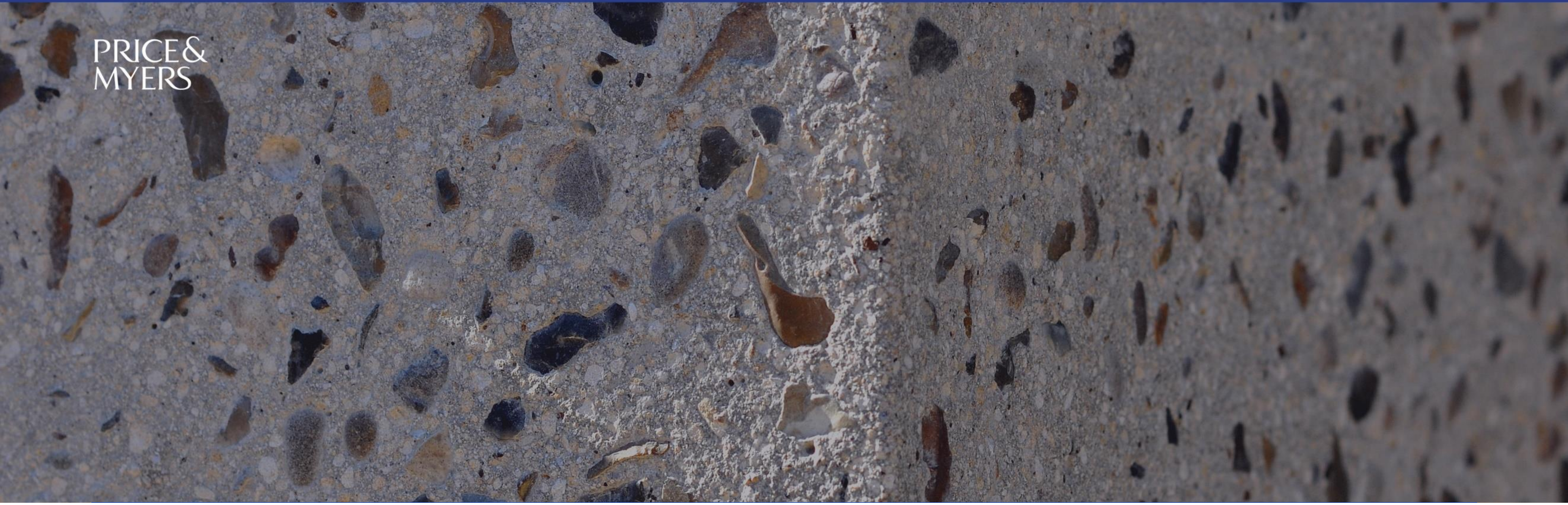

Kennington Park Skatebowl
London, SE11 4BE

Structural Engineering
Development Outlines Report

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Job Number: **29471**

Date	Revision	Notes/Amendments/Issue Purpose
Mar 2021	P1	For Information
Apr 2021	P2	Minor updates to section 4.1

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Contents

1 Introduction

Price and Myers have been appointed as structural engineers to undertake a visual inspection of the Kennington Skatebowl at Kennington Park, London, SE11 4BE. The purpose of this report is to report on the general condition of the skatepark as well as outline repair works and measures to reinstate the damaged and settled areas of the existing precast ferrocement skatepark units.

It should be noted that the assumptions made regarding the existing construction are based on the available trial pits and visible areas that were accessible at the time. Where assumptions have been made these are stated and for any future works further areas of investigation are outlined.

2 The Site

The site is located off Kennington Park Road, with the skatebowl sited in the Northern corner of the park adjacent to Kennington Park Place. The skatebowl is sited on the location of an old Tarmac tennis court, surrounded by mature trees. These are appear to be generally London Plane trees of height varying from 5-10+ meters.

Figure 1 - Aerial view of site location. Ref: Google Maps, 2020

Figure 2 - Left: Southern end of skatepark
Right: Northern end of skatebowl with Trial pit at broken out flat panel location
In both cases trees visible in Foreground

3 Existing construction and ground conditions

General construction

The general construction of the skatebowl is that of a precast ferrocement system of units supported on concrete bearing pads. These are part of the modular 'Radical Banking' system by The Great Outdoors Skatepark Company Limited. This organisation was spearheaded by the Skatepark designer and architect Lorne Edwards, with construction of Kennington Bowl taking place in 1978. The park consists of the RB6 hard lipped 'Banked' sections seated on perimeter wall units at their higher end, with the 'flat-bottom' of the skatebowl formed of the RB1 'standard flat sections' (Figure 3). Typical system elements are outlined in further detail in the Radical Banking System's design catalogue.

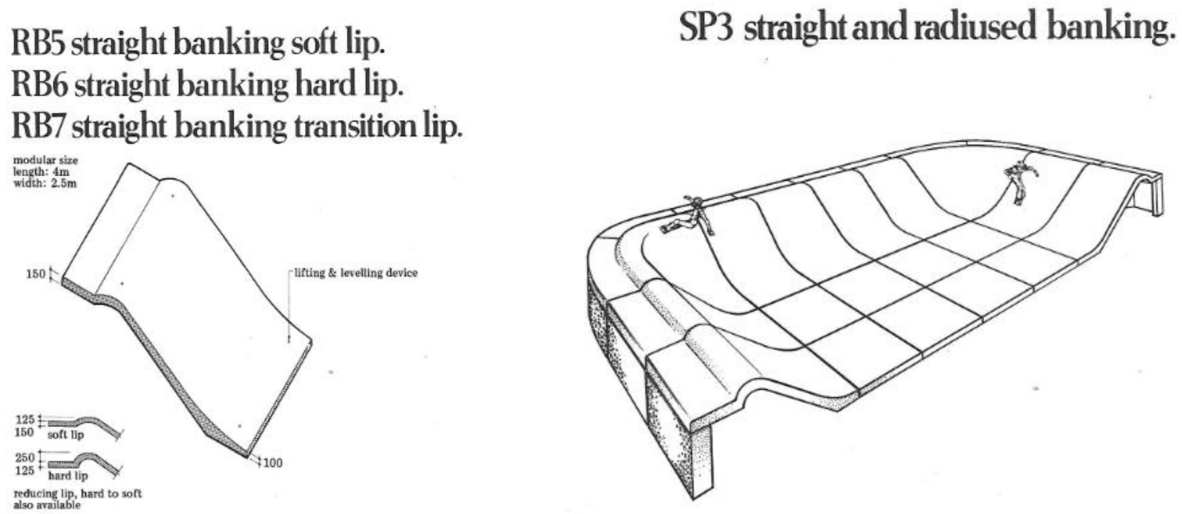

Figure 3 - Left: Typical precast banked unit from Radical Banking catalogue
Right: Typical sectional arrangement using banked units on wall sections with flat panel bottom pieces
(note; Kennington is larger in arrangement)

Of note is that the system uses a levelling device for the support of all units (Figure 4 – Left: Levelling device detail from Radical Banking catalogue). These are embedded plates cast-in with a stainless-steel threaded barrel bolt. This threaded bolt bears onto a steel plate which then sits on top of the proposed foundation (in the case of the catalogue a 'paving slab'). This acts as both the fixing for any lifting eyes during construction and as the levelling device on the bearing pad.

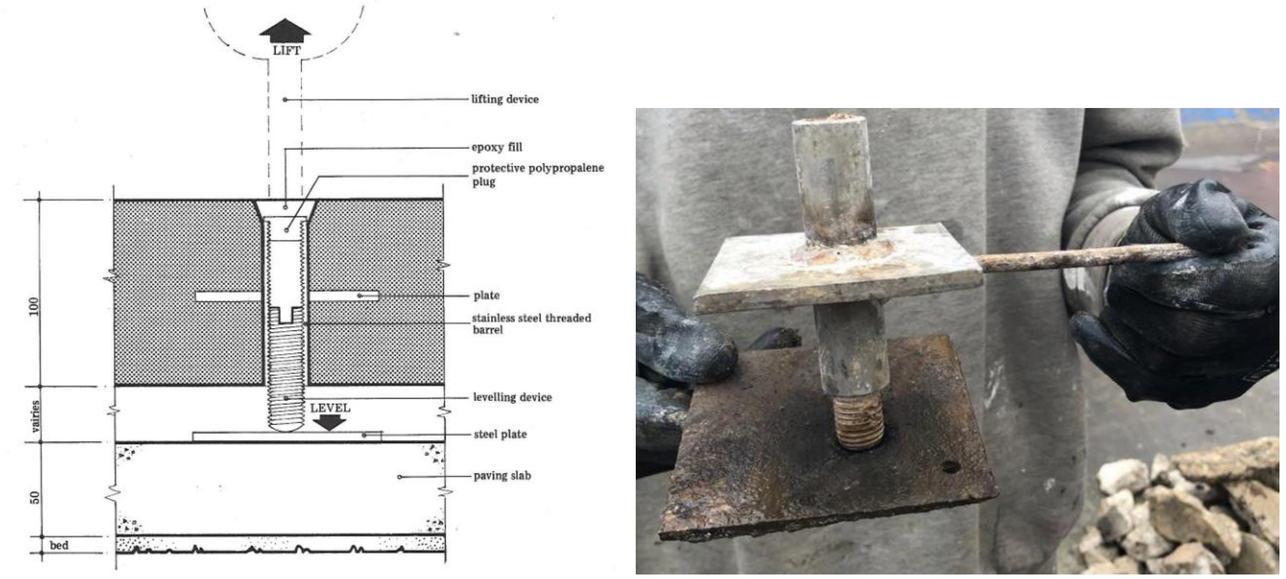

Figure 4 – Left: Levelling device detail from Radical Banking catalogue
Right: Levelling device broken out from removed flat panel unit

The skatepark has seen noticeable movement over the years since its construction, with the gaps between the precast elements varying considerably in horizontal and vertical distance. Thus, the rideability of the skatepark deteriorated as these gaps became untraversable for skateboard and rollerblade wheels. The original jointing detail is that of a neoprene gasket strip with a nominal gap of 3mm provided (Figure 5 - Jointing detail between PC units). Whilst the park pre-dates the current British Standard for skatepark construction joints, the original 3mm horizontal gap is within the acceptable construction joint deviation in BS EN14974:2010.

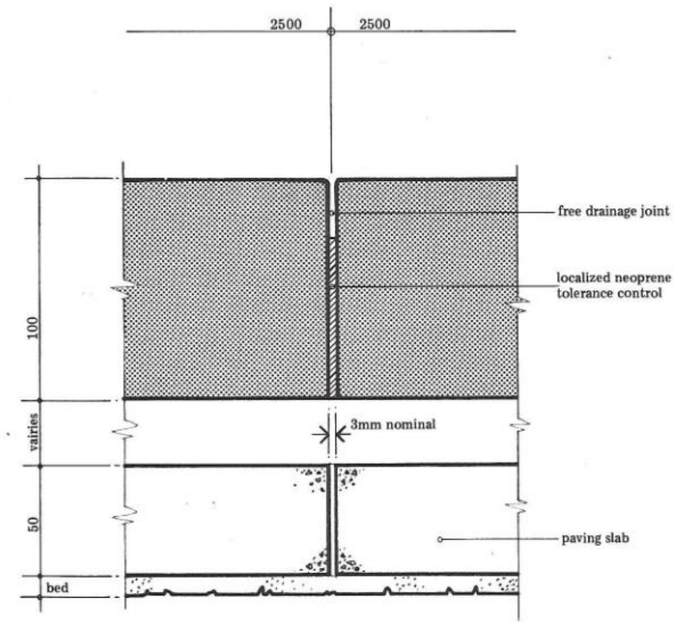

Figure 5 - Jointing detail between PC units from Radical Banking Catalogue

As a result of the movement works were undertaken in 2012 by California Skateparks for a skateboarding event (on behalf of their client Converse). However rather than remedying any of the issues with the tolerances between the units, a nominal unreinforced screed of approximately 20mm thick was placed over the skatepark. This has since deteriorated significantly and mirrored the movement and seams of the precast units. This was then detailed in a conditions report undertaken by Wheelscape Skateparks Limited in 2016, however this report covered only a visual inspection with regards to rideability. Since then it is likely that the park has seen further movement.

Site visit to view opening-up works

The site was visited on 16th February to view opening-up works and a trial pit dug by contractors on behalf of Lambeth Council. The purpose was to expose a typical foundation junction between a flat section with the banked units, the general high-level geology of the site and to visually assess the current condition of the skatepark. The units identified to be removed were the rocking flat panel units at the Northern end of the skatepark (Figure 6).

It was found that the typical foundation for the units was that of a nominal mass concrete pad varying in thickness from 20-75mm (Figure 7). Each pad was sized such that the meeting corners of four units sat directly on top via the levelling device in Figure 4. The trial pit found that the concrete bases were sat either directly on topsoil or the tarmac from the previous tennis courts. Below this Clay was found, with some parts appearing to be Made Ground (notable brick rubble, Figure 8). Site findings are detailed in Appendix A.

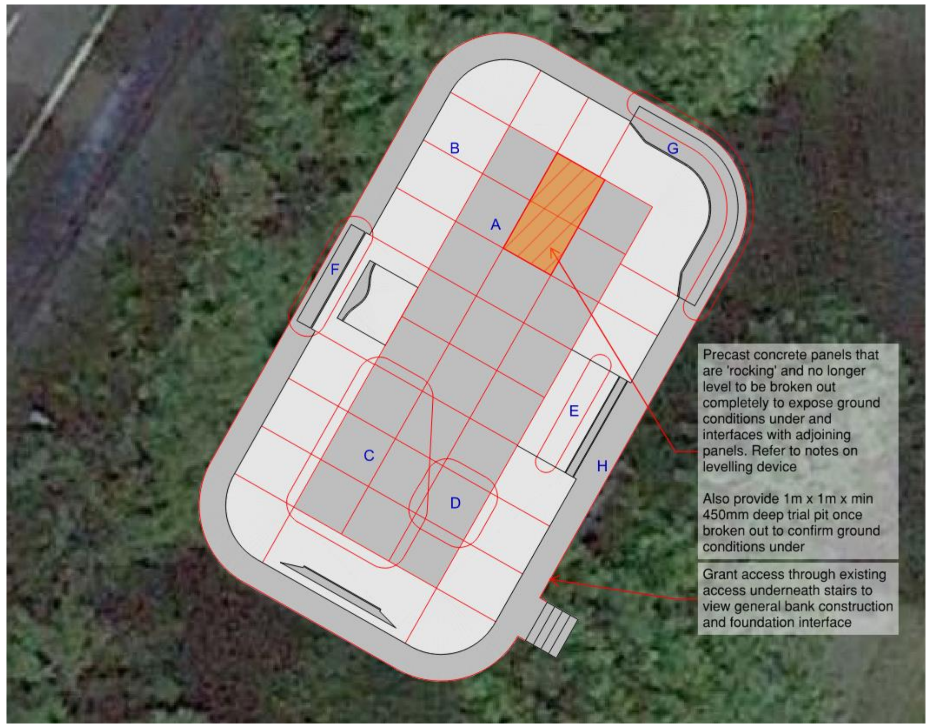

Figure 6 - Excerpt from P&M investigations mark-up outlining removed panel units

Figure 7 - Exposed trial pit and slab junction at northern end of skatepark.
Existing tarmac on topsoil visible at top of picture with nominal mass concrete pads in foreground

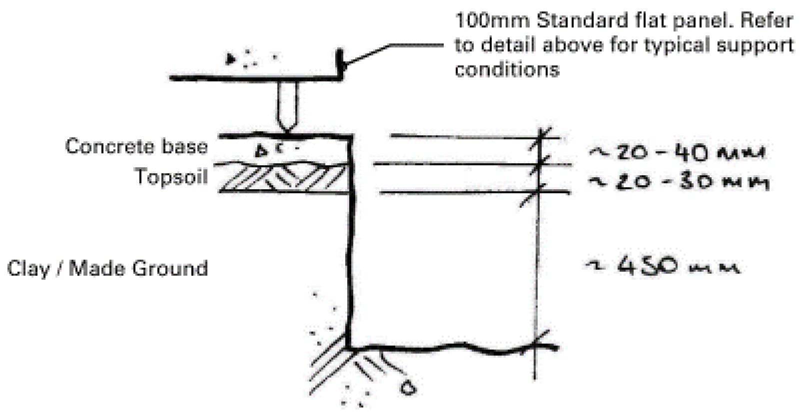

Figure 8 - Trial pit log – refer to Appendix A

The extent of the ground conditions and foundation interfaces could not be discerned for other areas of the skatepark due to the limited opening up. As part of any future repair strategies it would be prudent to further investigate the skatepark construction, particularly around the outer perimeter to understand the founding of the external wall units.

Given the shallow skatebowl foundations it is understandable that the construction has seen considerable movement over the last 43 years. The differential movement of the precast units is likely caused by the seasonal water demand of the trees surrounding the skatepark combined with the high shrinkability of the clay strata. Similarly, the shallow mass concrete pads being part cast on historic tarmac and part on topsoil would have had an effect, particularly given that this is above the 450mm zone that is susceptible to frost-heave in winter months.

Typical best practice would have seen the skatepark founded on footings that are not susceptible to significant ground movement. If these were traditional mass concrete strip or pad footings NHBC 'Building Near Trees' guidance would put the foundations at a required depth of minimum 1.5 meters below ground level. Alternatively, a piled solution could also have been adopted. This is not to say that ground movement could have been completely avoided, though a deeper foundation solution when first built would have significantly limited the differential movement of the individual precast units and likely left the bowl skateable. Therefore, it is also understandable that the works in 2012 to refurbish the skateparks were hastily executed. Rather than address the engineering challenge of re-levelling the skatepark an unreinforced concrete skim was applied to temporarily mask this. Eventually the top surface cracked with seasonal movement, mirroring the seams between precast units and continuing to spall further to bring the park to its unusable state.

Figure 9 - Typical mirror crack in 2012 Concrete skim over top of units
(white material is a DIY infill from local skateboarders)

Visual inspection of perimeter construction

Measurements were taken along the top standing deck of the skatebowl, specifically looking at the gaps to the top of the banked units. This was to ascertain the approximate magnitude of deviation between units, both vertically and horizontally. If it is assumed that all panels were installed to the 3mm gap that the original radical banking catalogue denotes, then this can serve as a benchmark for the current deviation. Appendix B contains a log of the horizontal and vertical deviation between panels. Ultimately the vertical gap averaged around 5mm, however the Northwestern corner of the park showed the most significant movement ranging from 10-20mm vertically (Figure 12). The horizontal deviation was noted to be of a similar magnitude. In some areas the gasket strip appeared to have either fallen out, been removed with wear, or in some cases compressed and squeezed out (Figure 11). It however appeared that these strips may not be of the original construction and possibly applied as part of the 2012 works. Due to the concrete skim over the main skateboarding surface, no measurements were able to be taken for the flat-bottom section. Therefore, this information should be taken as a window into the anticipated movement and any future works should seek to expose the precast construction to ascertain the full extent of movement.

Figure 10 - Left: Horizontal gap between PC units in excess of 20mm
Right: Vertical panel gap approx. 20mm

Figure 11 - Areas of gasket strips between units.
Left: Partially removed sections with moss growth in between
Right: compressed strips bulging out

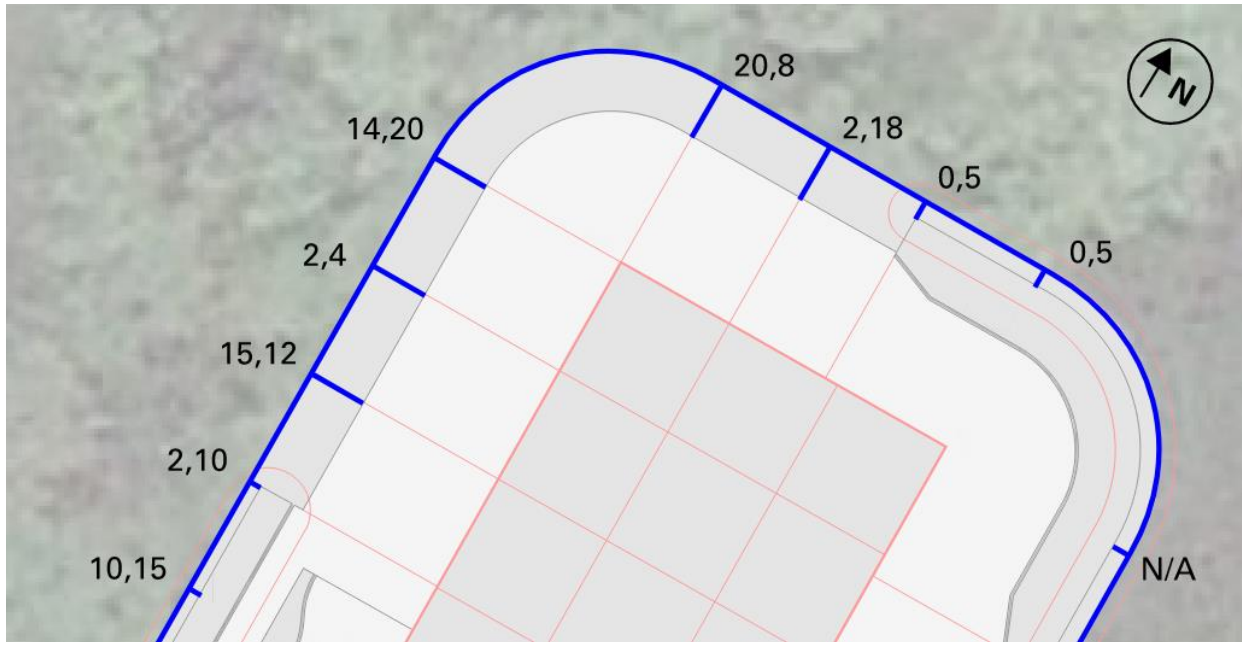

Figure 12 – North Western corner showing significant panel movement. Refer to Appendix B for further information

4 Outlines for reparation works

Repair strategies

Generally, with new skatepark constructions any possible differences in height between panels or construction joints should be smaller than the material thickness of the rolling surface and not exceed a maximum 3mm in height difference over a length of 300mm, with the width of joints not exceeding 3mm as BS EN14974:2010. Whilst this is not entirely applicable to a historic construction of this time, this is still a suitable benchmark for rideability of the skatepark.

It is therefore with this in mind that the repair works at Kennington work towards this. It is also understood from Conversation with the Local Authority and the project steering group that there is an intention to maintain the architectural heritage of this construction where possible. It is therefore proposed that a phased approach is taken to the remediation works for this skatebowl. This will function part as investigate works to better understand the movement of the bowl and as a procedural remediation method.

Fundamentally the issue of Kennington Skatepark is that of a serviceability problem arising from the current foundation solution; shallow footings placed on a shrinkable near-surface soil strata. The superstructure (under the skim) appears in relatively good condition. The following solutions outlined should be approached in a phased manner to ascertain the extent of what requires rectification.

4.1 Phase 1 options; investigations and re-levelling existing devices

Phase 1A: Survey

For whatever works go forward, it is essential that a topographical survey is undertaken. Without fully understanding the extent of movement between adjacent units it is difficult to determine the suitability of finalised repair works. From this a detailed snapshot can be taken of the relative park. To do so:

- **Appoint contractors to remove top skim of concrete applied in 2012 and rake out neoprene soft joints between precast units.** There is a risk that any percussive tools used to break away the top skim of concrete may cause some additional movement to the units; however it is not envisaged that this should be considerable.

- **Appoint topographical survey contractor to undertake site survey;** Once the precast units are exposed, a survey should be taken. Given that we are looking at discerning movements within the millimetre range it is best that this is something of reasonable accuracy, i.e. a point cloud survey. Measurements can also be taken using traditional means, though the contractor will need to demonstrate their ability to capture information accordingly.

  In all cases. Values should be given at all four corners of each precast unit as well as around the perimeter wall units

This information should then be collated into a CAD model, with future design and construction works referencing this.

In liaison with Wheelscape Skateparks who authored the original conditions survey report in 2016, it has been anecdotally brought to our attention that during the 2012 works, certain unit edges were ground down to make the transition between adjacent units smoother. Any findings of this should be made apparent.

Phase 1B: Re-levelling of units

Phase 1A will then inform this stage. With the top of the structure exposed and levels known, the existing levelling devices encased within the structure should be exposed. Then a re-levelling exercise undertaken to bring the units to within the 3mm tolerance:

- **Chase out the epoxy fill and polypropylene plug used to seal the top of levelling devices** (Figure 1).
- **Test if panels can be levelled** (extent informed by topographical survey information). If panels can be levelled, follow next step;
- **Level all devices using existing foundations:** where levelling devices are seized use a rust penetrant / remedial levelling detail where applicable

This is a light-touch recommendation with the least structurally intrusive works proposed. Should the units be capable of being re-levelled then this is a cost-effective solution for re-instating the skatebowl to a skateable condition. Once these works are completed, a maintenance regime should be put in place to monitor the movement in the panel units. It is difficult to comment on how long the park will hold its current position and whether the panels may move excessively in the years, so this data should be collated over the usage duration of the park. Typically, quarterly for the first year, then once annually thereafter. Similarly, it may be that certain panel units have only so much play, such that further profiling of the PC unit edges may be required. The final extent is to be agreed with the council and chosen contractor.

Whilst the downside of this solution is that the existing foundation solution is not improved, given the extent of movement that has occurred over the last 43 years it may be possible that with the right maintenance regime and monitoring of movements that this buys additional design life for the currently constructed park. The re-levelled units should then have the soft-joint re-instated, with the flat-bottom of the skatebowl capable of free-draining to the ground beneath (as per original proposals).

For further information refer to the outline drawings in Appendix C.

4.2 Phase 2: Structural interventions

Should it not be possible to re-level the park either due to unsalvageable levelling devices or the seasonal ground movement profile being too considerable to mitigate, then a greater level of structural intervention will be required. This is broken down into two options as follows.

Option 2A: Jacking of existing units

This would employ keeping the existing banked units in place with the removal of the flat-bottom panels to give access to all supporting perimeters of these elements. Through removing the flat-bottom slab, then a proprietary solution for jacking the devices on new foundations can be brought forward. Typically, this could entail steel screw-piles installed at perimeter points of the banked units, close to the edges of the banked units (example in Figure 13). Then screw-piles would form a new founding level, with the edges of these units jacked into positions removing the deviation between units. The advantage of using screw-piles is that these can be founded to a level not adversely affected by the near-surface ground movement; screw-piles being partially threaded, in that the shank area with the helical screw is located below the region of anticipated ground movement (trees and frost-heave). Whilst traditional mass or strip footings in a hit-and-miss underpinning sequence can also be considered, the required depths along with the likelihood of tree roots under the skatepark could prove an issue when excavating for footings. A screw-pile solution can also be installed by hand-held means.

Once the external banked members are re-positioned then the new flat-bottom slab can be installed in-situ with support off the same screw-pile foundations.

Figure 13 – left: Screw-pile underpinning installed onto subsiding masonry to external corner of residential property Right: Typical manual installation of helical screw-pile installation

Option 2B: Disassembly and re-construction of park as existing

Failing the previous option, it would be possible disassemble the existing skatepark and re-instate this on new foundations. It may be that tendering contractors for the skatepark works would prefer to have a clear working site. The advantage of the existing structure is that it is theoretically capable of being deconstructed. There is a risk however that the required handling during disassembly may damage certain panel units. Similarly, the required site storage and extent of craneage is to be considered.

Once disassembled, new foundations to a suitable depth can be installed. These would be provided at similar support points to the existing scheme with the units then re-installed to bear onto these. Once assembled, a new slab to the flat-bottom of the park is installed to cap it off.

There is also an option to re-instate the skatepark with the members supported on landscaped fill to form a ground-bearing system. This process would require stripping out approximately 0.5m-1.0m of existing ground, with this improved to receive a typical build-up of 0.5-1.5m of 6F1/6F2 (varying to suit unit heights) and topped with 150mm top layer of Type1 to found the units on. This solution would effectively improve the ground and form a granular mat that can dissipate the ground movements over the years in a more uniform manner. It is prudent that this is all underlain by geo-grid or geo-textile and with all layers carefully compacted as per Specification for Highway Works requirements. Similarly, the provision of trench drains under would be required to mimic the existing drainage profile / surface sheet water run-off to the nearby trees. This solution may be preferable to skatepark contractors as this is a common form of skatepark landscaping. This would require detailed geotechnical investigation of the ground with CBR and soakaway tests performed.

5 Conclusions

Through investigative works, it has been found that the condition of Kennington Skatebowl is subject to historic ground movements due to the shallow nature of the existing foundation construction. As such, the resurfacing works undertaken in 2012 have mirrored this movement with cracking to the top surface skim exacerbated at the existing soft junctions between the underlying precast units.

Given the nature of the construction used at this skatepark it is the understanding that the skatebowl is to be reinstated in a nature where the structural works retain the architectural character of the 'Radical Banking System'. For re-instatement of the skatepark into a useable condition the following phased options, concurrent with investigative works, are proposed:

Phase 1A: Breaking away of top surface concrete skim to expose and assess in detail the condition of the existing skatepark. Topographical survey information to be obtained with monitoring of the skatepark over a seasonal time period.

Phase 1B: With the topographical information obtained an informed exercise of testing the ability to re-level the park using the existing levelling devices is undertaken. Should this be successful the skatepark is observed for movement and a maintenance regime put in place by the local authority.

Should re-levelling not be possible then the following options are to be considered;

Phase 2A: Remove the flat-bottom slab and re-support the perimeters on new footings (typically stainless-steel screw-piles). Use new footings to jack the perimeter units into the correct position. Once complete provide new in-situ slab to middle of skatebowl.

Phase 2B: Deconstruction of the existing park to clear space for new foundations. Once foundations are placed, re-instatement of existing precast units. There is a risk however that the existing units may be damaged during handling.

In all cases, the input of specialist contractors for the construction of the skatepark is highly recommended.

Appendix A
Trial pit logs

PRICE & MYERS

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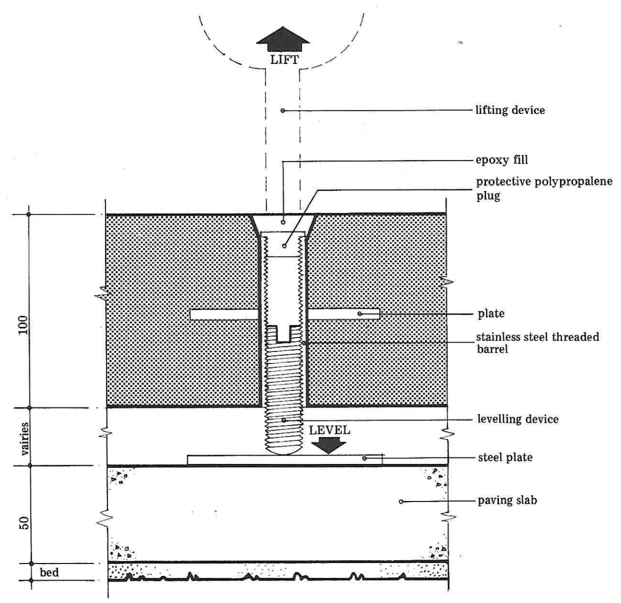
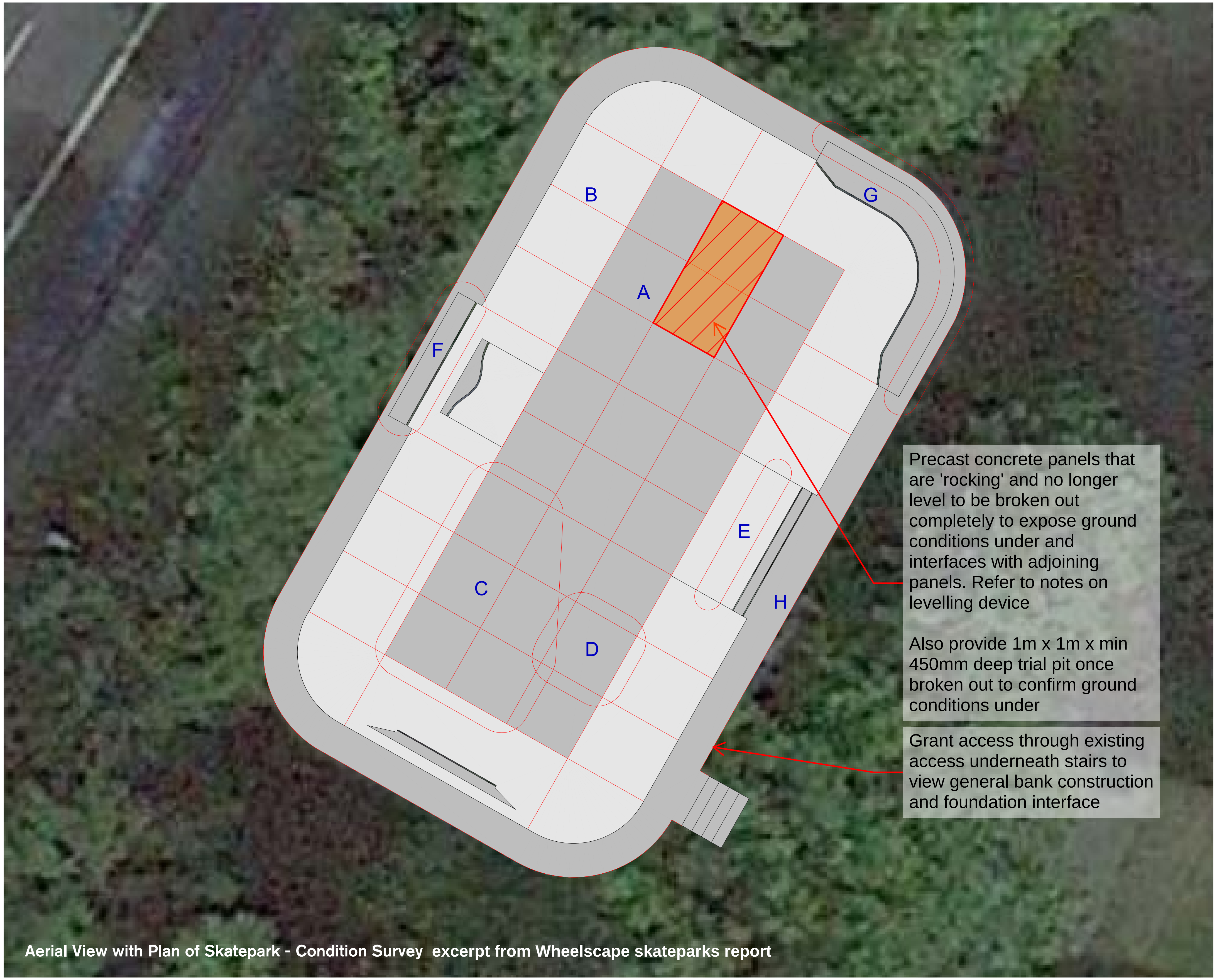
Date 04/02/21 Eng BB Chd

Job Kennington Skatepark

Typical PC unitlevelling / support device - Ref: Radical Banking system



Care to be taken no to affect anticipated leveling device at boundaries of precast panel units that support adjoining panels.



Aerial View with Plan of Skatepark - Condition Survey excerpt from Wheelscape skateparks report

Notes:

All items shown are indicative and not to be scaled off

Contractor responsibleor opening up works to make good existing construction / cover over any openings so as not to create any undue hazards. The above assumes that the park is still closed off and not open for formal use

Notes:

- All items shown are indicative and should not be scaled off
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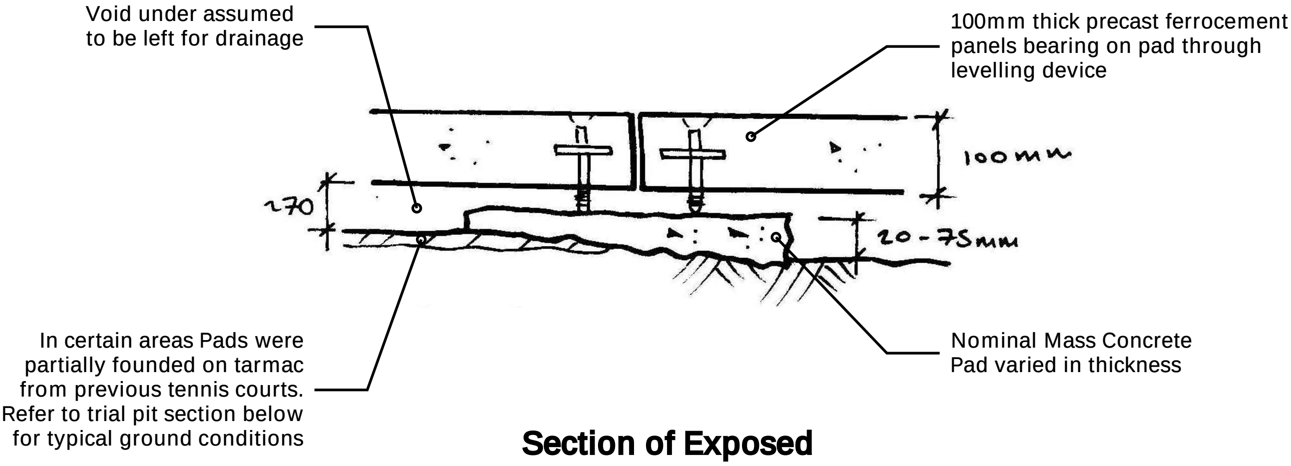

Section of Exposed Standard Flat Support

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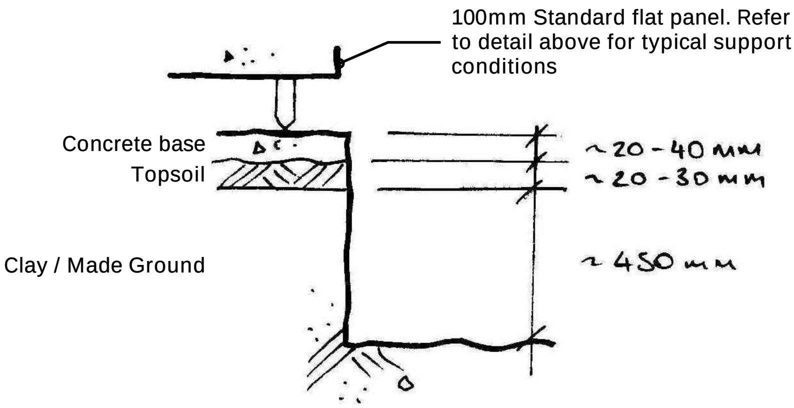

Trial Pit Section

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PRICE& MYERS

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Appendix B
Concrete surface repair methods

Notes:

The deviations in seams between banked units were measured approximately at top junctions only at the top standing platform ofthe skatebowl. These are magnitude values of typical variation and should not be taken as detailed survey values.

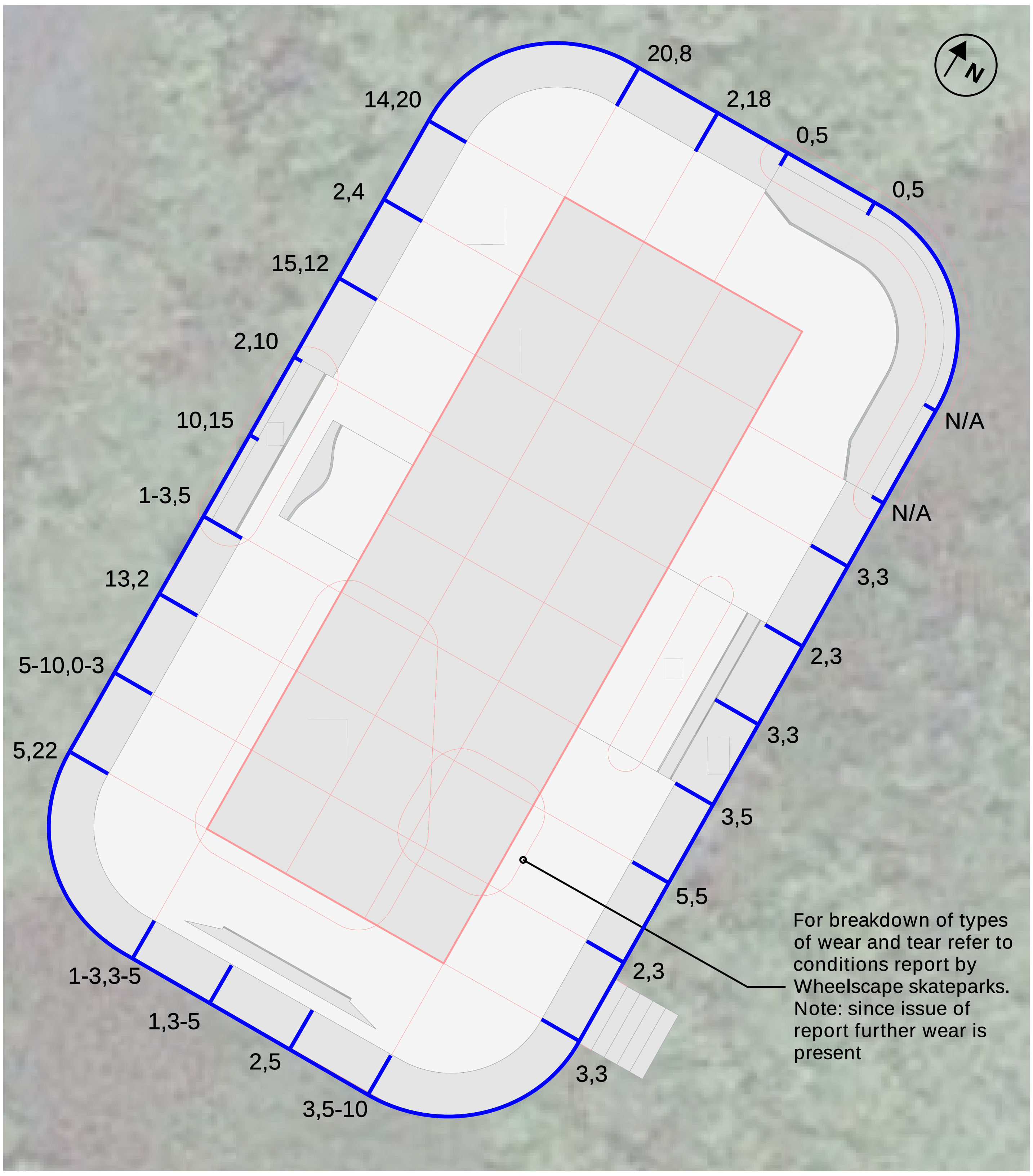
All items shown are subject to detailed survey of existing Precast elements.

Deviation legend:

(Vertical , Horizontal)

All units in mm. Noting the approximate gap between tops of panel units

Where ranges are given these are approximated among seam length



Aerial view of Skatebowl showing movement / unit deviation among top standing area

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Appendix C
Phase 1 levelling proposals

PRICE & MYERS

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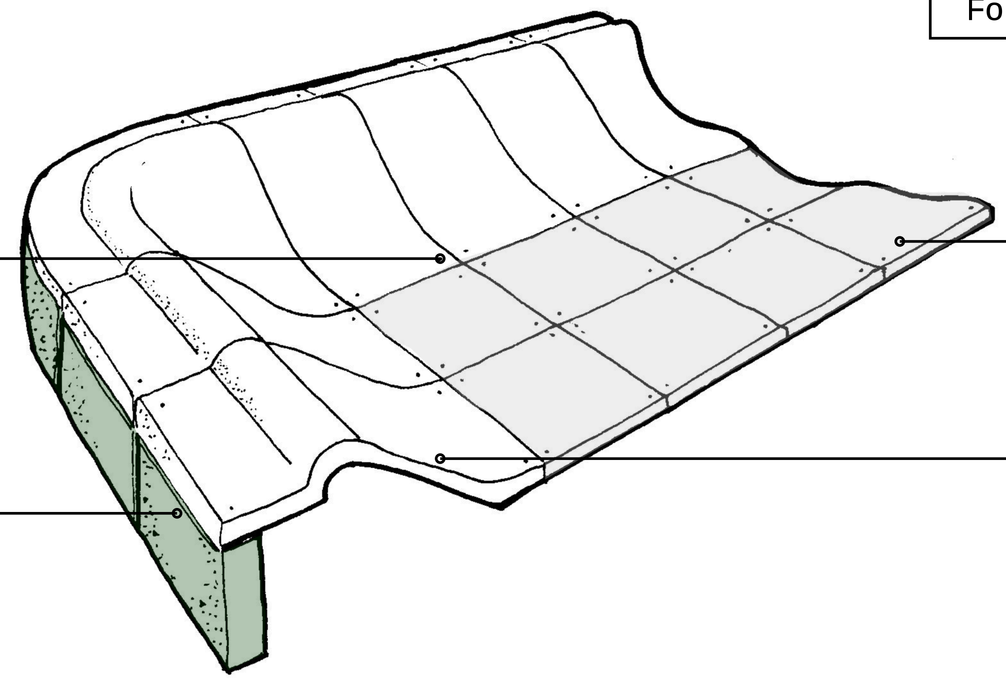
Notes:

All items shown are indicative and subject to detailed design development with input from specialist contractor, steelwork fabricator and further investigative works

Isometric section of typical skatebowl corner

Foundations omitted for clarity



Sequence for using existing levelling devices
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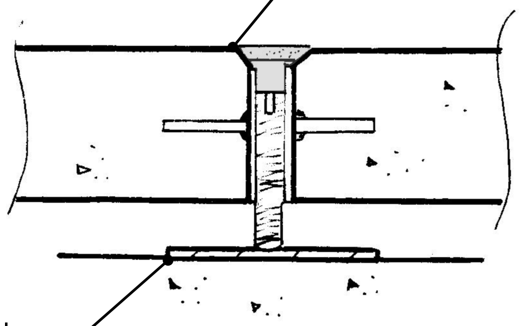
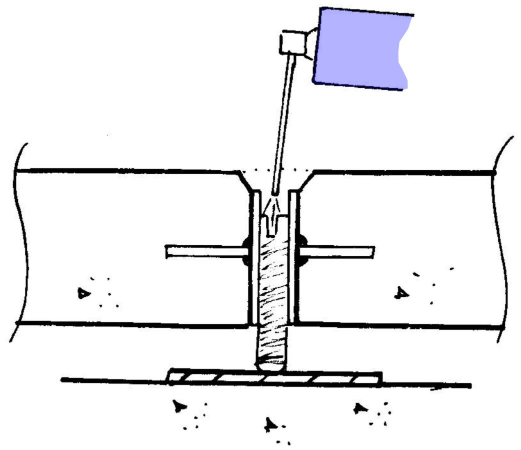
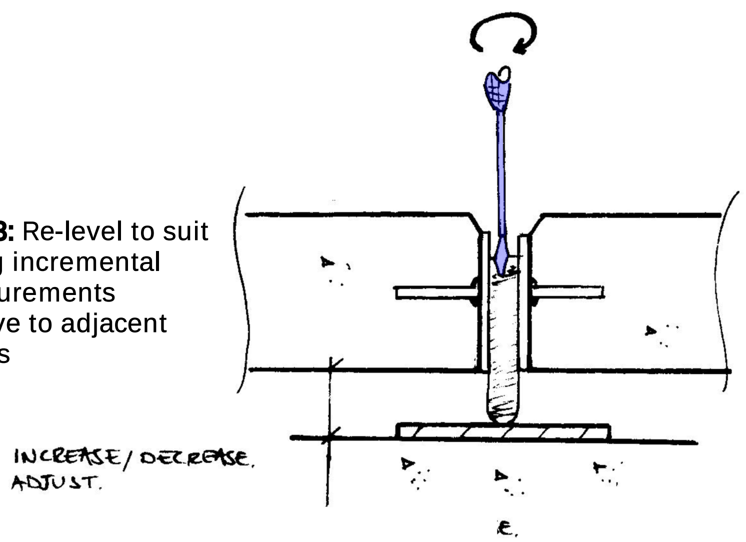


Step 1: Locate existing levelling devices and remove epoxy fill and polypropylene plug

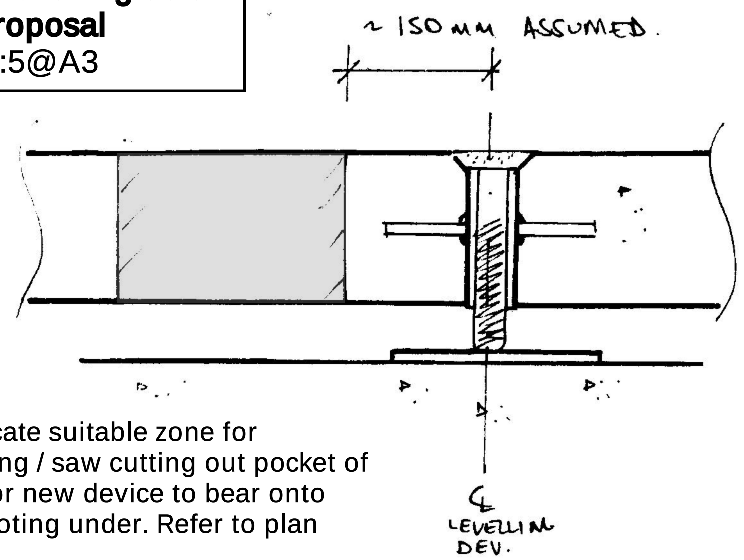


Step 2: Test device for functioning of barrel bolt. If seized apply penetrant to remove rust

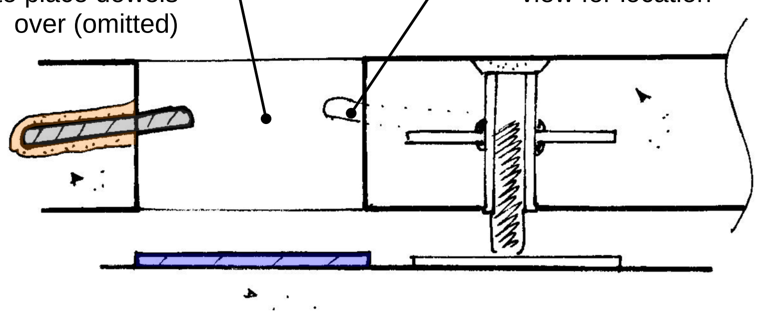


Step 3: Re-level to suit taking incremental measurements relative to adjacent panels

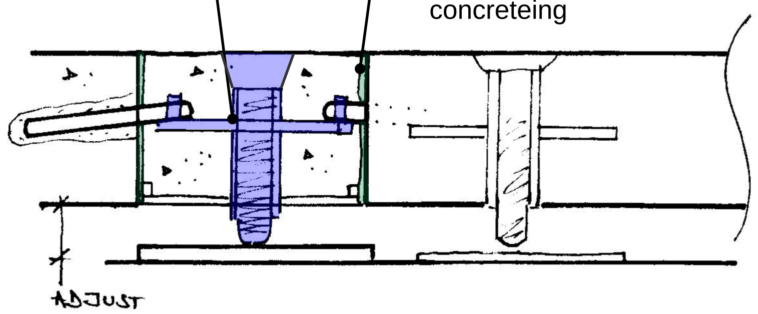
Remedial levelling detail proposal
1:5@A3



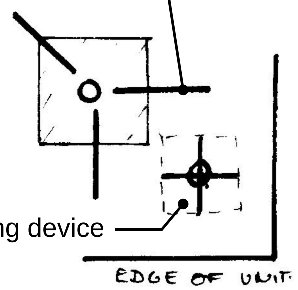
Step 1: Locate suitable zone for stitch-drilling / saw cutting out pocket of concrete for new device to bear onto existing footing under. Refer to plan location



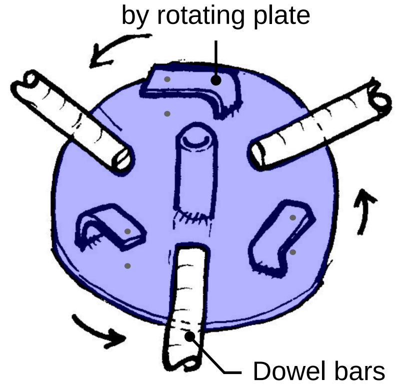
Step 2: Install resin-anchored stainless steel dowel bars into existing PC unit. Allow for skew-drilling. Place bearing plate underneath on existing concrete footings



Step 3: Install new levelling device. Couple to anchors and concrete in with high-cement concrete. Allow for sacrificial formwork and application of bonding primer to clean existing surfaces. Level units.



Typ. plan view of dowels



Iso. view of levelling plate top