Rack Repair Principles

The Responsibilities of Owners/Operators include:

- Maintaining appropriate documents that reflect the design and engineering of the rack system
- Consulting with an appropriate Rack Design Professional or Engineer when moving, reconfiguring, replacing or repairing rack systems
- Maintaining a regular program for inspecting and maintaining racks as outlined in the RMI *"Considerations for the Planning and Use of Industrial Steel Storage Racks"* [2]

The RMI Specification [1] can provide the technical framework that guides the design of rack repair solutions.

The repair process (assessment, design and installation) must be overseen by a qualified Rack Design Engineer (Supervising Engineer).

The assessment and design of rack repairs must address all loads that may be imparted on damaged members (static, seismic, etc.), not just on the specific members being repaired.

Rack systems lacking original engineering documentation must be evaluated in accordance with applicable building codes. If stamped and sealed calculations of the original installation are needed, but not available, the system must be evaluated in accordance with applicable building codes.

Repair Options

Replacement:

When original or updated engineering documentation is available, replacement of damaged components with identical parts from the original manufacturer is an approved method to address the damaged rack, as long as the rack system still meets appropriate capacity requirements. It is important to not interchange uprights, beams or other components that look "similar" to each other, but may be designed and approved to interface with different models of rack, without appropriate approval.

RMI members have performed extensive testing to ensure that their proprietary components will meet the RMI Specification [1]. When products from different manufacturers are mixed, appropriate testing must be performed to validate the capacity of the mixed components. Mixed and matching components without engineering oversight is not recommended, because it is highly risky. Replacing a load-bearing component of a rack structure without performing an engineering evaluation, that incorporates the loads on the replaced component, is not recommended.

Rack Repair Kits:

In some situations it may be more economical, or otherwise more advantageous to remove the damaged section of an upright and to replace it with a pre-engineered rack repair kit.

Such kits are typically bolted or welded in place and anchored to the floor. When designing the kit, a Supervising engineer must evaluate the configuration and loading of the existing rack at the location of damage, taking into account the loads imparted on the damaged component, not just on the particular member being repaired. Each load configuration must be evaluated separately. The repair kits must be engineered to meet applicable building codes.

Repair Options

Member Straightening:

If a repair solution requires bending or straightening damaged members, the straightening process must ensure that appropriate properties of the steel are maintained in the repaired member as approved by the Supervising Engineer.

Welded Field Repair:

Where replacement or repair kits are not an option, the Owner may choose to perform a welded field repair on a rack system. Any field repairs must be overseen by a qualified Professional Engineer so that the work is performed in accordance with applicable American Welding Society (AWS) codes. (Refer to Appendix 1 in the RMI Rack Repair Guidelines for additional risks that are associated with field welding)

Risks of Field Welding

Although field welding may seem to be a fast and economical option in repairing a damaged rack system, there are several risk factors that should be reviewed before moving forward:

- **Fire Risk** - The welding process will throw off sparks and embers into the area immediately surrounding the work, which may include flammable materials. This has often resulted in catastrophic fires and product damage. If field welding is the only option, the repair supplier must follow all appropriate fire safety procedures. Consult OSHA standard 29 CFR 1910.252(a) for more detail.

- **Weld Contamination** - When racks are manufactured, the environment where welding is performed is tightly controlled so that the welds meet engineered design requirements. In a field situation where a painted product is welded, the surface where welding is to take place must be cleaned to bare metal so that there is no contamination of the weld metal which could otherwise result in a weakened weld or hydrogen embrittlement (in turn, leading to failure).

- **Operating Temperature** - Welding processes generally assume that the welds are made in relatively narrow operating temperatures. When a welded solution is necessary to pallet racks that are used in cooler or freezer environments, it is incumbent upon the repair provider to ensure that weld techniques for low temperature implementation including ensuring proper ventilation (heating of the material may be required) are followed. Welding in freezers is generally discouraged.

  If field welding is necessary, the Supervising Engineer must provide a qualified or pre-qualified procedure for the weld joint that meets appropriate AWS standards.

- **Welder Certification** - Welder certifications are limited to specific skill sets that the welder has demonstrated and are often not transferable. A welder who is certified for making a fillet weld in a flat position may not be certified (or have the skill) to make a fillet weld in a vertical or overhead position that may be necessary to effect a proper repair. A welder must present documentation of his certification to execute the welding procedure specified by the Supervising Engineer.

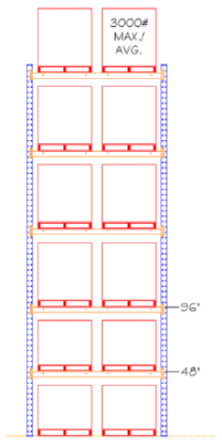
Repair The System vs. Repair A Component

When repairing rack systems:

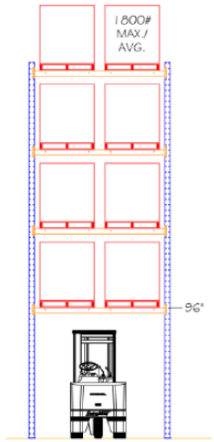
The Supervising Engineer must evaluate the loads that are imparted on the damaged component, not just on the specific member being repaired. This evaluation is especially important with older systems that may have been moved or reconfigured during their lifetime. The following example shows how a seemingly simple reconfiguration can dramatically reduce the load capacity of a system and can create a significant safety risk.

An Owner reconfigured a rack without engineering insight. The Owner's maintenance department removed the lower level of a pushback rack system to allow for additional clearance for fork lifts to drive under the rack to place floor-level pallets.

The Owner did not realize that this reconfiguration reduced the capacity of the rack system from 3,000 lbs. (1,360 kg) per pallet to 1,800 lbs. (816 kg) per pallet because the unsupported span of the uprights was increased. The Owner continued to store 3,000 lb. (1,360 kg) pallets on the system, thereby exposing lift truck operators driving under a system that was loaded 66% over its rated capacity.



Original Configuration
3,000 pound (1,360 kg) per pallet capacity



Owner Revision
1,800 pound (816 kg) per pallet capacity
Lift trucks under structure

A simple engineering review of the system that would be conducted before the repairs were implemented would have uncovered this unsafe operating condition, and would have allowed the repair supplier to work with the Owner to avoid this unsafe condition, so that the repaired system provided the appropriate load capacity.

Repair The System vs. Repair A Component

When repairing rack systems:

Owners, manufacturers and repair suppliers should not rely only on experience or history when planning or executing rack repair. It is critical to first ensure that the original system meets applicable codes and safety requirements, before repairs are begun. If this critical step is ignored, the repair provider could repair a damaged component but leave the rest of the system in an unsafe condition if, for example, the system was overloaded. Careful review by a qualified Rack Design Engineer is imperative.