FACE CONSULTANTS LTD
Global Flooring Consultants

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ASTM : E1155 M

American Society of Testing Materials (USA)

F Number Surveys

Further explanatory information

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F NUMBER SURVEYS

Method statement to survey a floor's surface regularity, in accordance with the 'American Society for Testing and Materials'

Equipment

F Speed Reader and Android Phone

Chalk

Long Tape Measure

Short Tape Measure

Method

The ASTM recommends that 2 basic properties of the floor's surface regularity should be checked:-

1. Flatness - FF
2. Levelness - FL

An FF and FL number will be specified for each local area and the overall area.

Example: Overall FF50/FL40, Local FF45/FL35.

A higher number indicates a better flatness or levelness.

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

The F Speed Reader is simply run down sections of the floor at walking speed and the F numbers for each of the test runs are generated by the F Speed reader software. The specification requires the minimum total length of the survey runs (L in metres) is greater than the Total floor Area (A) divided by 10.

Example: A floor area (A) or 'Test Section' 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. Placing equal numbers of lines of equal aggregate length both parallel to and perpendicular to the longest test section boundary.

Example: 3 x 15m runs parallel to longest boundary and 3 x 15m runs at right angles to longest boundary.

Organisation of Survey Area

1. Test Surface – On any one building level, the entire floor area constitutes the test surface.
2. Test Section – A test section consists of any sub division of the test surface.
3. No test section shall measure less than 2.4 metres on a side nor comprise an area less than 12 m^2.
4. No test section boundary shall cross a construction joint.

a) Divide the test surface into test sections. Give each test section an identification number and record location of all test section boundaries on the survey plan. See example 'Organisation of Survey Area' plan.

b) Determine the number, length and location of all sample measurement lines (survey runs) to be used in each test section.

No survey run should be less than 3.3 metres.

No part of any survey run shall be within 0.6 metres of any test section boundary, wall, penetration or similar discontinuity.

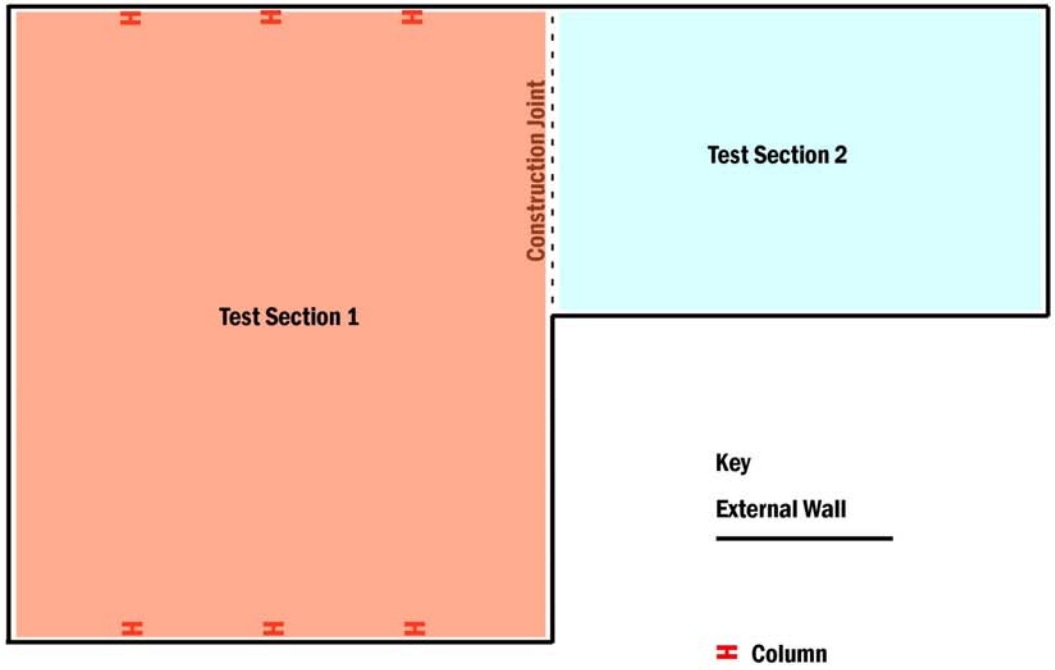
c) The area is set out by marking the start and stop positions of each survey run. This can be done from building features such as columns, construction joints, walls etc. Give each survey run a different identification number. See example 'Organisation of Survey Runs' plan. The start and stop positions of each survey run should be recorded on the survey plan.

Survey runs parallel with the longest test boundary should be of equal length to those at 90 degrees to the longest test boundary (alternatively lines may be orientated at 45 degrees to the longest boundary).

Example

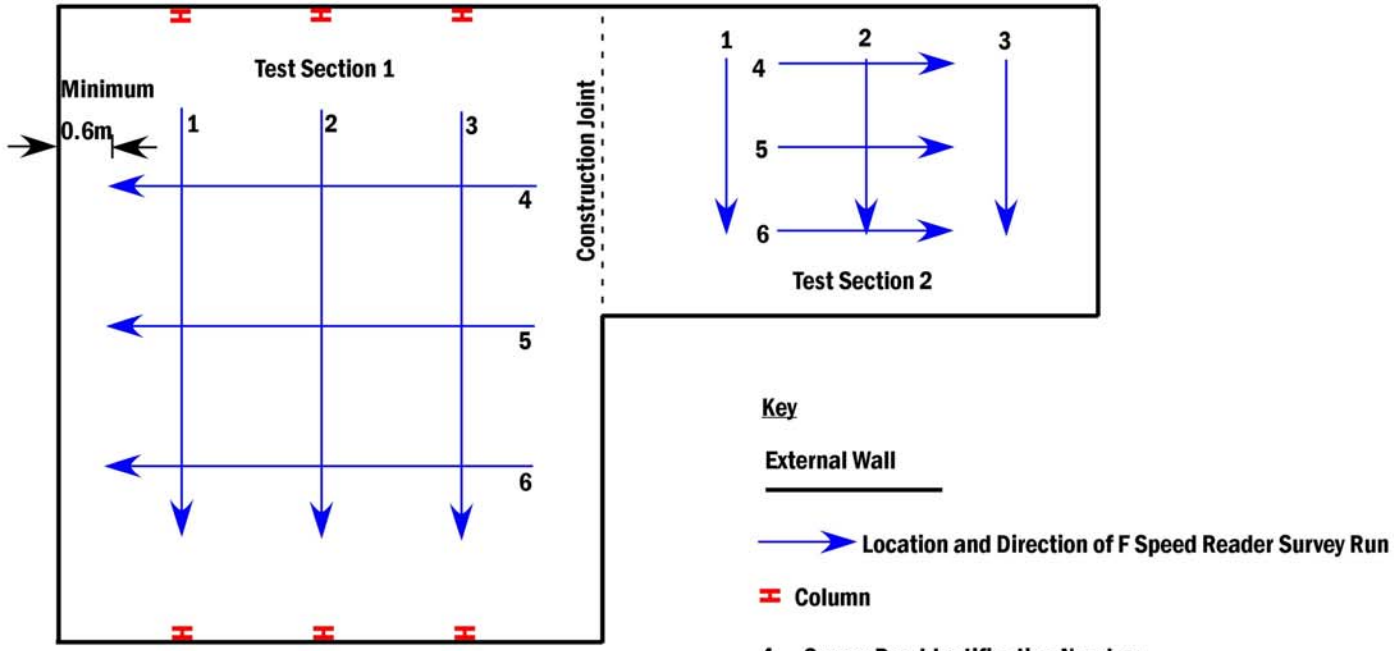
Organisation of Survey Area

Test Surface = Test Section 1 and Test Section 2



Example

Organisation of Survey Runs



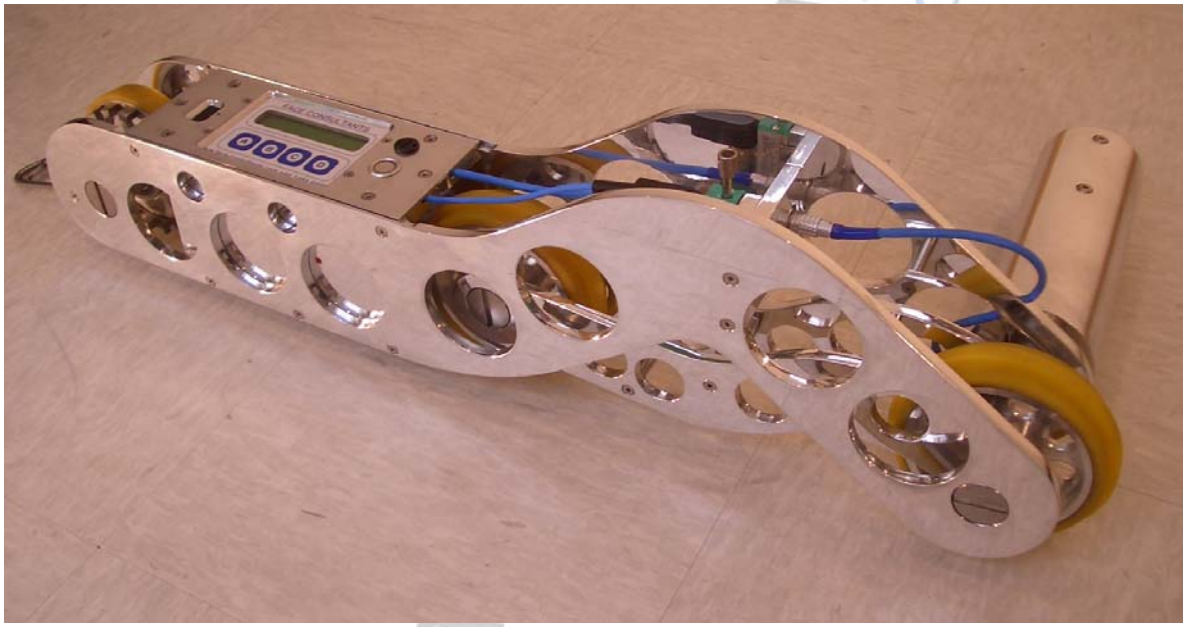
Note

In each test section survey runs 1,2,3 will be of equal total length to survey runs 4,5,6 in the same test section.

Survey Procedure

The F Speed Reader is simply walked along the floor between the start and stop points and the data collected digitally. At the end of a survey run the data is downloaded to a phone and then the next run can start. When the whole of the floor is surveyed the phone is then connected to a laptop or PC and all the survey data downloaded to the F Speed Reader program. At the touch of a button the data is analysed, the overall and local F numbers are calculated and a results table produced.

F Speed Reader



Results

On the page overleaf is an example of a summary sheet of results produced by the F Speed Reader.

The job details include: Job name, job number, location, survey date, surveyors initials, area tested (m^2) and specified tolerances (overall and local)

The surface results are then tabulated as follows

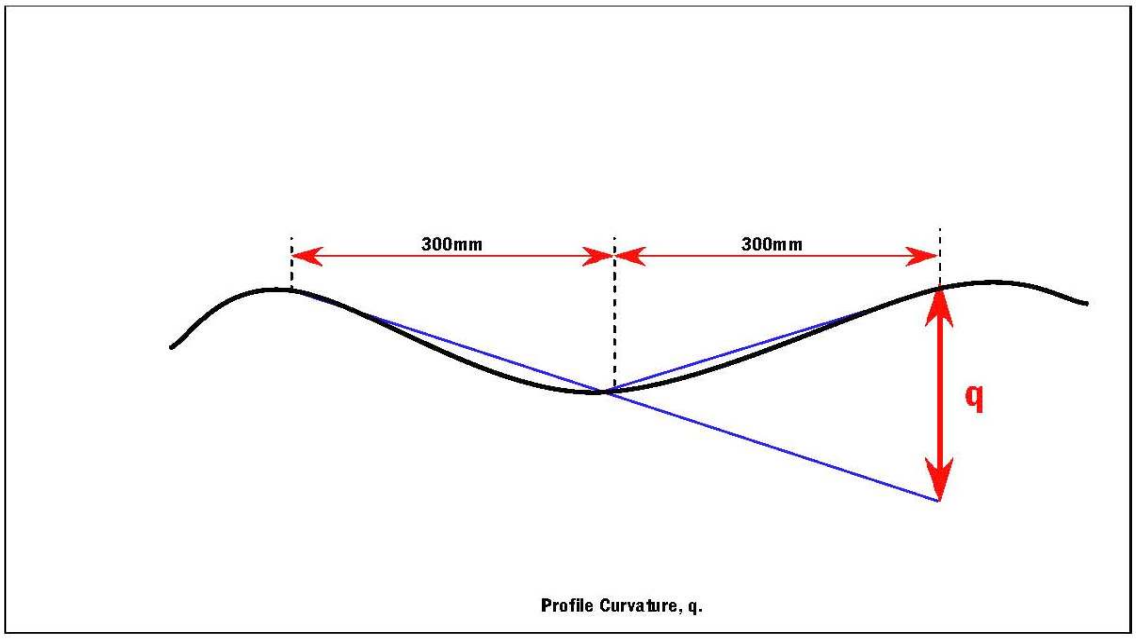
Overall FF and FL achieved

FF and FL by section

Each test section then has the survey runs listed with there individual FF and FL numbers.

Understanding F Numbers

F numbers is a statistical method for the evaluation of the surface regularity of a floor. Along each of the straight lines measured, a curvature profile is obtained, represented by the parameter, q, in millimetres - see below.



F-Numbers Report

Job Name:	Job Name
Job Number:	FC/XX/XXXX
Location:	Location
Date:	DD/MM/YYYY
Surveyor:	JD
Total Area:	900.0

Specified Tolerances	**FF**	**FL**
Overall	**30**	**30**
Minimum Local	**30**	**30**

Surface Results	**FF**	**FL**
Overall	**19.7**	**18.0**

Section	**Section Area**	**FF**	**FL**	**Combined Values**		
				Cumalative Area	**FF**	**FL**
Section1	**550**	18.9	17.2	550.0	18.9	17.2
Section2	**350**	21.1	19.5	900.0	19.7	18.0

Section 1

Minimum Local FF	30	Achieved FF =	**18.9**	[17.3 - 20.5]	
Minimum Local FL	30	Achieved FL =	**17.2**	[15.6 - 18.8]	

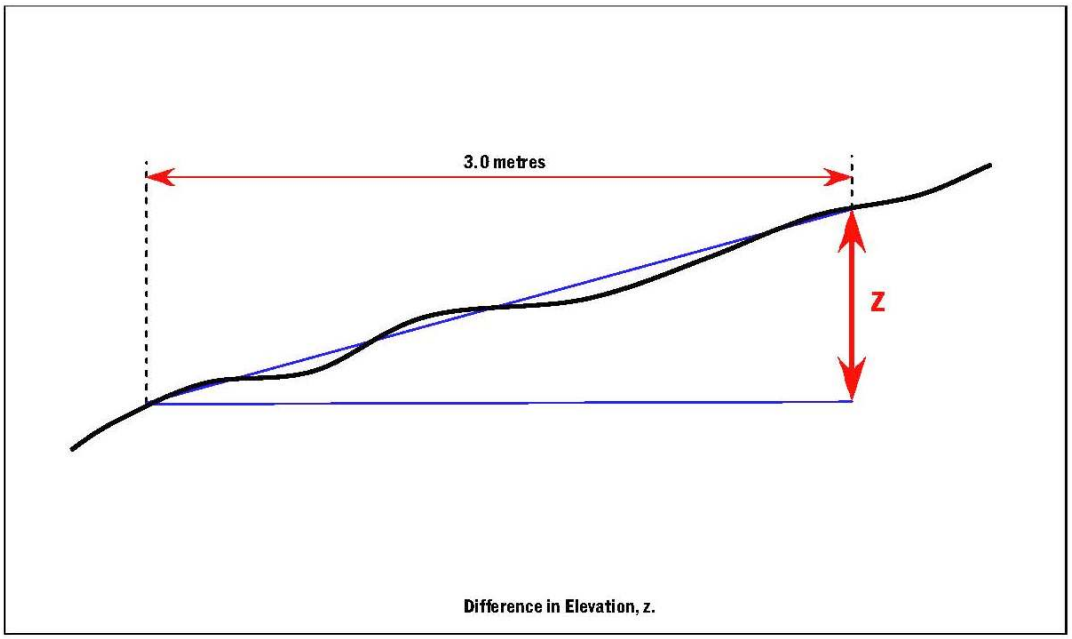
Run	**FF**		**FL**		**Length**	**Readings**
Run 1	20.3	[16.6 - 24.0]	19.8	[15.9 - 23.7]	14.4	48.0
Run 2	17.3	[14.1 - 20.4]	14.3	[11.5 - 17.1]	14.4	48.0
Run 3	18.2	[14.8 - 21.5]	19.4	[15.5 - 23.2]	14.4	48.0
Run 4	20.5	[16.7 - 24.2]	17.2	[13.8 - 20.7]	14.4	48.0

Section 2

Minimum Local FF	30	Achieved FF =	**21.1**	[19.0 - 23.2]	
Minimum Local FL	30	Achieved FL =	**19.5**	[17.1 - 21.8]	

Run	**FF**		**FL**		**Length**	**Readings**
Run 5	23.5	[17.4 - 29.6]	14.8	[10.3 - 19.4]	7.2	24.0
Run 6	20.7	[15.3 - 26.0]	18.7	[13.0 - 24.4]	7.2	24.0
Run 7	25.1	[18.6 - 31.5]	30.7	[21.3 - 40.0]	7.2	24.0
Run 8	16.3	[12.1 - 20.5]	28.3	[19.7 - 37.0]	7.2	24.0
Run 9	20.7	[15.4 - 26.1]	26.9	[18.7 - 35.1]	7.2	24.0
Run 10	24.7	[18.3 - 31.1]	14.5	[10.1 - 18.9]	7.2	24.0

In the same manner, the elevation between points separated by three meters are calculated, z in mm, as indicators of levelness – see below.



The average and standard deviation of the values q ($\bar{q}$ y S_q) and z ($\bar{z}$ y S_z) are then calculated and the F numbers of a measurement line are defined as:

$$F_F = \frac{115.84}{3s_q + |\bar{q}|}$$

$$F_L = \frac{314.67}{3s_z + |\bar{z}|}$$

In order to obtain the F numbers of a section having two or more measurement lines, a combined F number is calculated by using the following equation.

$$F_{j+k} = F_j \cdot F_k \sqrt{\frac{r_j + r_k}{r_k \cdot F_j^2 + r_j \cdot F_k^2}}$$

With r_j and r_k as the number of measurements obtained in lines j y k, and F_{j+k} the value of the combined F number of both lines.

By proceeding in an iterative manner with all the lines of a section, the F numbers of the section are obtained.

Finally, the F numbers of the surface are calculated by weight averaging the F numbers of the sections according to the corresponding area of each section.

The distribution of the lines should be chosen so that they are evenly arranged across the entire test section; lines may be orientated at 45 degrees however Face Consultants usually place the lines perpendicular and parallel to the longest boundary having an equal total length in each direction.

F number values usually vary between 10 and 100, a higher number indicates better flatness or levelness.

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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