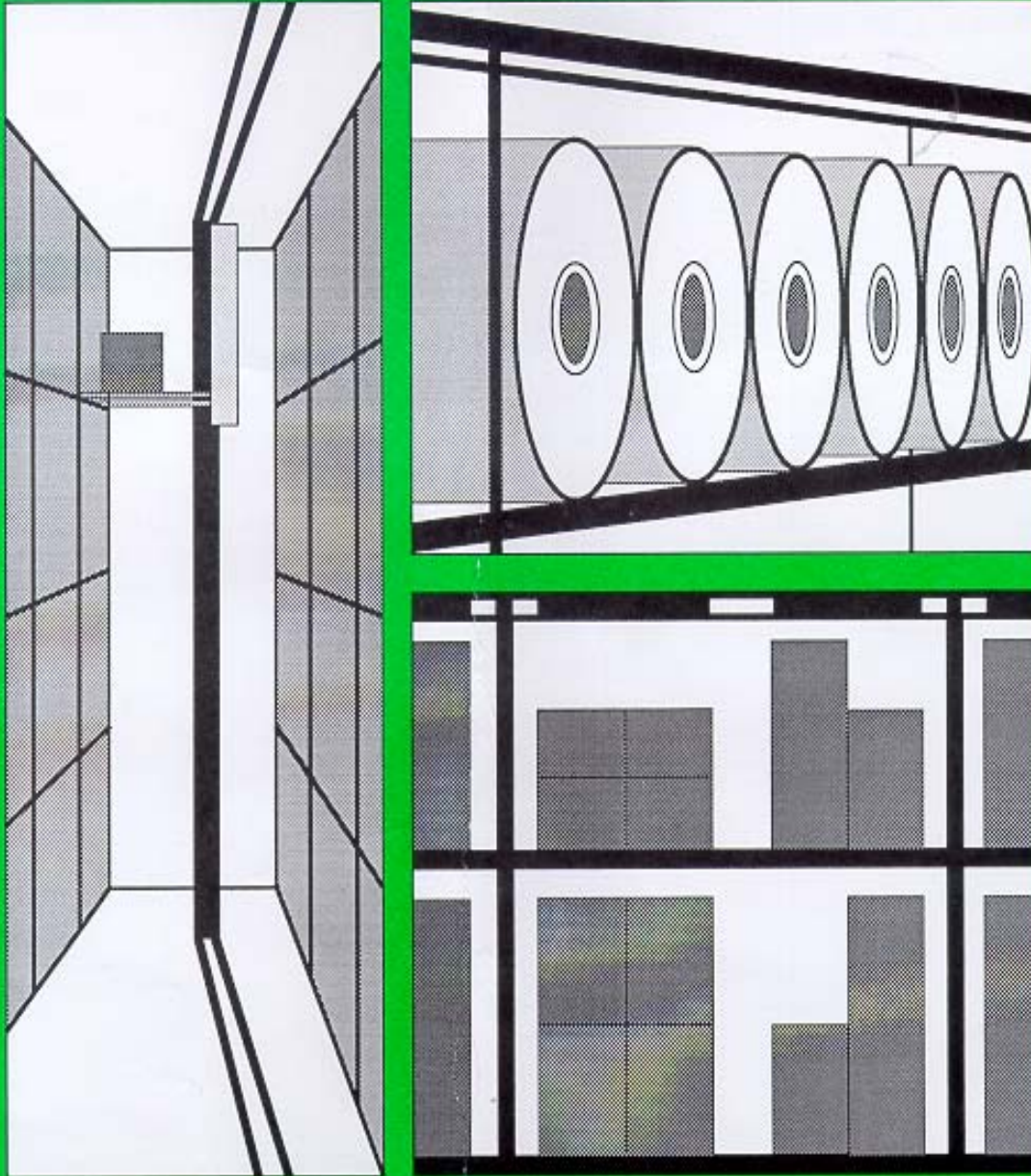


GUIDELINES FOR INDUSTRIAL STEEL STORAGE RACKS



Manitoba
Labour



INTRODUCTION

A well-maintained and clear storage area is essential to an efficient and safe warehousing operation.

This guideline provides general information on the design, installation and use of steel storage racking. Due to the diversity of design and installation requirements for steel storage racking, it is essential that the manufacturer's recommendations be followed. Some provisions in this guideline may not apply to custom-engineered or specialized racking, and the manufacturer of such racking should be consulted.

ACKNOWLEDGMENT

Some of the information and illustrations in this guideline are provided courtesy of the Rack Manufacturers' Institute (RMI).

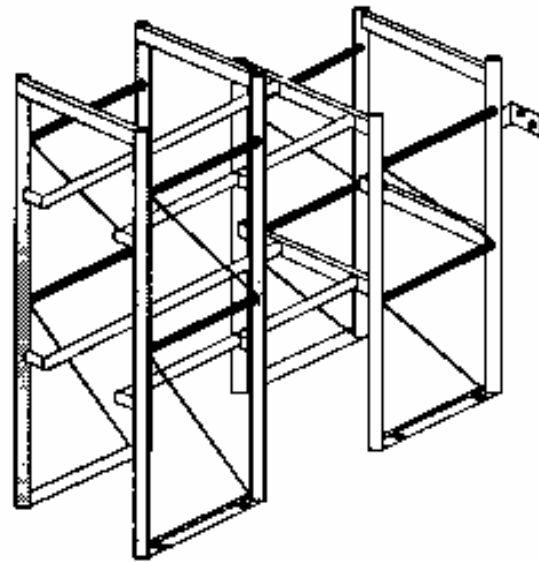
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RACK DESIGN

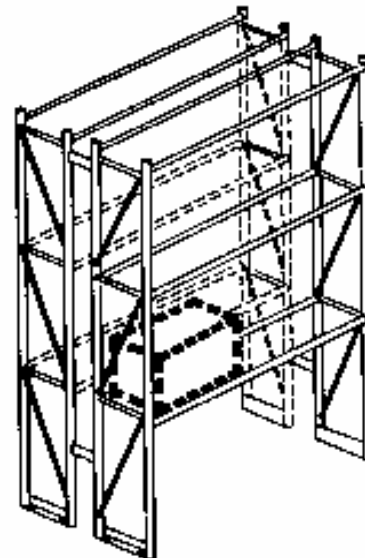
Steel storage racks must be designed and fabricated according to the requirements established by a professional engineer. If there is doubt as to the structural capacity of the racking system or any of its components, a request should be made for the approved design drawings. This may be obtained from the manufacturer or an independent professional engineer.

TYPES OF RACKS



DRIVE - IN/DRIVE - THROUGH RACK

Upright frames of vertical posts and braces support and position horizontal, load-supporting rails.



PALLET RACK

Vertical posts, horizontal and diagonal braces, shelves and load carrying beams make up the basic rack.

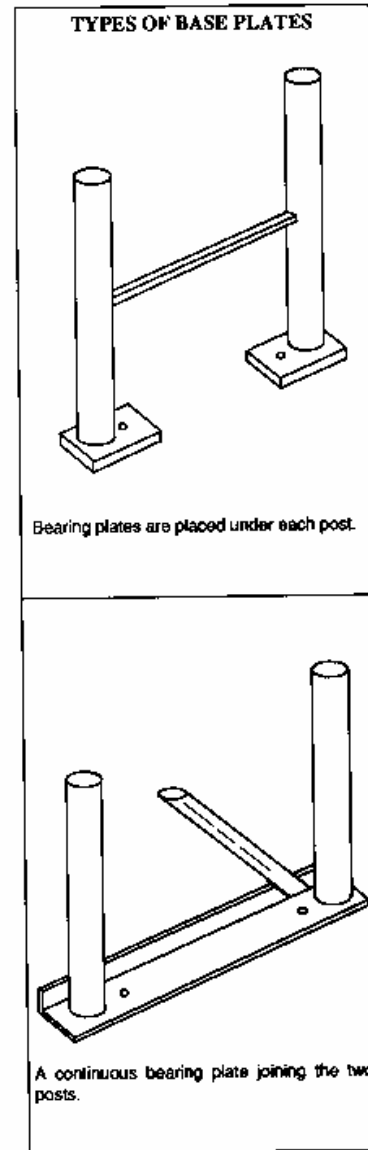
RACK SPECIFICATIONS

1. LAYOUT

A proper layout of the proposed racking system and total floor area should be developed before installation. This is to ensure that adequate clearance and working space is provided for the safe movement and storage of the materials.

2. BASE PLATES

All columns of racks must be furnished with proper bearing plates. The bearing plate is designed to provide a uniform transfer of the column load to the floor. The rack manufacturer or designer can supply data on the size and pressure exerted under the bearing plates for each type of upright and setup (fig. 2 and fig. 3). This will confirm whether the floor can take the anticipated load.



3. RACK TOLERANCES AND STABILITY

VERTICAL CONSTRAINTS

Rack capacity and rating is based on the racks being installed vertically straight or 'plumb.' It is essential that the vertical components of the racks be installed in conformance with the design specifications (maximum tolerance is 25mm in 3m of height). A rack that is not installed and maintained 'plumb' is subject to additional stresses that will reduce the rack's capacity and stability.

OVERTURNING

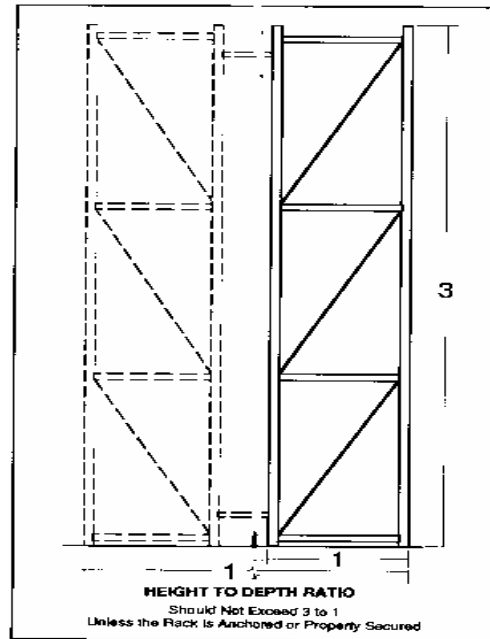
The height-to-depth ratio of the entire rack should not exceed 3-to-1 measured from the floor to the top of the rack (fig. 5). This ratio may be exceeded only if the rack is suitably anchored, externally braced, or properly secured to the building structure

'BACK-TO-BACK' RACKS

Even if individually they do not exceed the 3-to-1 ratio, 'back-to-back' racks should be fastened together to provide greater stability.

DEFLECTIONS

At maximum working load, the deflection of rack beams must not exceed 1/180th of the span of the beam (i.e., if the span of the beam is 4m, the maximum deflection allowed is 22mm.)



BRACING

Diagonal bracing of the structure is dependent upon design considerations, and varies from one rack to another. Diagonal bracing must be provided to ensure the stability of the uprights (columns). Reference to the original design specifications would be necessary to determine if the structure is properly braced.

Floors

Racks cannot sit on uneven floors without being properly leveled. The uprights must meet the vertical constraint standards described above and all shelves must be level.

BUILDING CONNECTIONS

BEAM CONNECTIONS

In addition to design load specifications, beams shall have support connections that are capable of withstanding an upward force of 4500 Newton's (1009 pounds - force) per connection without failure. This is required due to the effect a forklift may have on the connection.

Rack connections made to the building must ensure that the loading of the racks does not affect the structural integrity of the building. The opposite is true also. The building should not damage the rack. This can occur if the rack is tied-in to the roof of a building and the roof deflects under a snow or rain load causing deflection of the rack itself.

'Drive-in' Racks

Specific guidelines for this type of rack are as follows:

- (1) **Racks without pallet guides** - the distance between the inside edge of the opposite rail shall not exceed the pallet width minus 25mm.
- (2) **Racks with pallet guides** - the distance between the guide and opposite rail shall not exceed the pallet width minus 19mm.

Both requirements must allow for lateral deflections that may occur under load.

4. ANCHORING

Application

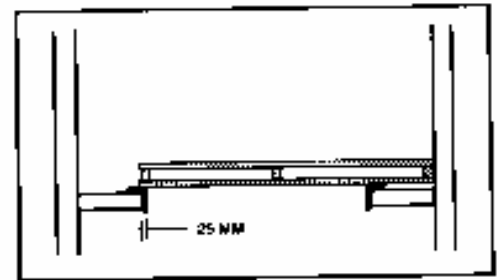
The practice of anchoring racks is recommended in all cases and must be done if the height-to-depth ratio exceeds 3-to-1.

Some pallet racks do not have to be anchored, provided they are stable and the manufacturer can show that the friction forces between the bearing plates and the floor are enough to resist the horizontal reaction.

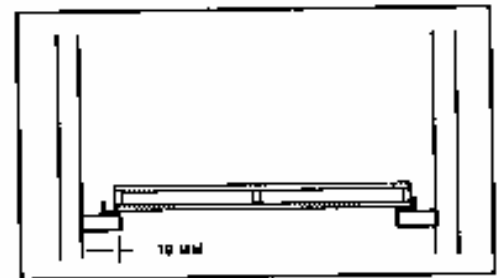
'Drive-in' and 'drive-through' racks **must be anchored** to the floor at all times.

Type of Bolts

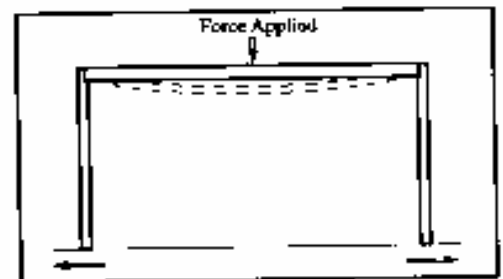
Anchor bolts must be capable of restraining the horizontal forces caused by vertical and horizontal loading conditions. Structurally-rated bolts should be used for anchoring purposes. Expandable bolts through the bearing plates and into the concrete should be of the type and size rated to resist these forces.



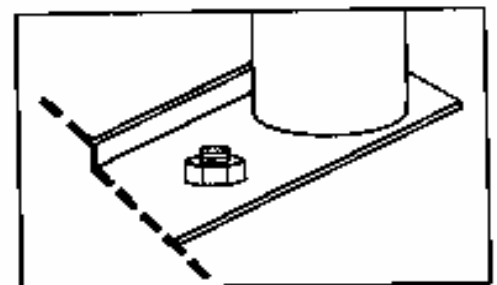
Racks without Pallet Guides



Racks with Pallet Guides



Effect of Horizontal Forces



Bolted Bearing Plates

5 COLLISION PROTECTION

It is difficult to design a rack to be 'collision-proof', but suitable protection can be provided. Serious structural damage usually occurs when the bottom portion of exposed forklifts or other moving equipment strikes racks columns.

Two ways of protecting against this are by providing;

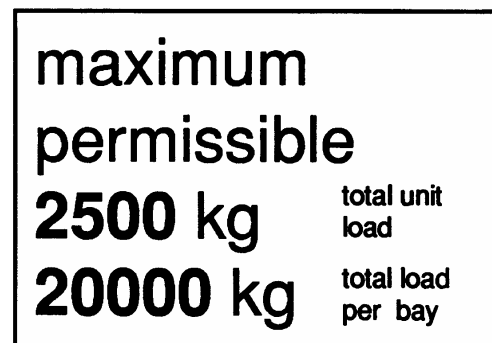
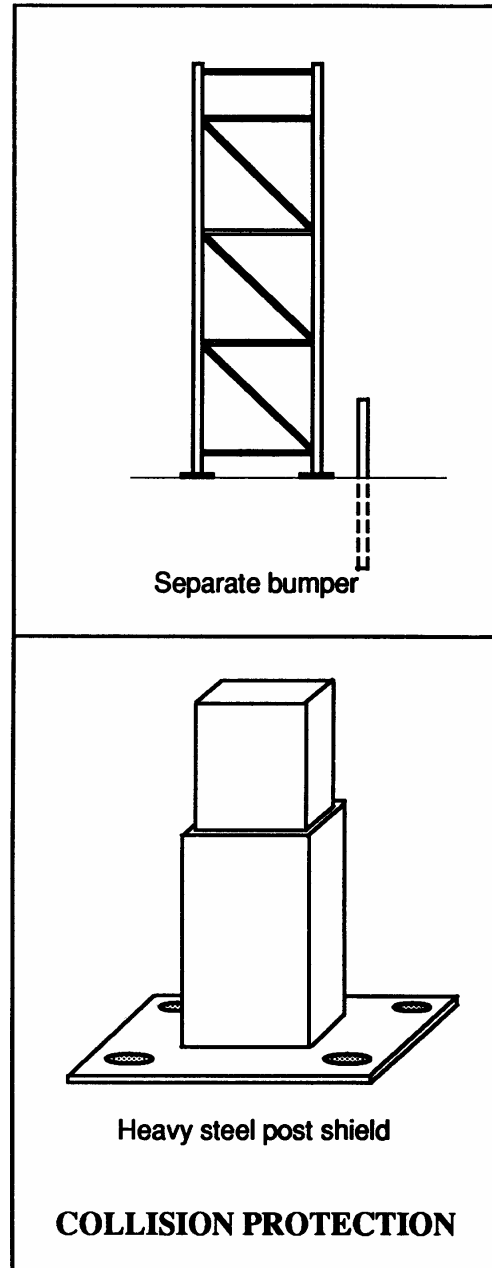
- a) A post or guardrail connected to the floor around the exposed columns to absorb the impact (fig. 10).
- b) Reinforcing the exposed columns by a device secured to the column to provide additional strength (fig. 11).

RATING PLATES

Maximum load plates shall be clearly posted in a conspicuous location at the work-site indicating allowable unit loads (i.e. maximum pallet weights, sizes, etc.) and total bay loads for each type of racking.

7. LIGHTING

An important consideration in rack design is the provision of adequate lighting. Proper lighting makes rack entry and pallet placement easier and will do much to reduce rack damage



INSPECTION AND MAINTENANCE

Inspection programs will vary depending on the size and use of each rack installation.

FREQUENCY OF INSPECTION

Experienced personnel should visually inspect heavily used racks on a daily basis. All connections must be inspected to ensure that bolts and other structural members are not loose or damaged.

DAMAGED RACKS

Ninety per cent of rack damage occurs between the floor and the first horizontal beam. Due to the variety of types of rack systems, repair of damaged parts will vary. The **manufacturer should always be consulted** on the proper way to repair damaged racks and components.

Severe Damage - components that are buckled or severely bent must be replaced.

Moderate Damage - columns that are dented, slightly skewed, etc. may be corrected by adding braces or splices strong enough to carry the intended load.