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Racking design code for steel static storage systems

立体仓库货架系统设计规范

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1 Scope

China's national design code for steel storage racking. Pallet racking is a structure that engineering has historically taken less seriously than it deserves. It is built from thin cold-formed steel sections, it is loaded to close to its capacity as a matter of routine, it is bolted to a floor slab and braced only in one direction, and it is surrounded by forklifts that strike it. The collapses that result are progressive: one damaged upright fails, the beams it carried drop, and the load transfers to neighbours that were never designed for it, so a rack can unzip across an entire aisle in seconds. The code addresses that specifically - the design is governed by the stability of thin-walled members rather than by material strength, the connections are semi-rigid and their stiffness has to be tested rather than assumed, and the accidental impact of a truck is a design load rather than an accident.

This Standard specifies the terms, materials, loads and load combinations, racking design and test methods for steel static storage systems. This Standard is applicable to steel static storage systems made of cold-formed steel or hot- rolled steel components, and mainly subjected to static loads.

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 228.1 Metallic Materials - Tensile Testing - Part 1: Method of Test at Room Temperature

GB/T 232 Metallic Materials - Bend Test

GB/T 700 Carbon Structural Steels

GB/T 1591 High Strength Low Ally Structural Steels

GB/T 2518 Continuously Hot-dip Zinc and Zinc Alloy Coated Steel Sheet and Strip

GB 4053.3 Safety Requirements for Fixed Steel Ladders and Platforms - Part 3: Industrial Guardrails and Steel Platform

GB/T 18354 Logistics Terminology

GB/T 28576-2012 Calculation of Industrial Rack Design

GB 50009 Load Code for the Design of Building Structures

GB 50011 Code for Seismic Design of Buildings

GB 50018-2002 Technical Code of Cold-formed Thin-wall Steel Structures

JB/T 9018 Automated Storage and Retrieval System - Design Rules

JB/T 11270 Assembled Steel Rack Structure for High-bay Warehouse - Technical Requirements comply with the requirements of

5 Loads and Load Combinations

5.1 Classification The loads on the rack structure can be divided into dead load, live load, vertical impact load, horizontal load and possible wind load, snow load, roof live load and seismic action, etc. If there are other types of loads, they shall comply with the stipulations of GB 50009.

5.2 Dead Load PDL Dead load refers to the self-weight of the racking system. The dead load of the rack-clad building shall also include the self-weight of the structures, such as: the roof and wall. The dead load is composed of the weight of all permanent structures, including the racks and auxiliary facilities connected to the racks, such as: fire sprinklers, heating ventilation and air conditioning systems, etc., as well as other fixed auxiliary equipment that needs to be supported by the rack members, and their masses shall all be

included in the dead load.

5.3 Live Load PPL Live load generally refers to the weight of the goods and carriers placed on the rack structure. In addition, the floor slab and aisle loads in

5.7 shall also be included.

5.4 Vertical Impact Load PIL

5.4.1 The vertical impact load refers to the additional impact force generated on the beam when the goods are stored, and usually, only loaded once at the most unfavorable position. When designing beams, (if designed) brackets and hanging pieces, the load can be calculated in accordance with the following situations:

a) When placing goods through mechanical equipment (automation), it shall be equal to 50% of the maximum unit load;

b) When manually placing goods (non-automation), it shall be equal to the maximum unit load.

5.4.2 The vertical impact load is used to inspect local components (beams, hanging pieces and brackets, etc.). When designing the overall structure of the racks, the influence of the vertical impact load is not considered.

5.5 Horizontal Load PHL

5.5.1 The horizontal load acting on the combined rack structure refers to the horizontal force generated by the defects caused by the initial bending of the rack structure members, the installation deviation and load eccentricity, etc., as well as the normal operation of the handling equipment.

5.5.2 The horizontal load generated by the defects described in

5.5.1 respectively acts on the connection node of the beam and the column along the longitudinal and transverse main directions of the combined rack structure. The horizontal load may be taken as 0.4% of the sum of the total dead load and the maximum live load transmitted from the beam to the node.

5.5.3 For racks with handling equipment, the horizontal load shall be determined in accordance with the relevant information provided by the manufacturer of the handling equipment.

5.6 Seismic Action PEL

5.6.1 The seismic action and structural seismic checking calculation shall comply with the relevant stipulations of GB 50011.

5.6.2 For rack structures with a height of not more than 40 m, mainly shear deformation, and relatively uniform distribution of mass and stiffness along the height, simplified methods, for example, the bottom shear force method can be adopted. For the rack structures other than this type, the mode decomposition response spectrum method should be adopted.

5.6.3 For the seismic checking calculation of the cross-section of the members, the design value of the seismic bearing capacity shall take R/0.75; the design value of the bearing capacity stability shall take R/0.8; R is the design value of the bearing capacity of the structural member.

5.7 Floor Slab and Aisle Loads For the load acting on the floor slab or aisle, in accordance with the actual demands, calculate the uniformly distributed load or concentrated load, which shall not be lower than 300 kg/m2. The other situations shall comply with the relevant stipulations of GB 4053.3.

5.8 Thrust on the Railing The railings of stairs and floor slabs shall be designed to be able to withstand a thrust of no more than

0.7 kN/m acting in any direction above the railings. The other situations shall comply with the relevant stipulations of GB 4053.3.

5.9 Wind Load PWL The wind load checking calculation of the rack-clad building shall comply with the relevant stipulations of GB 50009.

5.10 Snow Load PSL and Roof Live Load PRL The snow load and roof live load checking calculation of the rack-clad building shall comply with the relevant stipulations of GB 50009. 0.9; cW

---the combined value coefficient of wind load, which shall take 0.6; cR

---the combined value coefficient of snow load and roof live load, which shall take 0.7. When designing the racks in accordance with the limit states of normal application, the partial factors for the various loads may refer to the combination of Formula (1) ~ Formula (6), and all the numerical partial factors can be changed to 1. The loads and load combinations of other circumstances shall comply with the relevant requirements of GB 50009.

6.1 General Design Requirements

6.1.1 This Standard adopts the limit state design method based on the probability theory and calculates with the design expressions of the partial factors. The combined conditions, in which, the horizontal load and wind load play a dominant role, and the seismic action condition shall be subjected to the second-order analysis of the structure.

6.1.2 The load-bearing members of the rack structure shall be designed in accordance with the limit states of the bearing capacity; the non-load-bearing members shall be designed in accordance with the structural requirements. The limit states of the bearing capacity