



TECHNICAL REPORT: PERFORMANCE TESTING

Moreton Morrell Real Tennis Club

Report Number LSUK.17-0627#2

Client Moreton Morrell Tennis Court Club

Client address Moreton Morrell
Warwick
CV35 9AL

Test Date 18th October 2017

Report Date 6th November 2017

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LABOSPORT UK

Labosport Ltd, Unit 3 Aerial Way, Hucknall Business Park, Watnall Road, Hucknall, Nottingham,
NG15 6DW, England
Email; info@labosport.co.uk and Tel; +44 (0) 115 968 1998

www.labosport.co.uk

SUMMARY

Moreton Morrell Tennis Court Club, was constructed in 1910, the Real Tennis Court has a concrete based floor which was installed at that time and is now showing signs of deterioration, the floor type is known as a ‘Bickley Type’ after a gentleman that was designing and installing the floors and walls at Real Tennis Clubs around the turn of the last century. It is based on a concrete slab with a coloured cementitious surface. The club has requested Labosports help in identifying certain performance characteristics of the floor and of samples of different floor types which have been prepared at the club, so that a solution can be sought to rectify the issues.

REPORT COPIES TO

Bruce Paxton

Moreton Morrell Tennis Court Club

REPORT PREPARED BY

Phil Keeley
Senior Consultant



REPORT APPROVED BY

Dave Rigby
Laboratory Manager



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1. INTRODUCTION

The floor to a Real Tennis Court constructed in 1910 at Moreton Morrell Tennis Court Club has deteriorated to an extent that the club is considering works to either patch poor areas of the court or its total replacement.

The club has undertaken a number of investigative tests on the floor in order to ascertain its constituents and surface textures etc, following these tests a number of test samples of concrete floors with different finishes have been prepared in the club's grounds.

Labosport have carried out further investigation of two key performance requirements for the existing flooring and some of the prepared samples, that of surface pace and that of slip resistance.

Initial testing of the existing floor surface was undertaken on 05/06/2017, with further testing of the existing floor and the prepared samples on the 18th October 2017.

2. TEST PROCEDURES

2.1 Surface Pace Testing

The key properties of the floor surface are as follows:-

Friction: The resistance to relative movement between a court surface and an object in contact with that surface. The coefficient of friction (COF) is the ratio of the horizontal and the vertical components of force between the ball and the surface. A rougher surface has a greater COF, causing a greater reduction in the horizontal velocity and the surface to play 'slower'.

Energy restitution: The energy returned by the surface (and ball) following impact. A decrease in energy return is manifested as a reduction in vertical velocity of the ball after impact. The coefficient of restitution (COR) is the ratio of the vertical velocity of the ball after the bounce to that before impact. A surface that yields a higher COR is typically perceived to play slower, because the player has more time to reach the ball.

The International Tennis Federation (ITF) has developed a system to measure the Court Pace Rating (CPR) which measures the effect of ball-surface interaction. This concept includes: friction, which primarily determines the reduction in the horizontal component of post-impact ball velocity, and vertical restitution, which determines the time between successive bounces. CPR is derived from a theoretical model of ball/surface impact that assumes that the ball and surface are rigid during the impact and that the ball slides throughout its contact

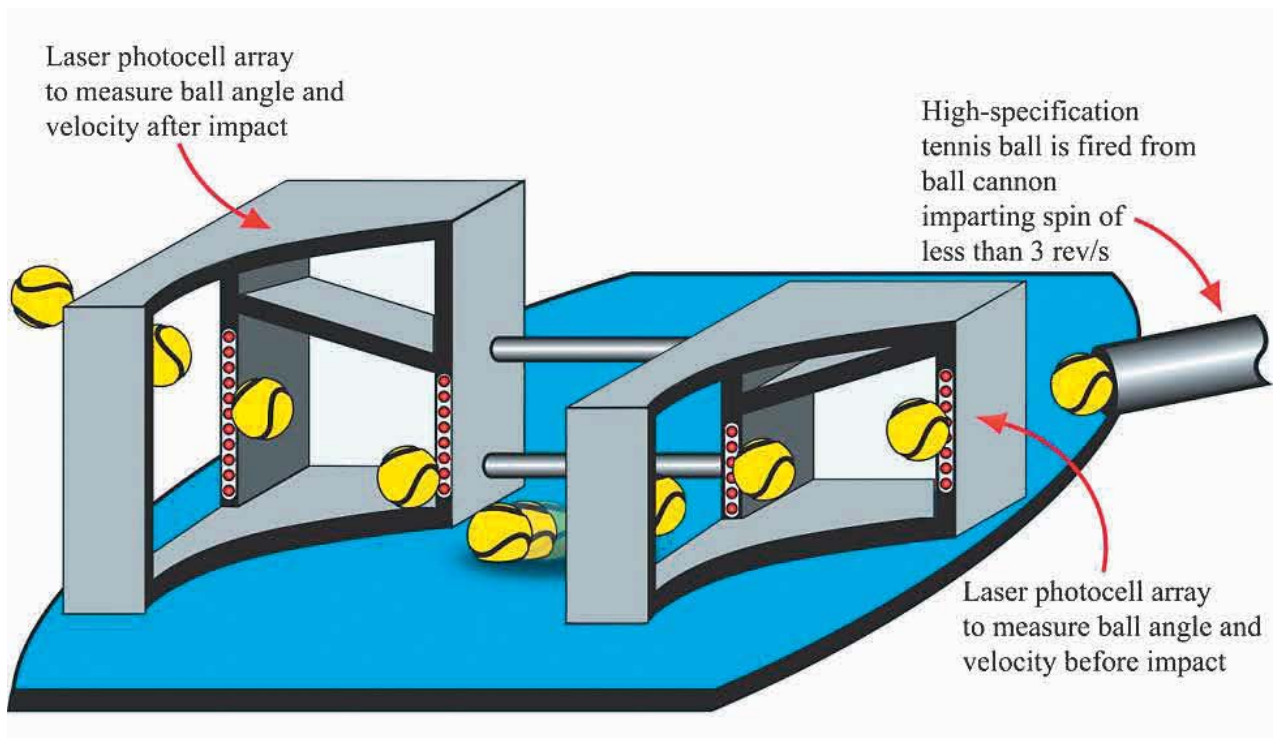
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with the surface. These assumptions necessitate that the ball impacts the surface with negligible spin and at a particular speed and angle.

Test apparatus consists of:

- A means of projecting a ball at the specified speed and angle onto the surface with spin of no more than 3 rev/s, such as a compressed air-powered ball cannon.
- A means of monitoring the trajectory of the ball before and after impact such that its horizontal and vertical speeds can be measured with a maximum uncertainty of ± 0.05 m/s (see Figure 2).
- A minimum of three high-specification balls.

Note: Angle of travel can be deduced from the vertical and horizontal speeds.



It was found by prior testing that the normally accepted speed used for tennis testing of 30m/s could not be achieved using a Real Tennis Ball and that speeds of around 20m/s were achieved, this has therefore been adopted along with the incident angle of 16° (as used by the ITF).

The ITF classify tennis surfaces into the following:-

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Category	Court Pace Rating
Slow	≤29
Medium-slow	30-34
Medium	35-39
Medium- fast	40-44
Fast	≥45

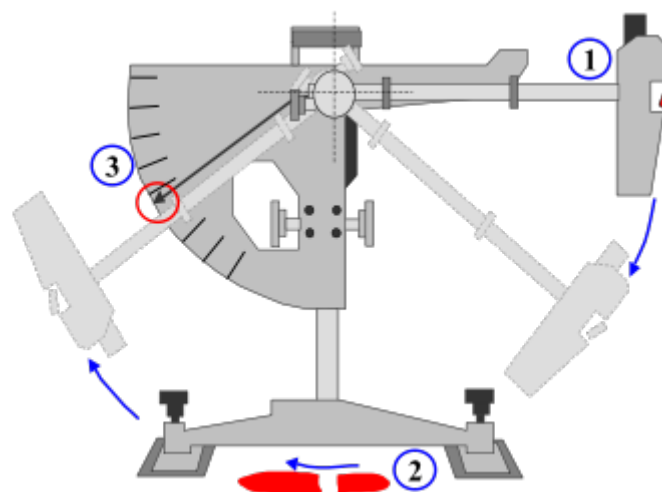
The coefficients of friction and restitution of a surface are categorised as follows:

Category	COR	COF
High	≥0.85	≥0.71
Medium	0.79-0.84	0.56-0.70
Low	≤0.78	≤0.55

Of course this is using a Lawn Tennis Ball, as the testing has been conducted using a Real Tennis Ball further thoughts about the surface pace and COR / COF categories has been given and is reported in this report.

2.2 Slip Resistance testing

Slip Resistance testing of the surface was undertaken in accordance with EN 13036 Part 4, which uses the transport and road research laboratory portable skid resistance tester, shod with a CEN (Soft) rubber foot.



1 = Test Foot

2 = Test Area

3 = Scale and pointer

The slip resistance requirements for tennis court surfaces can be found in three documents:-

- 1) The International Tennis Federations 'An Initial ITF Study on Performance Standards for Tennis Court Surfaces' this documents describes the test for slip resistance in Method CS02/01 and recommends a level of slip resistance of between 60 and 110.
- 2) The Sport England document 'A guide to the design, specification & construction of multi-use games areas (mugas)', This document described a Type 1 MUGA as a painted open textured macadam MUGA where tennis is the predominant sport, this states a requirement of >60.
- 3) The Sport and Play Construction Associations 'Code of Practice for the construction and maintenance of tennis courts' in this the minimum slip resistance is stated to be 60.

After three conditioning swings the test is repeated five times in one direction and the mean result calculated.

The requirements for slip resistance detailed above are for Lawn Tennis or multi use games areas and are only applicable for solid engineered surface and are not applicable for tennis played on grass or clay, similar limits could be used for Real Tennis.

2.3 Court Test Locations

Three test locations were chosen on the court area, they were located:-

1. In the service box at the hazard side.
2. Close to the net
3. Approximately 3 feet in from the wall near the 6 yard line in the serving court

All three locations represented what appeared to be less worn areas of the court floor, with no surface damage or cracking.

Tests were carried out under the following conditions:-

- Ambient Temperature = 15.4°C
- Surface Temperature = 17.5°C
- Relative Humidity = 79.1%
- Surface Condition = Dry

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2.4 Test Panels

The test panels of concrete prepared by the club in their grounds were formed of C35 concrete and had initial surface preparation grinding with 16grit and 30 grit metal bond. They then had the following surface finishes (data provided by the club).

1. Cemflow exterior topping, no primer, polished with 800 grit – 6mm
2. Cemflow exterior topping, no primer, polished with 400 grit – 6mm
3. Cemflow industrial topping (self levelling), with 2 coats of strong primer, 1 densifier and polished with 800 grit.
4. Cemflow interior topping, with 2 coats of strong primer, 400 grit + seal -6mm.
5. Concrete polished with 800 grit no sealer
6. Concrete polished with 400 grit no sealer
7. Granolythic (Steyson) (small slab)
8. Cemflow interior topping, with 2 coats of strong primer, and 2 coats of sports coating – 8mm

Tests were carried out under the following conditions:-

- Ambient Temperature = 13.2°C
- Surface Temperature = 12.9°C
- Relative Humidity = 85.4%
- Surface Condition = Dry

3. INSPECTION RESULTS

3.1 Pace Testing Results

The results of the pace testing are shown on the following pages:-

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Indoor Court

Position	Speed In (m/s)	Horizontal Speed In (m/s)	Vertical Speed In (m/s)	Angle In (°)	Speed Out (m/s)	Horizontal Speed Out (m/s)	Vertical Speed Out (m/s)	Angle Out (°)	Unadjusted COR	Temp. Adjusted COR	COF	SPR	Unadjusted CPR	Temp. Adjusted CPR	Sliding Length (mm)	Contact Duration (ms)
1	25.00	23.93	7.23	16.82	20.34	20.00	3.72	10.54	0.515	0.537	0.359	64.1	108.5	105.0	69.9	3.14
1	25.19	24.09	7.39	17.05	20.57	20.18	3.96	11.11	0.536	0.558	0.344	65.6	106.6	103.4	59.7	2.63
1	25.78	24.67	7.51	16.93	20.90	20.51	3.99	11.02	0.532	0.554	0.361	63.9	105.6	102.3	74.6	3.28
1	24.42	23.36	7.13	16.97	20.06	19.71	3.72	10.70	0.523	0.545	0.337	66.3	109.5	106.0	61.4	2.79
1	26.39	25.25	7.67	16.90	21.66	21.29	3.99	10.61	0.520	0.542	0.34	66	109.6	106.2	66.1	2.78
1	25.61	24.50	7.46	16.92	20.96	20.59	3.91	10.75	0.525	0.547	0.344	65.6	108.4	105.0	70.9	3.15
1	24.86	23.75	7.35	17.20	20.46	20.14	3.61	10.15	0.491	0.513	0.33	67	115	111.5	65.2	2.95
1	25.32	24.19	7.46	17.14	20.91	20.49	4.14	11.42	0.555	0.577	0.319	68.1	106.4	103.0	72.0	3.15
1	24.73	23.64	7.24	17.03	20.43	20.05	3.95	11.15	0.546	0.568	0.321	67.9	107.5	104.2	65.4	3.01
Average	25.26	24.15	7.38	17.00	20.70	20.33	3.89	10.83	0.527	0.549	0.339	66.1	108.6	105.2	67.2	2.99
2	24.36	23.17	7.52	17.97	19.82	19.45	3.81	11.08	0.507	0.529	0.329	67.1	112.6	109.2	48.9	2.29
2	25.99	24.74	7.95	17.81	21.02	20.63	4.04	11.08	0.508	0.530	0.343	65.7	111	107.7	57.3	2.51
2	25.53	24.28	7.89	18.01	20.41	19.98	4.16	11.77	0.527	0.549	0.357	64.3	106.7	103.4	57.5	2.37
2	26.38	25.07	8.21	18.14	21.24	20.81	4.30	11.67	0.523	0.545	0.341	65.9	109	105.6	58.8	2.42
2	24.27	23.03	7.67	18.41	19.74	19.35	3.90	11.41	0.509	0.531	0.318	68.2	113.3	110.0	54.4	2.44
2	24.67	23.41	7.77	18.35	19.99	19.57	4.07	11.75	0.524	0.546	0.325	67.5	110.4	107.1	59.3	2.75
2	25.69	24.45	7.89	17.89	20.81	20.43	3.96	10.97	0.502	0.524	0.339	66.1	112.3	109.0	55.7	2.47
2	25.56	24.33	7.82	17.83	20.97	20.57	4.08	11.23	0.522	0.544	0.316	68.4	111.6	108.3	59.5	2.63
2	24.60	23.40	7.56	17.90	20.16	19.80	3.79	10.84	0.501	0.523	0.318	68.2	114.5	111.2	57.3	2.59
Average	25.23	23.99	7.81	18.03	20.46	20.07	4.01	11.31	0.514	0.536	0.332	66.8	111.3	107.9	56.5	2.50
3	24.32	23.08	7.65	18.34	19.82	19.40	4.07	11.84	0.531	0.553	0.314	68.6	110.4	107.1	61.0	2.82
3	26.37	25.08	8.13	17.95	21.53	21.08	4.39	11.76	0.540	0.562	0.32	68	108.5	105.2	66.2	2.82
3	25.80	24.58	7.86	17.73	21.19	20.77	4.20	11.44	0.535	0.557	0.316	68.4	109.7	106.3	73.1	3.16
3	25.00	23.78	7.73	18.01	20.61	20.16	4.26	11.94	0.552	0.574	0.302	69.8	108.6	105.2	66.8	3.00
3	25.35	24.15	7.72	17.73	21.01	20.63	4.00	10.98	0.518	0.540	0.3	70	113.7	110.5	66.3	2.91
3	25.20	23.98	7.74	17.90	20.88	20.51	3.92	10.82	0.506	0.528	0.298	70.2	115.8	112.5	65.9	2.95
3	25.23	23.99	7.81	18.03	21.01	20.55	4.35	11.95	0.557	0.579	0.283	71.7	109.7	106.3	71.9	3.18
3	25.36	24.13	7.82	17.96	21.03	20.60	4.19	11.49	0.535	0.557	0.294	70.6	111.8	108.5	64.9	2.88
3	25.08	23.88	7.66	17.78	20.88	20.45	4.19	11.59	0.548	0.570	0.289	71.1	110.4	107.1	69.1	3.07
Average	25.30	24.07	7.79	17.94	20.88	20.46	4.17	11.53	0.536	0.558	0.302	69.8	111.0	107.6	67.2	2.98



Test Slabs

Position	Speed In (m/s)	Horizontal Speed In (m/s)	Vertical Speed In (m/s)	Angle In (°)	Speed Out (m/s)	Horizontal Speed Out (m/s)	Vertical Speed Out (m/s)	Angle Out (°)	Unadjusted COR	Temp. Adjusted COR	COF	SPR	Unadjusted CPR	Temp. Adjusted CPR	Sliding Length (mm)	Contact Duration (ms)
Slab 1	23.63	22.42	7.49	18.47	17.12	16.55	4.38	14.81	0.585	0.615	0.494	50.6	84.4	79.8	49.5	2.56
Slab 1	23.91	22.65	7.66	18.69	17.23	16.66	4.39	14.77	0.573	0.603	0.496	50.4	85.8	81.4	53.0	2.73
Slab 1	24.11	22.85	7.69	18.60	17.76	17.21	4.38	14.27	0.569	0.599	0.467	53.3	89.4	84.9	52.7	2.63
Slab 1	25.50	24.15	8.80	18.71	18.65	18.00	4.88	15.16	0.596	0.626	0.471	52.9	85	80.5	56.3	2.64
Slab 1	24.10	22.84	7.69	18.59	18.05	17.49	4.44	14.24	0.578	0.608	0.441	55.9	90.7	86.2	58.7	2.85
Slab 1	24.65	23.34	7.93	18.76	18.22	17.60	4.71	14.98	0.594	0.624	0.454	54.6	87	82.5	58.7	2.83
Slab 1	24.19	22.94	7.65	18.45	17.91	17.36	4.37	14.11	0.570	0.600	0.464	53.6	89.5	85.1	57.3	2.85
Slab 1	25.28	23.97	8.04	18.54	18.85	18.31	4.46	13.69	0.555	0.585	0.453	54.7	93	88.4	57.0	2.71
Slab 1	25.01	23.72	7.91	18.45	18.88	18.33	4.56	13.97	0.576	0.606	0.433	56.7	91.8	87.3	57.1	2.70
Average	24.49	23.21	7.87	18.58	18.07	17.50	4.51	14.44	0.577	0.608	0.464	53.6	88.5	84.0	55.6	2.72
Slab 2	23.22	22.01	7.40	18.59	16.74	16.19	4.25	14.70	0.574	0.604	0.499	50.1	85.5	81.0	60.7	3.25
Slab 2	24.06	22.80	7.68	18.62	17.65	17.03	4.64	15.24	0.604	0.634	0.468	53.2	84.1	79.6	65.3	3.31
Slab 2	24.76	23.48	7.87	18.53	17.88	17.28	4.58	14.84	0.582	0.612	0.498	50.2	84.5	79.9	59.0	2.78
Slab 2	22.15	21.03	6.96	18.31	16.24	15.69	4.16	14.85	0.598	0.628	0.48	52	83.8	79.3	60.5	3.25
Slab 2	24.41	23.13	7.78	18.59	17.83	17.25	4.50	14.61	0.578	0.608	0.479	52.1	86.9	82.4	59.4	2.92
Slab 2	25.02	23.73	7.93	18.49	18.33	17.71	4.75	15.02	0.599	0.629	0.475	52.5	84.2	79.6	62.0	3.00
Slab 2	24.43	23.19	7.71	18.39	18.49	17.93	4.51	14.12	0.585	0.615	0.43	57	90.7	86.2	61.8	2.96
Slab 2	24.78	23.45	8.02	18.88	17.87	17.33	4.37	14.14	0.544	0.574	0.494	50.6	90.4	86.0	59.9	2.96
Slab 2	23.07	21.84	7.43	18.79	16.75	16.16	4.42	15.29	0.595	0.625	0.479	52.1	84.4	79.8	57.9	3.02
Average	23.99	22.74	7.64	18.58	17.53	16.95	4.46	14.76	0.584	0.615	0.478	52.2	86.1	81.5	60.7	3.05
Slab 3	23.41	22.30	7.13	17.73	18.19	17.69	4.22	13.42	0.592	0.622	0.406	59.4	92.1	87.6	65.1	3.24
Slab 3	24.17	23.03	7.35	17.71	18.71	18.19	4.40	13.60	0.599	0.629	0.412	58.8	90.5	85.9	66.7	3.22
Slab 3	24.79	23.60	7.60	17.84	19.22	18.70	4.45	13.38	0.585	0.615	0.407	59.3	93	88.5	67.4	3.13
Slab 3	24.19	23.04	7.36	17.72	18.82	18.33	4.26	13.10	0.579	0.609	0.405	59.5	94.1	89.6	64.5	3.13
Slab 3	25.28	24.08	7.69	17.72	19.75	19.25	4.41	12.90	0.573	0.603	0.4	60	95.6	91.0	68.4	3.17
Slab 3	25.83	24.59	7.91	17.82	19.99	19.46	4.59	13.28	0.581	0.611	0.41	59	93.3	88.8	64.6	2.91
Slab 3	24.30	23.18	7.29	17.46	18.95	18.50	4.13	12.60	0.567	0.597	0.41	59	95.4	90.9	65.3	3.09
Slab 3	25.98	24.72	7.97	17.87	19.81	19.30	4.50	13.12	0.564	0.594	0.435	56.5	93.3	88.9	69.3	2.97
Slab 3	24.37	23.19	7.49	17.89	18.81	18.28	4.44	13.65	0.593	0.623	0.412	58.8	91.4	86.8	66.8	3.20
Average	24.70	23.53	7.53	17.75	19.14	18.63	4.38	13.23	0.581	0.612	0.411	58.9	93.2	88.7	66.5	3.12



Slab 4	23.94	22.88	7.03	17.08	18.63	18.22	3.88	12.02	0.552	0.582	0.427	57.3	96	91.5	64.2	3.13
Slab 4	24.20	23.10	7.21	17.35	19.04	18.62	3.97	12.03	0.550	0.580	0.4	60	99	94.5	64.6	3.13
Slab 4	24.87	23.76	7.34	17.16	19.51	19.07	4.12	12.20	0.562	0.592	0.41	59	96.3	91.7	64.3	2.98
Slab 4	24.98	23.87	7.37	17.15	19.60	19.17	4.10	12.08	0.557	0.587	0.41	59	96.9	92.4	65.3	3.03
Slab 4	24.81	23.71	7.29	17.08	19.54	19.14	3.96	11.70	0.544	0.574	0.407	59.3	99.2	94.7	61.1	2.84
Slab 4	24.46	23.36	7.27	17.29	19.11	18.64	4.23	12.77	0.581	0.611	0.41	59	93.3	88.8	67.3	3.25
Slab 4	24.41	23.29	7.33	17.46	19.05	18.65	3.92	11.88	0.536	0.566	0.413	58.7	99.9	95.3	67.6	3.26
Slab 4	25.85	24.67	7.71	17.34	20.02	19.50	4.57	13.19	0.593	0.623	0.422	57.8	90.3	85.8	66.4	3.01
Slab 4	24.63	23.55	7.21	17.02	19.31	18.90	3.92	11.72	0.544	0.574	0.418	58.2	98.2	93.6	62.9	2.97
Average	24.68	23.58	7.31	17.21	19.31	18.88	4.07	12.18	0.558	0.588	0.413	58.7	96.6	92.0	64.9	3.07
Slab 5	25.93	24.78	7.64	17.13	19.73	19.37	3.73	10.90	0.488	0.518	0.476	52.4	100.6	96.2	62.8	2.87
Slab 5	24.56	23.44	7.34	17.38	18.14	17.68	4.06	12.93	0.553	0.583	0.505	49.5	88	83.5	64.0	3.18
Slab 5	24.89	23.68	7.66	17.92	18.58	18.08	4.27	13.28	0.557	0.587	0.47	53	90.9	86.4	63.3	3.08
Slab 5	25.95	24.76	7.79	17.48	19.64	19.18	4.24	2.46	0.544	0.574	0.464	53.6	93.6	89.0	59.3	2.70
Slab 5	25.05	23.89	7.52	17.48	18.84	18.39	4.09	12.55	0.544	0.574	0.473	52.7	92.5	88.1	64.9	3.10
Slab 5	25.18	24.02	7.58	17.52	19.25	18.77	4.26	12.79	0.562	0.592	0.443	55.7	92.9	88.4	65.8	3.12
Slab 5	25.44	24.27	7.62	17.43	19.68	19.22	4.25	12.48	0.558	0.588	0.426	57.4	95.2	90.7	63.4	2.89
Slab 5	24.54	23.42	7.32	17.37	19.33	18.95	3.80	11.33	0.519	0.549	0.402	59.8	103.6	98.9	65.7	3.09
Slab 5	24.68	23.55	7.40	17.44	19.41	18.96	4.19	12.46	0.566	0.596	0.396	60.4	97	92.5	65.9	3.09
Average	25.14	23.98	7.54	17.46	19.18	18.73	4.10	11.24	0.543	0.574	0.451	54.9	94.9	90.4	63.9	3.01
Slab 6	24.71	23.57	7.44	17.51	18.19	17.67	4.35	13.82	0.585	0.615	0.501	49.9	83.7	79.1	50.1	2.38
Slab 6	25.11	24.00	7.38	17.09	18.77	18.26	4.34	13.36	0.587	0.617	0.49	51	84.4	79.9	56.9	2.69
Slab 6	25.53	24.34	7.73	17.62	18.63	18.10	4.40	13.67	0.570	0.600	0.514	48.6	84.6	80.1	50.2	2.35
Slab 6	24.68	23.53	7.45	17.57	18.41	17.90	4.28	13.46	0.575	0.605	0.48	52	87.3	82.7	51.8	2.54
Slab 6	25.25	24.08	7.62	17.55	18.79	18.32	4.15	12.76	0.545	0.575	0.89	51.1	90.8	46.2	53.9	2.39
Slab 6	24.80	23.67	7.38	17.32	18.49	17.95	4.45	13.93	0.603	0.633	0.484	51.6	82.7	78.1	51.8	249.00
Slab 6	25.07	23.92	7.51	17.43	18.82	18.37	4.10	12.58	0.546	0.576	0.478	52.2	91.8	87.3	55.0	2.66
Slab 6	23.57	22.52	6.96	17.17	17.99	17.53	4.05	13.01	0.582	0.612	0.453	54.7	88.9	84.4	56.3	2.81
Slab 6	23.71	22.63	7.08	17.37	18.23	17.83	3.82	12.09	0.540	0.570	0.441	55.9	96.5	91.9	55.1	2.72
Average	24.71	23.58	7.39	17.40	18.48	17.99	4.22	13.19	0.570	0.601	0.526	51.9	87.9	78.8	53.5	29.95



Slab 7	24.81	23.66	7.44	17.46	19.78	19.35	4.10	11.97	0.551	0.581	0.374	62.6	101.4	96.9	67.0	3.07
Slab 7	24.56	23.43	7.34	17.40	19.70	19.28	4.05	11.85	0.551	0.581	0.365	63.5	102.4	97.8	68.2	3.11
Slab 7	24.76	23.58	7.55	17.75	19.51	19.09	4.01	11.85	0.531	0.561	0.388	61.2	103.1	98.5	79.2	3.67
Slab 7	23.49	22.40	7.06	17.49	18.60	18.21	3.77	11.71	0.534	0.564	0.387	61.3	102.7	98.2	75.4	3.66
Slab 7	23.76	22.65	7.19	17.61	18.83	18.51	3.45	10.57	0.480	0.510	0.389	61.1	110.6	106.1	84.6	4.11
Slab 7	24.39	23.25	7.40	17.65	19.27	18.83	4.08	12.22	0.552	0.582	0.385	61.5	100.3	95.7	72.2	3.35
Slab 7	24.61	23.44	7.50	17.74	19.43	19.01	4.01	11.92	0.535	0.565	0.385	61.5	102.7	98.2	73.4	3.43
Slab 7	24.52	23.32	7.56	17.96	19.37	18.97	3.91	11.65	0.518	0.548	0.379	62.1	106	101.4	66.7	3.08
Slab 7	24.31	23.16	7.40	17.72	19.29	18.90	3.83	11.45	0.517	0.547	0.379	62.1	106	101.5	79.3	3.69
Average	24.36	23.21	7.38	17.64	19.31	18.91	3.91	11.69	0.530	0.560	0.381	61.9	103.9	99.3	74.0	3.46
Slab 8	24.62	23.51	7.30	17.26	17.63	17.12	4.22	13.86	0.578	0.608	0.554	44.6	79.3	74.9	52.8	2.72
Slab 8	24.79	23.68	7.33	17.20	17.95	17.53	3.83	12.34	0.523	0.553	0.55	45	88	83.5	56.2	2.70
Slab 8	24.23	23.15	7.16	17.18	17.26	16.72	4.29	14.37	0.599	0.629	0.562	43.8	75.5	70.9	58.6	2.93
Slab 8	24.34	23.22	7.28	17.40	16.59	16.12	3.94	13.75	0.542	0.572	0.633	36.7	76.9	72.4	64.5	2.79
Slab 8	25.25	24.11	7.51	17.31	18.30	17.80	4.27	13.49	0.568	0.598	0.536	46.4	82.7	78.2	56.9	2.71
Slab 8	25.79	24.63	7.67	17.30	18.43	17.89	4.40	13.80	0.573	0.603	0.558	44.2	79.7	75.2	59.5	2.77
Slab 8	23.69	22.60	7.12	17.50	16.78	16.28	4.08	14.08	0.573	0.603	0.564	43.6	79.1	74.6	61.8	3.19
Slab 8	24.95	23.79	7.52	17.55	17.87	17.32	4.42	14.31	0.587	0.617	0.542	45.8	79.2	74.7	65.4	3.25
Slab 8	23.12	22.04	6.96	17.53	16.63	16.24	3.59	12.46	0.515	0.545	0.55	45	89.2	84.7	47.2	2.49
Average	24.53	23.41	7.32	17.36	17.49	17.00	4.12	13.61	0.562	0.592	0.561	43.9	81.1	76.6	58.1	2.84

3.2 Slip Resistance Results

The slip resistance results are as follows:-

Indoor Court

Test Location	Result
1	62
	61
	60
	59
	60
Average	60
2	63
	62
	62
	61
	60
Average	62
3	62
	60
	59
	58
	58
Average	60

The values of slip resistance stated are subject to a test error value of ± 3 units.

Test Slabs

Test Location	Result
1	58
	57
	57
	57
	57
Average	57
2	58
	57
	57
	57
	57
Average	57
3	105
	106
	107

LABOSPORT UK

Labosport Ltd, Unit 3 Aerial Way, Hucknall Business Park, Watnall Road, Hucknall, Nottingham,
NG15 6DW, England
Email; info@labosport.co.uk and Tel; +44 (0) 115 968 1998

www.labosport.co.uk

	108
	109
Average	107
4	89
	88
	87
	91
	92
Average	89
5	58
	57
	57
	56
	56
Average	57
6	60
	58
	59
	58
	59
Average	59
7	69
	70
	71
	71
	72
Average	71
8	95
	97
	97
	98
	98
Average	97

Table 1; showing Average results for Surface Pace information and Slip Resistance for the court area and the test slabs.

Test	Description of surface	Court Pace Rating	Coefficient of friction	Sliding Length (mm)	Contact Duration (ms)	Slip Resistance
Court area	As found	107	0.32	64	2.8	61
Test Slab 1	Cemflow exterior topping, no primer, polished with 800 grit – 6mm	84	0.46	57	2.7	57
Test Slab 2	Cemflow industrial topping (self levelling), with 2 coats of strong primer, 1 densifier and polished with 800 grit.	82	0.49	61	3.1	57
Test Slab 3	Cemflow exterior topping, no primer, polished with 400 grit – 6mm	89	0.41	67	3.1	107
Test Slab 4	Cemflow interior topping, with 2 coats of strong primer, 400 grit + seal -6mm.	92	0.41	65	3.1	87
Test Slab 5	Concrete polished with 800 grit no sealer	90	0.45	64	3.0	59
Test Slab 6	Concrete polished with 400 grit no sealer	79	0.53	54	2.6	57
Test Slab 7	Granolythic (Steyson) (small slab)	99	0.38	74	3.5	71
Test Slab 8	Cemflow interior topping, with 2 coats of strong primer, and 2 coats of sports coating – 8mm	77	0.56	58	2.8	97

4. CONCLUSIONS

4.1 General Discussion

The three locations chosen within the court area represented areas which were similar in the appearance of their surface texture and most likely, areas that have received less foot traffic over the years of the courts use. Thus are considered to represent locations, where both surface pace and slip resistance values would be in the correct ranges preferred by players and which should be looked for in relation to the results from the trial slabs. Both in terms of the surface pace and the slip resistance. The surface pace is very sport specific and is discussed further below in section 4.2.

The slip resistance can also be sports specific, but the levels required should be considered in relation to providing a minimum level so that players are afforded a reasonable level of grip so that they are able to play with an assured foot hold. It is equally important that not too much grip is given as this can result in leg injuries. When considering slip resistance requirements for the surface, slip resistance for other similar sports should be taken into account. Players of Real Tennis do not use any sport specific footwear and in general use a typical general purpose tennis shoe. Thus looking at the levels of slip resistance applied for Lawn Tennis on hard surfaced tennis courts would be prudent. Slip resistance is further discussed in section 4.3.

4.2 Surface Pace

The surface pace measurements at the three locations within the court area were all very similar and gave an average Court Pace Rating (CPR) of 107, and average Coefficient of Friction (COF) of 0.32, an average Sliding Length of 64mm and an average contact duration of 2.8ms. We conclude from these figures that in order to match the surface pace properties of the existing floor with a new floor surface (allowing for possible changes during its anticipated life), the new floor surface should be have a CPR of 95-105, a COF 0.3-0.4, Sliding length of 65-75mm and a contact duration of 2.5- 4.0ms.

The surface pace measurements of the test slabs varied considerably, as would be expected with different surface finishes. The test slabs that come close to the above parameters are Test Slab 4 (which is quite close) and Test Slab 7 (which falls in the suggested ranges).

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4.3 Slip Resistance

The slip resistance measurements obtained from the court tests locations gave an average of 61. Other specified requirements for Lawn tennis can be found in the following documents:-

- 1) The International Tennis Federations 'An Initial ITF Study on Performance Standards for Tennis Court Surfaces' this documents describes the test for slip resistance in Method CS02/01 and recommends a level of slip resistance of between 60 and 110.
- 2) The Sport England document 'A guide to the design, specification & construction of multi-use games areas (mugas)', This document described a Type 1 MUGA as a painted open textured macadam MUGA where tennis is the predominant sport, this states a requirement of >60.
- 3) The Sport and Play Construction Associations 'Code of Practice for the construction and maintenance of tennis courts' in this the minimum slip resistance is stated to be 60.

From the above results of the court surface and the requirements for tennis specified by other documents we conclude that an appropriate range of slip resistance for Real Tennis is from 60 to 100. The test slabs that come close to the above parameters are again Test Slab 4 and Test Slab 7. Test slabs 1, 2 and 5 and 6 fell just below 60 and test slabs 3 and 8 were considered to have a little too much grip.