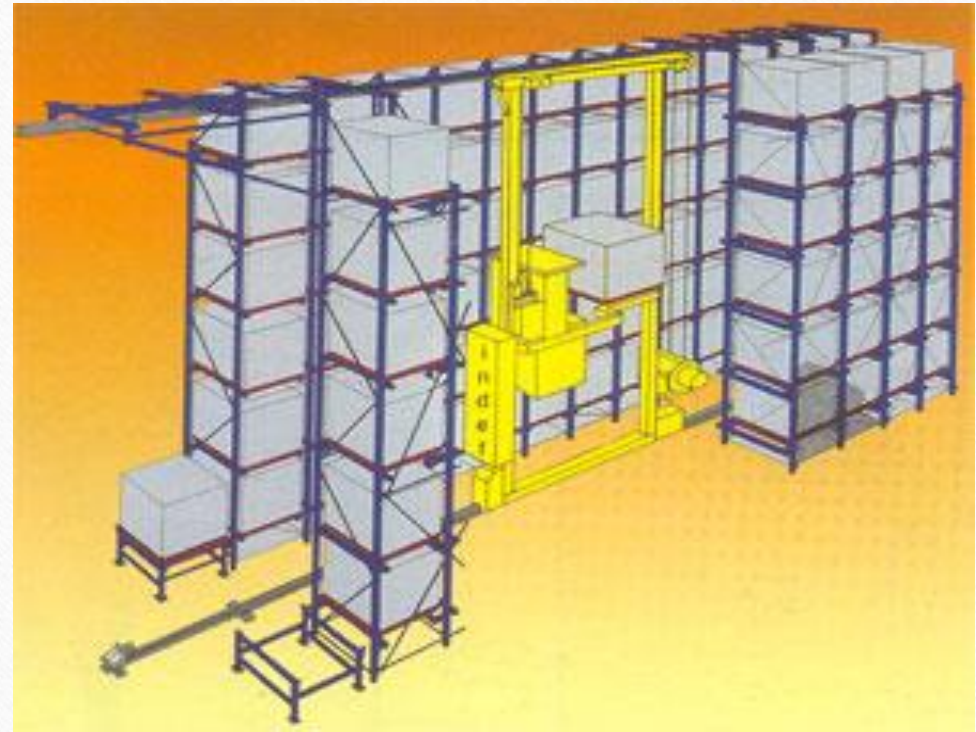








# Stacker Crane



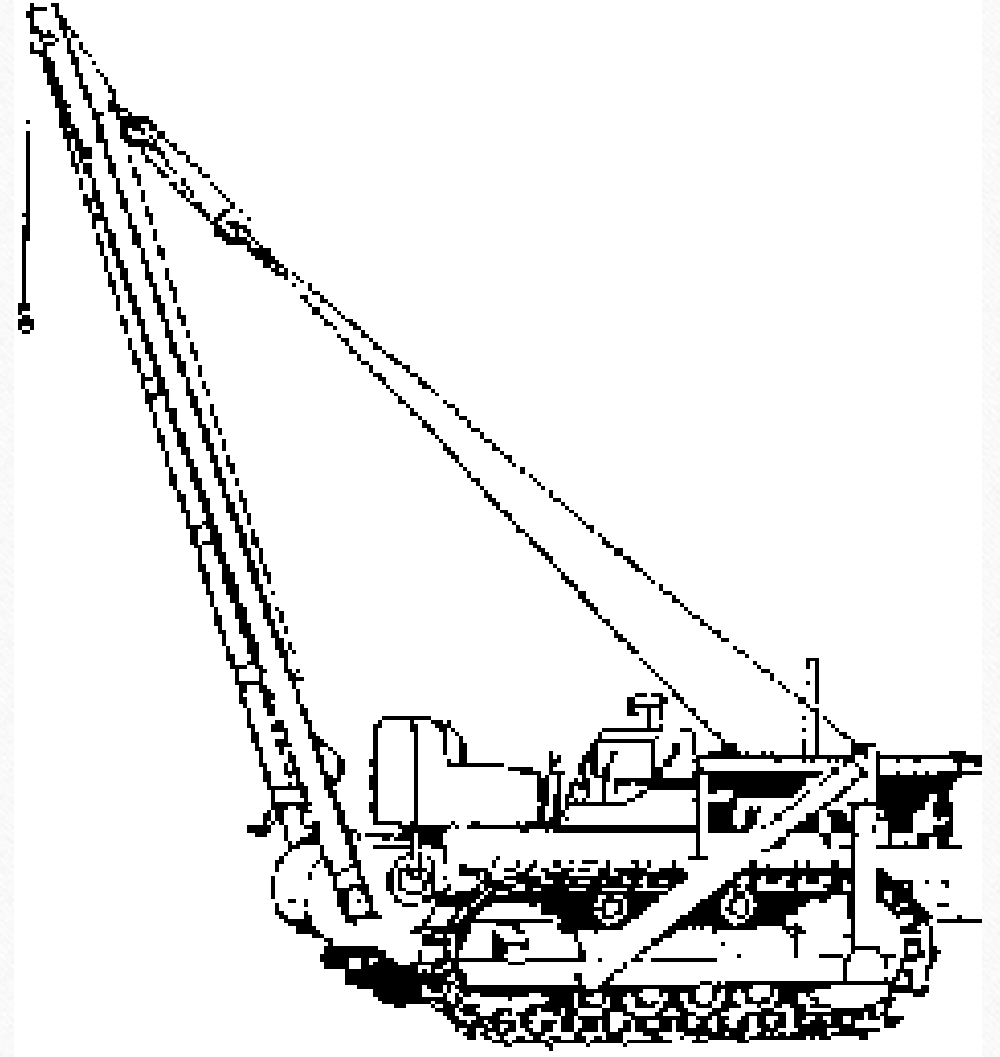


# Industrial Mobile Crane

- They are particularly useful for large and unusual size and where careful replacement is required.
- These cranes are operating independently of any supporting structure.
- The primary advantage of a crane is its ability to reach into places normally not accessible by other types of material handling equipment.
- They are classified as:
  - Non swing cranes
  - Full swing revolving boom cranes
  - Straddle Cranes.



# Non swing cranes



# Full Swing Revolving Boom Cranes





# Straddle Cranes

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# HOISTS

- Hoists are used for lifting the loads vertically and horizontally.
- It operates between fixed guide rails.
- A hoist consists of a hook, a lifting medium, which is usually a rope, chain and container for storing the rope or chain.
- The power use can be electric motor or of compressed air pneumatic. Some hand retched hoists are also available.
- The electric or pneumatic hoists are for heavy loads and hand retched are for small roads.



# Types of Hoists

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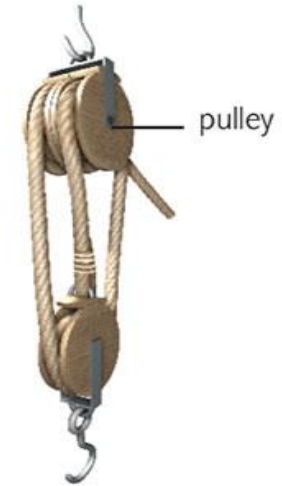
They are classified as follows:

- Block and Tackle
- Winches
- Power Hoists (Electrical)
- Elevators

# Block and Tackle



**block and tackle**

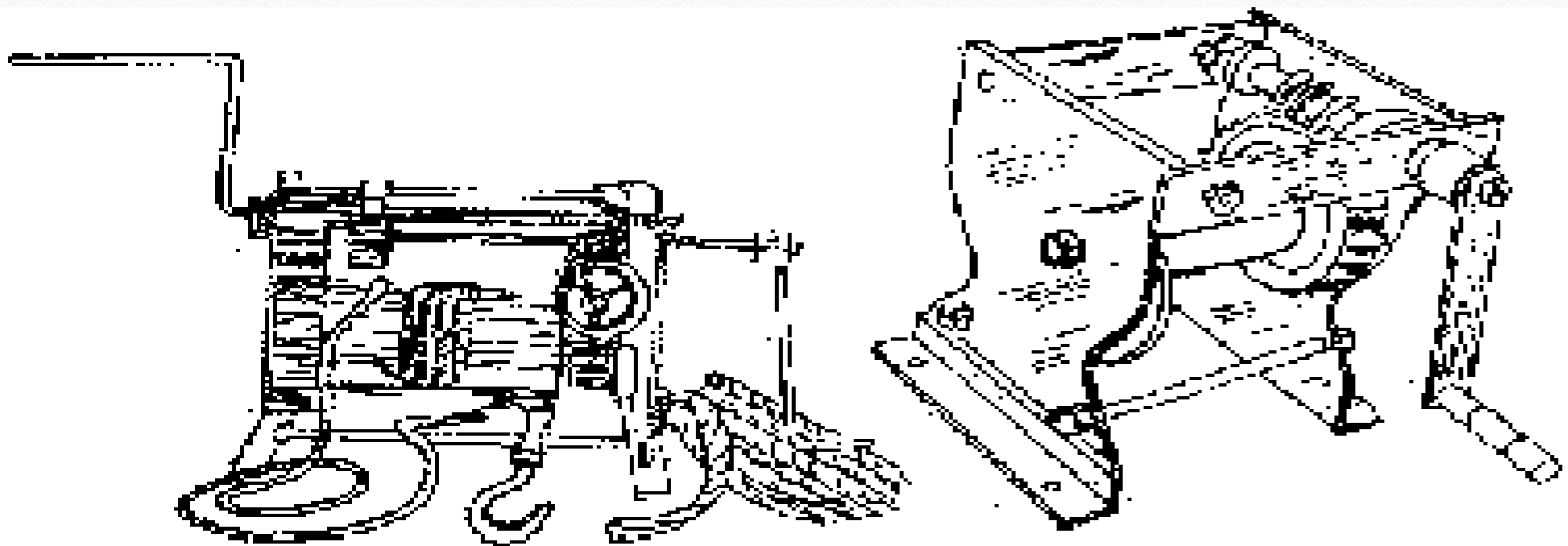




# Winches

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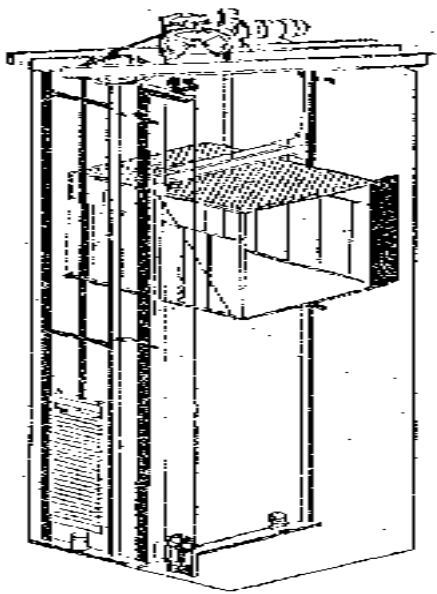
Winches



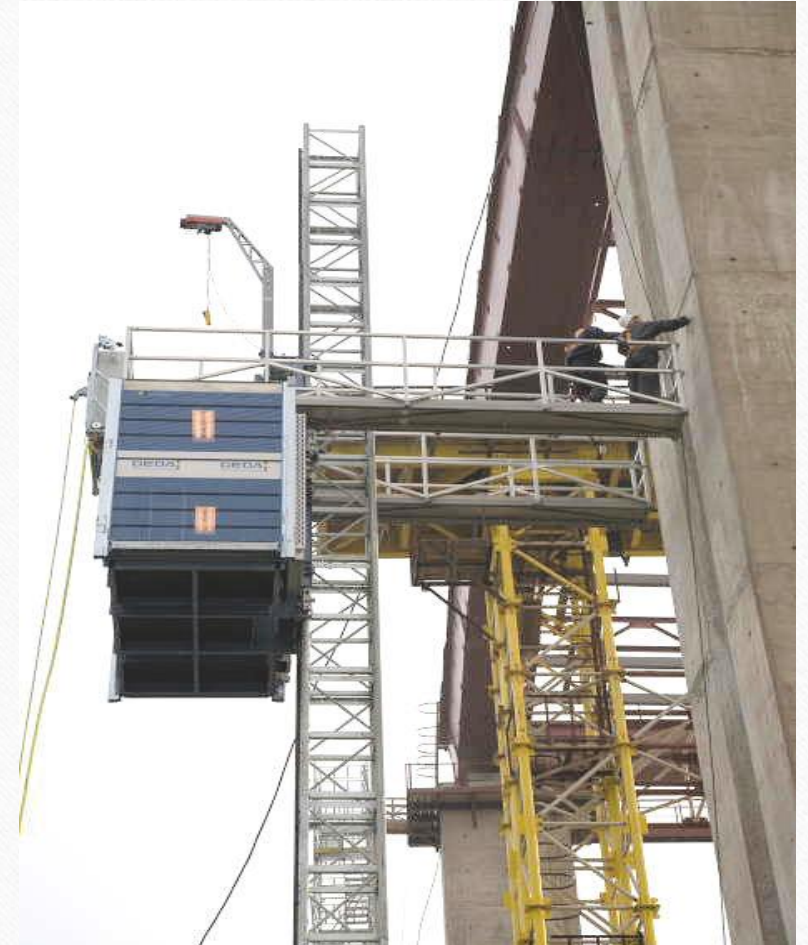
# Power Hoists (Electrical)



# Elevators



- Hoists and elevators are similar except that the operator slides with the load in case of elevators whereas in hoists it is not so.
- Now days hydraulic elevators are used more as compared to electric elevators due to danger of spark.





# TRUCKS OR VEHICLES

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These are simple in construction, widely used in industries. These can be broadly classified in two main categories:

- Floor Trucks
- Fork lift Truck

# Floor Trucks

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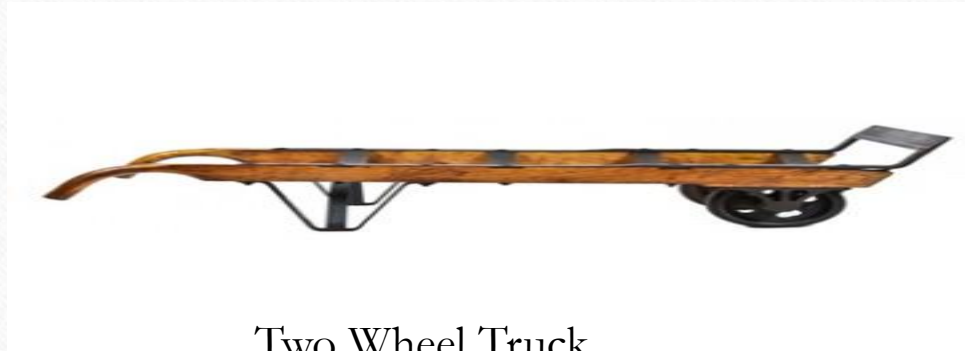
- These are available in a wide variety and are recommended only for short hands and auxiliary service.
- The important types of floor trucks are:
  - **Hand Wheel Trucks**
  - **Dollies:** These are smaller wheel platforms upon which a load is placed for short distances and intermittent moves.



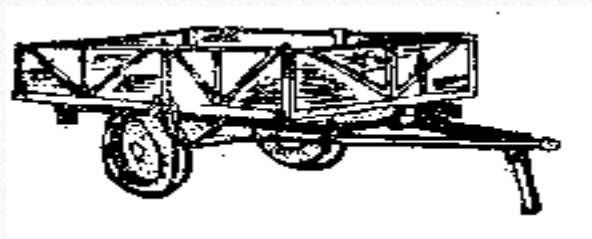
# Hand Wheel Trucks and Dollies



Single Truck



Two Wheel Truck

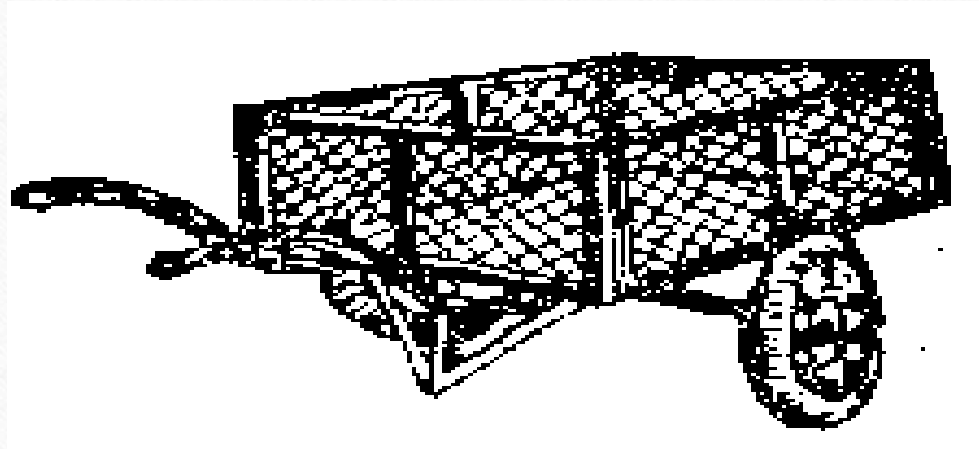


Wheeled open Top Platform



Platform Truck

# Hand Wheel Trucks and Dollies

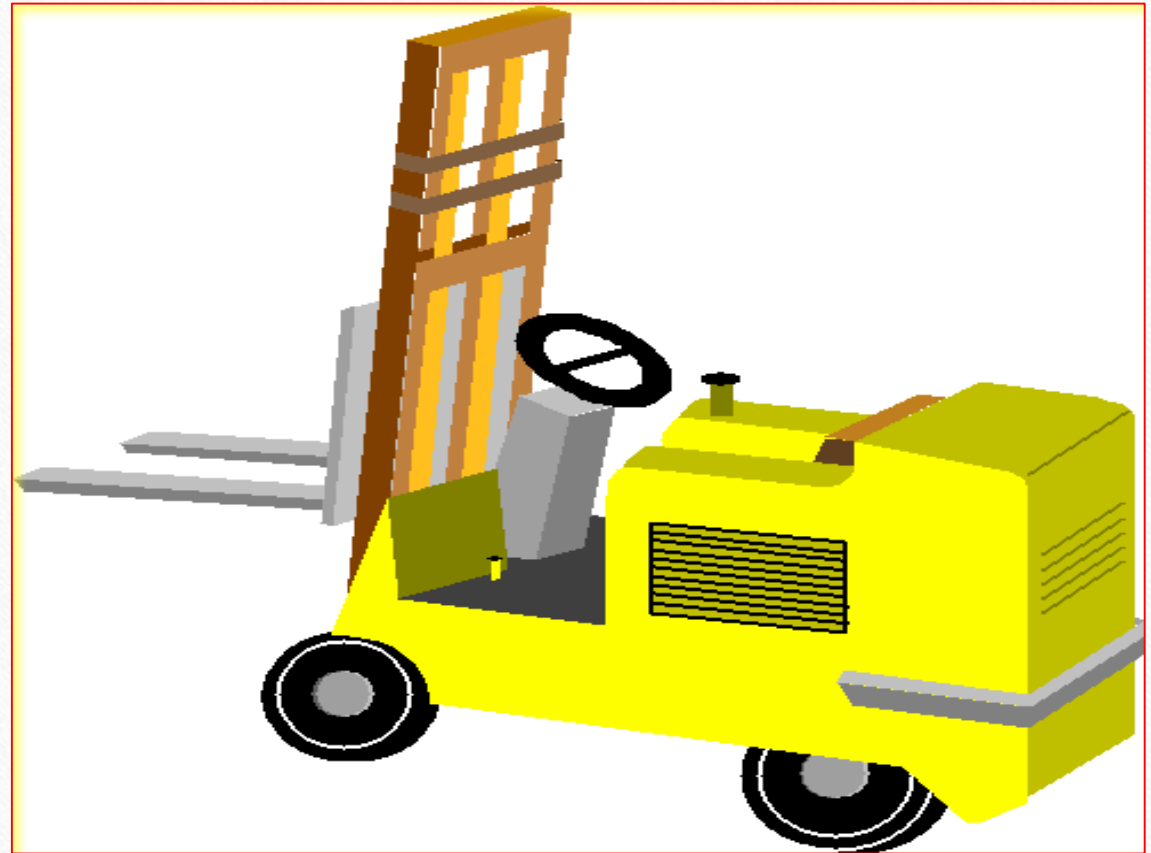


Wheeled Hand Trolley Suitable for Carrying Finished Goods/raw Materials Complete with Iron Net



# Fork Lift Trucks

- These are the motor driven trucks, which may be powered by engines, by electric motor drawing current from storage batteries are capable of handling much heavier loads than the hand type and are a familiar feature of most works.



- Fork lift trucks being able to easily pick up the unit load transport it quickly and then position the load vertically at almost any point within the capacity of equipment and most is mounted ahead of the vehicle to permit lifting and stacking of loads.





# Fork Lift Trucks



# Auxiliary Equipment's

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- These are the devices or attachments used with handling equipment to make their use more effective and versatile. Examples are ramps, pallets, containers, positioners, turn tables.



# Question?

## **Skill Development**

### **FAST FOOD RESTAURANT VISIT:**

Get the information for the following questions:

1. Material handling in the restaurant for production and services.
2. Type of material handling equipment used for production and services.
3. Utilization of material handling equipment

# THANK YOU

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