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SEEING IS BELIEVING

How augmented reality can boost concrete construction efficiency

NETHERDALE STADIUM

Sympathetic repairs to a Grade A listed concrete stand

REINFORCEMENT AND ACCESSORIES

New guidance on the difference between standard and 'eco' fabric

NETHERDALE STADIUM, GALASHIELS

The town of Galashiels in the Scottish Borders is the home of the Gala Fairydean Football Club, whose concrete stand is a Grade A listed structure. In 2018, the stand was closed for safety reasons due to spalling concrete from the roof soffit falling onto the terracing below. Tony Parsons of Concrete Repairs Limited (CRL) explains how the repairs were sympathetically carried out to this listed building, to restore it to its former glory.

ABOVE:
Figure 1 – completed view.

TOP RIGHT:
Figure 2 – general view of the stadium prior to repairs commencing.

BELOW RIGHT:
Figure 3 – underside of roof showing patches broken out ready to be repaired (note board-marked finish).

INSET:
Figure 4 – mock repair used during trials to determine final methodology.

The original design of the stand was carried out by the architect Peter Womersley with the structural works carried out by Ove Arup. The construction works were undertaken by Holst, later to become Norwest Holst, with completion in November 1964 at a cost of £25,000.

Shortly after the stand was completed, *Architecture Today* described it as a "geometrical composition of unusual interest and subtlety"[1]. Historic Scotland, as it was then, in its 2006 listing described the stand as an "outstanding work of Late Modernist Formalism in Scotland"[2]. The locals, as with Marmite, either love it or hate it.

In 2018, shortly after the stand was closed, the Edinburgh office of Narro Associates was appointed as project manager and lead designer to carry out the necessary investigations works and schedule what works were required to reopen the stand. Architect Reiach and Hall was appointed to deal with the architectural aspects of the project.

SURVEY AND TESTS

CRL Surveys was commissioned to carry out an in-depth site survey with lab testing of concrete samples. From the results of the survey and tests, it was concluded that the structure was generally in a good condition. However, it was found that the steel reinforcement was positioned too close to the concrete surface and was being affected by moisture, from both the external environment and the high humidity levels within the roof void.

It has to be pointed out that the original construction drawings show that the designed cover for the reinforcement was specified as ½-inch (13mm) to the soffits and 1-inch (25mm) elsewhere, and in the majority of the areas requiring repair, this was found to be the case. Certainly not acceptable by today's standards, but quite common for structures built in the 1960s.

Two distinct areas of repairs existed: the external concrete elevations of the stand and the concrete elements within the roof void below the terracing. In both areas, Douglas fir planks 125mm wide, were used for the formwork, which gives the building a distinctive board-marked finish, with graining from the planks imprinted into the concrete surface.

Of the two areas, those within the roof void, where the visual impact of the repair would be minimal, were the easiest to deal with, allowing straightforward concrete repair methods and materials to be used on the underside of the roof. However, the external elevations required a repair strategy that

recognised the importance of retaining the board marking and timber graining from the original formwork and other cast-in visual imperfections present on the concrete surface. Replicating the original surface finish as closely as possible was essential in helping to minimise the visual impact of the repaired areas.

In November 2021, CRL was appointed as the principal contractor for the reinstatement works. Trials commenced on finding a method that could replicate the 'board-mark' finish from the original formwork. These trials took place on-site and in CRL's yard. The use of timber planks was soon discounted due to various factors, namely:

- the difficulty in matching the existing graining on a consistent basis
- the rigidity of the board formwork posed problems in matching the uneven surface surrounding the repair, often resulting in lipping between the new repair material and the existing surrounding concrete.

It was therefore decided to take silicone casts of the existing surfaces and produce a silicone lining that could be applied to a plywood backing. During the trials, various methods of filling the formwork/placing the repair material were tested using different mixes and methods to secure the falsework lining in place.

Figure 4 shows a 'mock' repair used during the trials of placing the concrete into the formwork to judge the success of the mix flowing around the reinforcement and the compaction against the silicone lining. The vertical section on the left is trialling a 'letterbox' system and on the right filling an inclined section through drill holes in the back of the formwork.

FORMWORK IN PLACE

In Figure 5 (page 24), we can see the formwork in place on the underside of the roof; the light-blue material sandwiched between the plywood and concrete is the silicone lining and the blue nibs between the ply are incorporated within the lining to allow grout seepage into them to replicate the original board seepage joints. Figure 6 shows a good example of the falsework used. This system was based on the Unistrut system of components, which is a lightweight system easily adapted to suit the size of repair and for single or multiple repairs.

Trials were also carried out using various concretes to obtain the right colour and texture. It was found that the success of the repair using concrete was governed by the depth of the breakout and the density and cover of the reinforcement.

The preferred material for the repairs, from an aesthetic point of view, was the 'bespoke' concrete, especially in prominent visual locations. To enable this 'bespoke' mix to be used for repair of a greater number of patches, a 10mm aggregate was used, as opposed to the 20mm aggregate in the original concrete. Where it was not possible to use the bespoke concrete, Fosroc Conbextra (a proprietary blended mix of Portland cement, graded fillers and various additives) was used. The Conbextra provided a good colour match, but the repair presented a block of consistent colour, whereas the bespoke concrete provided a desirable variation in colour shades within the repair.

LEFT:
Figure 5 – trial repairs carried out to the underside of the roof.

MIDDLE:
Figure 6 – formwork showing the use of the Unistrut system for bracing.

BOTTOM:
Figure 7 – spalled concrete prior to repairs being carried out.

Extensive repairs were also required to the terracing of the stand. This was originally constructed using precast concrete planks acting as permanent formwork, with concrete then poured to form the steps. Sacrificial forms of 200mm-diameter cardboard tubing were used as part of the original construction to minimise the weight of concrete forming the steps. Unfortunately, the cardboard tubing forms an excellent route for any water entering the structure, causing expansive corrosion to the reinforcement situated in the ribs on the bottom of the precast planks and resulting in spalling of the concrete.

'HIT AND MISS' SEQUENCE

Remedial works to the ribs were carried out by hand application of Fosroc HB45. Due to the length of the spalled concrete areas to the ribs, for structural reasons the trimming up of the spalled area and subsequent repair could only be carried out in a 'hit and miss' sequence of 500mm. Figure 9 illustrates the sequencing with repairs at various stages. In total, 277 repairs were carried out within the void, with a total length approaching 165m.

Along with the concrete repairs it was decided to tackle the high humidity within the roof void and deal with the moisture penetrating the concrete, which was identified during the original investigation.

The drainage channel to the rear of the roof was reformed to provide falls to the two outlets on the roof. Drainage holes were enlarged and additional holes cored through the beams to allow rainwater to flow to the channel. Finally, a waterproof membrane system was applied to the main roof and to both turnstile roofs.

Within the roof void, ventilation fans were installed; these are automatically controlled by humidity sensors. A vapour barrier and insulation were also installed

RIGHT:
Figure 8 – completed repair using the 'bespoke' concrete.

MIDDLE:
Figure 9 – repairs to the ribs showing the 'hit and miss' sequence.

BOTTOM:
Figure 10 – the completed waterproofing membrane to the roof.

across the whole of the roof area.

Other upgrades that were also carried out to the stand included:

- upgrade of external lighting and installation of floodlights
- installation of a lightning protection system
- repairs to external joinery items
- redecorations of various areas
- removal of superfluous fixtures and fittings to the external concrete elevations to attain the uncluttered appearance of when the stand first opened.

During the early stages of the project, the site was paid a visit by the 2022 scholars from the Society for the Protection of Ancient Buildings, who spent the morning being shown around the site and had the aims and methodology of the repairs explained.

UNIQUE INSIGHT

Jacob Long, one of the scholars, made the following observation that sums up what everyone involved was trying to achieve on the project, "The visit was a unique insight into the materials and methods that can be used for the repair of 20th Century concrete structures. It was strange to be discussing Portland cement as a 'conservation material', but it required a material widely accepted as being detrimental to historic buildings to be reframed – in this context, cementitious mortars without additives and polymers are the traditional ones. Unquestionably, these buildings are an important part of our architectural heritage and as increasing numbers of them begin to show signs of decay, we're increasingly likely to come across them in our professional practice."

References:

1. L'ARCHITECTURE D'AUJOURD'HUI. *Evolution or revolution*. No 119, March 1965.
2. HISTORIC ENVIRONMENT SCOTLAND. *Nether Road, Gala Fairydean Football Stadium*. Available at: *https://bit.ly/2YHDphY*, November 2006.