Storage Systems

L-13

Storage System

- The function of material storage system is to store materials for a period of time and to permit access to those materials when required. Materials stored by manufacturing firms include a variety of types.

TABLE 11.1 Types of Materials Typically Stored in a Factory

Type	Description
1. Raw materials	Raw stock to be processed (e.g., bar stock, sheet metal, plastic molding compound)
2. Purchased parts	Parts from vendors to be processed or assembled (e.g., castings, purchased components)
3. Work-in-process	Partially completed parts between processing operations or parts awaiting assembly
4. Finished product	Completed product ready for shipment
5. Rework and scrap	Parts that are out of specification, either to be reworked or scrapped
6. Refuse	Chips, swarf, oils, other waste products left over after processing; these materials must be disposed of, sometimes using special precautions
7. Tooling	Cutting tools, jigs, fixtures, molds, dies, welding wire, and other tooling used in manufacturing and assembly; supplies such as helmets, gloves, etc., are usually included
8. Spare parts	Parts needed for maintenance and repair of factory equipment
9. Office supplies	Paper, paper forms, writing instruments, and other items used in support of plant office
0. Plant records	Records on product, equipment, and personnel

Storage System Performance

- Various measures used to assess the performance of a storage system include

1) Storage capacity
2) Density
3) Accessibility
4) Throughput
5) Utilization
6) Reliability

1) Storage capacity

--It is measured in two ways

a) as the total volumetric space available or

b) as the total number of storage compartments in the system available for items or loads

--- the standard container can be readily be handled, transported and stored by the storage system and by material handling system that may be connected to it.

2) Storage Density

- It is defined as the volumetric space available for actual storage relative to the total volumetric space in the storage facility.
- In many warehouses, aisle space and wasted overhead space account for more volume than the volume available for actual storage of materials.

3) Accessibility

- Accessibility refers to the capability to access any desired item or load stored in the system.
- In the design of a given storage system, trade offs must be made between storage density and accessibility

4) System throughput

- It is defined as the hourly rate at which the storage system

a) Receives and puts loads into storage and/or

b) Retrieves and delivers loads to the output station.

- System throughput is limited by the time to perform a storage or retrieval (S/R) transaction. A typical storage transaction consists of the following elements

a) Pick up load at input station

b) Travel to storage location

c) Place load into storage location

d) Travel back to input station

Contd.

--- The retrieval system consist of:

a) Travel to storage location
b) Pick item from storage
c) Travel to output station
d) Unload at output station

5) Utilization

- It is defined as the proportion of the time that the system is actually being used for performing storage and retrieval operations compared with the time it is available.
- Utilization varies throughout the day, as requirements change from hour to hour
- It is desirable to design an automated storage system for relatively high utilization, in the range 80-90%
- If utilization is too low, then the system is probably overdesigned. If utilization is too high, then there is no allowance for rush periods or system breakdowns.

6) Availability

- Availability is the measure of system reliability, defined as the proportion of time that the system is capable of operating (not broken down) compared with the normally scheduled shift hours
- Malfunctions and failures of the equipment cause downtime
- Reasons for downtime include computer failures, mechanical breakdowns, load jams, improper maintenance and incorrect procedures by personnel using the system.

Storage Location Strategies

 There are two basic strategies.

a) Randomized storage:

- Each item type stored in a warehouse is known as stock-keeping-unit (SKU).
- In this storage, items are stored in any available location in the storage system. In the usual implementation of randomized storage , incoming items are placed into storage in the nearest available open location
- When an order is received for a given SKU, the stock is retrieved from storage according to first-in –first out policy so that the items held in storage the longest are used to make up the order.

Contd.

b) Dedicated storage:

- In this SKUs are assigned to specific locations in the storage facility. This means that locations are reserved for all SKUs stored in the system, and so the number of storage locations for each SKU must be sufficient to accommodate its maximum inventory level.
- The basis for specifying the storage locations is usually one of the following:

i) Items are stored in part number or product number sequence

ii) Items are stored according to activity level, the more active SKUs being located closer to the input/output station.

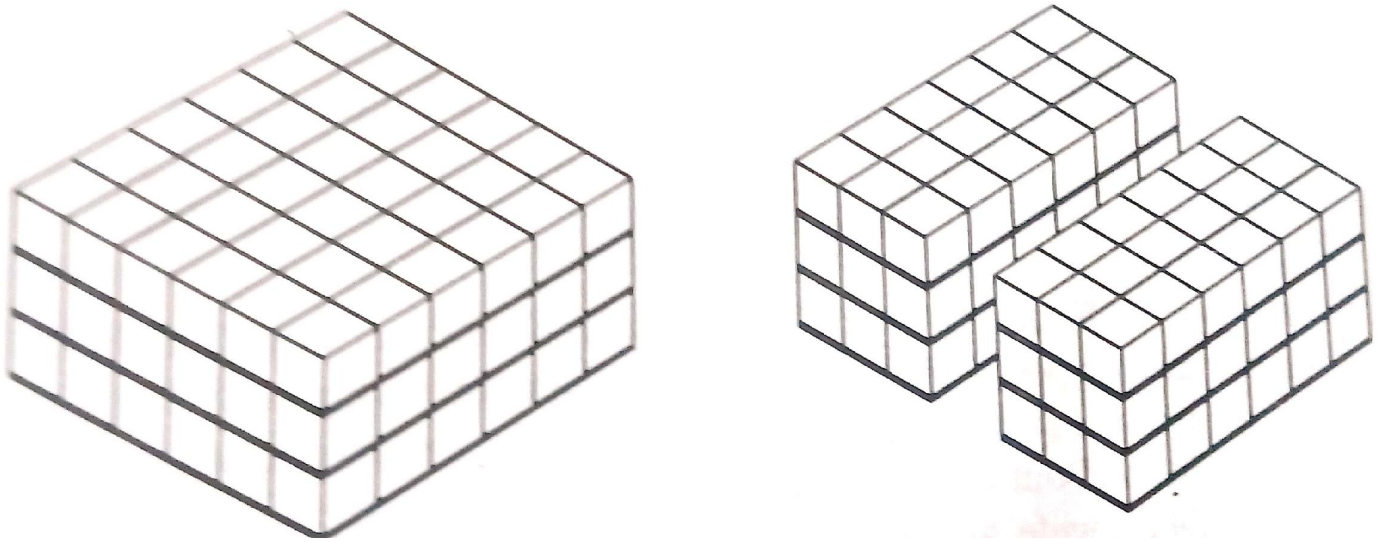
iii) Items are stored according to their activity-to-space ratios, the higher ratios being located closer to the input/output station.

Conventional Storage Methods and Equipment

1) Bulk storage
2) Rack Systems
   (i) Cantilever racks
   (ii) Portable racks
   (iii) Drive-through racks
   (iv) Flow-through racks
3) Shelving and Bins
4) Drawer Storage

1) Bulk Storage

- It refers to the storage of stock in an open floor area.
- The stock is generally contained in unit loads on pallets or similar containers, and unit loads are stacked on top of each other to increase storage density.

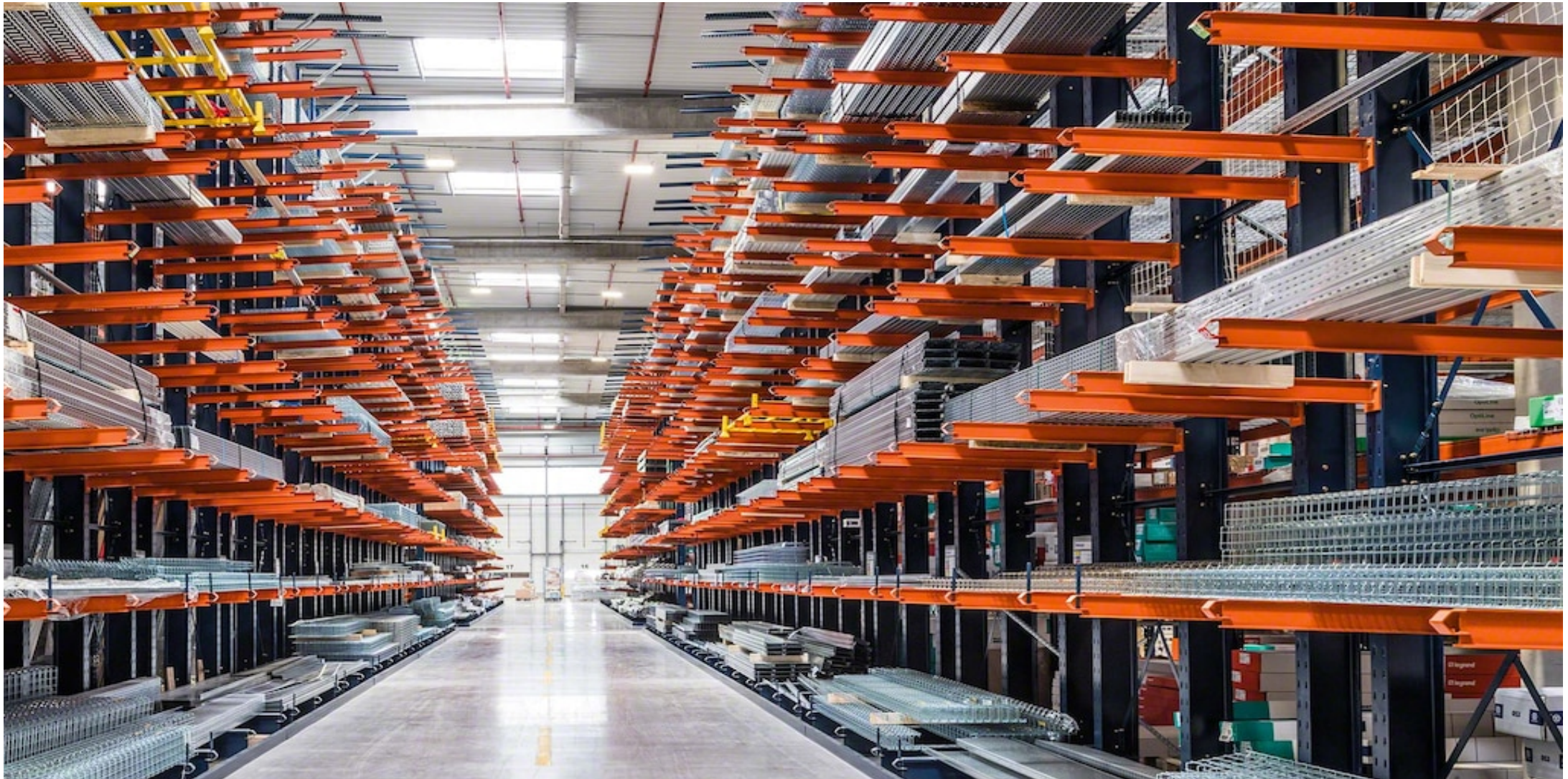


2) Rack system

 Rack systems provide a method of stacking unit loads vertically without the need for the loads themselves to provide support. One of the most common rack systems is the pallet rack, consisting of a frame that includes horizontal load-supporting beams.

(i) Cantilever racks

Cantilever Racks

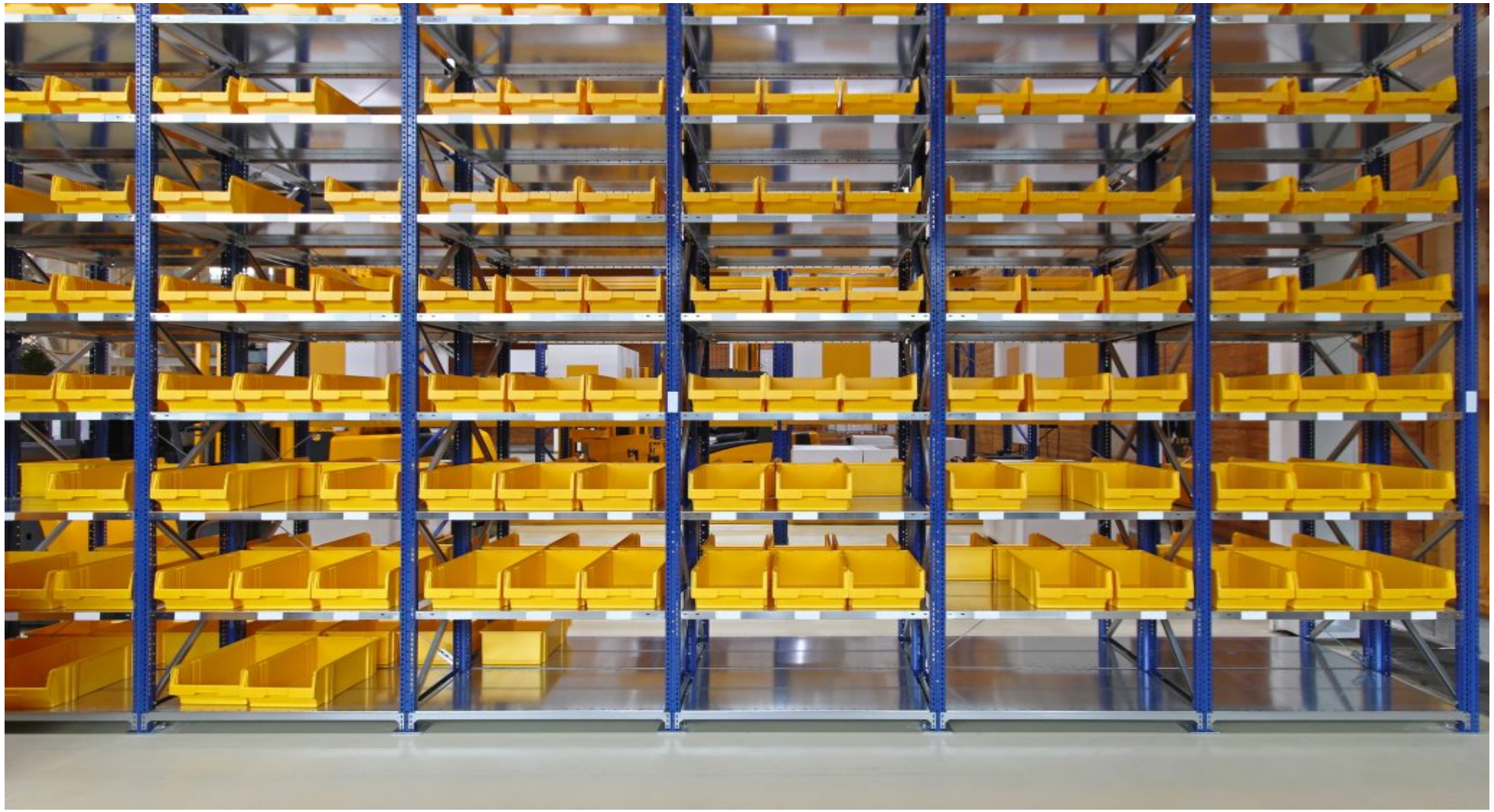


(ii) Portable racks

iii) Drive-through racks

iv) Flow-through racks

3) Shelving and Bins



4) Drawer Storage

TABLE 11.2 Application Characteristics of the Types of Storage Equipment and Methods

Storage Equipment	*Advantages and Disadvantages*	*Typical Applications*
Bulk storage	Highest density is possible Low accessibility Lowest possible cost per sq ft	Storage of low turnover, large stock or large unit loads
Rack systems	Low cost Good storage density Good accessibility	Palletized loads in warehouses
Shelves and bins	Some stock items not clearly visible	Storage of individual items on shelves Storage of commodity items in bins
Drawer storage	Contents of drawer easily visible Good accessibility Relatively high cost	Small tools Small stock items Repair parts
Automated storage systems	High throughput rates Facilitates use of computerized inventory control system Highest cost equipment Facilitates interface to automated material handling systems	Work-in-process storage Final product warehousing and distribution center Order picking Kitting of parts for electronic assembly

Automated storage system

- An automated storage system represents a significant investment, and it often requires a new and different way of doing business. Companies objectives to automate its storage operations are:

a) To increase storage capacity
b) To increase storage density
c) To recover factory floor space presently used for storing work-in- process
d) To improve security and reduce pilferage
e) To reduce labor cost and/or increase labor productivity in storage operations
f) To improve safety in the storage function
g) To improve control over inventories
h) To improve stock rotation
i) To improve customer service
j) To increase throughput

Contd.

Automated storage/retrieval systems divide into two general types :

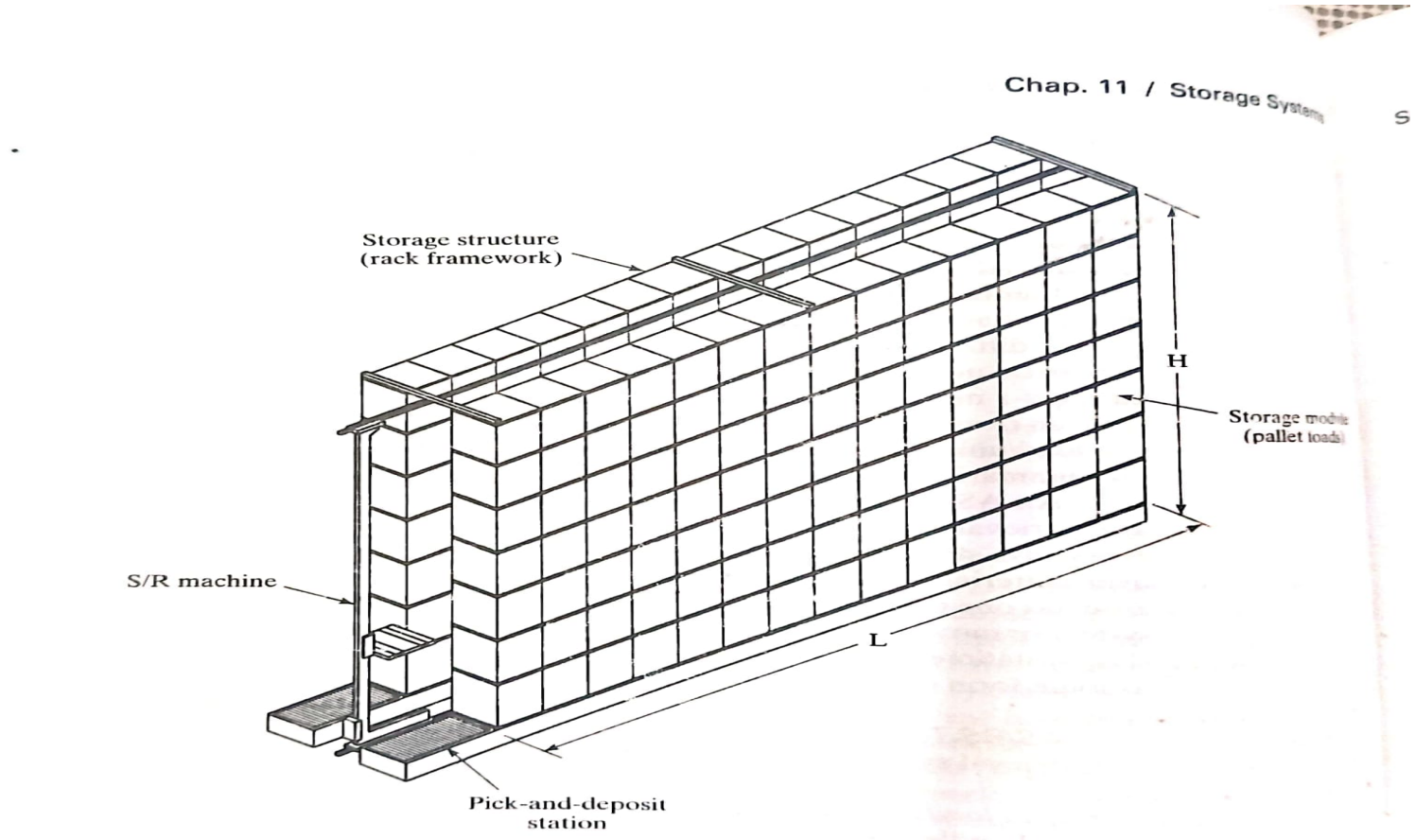
(i) Automated storage/retrieval systems

(ii) Carousel storage systems

--Automated storage/retrieval system (AS/RS) is defined as a storage system that performs storage and retrieval operations with speed and accuracy under defined degree of automation

AS/RS types

(i) Unit load AS/RS



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(ii) Deep-lane AS/RS

Contd.

(iii) Miniload AS/RS

Contd.

(iv) Man-on board AS/RS

Contd.

(v) Automated item retrieval system

Contd.

vi) Vertical lift storage modules

Three distinguished application of AS/RS

(i) Unit load storage and handling

(ii) Order picking

(iii) Work-in-process storage systems

Reasons why automated storage system used for work –in process

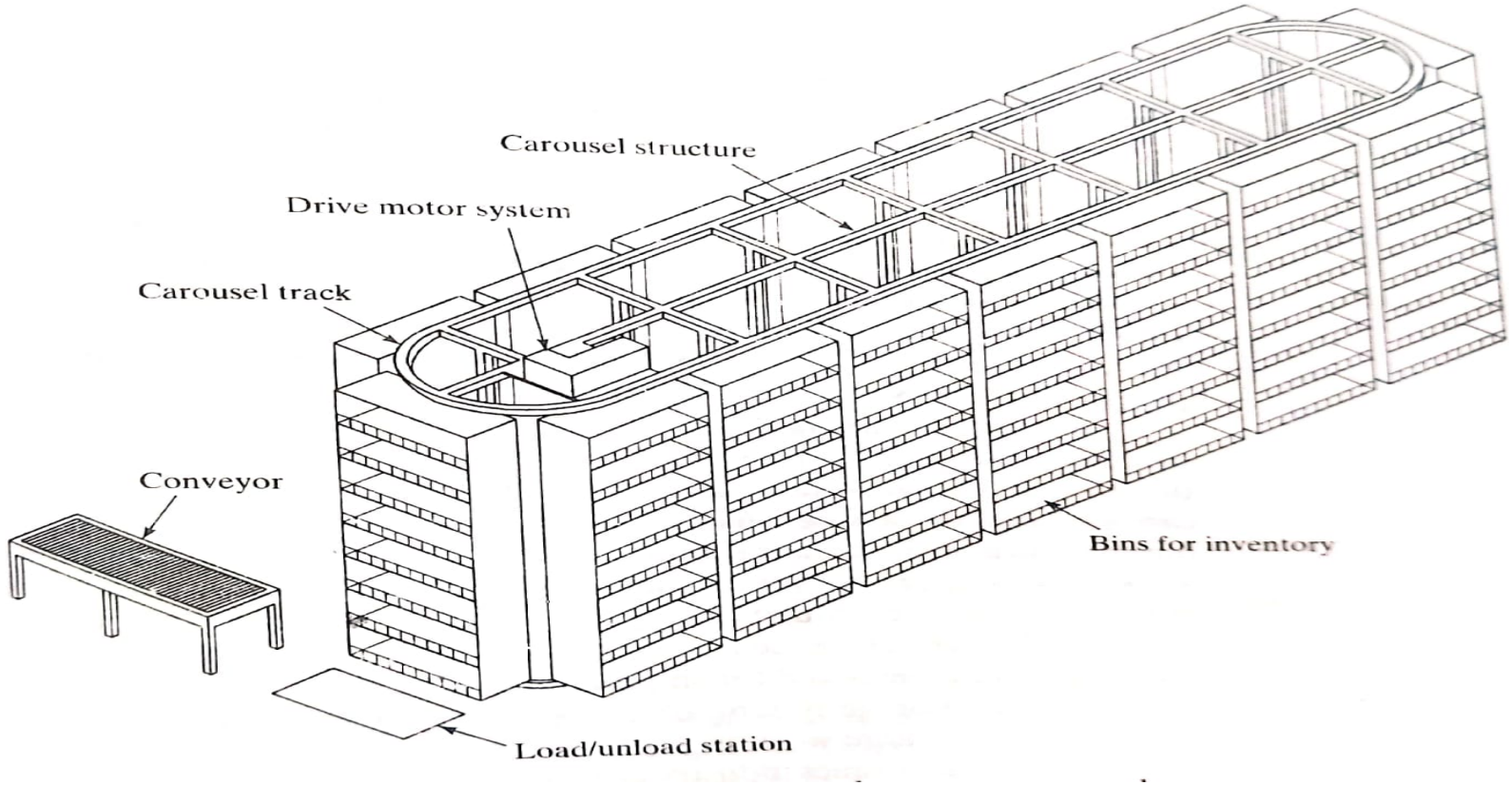
a) Buffer storage in production
b) Support of just- in time delivery
c) Kitting of parts for assembly
d) Compatible with automatic identification systems
e) Computer control and tracking of materials
f) Support of factory-wide automation

Components and operating features of AS/RS

i) Storage structure
ii) S/R machine
iii) Storage modules (e.g, pallets for unit loads)
iv) One or more pick up and deposit stations

In addition, a control system is required to operate the AS/RS

Carousel Storage system



Carousel Applications

(i) Storage and retrieval operations
(ii) Transport and accumulation
(iii) Work-in-process
(iv) Unique applications

Difference between as AS/RS and carousel Storage System

Feature	Basic AS/RS	Basic Carousel Storage System
Storage Structure	Rack system to support pallets or shelf system to support tote bins	Baskets suspended from overhead conveyor trolleys
Motions	Linear motion of S/R machine	Revolution of overhead conveyor trolleys around oval track
Storage/retrieval operation	S/R machine travel to compartments in rack structure	Conveyor revolves to bring baskets to load/unload station
Replication of storage capacity	Multiple aisles,each consisting of rack structure and S/R machine	Multiple carousels, each consisting of oval track and suspended bins