SNS COLLEGE OF TECHNOLOGY

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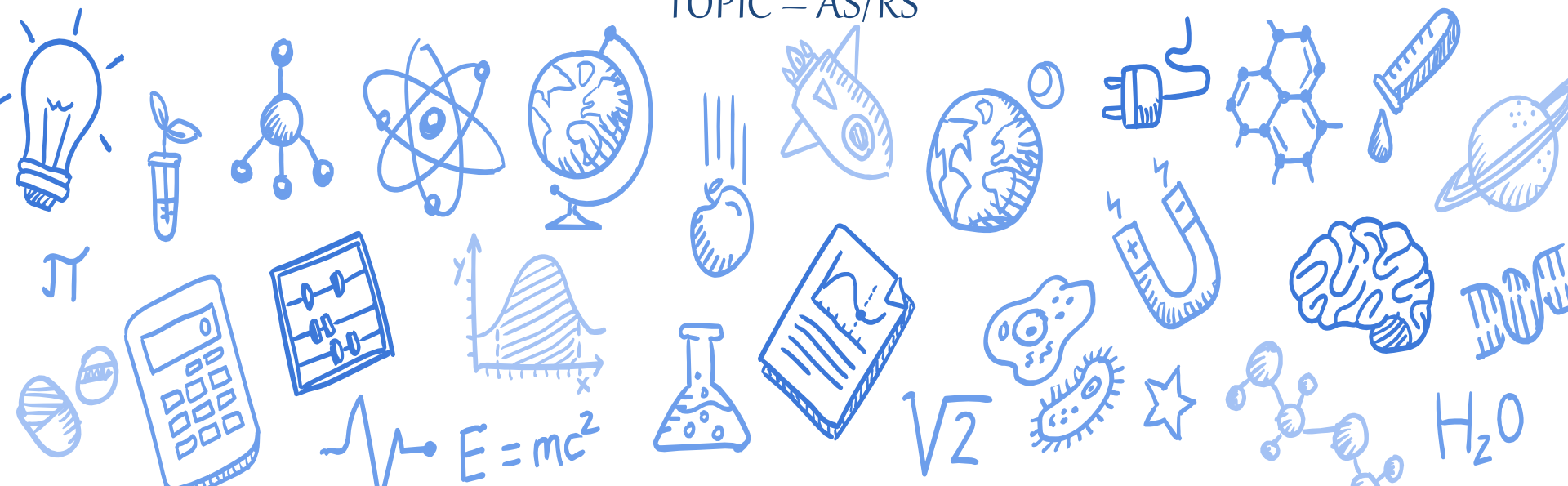
DEPARTMENT OF MECHANICAL ENGINEERING

19MEB204 IoT FOR PRODUCTION SYSTEM

III YEAR VI SEM

UNIT 4- IoT IN PRODUCTION AUTOMATION

TOPIC – AS/RS



Introduction:

- An automated guided vehicles(AGV) is a battery operated , programmable and automatic guided mobile vehicle without the need of human intervention, used for transporting the material from the stores to the shop/ assembly line or vice versa.
- **Main parts of AGV:**

(1)Structure
(2)Driver system
(3)Steering mechanism
(4)Power source
(5)Onboard computer for control

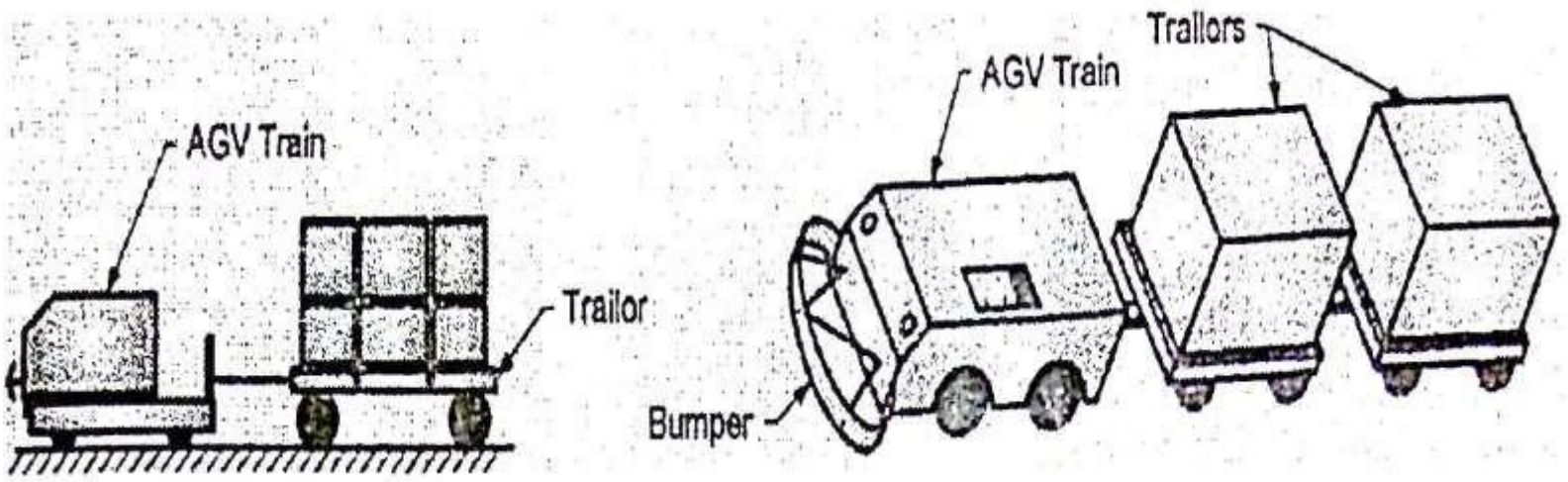
Types of automated guided vehicles:

- The automated guided vehicles are divided into **six types**:

(1)Unmanned AGV trains
(2)AGV Fork lift trucks
(3)AGV light load vehicles
(4)AGV pallet trucks
(5)AGV unit load vehicles
(6)AGV assembly line vehicles

(1) Unmanned AGV trains:

- Unmanned AGV trains consist of a towing vehicle which pulls one or more trailers to form a train.
- As shown in fig.

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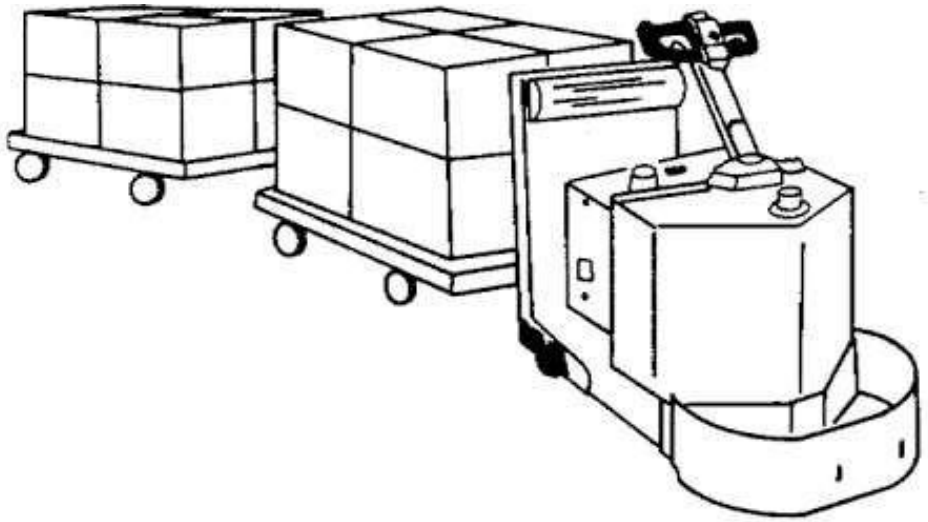
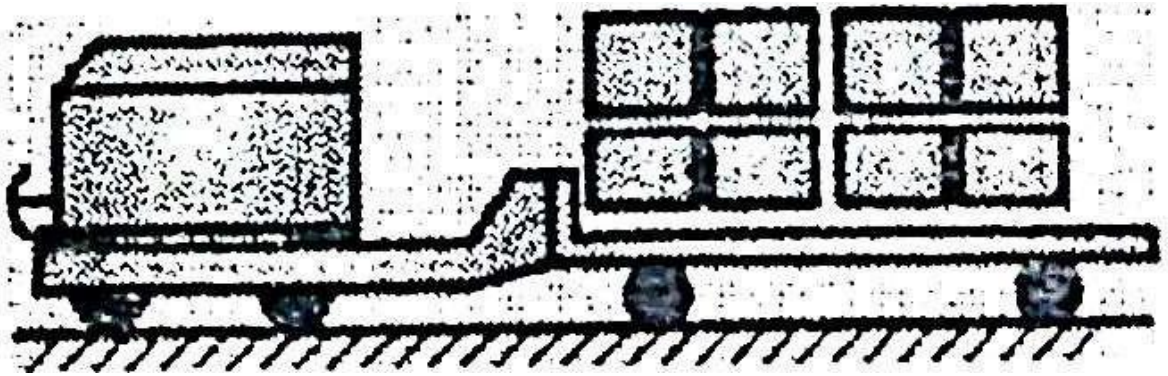
TBT Corporation



(2) AGV pallet trucks:

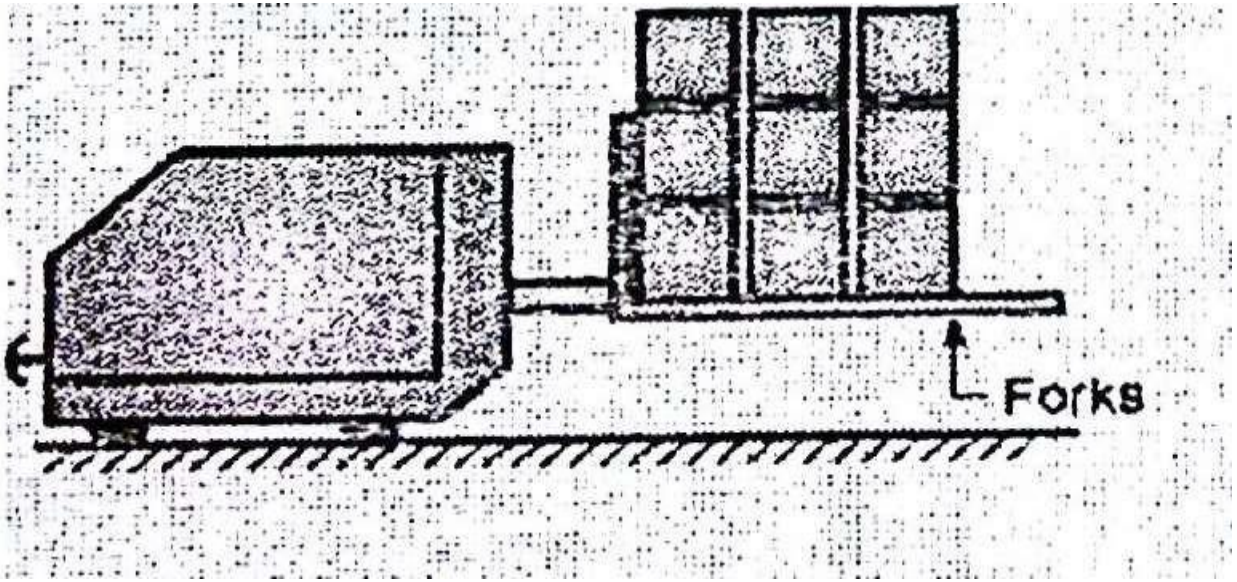
- The worker drives the pallet truck to the guide path and programs its destination points. The vehicle then automatically proceeds to the destination point for unloading.
- The capacity of AGV pallet truck **ranges up to several tons**.
- It is used to move the palletised loads from floor level along predetermined route.

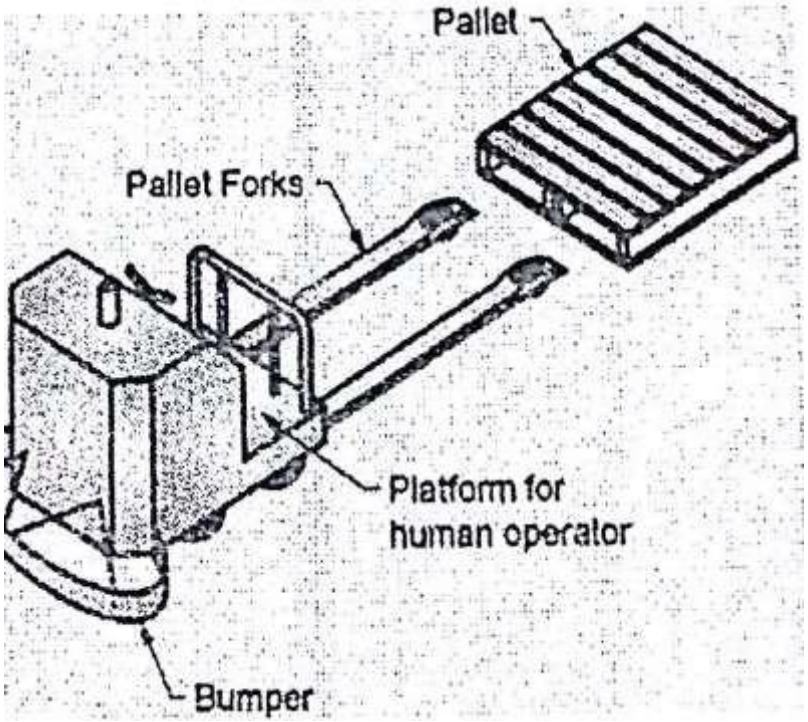



NO RIDING

(3) AGV fork lift trucks:

- It is equipped with forks which can move in vertical direction to reach palletised loads on racks and stands.
- This vehicle has an ability to load and unload the palletised loads both at floor level as well as stands.
- It can position its forks at any height so that load stands of varying height can be accessed easily.

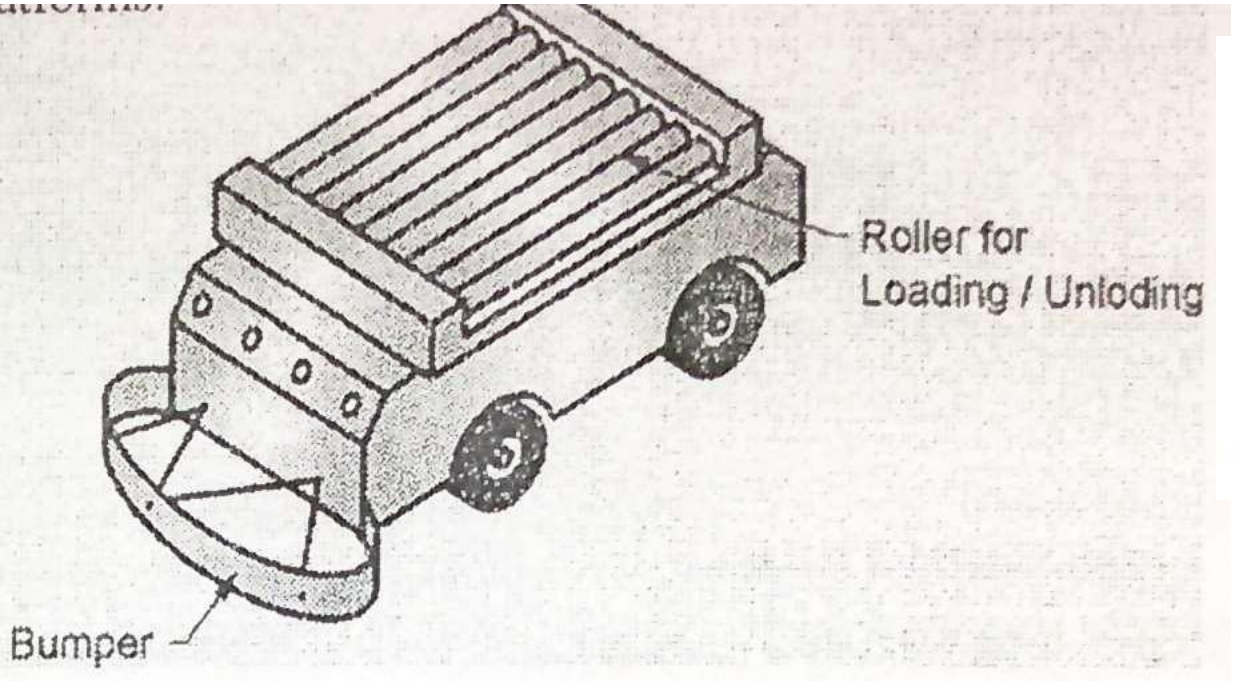


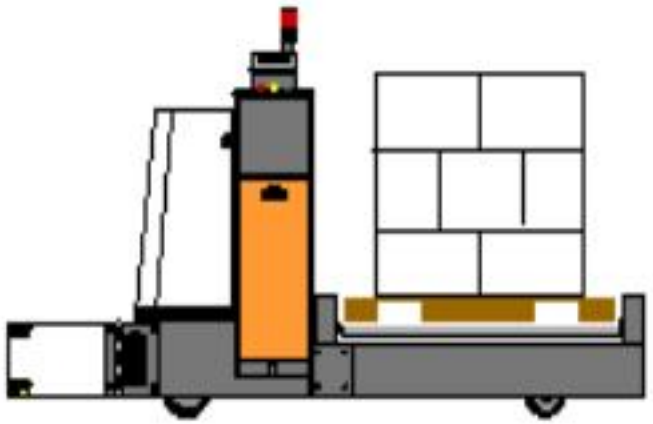

Pallet
Pallet Forks
Platform for
human operator
Bumper


RA·GV

(4) AGV unit load vehicles:

- The AGV unit load vehicle is used to move unit loads from one workstation to another.
- The vehicle is equipped for automatic loading and unloading of pallets by means of powered rollers or lifting platforms.





(5) AGV light load vehicles:

- AGV light load vehicle is a small capacity vehicle with a capacity of order of 200 kg. It is used to transport small loads through plants of limited size engage in light manufacturing.

(6) AGV assembly line vehicles:

- AGV assembly line vehicles is a modification of AGV light load vehicles used for assembly operation.
- AGV assembly line vehicle is designed to carry a subassemblies through a sequence of assembly workstation where parts are assembled to finished assembly.

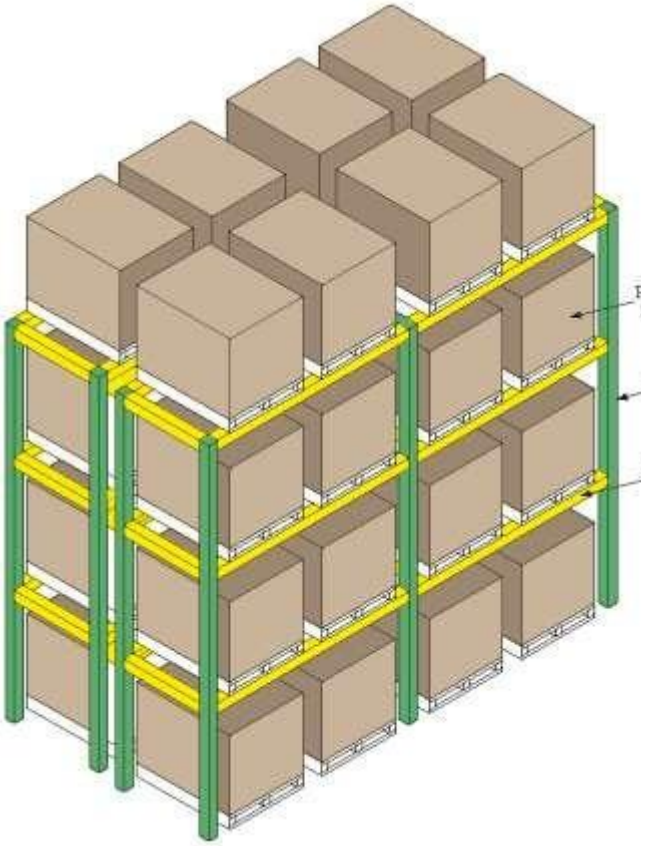
Advantages:

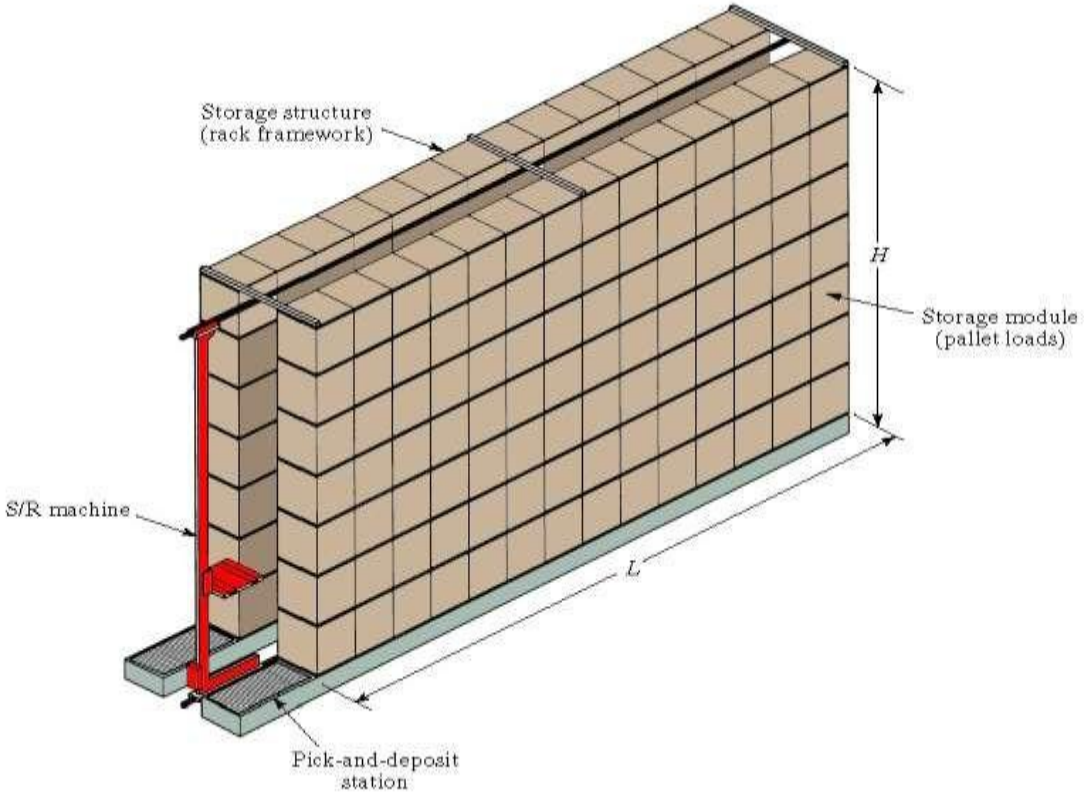
1. AGV ensure the increased control over the material flow and movement.
2. As the material movement is automated, the possibility of product damage is minimum.
3. AGV ensures high locational and positional accuracy.
4. **AGVs are great of help in hazardous working environment.**

Limitation:

1. The system requires high initial investment.
2. **AGV system is not suitable for small units.**

AS/RS
Automated Storage and Retrieval System





Introduction

- In large manufacturing industry, the volume of items and components is so large that it becomes extremely unreliable and time consuming to use manual storage and retrieval system. Therefore, in such cases it is advisable to use the automated storage and retrieval system.

- An automated storage/retrieval system (AS/RS) can be defined as a storage system under which a defined degree of automation is to be implemented to ensure precision accuracy and speed in performing storage and retrieval operations. These automated storage and mechanized systems eliminate human intervention in performing basic sets of operations.

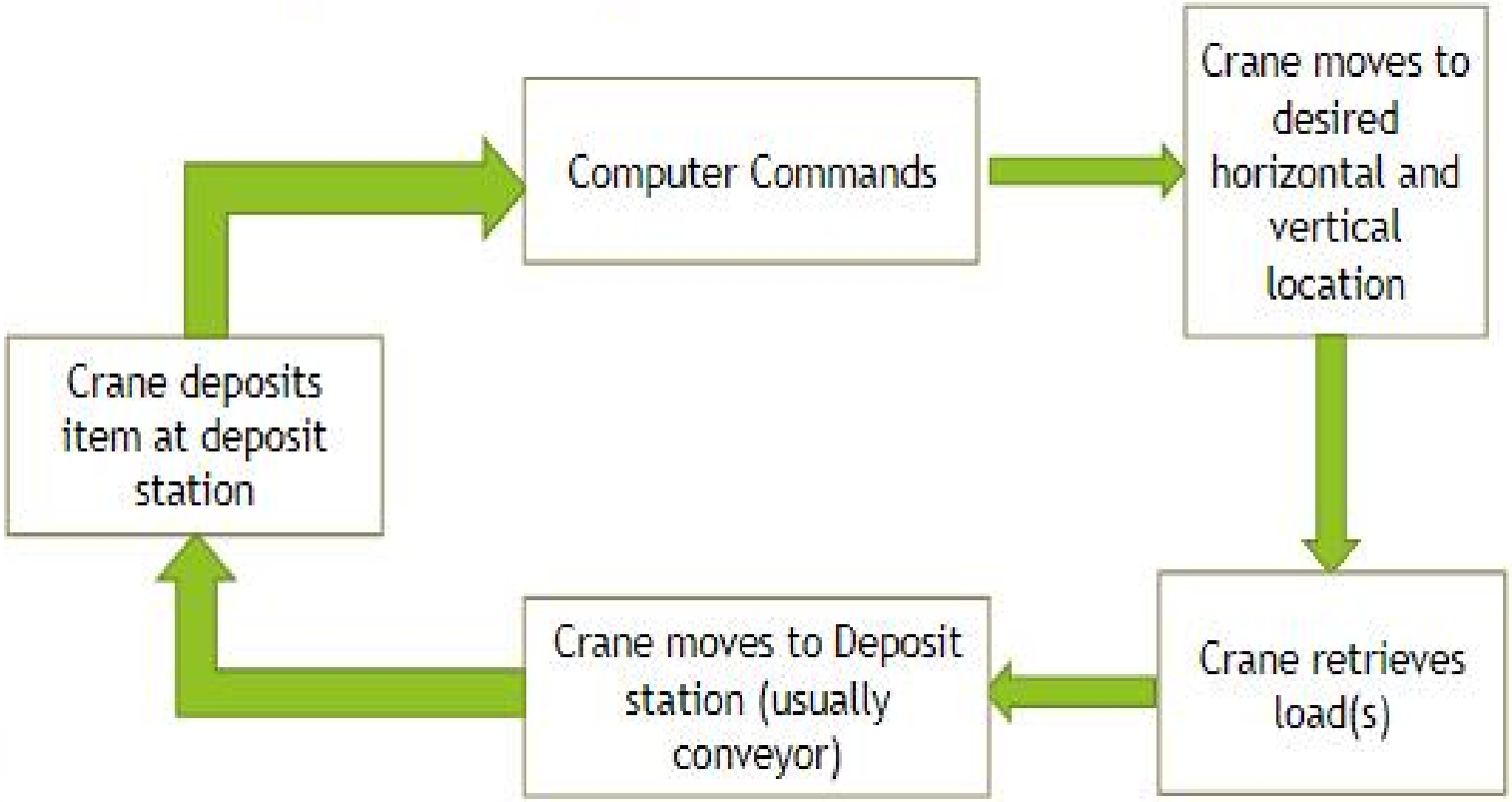
Objectives for Installing AS/RS

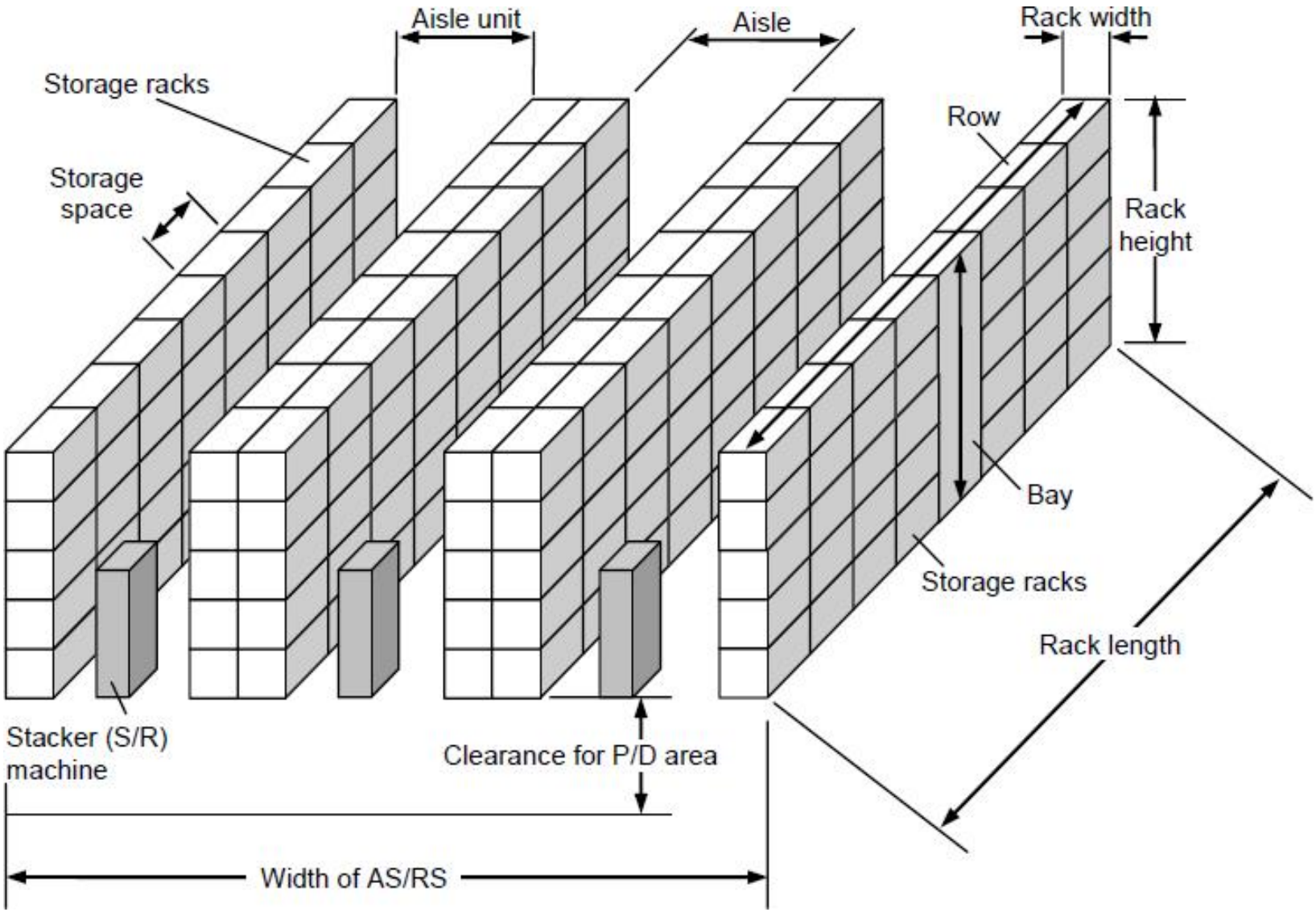
1. Increasing the storage capacity
2. Increasing the stock rotation
3. Utilization of maximum floor space
4. Recovering the space for manufacturing facilities
5. Customer service to be improved
6. Control over inventories to be improved
7. Ensuring safety in storage function
8. Increasing the labour productivity in storage function
9. Reducing labour cost in storage operation
10. Reducing pilferage and improving security

AS/RS Terminology

- An AS/RS consists of one or more storage aisles that are serviced by a storage/retrieval (S/R) machine.
- The stored materials are held by storage racks of aisles.
- The S/R machines are used to deliver and retrieve materials in and out of inventory.
- There are one or more input/output stations in each AS/RS aisle for delivering the material into the storage system or moving it out of the system.
- In AS/RS terminology, the input/output stations are called pickup-and-deposit (P&D) stations.

Basic System Layout




Aisle unit
Aisle
Rack width
Storage racks
Row
Storage space
Rack height
Bay
Storage racks
Rack length
Stacker (S/R) machine
Clearance for P/D area
Width of AS/RS

AS/RS Components

1. Storage Racks or Storage Structure
2. Transport Devices (AGV, Conveyor, etc)
3. Pick-Up and Delivery (P and D) Stations
4. Storage and Retrieval Machines (Stacker Crane)
5. Computer Control System

❑ **Storage Racks or Storage Structure :**

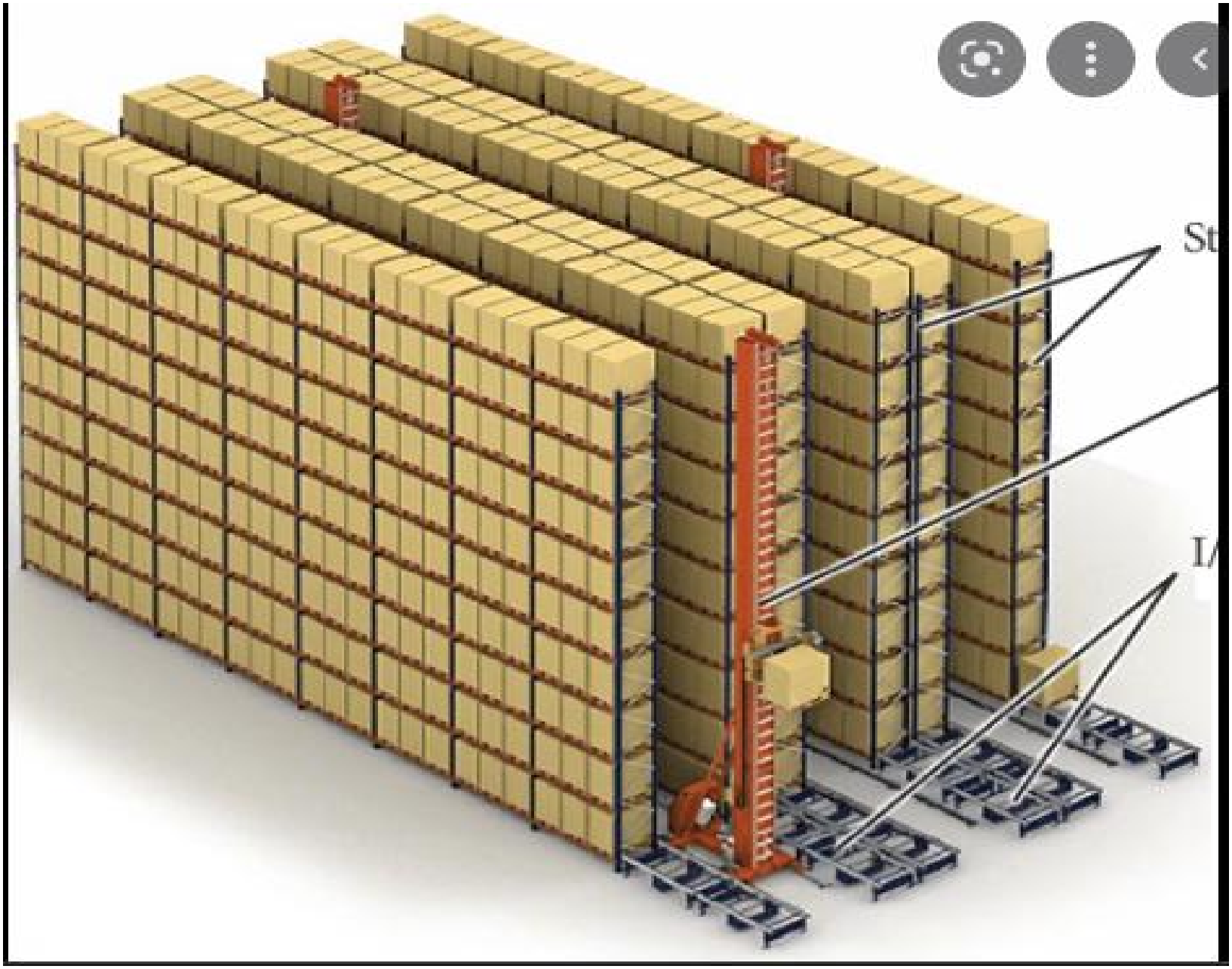
- The automated storage and retrieval system contains several rows of storage racks for storing the material items. The storage structure of automated storage and retrieval system is much taller (can be as tall as 30 meters) than that of the conventional storage and retrieval systems.

❑ Transport Devices (AGV, Conveyor, etc.) :

- The storage structure, where the material/items are stored, is linked to the shop floor by transport devices such as automated guided vehicles or conveyors.
- The incoming material/items are first sorted and loaded to pallets. The loaded pallets are then passed through weighing and sizing stations to ensure that they are within the load and size limits.

❑ Pick-Up and Delivery (P and D) Stations :

- The input/output stations are called pick-up and delivery (P and D) stations. The pallets are transported by the automated guided vehicles or conveyors are received at P and D.
- The details of the pallet contents are communicated to the central computer. The central computer assigns the storage location in storage racks to the pallet.


St
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❑ Storage and Retrieval Machine (Stacker Crane) :

- The pallet is moved from P and D station to the storage rack by storage and retrieval cranes.
- Whenever there is a request for the item to the central computer, the computer searches its memory for the storage location and directs the stacker crane to retrieve the pallet.
- An S/R machine is capable of both horizontal and vertical movement. A rail system along the floor guides the machine and a parallel rail at the top (up to 30m) of the storage structure is used to maintain its alignment.

❑ Computer Control System:

- The computer control unit performs two functions:

1. To control the operation of the system
2. To store the material movement and inventory data.

Types of AS/RS

- Several important categories of AS/RS can be distinguished based on certain features and applications. The following are the principle types :

❑ **Unit Load AS/RS**

- The unit load AS/RS is used to store and retrieve loads that are palletized or stored in standard-sized containers. The system is computer controlled. The S/R machines are automated and designed to handle the unit load containers. Usually, a mechanical clamp mechanism on the S/R machine handles the load. However, there are other mechanisms such as a vacuum or a magnet-based mechanism for handling sheet metal. The loads are generally over 500 lb per unit. The unit load system is the generic AS/RS.

❑ Mini Load AS/RS :

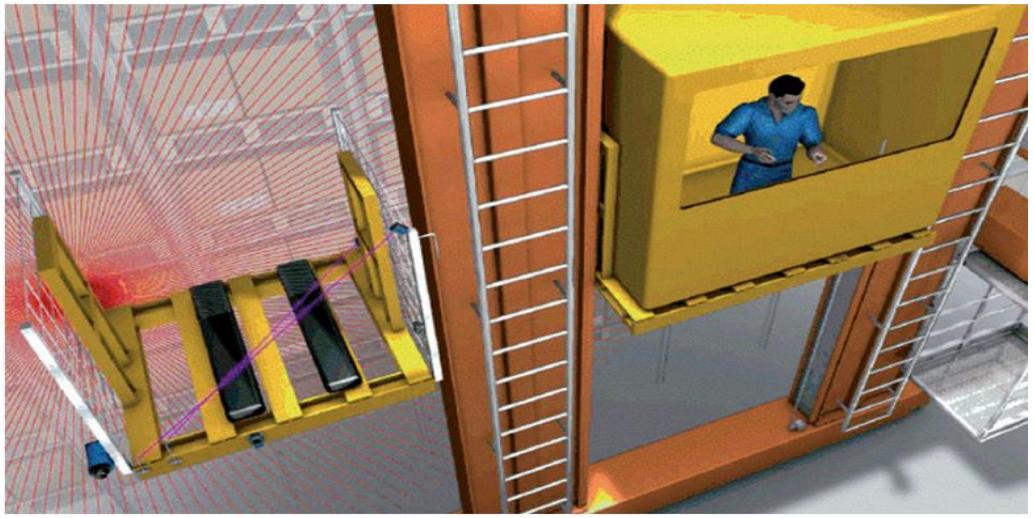
- This system is designed to handle small loads such as individual parts, tools, and supplies that are contained in bins or drawers in the storage system. Such a system is applicable where the availability of space is limited. It also finds its use where the volume is too low for a full-scale unit load system and too high for a manual system. A mini load AS/RS is generally smaller than a unit load AS/RS and is often enclosed for security of items stored.

❑ Deep-lane AS/RS :

- This is a high-density unit load storage system that is appropriate for storing large quantities of stock. The items are stored in multi deep storage with up to 10 items in a single rack, one load behind the next. Each rack is designed for flow-through, with input and output on the opposite side. Machine is used on the entry side of the rack for input load and loads are retrieved from other side by an S/R- type machine.

❑ Man-on-board AS/RS :

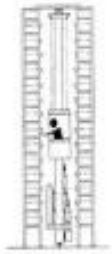
- This system allows storage of items in less than unit load quantities. Human operator rides on the carriage of the S/R machine to pick up individual items from a bin or drawer. The system permits individual items to be picked directly at their storage locations. The operator can select the items and place them in a module. It is then carried by the S/R machine to the end of the aisle or to a conveyor to reach its destination.



❑ Automated Item Retrieval System :

- This system is designed for retrieval of individual items or small product cartoons. The items are stored in lanes rather than bins or drawers. When an item is retrieved from the front by use of a rear-mounted pusher bar, it is delivered to the pickup station by pushing it from its lane and dropping onto a conveyor. After moving itself to the correct lane, the picking head activates the pusher mechanism to release the required number of units from storage.

Unit Load	Large standard unit packages
Deep Lane	Deep aisles of single SKU items
Mini Load	Items stored in bins, which are retrieved
Man On Board	Picker is carried to retrieval location
Item Retrieval	Stored in lanes, pushed onto a conveyor
Vertical Lift	Vertically stored unit loads



Comparisons

	Unit Load	Deep-Lane	Mini-Load
Application	Large load, one at a time	High density unit storage	Several small loads at once
How many loads	1	1	Several
Horizontal Speed	800 ft/min	800 ft/min	600 ft/min
Vertical Speed	300 ft/min	300 ft/min	350 ft/min
Load Capacity	6000 lbs	6000 lbs	600 lbs
Height Capacity	40-100 ft	40-100 ft	10-40 ft
Number of cranes	1 per aisle	1 per aisle, 2 needed per operation	1 per aisle

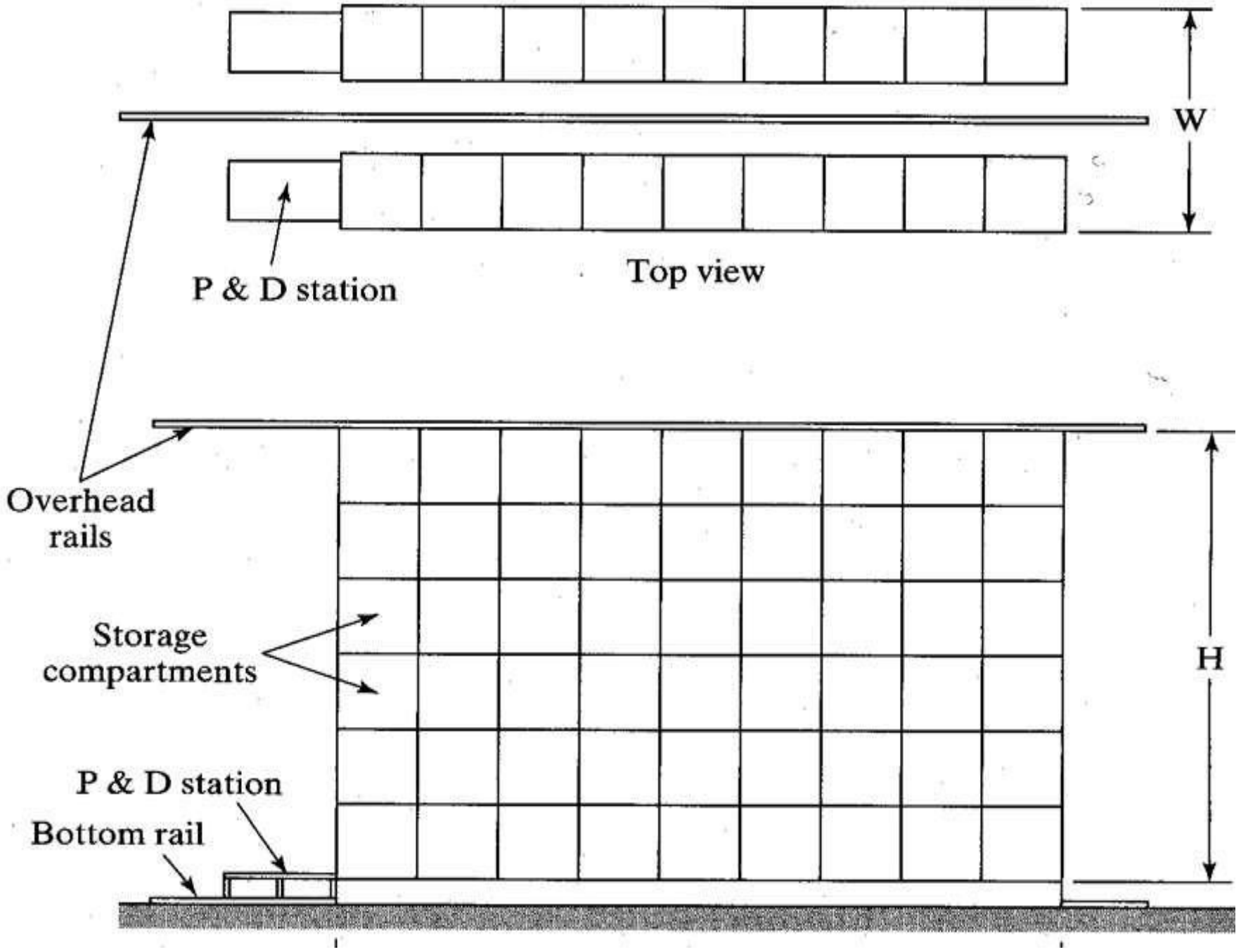
Cost is roughly the same independent of type...
all depends on size and load requirements!
Roughly $2 million-10 million+

Analysis of Automated Storage/Retrieval Systems

- The total storage capacity of one storage aisle depends on how many storage compartments are arranged horizontally and vertically in the aisle. This can be expressed as follows:

$$\text{Capacity per aisle} = 2\, n_y\, n_z$$

- Where n_y = number of load compartments along the length of the aisle, and n_z = number of load compartments that make up the height of the aisle. The constant 2 accounts for the fact that loads are contained on both sides of the aisle.
- If we assume a standard size compartment (to accept a standard size unit load), then the compartment dimensions facing the aisle must be larger than the unit load dimensions.
- Let x and y = the depth and width dimensions of a unit load, and z = the height of the unit load.


W
P & D station
Top view
Overhead rails
Storage compartments
H
P & D station
Bottom rail

- The width, length, and height of the rack structure of the AS/RS aisle are related to the unit load dimensions and number of compartments as follows:

$$W = 3\,(x + a)$$

$$L = n_y\,(y + b)$$

$$H = n_z\,(z + c)$$

- Where, *W, L, and H* are the width, length and height of one aisle of the AS/RS rack structure (mm).
- *x, y,* and *z* are the dimensions of the unit load (mm).
- a, b, and c are allowances designed into each storage compartment to provide clearance for the unit load (mm).

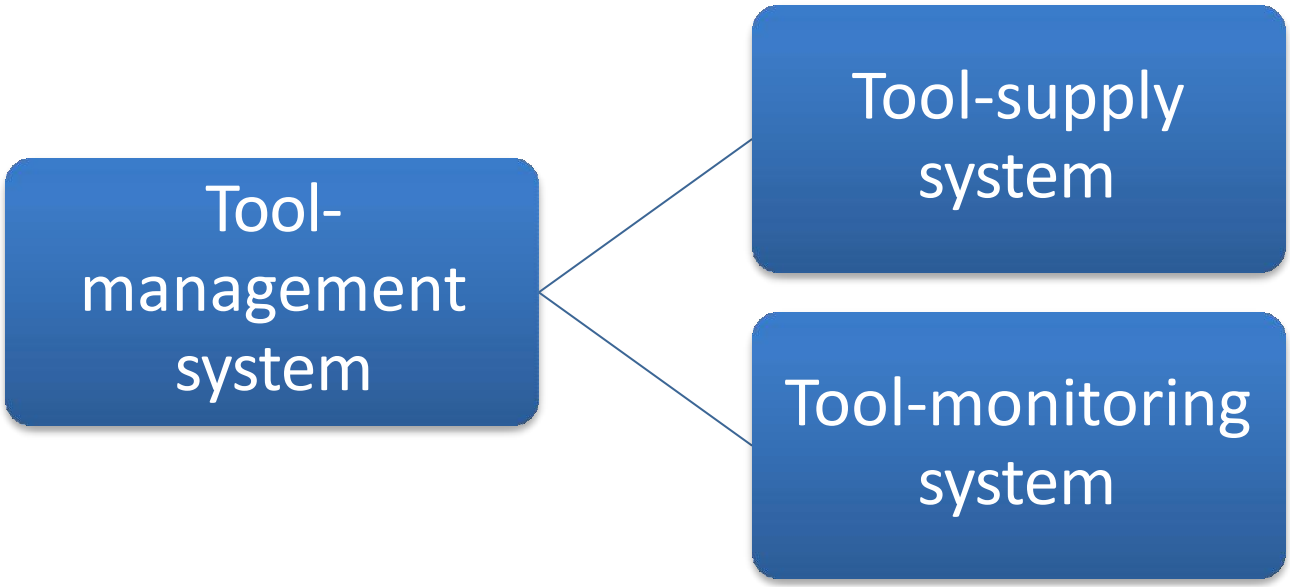
❑ **Some of the <u>limitations</u> of automated storage and retrieval system are as follows :**

- The initial cost of the AS/RS is high.
- AS/RS requires automated guided vehicles or conveyors.
- AS/RS is feasible only for large manufacturing establishments.

INTRODUCTION OF TOOL MANAGEMENT SYSTEM

TOOL MANAGEMENT SYSTEM

- Tooling is one of the important part of manufacturing system in flexible manufacturing system.
- Therefore its necessary that the tooling system are to be managed effectively for successful functioning of FMS.



Tool Supply System

- **In automated manufacturing system , the set of tools have to be supplied to the system and taken out from the system at regular interval depending upon the requirement.**
- ***In NC/CNC machines***
- In NC/CNC machines tools and FMS, all the tools are mounted on the tool magazine of automatic tool changer at the beginning. if any of tool has to be replaced from tool magazine ,during the operation the machine tool may have to be stopped.
- That will Lead to **loss of production time**, so alternative method has to be used to replace the tool from the tool magazine, during the operation.
- In NC/CNC machine tools, the parts of components are not changed frequently, so tool replacement is not the major problem.

Tool Supply System(con…)

- ***In FMS***
- In FMS, there can be more than one work station and the part to be machined get changed more frequently than that in NC/CNC machine tools.
- Therefore there has to be effective machine tool supply system in place.
- The basic concept used in tool supply system is to use auxiliary tool storage from where the required tools can be transferred to main tool magazine as and when required without much loss of production time.

Various Tool Supply Systems

Tool supply systems used in FMS are as follows:

I. Single tool magazine system
II. Multiple tool magazine system
III. Interchangeable tool magazine system
IV. Main and auxiliary tool magazine system
V. Interchangeable tool cassettes system
VI. Tool highway system

Tool-monitoring System

- ***In order to ensure safety of the performance of the cutting tool, its necessary to monitor tool continuously while it is performing the cutting operations.***

There are **three methods of tool monitoring system**:

- 1. Tool-wear monitoring
- 2. Tool breakage monitoring
- 3. Tool-life monitoring