Standard Test Method for

Determining F_F Floor Flatness and F_L Floor Levelness Numbers

Based on the
ASTM International Designation
E 1155 M - 96 (Reapproved 2001)

Excel Sheet Developed
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Alignment Engineering Group

Type I Flatness Raw Data

(height units = mm)

Test Sample j=0

Reading Points		Elevation
	Name	h_i
P_0		418.617
P_1		419.938
P_2		421.894
P_3		423.748
P_4		425.221
P_5		424.739
P_6		423.799
P_7		424.307
P_8		425.425
P_9		424.688
P_{10}		423.164
P_{11}		422.758
P_{12}		420.472
P_{13}		416.738
P_{14}		
P_{15}		
P_{16}		
P_{17}		
P_{18}		
P_{19}		

Test Sample j=1

Reading Points		Elevation
	Name	h_i
P_0		418.592
P_1		421.081
P_2		422.072
P_3		421.513
P_4		420.040
P_5		421.132
P_6		420.675
P_7		421.640
P_8		421.894
P_9		421.538
P_{10}		421.183
P_{11}		421.894
P_{12}		419.684
P_{13}		420.040
P_{14}		417.982
P_{15}		
P_{16}		
P_{17}		
P_{18}		
P_{19}		

Test Sample j=2

Reading Points		Elevation
	Name	h_i
P_0		418.338
P_1		419.659
P_2		419.227
P_3		419.227
P_4		418.668
P_5		418.186
P_6		418.973
P_7		419.379
P_8		420.141
P_9		419.532
P_{10}		418.643
P_{11}		418.719
P_{12}		416.763
P_{13}		414.782
P_{14}		
P_{15}		
P_{16}		
P_{17}		
P_{18}		
P_{19}		

Test Sample j=3

Reading Points		Elevation
	Name	h_i
P_0		418.617
P_1		418.973
P_2		419.100
P_3		420.878
P_4		419.989
P_5		419.227
P_6		419.684
P_7		420.751
P_8		420.065
P_9		421.259
P_{10}		421.386
P_{11}		418.846
P_{12}		419.887
P_{13}		418.363
P_{14}		
P_{15}		
P_{16}		
P_{17}		
P_{18}		
P_{19}		

Type I Raw Data Continued

(height units = mm)

Test Sample j=4

Reading Points		Elevation
	Name	h_i
P 0		418.846
P 1		418.135
P 2		418.998
P 3		419.405
P 4		420.294
P 5		420.370
P 6		421.640
P 7		421.259
P 8		422.910
P 9		423.926
P 10		424.053
P 11		423.164
P 12		422.732
P 13		422.834
P 14		421.513
P 15		
P 16		
P 17		
P 18		
P 19		

Test Sample j=5

Reading Points		Elevation
	Name	h_i
P 0		419.735
P 1		420.370
P 2		421.640
P 3		422.199
P 4		423.342
P 5		423.748
P 6		423.875
P 7		424.688
P 8		423.672
P 9		423.672
P 10		424.282
P 11		422.148
P 12		420.624
P 13		
P 14		
P 15		
P 16		
P 17		
P 18		
P 19		

Test Sample j=6

Reading Points		Elevation
	Name	h_i
P 0		
P 1		
P 2		
P 3		
P 4		
P 5		
P 6		
P 7		
P 8		
P 9		
P 10		
P 11		
P 12		
P 13		
P 14		
P 15		
P 16		
P 17		
P 18		
P 19		

Test Sample j=7

Reading Points		Elevation
	Name	h_i
P 0		
P 1		
P 2		
P 3		
P 4		
P 5		
P 6		
P 7		
P 8		
P 9		
P 10		
P 11		
P 12		
P 13		
P 14		
P 15		
P 16		
P 17		
P 18		
P 19		

Type I or II Flatness: Procedure and Calculations

(Height Units = mm)

Data Entry Field

Section 7 Tests: (See ASTM E 1155M for details)

Slab Dimensions							
Width (m)	3.36	*Pass 7.2.1*		Area (m^2):	20.53	*Pass 7.2.1*	
Length (m)	6.11	*Pass 7.2.1*					

Applicable Tests and Warnings			
Section	Comment		Calcs
7.3.1	*Make sure no sample line < 3.3 meters in length*		
7.3.2.2	*NO 600 mm edge restriction*	<= Area excluded (m^2) =>	15.21
7.3.3	*Make sure no sample lines closer than 1.2 meters to each other*		
7.4, 7.5	*Slab is large enough*	<= Max # points on longest diag =>	16
7.6	*Minimum number of zi values has been met*	<= (N_{min}): =>	10
7.7	*Construction joints are not presently accounted for*		

Section 8 Procedure and Tests: (See ASTM E 1155M for details)

8.1 Name of Subject Building

SPEAR3 Concrete Test Pad

Building Location

Behind Fort Apache on hill top

Installation Date of Subject Floor (MM/DD/YY)

04/04/03

Floors Specified F_f and F_l Values

Composite Values for Entire Floor		Minimum Values For Any Section	
F_f	30	F_f	15
F_l	20	F_l	10

Instrument Make, Model and Serial Number

K+E Site Level, PC14688, SN 71-1111 with K+E 40 Rod

Date of Test (MM/DD/YY)

05/05/03

Crew

Banuelos, Griffin, Gaudreault

Note 5: Ref. ACI 117-90 requires tolerances be check within 72 hours of concrete pour.

Section 8 Procedure and Tests: (continued)

8.2 Lay out the test surface.

8.2.1 Divide entire test surface into test sections. (i.e. divide large area into sub-areas)
Assign unique ID number to each test section and note locations

	ID Number	Location Details
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		

- - - if more rows are needed, continue entering values on the "Overall F-Numbers" TAB section - - -

8.2.2 Determine number and location of all sample measurement lines
Assign different number for each line in test area starting with j = 0
Record locations of all line starting and stopping points and mark on surface

8.2.3 *Test section width < 7.5 so orient sample lines 45° to longest const. joint*
Do NOT orient sample lines corner to corner

8.3 Collected Type I or Type II raw data ===> Type: I

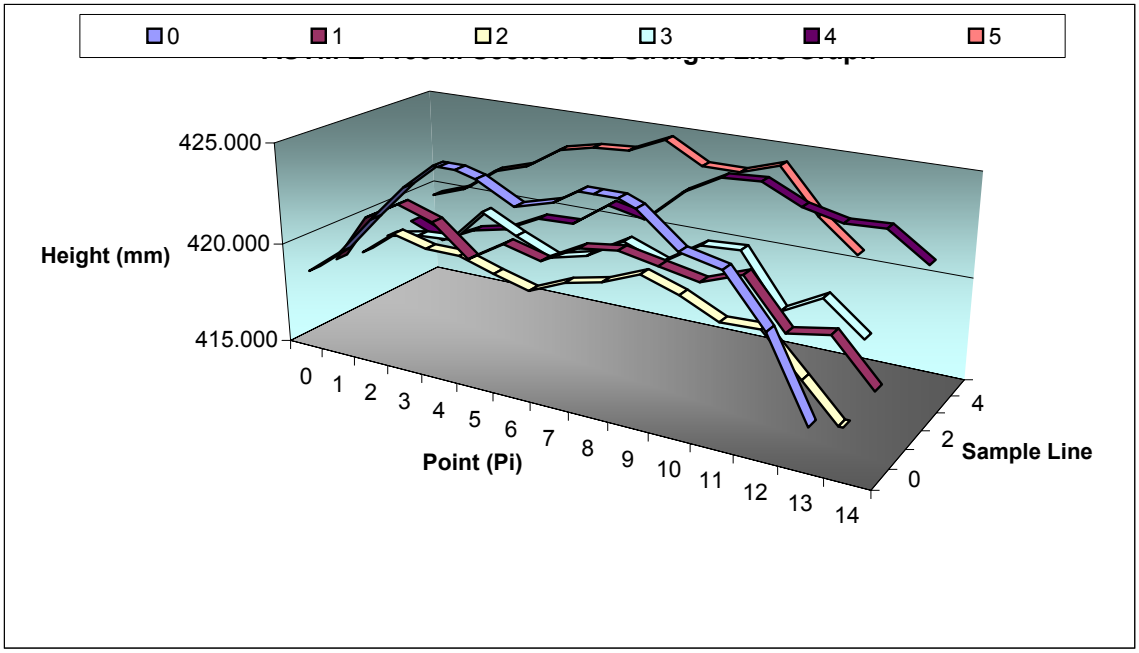
Type I: Instruments that measure point elevations (see 6.1.1)
Type II: Instruments that measure change in elevations (see 6.1.2)

8.3.1 Ensure each sample measurement line subdivided into 300 mm intervals
Starting point is designated as P_0 for each line

8.3.2 TYPE I Data Entered: Measure and record in sequence the elevations (mm) of all points

Section 9 Calculations: (See ASTM E 1155M for details)

9.2 The chart below is a subjective quality control check for gross anomalies
Check each profile to ensure it really represents the actual floor



9.4 For each test sample line j the **profile curvatures** are calculated

pos = *trough*
neg = *crest*

	0	1	2	3	4	5		
q2	0.635	-1.499	-1.753	-0.229	1.575	0.635		
q3	-0.102	-1.549	0.432	1.651	-0.457	-0.711		
q4	-0.381	-0.914	-0.559	-2.667	0.483	0.584		
q5	-1.956	2.565	0.076	0.127	-0.813	-0.737		
q6	-0.457	-1.549	1.270	1.219	1.194	-0.279		
q7	1.448	1.422	-0.381	0.610	-1.651	0.686		
q8	0.610	-0.711	0.356	-1.753	2.032	-1.829		
q9	-1.854	-0.610	-1.372	1.880	-0.635	1.016		
q10	-0.787	0.000	-0.279	-1.067	-0.889	0.610		
q11	1.118	1.067	0.965	-2.667	-1.016	-2.743		
q12	-1.880	-2.921	-2.032	3.581	0.457	0.610		
q13	-1.448	2.565	-0.025	-2.565	0.533			
q14		-2.413			-1.422			
q15								
q16								
q17								
q18								
q19								

Section 9 Calculations: (continued)

9.5 For each test sample line j the **elevation differences** z_i are calculated. Points are separated by 3 meters

Positive = *uphill* change in elevation Negative = *downhill* change in elevation

	0	1	2	3	4	5		
z10	4.547	2.591	0.305	2.769	5.207	4.547		
z11	2.819	0.813	-0.940	-0.127	5.029	1.778		
z12	-1.422	-2.388	-2.464	0.787	3.734	-1.016		
z13	-7.010	-1.473	-4.445	-2.515	3.429			
z14		-2.057			1.219			
z15								
z16								
z17								
z18								
z19								

9.6 For each test sample line j the mean $\underline{q}_{ij}$ is calculated (from section 9.4)

9.7 For each test sample line j the standard deviation $S_{q\,j}$ is calculated (from section 9.4)

	0	1	2	3	4	5		
$\underline{q}_{ij\ (mm)}$	-0.421	-0.350	-0.275	-0.157	-0.047	-0.196		
$S_{q\,j\ (mm^2)}$	1.201	1.776	1.026	2.039	1.175	1.207		

9.8 For each test sample line j the mean $\underline{z}_{ij}$ is calculated (from section 9.5)

9.9 For each test sample line j the standard deviation $S_{z\,j}$ is calculated (from section 9.5)

	0	1	2	3	4	5		
$\underline{z}_{ij\ (mm)}$	-0.267	-0.503	-1.886	0.229	3.724	1.770		
$S_{z\,j\ (mm^2)}$	5.148	2.134	2.048	2.192	1.602	2.781		

9.10 For each test sample line j the $F_{f\,j}$ Flatness Number is calculated (sec. 9.6 and 9.7)

	0	1	2	3	4	5		
$F_{F\,j}$	28.8	20.4	34.6	18.5	32.4	30.4		
r	12	13	12	12	13	11		

9.11 Calculation of the COMPOSITE F_F Flatness Number estimate

Based upon 73 readings of 600 mm profile curvatures, the test section has an estimated Flatness *F*-Number of =====> F_F 25.2

Section 9 Calculations: (continued)

9.12 For each test sample line j the F_{Lj} Levelness Number is calculated (sec. 9.8 and 9.9)

	0	1	2	3	4	5		
F_{Lj}	20.0	45.6	39.2	46.2	36.9	31.1		
r	4	5	4	4	5	3		

9.13 Calculation of the COMPOSITE F_L Levelness Number estimate

Based upon 25 readings of 3 m elevation differences, the test section has an estimated Levelness *F*-Number of ====> F_L 32.5

9.14 Calculation of the 90% confidence intervals, $CI_{90\%}$

F_{Fj}	$CI_{90\%}$ ==>	14.6				
	F-Number 90% Confidence Interval ===>				21.5 to 28.8	

F_{Lj}	$CI_{90\%}$ ==>	25.3				
	F-Number 90% Confidence Interval ===>				24.3 to 40.8	

9.15 Enter all test section (sub-section) *area* and *F* values on "Overall F-Numbers" TAB page to compute the overall F_F *and* F_L Numbers for the entire test surface

Overall F_F ====>	
Overall F_L ====>	

Section 10 Report: (See ASTM E 1155M for details)

10.1 Summary of each test section results: (Namely 9.1, 9.3, 9.4 and 9.10 to 9.14)
To satisfy this condition, print all TAB pages in this report for this concrete test section and all TAB pages in every other sectional report

10.2 Final *F*-Numbers for this particular test section at 90% confidence

F_f 25.2 (21.5 - 28.8)

F_l 32.5 (24.3 - 40.8)

Section 10 Report: (continued)

10.3 Maximum q_i for each straight section (choose construction joints if applicable)

	0	1	2	3	4	5		
q_{max}	1.448	2.565	1.270	3.581	2.032	1.016		

10.4 Overall F-Number results for entire test surface

Warning: The values below may not include all test surfaces. See "Overall F-Numbers"

Overall F_F =>

Overall F_L =>

Sections 11 and 12 Precision and Bias Factors: (See ASTM E 1155M for details)

11.2 On very level floors the *F*-Numbers *could* be computed as functions of only the standard deviations if the sample size is large enough. For interest only all test sample lines are computed using this criteria in the following table:

11.3 99.73% of all q_i and z_i readings have absolute max q and z values less than of equal to:

DO NOT USE THESE VALUES ! !

	0	1	2	3	4	5		
F_F	32.1	21.7	37.6	18.9	32.8	32.0		
F_L	7.5	18.1	18.9	17.6	24.1	13.9		
q_{max} (mm)	3.605	5.330	3.078	6.119	3.527	3.622		
z_{max} (mm)	15.450	6.404	6.145	6.579	4.808	8.347		

12.1 The repeatability standard deviation for both F_F and F_L is less than 0.25

12.2 ASTM Test Method E 1155 has no bias by definition