Material handling

Figure 1. Fabric storage equipment

Figure 2. Different types of equipment for material handling

Material handling

- Raw materials form a critical part of manufacturing as well as service organization. In any organization, a considerable amount of material handling is done in one form or the other. This movement is either done manually or through an automated process. Throughout material, handling processes significant safety and health; challenges are presented to workers as well as management. Therefore, **manual material handing is of prime concern for health and safety professional, and they must determine practical ways of reducing health risk to the workers.**

Material handling (MH) can be defined as the "art and science of conveying, elevating, positioning, transporting, packaging and storing of materials and this movement is either performed by manually or through an automated process".

Objectives of Material Handling

- Manual material handling ranges from movement of raw material, work in progress, finished goods, rejected, scraps, packing material, etc. These materials are of different shape and sizes as well as weight. Material handling is a systematic and scientific method of moving, packing and storing of material in appropriate and suitable location. **The main objectives of material handling are as follows:**

a) It should be **able determine appropriate distance to be covered**.

b) Facilitate **the reduction in material damage** as to improve quality.

c) **Reducing overall manufacturing time** by designing efficient material movement

d) **Improve material flow control**

e) **Creation and encouragement of safe and hazard-free work condition**

f) Improve **productivity and efficiency**

g) **Better utilization of time and equipment**

- In the current competitive and globalized environment, it is important to control cost and reduce time in material handling. **An efficient material handling process promotes:**

a) Design of proper facility layout

b) Promotes development of method which improves and simplifies the work process

c) It improves overall production activity.

d) Efficient material handling reduces total cost of production.

Principles of Material Handling:

- **Orientation Principle:** It encourages study of all available system relationships before moving towards preliminary planning. The study includes looking at existing methods, problems, etc.
- **Planning Principle:** It establishes a plan which includes basic requirements, desirable alternates and planning for contingency.
- **Systems Principle:** It integrates handling and storage activities, which is cost effective into integrated system design.
- **Unit Load Principle:** Handle product in a unit load as large as possible
- **Space Utilization Principle:** Encourage effective utilization of all the space available
- **Standardization Principle:** It encourages standardization of handling methods and equipment.
- **Ergonomic Principle:** It recognizes human capabilities and limitation by design effective handling equipment.
- **Energy Principle:** It considers consumption of energy during material handling.
- **Ecology Principle:** It encourages minimum impact upon the environment during material handling.
- **Mechanization Principle:** It encourages mechanization of handling process wherever possible as to encourage efficiency.

Principles of Material Handling:

- **Flexibility Principle:** Encourages of methods and equipment which are possible to utilize in all types of condition.
- **Simplification Principle:** Encourage simplification of methods and process by removing unnecessary movements
- **Gravity Principle:** Encourages usage of gravity principle in movement of goods.
- **Safety Principle:** Encourages provision for safe handling equipment according to safety rules and regulation
- **Computerization Principle:** Encourages of computerization of material handling and storage systems
- **System Flow Principle:** Encourages integration of data flow with physical material flow
- **Layout Principle:** Encourages preparation of operational sequence of all systems available
- **Cost Principle:** Encourages cost benefit analysis of all solutions available
- **Maintenance Principle:** Encourages preparation of plan for preventive maintenance and scheduled repairs
- **Obsolescence Principle:** Encourage preparation of equipment policy as to enjoy appropriate economic advantage.

Types of Material Handling Equipments:

- The four main categories of material handling equipment include
- i) Storage handling equipment
- ii) Engineered systems
- iii) Industrial trucks, and
- iv) Bulk material handling.

i. Storage Handling Equipment

- Storage equipment is usually **limited to non-automated examples, which are grouped in with engineered systems**.
- Storage equipment is used **to hold or buffer materials during "downtimes," or times when they are not being transported.**
- These periods could refer to temporary pauses during **long-term transportation or long-term storage designed to allow the buildup of stock.**
- **The majority of storage equipment refers to pallets, shelves or racks** onto which materials may be stacked in an orderly manner to await transportation or consumption.
- Many companies have investigated increased efficiency possibilities in storage equipment by designing proprietary packaging that allows materials or products of a certain type to conserve space while in inventory.

- **Examples of storage and handling equipment include:**
- **Racks**, such as pallet racks, drive-through or drive-in racks, push-back racks, and sliding racks, are a basic but important method of storage, saving floor space while keeping their contents accessible.
- **Stacking frames** are stackable like blocks, as their name implies. They allow crushable pallets of inventory, such as containers of liquid, to be stacked to save space without damage.
- **Shelves, bins, and drawers.** Shelves, another basic storage method, are less open than racks. Used with bins and drawers, they're more able to keep smaller and more difficult to manage materials and products stored and organized. Shelving types can include boltless, cantilever, revolving, and tie-down.
- **Mezzanines**, a type of indoor platform, help to create more floor space in a warehouse or other storage building for offices or more storage. Typical types include modular, movable, rack supported, building supported, and free-standing versions.
- **Work assist tooling** enables safe and efficient product handling across numerous industries in applications that require the movement of products, enhancing the efficiency of assembly and manufacturing operations.

Shelves

Rack

Mezzanine floor

Bin

Staking frame

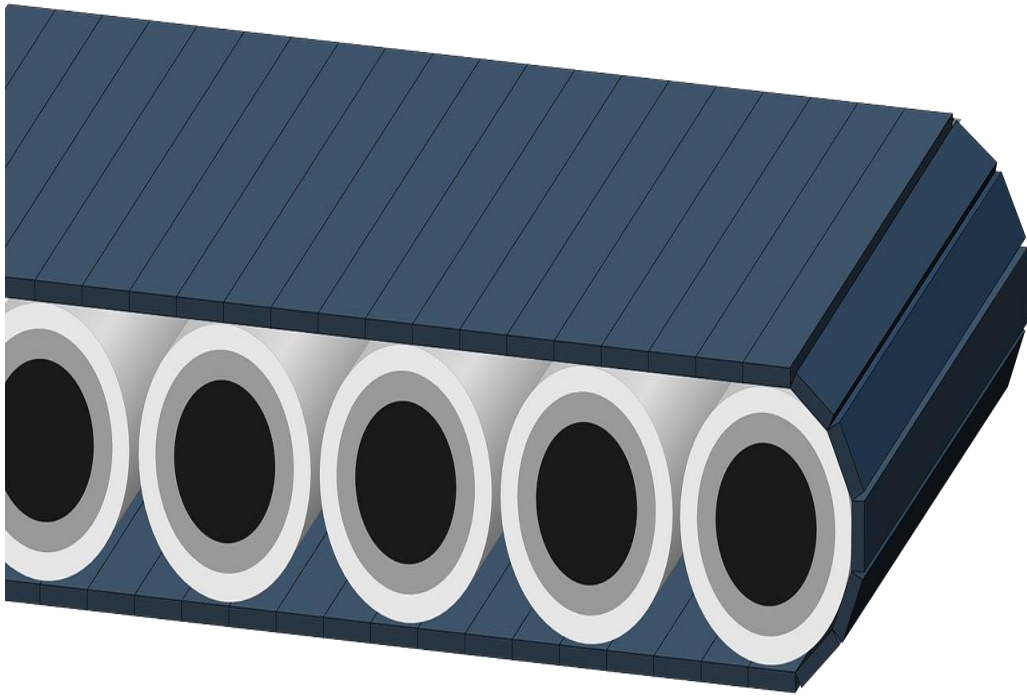
ii. Engineered Systems:

- Engineered systems cover a variety of units that work cohesively to enable storage and transportation.
- They are often automated.
- A good example of an engineered system is an Automated Storage and Retrieval System, often abbreviated AS/RS, which is a large automated organizational structure involving racks, aisles and shelves accessible by a “shuttle” system of retrieval.
- The shuttle system is a mechanized cherry picker that can be used by a worker or can perform fully automated functions to quickly locate a storage item’s location and quickly retrieve it for other uses.

Other types of engineered systems include:

- **Conveyor systems** come in a variety of types, depending on what they are meant to transport, including vibrating, overhead, chain, vertical, and apron conveyors.
- **Automatic Guided Vehicles (AGV)** are independent computer-operated trucks that transport loads along a predetermined path, with sensors and detectors to avoid bumping into anything.

Automatic Guided Vehicles (AGV)



Conveyor system (Belt type)

- **Industrial Material Handling Trucks:**
- Industrial trucks (material handling trucks) refer **to the different kinds of transportation items and vehicles used to move materials and products in materials handling.**
- These transportation devices can include **small hand-operated trucks, pallet jacks, and various kinds of forklifts.**
- These trucks have a variety of characteristics to make them suitable for different operations.
- Some trucks have **forks, as in a forklift, or a flat surface with which to lift items**, while some trucks require **a separate piece of equipment for loading**. Trucks can also be **manual or powered lift** and **operation can be walk or ride**, requiring a user to **manually push them or to ride along on the truck.**
- **A stack truck** can be used **to stack items**, while **a non-stack truck** is typically **used for transportation and not for loading.**

- **There are many types of industrial trucks:**
- **Hand trucks**, one of **the most basic pieces of material handling equipment**, feature a small platform to set the edge of a heavy object on, and a long handle to use for leverage. Whatever is being moved must be tipped so that it rests on the handle, and is carried at a tilt to its destination.
- **Pallet Trucks,** also known as **pallet jacks**, are a type of truck specifically for pallets. They slide into a pallet and lift it up to move it. Pallet trucks come in both manual and electrical types.
- **Walkie Stackers transport and lift pallets like a forklift,** though they don't include a place for the operator to ride in. They come in both powered or manual versions.
- **Platform trucks** are hand trucks low to the ground, with a wide platform for transporting goods.
- **Order pickers** lift the operator **several feet above the ground on a platform** so they can retrieve or **store goods on high shelves**.
- **Side loaders**, **also known as VNA (Very Narrow Aisle) trucks, are meant to fit in narrow warehouse aisles**, as they **can load objects from different directions**. They're also good for long, awkward products that need moving.
- **Many types of AGV**, or automatic guided vehicles, as discussed above, shuttle products along a route automatically, without human guidance.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- Bulk Material Handling Equipment:
- Bulk material handling refers to the storing, transportation and control of materials in loose bulk form. These materials can include food, liquid, or minerals, among others. Generally, these pieces of equipment deal with the items in loose form, such as conveyor belts or elevators designed to move large quantities of material, or in packaged form, through the use of drums and hoppers.
- **Conveyors**, as mentioned above, come in a wide variety of types for different types of bulk material.
- **Stackers**, which are usually automated, pile bulk material onto stockpiles, moving between two points along rails in a yard.
- **Reclaimers** are the opposite of stackers, retrieving materials from stockpiles, some using bucket wheels to carry the material while others are scraper or portal style.

- **Bucket elevators**, also known as grain legs, use buckets attached to a rotating chain or belt to carry material vertically.
- **Grain elevators** are tall buildings specifically for storing grain. They include equipment to convey the grain to the top of the elevator, where it is sent out for processing.
- **Hoppers** are funnel-shaped containers that allow material to be poured or dumped from one container to another. Unlike a funnel, though, hoppers can hold material until it’s needed, then release it.
- **Silos** are generally large storage structures for bulk materials, though they don’t necessarily include equipment to convey the material to the top of the structure like grain elevators. Different varieties include tower, bunker, and bag silos.

Broadly material handling equipment's can be classified into two categories:

- Fixed path equipment's; which move in a fixed path
- Variable path equipment’s have no restriction in the direction of movement.

Factors affecting the Selection of material handling equipment:

1)Properties of the material

2) layout and characteristics of the building

3) Production flow

4) Cost consideration

5) Nature of operations

6) Engineering factors

7) Equipment reliability

Relationship between plant layout and material handling:

There is a close relationship between plant layout and material handling. **A good layout ensures minimum material handling and eliminates rehandling** in the following ways:

1. Material movement **does not add any value to the product**. So, the material handling should be kept at minimum though not avoid it. This possible only through the systematic plant layout. Thus a good layout minimizes handling.

2.The productive time of workers **will go without production if they are required to travel long distance to get the material tools**, etc. Thus a **good layout ensures minimum travel for workman thus enhancing the production time and elimination the hunting time and travelling time.**

3. **Space** is an important criterion. **Plant layout integrates all the movements of man, material through a well designed layout** with material handling system.

4. Good plant layout helps in building efficient material handling system. It helps to **keep material handling shorter, faster and economical**. A good layout **reduces the material backtracking, unnecessary workmen movement ensuring effectiveness in manufacturing.**

Accident and safety:

Accident:

An event that happened all on sudden unexpectedly resulting in something bad is called an accident.

- Types of accident:
  - A) Lost time accident
  - B) Home case
  - C) First aid cases
  - D) Other accident:
    - i) Traffic accidents
    - ii) Passenger accidents
    - iii) Machine accident
    - iv) Non machine accidents
    - v) Natural accidents
    - vi) Nature of accidents: They include-
      - -Fatal
      - - Fractures
      - - Cuts
      - - Burns

Effect of an accident:

1) Personal effects:

- i) Death
- ii) Disability
- iii) Physical suffering
- iv) Loss of earning capability
- v) Loss of ability for efficient working
- vi) Psychological suffering

- 2) Social effects:
- i) Social status may be lost
- ii) Family humiliation the disability is permanent
- iii) An asset in the form earning hand becomes a liability

3) Other effects: These includes”

i) Loss of man hours

ii) Loss of machine hours

iii) Loss of materials

iv) Damaged machinery

v) Loss of capital

vi) Loss of reputation

vii) Compensation costs

Causes of an accident:

1) Improper working condition: Factors such as

-Improper temperature

-Improper humidity

- Insufficient light

- More working hours

- Layout plan

- Machine arrangement etc.

2) Work methods

-Lengthy period working

- Severity of work

- The rapidity of production etc.

3) Factors concerning the workers

- -Immature age
- - Less experience
- -Bad state of health
- - Physical defects
- -Un favorable mental and emotional conditions etc.

Means of preventing accidents:

i. Reform of working condition

ii. Provision of safety methods

iii. Pay attention of individual difference

iv. Training in right work methods

v. Means of removing fatigue

vi. Proper speed of work

vii. organisation of safety committee

viii. Safety campaign and posters

Industrial Hazard:

The accidental injuries are mostly occurred due to exposure to unsafe condition and unsafe personal acts. In the industrial environment the unsafe condition and unsafe activities are turned as industrial hazard. Industrial hazards are the main causes of industrial accidents.

Categories of common industrial hazards:

i. **Personal hazards:** Personal hazards ae unsafe activities e.g :

- ❑ operating machine without clearance
- ❑ operating machine at unsafe speed
- ❑ using unsafe equipment’s unsafely
- ❑ taking unsafe position
- ❑ failure in using personal protective devices.

Hazards due to personal deficiency: This includes:-

- Lack of knowledge or skill of a person
- Improper attitude of a person
- Bodily defects

ii **Mechanical hazards:** Mechanical hazards are unsafe conditions e.g:

- Inadequately guarded machine tools & parts
- unguarded or absence of required guards
- Defective, rough, sharp, slippery, decayed, cracked machine surface.
- unsafely arranged or poor house keeping
- poor layout, congestion, blocked etc.
- Inadequate lightings and ventilations
- unsafely clothed, no goggles, gloves or masks, wearing loose garments, high heats etc.
- unsafe mechanical, electrical or chemical process.

Provision of Safety Under Factory Acts:

i) Fencing and guarding must be provided for rotating parts such as fly wheels, moving motors parts etc.

ii) No lifting device should be loaded beyond permissible limits.

iii) No women or young person should be allowed to clean, lubricate or adjust a running machine. Only a skilled operator should be permitted to handle such operation is necessary.

iv) Suitable mechanism should exist for shifting a belt drive.

v)No young person should be permitted to work on dangerous machine.

vi) Workers should be made safety conscious

General Safety Rules:

i) No smoking

ii) Horseplay prohibited

iii) Wearing protective equipment's

iv) Maintain good house keeping

v)Get first aid promptly

vi) Wear proper clothing

vii) Running prohibited

viii) Do not operate unless authorized

ix) Observe all safety tags

x) Use safety devices and guards

Plant safety inspection:

Plant safety inspection:

Responsibility for inspection:

- a) Safety officer:
- b) Line management:
    - i) Senior plant management
    - ii) First line supervisor
    - iii) Engineering and maintenance engineers
    - iv) Workers

Types of inspection:

- Periodic inspection:
- Intermittent inspection:
- Continuous inspection
- Special inspection

- Inspection procedures:

- Reporting and follow-up:

- Safety sampling technique: N=4(1-P)/Y^2P

  Where N=No. of observations

  P= % of unsafe operations

  Y=Assigned value of accuracy considered satisfactory; normally this value is 10%

- For example: If during the preliminary survey 200 observations were made and of these 50 were unsafe observations
- P=50/200 x100%=25%
- N=4(1-0.25)/0.10x0.10 x0.25=1200

- This means that 1200 observations would be required to as certain

the various unsafe practices with an accuracy of +_ 10%. If 200 observations had been observed in one inspection tour.

No. of tour= 1200/200=6

- **Broad check list for plant inspection:**
- a) House-keeping
- b) Material handling methods
- c) Adequacy of aisle space and working place
- d) Guarding of transmission machinery
- e) Point of operation guards.

Statistics of Accident:

- i) Frequently rate=(Number of lost time accident x1000,000)/Total
- no. of man hours worked
- ii) Severity rate= (No. of man-daysx1000,000)/Total
- no. of man hours worked

- Problem: An undertaking with 500 workers, working 50 weeks of 48 hours each, had 60 accidents during one year. Owing to illness, accidents and other reasons the workers were absent during 5% of the aggregate working time. The no. of days lost due to 60 accidents along was 1200. Calculate the frequency rate and severity rate.
- Solution: Total no. of manhours worked= 500x50x48=1,200,000
- Absence manhours=1,200,000x5%=60,000= Lost time
- Manpower exposure= 1,200,000-60,000=1,140,000

- Frequency rate= (60x1,000,000)/1,140,000=52.63=53; This indicates that in a year about 53 accidents occurred per million manhours worked
- Severity rate=(1,200x1,000,000)/1,140,000=1053; This mean that in year over 1000 mandays were lost per 1,000,000 manhours (Accident per 1000 workers employed gives a rough index of incidence of accident. But this is not so good as the frequency rate)
- This value is more than 1000; so severity rate is major.

Primary Accident Report (PAR)

- Department: Section:
- Ref. No.: Dated:
- Name of injured person:
- Date of accident: Time:
- Shift hours: Work started at:

- Brief narration of the accident:
-
- Signature of Foreman/Supervisor-in-Charge

Note: This report should originate in triplicate from the shop-floor foreman or Assistant Superintendent in whose section or department the accident occurred.

(TO BE FILLED IN BY MEDICAL OFFICER)

1. Nature & Extent of injury :
2. Classification of Accident :
   a) Minor (Does not cause disablement for 48 Hours) :
   b) Reportable (cause disablement for 48 hours) :
3. Cause of injury :
4. How the injury could have been prevented :

I certify that the employee was/was not under the influence of any intoxicating drink or drugs at the time of accident. The employee is fit to resume duty/not fit to resume duty and advised treatment and rest for ____ days with effect from ____ to ____

Name_____
Signature of Medical Officer