

Pallet Rack Glossary

- 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.

- Allowable strength

Nominal strength divided by the safety factor.

- Allowable stress

Allowable strength divided by the appropriate section property, such as section modulus or cross-section area.

- Applicable code

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

- ASD (Allowable Strength Design)

Method of proportioning structural components such that the allowable strength equals or exceeds the required strength of the component under the action of the ASD load combinations.

- ASD load combination

Load combination in the applicable building code intended for allowable strength design (allowable stress design).

- 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.

- **Buckling strength**
Nominal strength for buckling or instability limit states.
- **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.
- **Cantilever Test**
A test designed and conducted to determine the connection moment existing capacity and the rotational rigidity, F , of a beam-to-column connection. The test set-up employs one column segment and one beam segment connected to one another with a beam-to-column connector, with a load applied downwardly in the plane of the frame at the cantilever end of the beam segment.
- **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-braking 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.
- **Column**
Structural member that has the primary function of resisting axial force.
- **Concrete crushing**

Limit state of compressive failure in concrete having reached the ultimate strain.

- **Concurrent forces**

Two or more forces acting in conjunction with one another at a single location.

- **Connection**

Combination of structural elements and joints used to transmit forces between two or more members.

- **Cyclic tests**

A test designed and conducted to determine the connection moment-resisting capacity and rotational rigidity, along with energy-dissipation properties, of beam-to column connections when those connections are subjected to cyclic loading conditions. The test set-up employs one column segment and two beam segments connected to one another, using two beam-to-column connectors, as a double cantilever. Two parallel loads are applied, in opposing reversing cyclic fashion, in the plane of the frame at the ends of, and normal to, the cantilevered beam elements.

- **Design load**

Applied load determined in accordance with either LRFD load combinations or ASD load combinations, whichever is applicable.

- **Design strength**

Resistance factor multiplied by the nominal strength, $[\Phi R_n]$

- **Design stress**

Design strength divided by the appropriate section property, such as section modulus or cross section area.

- **Diagonal bracing**

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

- **Distortional Buckling**

A mode of buckling involving change in cross-sectional shape, excluding local buckling.

- **Double-stacking**

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

- **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 from can be accomplished from both ends of a bay.

- **Effective length**

Length of an otherwise identical column with the same strength when analyzed with pinned end conditions.

- **Effective length factor**

Ratio between the effective length and the unbraced length of the member.

- **Effective section modulus**

Section modulus reduced to account for buckling of slender compression elements.

- **Effective width**

Reduced width of a plate or slab with an assumed uniform stress distribution which produces the same effect on the behavior of a structural member as the actual plate or slab width with its non-uniform stress distribution.

- **Factored load**

Product of a load factor and the nominal load.

- **Flexural buckling**

Buckling mode in which a compression member deflects laterally without twist or change in cross-sectional shape.

- **Flexural-torsional buckling**

Buckling mode in which a compression member bends and twists simultaneously without change in cross-sectional shape.

- **Force**

Resultant of distribution of stress over a prescribed area.

- **Gravity load**

Load such as that produced by dead and live loads, acting in the downward direction.

- **Kick-plate**

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. (Section 8.4.3.3)

- **Load factor**

Factor that accounts for deviations of the nominal load from the actual load, for uncertainties in the analysis that transforms the load into a load effect and for the probability that more than one extreme load will occur simultaneously.

- **Local buckling**

Limit state of buckling of a compression element within a cross section.

- **LRFD (Load and Resistance Factor Design)**

Method of proportioning structural components such that the design strength equals or exceeds the required strength of the component under the action of the LRFD load combinations.

- **LRFD load combination**

Load combination in the applicable building code intended for strength design (load and resistance factor design).

- **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.

- **Net area**

Gross area reduced to account for removed material.

- **Nominal strength**

Strength of a structure or component (without the resistance factor or safety factor applied) to resist load effects, as determined in accordance with this Specification.

- **Out-of-plumb ratio**

Maximum horizontal distance (in.) 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 (ft.) from the floor to the top shelf elevation.

- **Out-of-straight ratio**

Maximum horizontal distance (in.) 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 (ft.) between the two points.

- **Overturning moment**

An applied force that causes a structure to turn over.

- **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 rack**

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, 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 Supports**

Members that extend 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 primarily 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) [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.

- **Portal test**

A test designed and conducted to determine the connection moment-resisting capacity and the rotational rigidity, F , of a beam-to-column connection. The test setup employs two column segments and one beam segment connected to one another using two beam-to-column connectors forming a portal frame, with the load applied laterally in the plane of, and to the corner of, the portal frame in the direction parallel to the beam segment.

- **Product load**

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

- **Push-back rack**

A specialized pallet rack structure in which the horizontal shelf beams support push-back lanes comprised of tracks and carts. The push-back 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 supported platforms**

A decked working surface supported by a 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 carry, wind, snow, and rain loads in addition to the normal storage rack loads.

- **Resistance factor**

Factor that accounts for unavoidable deviations of the nominal strength from the actual strength and for the manner and consequences of failure.

- **Safety factor**

Factor that accounts for deviations of the actual strength from the nominal strength, deviations of the actual load from the nominal load, uncertainties in the analysis that transforms the load into a load effect, and for the manner and consequences of failure. The nominal load divided by the safety factor results in the allowable load for an Allowable Strength Design.

- **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 response modification coefficient**

Factor that reduces seismic load effects to strength level.

- **Sidesway buckling**

Limit state of lateral buckling of the tension flange opposite the location of a concentrated compression force.

- **Simple lip**

Single plate elements used to stiffen a compression flange.

- **Site class definition**

A classification assigned to a location based on the types of soils present.

- **Stability**

Condition reached in the loading of a structural component, frame or structure in which a slight disturbance in the loads or geometry does not produce large displacements.

- **Stacking rack**

See Portable rack.

- **Stacker rack**

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

- **Stiffness**

Resistance to deformation of a member or structure, measured by the ratio of the applied force (or moment) to the corresponding displacement (or rotation).

- **Stress**

Force per unit area caused by axial force, moment, shear or torsion.

- **Structural system**

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

- **Stub column test**

Concentric compression testing of members not affected by column buckling used to determine the column effectiveness.

- **Torsional buckling**

Buckling mode in which a compression member twists about its shear center axis.

- **Torsional-Flexural Buckling**

Buckling mode in which compression members bend and twist simultaneously without change in cross section shape.

- **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. (It is referred to as a vertical truss.).

- **Unbraced length**

Distance between braced points of a member, measured between the centers of gravity of the bracing members.

- **Unit Load**

The total weight expected to be positioned in the rack consisting of the product load and pallet weight.

- **Upright frame**

The structural assembly that carries 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 carry the loads to the columns.

- **Vertical impact load**

Additional downward force added to the beams produced during loading of the rack.

- **Yield point**

First stress in a material at which an increase in strain occurs without an increase in stress as defined by ASTM.

- **Yield strength**

Stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain as defined by ASTM.