



UNIT-11

Warehousing and Material Handling

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Explain the functions of Materials Handling Systems (MHS)
- ✓ Discuss the benefits of an effective MHS in warehouse management
- ✓ Understand the different types of powered and non-powered pallet trucks

Unit 11

Warehousing and Material Handling

Materials Handling Systems (MHS) can be defined as “the set of all pieces of equipment that make possible the physical movement within the distribution chain – including the production chain and the warehouse – of raw material, work in progress and finished goods”. Therefore, materials handling systems perform a wide range of activities. In general, Materials Handling refers to the necessary tasks to be performed in order to move a load around the factory floor as well as to store and freight it. Materials handling takes place one way or another along all the links of the supply chain including production, distribution, and storage and retail functions.

Handling in a warehouse or distribution centre will have a major impact on how effectively materials flow through the system, and on the cost, resource and time taken to get orders out to the customer. In addition, handling equipment can be capital – intensive, and the act of movement can be labour – intensive. Material handling equipment eases manual handling chores and enhances operational efficiency.

Various methods of handling goods are used in warehousing, from manual through to automated or robotic systems, and a broad categorisation could be:

- Manual handling;
- Manually operated trucks and trolleys;
- Powered trucks and tractors, operator controlled and driven;
- Powered trucks and trolleys, driverless, computer-controlled;
- Crane systems;
- Conveyors;
- Robotics.

Although this chapter will concentrate on powered trucks, cranes, and conveyors, it must not be forgotten that there is a wide range of non-powered industrial trucks for pedestrian use. These include hand pallet trucks, order picking trolleys, stair climbing trolleys and a wide range of platforms, shelf and cage trolleys.

Industrial lift trucks are used in warehousing for moving material over relatively short distances, for lifting into and out of storage, and for vehicle loading and unloading. Trucks facilitate load utilisation, speed up movement, can handle large loads and consequently reduce the frequency of movements.

The main types of powered trucks used in warehousing and stock yard operations are:

- Powered pallet trucks;
- Counterbalanced fork-lift trucks;
- Reach trucks including double reach and four – directional reach variants;

- Stacker trucks;
- High rack stacker trucks-very narrow aisle;
- Side loaders;
- Order picking trucks;
- Tugs and tractors;
- Straddle carriers-container handling

Non-powered hand trucks

Non-powered hand trucks are used in many situations. They are inexpensively manufactured for diverse and specific applications. Common construction materials include aluminium/magnesium, steel, and wood. Because these trucks are so inexpensive, it makes sense to design them for specific material handling functions. In this way, it is possible to increase the cube utilisation within the truck for material handling optimisation. Aluminium or magnesium trucks generally carry 300-500 pounds of material, while steel or wooden trucks can be used to carry approximately 1000 pounds to 2000 pounds, respectively. The trucks range in weight from as little as 20 pounds for aluminium trucks to as much as 125 pounds for wooden trucks.

Non-powered hand pallet trucks

These trucks are designed to carry unit loads on pallets from one location to another, generally in indoor settings. Because unit loads can be quite heavy, the distances transported using this type of equipment is generally short. In many settings, hand pallet trucks are used to supplement motorised truck fleets. They are extremely efficient for transporting unit loads short distances when high lifting is not required. They can be used to position materials very precisely. Generally speaking, nonpowered hand trucks cannot be used to lift more than 8,000-10,000 pounds and cannot lift a unit load to a height more than 8 inches. For heavy duty applications, steel wheels are required while lighter duty applications require only nylon or polyurethane construction. These trucks can range in weight from 200 to 400 pounds.

Pallet Trucks

The full featured ergonomic pallet truck is an economical way for one person to move heavy pallet loads without the use of a fork truck. Proven ergonomic design has been tested for providing years of reliable usage.

This pallet truck includes two articulating steering wheels and two front load rollers. Ergonomic design requires only 34 kgs of pulling force when fully loaded. Steering wheels include bearing dust covers for added life. Nose wheels are located on the front edge of each fork to assist in clean pallet entrance and exit. Reinforced triple formed steel forks provide twice the strength of standard single-formed forks.

Equipped with internally mounted solid steel adjustable push rods. Spring loaded loop handle automatically returns to vertical position when not in use. Chrome-plated hydraulic pump piston for long seal life.

Powered pallet trucks

Hand pallet trucks, with capacities up to a maximum of 2 tonnes, are probably the most commonly used trucks for the horizontal movement of pallets. It is not uncommon to see these trucks lifted on to the back of the vehicle for positioning pallets during loading and unloading. However, for frequent movements, and where there are inclines to be negotiated, battery –powered trucks are preferable in terms of operator effort and safety, and these can be pedestrian – or rider-controlled



Figure 11.1

Pallet truck and counter scale pallet truck

Counter balanced fork-lift trucks

Counterbalanced fork-lift trucks carry the payload forward of the front wheels, so there is always a turning moment lending to tip forward. To balance this, a counter balance weight is built into the rear of the machine-hence the name. These machines capacity varies from 1000kgs to 45,000 kgs with a lift height of up to 6/7 metres.



Counter balanced truck

Figure 11.2

Reach trucks

Reach trucks are designed to be smaller and lighter than counter-balanced trucks and to operate in a smaller area. Its capacity varies from 1000kgs to 3,500 kgs with a max fork-lift up to about 11 metres. This is achieved by having a mast that can move forward or back in channels in the outrigger truck legs. When picking up or setting down a load, the truck is turned through 90 degrees to face the load location; the mast reaches forward, places or retrieves the load, and is retracted back into the area enclosed by the wheels.



Figure 11.3 Reach Truck

Double reach trucks

A conventional reach truck can only reach one pallet deep into racking. For accessing double deep racking a double reach truck has to be used, which uses a pantograph mechanism to achieve the additional reach. Double reach can also be achieved on some lighter trucks by the use of telescopic forks. Double reach machines are also used for side-loading pallets on to road vehicles, working only from one side of the vehicle.



Figure 11.4 Double reach truck

Four-directional reach trucks

On a conventional reach truck, the front wheels always face forward, and steering is from the rear wheels. The 4D truck has an additional option of being able to turn the front wheels through 90 degrees and lock them in this mode. This effectively converts the truck into a side loader and is especially useful in stores and warehouses where part of the stock range consists of long loads. For access to say cantilever storage, very wide aisles would be necessary if this option were not available.



Figure 11.5 Four-directional reach truck

Stacker trucks

These are fairly light weighted trucks with max capacities up to 2000 kgs. Stacker trucks are often used in narrow aisle applications for high stacking of relatively small loads. They can be used for pallets that vary in width, as the straddle width setting is adjustable. Stackers are ideal for moving small loads over short distances, such as in applications involving staging or order pick up and drop off. The machines should only be used on smooth surfaces, and distances for transporting goods should not exceed that which the operator can comfortably walk. Stacker trucks also come as

counterbalanced units, if straddle legs are not desirable. These trucks are usually limited to about a 6 metre lift, but they can operate in 90-degree turning aisles of only 2 metres or less.



Figure 11.6 Stacker truck

High rack stacker trucks-very narrow aisle

These trucks typically will lift capacities up to 2 tonnes and lifting to 12/13 metres are equipped with mechanisms on the mast that can set down or pick up pallets from the racking without the truck having to turn in the aisle. Consequently they can operate in aisles of 1.8 metres or less. The very narrow aisles and high lifts give good space utilisation, but also necessitate very flat floors, which are expensive, to minimise the risk of collision between load and racking when manoeuvring loads. It is also necessary to have a guidance system to keep the trucks centrally positioned in the aisles.



Figure 11.7 High rack stacker trucks

Order picking trucks

There is a range of manual and powered trucks designed specifically for order picking operations. These range from trolleys, such as roll cage pallets, to ground-level pedestrian trucks such as long fork powered pallet trucks, up to multi-level trucks in which the operator is raised for high-level picking.



Figure 11.8 Order picking truck

Conveyors for unit load handling

Conveyor systems are used for moving material between fixed points, for holding material as short-term buffer, for sortation and for process industry applications such as separation, grading and cooling.

The general characteristics of the conveyor systems are:

- High through-put with few operators and low power requirement;
- Suitable for fixed routes, and floor surfaces are not as critical as they are for fork trucks;
- Fast response and suitable for continuous or intermittent movements;
- Can utilise very sophisticated movement control.

Conveyor systems are found in both conventional and automated warehousing.

The less positive aspects of conveyor systems include:

- High capital cost;
- Can obstruct working areas and access;
- Inflexibility for future change;
- Hence very careful system design required including safety features.

The handling of products is a key to warehouse productivity for several important reasons.

1. The relative number of labour hours required to perform material handling creates a vulnerability to any reduction in the output rate per labour hour. Warehousing is typically more sensitive to labour productivity than manufacturing since material handling is highly labour-intensive.
2. The nature of warehouse material handling is limited in terms of direct benefits gained by improved information technology. While computerisation has introduced new technologies and capabilities, the preponderance of material handling requires significant manual input.

Material handling in the logistics system is concentrated in and around the warehouse facility. A basic difference exists in the handling of bulk materials and master cartons. Bulk handling is a situation where protective packaging at the master carton level is unnecessary. Specialised handling equipment is required for bulk loading, such as for solids, fluids, or gaseous materials.

Over the years a variety of guidelines have been suggested to assist management in the design of material handling systems.

These are representative:

- Equipment for handling and storage should be as standardised as possible.
- When in motion, the system should be designed to provide maximum continuous product flow.
- Investment should be in handling rather than stationary equipment.
- Handling equipment should be utilised to the maximum extent possible.
- In handling equipment selection, the ratio of deadweight to payload should be minimised.
- Wherever practical, gravity flow should be incorporated in system design.

The factors to be considered when deciding on the appropriate type of handling system for a particular application include:

- Types of load being handled including the unit load characteristics
- Quantity of material being handled;
- Frequency of movement;
- Distances to be travelled, horizontal and vertical;
- Numbers and locations of pick-up and drop points
- Adjacent activities;
- Nature of terrain;
- Flexibility required.

The principles governing the design and use of handling systems include:

- Control of position and movement;

- Elimination of unnecessary movement and minimisation of the necessary movement;
- Selection of the most appropriate handling method to meet the system requirements;
- Provision of adequate handling capacity;
- Integration of handling with the storage and other adjacent operations;
- Thorough and effective operator training;
- Effective equipment maintenance for operational availability and safety;
- Safe methods of handling and working practices.

Handling systems are classified as:

- mechanised,
- semi automated,
- automated, and
- Information-driven.

A combination of labour and handling equipment is utilised in mechanised systems to facilitate receiving, processing, and/or shipping. Generally, labour constitutes a high percentage of overall cost in mechanised handling.

Automated systems, in contrast, attempt to minimise labour as much as practical by substituting capital investment in equipment. An automated handling system may be applied to any of the basic handling requirements depending on the situation. When selected handling requirements are performed using automated equipment and the remainder of the handling is completed on a mechanised basis, the system is referred to as semi automated. Directed system uses computers to maximise control over mechanised handling equipment. Mechanised handling systems are the most common.

However, the use of semi automated and automated systems are rapidly increasing. As noted earlier, one factor contributing to low logistical productivity is that information-directed handling has yet to achieve its full potential.

Further Reading:

- ✓ *Materials Handling System Design by Sunderesh S. Heragu and Banu Ekren*
- ✓ *Materials Handling Handbook Raymond A. Kulweic*