



Storage Solutions

**USE AND MAINTENANCE
GUIDE
FOR
LONGSPAN SHELVING STORAGE**

TABLE OF CONTENTS

OVERVIEW 4

GOAL..... 5

SCOPE 5

REVISIONS 5

TERMS AND DEFINITIONS..... 5

SYSTEM USAGE 8

 Prior Considerations 8

 Checking the System..... 8

 Loads 9

 Transport, Loading and Unloading 10

GENERAL SAFETY 10

 Person Responsible for Safety (PRSES) 10

 Safety Warnings..... 10

 Access to Highest Levels..... 10

 Hazards..... 10

 Training 11

 Irregularities and Failures 11

 Safety Recommendations..... 12

MAINTENANCE (PREVENTIVE AND CORRECTIVE)..... 12

 Regular Inspections 12

 Damage Analysis 13

 Criteria for Damage Assessment..... 15

 Immediate Action 16

 Repairs..... 16

 Reuse and Recycling..... 16

ANNEX A 17

OVERVIEW

Adjustable longspan shelving enable you to store any kind of loose or packed items in height, providing excellent space usage. The static nature of these elements allows for the idea that the goods will preserve the same condition as when stored.

On the other hand, this system facilitates access to goods and correct inventories.

The larger presence of goods warehousing in the logistics sector and the more intense use of facilities, with ever more stringent response times, results in less strict work conditions, which in turn increase the hazards related to damages to facilities and people. For this and other reasons, this guide is required to help all involved personnel: designers, assembly team, control staff and, particularly, operators.

If damage to the shelving system, such as impacts, dents, fracture, etc., is not immediately repaired, the structure is at a high risk of collapsing, thereby posing a risk to people's physical integrity.

AR Storage Solutions is available to advise customers on any issue related to the use, service and safety of our systems.

End clients using the shelving structure have their own specific responsibilities to ensure the operating conditions of workers and proper storage of goods. Regarding this point, we must highlight that in general there must be a person in charge of the facilities.

However, the end user is responsible for using and keeping the systems in good condition, reporting any irregularities, irrespective of its severity, to the safety manager (PRSES).

Operator training as well as knowledge of these principles by the people using the shelving system is assumed.

Consulting partners/designers of installations and the users of storage equipment are responsible for:

- Complying with the current regulations, whether local, national, European or international.
- Once ensured that the system has been installed correctly according to the manufacturer's instructions, the responsibility lies with the end client or the end client's contractor.
- Complying with maximum load specifications and any variations thereof that may arise.
- Complying with the shelving specifications on the condition of the floor, anchor limitations, etc.
- The specifications regarding the placement of loads.
- The use of storage equipment according to the contractual terms.
- Regularly inspecting the system or structure over its working life, ensuring repair or replacement with new identical parts from the same manufacturer.

- Staffing and training personnel in the use of the handling equipment and load capacities.
- Specifying the environment, such as humidity, internal and external pollution, in order to determine the quality and durability of paint or other protecting surface treatments.

GOAL

This document is mainly intended to make aware and educate the consulting partners/designers and the end users on the correct use of the installed storage systems. Also, to guide the end user on both the predictive and corrective maintenance to be performed on the facilities. The system will therefore enjoy an optimal long life.

SCOPE

The information herein contained is defined within the context of manual handling steel systems in different formats, such as *Picking, Two Tier Racking, Mezzanine Storage, etc.*, intended for manually storing loose, packed or boxed goods. The use of heavy machinery for loading/unloading the shelving system is explicitly prohibited.

The manual handling system herein described is designed in such a way that only manual means must be used for loading and unloading operations. Therefore, it is not intended to be used with forklift trucks or similar means because of the requirements those may impose on the system. Likewise, stored loads must be static and stable.

Other storage solutions might be partially covered by this document. This document is based on the European standards EN15635, EN15512, EN15620, EN15629 and technical prevention notes NTP 618 replacing NTP 298 (both from Instituto Nacional de Seguridad e Higiene en el Trabajo [Spanish National Institute for Health and Safety at Work]).

Since there are countless possible setups, this document will only address general aspects.

Pictures shown are for illustration purposes only and cannot be used for potential future claims.

REVISIONS

This document supersedes and replaces any other previous one.

TERMS AND DEFINITIONS

This section defines the most common concepts, sorted alphabetically:

Accessory:

An auxiliary item for placing loads, e.g. a bar for hanging clothes, a deck, etc.

Storage Cell:

The area between two frames and two contiguous beams where loads are placed.

Bracing:

Crossly-arranged structure with batten members and tensioning devices aimed to

strengthen the system.

Frame:

The carrying set formed by two uprights and their bracing members (horizontal and diagonals). It includes upright bases, fastening bolts and spacer fixing plates. Floor anchor bolts are not included.

Allowable Load:

Maximum weight that is supported by beams, frames or shelves under safe conditions, given to the user by the storage equipment supplier and based on the data supplied by the manufacturer.

Allowable Load per Bay/Frame:

Maximum weight that is supported under safe conditions by all loads at the different levels in the bay, excluding any loads stored on the floor.

Allowable Load per Pair of Beams:

Maximum weight that is supported under safe conditions by each shelving level (comprising two beams). The load is assumed to be uniformly distributed along the pair of beams.

Unit Load:

Most basic load that is handled or a unit load that can be placed on the shelving system in a single operation.

Foundations:

Floor construction on which the storage equipment is erected and to which it is fixed and stabilized.

Connector:

An element welded to the beam ends. It has hooks that fit into the upright's slots.

Specifier:

Person or company determining a specification based on the user's requirements. For example, the specifier can be a consulting partner, a designer or another expert, the end user or the storage equipment supplier in his own capacity.

Clearance:

Nominal gap between elements.

Installer:

Qualified and trained person or company that carries out the assembly of the shelving system on its proper location. This person/company is responsible for complying with the assembly-related safety rules.

Beam:

An element supporting goods. It is formed by a profile welded to two connectors. It is placed horizontally and longitudinally with respect to the system.

Beam/Load Level:

The area or set of components intended to support the stored unit loads. It is generally composed of a pair of beams plus a board or decks.

Competent Person:

Person having a combination of qualification, training, education and experience offering the capacity to properly perform the tasks and safety requirements demanded.

Person Responsible for Storage Equipment Safety (PRSES):

Person designated by the warehouse management and responsible for keeping the safety of operations at the storage facilities.

Uprights:

Perforated profiles lying on the vertical plane in the cross direction of the system. Beams are linked to them in order to form a frame.

Supplier:

Company supplying the material. It may be the manufacturer or another intermediary acting solely as a dealer.

Operator:

Trained person responsible for the safe use of a forklift truck or similar equipment.

User:

Company or person managing or operating the installation on a constant basis. This person/company is responsible for complying with the safety rules related to usage.

Working Life:

Timeframe in which the system can be safely used.

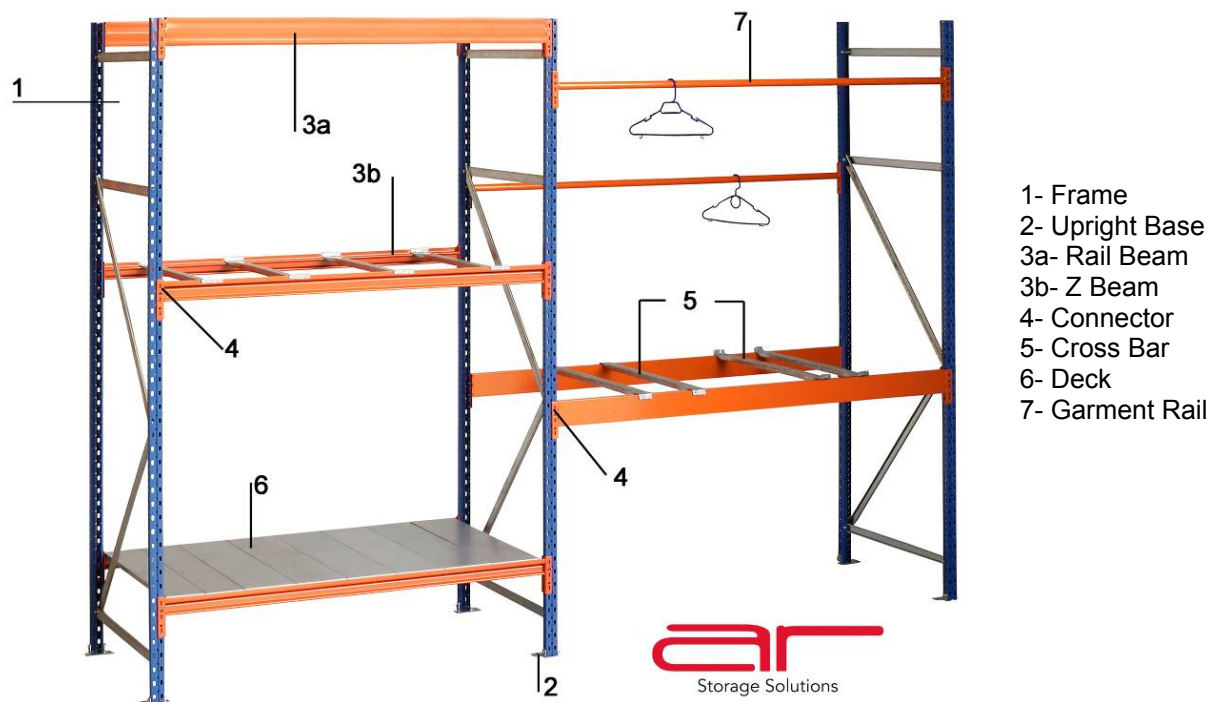


Figure 1

SYSTEM USAGE

Prior Considerations

The use and operation of a shelving system, if not performed according to minimum use and maintenance requirements, may lead to situations that result in:

- Costly service downtime.
- Unsafe working conditions and risk to the people in the environment.
- Damage to the system and the goods.

Prior to first use and periodically during everyday operations, the user must verify whether the system specifications' data is valid.

When it comes to safe and proper use of the installation, the following must be taken into account:

- Shelving must have been erected in compliance with the drawings and detailed assembly instructions (see Assembly Instructions) provided by the supplier based on the manufacturer's requirements.
- The building floor must be sufficiently strong and free of defects, as well as conform to the adequate surveying for its intended use.
- Installations must be equipped with the required signs and help elements, such as mirrors, vertical signs, traffic lights, etc.
- We also recommend identifying the aisles in order to quickly find a specific installation zone where damaged elements may be located.
- In order to educate the end user, the installation must have a name plate provided by the supplier (see Annex B of standard EN 15635) containing enough information related to the type and characteristics of the load, and the characteristics of the system, as well as safety warnings. This plate must always be conspicuously located on or near the system.
- The safety manager (PRSES) must ensure that the maximum load capacity is not exceeded (see Appendix).
- The end user shall be responsible for ensuring the installation is correctly used according to the supplier's instructions and for damage to the system during usage.
- The design and use of certain materials and finishes allows for utilization of the shelving system in wet and freezing environments up to -25 °C.
- In addition, the current laws regarding fire prevention must be applied.

Checking the System

The following must be checked:

- All shelving must be fixed to the floor using adequate anchors following the supplier's instructions and must be installed according to the instructions of the anchor and shelving system manufacturer.
- For single-sided runs not exceeding 2.5m high or double-sided runs not exceeding 4m and meeting a 4:1 ratio maximum of the highest beam level height with respect to the nominal depth, the point specified above is not

required.

- If bracing elements are supplied for stabilizing the shelving system, these must be anchored to the floor following the instructions of the anchor's supplier or manufacturer. They must be assembled according to the manufacturer's instructions and must not be removed or relocated.
- Upright bases must be fully seated on the building floor using levelling shims with different thicknesses, and differences between bases of the same frame must not exceed 1/500 of the frame width.
- When shelving is placed back to back forming double runs, frame spacers must be used. These must be positioned closest to the frame bracing nodes in order to avoid local damage on the upright. Quantity and position are governed by the criteria shown in the following figure:
 - Lower spacer, near the second frame node.
 - Upper spacer, close to the last horizontal member adjacent to a diagonal.
 - If applicable, near the upright splice.
 - Where the distance between both frame spacers exceeds 3m, we recommend placing an additional spacer every 2-3 meters. Figure 2 shows the optimal position.

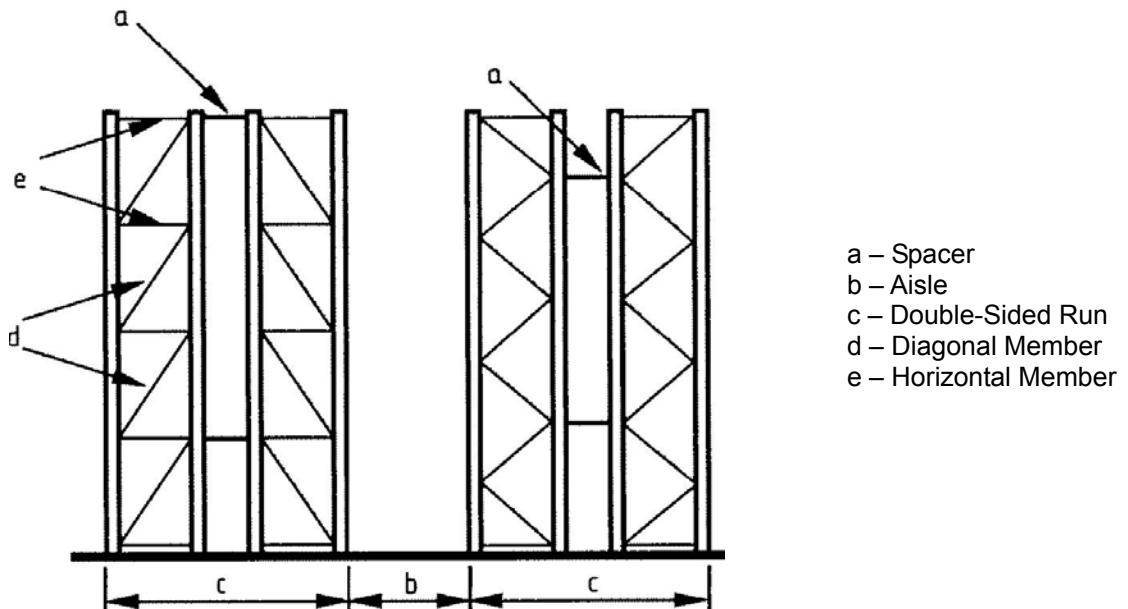


Figure 2

- The distance between beams, decks, shelves, etc. must not be greater than specified by the supplier and noted on the name plate.
- Beams must be secured using safety locking pins as prescribed by the supplier.
- Safety warnings must be conspicuously located.

Loads

Considerations:

- In general, loads manually handled by an operator must not exceed 25 Kg in order to prevent them harming the operator.
- We recommend that loads to be deposited be correctly packaged and stored either in boxes, cartons, drums, etc. and provide in turn uniformly distributed

- loading.
- Loads or their arrangement must not exceed the perimetric boundaries of beam levels.

Transport, Loading and Unloading

The procedure for the safe use of manually handled systems is as follows:

- The load must be placed within the storage cell starting near the frame and ending at the center, trying to maintain a uniformly distributed load.
- Heaviest loads shall be predominantly placed on the lowest shelves. Similarly, light and volume loads shall be placed at the top of the shelving system. All of this will depend on factors such as product turnover, ergonomics, etc.

GENERAL SAFETY

Person Responsible for Safety (PRSES)

The end user must designate a person to be responsible for the safety of the warehouse whose name must be made known to the warehouse personnel. The safety manager (PRSES) must be trained to be able to identify the supplier(s) of the shelving system, contact them and determine the training required to keep the warehouse under safe conditions.

Safety Warnings

The supplier provides customers with a safety information plate in the local language or a different one as requested by the customer (so that any user can understand it) indicating the load capacities and other warnings. This plate must be conspicuously located on each run. Safe load capacity is based on the correct use of the shelving system.

Access to Highest Levels

To reach the highest levels, either for use or service, appropriate and safe lifting elements (ladders, elevators, etc.) must be used. Neither standing on the shelving system nor free climbing on it is allowed.

Hazards

Unlike pallet racking, heavy machinery is not used, so the risk is lower. But lightweight machinery (electrical pallet trucks, stackers, etc.) can be used for transport of loads, so the risk of damage to the system still remains.

The major hazards related to the specifications, design, manufacture and assembly are the following:

- a) **Load falling wholly or partially** over the aisles or working area. This is caused by:
 - a. Total or partial instability of the system due to improper use. Mainly caused by errors regarding:
 - i. Abrupt placement of load.
 - ii. Packaging of unit load. (Broken and/or unsealed boxes, displaced load, etc.)

- b. Total or partial instability of the system because of lack of mechanical strength of the set or any of its elements and/or connections, caused by a change of the original characteristics and/or unit load. Mainly caused by errors regarding:
 - i. Changes in the configuration of beam levels.
 - ii. Use of loads different to those originally intended, causing beam overload.
 - iii. Incorrect assembly and disassembly of the shelving system.
 - iv. Relocation of the system on inadequate floors.
 - c. Impacts on the shelving system by the mechanical handling equipment (hand and powered pallet jacks, etc.). This may lead to disengagement of beams, frames, etc. and also cause permanent and elastic deformation of the elements composing the system, as well as make carrying elements out-of-plumb.
 - d. Total or partial instability of the system due to lack of mechanical strength of the set or any of its elements and/or connections, caused by a design based on inadequate or inaccurate data.
- b) **Traffic Collisions**, either between vehicles or between a vehicle and a pedestrian. Usually caused by faulty signaling, insufficient lighting, inadequate aisle size, speeding, etc.

Training

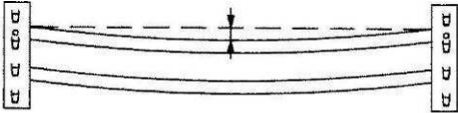
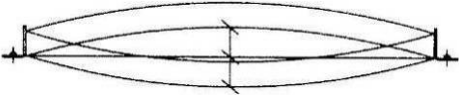
Operators must be properly trained in the use of the shelving system and handling equipment.

Everyone must be educated on the measures affecting his/her own safety and the safety of others.

Irregularities and Failures

The following tables show the irregularities and failures, and their consequences:

For pairs of beams:

FAILURES AND/OR IRREGULARITIES	CONSEQUENCES
Overload	Excessive and/or permanent deformation. Beam fracture and falling.
Concentration of loads on a given point, non-uniform distribution of loads.	Excessive and/or permanent deformation.
Abrupt placement of load.	Excess deformation. Risk of beam falling.
Missing safety pin.	Risk of beam falling.
Impacts by machines or loads.	Lateral deformation. Beam falling.
Paint oxidation and chipping.	Shortened working life. Fracture and later falling of the beam.
	

For frames:

FAILURES AND/OR IRREGULARITIES	CONSEQUENCES
Overload (note that a bit more weight on each load, when multiplied by all the loads in the bay, makes a much larger total load applied).	Excess deformation. Overturning of shelving system.
Impacts by machines or loads.	Component fracture. Dents. Out-of-plumbing. Overturning of shelving system.

Safety Recommendations

Consider the following:

- a. Placing nets and/or panels at the back of single-sided runs when adjacent to areas for forklift trucks or pedestrian traffic, or working areas, in order to avoid falling loads.
- b. For raised tiers, railings on the outer boundaries with a bar 90cm from floor, a middle bar and a baseboard not less than 150mm high.
- c. The shelving system must not be anchored to the building walls in order to avoid transferring forces in both directions.
- d. Loads or other objects must not be placed in aisles in order to keep them free to pass.
- e. Maximum loads cannot be exceeded at any time.

MAINTENANCE (PREVENTIVE AND CORRECTIVE)

Below is an explanation of how to perform preventive maintenance and repairs.

Regular Inspections

The storage equipment must be systematically and regularly inspected, particularly addressing the lowest levels, where damage can result in greater hazards. A regular written report of damages must be kept.

If highest levels require inspection, this must be done using adequate and safe means; free climbing on the shelving system is not allowed.

The main structural elements to be inspected include:

- Scope of damage to any part of the structure, especially uprights and beams.
- Vertical failure of uprights.
- Condition and effectiveness of all components, in particular upright bases and beam-upright connections.
- Rupture of weldments or nearby material at the welded components.
- Tightening torque of bolted joints.
- Condition of the building floor.
- The shelving system has been assembled according to instructions.

Other elements to be inspected include:

- Safety plates are present and updated.
- No overloads in load positions.
- Unit loads do not overshoot the outer perimeter of the storage cell.

The degree and frequency of inspections for each system depends on many factors and must be determined by the safety manager (PRSES). However, *AR Storage Solutions* recommends following these rules:

- Daily inspection for any damage during everyday use.
- Weekly inspection, visually checking the first two levels of the full system.
- Monthly inspection, a deeper visual check also assessing the highest levels as well as plumbing and leveling of the whole system.
- Yearly inspection; this is an expert inspection.

- ***Immediate Report***

As soon as any person notices a safety issue or fracture, he/she should immediately inform the safety manager (PRSES) for appropriate measures to be implemented.

- ***Visual Inspections***

The safety manager (PRSES) will ensure that visual inspections of the whole system are performed weekly (or other previously defined regular intervals) based on a risk assessment.

- ***Expert Inspections***

A qualified technician will perform regular inspections within a timeframe no longer than 12 months. A written report will be submitted to the safety manager (PRSES) containing remarks and proposed course of action.

Damage Analysis

For frames and bracing, the accepted limits are:

- A deflection of 3mm or more per meter on uprights in the direction of the frame plane (see Fig. 3)
- A deflection of 5mm or more per meter on uprights in the direction of the beams (see Fig. 3)
- A deflection of 10mm or more per meter on bracing in any direction.
- Major point damage, such as ripping, bending, denting, regardless of deflection.

NOTE: If the shelving design does not allow the use of a 1m rule, deflection limits proportional to the datum length must be taken. For measurement, a story pole must be used if possible. In turn, the reference rule shall be placed in the concave side at an equal distance from the maximum deflection zone, as shown by the following figure.

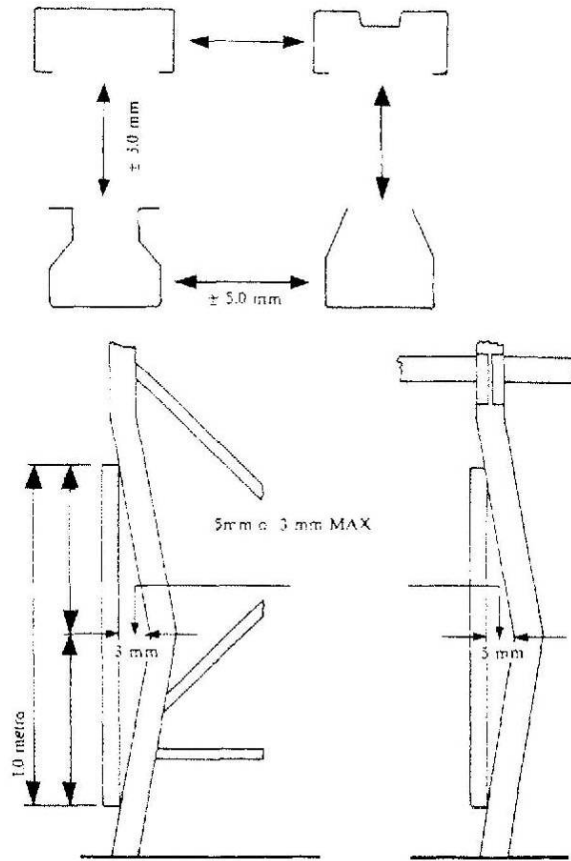


Figure 3

For beams, the limits are:

- A permanent vertical deflection greater than 20% of the nominal vertical deformation under load.
- A permanent lateral deflection greater than 40% of the nominal vertical deformation under load.
- Ripping or cracking at connector welds or close to them.
- Open or cracked connector hooks.
- Specific major dents even if not reaching maximum acceptable deformation.

In addition, presence and correct placement of safety pins must be checked.

NOTE: Permanent deformation is deformation which remains after removing the load.

For runs, damage exists when the following limits are exceeded:

- Plumbing exceeding the stipulations in the EN 15620 standard, as shown by the following table:

Cx	$\pm H/350$
Cz	$\pm H/350$
Jx	$\pm 3\text{mm}$ or $\pm \text{HB}/400$ (the greater)
Jz	$\pm H/500$

Where:

Cx → Out of plumb for each frame in the X direction (longitudinal)

Cz → Out of plumb for each frame in the Z direction (cross)

Jx → Straightness of the upright in the X direction between beams spaced HB

Jz → Initial straightness of the upright for a frame in the Z direction

H → Height from the top of the base plate to the upright end

HB → Height from the top of a beam to the top of the next beam

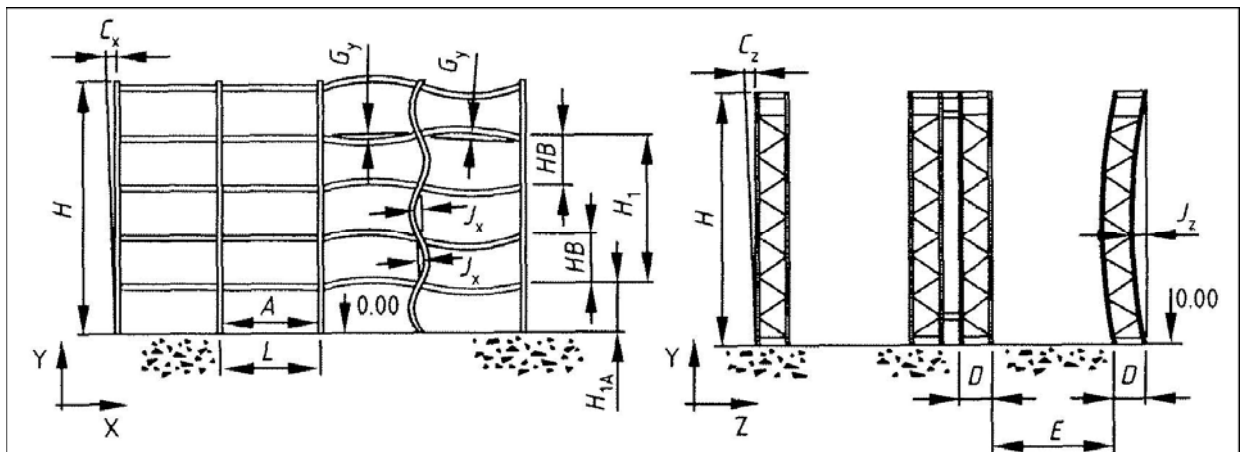


Figure 4

- Lack of verticality under load, both in the longitudinal and cross directions, exceeding 1/200 its height. Any errors of this kind must be reported to the supplier for the design to be checked.
- Lack of levelling under load between two contiguous upright bases greater than $1/500 * A$ (where A is the free distance between uprights)

Criteria for Damage Assessment

When assessing damage, the following criteria must be followed (VAR assessment):

Green Level: only watching is required; this level indicates cases where damage is within the limits above.

Yellow Level: dangerous damage requiring action as soon as possible. This level indicates cases where the limits above have been exceeded by a factor less than two (<2), forcing substitution of the damaged component.

Red Level: severe damage requiring immediate action (see next section). This

category indicates damage exceeding the above limits by a factor greater or equal to two (≥ 2). This is a situation in which damage is critical.

Immediate Action

From the very first time any red-level damage is detected, the following steps must be orderly taken:

1. Evacuate the personnel.
2. Signpost and restrict access to the area.
3. Unload the shelving system.
4. Call the safety manager.

Repairs

Before proceeding, it is important to:

- Identify the problem.
- Restrict access to the area (if considered appropriate by the PRSES).
- Unload the damaged shelving system (this must be done as soon as possible).
- Proceed with repairs.

When replacing a component, always refer to the applicable assembly instructions.

Reuse and Recycling

This refers both to complete installations and individual components. Moving a complete installation or any individual components from one location to another involves changes in behavior affecting the system's bearing capacity that cannot be foreseen without a prior appropriate study. Because of this, *AR Storage Solutions* does not assume any liability for reused materials and/or systems without a prior study.

Therefore, it is explicitly prohibited to make any changes and/or enlargements to the system as designed. Any changes and/or enlargements must be approved by the supplier/manufacturer, in this case *AR Storage Solutions*.

At the end of the working life of a component or a complete installation, it is convenient to dispose of the material with an appropriate waste management company.

ANNEX A

Following the damage analysis and aimed at determining the level of compliance with these guidelines, a safety checklist is included below as an example:

Safety Checklist – LONGSPAN SHELVING

Load

- Is load stable?
- Is load uniformly distributed at all levels?
- Is packaging safe?
- Is it in good condition?

Yes	No	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	

Storage System

- Are aisles wide enough?
- Is the intended design correctly implemented?
- Are passages signposted?
- Is there a name plate with characteristics and warnings?
- Is proper maintenance performed?

<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	

Building

- Is floor condition correct?
- Is floor strength correct?
- Is lighting enough?
- Are aisles free of obstacles?
- Is it regularly cleaned?
- Is it specifically cleaned after a spillage?

<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	

Handling Equipment (if applicable)

- Is it appropriate for the load to be handled?
- Is it correctly serviced?
- Is basic functioning checked daily?

<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	

Warehouse Personnel

- Are they properly trained?
- Are they in good physical-mental condition?
- Do they work and move according to signposting?
- Do they report damage found?

<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	

NOTES: Manually handled loads Max. 25kg (Decree 487/97)