

Material Handling

- **What is Material Handling?**
 - It is handling material !
- **Right Definition**
 - Material handling uses the right method to provide the right amount of the right material at the right place, at the right time, in the right sequence, in the right position, in the right condition, and at the right cost.
 - » This is a relatively broad definition of material.
- **Material handling ...**
 - involves handling, storing, and controlling material
 - adds value through time and place utility
 - impacts space requirement, profits, quality, safety, and productivity

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Material Handling

- **Checklists**
 - Provide a check of new designs
- **Principles**
 - Provide “rules-of-thumb”
 - » Planning
 - » Standardization
 - » Work
 - » Ergonomic
 - » Unit Load
 - » Space Utilization
 - » System
 - » Automation
 - » Environmental
 - » Life Cycle Cost

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Material Handling

- **Material Handling System Design Process**
 - Define the objectives and scope of the mhs
 - Analyze the requirements for handling, storing, and controlling material
 - Generate alternative designs for meeting mhs requirements
 - Evaluate alternative mhs designs
 - Select the preferred design for handling, storing, and controlling material
 - Implement the preferred design
 - » Selection of suppliers
 - » Training
 - » Installation, debug, and start-up
 - » Performance audits

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Material Handling

- **Questioning Attitude: Why, what, where, when, how, who, and which?**
 - Why is handling required?

```

graph TD
    Why[Why?] --> What[What?]
    Why --> Where[Where?]
    Why --> When[When?]
    Why --> How[How?]
    Why --> Who[Who?]
    Why --> Which[Which?]
    What --> Materials[Materials]
    Where --> Moves[Moves]
    When --> Methods[Methods]
    How --> Preferred[Preferred System]
    Materials --- Plus1[+]
    Moves --- Plus2[+]
    Methods --- Plus3[+]
    Plus1 --- Plus2
    Plus2 --- Plus3
    Plus3 --- Preferred
    subgraph Alternatives [Material Handling System Alternatives]
        Materials
        Moves
        Methods
    end
    
```

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Material Handling

- **Factors**

- Type of materials
- Physical characteristics
- Quantities to be moved
- Sources and destinations for each move
- Frequency or rate of each move
- Equipment alternatives
- Units to be handled

- Material Flow → Method of handling, storing, and controlling → Material Handling

$$\sum_{\text{moves}} [\text{Why}(\text{Where} + \text{What} + \text{When})]$$

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Material Handling

- **Study each move**

- Can the move be eliminated?
- Can the move be combined with another or with an in-transit operation?
- Can the move be simplified?
- Is resequencing the moves possible? Is it advantageous?

- If the move must take place, then determine the best method.

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Material Handling

- **Unit Load Principle**
 - Unit load is the unit to be moved or handled at one time.
 - Advantage: handle multiple items -- reduce the number of trips
 - Unit loads can be contained in totes, cartons, pallets, pallet boxes, etc.
 - Enclosure and stabilization is provided by strapping, shrinkwrapping, and stretchwrapping
- **Unit load specification is an integral part of material handling and storage system design**

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- **Pallets**
 - **Style and Size based on:**
 - » Shipping and receiving restrictions
 - » Size and weight of items on the pallet
 - » Space restrictions
 - » Equipment used to move the pallet
 - » Slave versus non-slave considerations
 - » Cost, supply, and maintenance
 - » Aisle widths, door sizes, stacking heights

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Material Handling Performance

- “Support efficient production operations”
- Throughput
- Response time
- Cost
- Space and cube utilization
- Flexibility
- Expandability

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Material Handling Costs

- Total Cost of Ownership
 - Initial purchase price
 - Operating expenses (fuel, disposables, etc.)
 - Maintenance costs
 - Direct and indirect labor costs
 - Miscellaneous associated costs
 - » Training
 - » Insurance
 - » Damage
 - » Environmental impacts

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Material Handling

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- Material ⇨ Move ⇨ Method ⇨ Equipment
- Equipment Classifications
 - Conveyors
 - Monorails
 - Hoists and Cranes
 - Automated Storage and Retrieval Systems
 - Industrial trucks
 - » Pallet jack
 - » Fork lift
 - » Automated guided vehicle system
 - Containers and supports
 - Auxiliary Equipment
- [Picture Bank](#)

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AGV Classification

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- [Introduction](#)
- Guidepath Determination
 - Static path
 - » Unidirectional
 - » Bidirectional
 - Dynamic path
- Vehicle Capacity
 - Single unit load
 - Multiple loads
- Vehicle Addressing Mechanism
 - Direct address
 - Indirect address

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