

Automated Storage and Retrieval Systems – A rack structure in which loading and unloading of the racks is accomplished by a stacker crane, or similar vehicle, without the aid of an on-board operator.

Applicable Code – Code (enforced by the local building department) under which the structure is designed.

Beam – Typically, a horizontal structural member that has the primary function of resisting bending moments.

Beam Locking Device – A pin, bolt, or other mechanism that resists disengagement of the beam connector from the column.

Braced Frame – An essentially vertical truss system that provides resistance to lateral forces and provides stability for the structural system.

Cantilever Rack – A rack structure comprised primarily of vertical columns, extended bases, horizontal arms projecting from the face of the columns, and down-aisle bracing between columns. There can be shelf beams between arms depending on the product being stored. Cantilever columns may be free-standing or overhead tied.

Case-Flow Rack – A specialized pallet rack structure in which either the horizontal shelf beams support case-flow lanes or case-flow shelf assemblies are supported by the upright frames. The case-flow lanes or shelves are installed at a slight pitch permitting multiple-depth case or box storage with loading from one service aisle and unloading or picking from another service aisle.

Cladding – Exterior covering of structure.

Cold-Formed Steel Structural Member – Shape manufactured by press-baking blanks sheared from sheets, cut lengths of coils or plates, or by roll forming cold- or hot- rolled coils or sheets; both forming operations being performed at ambient room temperature; that is, without manifest addition of heat, such as would be required for hot forming.

Component - A finished part consisting of members. For example, an upright frame is considered a component, while the pieces that are used to build the frame are considered members.

Cross-Aisle – One of the two principal directions of the storage rack, corresponding to the direction perpendicular to the principal handling equipment aisle. This is also referred to as the transverse direction.

Cube Based Storage (AS/RS) - Ultra-high density goods-to-person piece picking system, which utilizes robots to store, and retrieve inventory bins from a cubical storage grid.

Diagonal Bracing – Inclined structural member carrying primarily axial force in a braced frame.

Double-Stacking – When a shelf is loaded with loads stacked one on top of another in a pallet position.

Down-Aisle – One of the two principal directions of the storage rack, corresponding to the direction of the principal handling equipment aisle. This is also referred to as the longitudinal direction.

Drive-In Rack – A rack structure comprised primarily of vertical upright frames, horizontal support arms, and horizontal load rails typically used for one-wide by multiple-depth storage. This structure includes an 'anchor section' with horizontal beams supporting the load rails. Loading and unloading within a bay must be done from the same aisle. A two-way drive-in rack is a special case where back-to-back rows of drive-in racks are combined into a single entity with a common rear post.

Drive-Through Rack – A rack structure comprised primarily of vertical upright frames, horizontal support arms and horizontal load rails typically used for one-wide by multiple-depth storage. This structure lacks the ‘anchor section’ found in drive-in racks; therefore, loading and unloading form can be accomplished from both ends of a bay.

Field Assessor – Works under the direction of the Supervising Engineer with responsibilities that include:

- Identifying the manufacturer of a rack system and obtaining the system’s documentation (if original engineering documentation is not available, field measurements to document the actual details of the rack system’s configuration and comparing it to the system’s drawings)
- Reviewing the system’s configuration and comparing it to the system’s drawings (beam levels, loads)
- Noting any variances from system drawings
- Identifying all damage based on instructions from the Supervising Engineer and recording the location of damaged components
- Performing post-repair or replacement inspections and reporting the results, as required by the Supervising Engineer

Guardrails – Members that are installed on an elevated rack supported platform or pick module walkway whose purpose is to provide fall protection for the occupants of the structure. Guardrails consist of a top rail, an intermediate rail and posts.

Handrail – Smooth, continuous railing that runs up a stairway assembly to provide added balance and safety for the occupants as they walk up or down the stairway assembly.

Horizontal Carousel (AS/RS) – Ideal for storing small parts and pieces, horizontal carousels are comprised of a series of bins that rotate horizontally around a track.

Kick-Plate (Toeboard) – A vertical plate (angle or barrier) that is installed at the edge of an elevated floor that is intended to prevent loose items from sliding off the edge of the floor.

Load Application and Rack Configuration (LARC) Drawings – Show appropriate details of the rack structure and repair solution encompassing the section of the rack system that is affected by the repair.

Mini Load (AS/RS) – Operating the same way as a unit-load AS/RS, a mini-load AS/RS handles lighter loads, usually weighing less than 1,000 pounds.

Movable-Shelf Rack – A rack structure comprised primarily of vertical upright frames and horizontal shelf beams and typically used for one-deep pallet or hand-stack storage. Typically, the locations of a couple of shelf levels are ‘fixed’ with the location of the in-fill shelves being flexible.

Occupancy Category – Classification of structures based on the nature of their use.

OEM – The original equipment manufacturer of the racking system.

Owner / Operator – The party that is responsible for managing and maintaining the rack system with responsibilities that include:

- Maintaining a safe pallet rack system, maintaining up-to-date drawings and engineering documentation
- Maintaining load capacity plaques
- Conducting regular inspections
- Selecting a Supervising Engineer and Rack Repair Provider

Out-Of-Plumb Ratio – Maximum horizontal distance from the centerline of the column at the floor to a plumb line that extends downward from the centerline of the column at the top shelf elevation divided by the vertical distance from the floor to the top shelf elevation.

Out-Of-Straight Ratio – Maximum horizontal distance (inches or mm) from the centerline at any point on the column to a plumb line from any other point on the column divided by the vertical distance (feet or m) between the two points.

Pallet Beam – The front and back shelf members that bear the weight of the load and transfer the load to the upright frames.

Pallet-Flow Racks – A specialized pallet rack structure in which the horizontal shelf beams support pallet-flow lanes. The pallet-flow lanes are typically installed on a slight pitch permitting multiple- depth pallet storage with loading from one service aisle and unloading from another service aisle.

Pallet-Load Support Member – Any load bearing member with the long axis on the horizontal plane and intended for use as support of unit loads in direct contact (pallet and shelf supports and beams, not bracing).

Pallet Rack – A rack structure comprised primarily of vertical upright frames and horizontal shelf beams and typically used for one and two deep pallet storage.

Pallet Support – A member that extends between the shelf beams at a given level underneath the stored load that aids in the support of that load.

Pick Modules – A rack structure comprised of vertical frames and horizontal beams, typically having one or more platform levels of selective, case flow or pallet flow bays feeding into a central pick aisle(s) or work platform(s) supported by the rack structure.

Plaque – Signage permanently and prominently displayed depicting the permissible loading of the rack.

Portable Rack (Stacking Frames) – An assembly, typically with four corner columns, that permits stacking of one assembly on top of another without applying any additional load to the product being stored on each assembly.

Product Load – The weight of the item(s) placed on the rack.

Pushback Rack – A specialized pallet rack structure in which the horizontal shelf beams support pushback lanes comprised of tracks and carts. The pushback lanes are installed on a slight pitch permitting multiple-depth pallet storage. Loading and unloading are done from the same service aisle by pushing the pallets back.

Rack Repair – Encompasses the process of returning a damaged rack system to its required design capacity and integrity. Repair work may include repairing the damaged rack components, as well as, replacing them, as needed.

Rack Repair Provider – The responsible party for assessing and/or repairing the rack system or components including:

- Reviewing drawings and repair solutions that the Supervising Engineer recommends
- Implementing the repair or replacement solution, as directed by the Supervising Engineer
- Providing updated LARC drawings to the Owner that incorporate proposed repairs or replacements, as direct by the
- Supervising Engineer



Rack-Supported Platforms – A decked working surface supported by the rack structure.

Rack-Supported Structure – A rack structure similar to other rack structures; however, this structure also includes wall girts and roof purlins or equivalent components used to support wall and roof cladding. This structure is designed to withstand wind and snow or rain loads in addition to the normal storage rack loads.

Rated Rack Capacity – Maximum allowable product loading accounting for the design safety factors. The design safety factor includes such factors as load uncertainties, uncertainties in the analysis, material and geometric properties, fabrication and installation tolerances.

Safety Flooring – A surface that is provided in areas where order picking personnel may need to step off the normal walking area or pick module walkway to dislodge loads that may not have properly flowed to their correct position.

Seismic Design Category - A classification assigned to a structure based on its Occupancy Category and the severity of the design earthquake ground motion at the site.

Shuttles (AS/RS) – Used for the automated handling of totes, trays, cartons or all three in the same system for either warehousing or manufacturing.

Site Class Definition – A classification assigned to a location based on the types of soils present.

Stacker Rack – A rack structure similar to one of the other rack structures that is serviced by an automated storage and retrieval machine.

Structural System – An assemblage of load-carrying components that are joined together to provide interaction or interdependence.

Supervising Engineer – A qualified Rack Design Engineer who is skilled in structural analysis, design and application of rack systems, and whose responsibilities include:

- Identifying the original manufacturer of the rack system and whether or not the system is compliant
- Reviewing system documentation to validate the capacity rating for the section of the rack that is being repaired
- Developing an assessment protocol to identify and grade damaged conditions that should identify overloading or damaged conditions that could render the system unsafe and that would require unloading
- Overseeing the scope and thoroughness of the assessment of damage repairs
- Designing and approving the repair protocol to address all conditions identified by the Field Assessor
- Developing repair solutions that address all of the loads imparted on the damaged components and not just the strength of individual members being repaired (all work must be compliant with applicable state laws and building codes).

Trussed-Braced Upright Frame – Upright frames having two columns similar to the chords of a truss and diagonal and horizontal bracing attached to and located between the columns. The diagonals and horizontals become the web members of the truss (referred to as a vertical truss).

Unit-Load – The total weight expected to be positioned in the rack consisting of the product load and pallet weight. Machines that store large loads (usually 1,000+ pounds), typically on pallets with storage rack structure (reaching 100 feet or more tall).



Upright Frame – A structural assembly that transfers the vertical and horizontal loads to the floor. It is usually made up of two columns and bracing members between the columns. The beams of the rack are attached to the columns of the frames and transfer the loads to the columns.

Welded Wire Rack Deck – A decking system used on pallet rack shelves. Wire decking is fabricated from welded wire mesh and generally has reinforcements in the form of channels or support wires. Its purpose is to provide additional support for stored material, as well as, becoming a safety net for unstable loads.

Vertical Carousel (AS/RS) – Rotating vertically, like a Ferris wheel, vertical carousels house a series of shelves or carriers to provide high-density storage.

Vertical Lift Module (AS/RS) – VLMs consist of a column of trays in the front and back of the module with an automatic inserter / extractor in the center that stores and retrieves the required trays.