Moreton Morrell Tennis Court Club

Post project report on court floor restoration

4th January 2021

Prepared for the club and for others planning similar floor works

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Bickley 1.0 floor 1905

Bickley 2.0 floor 2020

1. Summary of project work

Issues with the court floor had been worsening over the years including cracks, pock marked areas and steps at the slab joints. These were increasingly affecting the true bounce of the ball.

In December 2016 the Committee of Moreton Morrell agreed to proceed with investigations to restore the playing surface with the objective that "It is of the essence to retain the superb playing qualities of the floor and the court appearance, after any restorative action." The scope and results of this research are summarised in Appendix B.

We have replaced the original floor with a modern floor with the style and performance very similar to the original built by Joseph Bickley in 1905.

The new floor is a granolithic reinforced concrete floor, 150mm thick, and polished to 400 grit. The concrete was pumped in, and when firm (after 2-3 hrs) a powder of pigment and crushed rock was distributed onto the surface.

Then the surface was power floated.

We waited 28 days for the concrete to cure, and then cleaned and polished the surface to 400 grit. The sheen has decreased over 3 months since completion.

To successfully paint the lines is challenging. Carefully chosen paint systems are needed, and must be applied with a very good key to the floor surface, prepared with sandpaper.

Please see the videos on www.mmtcc.org court floor restoration.

The Professionals, Club members and players from other clubs (including the World Champions Rob and Clare Fahey, see video "The verdict") are very clear that the superb playing qualities of the 1905 floor and the court appearance have indeed been retained after the restoration work, delivering the 2020 Bickley 2.0 floor.

At the time of writing (January 2021) a re-measurement of the floor pace and slip by Labosport has not been undertaken. When the Club has emerged from the COVID-19 pandemic restrictions

of 2020 and 2021, it is expected that the confirmatory work may be considered by the Board of the Club.

2. Sectional detail of the project

2.1. Preparation of the building

The 1905 building was not built for easy access, and has a number of decorative plaster work panels, mosaic floors, and marble steps internally, as well as rounded external concrete steps up to the entrance lobby. We needed access for a small backhoe digger, motorised barrows, concrete pumping and power-floating and polishing machines. The only access to the court was at the net-post, unless significant demolition and rebuilds of court walls were contemplated.

The slopes for machinery access were low angle aluminium planks, covered and supported by sterling board and structural wood. The floors (mosaic, marble steps, wood plank) were protected with 30mm rubber mats and covered with sterling board, which was also used for protective walls to the access corridor under the penthouse, and where necessary, ceiling protection. Additional lighting was provided.

A notable amount of concrete dust was expected, and the galleries were all sealed court-side. The access corridor was also dust proofed to minimise further dust permeation to other rooms during the expected 12-15 week programme. The net-post was removed for the works access.

2.2. Removal of the 1905 floor

From the two sample cores we had drilled, plus the description in Joseph Bickley's patent of 1909 and other research, we expected the 12 concrete panels of the 1905 floor to be about 8" (200mm) thick, with no reinforcement but thicker (10"-12"/ 250-300mm) at the edges. Underneath the concrete we expected crushed rock on the ground, decently levelled before pouring the floor originally. There was a ball trough which we aimed to replicate, with the exception of the 4" cast iron pipes at the bottom, originally used to put heat into the court.

Before removal work started, levels and references were taken to ensure the new playing surface was within 2mm of the original, and we had several reference levels to check this. In addition, the ball trough and basket well needed invert level definition. Note that a survey of the court showed that the floor level was within ±5mm, with higher points generally near to slab edges. Our approach of casting two half-court slabs (rather than 12 slabs) aimed to avoid the slab edge level problem.

The backhoe digger entered the court area without incident, and used a water spray fixed to the hydraulic drill to minimise any raised dust during breakout. This was very successful. The original floor was broken out without problems either in reducing it to manageable pieces, or in causing collateral damage to the walls (either by vibration or direct impact). Wall damage was a major technical risk we identified prior to the project. Provisional sums had been allocated and contingency plans set up with Amourcoat in the event of the need for a major wall repairs. The

spoil was attractive high quality clean concrete useful for hardcore, and local disposal to other project works was cost neutral. Roughly 130 tonnes (16 truck loads) of concrete was removed. This was more than originally estimated as the floor depth varied from the core samples (see below).

2.3. Levelling and preparation of the ground

After the removal from the court of the broken concrete by motorised barrow, a range of smaller sized rubble was left in the court for the subsequent levelling work. We found that the service end of the court was indeed much as expected in thickness and level, but the receiving end was not. There the ground had not been well-levelled, crushed rock was sparse and indeed the concrete was up to 24" (600mm) thick in places. In particular, the area in front of the tambour had two large clay boulders protruding from the surround and bare of crushed rock. We speculated that these had caused the old floor to crack significantly about 40 years ago, when they swelled in high water table conditions. (About 30 years ago, the bank outside the main wall had been dug back, probably modifying the water table and preventing further damage). All the floor and in particular the receiving end was worked to level the soil, fill voids with suitably broken recycled concrete, and using the more finely crushed rubble to consolidate to a suitable level throughout.

2.4. Installation of the floor base and shuttering for the ball trough

As this was being done, the valley detail under the net was prepared at a lower level to receive the necessary shuttering to shape the finished ball trough and basket well. A layer of concrete was poured in this valley, onto which the shuttering box was fastened on top of a local damp-proof membrane before the main floor concrete was poured. Once the ball-trough shuttering was in place, 100mm crushed new rock (Type 1 Road Stone 40mm down) was added and compacted across the whole court to a finished level 150mm below the original floor.

2.5. Damp-proof course, reinforcing and pouring of concrete

A damp-roof course membrane was spread over the entire crushed rock surface, with the edges turned up at the walls to above the final finished floor level. Conventional reinforcing mesh was used to give structural strength to the floor, arranged in two halves, either side of the ball trough. Block shuttering was added so that the concrete from the first half-court pour did not slump into the second half court.

Each half court was poured and floated in a day, and the process was the same for each pour. Readymix wagons delivered the C35 quality assured concrete (no additives) and it was pumped from outside the building, down the corridor and distributed into the court floor volume by a skilled team. The concrete was vibrated to remove air pockets and levelled to laser lines with hand trowels and beams. From a start at about 8.30am, the floor was filled by around noon. As soon as the concrete had gone off sufficiently to allow soft-shoe walking on it, the granolithic quartz and pigment was precisely scattered onto the wet concrete. Power trowels were used to float this into the still-setting concrete. Hand finishing by trowel was applied at the edges and shuttering junctions. The walls were protected from discolouration by the pigment by use of adhesive plastic sheeting about 1 metre high. Note that this standard construction protective material left marks on some areas of the walls after removal, appearing to have lifted the

polished surface from the wall. Luckily, this seems to be more of a visual problem than impacting the grip or bounce of the ball.

On the following day, the process was repeated for the second half court. In addition, the first half court has sufficiently cured to permit the crack-inducement slots to be cut with a diamond track saw 3mm wide x 25mm deep. Although current best practice indicated two longitudinal cuts (about 3m spacing), it was decided to replicate the original joint pattern and cut one on the centreline of the court. Two more cuts were put across each half of the court, dividing each half into six sections in total (as per the original slabs).

On the following day, the second court half had the inducement cuts made. The court was left with open windows to keep the ventilation and temperature in the right zone (July-August) for a full week and to let excess moisture escape from the curing concrete. It was then covered with a geo-fabric (geotextile 609) and topped with panels of Correx Twinshield taped together, to protect it during the remainder of the ~30 days natural curing.

2.6. Mastic filling of inducement cuts

At about 25 days after pouring, with the majority of the curing completed, a polyurethane mastic was applied to fill the inducement cuts. Colour matching was sought, but the “brick red” choice was not an accurate match for the floor (which on a different shade-scale and with the application rate critical was chosen from 300mm square slab samples as “dark red”). However, it is very close to matching and an acceptable floor detail shade. It is possible that at about a year after pouring, we will need to rake out and re-mastic the inducement cuts. Note that the inducement cuts, at 3mm, are significantly finer than the original joints which were ~10mm wide, thus producing a better playing surface.

2.7. Polishing

This is the phase of work where not only skill and experience, but also a finely honed craft is necessary to create the right surface. In my opinion! There are a number of tradesmen who will very adequately quote and deliver polished concrete. They will all, as we had done by Steysons, apply densifier to the cleaned surface before polishing with sequentially finer grade abrasive pads (finishing at 400 grit in our case, informed by our earlier research and triangulation with other recent courts). The ground surface is then buffed to finish with a high shine. This gives a functional surface closely matching (in the opinion of the players at MMTCC, but not as I write, measured by Labosport in ball pace and foot-slip terms) the 1905 floor in terms of ball play. The floor gave, and continues to give, audible foot contact noise which is generally perceived as useful. The high gloss initial finish was a surprise to me, but not unexpected by Steysons. (I didn’t ask the right questions!). It was visibly different from the ~800mm square sample we had for ball-pace testing, and the 300mm square samples for colour choice. However, as Steysons predicted, the gloss has decreased over a few months, without detriment to the ball-pace functionality or the foot-slip. The initial gloss however gave rise to a challenge in painting the lines as described below.

2.8 Line painting

Our selected contractor for line painting and for the renewal of the painted crowns, crest at the net and lines on the walls, had by agreement done some investigation into paint systems for us. The information we had from other courts was that “road paint” was good, plus we had our own experience of line paint, and others indicated generally that epoxy paint adhered well. We used the two 300mm square colour samples to test paint systems for adherence (undercoat to floor, top colour coat to undercoat) and arrived at what we thought was an acceptable system and choice of paints. These were not the undercoat or finished colour paints we had been using at MMTCC on the old floor. We had noted that on demolition with water spray, the floor lines peeled off the old floor pieces very easily.

What we found was that the chosen paint system did not adhere to the (unexpected) high gloss new polished floor as well as we had expected from the trial pieces. In areas of high foot-traffic (chases 1-6 and receiving end service box) the black lines in particular did not adhere well to the floor. The blue half chase indicators (only painted, as before, some 800mm out from each side wall and in the centre of the court) fared better but still showed wear. Much urgent research was done and an undercoat identified from Watco which was found to be an epoxy with good history on performing on Steysons granolithic floors. The COVID-19 pandemic had landed us with a further period of no play in November and we re-worked the chase lines 1-6 and the receiving end centre line (all black lines) using the Watco undercoat. On removing the first paint system lines, it was obvious how the gloss had decreased on the unpainted floor. As a precaution, most of the re-worked lines were sanded to provide an assured key for the undercoat. An area has been left un-sanded to provide a comparative reference, but under the Watco undercoat. The Watco undercoat and re-worked lines have performed well to date. We may need to re-work other lines, say in the summer 2021.

We noted during December 2020 that in a few limited areas the floor was suffering from some sweating, and that where blue (half chase) and yellow (gallery) lines were affected, their adhesion was notably reduced particularly with foot traffic. See Observations for future projects in Section 5.0 also.

3. Actual spend profile

The budget line-items were prepared in greater detail than is presented here by a practising Quantity Surveyor, using the work package analysis which emerged from various scope and interface discussions with the selected contractors. This statement included provisional sums and contingency items to cover the unknown aspects of the project e.g. the state of the ground underneath the old floor, possible damage to the playing walls by demolition works, structural defects in the 115 year old building (either original or time-induced e.g. rot).

	£
Building preparation, ramps, protective wood Ball-trough shuttering, sundry carpentry e.g. net post remove and reinstall	7092
Skip hire	630
Floor removal and ground base preparation	42000
New floor 150mm slab, clean grind and polish	40938
Cover floor during strength development, remove after	954
Construction & Design Management (CDM) admin	850
Mastic fill of inducement cuts	438
Sundry	250
Line painting (including wall & crest)	3450
Painting crowns renewal, ball-trough, sundry touch-up	1500
Lines floor	1240
Lines floor phase 2	800
Court top edge moulding repair (includes making profile cutter)	450
Actual spend total incl VAT	**100592**
Labosport re-measuring of slip & ball pace (not yet committed)	1380
Professional services for the project. Pro-bono from members say	25000
Equivalent total purchase	**126972**

The line-item for professional services which were given pro-bono by club members to enable the project covered quantity surveyor services, design services, project and programme management, and site supervision. No costs are included above for these items, and an estimate of their value should be included for any club considering similar work, at around £25k.

Contingencies included for risk items e.g. unknown ground conditions, risk of wall damage, building damage, condition of building due to age were not in the event used for those purposes. However more painting and restoration of crowns, crest etc. was done, as well as sundry court repairs, such as to the moulding above the tambour. The MMTCC approved budget was £103,600 incl VAT.

4. Contacts

Item	Contractor	Contact
Building preparation	Oriel Glazing orielglazing@btinternet.com	Richard Belham
Groundworks	DHS Contractors Ltd office@dhscontractorsltd.co.uk	Dave Hunt
The new floor, surface treatment	Steysons Granolithic Contractors Ltd www.steysonconcretefloors.co.uk	Keith Branscome
Mastic filling of inducement cuts	G L Mastics info@glmastics.co.uk	Gary Lakin
Line painting	Jenny Edge Interiors www.jennyedgeinteriors.com	Jenny Edge

Safety, CE compliance and administration	Bob Millerchip Designs design@rmdstudio.co.uk	Bob Millerchip
Court ball-pace and slip measurement Labosport	www.labosport.co.uk	Phil Keeley

These were chosen after a period of competitive tendering, including alternative work packages.

5. Observations for future similar projects

These comments are intended to be helpful to the Club for future reference and to any other club considering a similar project.

The club took the design risk on the basis of the research we had done prior to initiating the project. We were focussed on the delivery of a functionally defined playing floor.

The club directly employed the contractors as individual businesses and gave each the responsibility to operate a safe site and conform to CDM regulations, which the club set out appropriately. The club coordinated between the contractors for scope, timing and detail. This was a significant effort from the membership in research, planning, design and delivery coordination but gave more control and was seen to reduce the functional risk to the playing surface.

What was found under the old floor, particularly near the tambour, indicates that original poor ground levelling may well have left causes of stress and hence the floor slab fracture which was observed around 40 years ago.

It is essential to seal the court before the demolition phase in order to contain any generated dust. Minimising the dust raised by using a water spray on the backhoe pick is also beneficial.

Apart from the modern methods and materials, we have replicated the 1905 Bickley 1.0 floor functionally. The Bickley 2.0 floor differs in that it is reinforced with steel, has a damp-proof membrane, and has crack-inducement cuts, all of which are conventionally used in current practice. However, the first time the club Pro can remember the MMTCC floor sweating was in December 2020 after the floor restoration (but only in limited patches). It has been noted that the first painting system lines became less adhered to the floor where sweating occurred. The sweating effect is not well understood, being associated with humid warm air and cold surfaces and a sudden change in temperature (inversion). The original Bickley floor was certainly damp from the ground and Bickley 2.0 is damp-proofed but it is not obvious that the inclusion of ground insulation for example would prevent this rare (at MMTCC) phenomenon. Underfloor heating may well be beneficial to guard against this, but did not fit into the club's value for money frame for this project.

On completion of the polishing of the floor, it was observed that in several places, machine marks were visible in the surface. There was also an observable difference where the surface had

been hand-trowelled around edges etc. This has no detrimental effect on the functionality of the floor for play, and has attracted less comment with the decrease in shine. I believe they are similar to watermarks in paper, and part of the attractive variation in floor shade.

The programme from shutting the court to re-opening for play was 17 weeks. A substantial part of this was during the lockdown 1 of the COVID-19 pandemic in England. The club wished to take advantage of the period when play was not permitted to carry out the work. As soon as sufficient of the construction sector was allowed to operate again we started, although with no prior notice, we suffered some 4 weeks of waiting between work packages. A planned similar programme, with due notice should be planned at 12-14 weeks.

On inspection of the wooden floor under the net post, some concern about rot was made. A further inspection by Kilrot indicated some insect infestation, which should be treated in the near future. The quote is with the Club bookkeeper.

Bruce Paxton

4th January 2021

6 Appendix Pictures of the project progress.

Court protection

Dust sealing

Floor and wall access protection.

Colour samples for our choice,

From Steysons

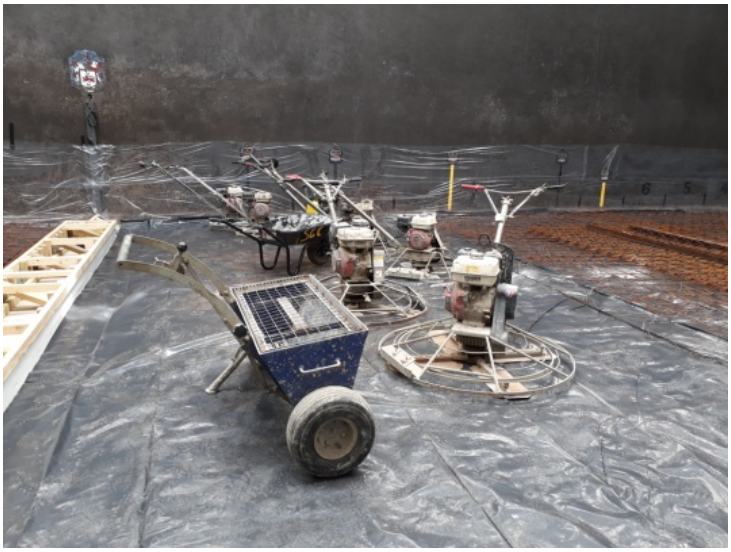
On the 1905 floor

The demolition

Cross section of concrete

The levelling and preparation of the base

With reinforcing and ball trough shuttering



Pigment addition machine

Receiving end

Partly filled with concrete

Pouring the service end

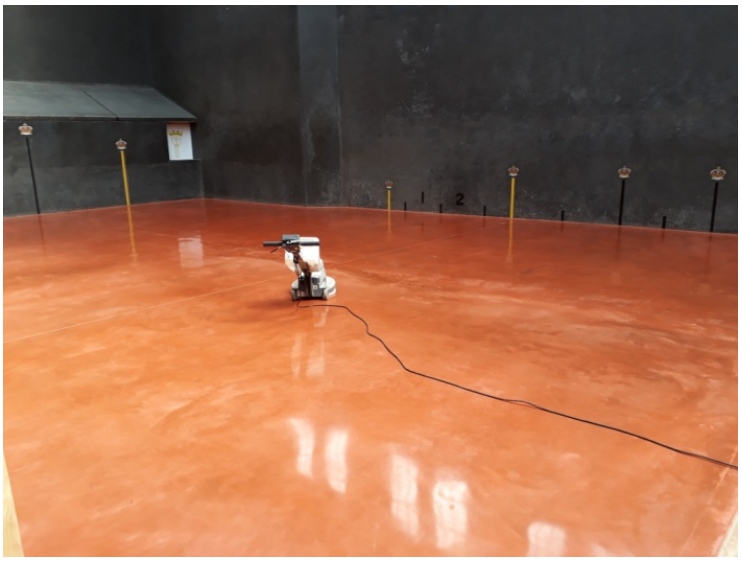
The pigment machinery after the first half

Pigment application on the second half

The first half on day 2.

After the pigment had been floated in, and the inducement cuts made

Protection for the floor after a week of open curing



The finishing polish

Bickley 2.0

2020

Appendix B. Research underpinning the project

Research scope

Extensive research was necessary to inform a decision whether to take any action to repair or replace the floor – either being a substantial undertaking. The scope of this work comprised:

a) Analysis of our court floor through core samples taken from the court
b) Experience from other courts, the Bickley patent and concrete industry knowledge
c) Testing of construction and materials options through creating "new floor" samples
d) Scientific analysis of physical characteristics of the existing floor and test samples
e) Presentation of the results to inform a decision

This research was carried out between December 2016 and November 2017 and is summarised below.

Core sample analysis

Two diamond drilled core samples were taken from under the net close to the main wall and from a point about 1m from the main wall and 1.5m from the ball trough on the service side. These were chosen as least likely to affect play and being representative of the original court surface.

The findings were:

- The Bickley concrete is about 200mm (8") thick, sitting directly on a rammed granite chipping base, with no reinforcement and contains significant airholes, a range of gravel and appears wet from groundwater.
- Analysis of the surface by Dr John Murphy showed a very smooth surface compared to that of a modern gym, and one that would be unacceptably slippery when wet. Roughness was measured at <10 micron and texture typically -110 to -120 microns.

Test slabs

Test slabs 2m x 1m x 0.1m were cast in the court grounds, using C35 ready-mix concrete with added fibre for strength, typical of an ordinary floated concrete floor construction today. The slabs were allowed to cure for 5 weeks and then the top 3-4mm removed by grinding, ready to take a toping or to be precision ground and polished.

The 5 test slabs were originally conceived as:

a) topped with a resin sports floor
b) ground and polished to 400 grit (ref. Wellington concrete floor)
c) ground and polished to 800 grit (smoother than 400 grit)
d) topped with a cementacious layer ~6mm to be defined e.g. Cemflow from DCP.
e) spare, possibly for colour experimentation

After consideration of the possible combinations of Cemflow topping, polish grit, primer, sports coating, densifier and sealant, we used 5 slabs with 1-2 areas on each treated differently to cover 9 different permutations. The conclusions from this test were:

Topping	Thickness	Apply onto old concrete?	Can be ground?	Long-lasting?
Cemflow	~6mm	yes with preparation	yes	unknown
Cemflow+Sports top	~7mm	yes with preparation	no	5-7 years?
Sports top x2	~2mm	yes with preparation	no	5-7 years?
Concrete 800gr	zero	challenging / expensive	yes	yes
Concrete 400gr	zero	challenging / expensive	yes	yes
Granolithic 400gr	75mm	yes with preparation	yes	yes+

The colour of Cemflow was grey for our test slabs, but can be delivered in red. Granolithic (from Steyson or DCP) is a floated fibre-reinforced concrete slab with pigment and granite dust scattered on the surface whilst it is wet and trowelled (floated) into it. Both firms appear to have good colour choices from which an Ox Blood colour match appears likely.

Granolithic appeared to be the closest material available currently to match a Bickley method. If the surface can be comparably smooth to the current court, the ball bounce characteristics should be similar. This is also very durable.

Comparative physical analysis

Preliminary tests with basic equipment showed that scientific testing of bounce and friction was feasible and industry standard tests were investigated.

The Schmidt Hammer survey of the Bickley court confirmed that the floor is straightforward concrete (albeit of older vintage than Schmidt is usually used to test, which is after curing at e.g. 30 days old).

Labosport were engaged to carry out ball pace and foot slip tests on the court floor and on eight sample surfaces on test slabs. The results indicated that two of the samples were very close and close to the current floor. The other test samples had more grip (two samples) and less grip (four samples). On pace testing (ball behaviour) the same two samples were the closest with all the rest being lower pace (slower). The closest in both tests was the modern granolithic floor – a very close 21st century version of Bickley's floor in method and construction. It can however only be created with a new concrete floor of at least 75mm thickness. Alternatively, the cementicious topping can be applied in 4-6mm thickness and can therefore be considered as a feasible basis for "patching" the floor.

Other research findings and observations

a) The Wellington court is a new concrete floor ground and polished to 400 grit smoothness. Holyport has ground off the highspots from the floor slab joints (after flooding) to improve bounce.

b) DCP Sports Surfaces have measured the Bickley floor to 70 slip units and can propose a resin sports floor ~6mm topping to 80 slip. This is the smoothest they supply, stated to be not distinguishably different from 70 slip, but we were not convinced.

c) Tarmac advice was to not replace the currently well-bedded and heritage Bickley concrete unless no suitable solution can be found without doing so.

d) A ground and polished concrete surface is widely seen as the best known modern solution to a new floor e.g. Wellington, Melbourne.

e) Available reference documents from the T&RA are centred around painting or topping the floor with reference to rackets courts. There is nothing available on construction or physical properties index.

f) The considered view is that the Bickley floor is not a suspended panel arrangement, and the concrete is not special. The red surface typical of Bickley is a smooth hardwearing surface imparting colour. It behaves as any concrete surface would do, given appropriate smoothness.

Summary

The research confirmed the likely constitution of the existing floor and showed that it would be reasonably possible to reproduce the surface, with the best option for similarity of playing characteristics being a granolithic concrete floor.

The club committee then agreed to engage with suppliers to understand likely costs, timescales, risks and supplier interest.

Initial engagement indicated that full replacement of the floor with a modern granolithic equivalent would be affordable, practical and presented an acceptable level of risk. This led to further options analysis regarding design details such as slab thickness, excavation approach, and division of responsibilities across suppliers, and finally to contracts being agreed.