SPEAR3 Concrete Test Pad

May 15, 2003

Alignment Engineering Group

History

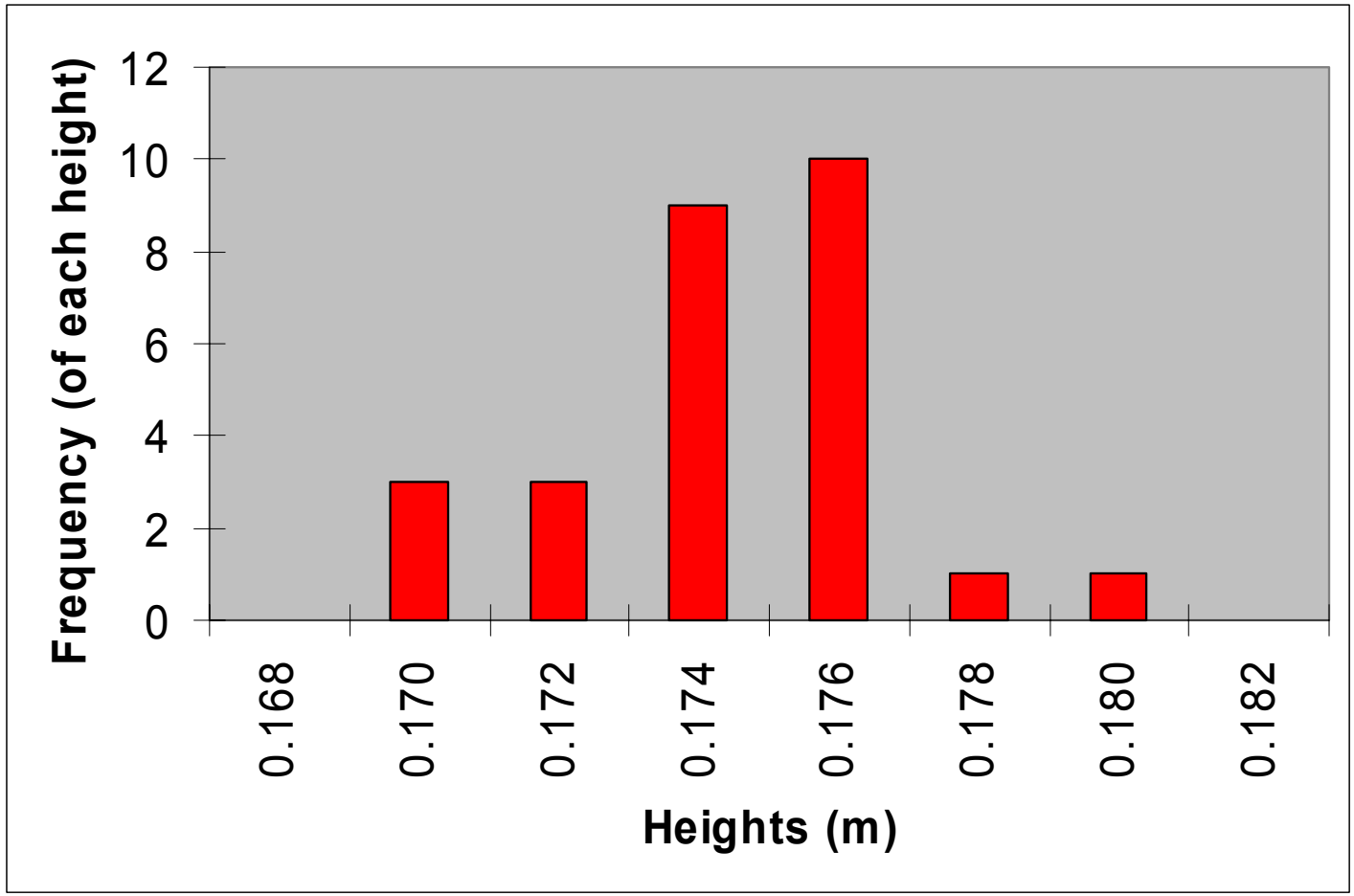
- April 4 — Concrete pour
- April 7 — Install 9 monuments
- April 8 — pad1am 16.5 deg
  pad1pm 22.9 - 23.1 deg
- April 9 — pad2am 11.6 - 14.9 deg
- April 15 — pad8am 7.2 - 8.8 deg
- April 22 — pad15am 11.5 - 13.3 deg
- April 28 — pad21am 15.2 - 17.7 deg
- May 5 — level data for F_f and F_l

First Measurements of Test Pad

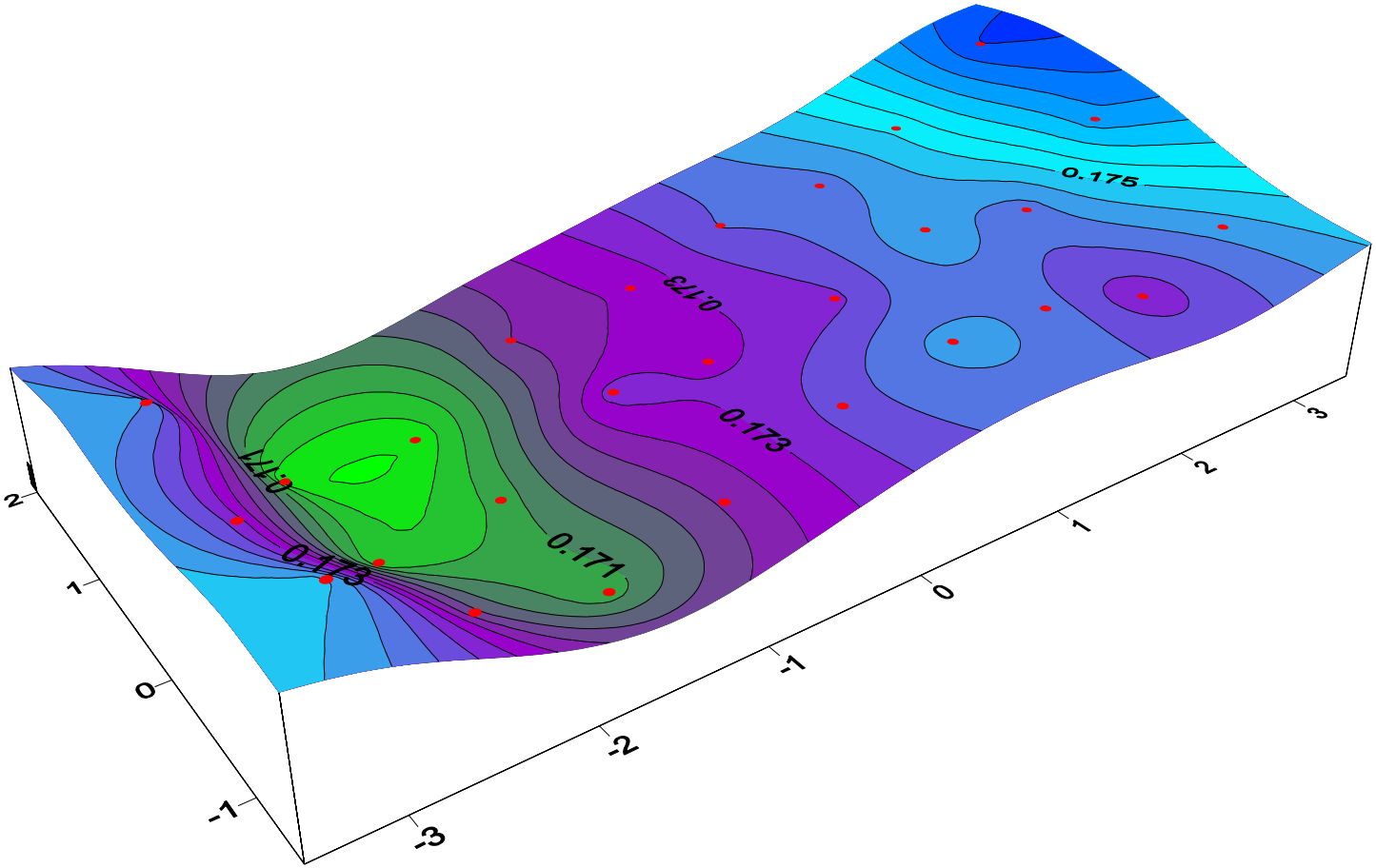
Flatness and Levelness Study

- 3 different methods using a reference point outside of the pad:
  - Sight level survey
  - Total station survey
  - ASTM E 1155 M standard
- 2 different outputs:
  - Histogram of height distribution
  - Surface plots

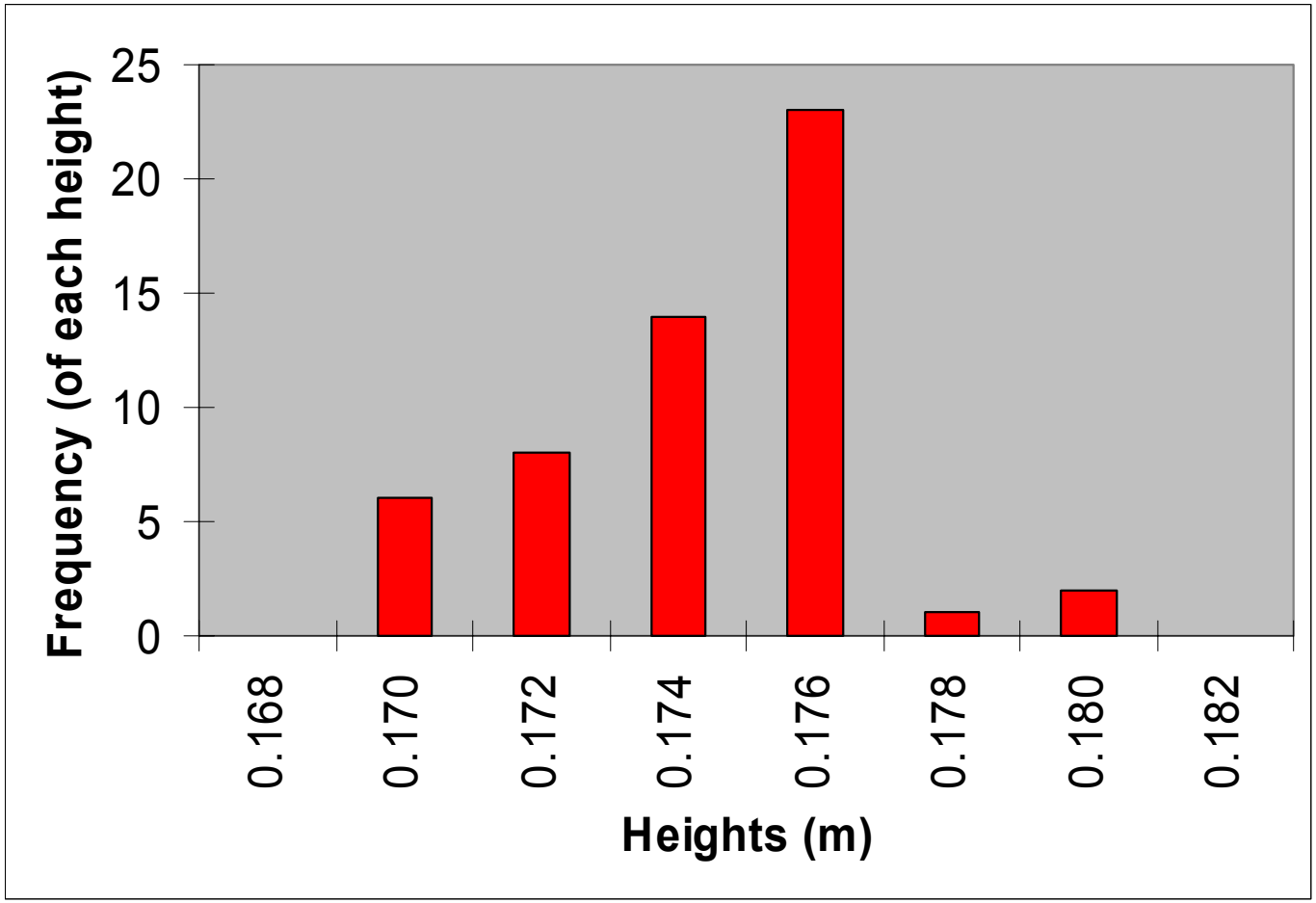
Optical Level Histogram of Observations



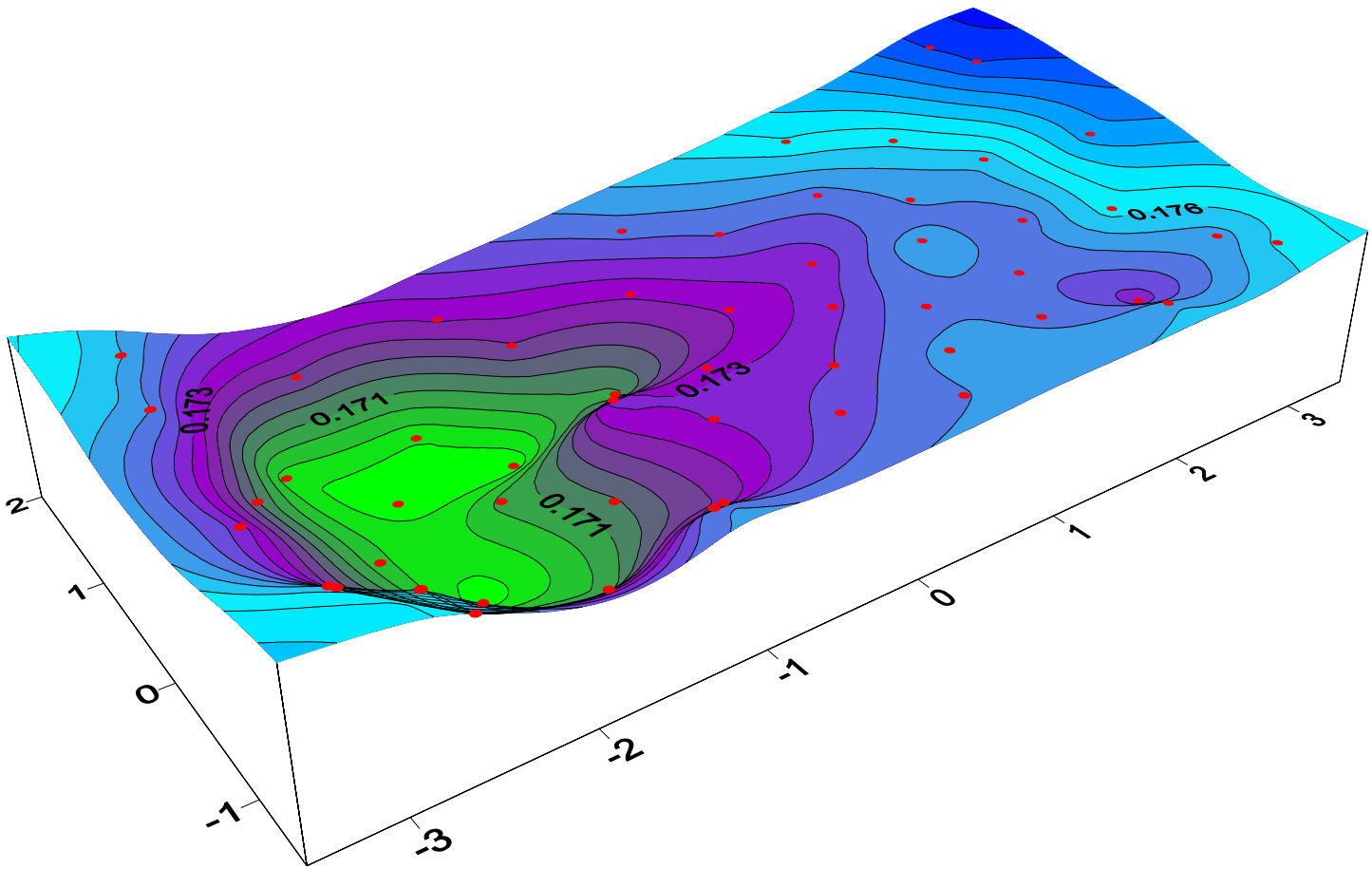
Optical Level Surface Plot in Meters



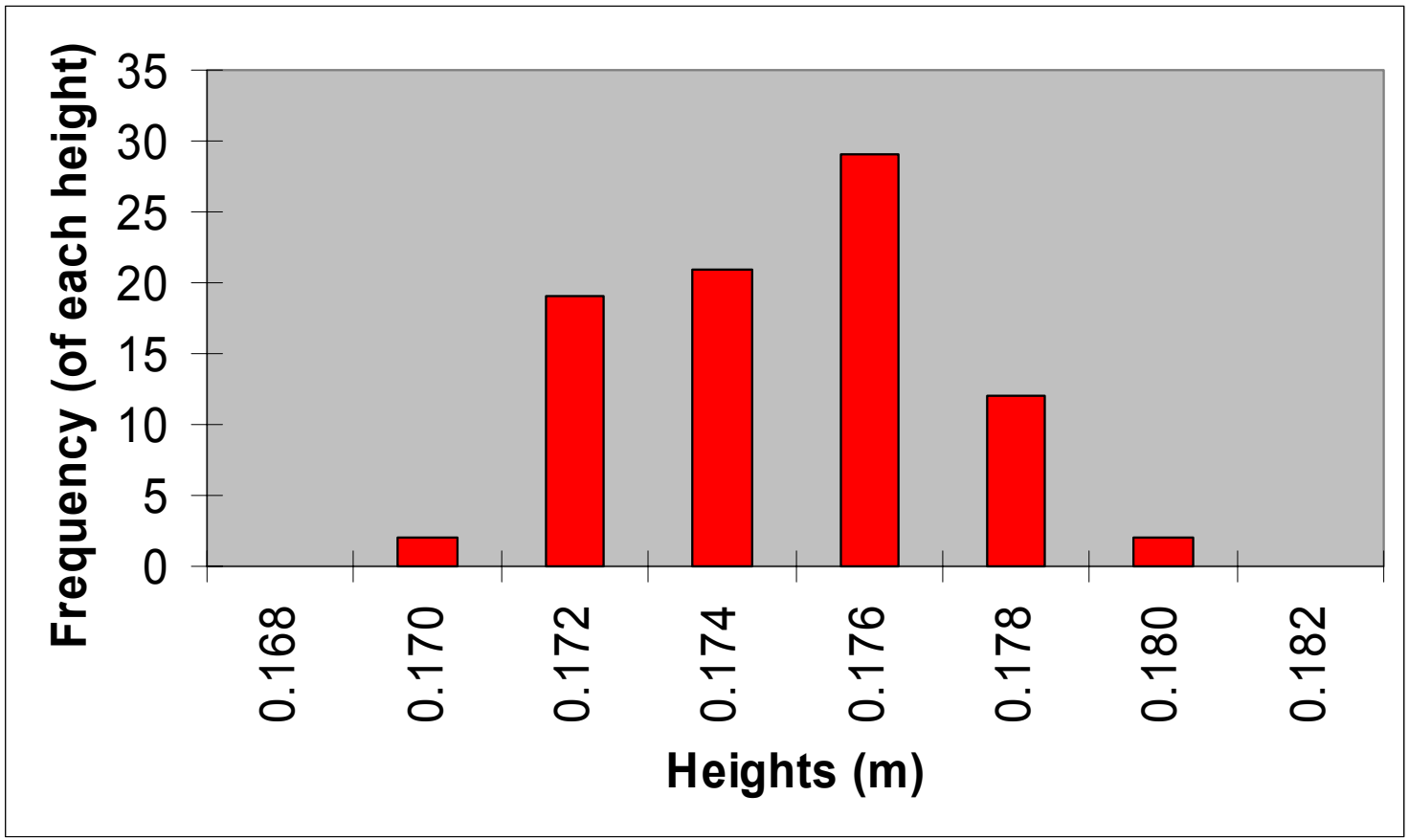
TC2002 Observation Histogram



TC2002 Surface Plot in Meters



ASTM Observation Histogram



Layout for ASTM Flatness and Levelness Testing

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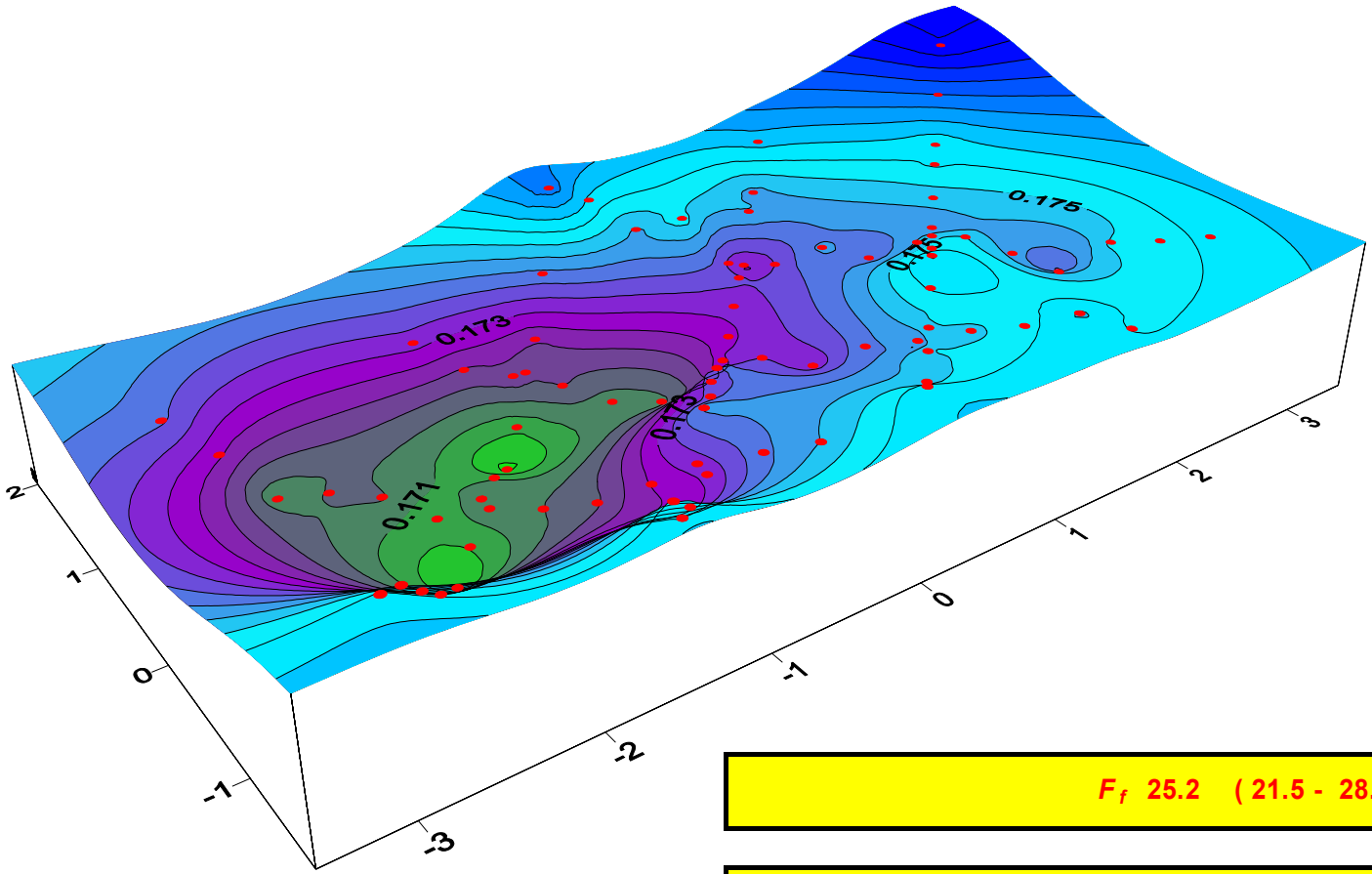
ASTM Surface Plot in Meters



click below to see report

ASTM Report

results

F_f 25.2 (21.5 - 28.8)

F_l 32.5 (24.3 - 40.8)

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Deformation Study

- 1 common observation plan:
  - 2 total station set-ups -> 18 triplets
    - Distance accurate to 100µm
    - Horizontal angle accurate to 40µm / D
    - Vertical angle accurate to 60µm / D
  - 16 height differences with 30µm standard deviation
- 1 common datum:
  - 1 fixed point: CEN
  - 1 fixed orientation: CEN->NE1

Pad1AM

• SW1	-2.403398	-0.934021	0.144994
• SW2	-1.225789	-0.419625	0.142751
• NW2	-1.457000	0.897089	0.139859
• NW1	-2.597059	1.338028	0.142145
• CEN	0.000000	0.000000	0.145148
• SE2	1.595192	-0.412381	0.145990
• NE2	1.588077	0.796422	0.145201
• NE1	2.582889	1.489047	0.148186
• SE1	2.727886	-0.950134	0.147144

Pad1PM

• SW1	-2.403659	-0.933931	0.144966
• SW2	-1.225937	-0.419536	0.142773
• NW2	-1.457220	0.897213	0.139880
• NW1	-2.597298	1.338135	0.142108
• CEN	0.000000	0.000000	0.145148
• SE2	1.595010	-0.412398	0.146008
• NE2	1.587940	0.796480	0.145229
• NE1	2.582964	1.489090	0.148153
• SE1	2.727810	-0.950244	0.147105

Pad2AM

• SW1	-2.403445	-0.933962	0.145006
• SW2	-1.225822	-0.419569	0.142755
• NW2	-1.457051	0.897101	0.139864
• NW1	-2.597137	1.337979	0.142149
• CEN	0.000000	0.000000	0.145148
• SE2	1.595032	-0.412361	0.145987
• NE2	1.588035	0.796401	0.145207
• NE1	2.582890	1.489048	0.148185
• SE1	2.727793	-0.950133	0.147143

Pad8AM

• SW1	-2.403338	-0.933898	0.144988
• SW2	-1.225743	-0.419534	0.142754
• NW2	-1.457065	0.897044	0.139870
• NW1	-2.597028	1.337896	0.142150
• CEN	0.000000	0.000000	0.145148
• SE2	1.594900	-0.412367	0.145992
• NE2	1.587818	0.796348	0.145210
• NE1	2.582646	1.488907	0.148196
• SE1	2.727510	-0.950153	0.147141

Pad15AM

• SW1	-2.403363	-0.933998	0.144988
• SW2	-1.225786	-0.419532	0.142751
• NW2	-1.456986	0.897005	0.139867
• NW1	-2.597048	1.337864	0.142146
• CEN	0.000000	0.000000	0.145148
• SE2	1.594904	-0.412376	0.145993
• NE2	1.587851	0.796364	0.145220
• NE1	2.582680	1.488926	0.148201
• SE1	2.727554	-0.950121	0.147143

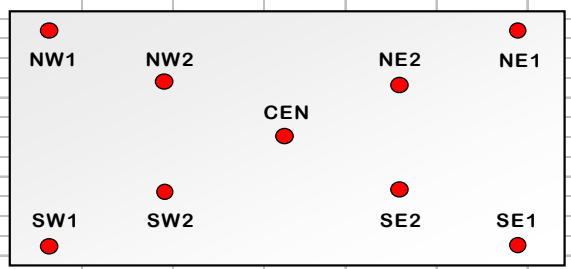
Pad21AM

• SW1	-2.403234	-0.934011	0.144990
• SW2	-1.225683	-0.419572	0.142752
• NW2	-1.456965	0.897032	0.139864
• NW1	-2.596905	1.337885	0.142136
• CEN	0.000000	0.000000	0.145148
• SE2	1.594903	-0.412336	0.146000
• NE2	1.587891	0.796321	0.145211
• NE1	2.582756	1.488970	0.148193
• SE1	2.727401	-0.950189	0.147148

Pad2AM-Pad15AM

Surface Analysis of SPEAR Concrete Test Slab

Reference Coordinates (meters)				Current Coordinates (meters)			
Pt. Name	Easting	Northing	Height	Pt. Name	Easting	Northing	Height
SW1	-2.403445	-0.933962	0.145006	SW1	-2.403363	-0.933998	0.144988
SW2	-1.225822	-0.419569	0.142755	SW2	-1.225786	-0.419532	0.142751
NW2	-1.457051	0.897101	0.139864	NW2	-1.456986	0.897005	0.139867
NW1	-2.597137	1.337979	0.142149	NW1	-2.597048	1.337864	0.142146
CEN	0.000000	0.000000	0.145148	CEN	0.000000	0.000000	0.145148
SE2	1.595032	-0.412361	0.145987	SE2	1.594904	-0.412376	0.145993
NE2	1.588035	0.796401	0.145207	NE2	1.587851	0.796364	0.145220
NE1	2.582890	1.489048	0.148185	NE1	2.582680	1.488926	0.148201
SE1	2.727793	-0.950133	0.147143	SE1	2.727554	-0.950121	0.147143
Date of Survey:			04/09/03	Date of Survey:			04/15/03



SE1_SW1	5.131264				SE1_SW1	5.130943		
Radial					**Radial**			
C_NW2	1.711086				C_NW2	1.710980		
C_NW1	2.921527				C_NW1	2.921395		
C_SE2	1.647474		5.79572		C_SE2	1.647353		5.795368
C_SE1	2.888531				C_SE1	2.888301		
C_SW2	1.295640				C_SW2	1.295594		
C_SW1	2.578533				C_SW1	2.578470		
C_NE2	1.776544		5.543873		C_NE2	1.776363		5.543572
C_NE1	2.981375				C_NE1	2.981132		

Deformations

Current minus Reference Distances (meters)

					PPM		
N-S							
SW1_NW1	-0.000079				-35		
SW2_NW2	-0.000136				-102		
SE2_NE2	-0.000022				-18		
SE1_NE1	-0.000135				-55		
E-W							
NE1_NW1	-0.000299				-58		
NE2_NW2	-0.000251				-82		
SE2_SW2	-0.000164				-58		
SE1_SW1	-0.000321				-63		
Radial							
C_NW2	-0.000106				-62		
C_NW1	-0.000132				-45		
C_SE2	-0.000120		-0.000351		-73	-61	
C_SE1	-0.000230				-80		
C_SW2	-0.000046				-36		
C_SW1	-0.000063				-25		
C_NE2	-0.000181		-0.000300		-102	-54	
C_NE1	-0.000243				-81		*5/15/2003*

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Conclusion

- The 3 levelness studies are consistent (surface plots and histogram distribution similar). But the best method should be the ASTM standard. This is the only consistent standard method to get the flatness and levelness numbers.
- The deformation study shows a change in distance of about 60ppm during the time frame. The limitations in this study are:
  - no way to get similar temperature and sun exposure from one survey to another. Differential heating effect on concrete due to sun exposure.
  - Started too late: more than 3 days after the pour. American Concrete Institute requires tolerances be checked with 72 hours of pour.
  - The survey methodology (only 2 set-ups and no scale bar) was made for larger deformations than measured. The maximum major axis of the 1-sigma a-posteriori error ellipse for the common survey treated as free datum is 60 microns.