



SOME EXPERIENCES FROM THE PRACTICE ABOUT RESULTS AND IMPORTANCE OF WAREHOUSE RACKING INSPECTION

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Abstract: Without implementation of regular inspections and proactive maintenance, normal functioning, health and safety can be endangered in any industrial system. When discussing about high warehouse pallet racking these activities are necessary to ensure storing of heavy-duty goods as safe as possible in the long term. According to the health and safety standards and regulations in the field of racking systems, each organization has to follow stringently all prescribed guidelines starting from the phase of design, over production, installation and up to usage of racking equipment. This paper brings some data collected from the practice after implemented procedures of regular inspections of pallet racking systems within several organizations. Some conclusions have been drawn about the types, locations and way of creation of the most common damages, possible preventive measures and, in connection with that, racking system functioning improvement at all.

Key words: warehouse, pallet racking, inspection, maintenace, practice

1 INTRODUCTION

Different pallet racking systems are not become over a time only the necessary but the perfect storage solution for companies with a large amount of inventory looking to make the most of all the available space in their warehouse or other premises where they are implemented at all. With a pallet racking system, warehousing units are safe, dry, and organised. The demand for home delivery and the rise of e-commerce operations has additionally led to significant growth within the warehouse industry. To compete with the growing demand for speedy delivery of goods, companies across the board are streamlining warehouse operations with tactics such as optimized pallet racking. Businesses must prioritize warehouse optimization, which means putting an

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emphasis on the efficient and safe use of space in storage facilities. The increased demand for capacity expansion in warehouses has led to significant growth in the warehouse racking market, which is forecasted to grow for 8% up to 2027, [1]. But as demand for convenience and rapid fulfillment has increased over the last several years, so too have injury rates for warehouse workers. According to a 2020 study by the U.S. Bureau of Labor Statistics, for every 100 full-time employees, there were 4.8 recordable injuries among warehousing and storage workers. In order to keep products and workforce safe using these complete storage solutions, management need to ensure there are regular pallet racking inspections and maintenance.

2 PALLET RACKING STRUCTURE

A typical selective pallet racking structure is shown in figure 1, [2]. The vertical elements - frames and horizontal elements - beams, usually made of thin - walled cold-formed profiles form a spatial frame structure of pallet racking system. Upright frames lie in the cross aisle direction, normal to the main aisle of the rack. They consist of two perforated uprights linked together by a system of diagonal and/or horizontal bracing welded or bolted to the uprights. This bracing system provide rack stability in cross-aisle direction. Beams connecting adjacent frames and lying in the horizontal direction parallel to the main aisle. Beam-end connectors are welded to or otherwise formed as an integral part of the beams, which has special devices which engage in holes or slots in the upright. The down-aisle stability primary is provided by the stiffness of the joints between uprights and beams. But, connections between baseplates and floor through the anchors provide additional stability, [3]. In order to enhance stability of racking structure in both directions, vertical and horizontal bracing systems are in usage too.

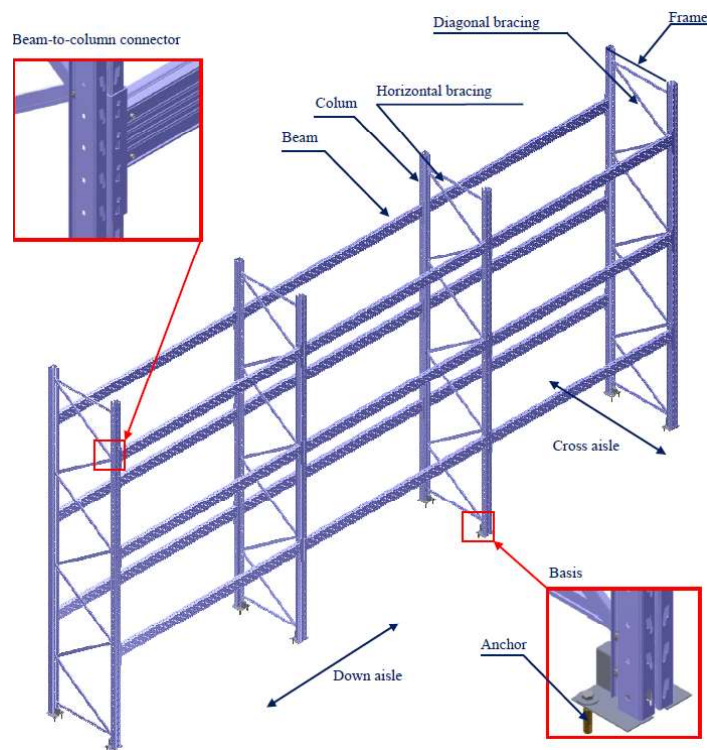


Figure 1. *Parts of the spatial structure of pallet racking*

3 RACKING INSPECTION

The inspection of storage equipment should be done regularly and systematically, usually from ground level, where most of the damage tends to occur unless there are indications of problems at higher levels of the racking structure that need to be checked. If it is necessary to carry out an inspection at higher levels, then it is necessary to ensure safe access to the locations using appropriate equipment in the form of working scissor platforms or service baskets that are safely placed on forklifts, with the mandatory use of safety belts. Free climbing on the structure is not allowed. These inspections should always be performed by competent persons like user's internal staff, external experts or the manufacturer's technical staff. In any case, this activity should be formal with a written report documenting the scope and results of the inspection. The frequency and scope of inspections depends on a number of factors that are specific to the given location and should be determined by the person responsible for the safety of the storage equipment, in order to match the operating conditions of the warehouse. It will take into account the frequency and way of operation together with the dimensions of the warehouse, the equipment used and the personnel involved, as well as what could damage the racking structure. The degree of seriousness of structural damage to beams, uprights or bracing members on any of the inspections should be classified as follows, [4, 5]:

- RED RISK - Serious damage requiring immediate action.
- ORANGE RISK - Hazardous damage requiring action as soon as possible.
- GREEN RISK - Non-critical damage requiring surveillance.

3.1 Inspection schedules

The inspections recommended below should be carried out at regular intervals by designated personnel or departments of the user company, [4, 5]:

- *Daily damage reports* by all warehouse operatives. This level of inspection is the most important of all inspection procedures and as previously mentioned relies on the honesty of the operatives to report accidental damage as it occurs. Care should be taken to use this reporting procedure with discretion as indiscriminate use for disciplinary purposes will result in very little being reported.
- *Weekly damage inspections* of all racking should be carried out based on a visual check from ground level. This may be carried out by the manager or supervisor and should cover all forms of accidental damage categorised as RED or ORANGE RISK.
- *Monthly damage inspections* should be carried out in a similar manner to the weekly surveys although they should also include a physical emptying of random bays in order to carry out a more detailed inspection. The monthly survey should also be used to confirm that items identified as a serious priority in the weekly survey have been isolated and that action has been taken on these and also on hazardous priority items to ensure that repairs are underway. Guidance from the racking supplier or specialist surveyor should be sought if there is any doubt about the course of action.
- *Six to twelve monthly damage inspections* should be carried out by a technically competent person fully experienced in the identification and categorisation of racking damage. Such a person might be employed as a specialist within a large company's organisation, or for smaller companies, the storage equipment manufacturer's technical services or an external

specialist surveyor may be used. The purpose of the yearly review is to examine the performance of the management procedures for controlling rack safety as well as checking that actual repairs are being made correctly.

3.2 Data collected within annual rack inspection

In order to prepare clear and more precise discussion on inspections reports, five pallet racking configurations with similar characteristics installed for the different users were considered. Main warehouse parameters like total number of installed pallet places, number of pallets on th epair of beams (i.e. in one compartment), type of pallet unit, mass of one pallet unit, number of beam levels excluding floor level, height of warehouse, type of fork-lift truck are shown in the Table 1.

Table 1. *Pallet racking characteristics*

PARAMETER	UNIT	COMPANY 1	COMPANY 2	COMPANY 3	COMPANY 4	COMPANY 5
No. Installed pallet places	pcs.	1380	1668	1680	1899	2604
No. Pallets on pair of beams	pcs.	3	3	3	3	4
Type of pallets / dimension	mm	EURO / 1000x1200	EURO / 800x1200	EURO / 800x1200	EURO / 800x1200	EURO / 800x1200
Mass	kg	650	1000	700	1000	500
No. of beam levels	pcs.	Ground + 5	Ground + 5	Ground + 6	Ground + 3	Ground + 6
Height of warehouse	mm	9000	6525	6500	5100	8000
Type of fork lift truck		Reach pallet truck	Reach pallet truck	Stacker	Reach pallet truck	Reach pallet truck
Ailse width	mm	3100	4750	2500	4100	3300

During the annual racking inspection performed by experts team [6], the following damages are presented in figure 2 and their quantity are shown in Table 2.

Table 2. *Number of damaged elements per user*

NUMBER OF DAMAGED ELEMENTS	COMPANY 1	COMPANY 2	COMPANY 3	COMPANY 4	COMPANY 5
Upright	3	1	1	0	0
Horizontal bracing	18	4	5	9	3
Diagonal bracing	53	9	33	16	13
Beam	64	68	0	2	16
Column protector	9	2	1	2	16
Pallet stopper	10	0	0	30	0

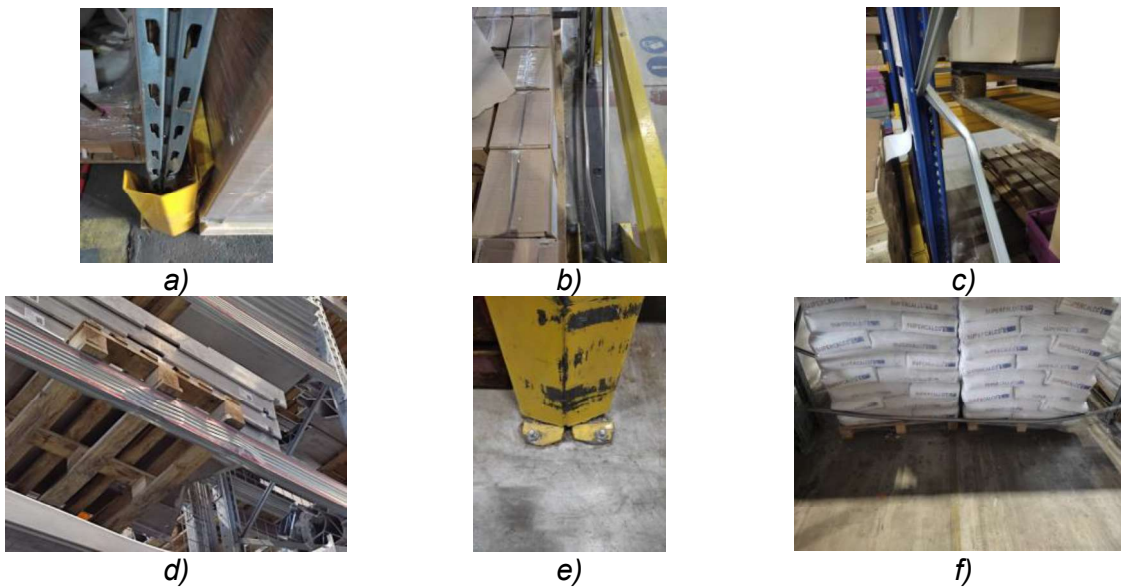


Figure 2. *Damaged elements specification: a) upright, b) horizontal bracing, c) diagonal bracing, d) beam, e) column protector, f) pallet stopper*

3.3 Reports analysis

An inspection reports of rack damage should initiate a management procedure to investigate any problem the conclusions may indicate and to make practical recommendations to reduce, if not eliminate the possibility of the problem and damage re-occurring. Conclusions should be reached on the basis of inspection reports but on the reasons why damage has occurred if possible to determine them.

The frequency and severity of damage to storage equipment generally speaking in all companies is primary influenced by the turnover rate of the stored goods and therefore driver training or retraining. The total number of stored itmes hasn't influence on warehouse operation and potential risks at all.

The skill of the fork lift truck drivers will have a significant impact on higher installations like in the companies 1 & 5.

Although the adequacy of the operating clearances in the rack structure is according to regulations and standards [7], bigger problems are observed in companies 1 & 5 where there are larger dimensions of the pallets or number of the pallets on a pair of beams is bigger, hence the presence of an adequate clearances is insufficient.

Also, smaller aisle width although in accordance with used fork-lift truck noticed in companies 1 & 5 cused increase in number of damaged parts.

Poor condition of the handling equipment or changes in the type of handling equipment will significantly affect on of damage to racking elements. On the other hand damaged pallets or changes in the type or quality of pallet used will have the same effects.

In each installation upright protection in front of each rack column, safety barriers located at the front of sigle or double entry racks or pallet stopper at the back side of each rack compartement will reduce the effects of an accidental collision but may prevent serious upright damage [8].

4 CONCLUSION

Pallet racking systems in combination with adequate material handling equipment, widely utilized in warehouses, play a crucial role in warehouse operations. The best racking needs to be durable to maintain its quality in the long-term. This allows it to store heavy-duty goods without the risk of the whole storage system collapsing. Their efficient, but simultaneously safe usage is essential in maintaining industry standards. To ensure pallet racking is as safe as possible inside an industrial workplace in order to reduce the risk of potential accidents occurring later primarily it needs to be installed by a professionals. Working with a specialist company also ensures all pallet racking regulations are followed, this is important for health and safety but also to avoid breaking the law. But, even the highest-quality pallet racking installed by professional service needs to be inspected regularly otherwise small issues could escalate and lead to an accident. A minor issue with a rack, if left unchecked, could lead to significant problems, impacting both safety and productivity. Health and safety is an essential aspect of any industrial workplace. Without routine inspections and maintenance, pallet racking can be an accident waiting to happen. Pallet racking inspection highlights potential problems such as loose connections or damaged parts which could eventually affect the structural stability of the pallet racking. Damage to the support elements like uprights and beams, or protective elements like upright protections, barriers and stoppers or pallets themselves could occur if a forklift knocks into the some of them. It doesn't have to be a massive crash, even slight bumps can accumulate and lead to problems. This is why any warehouse owners or staff in charge of warehouse logistics should implement regular inspections and proactive maintenance.

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