HANDLING EQUIPMENT

8.1 Material Handling - Principles, Operations and Equipment

Introduction

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.

8.2 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:

- It should be able determine appropriate distance to be covered.
- Facilitate the reduction in material damage as to improve quality.
- Reducing overall manufacturing time by designing efficient material movement
- Improve material flow control
- Creation and encouragement of safe and hazard-free work condition
- Improve productivity and efficiency
- Better utilization of time and equipment

It is critical for manufacturing organization to identify importance of material handling principle as the critical step in promoting the job improvement process. Manual material handling significantly increases health hazard for the workers in from lower back injuries.

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:

- Design of proper facility layout
- Promotes development of method which improves and simplifies the work process
- It improves overall production activity.
- Efficient material handling reduces total cost of production.

8.3 PRINCIPLES OF MATERIAL HANDLING

Material handling principles are as follows:

- **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.
- **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.

Material handling operations are designed based upon principles as discussed above. Material handling equipment consists of cranes, conveyors and industrial trucks.

8.4 DISCUSSION ON TEN MAJOR PRINCIPLES OF MATERIAL HANDLING

(1) PLANNING PRINCIPLE

All material handling should be the result of a deliberate plan where the needs, performance objectives and functional specification of the proposed methods are completely defined at the outset.

Definition: *A plan is a prescribed course of action that is defined in advance of implementation. In its simplest form a material handing plan defines the material (what) and the moves (when and where); together they define the method (how and who).*

Very important points:

- The plan should be developed in consultation between the planner(s) and all who will use and benefit from the equipment to be employed.
- Success in planning large scale material handling projects generally requires a team approach involving suppliers, consultants when appropriate, and end user specialists from management, engineering, computer and information systems, finance and operations.
- The material handling plan should reflect the strategic objectives of the organization as well as the more immediate needs.
- The plan should document existing methods and problems, physical and economic constraints, and future requirements and goals.
- The plan should promote concurrent engineering of product, process design, process layout, and material handling methods, as opposed to independent and sequential design practices.

(2) STANDARDIZATION PRINCIPLE

Material handling methods, equipment, controls and software should be standardized within the limits of achieving overall performance objectives and without sacrificing needed flexibility, modularity and throughput .anticipation of changing future requirements

Definition: *Standardization means less variety and customization in the methods and equipment employed.*

Very important points:

- The planner should select methods and equipment that can perform a variety of tasks under a variety of operating conditions and in
- Standardization applies to sizes of containers and other load forming components as well as operating procedures and equipment.
- Standardization, flexibility and modularity must not be incompatible.
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(3) WORK PRINCIPLE

Material handling work should be minimized without sacrificing productivity or the level of service required of the operation.

Definition: *The measure of work is material handling flow (volume, weight or count per unit of time) multiplied by the distance moved.*

Very important points:

- Simplifying processes by reducing, combining, shortening or eliminating unnecessary moves will reduce work.

- Consider each pickup and set-down, or placing material in and out of storage, as distinct moves and components of the distance moved.
- Process methods, operation sequences and process/equipment layouts should be prepared that support the work minimization objective.
- Where possible, gravity should be used to move materials or to assist in their movement while respecting consideration of safety and the potential for product damage.
- The shortest distance between two points is a straight line.

(4) ERGONOMIC PRINCIPLE

Human capabilities and limitations must be recognized and respected in the design of material handling tasks and equipment to ensure safe and effective operations.

Definition: *Ergonomics is the science that seeks to adapt work or working conditions to suit the abilities of the worker.*

Very important points:

- Equipment should be selected that eliminates repetitive and strenuous manual labor and which effectively interacts with human operators and users.
- The ergonomic principle embraces both physical and mental tasks.
- The material handling workplace and the equipment employed to assist in that work must be designed so they are safe for people

(5) UNIT LOAD PRINCIPLE

Unit loads shall be appropriately sized and configured in a way which achieves the material flow and inventory objectives at each stage in the supply chain.

Definition: *A unit load is one that can be stored or moved as a single entity at one time, such as a pallet, container or tote, regardless of the number of individual items that make up the load.*

Very important points:

- Less effort and work is required to collect and move many individual items as a single load than to move many items one at a time.
- Load size and composition may change as material and product moves through stages of manufacturing and the resulting distribution channels.
- Large unit loads are common both pre and post manufacturing in the form of raw materials and finished goods.
- During manufacturing, smaller unit loads, including as few as one item, yield less in-process inventory and shorter item throughput times.
- Smaller unit loads are consistent with manufacturing strategies that embrace operating objectives such as flexibility, continuous flow and just-in-time delivery.
- Unit loads composed of a mix of different items are consistent with just-in-time and/or customized supply strategies so long as item selectivity is not compromised.

(6) SPACE UTILIZATION PRINCIPLE

Effective and efficient use must be made of all available space.

Definition: *Space in material handling is three dimensional and therefore is counted as cubic space.*

Very important points:

- In work areas, cluttered and unorganized spaces and blocked aisles should be eliminated.
- In storage areas, the objective of maximizing storage density must be balanced against accessibility and selectivity.
- When transporting loads within a facility the use of overhead space should be considered as an option.

(7) SYSTEM PRINCIPLE

Material movement and storage activities should be fully integrated to form a coordinated, operational system which spans receiving, inspection, storage, production, assembly, packaging, unitizing, order selection, shipping, transportation and the handling of returns.

Definition: *A system is a collection of interacting and/or interdependent entities that form a unified whole.*

Very important points:

- Systems integration should encompass the entire supply chain including reverse logistics. It should include suppliers, manufacturers, distributors and customers.
- Inventory levels should be minimized at all stages of production and distribution while respecting considerations of process variability and customer service.
- Information flow and physical material flow should be integrated and treated as concurrent activities
- Methods should be provided for easily identifying materials and products, for determining their location and status within facilities and within the supply chain and for controlling their movement.
- Customer requirements and regarding quantity, quality, and on-time delivery should be met without exception. Consistency and predictability, regarding quantity, quality, and on-time delivery should be met without exception.

(8) AUTOMATION PRINCIPLE

Material handling operations should be mechanized and/or automated where feasible to improve operational efficiency, increase responsiveness, improve consistency and predictabil

Very important points:

- Pre-existing processes and methods should be simplified and/or re-engineered before any efforts at installing mechanized or automated systems.
- Computerized material handling systems should be considered where appropriate for effective integration of material flow and information management.
- Treat all interface issues as critical to successful automation, including equipment to equipment, equipment to load, equipment to operator, and control communications.
- All items expected to be handled automatically must have features that accommodate mechanized and automated handling.

(9) ENVIRONMENTAL PRINCIPLE

Environmental impact and energy consumption should be considered as criteria when designing or selecting alternative equipment and material handling systems.

Definition: *Environmental consciousness stems from a desire not to waste natural resources and to predict and eliminate the possible negative effects of our daily actions on the environment.*

Very important points:

- Containers, pallets and other products used to form and protect unit loads should be designed for reusability when possible and/or biodegradability as appropriate.
- Systems design should accommodate the handling of spent dun age, empty containers and other by-products of material handling.
- Materials specified as hazardous have special needs with regard to spill protection, combustibility and other risks.

(10) LIFE CYCLE COST PRINCIPLE

A thorough economic analysis should account for the entire life cycle of all material handling equipment and resulting systems.

Definition: *Life cycle costs include all cash flows that will occur between the time the first dollar is spent to plan or procure a new piece of equipment, or to put in place a new method, until that method and/or equipment is totally replaced.*

Very important points:

- Life cycle costs include capital investment, installation, setup and equipment programming, training, system testing and acceptance, operating (labor, utilities, etc.), maintenance and repair, reuse value, and ultimate disposal.
- A plan for preventive and predictive maintenance should be prepared for the equipment, and the estimated cost of maintenance and spare parts should be included in the economic analysis.
- A long-range plan for replacement of the equipment when it becomes obsolete should be prepared.
- Although measurable cost is a primary factor, it is certainly not the only factor in selecting among alternatives. Other factors of a strategic nature to the organization and which form the basis for competition in the market place should be considered and quantified whenever possible.

8.5 Major Equipment Categories

Old adage (that applies to a lack of MH equipment knowledge): “If the only tool you have is a hammer, it’s amazing how quickly all your problems seem to look like nails.”

The different types of MH equipment listed can be classified into the following five major categories:

I. *Transport Equipment*. Equipment used to move material from one location to another (e.g., between workplaces, between a loading dock and a storage area, etc.). The major subcategories of transport equipment are conveyors, cranes, and industrial trucks. Material can also be transported manually using no equipment.

II. *Positioning Equipment*. Equipment used to handle material at a single location (e.g., to feed and/or manipulate materials so that are in the correct position for subsequent handling, machining, transport, or storage). Unlike transport equipment, positioning equipment is usually

used for handling at a single workplace. Material can also be positioned manually using no equipment.
III. *Unit Load Formation Equipment*. Equipment used to restrict materials so that they maintain their integrity when handled a single load during transport and for storage. If materials are self-restraining (e.g., a single part or interlocking parts), then they can be formed into a unit load with no equipment.
IV. *Storage Equipment*. Equipment used for holding or buffering materials over a period of time. Some storage equipment may include the transport of materials (e.g., the S/R machines of an AS/RS, or storage carousels). If materials are block stacked directly on the floor, then no storage equipment is required.
V. *Identification and Control Equipment*. Equipment used to collect and communicate the information that is used to coordinate the flow of materials within a facility and between a facility and its suppliers and customers. The identification of materials and associated control can be performed manually with no specialized equipment.

1. Load Formation Equipment

Unit load formation equipment is used to restrict materials so that they maintain their integrity when handled a single load during transport and for storage. If materials are self-restraining (e.g., a single part or interlocking parts), then they can be formed into a unit load with no equipment.

2. Self-restraining (no equipment)

One or more items that can maintain their integrity when handled as a single item (e.g., a single part or interlocking parts)

3. Pallets

Platform with enough clearance beneath its top surface (or face) to enable the insertion of forks for subsequent lifting purposes
Materials: Wood (most common), paper, plastic, rubber, and metal Size of pallet is specified by its depth (i.e., length of its stringers or stringer boards) and its width(i.e., length its deck boards)—pallet height (typically 5 in.) is usually not specified.
Orientation of stringers relative to deck boards of pallet is specified by always listing its depth first and width last: *Depth* (stringer length) × *Width* (deck board length)
48 × 40 in. pallet is most popular in the US (27% of all pallets—no other size over 5%) because its compatibility with railcar and truck trailer dimensions; e.g., the GMA (Grocery Manufacturers of America) pallet is four-way and made of hardwood 1200 × 800 mm “Euro-Pallet” is the standard pallet in Europe
Single-face pallets are sometimes referred to as “skids”

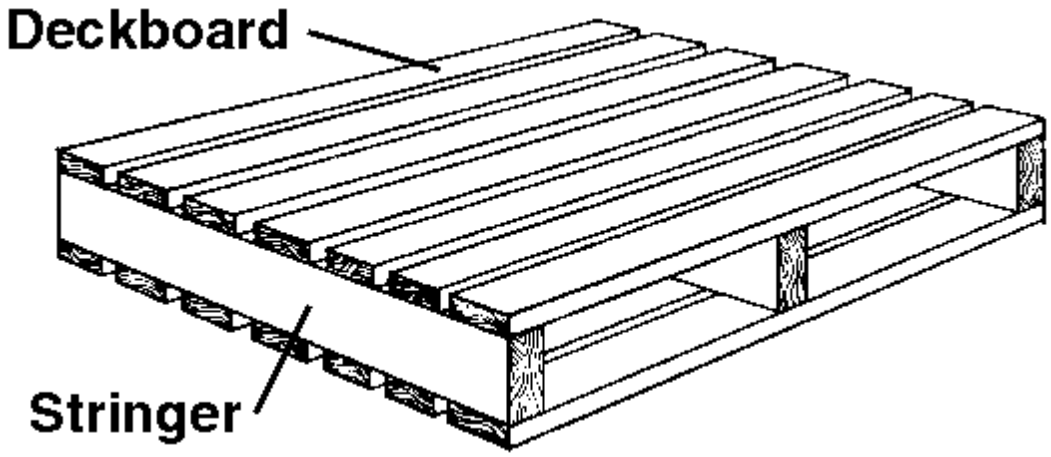

Fig. 8 Pallet

4. Skids

Platform (typically metal) with enough clearance beneath its top surface to enable a platform truck to move underneath for subsequent lifting purposes

Forks can also be used to handle skids since the clearance of a skid is greater than that of a pallet

Compared to a pallet, a skid is usually used for heavier loads and when stacking is not required

A metal skid can lift heavier loads than an equal-weight metal pallet because it enables a platform truck to be used for the lifting, with the platform providing a greater lifting surface to support the skid as compared to the forks used to support the pallet

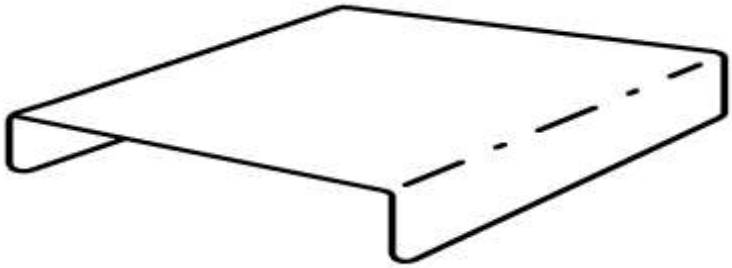

Fig. 9 Skid

5. Slip-sheets

Thick piece of paper, corrugated fiber, or plastic upon which a load is placed

Handling method: tabs on the sheet are grabbed by a special push/pull lift truck attachment

Advantages: usually used in place of a pallet for long-distance shipping because their cost is 10–30% of pallet costs and their weight and volume is 1–5% of a pallet

Disadvantages: slower handling as compared to pallets; greater load damage within the facility; special lift truck attachment reduces the vehicle's load capacity

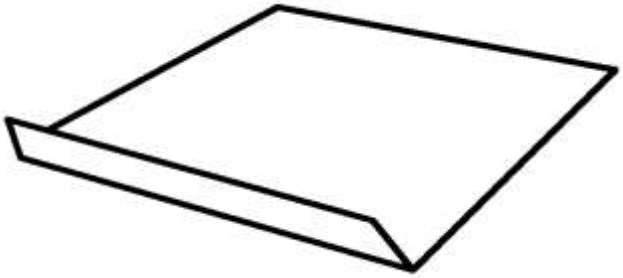

Fig. 10 Slip - Sheet

6. Tote pans

Reusable container used to unitize and protect loose discrete items

Typically used for in-process handling

Returnable totes provide alternative to cartons for distribution

Can be nested for compact storage when not in use

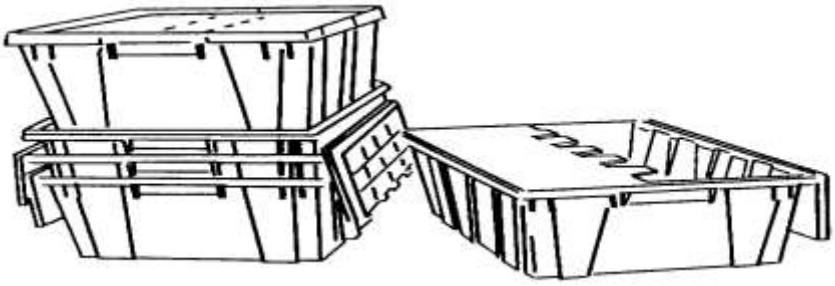

Fig. 11 Tote pan

6. Pallet/skid boxes

Reusable containers used to unitize and protect loose items for fork/platform truck handling Pallet box sometimes referred to as a “bin

7. Cartons

Disposable container used to unitize and protect loose discrete items. Typically used for distribution. Dimensions always specified as sequence: *Length* × *Width* × *Depth*, where length is the larger, and width is the smaller, of the two dimension of the open face of the carton, and depth is the distance perpendicular to the length and width

Large quantities of finished carton blanks or knocked-down cartons can be stored on pallets until needed.

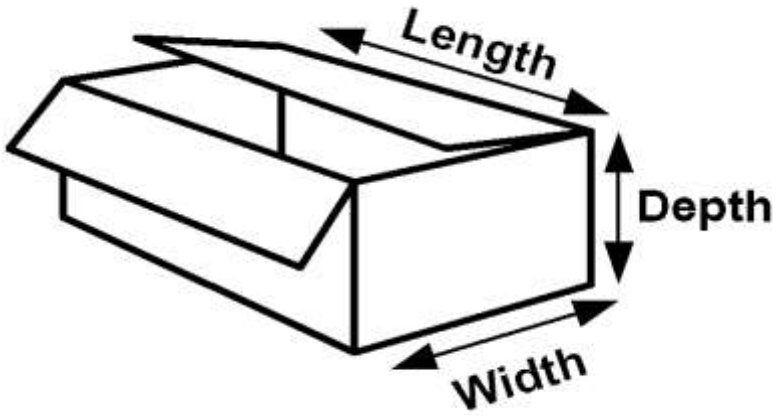

Fig. 12 Carton