FACE CONSULTANTS LTD
Global Flooring Consultants

FACE CONSULTANTS LTD

FREE MOVEMENT SURVEYS
Concrete Society's Technical Report Number 34
2003 Edition
Table 4.2 and Table 4.4

Further explanatory information

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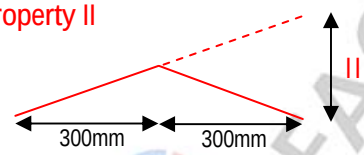
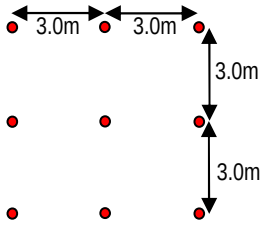
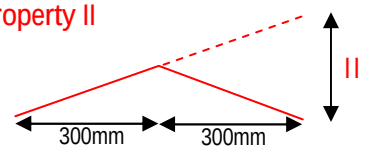
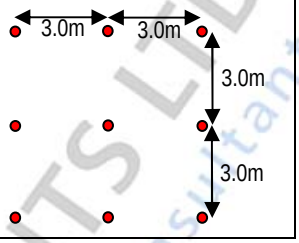
FREE MOVEMENT SURVEYS

Method statement to survey a floor's surface regularity, in accordance with The Concrete Society's Supplement to Technical Report No:34

Floor Classification	Location and floor use	Maximum permissible limits			
		Property II		Property IV	
	Confidence limits	95%	100%	95%	100%
FM1	Areas of free movement where very strict flatness & levelness may be required. See note below	2.5mm	4.0mm	4.5mm	7.0mm
Note: The FM1 limits are extremely onerous and are likely to be achieved by specialist contractors using strip construction. FM1 should only be specified where recommended by specialist material handling equipment manufacturers or where narrow aisle racking height could exceed 13m.					
FM2	• Wide aisle warehousing using reach trucks where potential rack or stacking height is greater than 8metres. • Transfer aisles for VNA truck use and AGV areas. Note: End user equipment suppliers may require a higher classification	3.5mm	5.5mm	8.0mm	12.0mm
FM3	• Wide aisle warehousing using reach trucks where potential rack or stacking height is less than 8metres. • Retail warehouses. • Manufacturing facilities Note: End user equipment suppliers may require a higher classification	5.0mm	7.5mm	10.0mm	15.0mm
Property II  Property II = The rate in change of slope over a distance of 600mm.		Property IV Property IV = Difference in level between two adjacent points set out on a 3.0m x 3.0m grid.  			

A representation of the revised Table 4.2, showing the allowable values of the properties of flatness and levelness for free movement floor areas.

Floor Classification	Floor use	Maximum permissible limits			
		Property II		Property IV	
	Confidence limits	95%	100%	95%	100%
FM2 (Special)	Floors for possible conversion to Category 1 Defined Movement	3.0mm	4.5mm	6.5mm	10.0mm
Property II  Property II = The rate in change of slope over a distance of 600mm.		Property IV  Property IV = Difference in level between two adjacent points set out on a 3.0m x 3.0m grid.			

A representation of the revised Table 4.4, showing the allowable values of the properties of flatness and levelness for free movement floor areas.

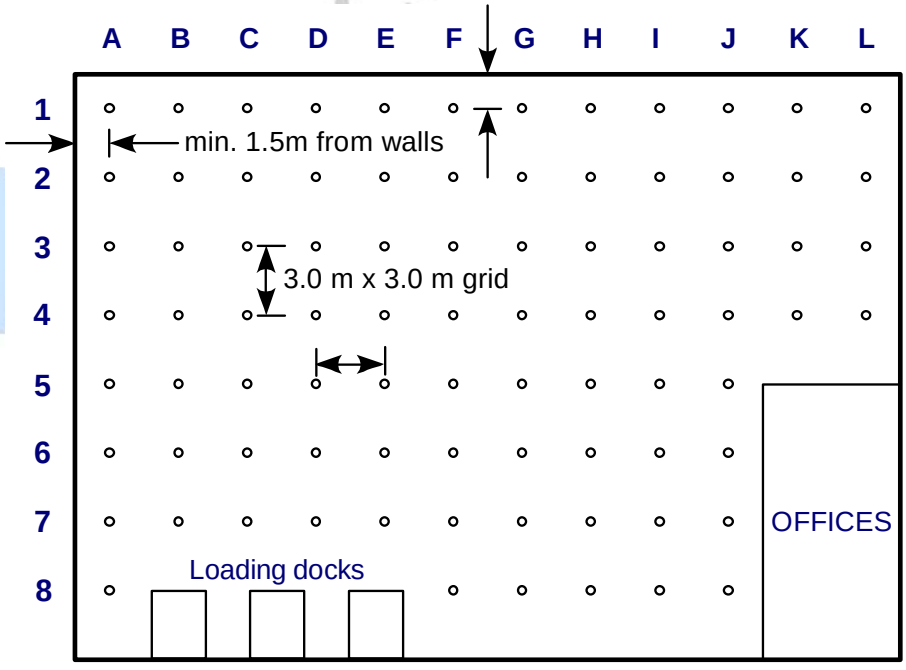
The Concrete Society's TR34 (table 4.2 and table 4.4) recommends that 2 basic properties of the floor's surface regularity should be surveyed:-

1. Flatness - Property II, as the rate in change of slope over 600mm.

2. Levelness - Property IV, as the difference in elevation between two opposing points 3.0 metres apart, set out on a 3.0 x 3.0 metre grid.

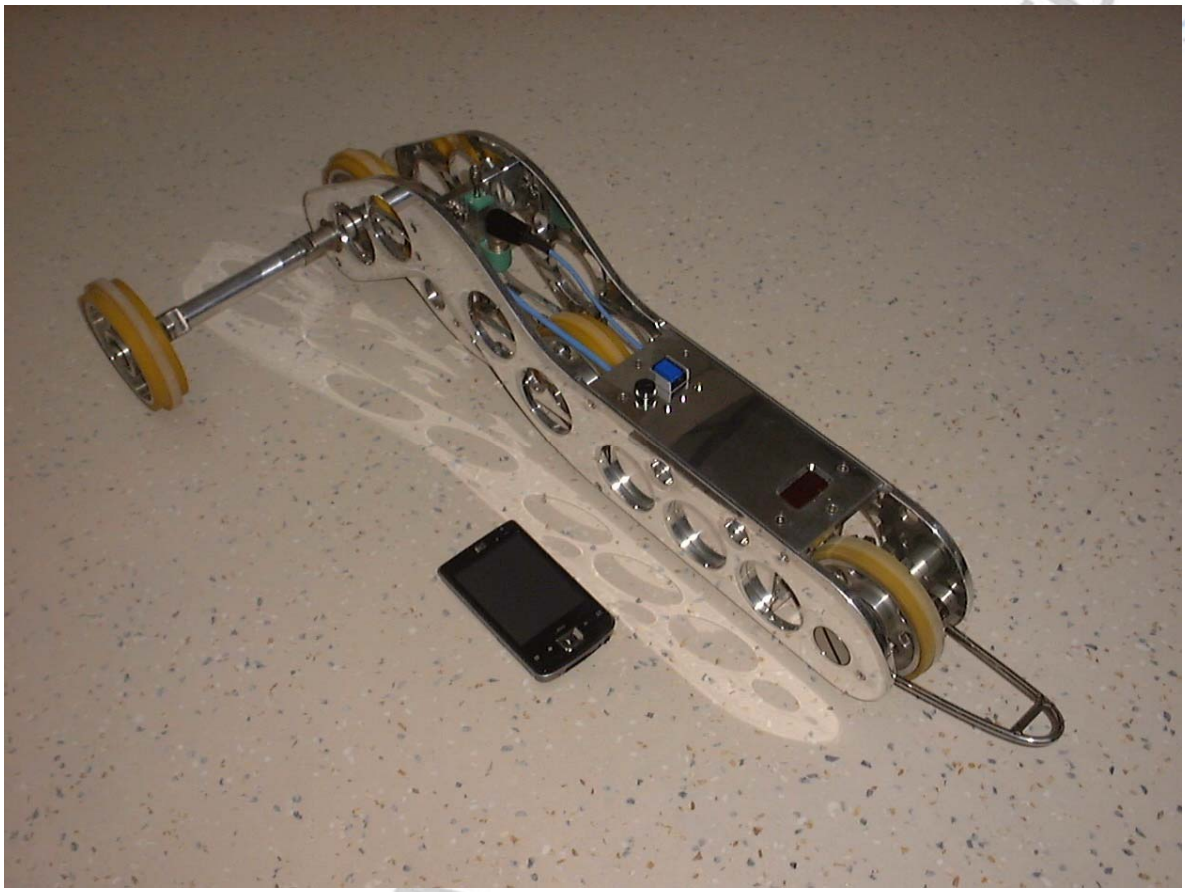
The above properties should be tested, by random sampling, in the following manner:

a) The area is set out on a 3 metre grid pattern.

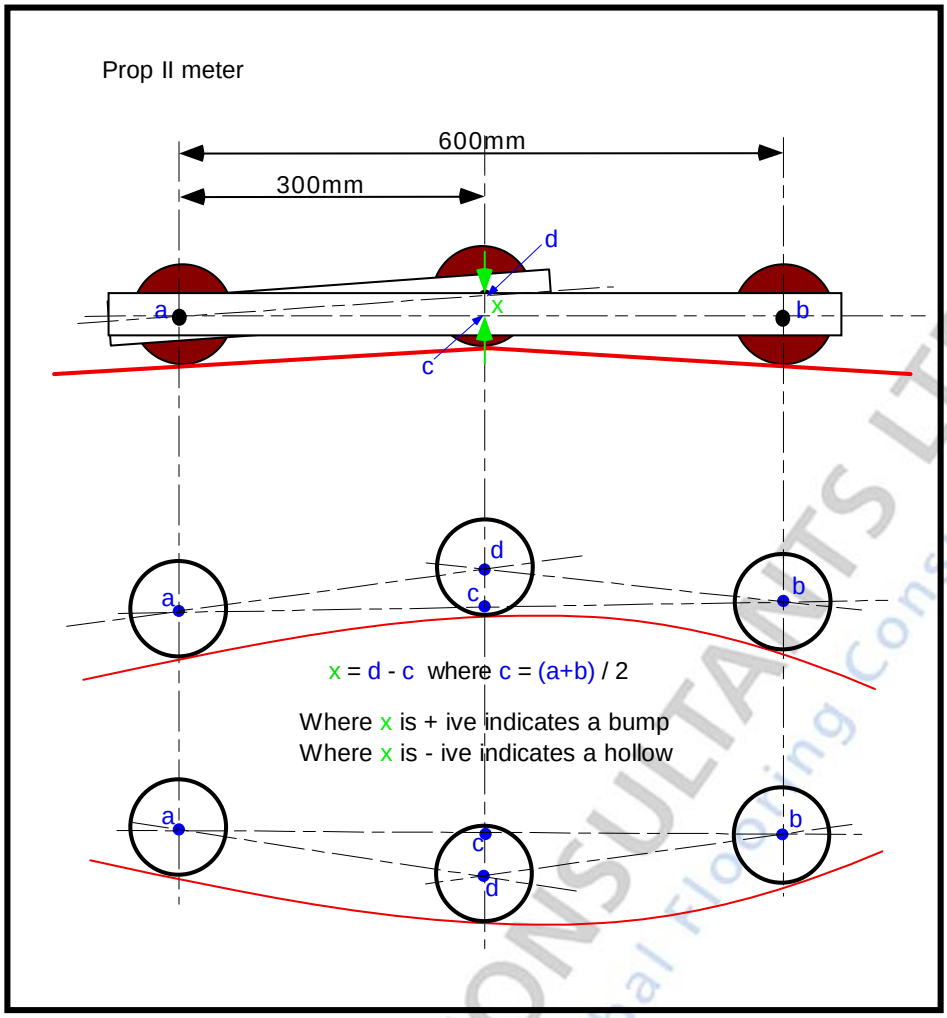


b) Level readings are taken at each grid intersection point, using an engineer's precise optical level, a parallel plate micrometer and an invar staff. This equipment takes readings to 0.1mm accuracy and the figures are used to calculate the Property IV results.

c) The Property II element is measured by means of the Face Prop II meter.

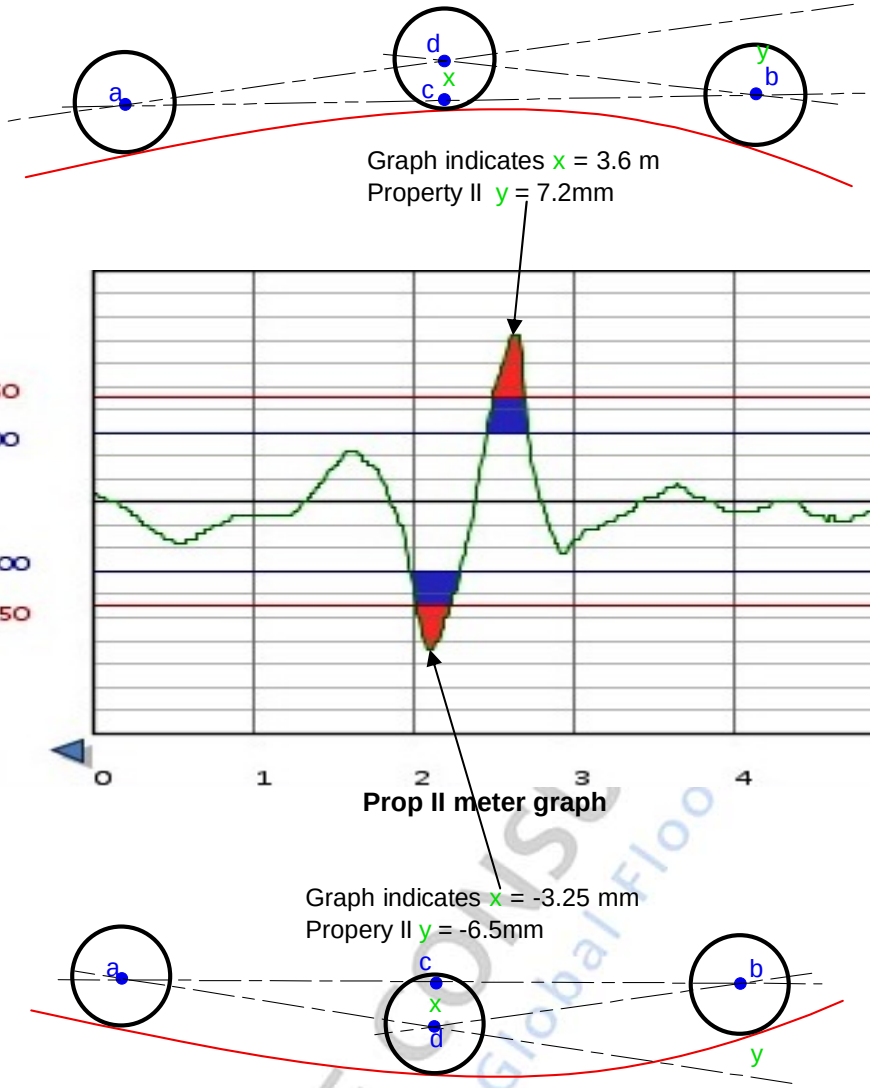


The Prop II meter is simply walked along the floor and the data is collected digitally. At the end of a survey run the data is downloaded to a hand held computer and then the next run can start. When the whole of the floor is surveyed the data is then transferred from the SD card in the hand held computer to a laptop or PC. At the touch of a button the data is analysed by the Face Prop II software, the % error per survey line and maximum error is calculated and the differential graphs produced.



From the data collected by the Face prop II meter the deviation in mm to the mean line of the outer two wheels is multiplied by two to calculate the property II rate in change value. This is generated into a continuous differential graph. The tolerance limits are then produced on the graphs. Where the resultant graphs cross the tolerance limit lines this indicates non-conformance with the classification.
Blue sections indicate property II readings over the 95% limit and red sections indicate readings exceeding the 100% limit.
The total extent of these 'errors' is measured and checked for compliance with the classification.

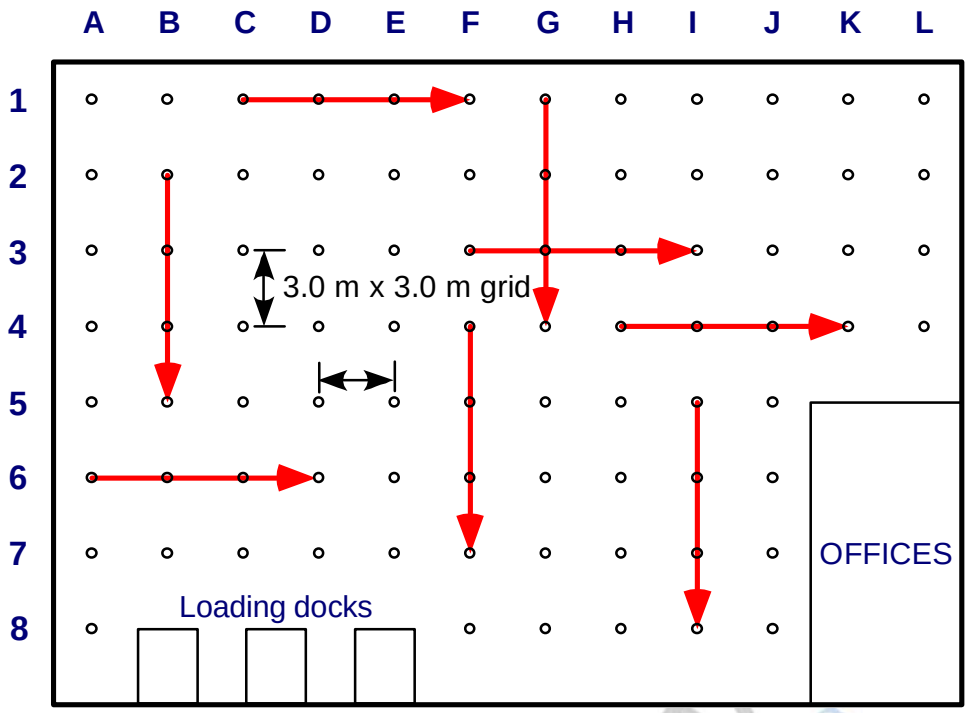
The percentage error is calculated by taking the total length of the graph shown out of tolerance, and dividing it by the length of the test run (i.e. the length of the aisles) then multiplied by 100



The Prop II meter is simply run down sections of the floor at walking speed and the profiles for each of the straight edge tests generated. We would suggest the total length of the survey runs (L in metres) equals Total floor Area (A) divided by 10.
E.g. A floor area (A) of 30m x 30m = 900m^2

Total length of survey lines L = 900 / 10 = 90 metres

Half of the total survey length is to be run in one direction and the other half at right angles.



THE SURVEY RESULTS

The survey results are calculated from the data collected on site, to check compliance with the following:-

a) TR34 table 4.2 or TR34 table 4.4, Property II

b) TR34 table 4.2 or TR34 table 4.4, Property IV

Property II

Below is an example of the summary sheet of results from a Face Prop II meter survey.

The upper section of the table shows:

Project name, location, surveyor's initials, job number & date of survey
Classification tested against, FM1, FM2 (Special), FM2 or FM3
Property limits relating to the Classification tested against.

Summary Of Results

Job Name:	Example	Job Number:	FC/XX/XXXX
Location:	Unit 1	Date:	10/10/2007
Surveyor:	AA		

Specification	Description	Limit
FM1 2003	95% Compliance	2.5 mm
	100% Compliance	4.0 mm

Run No.	Limits	Compliance	Achieved	Run Length
1	95% Compliance	95%	99.3%	35.4 m
	100% Compliance	100%	100%	
2	95% Compliance	95%	98.7%	35.4 m
	100% Compliance	100%	100%	

The lower section of the summary sheet shows:

Run number.
Property II compliance percentage achieved
Run length.

The results in the table are colour coded:

For each run, if the minimum required compliance percentage is achieved, the result is displayed in green text.
If the minimum required compliance percentage is not achieved the result is displayed in red text.

Property IV

From the level readings taken at the intersection points of the 3.0m grid, the difference in elevation between adjacent points can then be calculated. Any differences in elevation exceeding the permitted limits in table 4.2 or table 4.4 dependent on classification are highlighted, and the total percentage number of errors is calculated to check compliance with the Property IV classification.

Example, FM2-Special (TR34 2003), Property IV

Property IV	Ref		A		B		C		D		E
			0m		3m		6m		9m		12m
Level Reading	1	0m	1630.0	5.7	24.3	-3.9	28.2	1.9	26.3	-3.6	29.9
Diff. In Elev.			4.1		-10.6		0.1		-6.7		-0.6
	2	3m	25.9	-9.0	34.9	6.8	28.1	-4.9	33.0	2.5	30.5
			-5.3		4.3		1.4		4.6		7.4
	3	6m	31.2	0.6	30.6	3.9	26.7	-1.7	28.4	5.3	23.1
			2.5		-0.4		-8.4		-1.9		-6.5
	4	9m	28.7	-2.3	31.0	-4.1	35.1	4.8	30.3	0.7	29.6

	Indicates results between	6.5	and	10 mm
	Indicates results over	10	mm	
	Indicates construction joint			
UTS	Indicates Unable to Survey due to obstruction			
COL	Indicates a Column within 1.5m radius			
VOID	Indicates a Void area (not surveyed)			

Results

Lowest Elev. from datum =	-5.6	mm	+/-15	mm
Highest Elev. from datum =	6.4	mm	+/-15	mm
Greatest Diff. in Elev. over 3m =	10.6	mm	10.0	mm
% of Results over 6.5mm =	19.4	%	5.0	%
% of Results over 10mm =	3.2	%	0.0	%
Range (Max - Min) =	12.0	mm		
Datum =	1629.5			

Non Compliance

Where the required property limits are exceeded, it is recommended that individual measurements are examined in detail to determine the significance of any possible effect on the performance of a floor. Remedial actions will affect the appearance of the floor.

Further queries on these specifications or on any other floor flatness issue can be answered by calling Face Consultants Limited direct on:

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Copies of the 2013 edition of the Concrete Society's Technical Report No.34 (TR34) can be purchased through Face Consultants Ltd, or direct from the Concrete Society on:

TEL: (01276) 607140 FAX: (01276) 607141