Floor flatness

WHY IT'S IMPORTANT

Flatness is an essential requirement of a floor slab in all categories of industry, none more so than in the aisles of high bay warehouses where defined path very narrow aisle (VNA) turret trucks operate. Even relatively minor variations in floor level between the wheel tracks of VNA trucks are magnified in direct proportion to the height of the racking they are operating within.

A poor standard of floor flatness can contribute significantly to the cost of operating and maintaining a VNA installation. In addition, frequent and expensive damage can be caused to the trucks, stock and racking.

A well maintained floor, with the correct standard of flatness and good quality joint construction, can contribute to increased VNA productivity and efficiency, low maintenance costs and a pleasant working environment. Don't forget to correctly specify compliance testing to ensure that you are getting the quality of floor required for the VNA installation.

TESTING

You will need a quality controlled measurement of floor surface regularity using digital floor measuring devices. For defined path narrow aisle floors, a survey is required. Graphs are produced relating to the transverse and longitudinal profiles of the floor, with areas highlighted that do not comply with the required specification.

This type of survey can be carried out in existing or proposed narrow aisles. Surveys can be carried out to check compliance with all current, worldwide floor flatness specifications; ACI Fmin, UK Concrete Society TR34, EN 15620, DIN 15185 and VDMA Guideline.

UPGRADING

Floors that are not designed and constructed specifically for narrow aisle use do not generally have the necessary flatness tolerances within the aisle locations. This means some remedial work will be required to upgrade the floor to make it suitable for narrow aisle use.

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FREE MOVEMENT FLOORS

In free movement floor areas, the materials handling equipment (MHE) travels randomly in any direction, for example; factories, wide aisles, block stacking and transfer areas in VNA warehouses. Free movement floors are measured according to the American Society of Testing Materials (ASTM) E 1155M standard. The ASTM recommends two basic properties of the floor's surface regularity should be checked:

Flatness (FF) — short wavelength characteristic
Levelness (FL) — long wavelength characteristic

An FF and FL number will be specified for each local area and the overall area. Eg. overall FF50/FL40, local FF45/FL35. A higher number indicates a better flatness or levelness. Measurement is carried out with a specialized device.

DEFINED MOVEMENT FLOORS

In defined movement floor areas, the MHE travels in a fixed (defined) path; normally VNA applications with high level storage racking and turret trucks. The higher the lift height or racking, the more important the floor flatness becomes. Defined movement floors are measured according to the American Concrete Institute (ACI) Fmin standard.

There is no direct correlation between the ASTM FF/FL and ACI Fmin standards, they are completely different measuring systems and there is no corresponding index for comparison purposes. A single F-number 'Fmin' is therefore used to define the acceptable flatness and levelness conditions in a VNA aisle. This Fmin value is assigned based on the expected rack and turret truck height, as shown in the table.

(Note: The ASTM states this method of measurement is not suitable for defined VNA applications; these should be measured according to the American Concrete Institute (ACI) Fmin standard.)

Rack Height	Longitudinal[1] F-min	Transverse[2] F-min
0-25 (0-7.6)	50	60
26-30 (7.9-9.1)	55	65
31-35 (9.4-10.7)	60	70
36-40 (11-12.2)	65	75
41-45 (12.5-13.7)	70	80
46-50 (14-15.2)	75	85
51-65 (15.5-19.8)	90	100
66-90 (20.1-27.4)	100	125

Maximum elevation difference "dl"

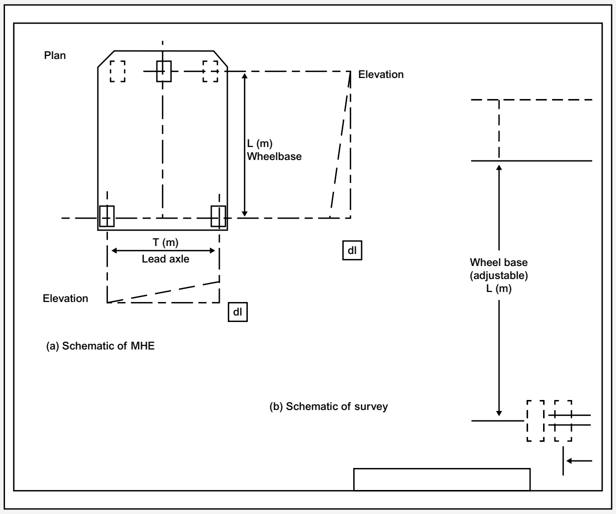
$$dl = \frac{\sqrt{1.3\ (l + 2.7) - 1.9}}{Fmin}$$ in inches

Maximum rate of change in elevation over one foot of travel down the aisle "el"

$$el = \frac{3.978}{Fmin}$$ in inches

Where l =
a: distance between load wheel centers (transverse)
b: distance between the front and rear axle (longitudinal)

Fmin = Fmin number chosen from table



1 Longitudinal value between the front and rear axle
2 Transverse value between loaded wheel tracks.

Table taken from ACI 306-R10
"Guide to Design of Slabs-On-Ground"

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