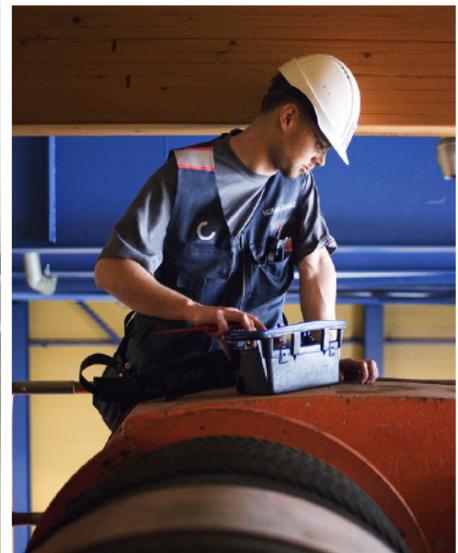


USMC - Blount Island - Building 350 --- Bay 4 (Survey 4/26/2011)

KONECRANES RAIL Q

GEOMETRIC ANALYSIS - RUNWAY



GEOMETRIC ANALYSIS - RUNWAY

Measured runway:	USMC - Blount Island - Building 350 --- Bay 4
Type:	
Length:	813.6 ft
Span:	68'-0"
Year of installation:	1981
Date of earlier measurement:	3/17/2011 12:00:00 AM
Date of inspection:	4/26/2011 12:00:00 AM

1 GENERAL

The condition of the runway strongly influences how well a crane moves on its rails, and also affects the usability and lifetime of the travelling machinery units. The CRS Runway Analysis checks that the permitted geometrical tolerances are met, by measuring them and by visually inspecting the rails and their fixings. The method and measuring devices of the CRS Runway Analysis and Konecranes' requirements for the analysis are described in detail in the corresponding CRS instructions.

A visual and optical inspection was conducted on the crane runway. The measured section was 812.8 ft in length, which is approximately 100% of the length of the whole runway. The distances between the measuring points were about 117 in. The measured values were compared to tolerances defined in CMAA Specification 70, Table 1.4.2 - 1.

The inspection was made by: Robert Pate

Description:

The runway rail type is '40 lb/yard ASCE rail'. The rails inspected were 1 (East Rail) and 2 (West Rail), as shown in Fig. 1.

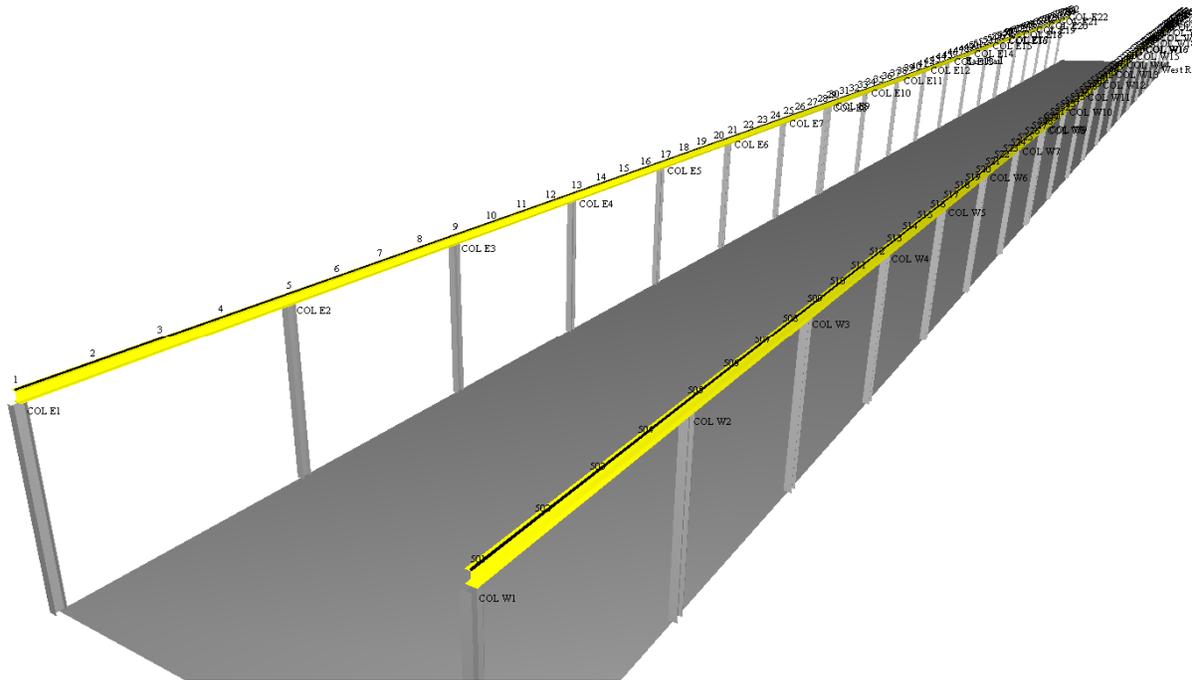


Fig. 1. Geometry of the runway and the measuring points.

Locations of the runway columns:

Rail 1 (East Rail)	Rail 2 (West Rail)
Rail 1 under the measure point 1 (COL E1)	Rail 2 under the measure point 501 (COL W1)
Rail 1 under the measure point 5 (COL E2)	Rail 2 under the measure point 505 (COL W2)
Rail 1 under the measure point 9 (COL E3)	Rail 2 under the measure point 509 (COL W3)
Rail 1 under the measure point 13 (COL E4)	Rail 2 under the measure point 513 (COL W4)
Rail 1 under the measure point 17 (COL E5)	Rail 2 under the measure point 517 (COL W5)
Rail 1 under the measure point 21 (COL E6)	Rail 2 under the measure point 521 (COL W6)
Rail 1 under the measure point 25 (COL E7)	Rail 2 under the measure point 525 (COL W7)
Rail 1 under the measure point 29 (COL E8)	Rail 2 under the measure point 529 (COL W8)
Rail 1 under the measure point 30 (COL E9)	Rail 2 under the measure point 530 (COL W9)
Rail 1 under the measure point 34 (COL E10)	Rail 2 under the measure point 534 (COL W10)
Rail 1 under the measure point 38 (COL E11)	Rail 2 under the measure point 538 (COL W11)
Rail 1 under the measure point 42 (COL E12)	Rail 2 under the measure point 542 (COL W12)
Rail 1 under the measure point 46 (COL E13)	Rail 2 under the measure point 546 (COL W13)
Rail 1 under the measure point 50 (COL E14)	Rail 2 under the measure point 550 (COL W14)
Rail 1 under the measure point 54 (COL E15)	Rail 2 under the measure point 554 (COL W15)
Rail 1 under the measure point 58 (COL E16)	Rail 2 under the measure point 558 (COL W16)
Rail 1 under the measure point 59 (COL E17)	Rail 2 under the measure point 559 (COL W17)
Rail 1 under the measure point 63 (COL E18)	Rail 2 under the measure point 563 (COL W18)
Rail 1 under the measure point 67 (COL E19)	Rail 2 under the measure point 567 (COL W19)
Rail 1 under the measure point 71 (COL E20)	Rail 2 under the measure point 571 (COL W20)
Rail 1 under the measure point 75 (COL E21)	Rail 2 under the measure point 575 (COL W21)
Rail 1 under the measure point 79 (COL E22)	Rail 2 under the measure point 579 (COL W22)
	Rail 2 under the measure point 583 (COL W23)

2 RESULTS

2.1 Geometry

Geometry of the runway is calculated by using the measuring points. Geometry is analysed and the runway span, straightness, elevation and rail to rail elevation are compared to the allowed values.

2.1.1 Span

Span difference values are given in Table 1. According to the selected standard it is required that the measured runway span compared to the nominal span (816.00 in) does not differ more than ± 0.250 in.

The maximum allowed span deviation (± 0.250 in) is exceeded in 24 of the measured points. The biggest measured span deviation is 0.96 in at the measure point 30 on the rail 1. This is 0.71 in outside the allowed tolerance.

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Table 1 Span difference values (from the measure points on rail 1)

Measure Point	Name of the Support	Measured Span	Difference to nominal span	Outside Tolerance
1	COL E1	816.60 in	0.60 in	0.35 in
2		815.98 in	-0.02 in	0 in
3		816.21 in	0.21 in	0 in
4		815.94 in	-0.06 in	0 in
5	COL E2	815.76 in	-0.24 in	0 in
6		815.83 in	-0.17 in	0 in
7		815.86 in	-0.14 in	0 in
8		816.06 in	0.06 in	0 in
9	COL E3	815.65 in	-0.35 in	-0.10 in
10		815.53 in	-0.47 in	-0.22 in
11		815.45 in	-0.55 in	-0.30 in
12		815.68 in	-0.32 in	-0.06 in
13	COL E4	815.86 in	-0.14 in	0 in
14		815.85 in	-0.15 in	0 in
15		815.95 in	-0.05 in	0 in
16		816.15 in	0.15 in	0 in
17	COL E5	816.08 in	0.08 in	0 in
18		816.34 in	0.34 in	0.08 in
19		816.20 in	0.20 in	0 in
20		815.82 in	-0.18 in	0 in
21	COL E6	815.91 in	-0.09 in	0 in
22		815.74 in	-0.26 in	-0.01 in
23		816.20 in	0.20 in	0 in
24		815.86 in	-0.14 in	0 in
25	COL E7	816.02 in	0.02 in	0 in
26		816.35 in	0.35 in	0.10 in
27		816.61 in	0.61 in	0.36 in
28		816.34 in	0.34 in	0.08 in
29	COL E8	816.91 in	0.91 in	0.66 in
30	COL E9	816.96 in	0.96 in	0.71 in
31		816.38 in	0.38 in	0.13 in
32		815.72 in	-0.28 in	-0.03 in
33		815.74 in	-0.26 in	-0.01 in
34	COL E10	815.81 in	-0.19 in	0 in
35		815.97 in	-0.03 in	0 in
36		816.54 in	0.54 in	0.29 in
37		816.37 in	0.37 in	0.12 in
38	COL E11	816.51 in	0.51 in	0.25 in
39		816.17 in	0.17 in	0 in
40		816.39 in	0.39 in	0.14 in
41		816.17 in	0.17 in	0 in
42	COL E12	816.37 in	0.37 in	0.12 in
43		816.02 in	0.02 in	0 in
44		816.21 in	0.21 in	0 in
45		815.91 in	-0.09 in	0 in
46	COL E13	816.05 in	0.05 in	0 in

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47		815.95 in	-0.05 in	0 in
48		815.78 in	-0.22 in	0 in
49		815.70 in	-0.30 in	-0.04 in
50	COL E14	815.80 in	-0.20 in	0 in
51		815.98 in	-0.02 in	0 in
52		816.11 in	0.11 in	0 in
53		815.86 in	-0.14 in	0 in
54	COL E15	815.79 in	-0.21 in	0 in
55		815.73 in	-0.27 in	-0.01 in
56		815.89 in	-0.11 in	0 in
57		815.82 in	-0.18 in	0 in
58	COL E16	815.84 in	-0.16 in	0 in
59	COL E17	815.87 in	-0.13 in	0 in
60		816.00 in	0.00 in	0 in
61		815.91 in	-0.09 in	0 in
62		816.17 in	0.17 in	0 in
63	COL E18	816.00 in	0.00 in	0 in
64		815.90 in	-0.10 in	0 in
65		815.92 in	-0.08 in	0 in
66		815.90 in	-0.10 in	0 in
67	COL E19	816.14 in	0.14 in	0 in
68		816.21 in	0.21 in	0 in
69		816.06 in	0.06 in	0 in
70		816.08 in	0.08 in	0 in
71	COL E20	816.09 in	0.09 in	0 in
72		815.88 in	-0.12 in	0 in
73		816.22 in	0.22 in	0 in
74		816.20 in	0.20 in	0 in
75	COL E21	815.98 in	-0.02 in	0 in
76		815.91 in	-0.09 in	0 in
77		816.02 in	0.02 in	0 in
78		815.69 in	-0.31 in	-0.06 in
79	COL E22	816.08 in	0.08 in	0 in
80		816.30 in	0.30 in	0.05 in
81		816.18 in	0.18 in	0 in
82		816.19 in	0.19 in	0 in

2.1.2 Straightness

Straightness deviation is calculated by comparing the horizontal location of each measured point to the regression line of the runway rail. Straightness deviation values are given in Table 2 and Table 3. Maximum allowed deviation in straightness is ± 0.375 in according to the selected standard.

The maximum allowed straightness deviation (± 0.375 in) is exceeded in 78 of the measured points. The biggest measured straightness deviation is 1.00 in at the measure point 41 on the rail 1. This is 0.62 in outside the allowed tolerance.

Table 2 Straightness deviation values (rail 1)

Measure Point	Name of the Support	Horizontal deviation to the regression line	Outside tolerance
1	COL E1	-0.22 in	0 in
2		-0.66 in	-0.29 in
3		-0.51 in	-0.14 in
4		-0.58 in	-0.21 in
5	COL E2	-0.45 in	-0.08 in
6		-0.44 in	-0.07 in
7		-0.45 in	-0.08 in
8		-0.23 in	0 in
9	COL E3	-0.51 in	-0.13 in
10		-0.63 in	-0.26 in
11		-0.49 in	-0.12 in
12		-0.35 in	0 in
13	COL E4	-0.27 in	0 in
14		-0.25 in	0 in
15		-0.28 in	0 in
16		-0.08 in	0 in
17	COL E5	-0.33 in	0 in
18		0.06 in	0 in
19		0.08 in	0 in
20		-0.18 in	0 in
21	COL E6	-0.11 in	0 in
22		-0.41 in	-0.03 in
23		0.16 in	0 in
24		-0.24 in	0 in
25	COL E7	0.15 in	0 in
26		0.41 in	0.04 in
27		0.50 in	0.12 in
28		0.42 in	0.05 in
29	COL E8	0.50 in	0.13 in
30	COL E9	0.42 in	0.05 in
31		0.40 in	0.02 in
32		0.45 in	0.07 in
33		0.26 in	0 in
34	COL E10	0.48 in	0.11 in
35		0.62 in	0.24 in

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36		0.94 in	0.56 in
37		0.93 in	0.56 in
38	COL E11	0.92 in	0.54 in
39		0.79 in	0.41 in
40		0.86 in	0.49 in
41		1.00 in	0.62 in
42	COL E12	0.92 in	0.55 in
43		0.60 in	0.22 in
44		0.74 in	0.36 in
45		0.83 in	0.45 in
46	COL E13	0.87 in	0.49 in
47		0.68 in	0.31 in
48		0.35 in	0 in
49		0.24 in	0 in
50	COL E14	0.24 in	0 in
51		0.28 in	0 in
52		0.17 in	0 in
53		-0.08 in	0 in
54	COL E15	-0.07 in	0 in
55		-0.15 in	0 in
56		-0.24 in	0 in
57		-0.36 in	0 in
58	COL E16	-0.38 in	0.00 in
59	COL E17	-0.36 in	0 in
60		-0.44 in	-0.07 in
61		-0.54 in	-0.16 in
62		-0.55 in	-0.17 in
63	COL E18	-0.71 in	-0.33 in
64		-0.69 in	-0.32 in
65		-0.69 in	-0.31 in
66		-0.72 in	-0.34 in
67	COL E19	-0.52 in	-0.14 in
68		-0.45 in	-0.08 in
69		-0.39 in	-0.01 in
70		-0.19 in	0 in
71	COL E20	-0.22 in	0 in
72		-0.26 in	0 in
73		-0.02 in	0 in
74		0.12 in	0 in
75	COL E21	0.08 in	0 in
76		-0.01 in	0 in
77		-0.07 in	0 in
78		-0.28 in	0 in
79	COL E22	-0.15 in	0 in
80		-0.06 in	0 in
81		-0.15 in	0 in
82		-0.03 in	0 in

Table 3 Straightness deviation values (measure points on rail 2)

Measure Point	Name of the Support	Horizontal deviation to the regression line	Outside tolerance
501	COL W1	0.80 in	0.43 in
502		0.61 in	0.24 in
503		0.70 in	0.33 in
504		0.50 in	0.12 in
505	COL W2	0.18 in	0 in
506		0.25 in	0 in
507		0.29 in	0 in
508		0.27 in	0 in
509	COL W3	0.13 in	0 in
510		0.14 in	0 in
511		-0.09 in	0 in
512		0.01 in	0 in
513	COL W4	0.10 in	0 in
514		0.07 in	0 in
515		0.19 in	0 in
516		0.20 in	0 in
517	COL W5	0.38 in	0.00 in
518		0.25 in	0 in
519		0.10 in	0 in
520		-0.03 in	0 in
521	COL W6	-0.02 in	0 in
522		0.12 in	0 in
523		0.00 in	0 in
524		0.07 in	0 in
525	COL W7	-0.17 in	0 in
526		-0.10 in	0 in
527		0.07 in	0 in
528		-0.12 in	0 in
529	COL W8	0.39 in	0.02 in
530	COL W9	0.52 in	0.15 in
531		-0.06 in	0 in
532		-0.78 in	-0.40 in
533		-0.55 in	-0.18 in
534	COL W10	-0.71 in	-0.34 in
535		-0.69 in	-0.31 in
536		-0.43 in	-0.06 in
537		-0.60 in	-0.23 in
538	COL W11	-0.45 in	-0.08 in
539		-0.66 in	-0.29 in
540		-0.51 in	-0.13 in
541		-0.87 in	-0.50 in
542	COL W12	-0.59 in	-0.22 in
543		-0.63 in	-0.25 in
544		-0.56 in	-0.19 in
545		-0.97 in	-0.59 in

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546	COL W13	-0.86 in	-0.49 in
547		-0.78 in	-0.40 in
548		-0.62 in	-0.25 in
549		-0.58 in	-0.21 in
550	COL W14	-0.48 in	-0.10 in
551		-0.35 in	0 in
552		-0.10 in	0 in
553		-0.12 in	0 in
554	COL W15	-0.20 in	0 in
555		-0.18 in	0 in
556		0.07 in	0 in
557		0.16 in	0 in
558	COL W16	0.17 in	0 in
559	COL W17	0.18 in	0 in
560		0.39 in	0.01 in
561		0.39 in	0.02 in
562		0.66 in	0.29 in
563	COL W18	0.65 in	0.27 in
564		0.53 in	0.15 in
565		0.55 in	0.17 in
566		0.55 in	0.18 in
567	COL W19	0.60 in	0.23 in
568		0.60 in	0.23 in
569		0.39 in	0.02 in
570		0.21 in	0 in
571	COL W20	0.26 in	0 in
572		0.08 in	0 in
573		0.19 in	0 in
574		0.02 in	0 in
575	COL W21	-0.17 in	0 in
576		-0.15 in	0 in
577		0.03 in	0 in
578		-0.10 in	0 in
579	COL W22	0.16 in	0 in
580		0.29 in	0 in
581		0.26 in	0 in
582		0.14 in	0 in
583	COL W23	0.27 in	0 in
584		0.03 in	0 in
585		0.03 in	0 in
586		0.09 in	0 in

The chart below illustrates the straightness deviations of both rails along the measured runway. Note! Negative value indicates that the measured point locates too close to the other rail.

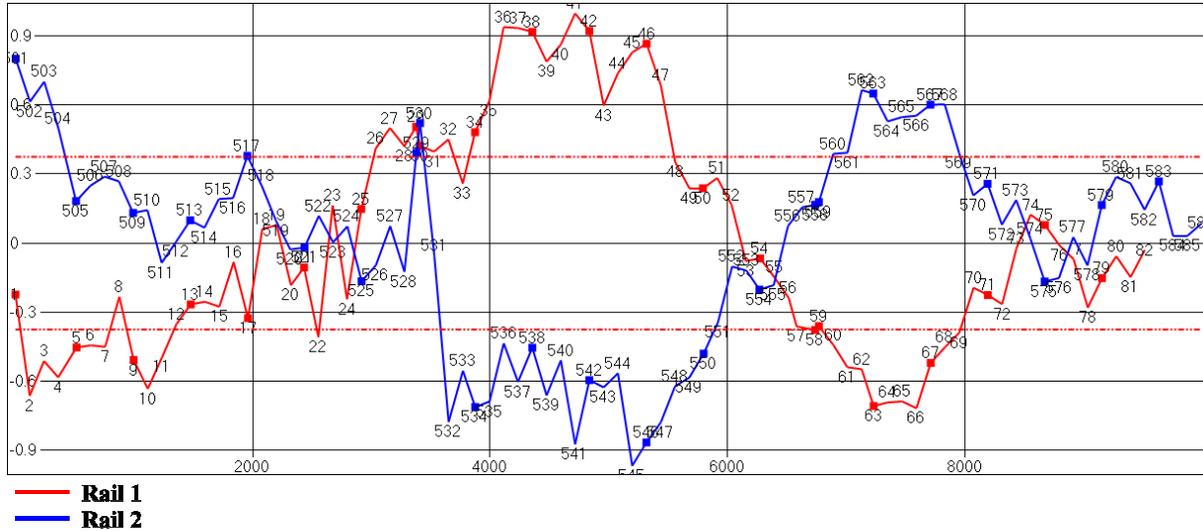


Chart 2 Measured straightness deviation values of the measure points.

Results of the straightness requirements are visualised in Fig. 3. Colors indicate, how good the runway is compared to the requirements of the selected standard (Green = close to optimal, Yellow/Orange = under the required tolerance, Red = permitted geometrical tolerances are NOT met).

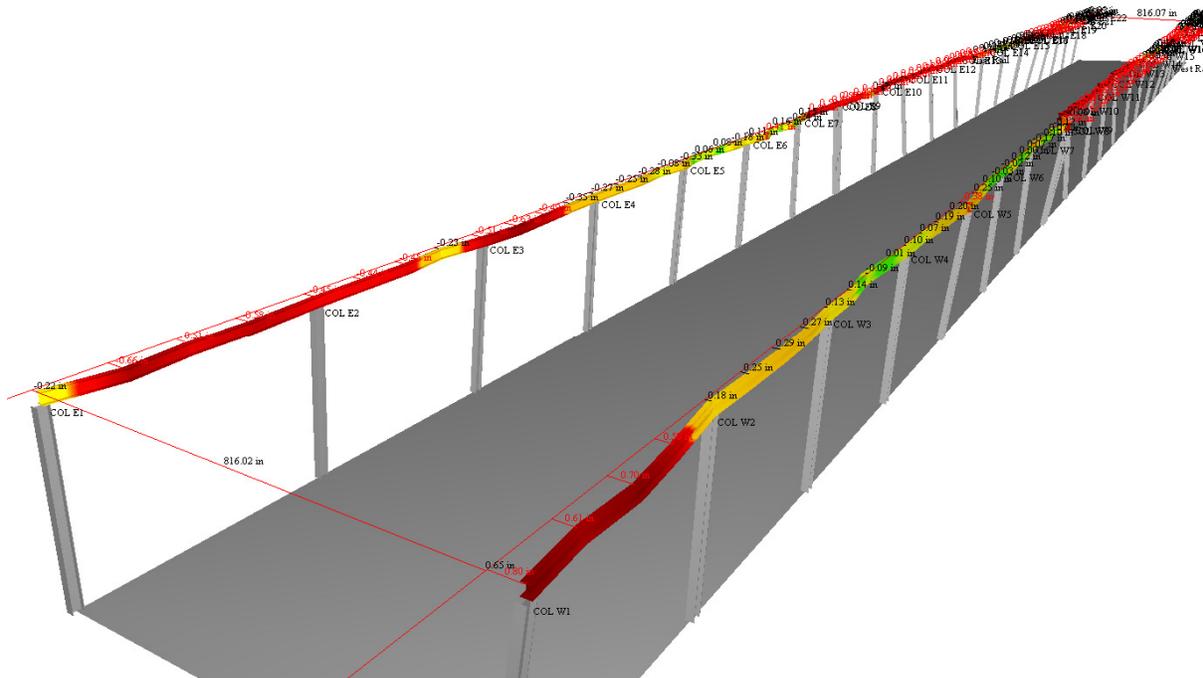


Fig. 3. Geometry of the runway. Horizontal errors to the regression lines are scaled to 60 times larger

2.1.3 Elevation

Elevation deviation is calculated by comparing the vertical location of each measured point to the regression line of the runway rail. Elevation deviation values are given in Tables 4 and 5. Maximum allowed deviation in elevation is ± 0.375 in according to the selected standard.

The maximum allowed elevation deviation (± 0.375 in) is exceeded in 159 of the measured points. The biggest measured elevation deviation is 3.52 in at the measure point 40 on the rail 1. This is 3.14 in outside the allowed tolerance.

Table 4 Elevation deviation values (rail 1)

Measure Point	Name of the Support	Vertical deviation to the regression line	Outside tolerance
1	COL E1	1.38 in	1.01 in
2		1.39 in	1.02 in
3		1.22 in	0.84 in
4		1.11 in	0.73 in
5	COL E2	0.88 in	0.50 in
6		0.61 in	0.24 in
7		0.47 in	0.10 in
8		0.23 in	0 in
9	COL E3	0.17 in	0 in
10		-0.15 in	0 in
11		-0.53 in	0.15 in
12		-0.72 in	0.34 in
13	COL E4	-0.86 in	0.48 in
14		-1.09 in	0.71 in
15		-1.16 in	0.78 in
16		-1.05 in	0.68 in
17	COL E5	-0.94 in	0.57 in
18		-1.14 in	0.76 in
19		-1.20 in	0.83 in
20		-1.26 in	0.89 in
21	COL E6	-1.53 in	1.16 in
22		-1.26 in	0.88 in
23		-1.22 in	0.84 in
24		-0.94 in	0.56 in
25	COL E7	-0.88 in	0.50 in
26		-0.79 in	0.42 in
27		-0.87 in	0.49 in
28		-1.14 in	0.76 in
29	COL E8	-1.37 in	1.00 in
30	COL E9	-1.45 in	1.08 in
31		-1.80 in	1.42 in
32		-2.00 in	1.63 in
33		-2.30 in	1.92 in
34	COL E10	-2.51 in	2.13 in
35		-2.65 in	2.27 in
36		-2.89 in	2.51 in

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37		-3.15 in	2.78 in
38	COL E11	-3.39 in	3.01 in
39		-3.50 in	3.13 in
40		-3.52 in	3.14 in
41		-3.41 in	3.04 in
42	COL E12	-3.13 in	2.75 in
43		-2.96 in	2.59 in
44		-2.73 in	2.36 in
45		-2.49 in	2.12 in
46	COL E13	-2.11 in	1.74 in
47		-1.65 in	1.28 in
48		-1.04 in	0.66 in
49		-0.41 in	0.04 in
50	COL E14	0.16 in	0 in
51		0.47 in	0.09 in
52		0.89 in	0.51 in
53		1.28 in	0.90 in
54	COL E15	1.73 in	1.36 in
55		2.00 in	1.63 in
56		2.24 in	1.87 in
57		2.35 in	1.97 in
58	COL E16	2.35 in	1.98 in
59	COL E17	2.39 in	2.01 in
60		2.49 in	2.12 in
61		2.53 in	2.16 in
62		2.45 in	2.07 in
63	COL E18	2.37 in	1.99 in
64		2.21 in	1.83 in
65		2.00 in	1.62 in
66		1.80 in	1.42 in
67	COL E19	1.57 in	1.19 in
68		1.39 in	1.01 in
69		1.33 in	0.95 in
70		1.28 in	0.91 in
71	COL E20	1.28 in	0.90 in
72		1.32 in	0.94 in
73		1.49 in	1.12 in
74		1.77 in	1.39 in
75	COL E21	2.11 in	1.74 in
76		2.04 in	1.66 in
77		2.07 in	1.70 in
78		2.22 in	1.84 in
79	COL E22	2.43 in	2.05 in
80		2.44 in	2.07 in
81		2.55 in	2.18 in
82		2.73 in	2.36 in

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Table 5 Elevation deviation values (measure points on rail 2)

Measure Point	Name of the Support	Vertical deviation to the regression line	Outside tolerance
501	COL W1	0.96 in	0.59 in
502		0.86 in	0.49 in
503		0.60 in	0.22 in
504		0.28 in	0 in
505	COL W2	-0.10 in	0 in
506		-0.26 in	0 in
507		-0.43 in	0.06 in
508		-0.46 in	0.08 in
509	COL W3	-0.41 in	0.03 in
510		-0.56 in	0.18 in
511		-0.79 in	0.42 in
512		-0.95 in	0.58 in
513	COL W4	-1.03 in	0.65 in
514		-1.03 in	0.65 in
515		-1.11 in	0.74 in
516		-1.17 in	0.79 in
517	COL W5	-1.15 in	0.78 in
518		-1.17 in	0.79 in
519		-1.26 in	0.88 in
520		-1.36 in	0.98 in
521	COL W6	-1.25 in	0.87 in
522		-1.34 in	0.97 in
523		-1.39 in	1.02 in
524		-1.46 in	1.09 in
525	COL W7	-1.64 in	1.26 in
526		-1.73 in	1.36 in
527		-1.90 in	1.52 in
528		-2.20 in	1.82 in
529	COL W8	-2.41 in	2.04 in
530	COL W9	-2.49 in	2.12 in
531		-2.45 in	2.08 in
532		-2.39 in	2.02 in
533		-2.38 in	2.00 in
534	COL W10	-2.49 in	2.11 in
535		-2.58 in	2.20 in
536		-2.75 in	2.38 in
537		-2.91 in	2.53 in
538	COL W11	-3.03 in	2.66 in
539		-3.13 in	2.76 in
540		-3.03 in	2.66 in
541		-2.96 in	2.59 in
542	COL W12	-2.77 in	2.40 in
543		-2.51 in	2.13 in
544		-2.27 in	1.89 in
545		-1.99 in	1.61 in
546	COL W13	-1.67 in	1.29 in

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547		-1.32 in	0.94 in
548		-0.88 in	0.50 in
549		-0.34 in	0 in
550	COL W14	0.28 in	0 in
551		0.68 in	0.30 in
552		1.07 in	0.70 in
553		1.47 in	1.09 in
554	COL W15	1.77 in	1.40 in
555		1.73 in	1.35 in
556		1.83 in	1.45 in
557		1.95 in	1.57 in
558	COL W16	2.19 in	1.81 in
559	COL W17	2.23 in	1.86 in
560		1.97 in	1.59 in
561		1.84 in	1.46 in
562		1.80 in	1.43 in
563	COL W18	1.91 in	1.54 in
564		1.95 in	1.58 in
565		1.78 in	1.40 in
566		1.56 in	1.19 in
567	COL W19	1.39 in	1.02 in
568		1.44 in	1.07 in
569		1.62 in	1.25 in
570		1.76 in	1.38 in
571	COL W20	1.98 in	1.61 in
572		2.06 in	1.68 in
573		2.02 in	1.65 in
574		1.97 in	1.59 in
575	COL W21	2.04 in	1.67 in
576		2.23 in	1.85 in
577		2.33 in	1.96 in
578		2.37 in	2.00 in
579	COL W22	2.36 in	1.98 in
580		2.36 in	1.99 in
581		2.49 in	2.12 in
582		2.62 in	2.24 in
583	COL W23	2.86 in	2.49 in
584		2.88 in	2.50 in
585		2.79 in	2.42 in
586		2.61 in	2.23 in

The chart below illustrates the elevation deviations of both rails along the measured runway. Note! Negative value indicates that the measured point locates lower than the regression line of the runway.

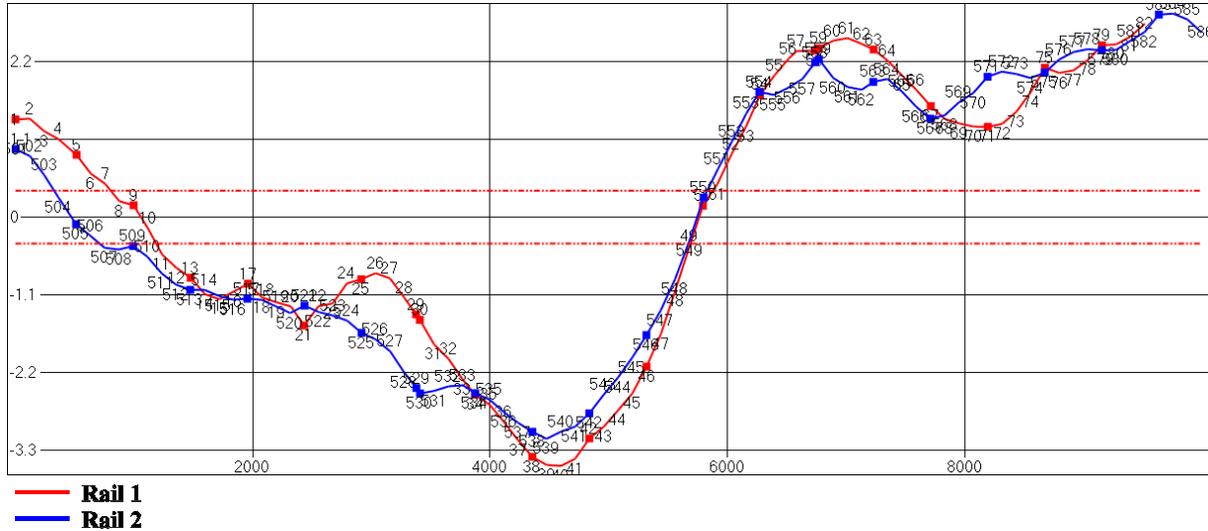


Chart 3 Measured elevation deviation values of the measure points.

Results of the elevation requirements are visualised in Fig. 4. Colors indicate, how good the runway is compared to the requirements of the selected standard (Green = close to optimal, Yellow/Orange = under the required tolerance, Red = permitted geometrical tolerances are NOT met).

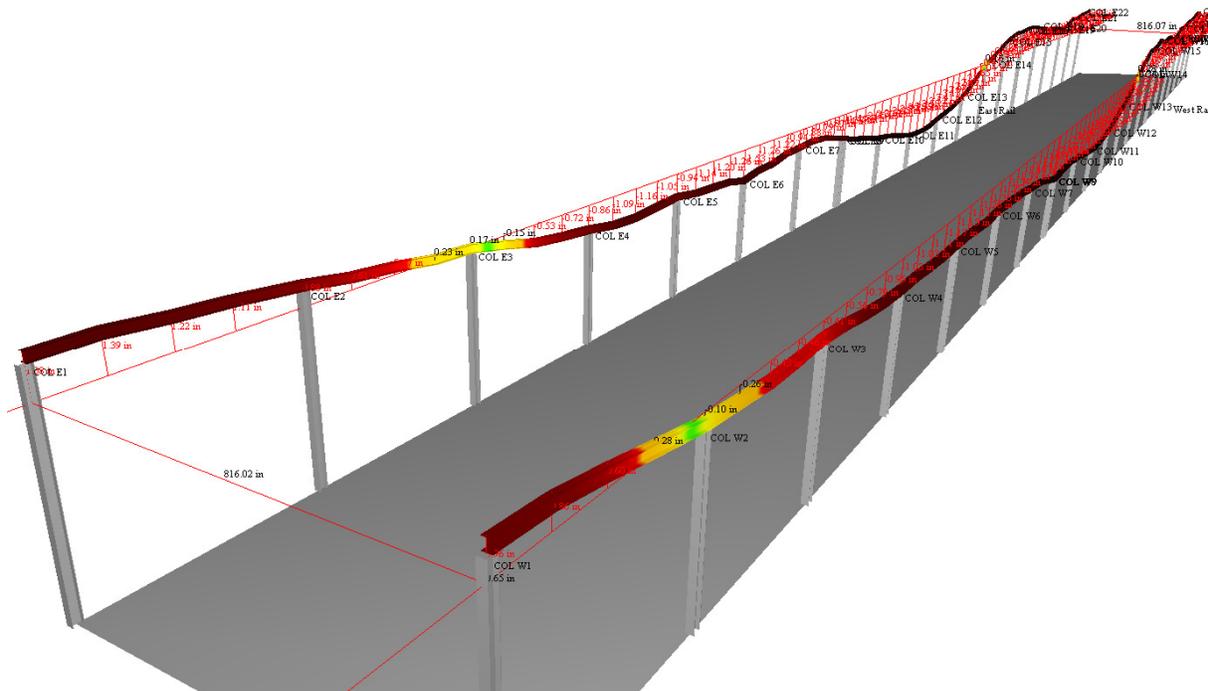


Fig. 4. Geometry of the runway. Vertical errors to the regression lines are scaled to 60 times larger

2.1.4 Rail to Rail elevation

Rail to rail elevation difference is calculated by comparing the vertical location of each measured point to the vertical location of the closest point of the other rail. Rail to rail elevation deviation values are given in Tables 6. Maximum allowed deviation in rail to rail elevation is ± 0.250 in according to the selected standard.

The maximum allowed rail to rail elevation deviation (± 0.250 in) is exceeded in 65 of the measured points. The biggest measured rail to rail elevation deviation is -1.38 in at the measure point 72 on the rail 1. This is -1.13 in outside the allowed tolerance.

Table 6 Rail to rail elevation difference values (rail 1)

Measure Point	Name of the Support	Z co-ordinate		Rail-To-Rail elevation error	Outside tolerance
		Measure point	Closest point of other rail		
1	COL E1	-15.28 in	-15.06 in	-0.23 in	0 in
2		-15.27 in	-15.15 in	-0.12 in	0 in
3		-15.45 in	-15.42 in	-0.03 in	0 in
4		-15.56 in	-15.74 in	0.18 in	0 in
5	COL E2	-15.78 in	-16.12 in	0.34 in	0.08 in
6		-16.05 in	-16.29 in	0.24 in	0 in
7		-16.19 in	-16.45 in	0.26 in	0.01 in
8		-16.44 in	-16.47 in	0.03 in	0 in
9	COL E3	-16.50 in	-16.43 in	-0.07 in	0 in
10		-16.82 in	-16.59 in	-0.23 in	0 in
11		-17.19 in	-16.82 in	-0.38 in	-0.12 in
12		-17.38 in	-16.97 in	-0.41 in	-0.16 in
13	COL E4	-17.52 in	-17.04 in	-0.48 in	-0.23 in
14		-17.75 in	-17.05 in	-0.71 in	-0.45 in
15		-17.82 in	-17.13 in	-0.69 in	-0.44 in
16		-17.72 in	-17.18 in	-0.53 in	-0.28 in
17	COL E5	-17.61 in	-17.17 in	-0.44 in	-0.18 in
18		-17.80 in	-17.19 in	-0.61 in	-0.36 in
19		-17.87 in	-17.28 in	-0.58 in	-0.33 in
20		-17.93 in	-17.37 in	-0.56 in	-0.31 in
21	COL E6	-18.20 in	-17.27 in	-0.93 in	-0.67 in
22		-17.92 in	-17.35 in	-0.57 in	-0.32 in
23		-17.88 in	-17.41 in	-0.48 in	-0.22 in
24		-17.60 in	-17.48 in	-0.12 in	0 in
25	COL E7	-17.54 in	-17.65 in	0.11 in	0 in
26		-17.46 in	-17.75 in	0.29 in	0.04 in
27		-17.53 in	-17.91 in	0.38 in	0.13 in
28		-17.80 in	-18.22 in	0.41 in	0.16 in
29	COL E8	-18.04 in	-18.42 in	0.38 in	0.13 in
30	COL E9	-18.11 in	-18.49 in	0.38 in	0.13 in
31		-18.46 in	-18.47 in	0.01 in	0 in
32		-18.67 in	-18.41 in	-0.26 in	-0.01 in
33		-18.96 in	-18.39 in	-0.57 in	-0.31 in

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34	COL E10	-19.17 in	-18.51 in	-0.67 in	-0.42 in
35		-19.31 in	-18.60 in	-0.72 in	-0.46 in
36		-19.55 in	-18.77 in	-0.79 in	-0.54 in
37		-19.81 in	-18.92 in	-0.89 in	-0.64 in
38	COL E11	-20.05 in	-19.05 in	-1.00 in	-0.75 in
39		-20.17 in	-19.15 in	-1.02 in	-0.76 in
40		-20.18 in	-19.05 in	-1.13 in	-0.88 in
41		-20.08 in	-18.98 in	-1.10 in	-0.85 in
42	COL E12	-19.79 in	-18.79 in	-1.00 in	-0.75 in
43		-19.63 in	-18.53 in	-1.10 in	-0.85 in
44		-19.39 in	-18.28 in	-1.12 in	-0.87 in
45		-19.16 in	-18.00 in	-1.15 in	-0.90 in
46	COL E13	-18.78 in	-17.68 in	-1.09 in	-0.84 in
47		-18.32 in	-17.33 in	-0.98 in	-0.73 in
48		-17.70 in	-16.89 in	-0.81 in	-0.56 in
49		-17.07 in	-16.35 in	-0.73 in	-0.47 in
50	COL E14	-16.50 in	-15.77 in	-0.73 in	-0.48 in
51		-16.20 in	-15.36 in	-0.84 in	-0.59 in
52		-15.77 in	-14.97 in	-0.81 in	-0.56 in
53		-15.39 in	-14.56 in	-0.82 in	-0.57 in
54	COL E15	-14.93 in	-14.25 in	-0.69 in	-0.43 in
55		-14.66 in	-14.29 in	-0.37 in	-0.12 in
56		-14.42 in	-14.18 in	-0.24 in	0 in
57		-14.32 in	-14.12 in	-0.20 in	0 in
58	COL E16	-14.31 in	-13.83 in	-0.48 in	-0.23 in
59	COL E17	-14.28 in	-13.79 in	-0.49 in	-0.24 in
60		-14.17 in	-14.05 in	-0.13 in	0 in
61		-14.13 in	-14.18 in	0.04 in	0 in
62		-14.22 in	-14.22 in	0.00 in	0 in
63	COL E18	-14.30 in	-14.11 in	-0.19 in	0 in
64		-14.46 in	-14.07 in	-0.39 in	-0.14 in
65		-14.66 in	-14.25 in	-0.42 in	-0.17 in
66		-14.87 in	-14.46 in	-0.41 in	-0.16 in
67	COL E19	-15.10 in	-14.62 in	-0.47 in	-0.22 in
68		-15.28 in	-14.57 in	-0.71 in	-0.46 in
69		-15.34 in	-14.39 in	-0.95 in	-0.70 in
70		-15.38 in	-14.26 in	-1.13 in	-0.87 in
71	COL E20	-15.39 in	-14.03 in	-1.36 in	-1.10 in
72		-15.35 in	-13.96 in	-1.38 in	-1.13 in
73		-15.17 in	-14.00 in	-1.18 in	-0.93 in
74		-14.90 in	-14.05 in	-0.85 in	-0.60 in
75	COL E21	-14.55 in	-13.97 in	-0.58 in	-0.33 in
76		-14.63 in	-13.79 in	-0.84 in	-0.59 in
77		-14.59 in	-13.68 in	-0.91 in	-0.65 in
78		-14.44 in	-13.64 in	-0.80 in	-0.55 in
79	COL E22	-14.24 in	-13.66 in	-0.58 in	-0.32 in
80		-14.22 in	-13.65 in	-0.57 in	-0.32 in
81		-14.11 in	-13.52 in	-0.59 in	-0.34 in
82		-13.93 in	-13.40 in	-0.53 in	-0.28 in

2.2 Recommended adjustments to the runway

Following adjustments to the runway geometry are recommended:

Table 7 recommended adjustments for Rail 1 measuring points

Measure Point	Name of the support	Adjustment	
		Vertical '+' value => Lift the point	Horizontal '+' value => Increase the span
2		0 in	0.43 in
3		0 in	0.28 in
4		0 in	0.35 in
5	COL E2	0 in	0.20 in
6		0 in	0.20 in
7		0 in	0.20 in
9	COL E3	0 in	0.28 in
10		0.06 in	0.39 in
11		0.12 in	0.31 in
12		0.18 in	0.12 in
13	COL E4	0.24 in	0 in
14		0.23 in	0.06 in
15		0.22 in	0.08 in
16		0.21 in	0.02 in
17	COL E5	0.20 in	0.16 in
18		0.33 in	-0.18 in
19		0.46 in	-0.04 in
20		0.59 in	0.10 in
21	COL E6	0.71 in	0.08 in
22		0.53 in	0.20 in
23		0.35 in	-0.08 in
24		0.18 in	0.16 in
26		0 in	-0.08 in
27		0 in	-0.28 in
28		0 in	-0.16 in
29	COL E8	0 in	-0.39 in
30	COL E9	0 in	-0.28 in
31		0.11 in	-0.04 in
32		0.22 in	-0.12 in
33		0.34 in	0 in
34	COL E10	0.43 in	-0.16 in
35		0.52 in	-0.28 in
36		0.61 in	-0.59 in
37		0.70 in	-0.59 in
38	COL E11	0.79 in	-0.59 in
39		0.79 in	-0.43 in
40		0.79 in	-0.51 in
41		0.79 in	-0.67 in
42	COL E12	0.79 in	-0.59 in
43		0.81 in	-0.28 in

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44		0.83 in	-0.39 in
45		0.85 in	-0.47 in
46	COL E13	0.87 in	-0.51 in
47		0.78 in	-0.35 in
48		0.69 in	0 in
49		0.60 in	0 in
50	COL E14	0.51 in	0 in
51		0.50 in	0 in
52		0.49 in	-0.04 in
53		0.48 in	0.04 in
54	COL E15	0.47 in	0.04 in
55		0.41 in	0.04 in
56		0.35 in	0 in
57		0.32 in	0.08 in
58	COL E16	0.24 in	0.08 in
59	COL E17	0.28 in	0.08 in
60		0.20 in	0.16 in
61		0.13 in	0.24 in
62		0.06 in	0.24 in
63	COL E18	0 in	0.39 in
64		0.06 in	0.39 in
65		0.12 in	0.39 in
66		0.18 in	0.43 in
67	COL E19	0.24 in	0.24 in
68		0.46 in	0.16 in
69		0.69 in	0.08 in
70		0.92 in	0 in
71	COL E20	1.14 in	0 in
72		0.94 in	0.08 in
73		0.75 in	-0.08 in
74		0.55 in	-0.04 in
75	COL E21	0.35 in	0 in
76		0.35 in	0.04 in
77		0.35 in	0 in
78		0.35 in	0.20 in
79	COL E22	0.35 in	-0.04 in
80		0.35 in	-0.20 in
81		0.35 in	0 in
82		0.35 in	0 in

Table 8 recommended adjustments for Rail 2 measuring points

Measure Point	Name of the support	Adjustment	
		Vertical '+' value => Lift the point	Horizontal '+' value => Increase the span
501	COL W1	0 in	-0.43 in
502		0.03 in	-0.24 in
503		0.06 in	-0.31 in
504		0.08 in	-0.12 in
505	COL W2	0.12 in	0 in
506		0.09 in	0 in
507		0.06 in	0 in
508		0.03 in	0 in
526		0.04 in	-0.04 in
527		0.08 in	-0.12 in
528		0.12 in	0.03 in
529	COL W8	0.16 in	-0.31 in
530	COL W9	0.16 in	-0.47 in
531		0.12 in	-0.20 in
532		0.08 in	0.50 in
533		0.04 in	0.25 in
534	COL W10	0 in	0.43 in
535		0 in	0.39 in
536		0 in	0.16 in
537		0 in	0.31 in
538	COL W11	0 in	0.16 in
539		0 in	0.35 in
540		0 in	0.24 in
541		0 in	0.59 in
542	COL W12	0 in	0.31 in
543		0 in	0.35 in
544		0 in	0.28 in
545		0 in	0.67 in
546	COL W13	0 in	0.59 in
547		0 in	0.47 in
548		0 in	0.31 in
549		0 in	0.31 in
550	COL W14	0 in	0.20 in
551		0 in	0.04 in
562		0 in	-0.28 in
563	COL W18	0 in	-0.24 in
564		0 in	-0.12 in
565		0 in	-0.16 in
566		0 in	-0.16 in
567	COL W19	0 in	-0.20 in
568		0 in	-0.20 in

The chart below illustrates the span difference (as measured and adjusted) along the measured runway. Note! Negative value indicates that the measured span is too narrow and positive value that the measured span is too wide.

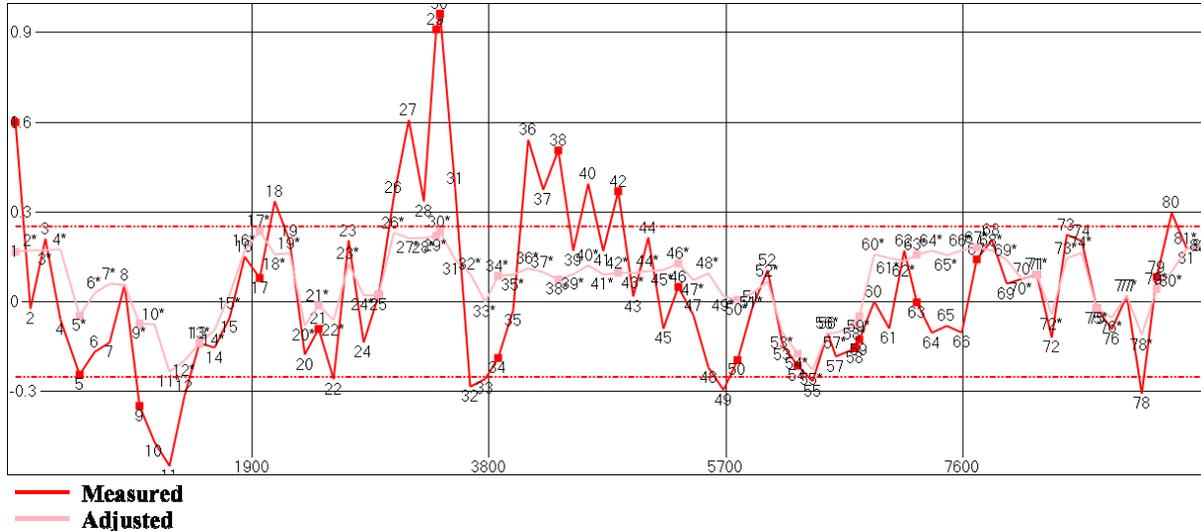


Chart 5 Measured span difference values (from the measure points on rail 1)

The chart below illustrates the elevation deviations of both rails (as measured and adjusted) along the measured runway. Note! Negative value indicates that the measured point locates lower than the regression line of the runway.

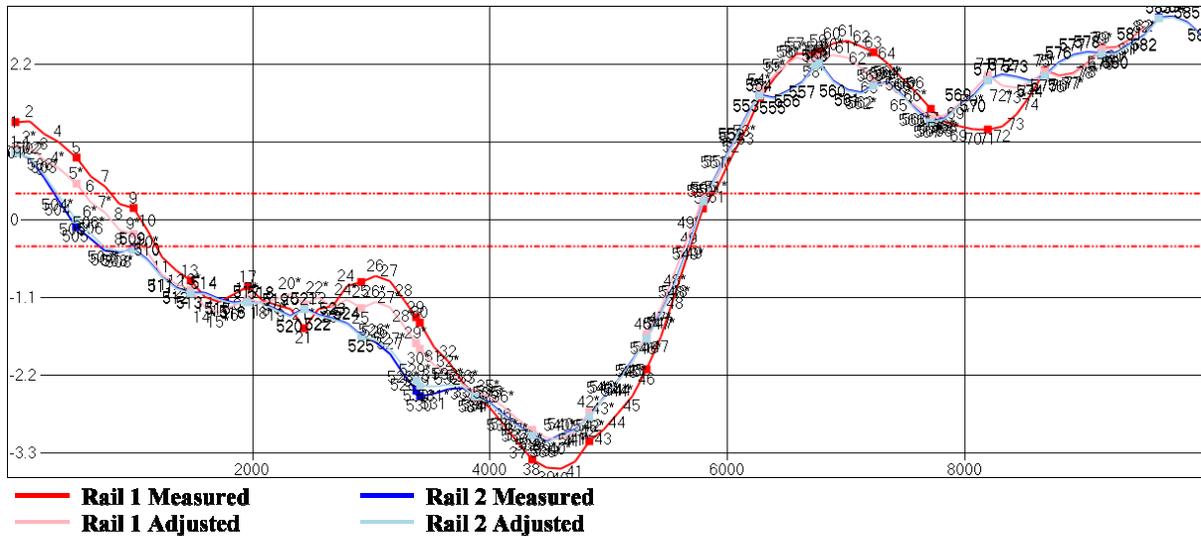


Chart 6 Measured elevation deviation values of the measure points

3 ASSESSMENT OF RESULTS

The geometrical measurement shows that the runway does **NOT** meet the requirements of the standard (CMAA Specification 70, Table 1.4.2 - 1).

The maximum allowed span deviation (± 0.250 in) is exceeded in 24 of the measured points. The biggest measured span deviation is 0.96 in at the measure point 30 on the rail 1. This is 0.71 in outside the allowed tolerance.

The maximum allowed straightness deviation (± 0.375 in) is exceeded in 78 of the measured points. The biggest measured straightness deviation is 1.00 in at the measure point 41 on the rail 1. This is 0.62 in outside the allowed tolerance.

The maximum allowed elevation deviation (± 0.375 in) is exceeded in 159 of the measured points. The biggest measured elevation deviation is 3.52 in at the measure point 40 on the rail 1. This is 3.14 in outside the allowed tolerance.

The maximum allowed rail to rail elevation deviation (± 0.250 in) is exceeded in 65 of the measured points. The biggest measured rail to rail elevation deviation is -1.38 in at the measure point 72 on the rail 1. This is -1.13 in outside the allowed tolerance.

We would recommend correction of both the horizontal and vertical deviations.

Thank you for the opportunity to conduct this analysis and please don't hesitate to call and discuss these results in detail.

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