COD WAREHOUSES A & B
JABULPUR, INDIA
Report into CSTR Category 1 Survey

Prepared for Lamba Techno Pvt Ltd

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Specification

The floor slab was surveyed in accordance with UK Concrete Society Technical Report 34:2003, Defined Movement Category 1. This category is appropriate for Very Narrow Aisle (VNA) warehouses where the lift height of the VNA truck is in the range of 8-13metres. By definition, the racking layout and fork-lift truck wheel-track dimensions are required to be supplied prior to undertaking the survey. Information on truck track width was received in advance of surveying therefore an assessment was made against the criteria given in TR34:2003 for track widths up to 1.5m.

Properties Measured and Significance of the Properties

The Category 1 specification has three properties which are measured at 300mm intervals. Property I is the elevation difference over 300mm along both the front wheel track paths, and Property II is the change in these values over two successive 300mm distances (i.e. the curvature of the floor along the truck wheel track over 600mm). These values control the ride quality of the floor. Excessive non-compliance can result in an uncomfortable ride for the operator, and a back and forth oscillation of the mast, which ultimately can cause damage to the truck mast.

The other property measured (Property III) is the difference in elevation from one wheel track to the opposite track (i.e. from side to side). This value is important in that there is a tolerance between the mast and the racks. If the wheel track is 1500mm, and the height of the racks is 12metres, each millimetre in variation in level across the aisle results in 8 times this in static lean. When the truck accelerates and if, in particular, there is a slope from one side of the aisle to another that frequently changes from one direction to the other, side to side sway is set up, and this dynamic movement can be more than twice the static sway. In exceptional circumstances the truck mast can collide with the racks. This only happens when the tolerances are significantly exceeded and the truck is running at full speed. Clearly Property III tolerances are less critical at the start and ends of the aisles when the truck is running slower. There is a sub-category in Table 4.3 which provides different values for Property III only depending on whether the wheel track width is less than or greater than 1,5metres. The values, in millimetres for the various categories of floor are quoted in Table 4.3 of Concrete Society Technical report 34. The relevant values are extracted below:

	Property I		**Property II**		**Property III (wheel track up to 1500mm)**	
Level of compliance	95%	100%	95%	100%	95%	100%
Permissible Limits	1.5	2.5	2.5	3.5	2.5	3.5

Table 1: Extract from CSTR34: Table 4.3

As illustrated in the table, TR34 provides for two levels of compliance. There is a value quoted for each property (I, II and III), over which not more than 5% of the values reported should lie. There is

also a value quoted in the specification which no reported value should exceed. For absolute compliance the tolerances achieved should pass both these tests.

Method of Surveying

The method of surveying is described in the appendix, but in essence this involves carefully setting out the positions of the aisles, dividing the aisles into manageable sections (particularly important when measuring soon after placing of the floor when only part of an aisle is constructed within a particular pour), and accurately determining the start and finish elevations of each of the sections. The FloorPro floor profiling robot is then run between each of these fixed datum points and an accurate floor profile is obtained. Calculations are then done using proprietary software which provides and output that can be read in Microsoft Excel and similar programmes to enable graphics and so on to be produced if required. In view of the accuracy of the equipment employed the floor has to be clean and free from spillages etc. at the time of survey. The floor is, in any case, swept directly in front of the survey robot.

Reporting

The standard output provides the height relative to the start point of the left-hand track for each aisle and the values of properties I, II and III, reported every 150mm down the aisles. The data is reported to 0.01mm. This level of accuracy is a result of the accuracy of the FloorPro and the precise nature of the calculations undertaken, but has to be evaluated carefully prior to final reporting. As an example, if a tolerance of 1.5mm is specified, the output would determine a figure of 1.51mm as an error, i.e. an error of 0.01mm. Since TR34 specifies values to the nearest 0.5mm for Category 1 tolerances it is reasonable to allow an additional tolerance of up to 0.25mm from the actual output data. In practice, Monofloor will generally ignore errors of slightly less than this (0.2mm) as they are both within the rounding that would be allowed if reporting to the nearest 0.5mm, and can also result from dust, variations in curing membrane thickness and so on.

Whilst the compliance figures in the summary are based upon the figures directly outputted from the survey, from the point of view of assessment of overall floor quality, the data has been reviewed on the basis of discarding these marginal errors.

Summary of Data

A summary of the results is given in the Appendix to this report, together with the individual aisle files.

Discussion of Data

After accounting for errors less than 0.2mm, as above, in Warehouse A, Aisles 3 and 5 are fully compliant. In Warehouse B, Aisles 2, 4 and 5 are fully compliant.

All the aisles comply with the Property I and II (i.e. longitudinal) requirements apart from isolated points, typically less than the 0.2mm allowance described above. No action is envisaged to be required, other than that associated with property II failures.

There are some Property III errors in a number of the aisles. However, the errors are typically not high in value. For example, the transverse errors in Aisle 1 (Warehouse A) are located at chainage 31.950m to 32.700m, between which there appears to be a high spot along the left hand track. The maximum error is over 1mm, therefore localised grinding is advised. However, overall the compliance level with the 95% limit is 95.2% when the 0.2mm margin of error is accounted for. Thus no further grinding is required other than to bring the transverse error below the 100% compliance limit. A similar approach can be taken at other locations in aisles where the 95% and 100% values are exceeded by 0.2mm or less.

Some rectification to the transverse tolerances is required in Warehouse A Aisle 2, 4, 6 and 7. Although the percentage compliance in Aisle 6 appears very low, the highest error against the 100% limit is just 0.8mm. Many errors are less than 0.5mm and a number are less than the 0.2mm margin normally allowed. Our print-out indicate areas where grinding is required. A similar pattern is found in the other non-compliant aisles, there are errors, but they generally are very minor.

Overall Warehouse B is much better, but again minor rectification of the transverse tolerances is required.

Recommendations

In our view, no grinding should take place until the racks are up, in order for the exact locations of the wheel track path to be certain. Often the position of the racking changes slightly from the issued drawings due to setting out issues.

Alternatively, grinding can take place at any time after the track width and path is irreversibly fixed. Thus if it is believed that the track-width is absolutely known now, and there is no risk of tolerance “creep” in the setting out of the racks, then the grinding can commence immediately. Wet grinding is recommended, using a diamond-headed grinder of width approximately twice that of the wheel width (to prevent “dishing” and consequently the truck tyres not sitting fully in contact with the slab).

Due to the relative simplicity of the grinding operations, (the grinding involves reducing the highest side of the two tracks to eliminate the Property III errors), control of this grinding can be done using a

precise level fitted with a parallel plate and a 2m straightedge. The straightedge should be used on edge to check to ensure Property I or II errors are not introduced by the grinding

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