

**OSC | 11**  
Ohio Safety Congress & Expo



**#174 – Rack usage and safety  
in warehousing, distribution  
and logistics facilities**

Arlin Keck, PE

Thursday, March 31, 2011  
1:15 to 2:15 p.m.



**Introduction to Pallet  
Racking and Pallet  
Rack Safety**

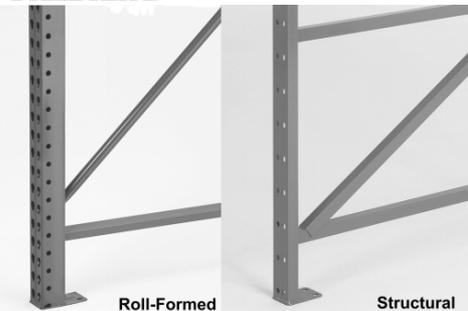
Arlin Keck, PE Corporate Engineer  
akeck@steelking.com



**Storage Racks - Benefits When  
Properly Applied**

**Correctly Applied  
Racks and Accessories will:**

- Utilize 'cubic' space efficiently
- Double or triple pallet storage per square foot of floor space
- Help with inventory control
- Reduce product damage
- Enhance warehouse safety
- Provide flexibility for growth



**STEEL KING**

**RMI**  
RACK MANUFACTURING INSTITUTE

## Storage Racks - Types and Styles

### Selective Rack:

- Most widely used system
- 100% access to all storage locations
- Wide range of accessories
- Standard components can be customized
- Very flexible



**STEEL KING**

**RMI**  
RACK MANUFACTURING INSTITUTE



**STEEL KING**

**RMI**  
RACK MANUFACTURING INSTITUTE

## Storage Racks - Types & Styles

### Double-Deep Rack:

- Floor space savings
- Good selectivity
- Slow throughput vs. single-deep
- More specialized handling equipment needed



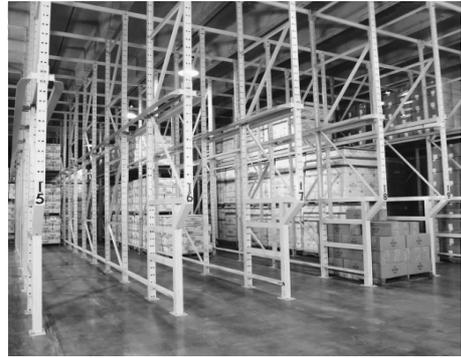


## Storage Racks - Types & Styles

### Drive-In / Drive-Through Rack:

#### Rack:

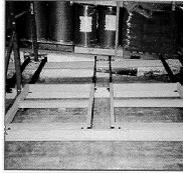
- High density
- Larger number of pallets per SKU
- FILO or FIFO inventory schemes based on layout
- Standard handling equipment
- Medium throughput
- Space savings



## Storage Racks - Types & Styles

### Push-Back Rack :

- High density like DI/DT
- Each level is accessible
- Floor space savings
- Reasonable selectivity
- Up to 5 or 6 positions deep
- Standard handling equipment
- FILO inventory approach
- Excellent throughput



## Storage Racks - Types & Styles

### Pallet-Flow Rack:

- Gravity or powered
- High density
- High throughput
- Standard handling equipment
- Space savings
- Reasonably flexible
- FIFO inventory approach



**STEEL KING**

**RMI**  
RACK MANUFACTURING INSTITUTE

## Storage Racks - Types & Styles

### Cantilever Rack:

- Full selectivity
- Long and irregular loads
- Standard or specialized handling equipment
- Floor space savings



**STEEL KING**

**RMI**  
RACK MANUFACTURING INSTITUTE

## Storage Racks - Types & Styles

### Portable Racks:

- Mobile and flexible
- Height limitation
- Good for small WIP buffers
- Good between works processes
- Standard handling equipment



**STEEL KING**

**RMI**  
RACK MANUFACTURING INSTITUTE

## Storage Racks - Types & Styles

### Order-Picking Racks:

- Pallet-flow
- Case-flow
- Deep-lane
- Pick-to-light and pick-to-belt
- Pick modules





### PICK MODULES

- ELEVATED FLOORS ARE ANY INTEGRAL PART OF THE RACK STRUCTURE
- DROP GATES
- HANDRAILING
- STAIRS
- RE-STOCK RACKS
- PICK RACKING
- CONVEYORS



### AUTOMATIC STORAGE AND RETRIEVAL SYSTEMS (AS/RS)

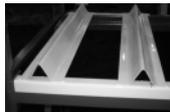
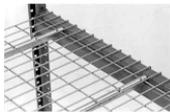
- AUTOMATED CRANE STORAGE
- MINI-LOAD AND UNIT LOAD
- CAN BE RACK-SUPPORTED BUILDINGS (IBC SECTION 503)
- CAN BE OVER 100'-TALL
- MEET FEM TOLERANCE REQUIREMENTS



### Storage Racks - Types & Styles

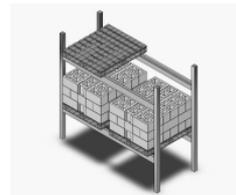
#### Accessories:

- Solid and wire mesh decking
- Pallet-support bars
- Fork-entry bars
- Drum cradles
- Safety devices
- Many, many more.....



### Pallet Rack Shelving Options

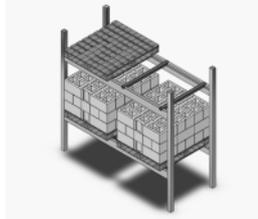
- No Supports





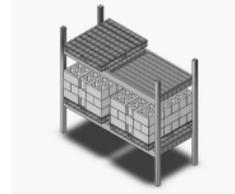
### Pallet Rack Shelving Options

- Cross Bar Supports



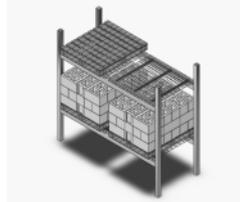
### Pallet Rack Shelving Options

- Solid Shelving



### Pallet Rack Shelving Options

- Wire Mesh Decking



### Pallet Racks - Safety Considerations

#### Specifying Rack:

- Thorough study of volume, activity, facility
- Properly match moving equipment
- 2010 RMI design specification
- Model building codes
- RMI-certified rack supplier



### About RMI

- Independent, incorporated non-profit Trade Association.
- Formed in 1958 – Welded Wire Decking Group incorporated as Affiliate Members in 2005.
- Mission: To advance standards, quality, safety and general fitness for intended use of Racking & Welded Wire Decking.



### RMI Members

- Must manufacture & control structural design of storage racks and decks for sale in USA.
- Pay dues
- Attend meetings
- Participate in monthly statistical information program
- Voluntarily agree to design and manufacture rack in accordance with RMI/ANSI MH16.1 – 2010 and RMI/ANSI MH26.2 – 2007.



## Who Are RMI Members

- Manufacturers from throughout and around the world.
- 28 companies
- Up-to-date listing can be accessed at [http://www.mhia.org/psc/PSC\\_products\\_racks](http://www.mhia.org/psc/PSC_products_racks)



## Forklift Considerations

### Specifying Forklift:

- Turning Radius
- Minimum service aisle width
- Guidance System
- Environment (ambient, cooler, freezer/lighting)



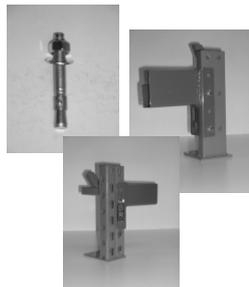
## Examples of Forklift Trucks



## Pallet Rack - Safety Considerations

### Rack Installation:

- Prior to installation
- Proper housekeeping
- Rack configuration
- Level and plumb
- Proper anchorage
- Connections
- Tying to other structures
- Rack capacity signage



### MAXIMUM PERMISSIBLE LOADS

**2000 lbs. Maximum Pallet Load**  
**1440 lbs. Average Pallet Load**  
**16,000 lbs. Maximum Bay Load**

**WARNING:** The above capacities are based on new, undamaged components. Damage reduces rack capacity. Repair or replace damaged components.

Customer Name and Address

This rack installation is designed and constructed in conformance with the 1997 RMI Specification.

Supplier Name and Address



## Pallet Rack - Safety Considerations

### Rack Usage:

- Know capacity, size and beam-profiling limits
- Proper lighting
- Proper equipment
- Operator training
- Minimizing chance of damage



## Pallet Rack - Safety Considerations Column Protection Devices



## Pallet Rack - Safety Considerations

### Rack Maintenance:

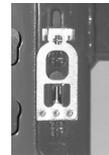
- Housekeeping
- Repair or replacement of damaged components
- Loose or missing hardware
- Dislodged components



## Pallet Rack - Safety Considerations

### Rack Maintenance (continued):

- Replacing damaged beams
  - Locking devices
  - Beam damage
- Regular inspection routines
- Relocated rack



## Pallet Rack - Safety Considerations

### Mixing rack types:

- Is it ever okay to mix?
- Check with both manufacturers
- Possible problems
- When in doubt, don't mix



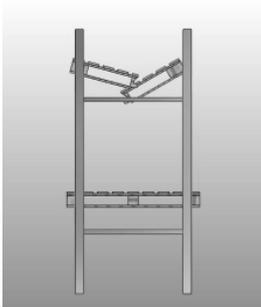
## Pallet Rack - Safety Considerations

### Avoid Unstable Loads:

- Shrink wrap
- Decking
- Load containment
- Load confinement
- Pallet selection



**Warehouse Safety & Liability**  
PALLET LOADED DIRECTLY ON BEAMS



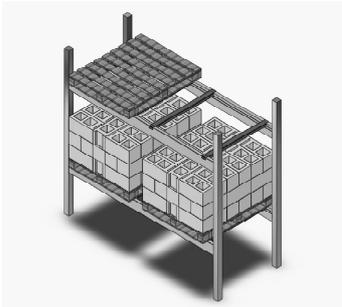
Vulnerable to the structural integrity of the pallet

**Warehouse Safety & Liability**  
PALLET LOADED DIRECTLY ON BEAMS



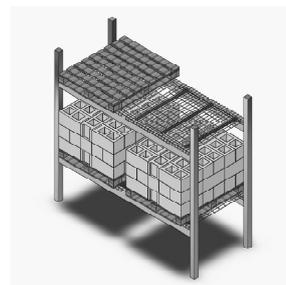
Pallets too small or improperly installed

**Warehouse Safety & Liability**  
CROSSBAR SUPPORT



Allows smaller materials to fall through

**Wire Decking Provides Solutions**  
FOR SAFER INSTALLATION AND HANDLING OF SHIPPING PALLET



**Examples of Non-Uniformly Distributed Loads**

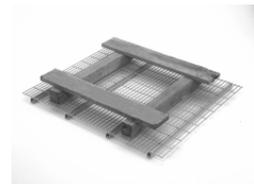
Loads other than uniformly distributed may require special designs

- 1 - Line Load
- 2 - Concentrated Load
- 3 - Point Load



**Line Load**

- Definition- A load that distributes its weight in a concentrated line vs. uniformly distributed



*Could cause the wire to carry the entire load and increase risk of failure*

### Concentrated Load

**• Definition-**

Any static load which is not uniformly distributed over the entire surface of the decking section.

Example – a 2500 lbs barrel placed in the center of a deck



### Point Loads

**• Definition -**

A load that has its weight on individual points vs. uniformly distributed

Example – A container with 4 contact points. All the points could be potentially on the wires only versus wires and channels



### Pallet Rack - Safety Considerations

**General Safety Considerations:**

- Climbing on racks
- Prevent overloading
- Special loading
- Beware of unsafe practices/conditions
- Provide fall protection where appropriate
- Consider back stops, rear vertical netting/fencing or similar

### Pallet Rack - Safety Considerations

**General Safety Considerations Cont'd:**

- Provide overhead protection for storage above work stations, pick tunnels and drive through tunnel bays
- Planned inspection, routine maintenance, and training

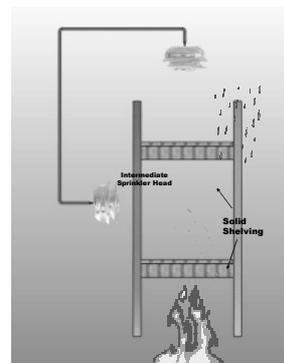
### Fire Codes

**■ National Fire Protection Association**

- Code 13 (2007)
  - 3.9.3.8
  - A.3.9.3.6
  - A.3.9.3.7

**■ FM Global**

- Factory Mutual 2.2



**Solid Shelving Hides & Spreads Fire**  
 FLAMES GROW UNDETECTED AND ARE OBSCURED FROM WATER

