FEM
European Materials Handling Federation
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Product Group /
Industrial Trucks

20.01.2017

FEM 4.005
(4th Edition)

Guideline /

Industrial trucks – 90° stacking aisle width

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Introduction

Information for the determination of the stacking aisle width has been included until now in the illustrated terminology of FEM IV and in the technical note, FEM IV-TN01. This information does not, however, cover all the peripheral conditions included in this new guideline. TN01 is replaced by this guideline.
This document assumes that forklift trucks are driven by trained and qualified operators.

1 Scope

In this guideline, the determination of the 90° stacking aisle width has been defined for major industrial truck types. Articulated counterbalance trucks are not included in this document.

NOTE: This method of calculation, due to its simplistic nature, may not necessarily represent the minimum possible safe stacking aisle width. More sophisticated methods are available and may be more suitable particularly when long or wide loads are being handled. BITA guidance note GN9 is an example of such a method.

2 Normative References

ISO 5053-1	Industrial trucks -- Terminology and classification -- Part 1: Types of industrial trucks
EN 15878	Steel static storage systems – Terms and definitions

3 Terms and definitions

The following tables compares the determination of noise emissions and the respective information by an example of counterbalanced lift trucks.

3.1 Operating aisle width

Minimum dimension across the aisle at any level between either unit loads located in their nominal position or between the rack structure components. [Ref EN 15878]

3.2 Operating aisle width required for 90° stacking (90° operating aisle)

Operating aisle width required for elevated stacking operations with the unit load perpendicular to the aisle axis. In this operation, the unit load is only moved within the operating aisle width whilst aligning it with the storage location in the rack.

3.3 Maneuvering allowance

Minimum dimension (total clearance on both sides) by which the theoretical aisle width determined from the dimensions of the industrial truck and the unit load is increased to give the operational aisle width.

NOTE: The maneuvering allowance is divided equally over both sides of the aisle.

4 Determination of the operating aisle width for 90° stacking

4.1 Peripheral conditions

In general, 200mm is adopted as the maneuvering allowance (dimension "a" in figures 2 to 6) and gives satisfactory levels of safe operation. However, due to other factors, it may be necessary to increase the maneuvering allowance. For example:

- unusual load dimensions which make precise maneuvering and stacking difficult;
- productivity requirement;
- operator skills.

For pedestrian controlled trucks the minimum operating aisle width is calculated based on the tiller at the upper driving position.

NOTE: It is normal practice to use a 200mm dimension is to enable comparison between different trucks designs and sizes.

4.2 Influence of industrial truck design and unit load dimensions

The load length ℓ_6 and load width b_{12} shall be determined from the actual dimensions of the unit loads to be stored including any load overhang (if present) see Figure 1.

NOTE: Industrial truck data sheets (VDI 2198) are typically based on standard pallet sizes i.e. 1200×800 and 1200×1000, without load overhang.

There are a number of possible geometrical situations of truck and unit load to calculate the aisle width and the largest value shall be taken from the equations in figures 2 to 6.

NOTE: If unit loads at floor level are positioned using another type of truck this may be possible without turning through 90° and without entering the rack.

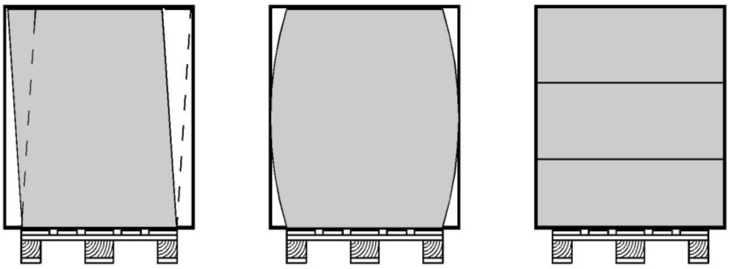

Figure 1: Examples of pallets with overhanging loads, resulting in an overall dimension of the unit load larger than the perimeter of the pallet

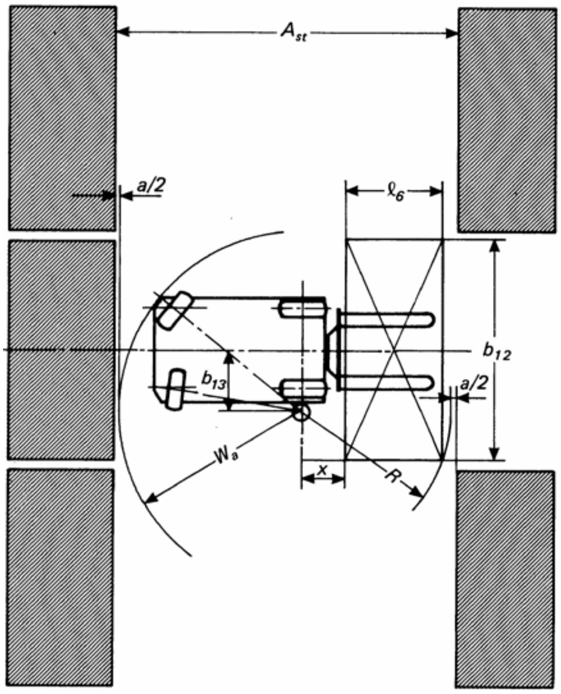

Figure 2: Four wheel lift truck (point of rotation outside axle centre)

$$R = \sqrt{(\ell_6 + x)^2 + \left(\frac{b_{12}}{2} - b_{13}\right)^2}$$

$$A_{st} = W_a + x + \ell_6 + a \quad \text{if} \quad \frac{b_{12}}{2} \leq b_{13}$$

$$A_{st} = W_a + R + a \quad \text{if} \quad \frac{b_{12}}{2} > b_{13} \text{ and } \left(\frac{b_{12}}{2} + b_{13}\right) < W_a$$

$$A_{st} = \frac{b_{12}}{2} + b_{13} + R + a \quad \text{if} \quad \left(\frac{b_{12}}{2} + b_{13}\right) > W_a$$

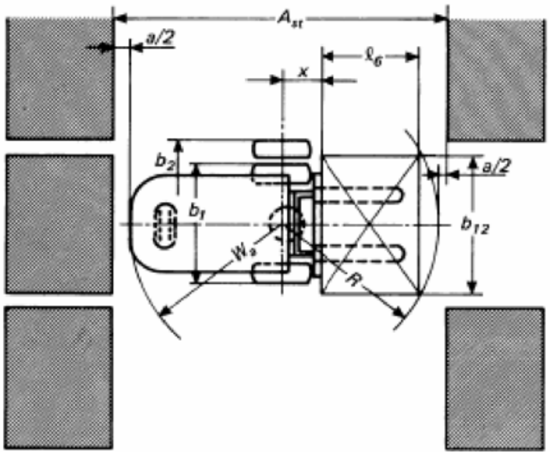

Figure 4: Three wheel fork-lift truck (point of rotation in centre of axle)

$$R = \sqrt{(\ell_6 + x)^2 + \left(\frac{b_{12}}{2}\right)^2}$$

$$A_{st} = W_a + R + a \quad \text{if} \quad \frac{b_{12}}{2} < W_a$$

$$A_{st} = \frac{b_{12}}{2} + R + a \quad \text{if} \quad \frac{b_{12}}{2} > W_a$$

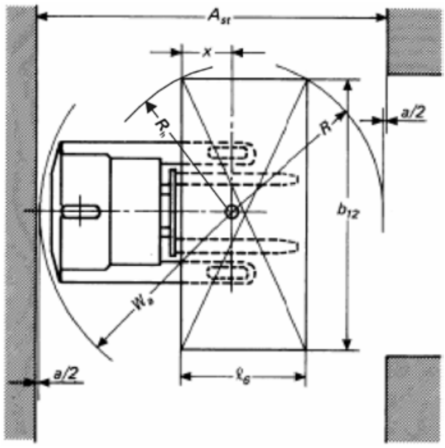

Figure 3: Reach truck (point of rotation in centre of axle)

$$R = \sqrt{(\ell_6 - x)^2 + \left(\frac{b_{12}}{2}\right)^2}$$

$$R_h = \sqrt{x^2 + \left(\frac{b_{12}}{2}\right)^2}$$

$$A_{st} = W_a + R + a \quad \text{if} \quad R_h < W_a$$

$$A_{st} = R_h + R + a \quad \text{if} \quad R_h > W_a$$

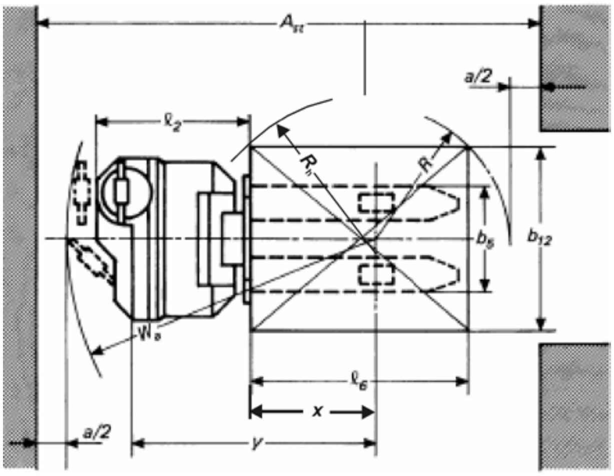

Figure 5: High lift pallet truck

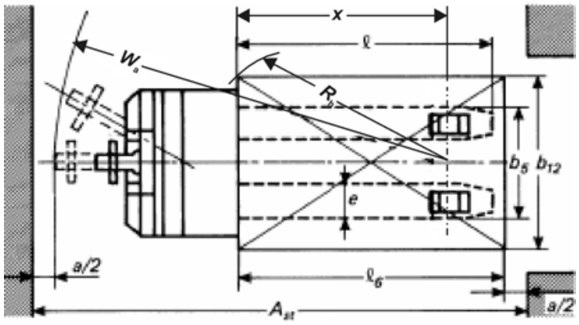

Figure 6: Low lift pallet truck

$$R = \sqrt{(\ell_6 - x)^2 + \left(\frac{b_{12}}{2}\right)^2}$$

$$R_h = \sqrt{x^2 + \left(\frac{b_{12}}{2}\right)^2}$$

$$R_h = \sqrt{x^2 + \left(\frac{b_{12}}{2}\right)^2}$$

$$A_{st} = W_a + R + a \text{ if } R_h < W_a$$

$$A_{st} = W_a + \ell_6 - x + a \text{ if } R_h < W_a$$

$$A_{st} = R_h + R + a \text{ if } R_h > W_a$$

$$A_{st} = R_h + \ell_6 - x + a \text{ if } R_h > W_a$$

5 Stacking aisle as traffic route

If the aisle is also used as a traffic route it shall be checked whether the safety distances are in accordance with guidelines given in 89/654/EEC, with its implementation respectively transposition into nation-al legislation (national regulations may specify different safety distances).

6 Bibliography

BITA GN9 — 90° stacking aisle widths – British Industrial Truck Association

89/654/EEC — Workplace requirements

VDI 2198 — Type sheets for industrial trucks

The recommendations and advice contained in this Guidance Note are based on specifications, procedures and other information that have been collected from the FEM from its members. They represent what is, as far as FEM is aware, the best available data at the time of publication on the instruction and use of the equipment concerned in the general conditions described and are intended to provide guidance for such use.

The suitability of this Guidance Note must be determined by the judgement of the person applying it in accordance with the conditions in which use is envisaged and subject to all relevant statutory requirements.

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