

# Automation in Material Handling and Storage

L-9

## CONTENT OF PRESENTATION

- Material handling
- Material handling equipment
- Automation in Material handling
- Automated guided vehicles (AGV)
- Conveyors
- AGV example
- Simulation
- Limitations



## WHAT IS MATERIAL HANDLING

- **Material handling** is the art and science of moving, storing, protecting, and controlling material
  - Moving:** Required to create time and place utility. The value of having the material at the right time and the right place.
  - Storing:** Provides a buffer between operations, facilitates the efficient use of people and machines.
  - Protecting:** Includes the packaging, packing against damage and theft.
  - Controlling:** Physical Orientation, sequence and space between material.



# CATEGORIES OF MATERIAL HANDLING EQUIPMENT

- 1. Material transport equipment** - to move materials inside a factory, warehouse, or other facility
- 2. Storage** - to store materials and provide access to those materials when required
- 3. Unitizing equipment** - refers to
  - (1) containers to hold materials, and
  - (2) equipment used to load and package the containers
- 4. Identification and tracking systems** - to identify and keep track of the materials being moved and stored



## MATERIAL TRANSPORT EQUIPMENT

- Industrial trucks
- AGVs
- Robots
- Monorails and other rail guided vehicles
- Conveyors
- Cranes and hoists



## WHY USE AUTOMATION IN MATERIAL HANDLING

1. To increase labor productivity
2. To reduce labor cost
3. To mitigate the effects of labor shortages
4. To reduce or remove routine manual and clerical tasks
5. To improve worker safety
6. To improve product quality
7. To reduce manufacturing lead time
8. To accomplish what cannot be done manually



## 1. AUTOMATED GUIDED VEHICLE

- **What is AGV ?**

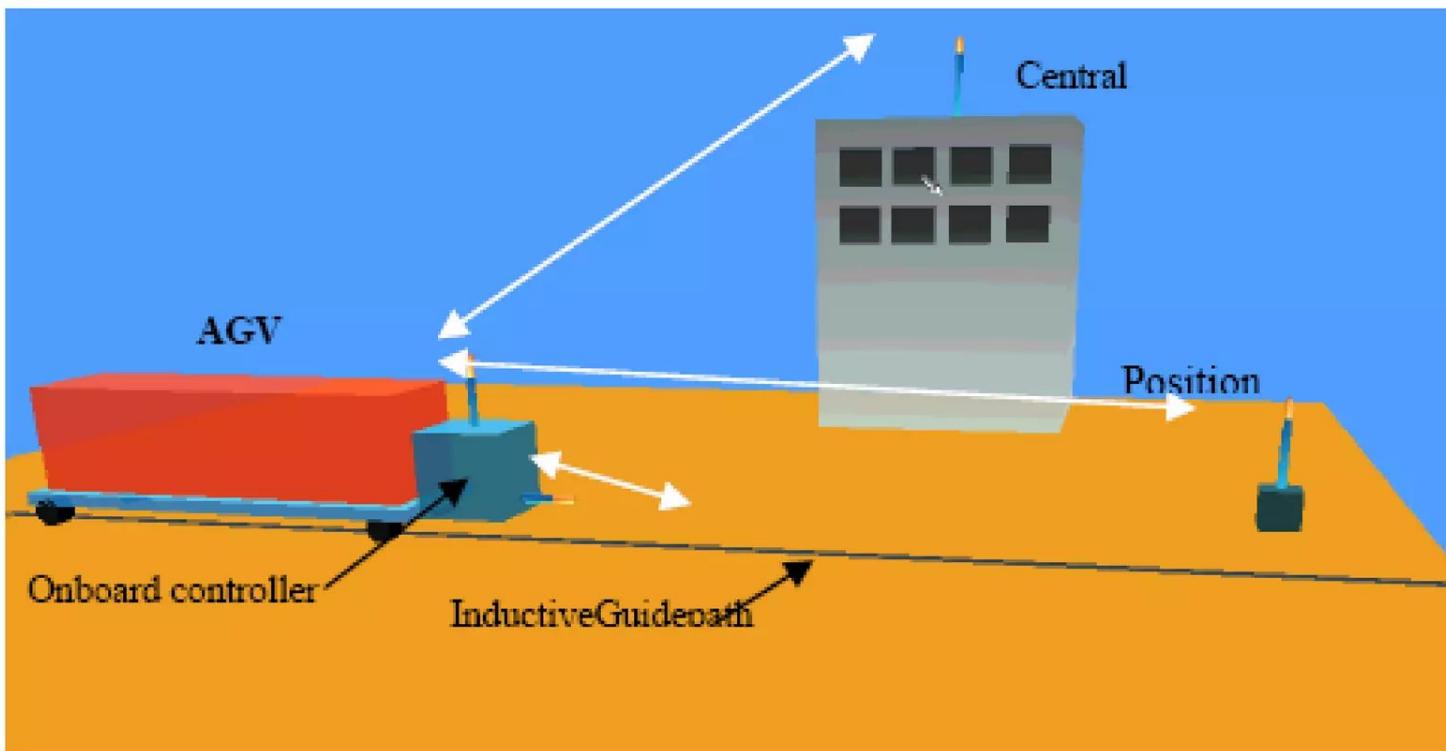
Material handling system that uses **independently operated, Self-propelled vehicles, Guided along defined pathways.**

- Increase efficiency and reduce costs by helping to automate a manufacturing facility or warehouse.
- AGVs are employed in nearly every industry, including, paper, metals, newspaper and general manufacturing.
- They follow guidance circuits connecting various workstations in the warehouse



# COMPONENTS OF AGV

- Vehicle
- Guided path
- Control unit
- Computer interface



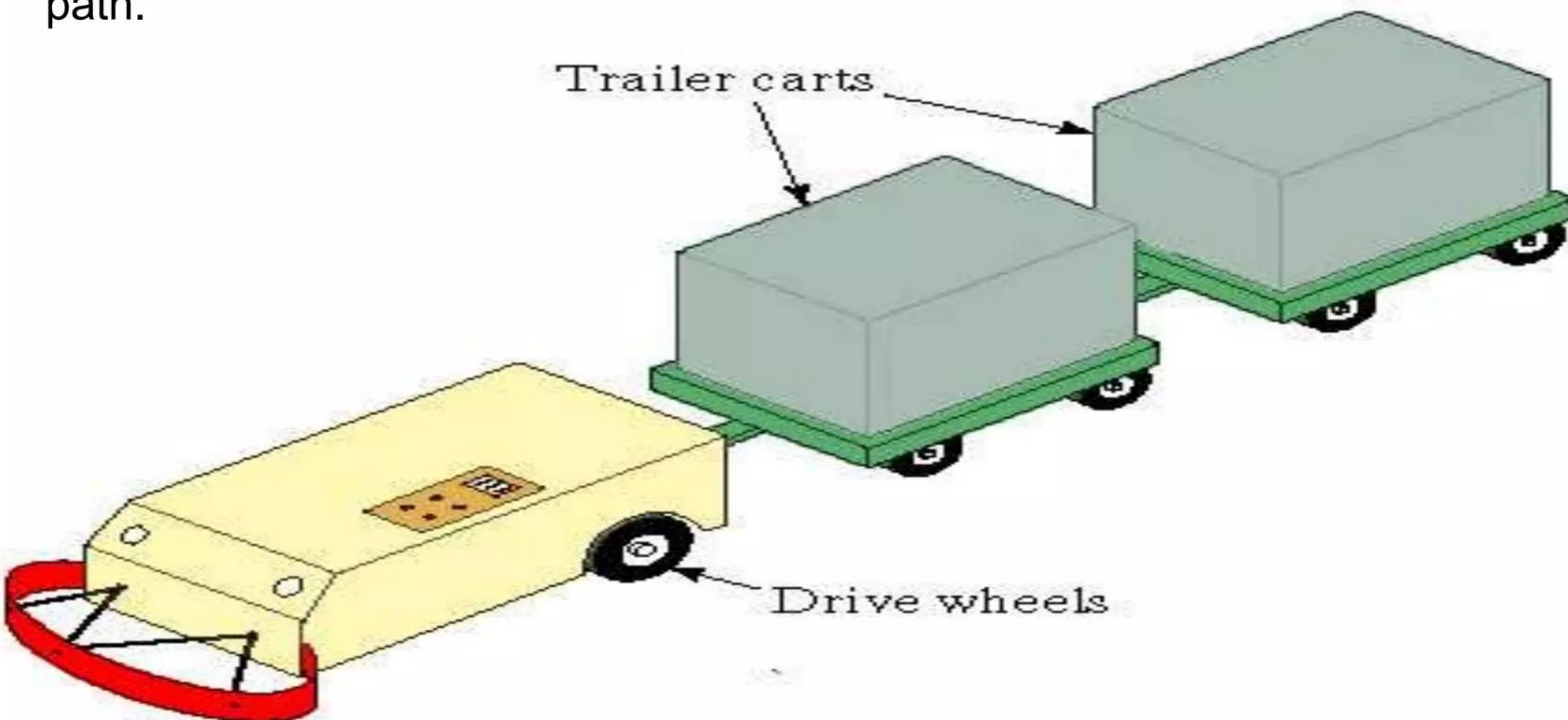
## AGV TYPES

- Driver less trains
- Pallet trucks
- Unit load carriers



## DRIVER LESS TRAINS

- Consists of towing vehicle, which is the AGV that pulls.
- One or more trailers forming a train.
- **Heavy payloads.**
- **Large distances** like in a warehouse.
- With or without intermediate pick-up and drop-off points along its path.

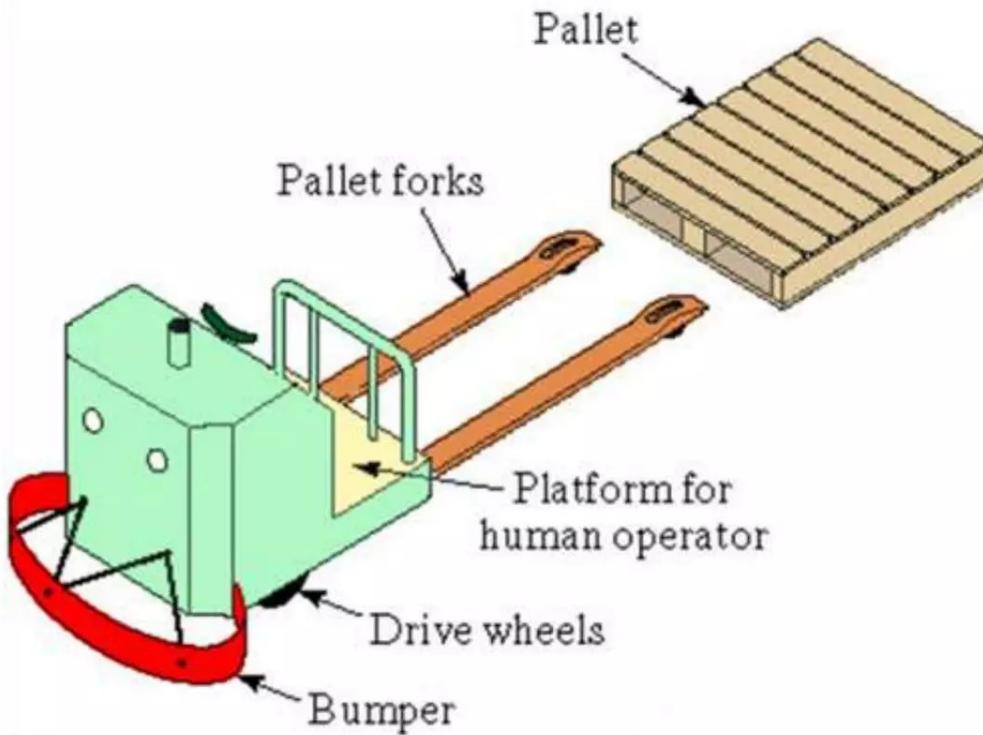


# DRIVER LESS TRAIN



## PALLET TRUCKS

- Used to move palletized loads along predetermined routes
- Vehicle is backed into loaded pallet by worker; pallet is then elevated from floor
- Worker drives pallet truck to AGV guide path and programs destination

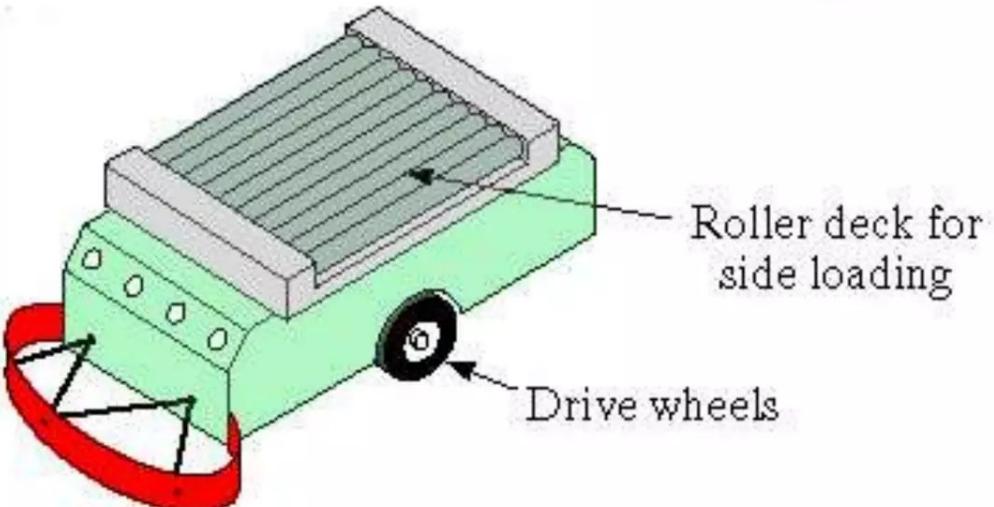


# PALLET TRUCKS



## UNIT LOAD CARRIER

- These are used to move **unit loads** from one station to another.
- **Light load AGVs**, up to **250 kg** or less.



# UNIT LOAD CARRIER



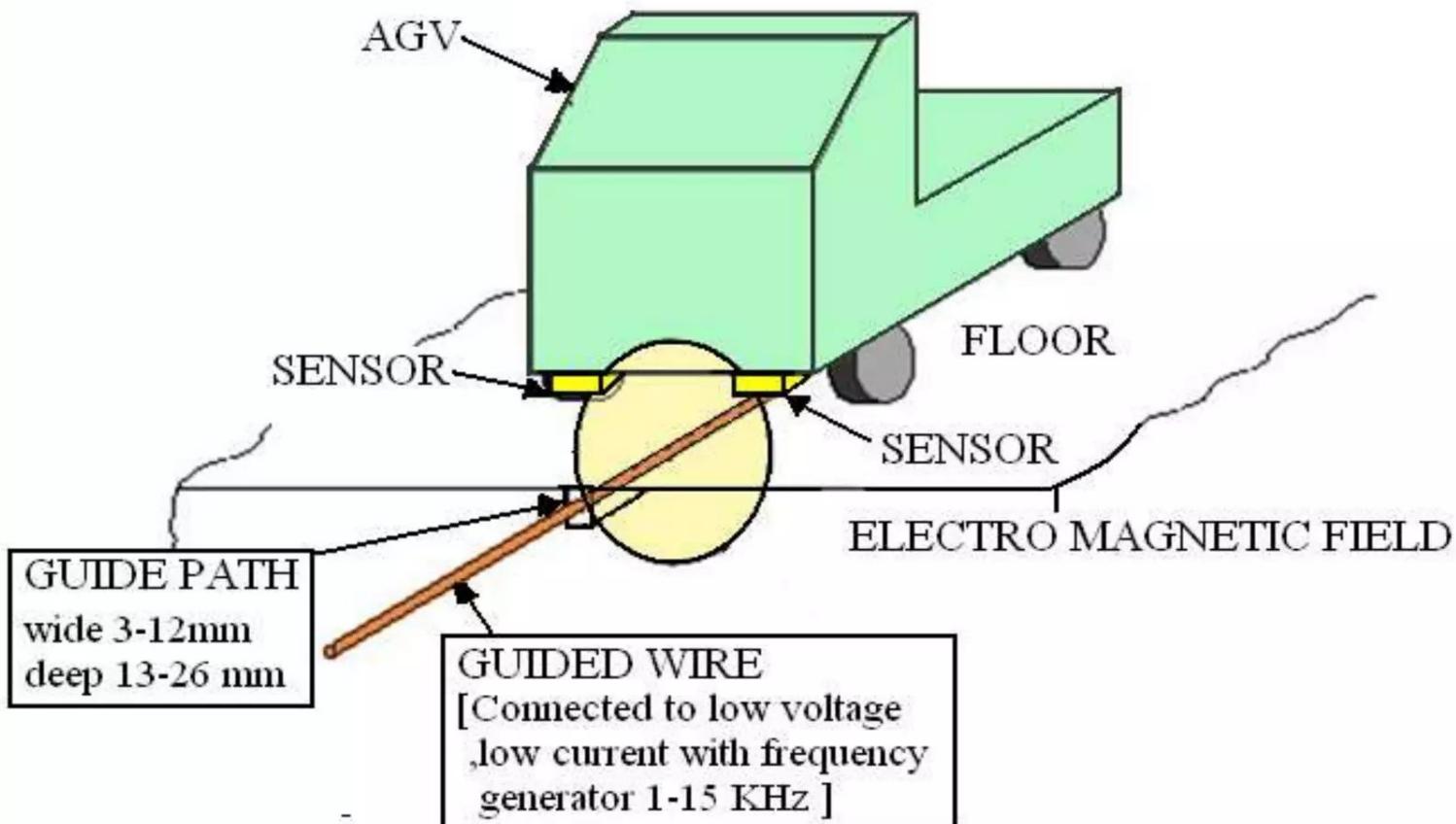
## VEHICLE GUIDANCE TECHNOLOGY

- Imbedded guide wires
- Paint strips (Optical navigation system)
- Self guided vehicles (Laser triangulation navigation system)



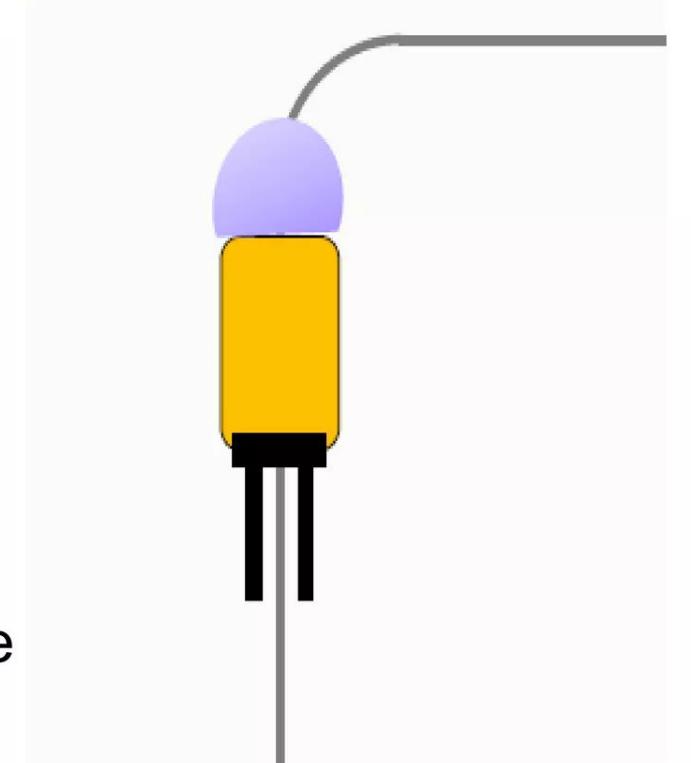
## 1. IMBEDDED GUIDE WIRES

- Faster and safer
- More accurate
- Less costly
- Simpler and less programming required



## 2. PAINT STRIPS (OPTICAL NAVIGATION SYSTEM)

- Chemical or tape strip is fixed or painted to the floor which contain **fluorescent particles** that reflect UV light source from vehicle
- Vehicle has an onboard sensor which allows it to detect the path.
- Not typically used in plants or warehouses because floor line needs to be cleaned or reapplied as it deteriorates with time.
- Useful in environment where guide wires in the floor surface is not practical.



### 3. SELF GUIDED (LASER TRIANGULATION NAVIGATION SYSTEM)

- Most popular method of AGV navigation.
- Operate without continuously defined pathways.
- Use **combination of dead reckoning** (capability of a vehicle to follow a given route in the absence of a defined pathway) and **beacons** located throughout the plant, which can be identified by on board sensors.
- Continuously verify position by comparing the calculated position with one or more known position



# CONVEYOR SYSTEMS

Large family of material transport equipment designed to move materials over fixed paths, usually in large quantities or volumes

## 1. **Non - powered**

- Materials moved by human workers or by gravity

## 2. **Powered**

- Power mechanism for transporting materials is contained in the fixed path, using chains, belts, rollers or other mechanical devices



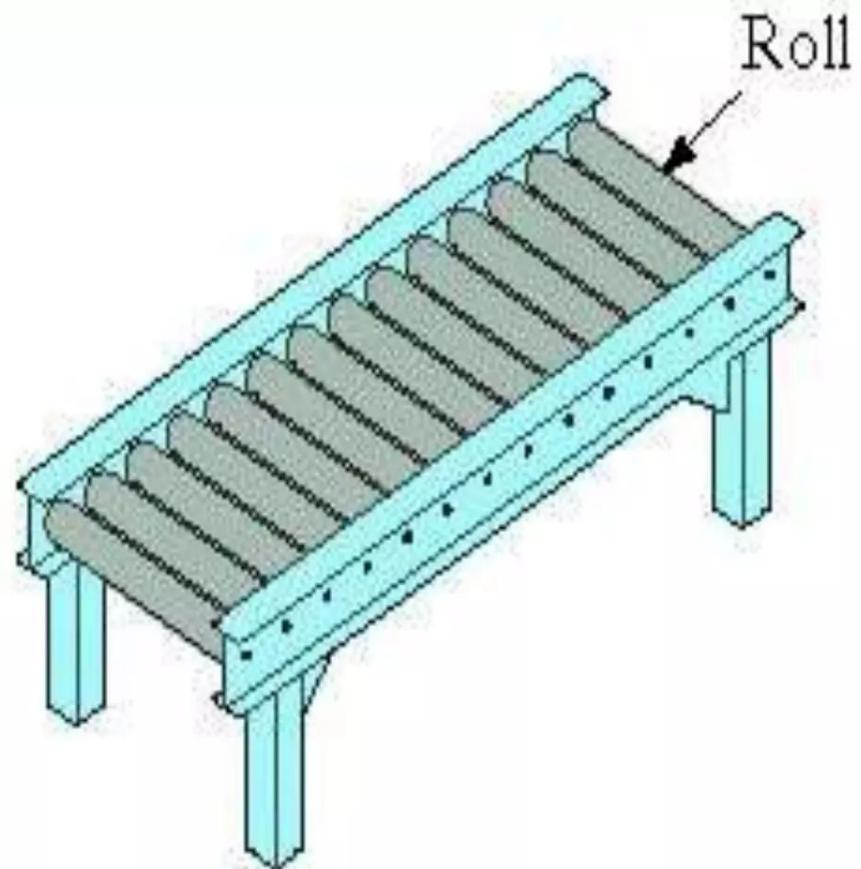
## CONVEYOR TYPES

1. Roller
2. Skate - wheel
3. Belt
4. In- floor towline



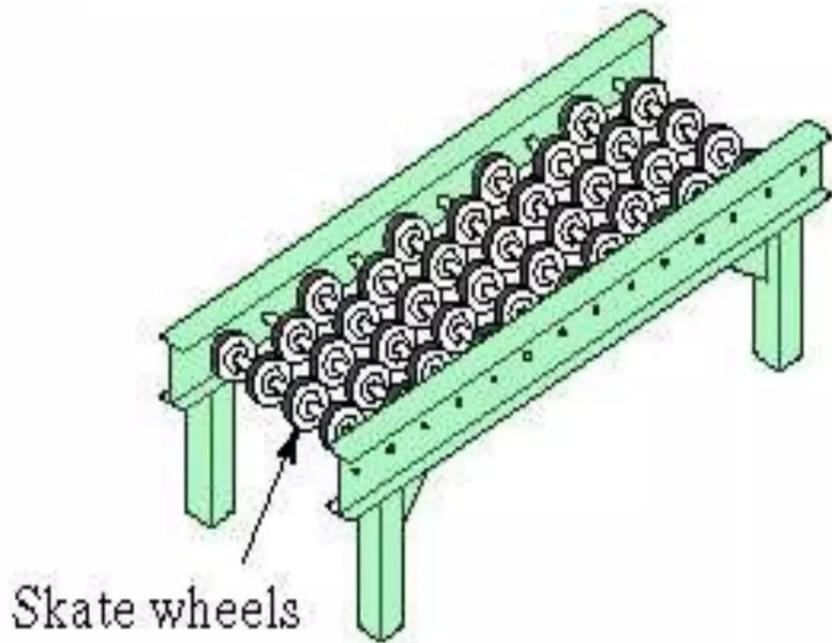
## 1. ROLLER CONVEYOR

- Pathway consists of a series of rollers that are perpendicular to direction of travel
- Loads must possess a flat bottom to span several rollers
- Powered rollers rotate to drive the loads forward



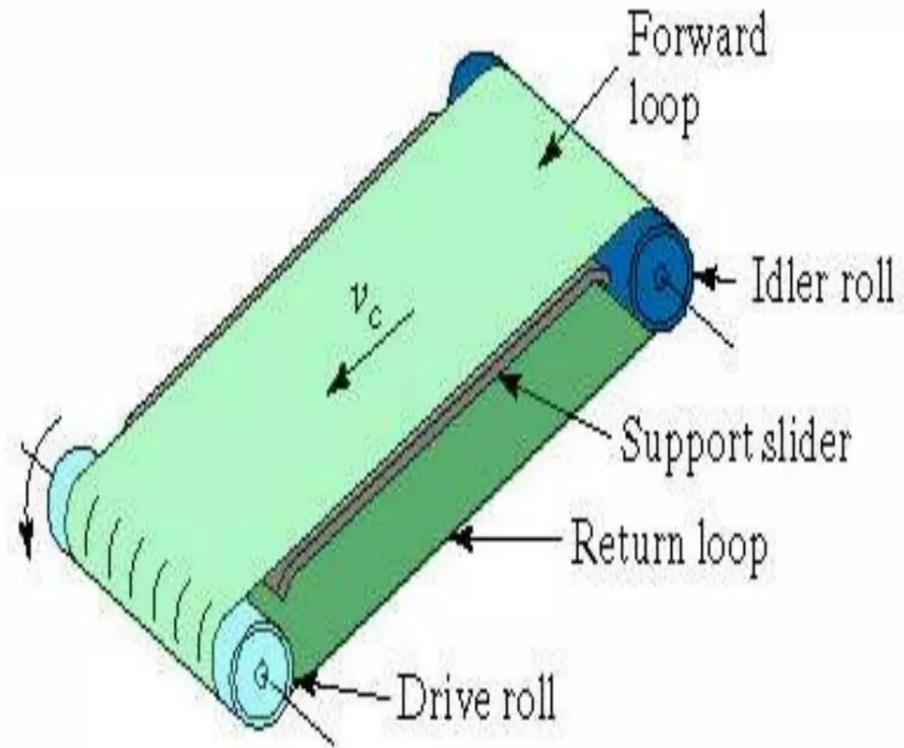
## 2. SKATE-WHEEL CONVEYOR

- Similar in operation to roller conveyor but use skate wheels instead of rollers
- Lighter weight and unpowered
- Sometimes built as portable units that can be used for loading and unloading truck trailers in shipping and receiving



### 3. BELT CONVEYOR

- Continuous loop with forward path to move loads
- Belt is made of reinforced elastomer
- Support slider or rollers used to support forward loop
- **Two common forms:**
  - Flat belt (shown)
  - V-shaped for bulk materials



## 4. IN-FLOOR TOW-LINE CONVEYOR

- Four-wheel carts powered by moving chains or cables in trenches in the floor
- Carts use steel pins (or grippers) to project below floor level and engage the chain (or pulley) for towing
- This allows the carts to be disengaged from towline for loading and unloading

