clancy consulting

Structural Appraisal Report for RAAC Roof Planks at Haywood Hospital, Stoke-On-Trent

Prepared for

Midlands Partnership NHS Foundation Trust

28/01/2020

Rev. 00

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1.0 Introduction

Clancy Consulting have been appointed by MPFT to inspect and provide recommendations for the Reinforced Autoclaved Aerated Concrete (RAAC) roof planks observed across the Rheumatology Building at Haywood Hospital.

The purpose of this inspection is to assess the condition of the RAAC roof planks, following on from previous inspections carried out by MLM and ABA consulting, while providing recommendations for the short and long term future.

Further to reporting on the visual inspection, this report will summarise an intrusive investigation carried out by Bi-TAS to the roof planks located above the Hydrotherapy pool.

This report should not be considered as a comprehensive appraisal of the structural condition or stability of the entire premises but deals solely with the matters referred to within it. Furthermore, the recommendations contained are intended to be outline only at this preliminary stage and are not intended to represent detailed design proposals.

This report is prepared for MPFT for their own use and no liability can be accepted for reliance or use of the report by any third parties. We have no objections to a copy of this report being shared with the maintenance staff.

2.0 Description of Property

Haywood Hospital comprises of a number of buildings with differing construction methods believed to be built between 1980 and 2010.

The Rheumatology Building is located on the southern end of the Haywood hospital site and is accessed from Haywood Road.

The building is typically a single storey block with localised second storeys for plant rooms along with a double height gymnasium. The building is formed with a mansard roof, which is generally constructed of long span steel trusses with portalised rolled steel sections for the plant rooms and gymnasium.

The RAAC planks are known to have been used across the Rheumatology Building and is therefore the subject of this report.

The external walls are constructed of masonry with tiling to the mansard roof sections.

The roof build up is consistent throughout the building and is believed to comprises of the 200-215mm thick RAAC planks with a further 100-120mm of insulation and single ply membrane.

3.0 Visual Inspection

Our survey comprised of a detailed visual inspection to assess the roof planks where access was permitted. The limited access allowed for an inspection to be carried out in the plant rooms and the gymnasium. With the presence of a suspended ceiling, this meant visibility was restricted to the roof planks in the majority of the building, therefore ceiling tiles were removed to inspect the void above in localised areas.

The inspection was carried out on 24th November 2020 and 14th January 2021 by Mr Ally Botfield when the weather was dry and after prolonged rain on respective inspection dates.

3.1 Plant Room 1 (Hydrotherapy)

Roof planks in the plant room above the hydrotherapy pool are exposed and typically span approximately 2.2m between rolled steel sections that generally have a flange width of 146mm. This would indicate that adequate bearing has been provided to the roof planks, however this was not visibly confirmed during our survey works due to limited access.

Planks in this area appear to be in reasonable condition with no visible sign of any significant defects, this is shown in Photos 1 to 3. Minor abrasions to the underside of planks are visible in certain locations, these are likely to have been caused during the erection process of the structure, shown in Photo 4.

There is no sign of widespread hair-line cracking, nor visible signs of staining that would suggest corrosion to embedded reinforcement, and no sign of excessive deflection to the planks in this area.

3.2 Plant Room 2 (Adjacent to gym)

Roof planks in the plant room adjacent to the gymnasium are exposed and have a maximum span of approximately 3.4m between rolled steel sections that generally have a flange width of 146mm. As above, this would indicate that adequate bearing has been provided to the roof planks, however this was not visibly confirmed during our survey works due to limited access.

Planks in this area appear to be in reasonable condition with no visible sign of any significant defects.

There appeared to be an alteration made to a mansard plank above the louvred door on the western side of the plantroom. This is shown in Photo 5. As this is to a mansard roof plank, it is likely that this alteration was carried out to remove a protruding ‘tongue’ section of the plank which would typically be utilised in the interlocking action between adjacent planks. It is assumed this was carried out so that not to clash with the angle bracing below. As a result of this, the transverse reinforcement has been exposed and left untreated. Refer to Photo 6.

Photo 7 indicates signs of historic alterations to the ends of the roof planks where they have been altered to suit the intersection and slope of the mansard planks. It is likely that over time the grouting to this area has come loose and fallen, resulting in a gap between planks.

There is no sign of widespread hair-line cracking, no visible sign of staining that would suggest corrosion to embedded reinforcement and no sign of excessive deflection to the planks in this area.

3.3 Gymnasium

Roof planks in the gymnasium have been painted and have a textured finish. Roof planks in this area are spanning approximately 4m between rolled steel sections.

There is staining to the finishes in the mansard section below the windows to the northern and southern elevations, as shown in Photos 8 and 9 respectively, suggesting moisture ingress. Externally there is a large gap between the window cill and mansard tiling, allowing moisture ingress below external finishes. This is shown in Photo 10. The water ingress is considered to occur under rainfall events which is evident to occur from the standing water on the cill

With the exception of the forementioned there is no sign of widespread hair-line cracking, no visible sign of staining that would suggest corrosion to embedded reinforcement and no sign of excessive deflection to the planks in this area.

3.4 General ceiling void

Roof planks on the main section of roof are exposed above ceiling level. Planks are generally spanning 3.4m between steel trusses.

The planks in these areas are generally in a reasonable condition with no sign of widespread hair-line cracking to the planks, no visible sign of staining from corrosion to the embedded reinforcement and no sign of excessive deflection.

Shown in Photo 11, there are a lot of fixings to the underside of the planks supporting the ceiling and mechanical equipment. This results in applying additional load to the planks. We would consider that the location of fixings for the original mechanical equipment was agreed between the Mechanical and Electrical and Structural consultants at the time of installation.

4.0 Intrusive Investigation

On the 24th November 2020 a specialist intrusive investigation was carried out by Bi-TAS to investigate the roof planks further. This focused on the roof planks to Plant Room 1 above the hydrotherapy pool.

This investigation included scans and intrusive breaks outs to determine structural build ups, reinforcement layout, reinforcement condition and chloride levels to the RAAC roof planks.

The intrusive investigations were concentrated in this area as it is currently unused, and access was permitted without affecting staff and patients of the hospital. Further to this, due to the pool being located below, it is a likely location for high levels of chlorides which could cause an inherent risk to the planks.

Elsewhere, scans were undertaken of the roof planks in a number of targeted locations of the building to determine build ups and reinforcement layout.

From the scanning of the roof planks in plant room 1, it is determined that the planks appear to be adequately reinforced. Each plank appears to contain two layers of longitudinal reinforcement (orientated in the direction of span) at 250mm c/c with two layers of transverse reinforcement at 900mm c/c. The cover to this reinforcement is approximate 25mm.

The scanning shows that longitudinal reinforcement extends towards the end of the plank, this suggests that there is adequate reinforcement at the bearing locations of the plank. However, due to the location of the supporting beam it was not possible to scan the end of the plank from below.

From intrusive break outs, which exposed the reinforcement in the roof planks, there was no sign of any surface corrosion or staining. This would indicate that the reinforcement is in a reasonable condition.

The Bi-TAS investigation determined, albeit for the localised area that was investigated, that the planks are in a reasonable condition with adequate reinforcement and no significant signs of deterioration.

The Bi-TAS report is included under Appendix B of this report.

5.0 Discussion and Recommendations

From the visual and intrusive investigations, the overall condition of the RAAC planks is considered reasonable with no visible signs that would indicate deterioration of the planks. Evidence shows that it is usually expected that there are some visible signs of deterioration before failure of the planks. Therefore, we would recommend that regular monitoring of the planks is carried out for the short term upkeep of the roof structure. The aim of this monitoring would be to capture any signs of deterioration to the planks before any defects become critical. A full description of scope for the monitoring is detailed within section 6.1.

Considering recent known failings of RAAC planks, there is still a risk of sudden and unexpected failure of the planks. Therefore, we would still highly recommend that access to the roof is restricted to light access only, recommendations and restrictions for this access is detailed further in Section 6.3. Furthermore, we would recommend that loading to the roof planks is reduced wherever possible, i.e the removal of any electrical or mechanical services.

Outline proposals for the long-term condition of the building have been detailed in section 7.0.

As stated previously, the condition of the planks are reasonable, however there is evidence of areas of historical alterations that have been undertaken to the planks.

Noted alterations include the mansard plank located above the louvred door in plant room 2. This plank appears to have had the interlocking section of plank removed so that not to clash with the angle bracing below (as noted under 3.2). In addition to this, due to being the face of the plank that is on show, the transverse reinforcement is visible and left exposed. As the plank is located in an unheated space which is susceptible to moisture, we would recommend that the exposed reinforcement should be manually cleaned with a wire brush to remove any surface corrosion and primed to provide protection against corrosion using an approved remedial steelwork primer such as Fosroc Nitoprime Zincrich. At this stage the alteration does not appear to have resulted in any deterioration to the plank itself, nor is it considered to be a cause for structural concern at this stage. However, it could be a point of weakness susceptible to cracking if corrosion to the reinforcement is to occur in the future. Therefore, it would be recommended that this area is monitored for any signs of deterioration in the future.

Additionally, in this plant room the ends of the roof planks have appeared to have been altered to suit the pitch of the incoming mansard. These areas had previously been grouted which appears to have fallen out at some point likely due to expected thermal movement of the planks. As this section of the plank is cantilevered from the main structural support, it is unlikely that this alteration has affected the structural integrity of the plank. However, it would be recommended that this area be re-grouted to eliminate the risk of moisture ingress in the future. Further to this, it would also be recommended to restrict access on the small portion of the roof where these alterations have been made, i.e. the outer 0.5m to the perimeter of the roof.

In the gymnasium it is evident that moisture ingress has occurred around the windows in the mansard roof on the north and south elevations. This is potentially due to a lack of sealant around the windows allowing moisture to ingress behind the external finishes. The staining to the internal finishes and columns suggests that the planks have potentially been affected by this moisture ingress. In these locations we would recommend works are undertaken to strip off the finishes and expose the planks so that these can be visually inspected. The source of the moisture ingress will also need to be addressed to prevent future ingress.

It is evident throughout the building that there are a vast number of fixings to the underside of the roof planks, which are typically supporting mechanical and electrical equipment along with secondary ceiling finishes. Whilst these are adding additional load to the roof planks, there is a greater likelihood that pullout of these fixings could occur if not of an approved fixing specification. This could result in in localised break outs of the concrete planks which could in turn affect the structural integrity of the planks. It is therefore recommended that during any maintenance to rooms that all fixings are removed from the planks. All equipment, that is currently supported from these fixings would then be required to be transferred to a Unistrut frame spanning between main structural steel members supporting the roof.

From our visual inspection the single ply membrane covering on the roof appears to be in a good condition with no clear visible signs of deterioration. However, along with the ongoing checks of the roof planks we would recommend that the condition of the single ply is regularly checked.

6.0 Short Term Recommendations - Monitoring

As stated in Section 5, our recommendation for the short term is for regular monitoring of the roof planks and of the waterproof membrane.

In this section of the report an outline recommendation is provided in order to offer the maintenance staff at Haywood Hospital guidance on aspects that are to be highlighted as a risk to the RAAC planks.

We would recommend that these inspections are carried out on a 6-month basis, however in this 6-months the overall footprint of the building may be divided into sub-areas to minimise disruption to the ongoing use of the building.

Further to the 6-month check, we would recommend that regular spot checks are carried out specifically after significant events including heavy rain or snowfall.

6.1 Visual Assessment of underside of plank

Particular attention is to be given to the following items during the monitoring process of the roof planks.

- Hair line cracking to the soffits of the planks, an example of this is shown in Figure 1. Specifically, near to the supports.

Figure 1 Hairline cracking to soffit of planks

- The deflected profile of the soffit.
    - A more detailed check could be carried out if a plank is suspected to be deflecting. This can be done with the use of a straight edge or spirit level to the underside of the planks.
- Differential deflections of adjacent planks.
- Areas where water has penetrated through the roof covering.
- Evidence of rust staining, an example of this is shown in the below figure 2.

Figure 2 Example of rust staining

If any of the above are observed, then we would recommend an assessment is carried out by a structural engineer.

6.2 Visual Assessment of roof covering

Further to the inspections of the underside of the roof planks we would recommend that regular inspections are carried out to the roof's waterproofing membrane and rainwater outlets in order to reduce the risk of water penetration through to the RAAC planks.

Again, for these inspections we would recommend that they are carried out every 6 months, in addition to after extreme rain or snowfall events.

Particular attention of the following items should be made during the inspections of the roof's waterproof membrane.

- Functionality of roof outlets and making sure there are no blocked grates.
- Intact waterproofing around rooflight kerbs.
- Perimeter upstand flashings with secure metal cappings.
- Expansion joint flashings with secure cappings.
- Support leg upstand flashings.
- Walkways and roof access points, ensuring nothing has been displaced and that walkway membranes or concrete paving slabs are in good condition.
- Flexible sealants, to ensure they are in good condition and still provide appropriate waterproofing.
- The cleaning of any algal growth or silt build-up using a soft-bristle broom and clean water.
- Signs of ponding of rainwater.
- Presence of leaf guards over roof outlets (replace if necessary)
- Removal of foreign objects, i.e. stones dropped by birds that might be trodden into the membrane
- Removal and replacement of disturbed tiles
- Removal of all contractor's debris following roof works

7.0 Recommendations of Roof Access

As the RAAC planks currently appear to be in a reasonable condition it is believed that roof access should be permitted albeit with the following restrictions:

- All roof access should be limited to light maintenance and be limited to point loads of 0.9kN (roughly 90kg) per plank.
- There should never be more than one person on a single plank. This is approximately 4x1m in the span direction of the plank. The below Figure 3 shows the assumed configuration of the structural arrangement supporting the roof. (This would be required to be confirmed before access is permitted so that not to overload a single planks).

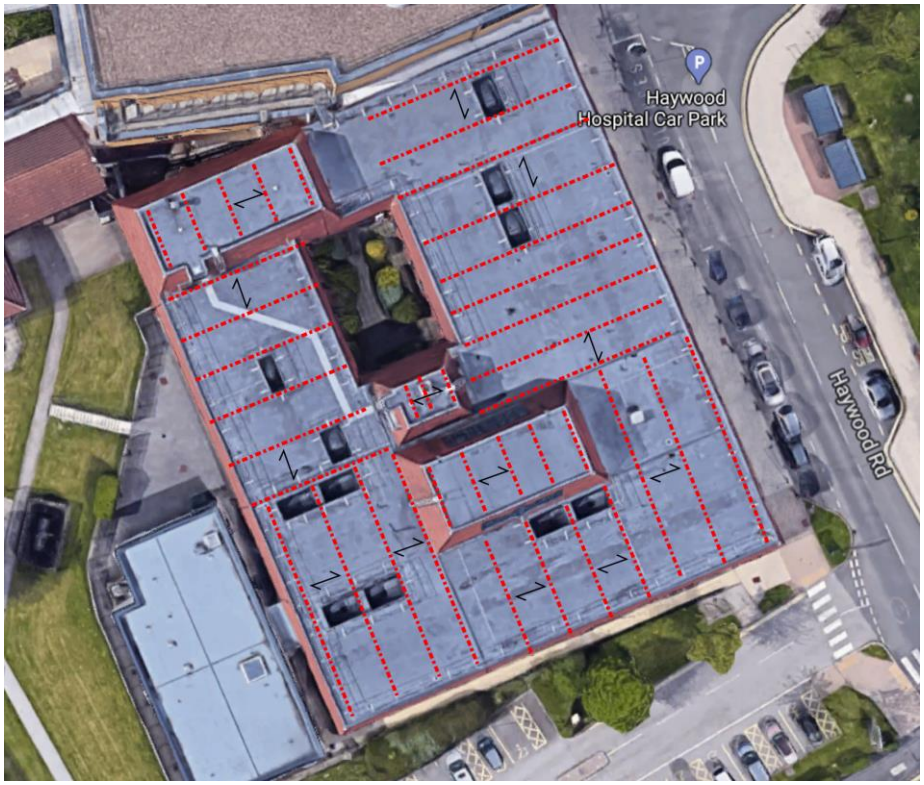

Figure 3 Assumed Structural Arrangement

8.0 Long Term Recommendations

In this section of the report, outline proposals have been put forward as a long-term solution for structural integrity of the roof planks.

8.1 Option One – Provide Additional Support

Option One would be to provide additional supports to the roof planks in order to reduce the span of the planks and subsequently reduce risk of failure in the future.

This could be achieved by installing a new arrangement of steel beams supported off the existing steel structure as indicated in the below Figure 4.

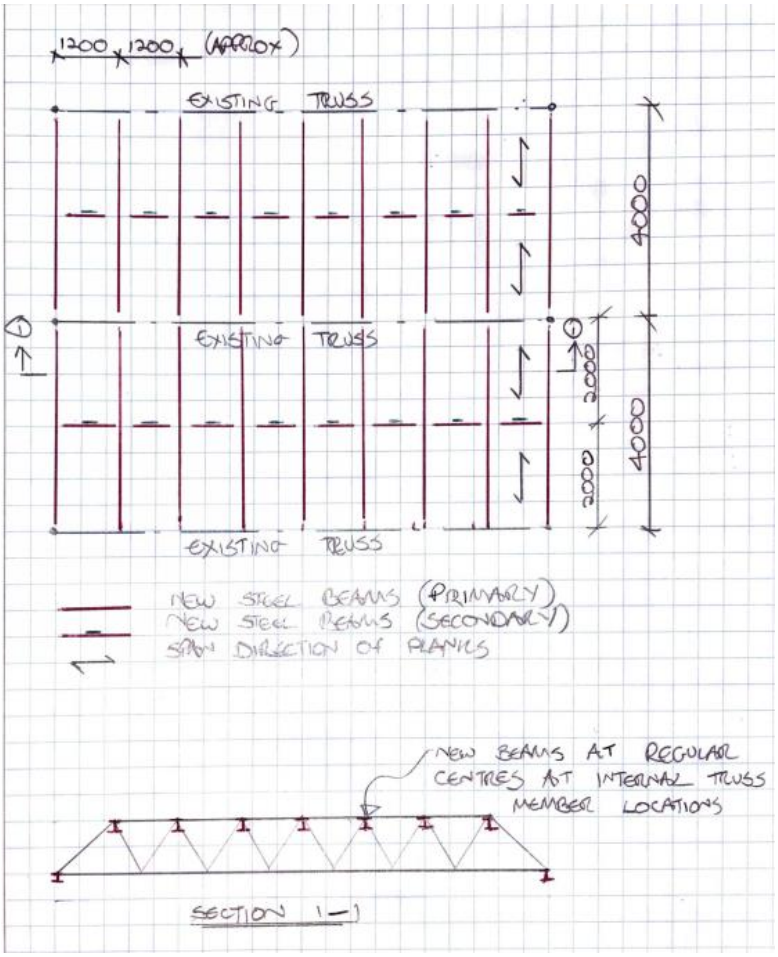

Figure 4 Option 1

Regular primary beams, which are set out to suit the intersection of internal truss members, and span between existing trusses and then provide support the new secondary beams located at mid span of the roof planks.

The regular centres of the new primary beams are set out so that not to alter how the existing structure is loaded by the planks, as this is currently as a uniformly distributed load across the span.

For this option 178x102UBs would required for the primary beams and secondary beams, with the possibility of the secondary beams being reduced to a 120x120x12 angle.

An alternative method could be to utilise a “hit and miss,” approach that alternates the locations of the incoming primary beams to the existing trusses. Which would utilise longer span secondary beams. This is shown in Figure 5.

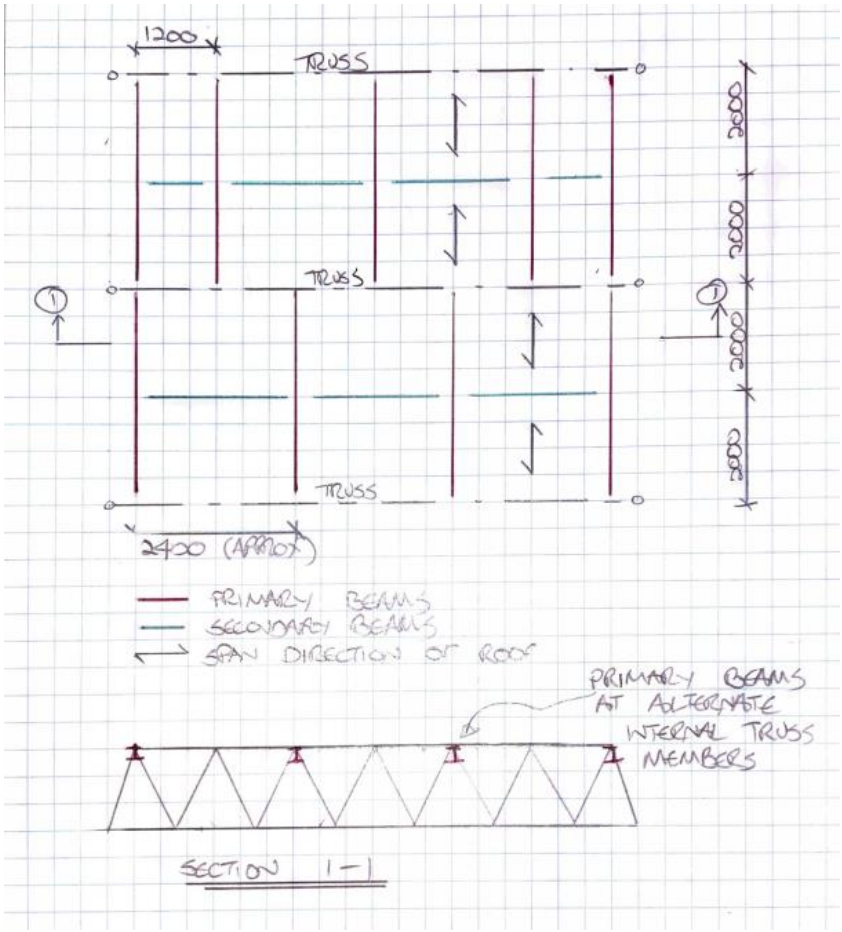

Figure 5 Alternative Option 1

The alternative option would reduce the number of beams required; however, this arrangement would be dependent on the existing arrangement and may not be suitable across the whole structure.

The alternative option 1 would require 178x102UBs for the primary and secondary beams.

The advantages for Option 1 are as follows;

- The roof structure can remain in place while the new steel structure is being installed, therefore the building would be weathertight while the works take place.
- The installation of the new steel structure can be carried out in localised areas, allowing for areas to remain active if they required.

Conversely, for this option the steelwork will need to be located around existing services and it may be necessary to relocate existing services in order to locate the proposed steelwork as required.

However, the risk for Option 1 is that the new intermediate support of the planks will not stop the possible deterioration of the RAAC planks it will only reduce the risk of failure. This would mean precautions, such as limiting the load on the roof and regular checks, would still have to remain in place.

8.2 Option Two – Replace Roof Structure

Option Two, would eliminate the risk completely and this would be achieved by removing the RAAC planks and replacing them with an alternative roof structure entirely.

This could be achieved by installing a structural metal roof deck, such as TATA RoofDek, that would span between the existing steel structure. Figure 6, indicates a typical structural roof deck build up.

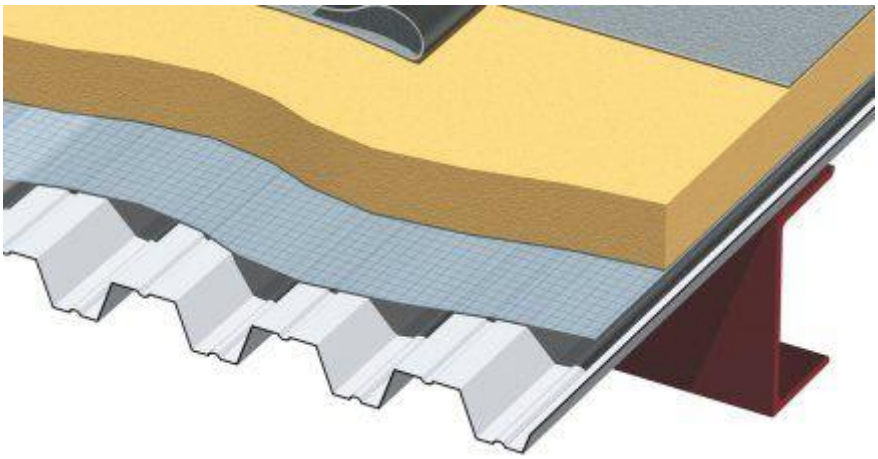

Figure 6 Typical TATA RoofDek build-up

As stated previously the advantage of this option would be that all risks from the RAAC planks would be eliminated as they would be no longer used across the site.

However, the disadvantages of this option are considered as follows;

- A new roof build-up including insulation and waterproofing system is required. This would also have to be coordinated with the existing rainwater outlets.
- The building would not be weathertight during the process of replacing the roof.

9.0 Conclusions

As on overview of the RAAC planks, these generally appear in a reasonable condition with no current signs of deterioration. However, regular monitoring would be required in the short term as it is considered that the planks are approaching the end of their design life span and may start to show signs of deterioration, which would likely be accelerated should accelerants such as moisture ingress be permitted.

During the monitoring period, access to the roof would be restricted so that not to overload the roof planks. Wherever possible it would be advised to remove as much load that is currently being applied to the planks, such as hung mechanical equipment. No additional mechanical or electrical services are to be hung from the planks. Where new services are provided or alterations made, Unistrut support is to be provided spanning between the existing steelwork trusses supporting the roof planks.

Long term proposals comprise options to either reduce or eliminates the risk of failure of the RAAC planks. These options are schematic at this stage and are to be developed further in the upcoming stages.

Appendix A – Photos

Photo 1 Plant Room 1 Mansard Planks

Photo 2 Plant Room 1 Roof Planks

Photo 3 Plant Room 1 Planks

Photo 4 Plant Room 1 Planks - Minor Abrasions

Photo 5 Plant Room 2 - Alteration to mansard plank

Photo 6 5 Plant Room 2 - Exposed Rebar

Photo 7 Plant Room 2 - Plank end alterations

Photo 8 Gym - Moisture Ingress

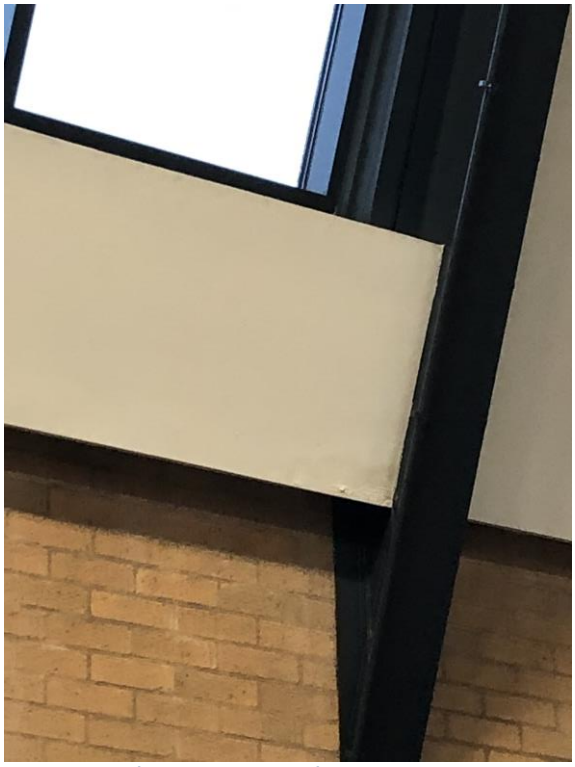

Photo 9 Gym - Moisture Ingress

Photo 10 Gym - Moisture Ingress

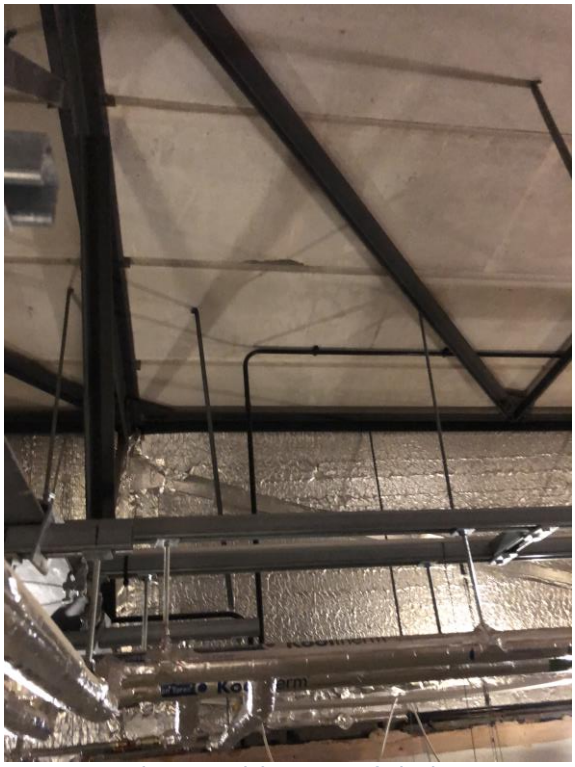

Photo 11 Fixings to roof planks

Investigation Report

Birmingham Testing and Scanning Ltd
04th December 2020
www.bi-tas.com

Structure Details:

Structure/Project Name: Hydrotherapy suite (and surrounding building)

Site Address/Location: Haywood Hospital, High Lane, Burslem, Stoke-on-Trent, ST6 7AG

Client Reference (if applicable): CLA-HAY-001 Issue A

Report Prepared By:

Name: Michael J Hughes

Title: Director

Date: 04th December 2020

Signed:

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Contents

Glossary of Terms

Within this report we use several abbreviations for ease of writing. To avoid confusion, abbreviations you may encounter are listed below:

EM – Electromagnetic

GPR – Ground Penetrating Radar

RC – Reinforced Concrete

MC – Mass Concrete

PC – Pre-cast

SSoW – Safe System of Work

RAMS – Risk Assessment and Method Statement

Approx. – Approximate(ly)

NW/SW/NE/SE – Compass directions (NorthEast, SouthWest etc.)

Summary

Birmingham Testing and Scanning Ltd was commissioned by Clancy Consulting in November of 2020 to carry out concrete scanning and structural investigation works at Haywood Hospital, Stoke-on-Trent, England.

As part of the commissioned works, Bi-TAS was instructed to undertake a series of GPR scans, intrusive breakouts and chloride dust sampling into the RAAC planks above the former hydrotherapy suite on site and the associated RC pool walls and slab/soffit above.

The areas to be investigated were agreed with Clancy Consulting prior to commencement of site works.

Location

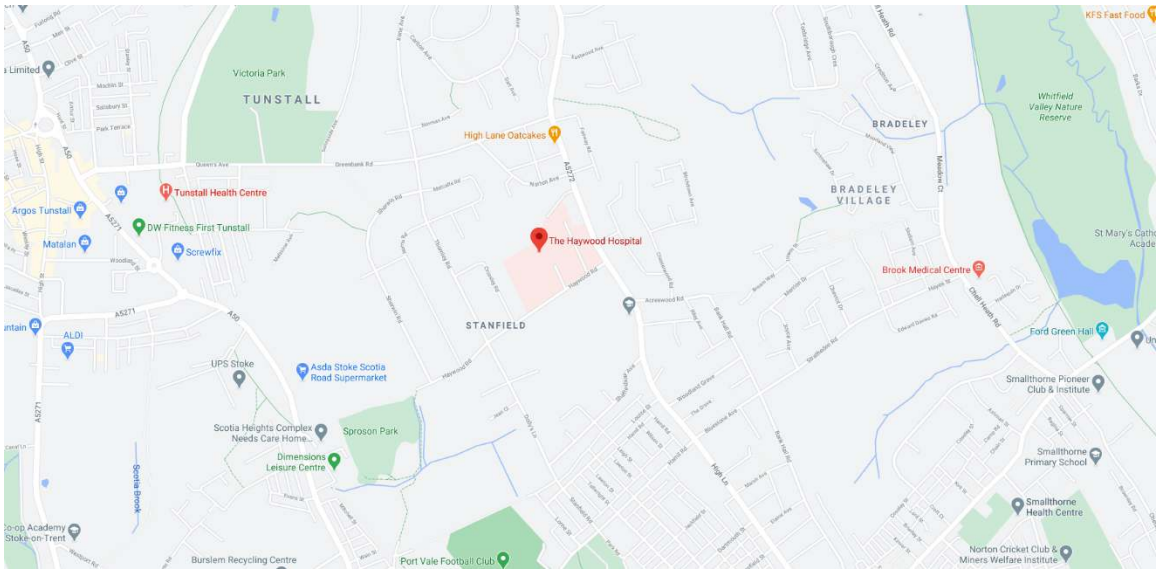


Figure 001 – Location plan, 1cm:100m scale

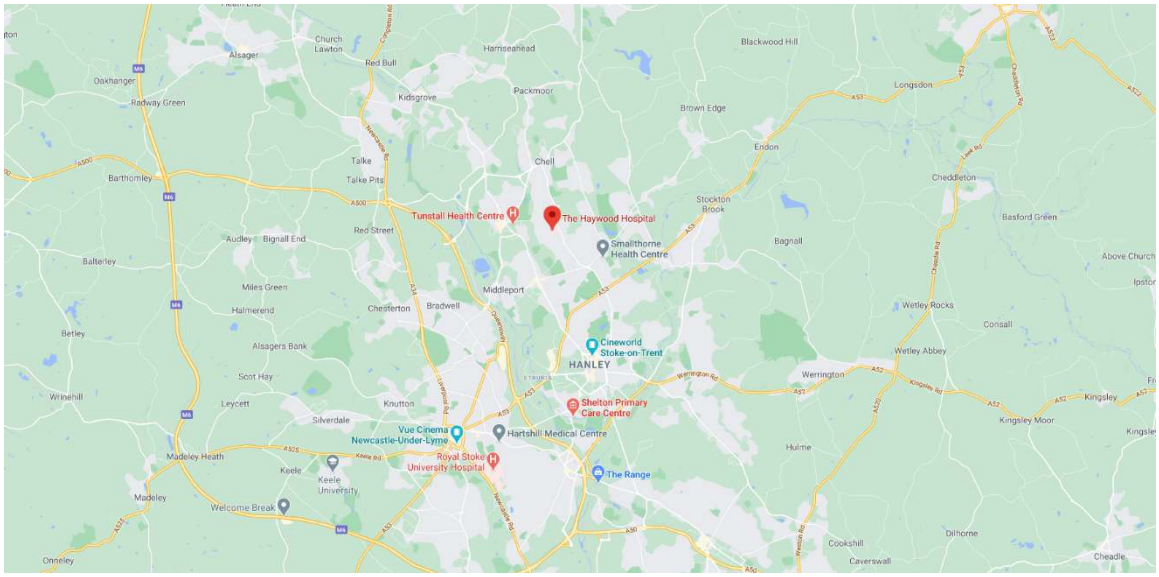


Figure 002 – Location plan, 1cm:1km scale

Scanning Images and Analysis

The site works were carried out on Tuesday 24th and Wednesday 25th November 2020.

The operatives from Bi-TAS were Gavin Jennings and Mischa Nicklin, with Gavin Jennings acting as the lead operative.

A Proceq GPR Live handheld GPR tool with iPad Pro was used to carry out the GPR scanning works and cover survey.

The GPR scans used were “line scans” in which the tool is run over the surface of the base material, detecting density changes and presenting a cross sectional image on the monitor in a perpendicular direction to the direction of the scan. These images are included in the report below together with photographs for ease of reference.

To assist with the interpretation of these images, the top of the image represents the concrete or base material surface, with chainage in m along the X-Axis and depth in cm along the Y-Axis.

In interpreted format, density changes appear as colour changes.

In raw format, reflections are shown as either parabola curves for rounded objects or flat lines for a uniform density change (i.e. between materials).

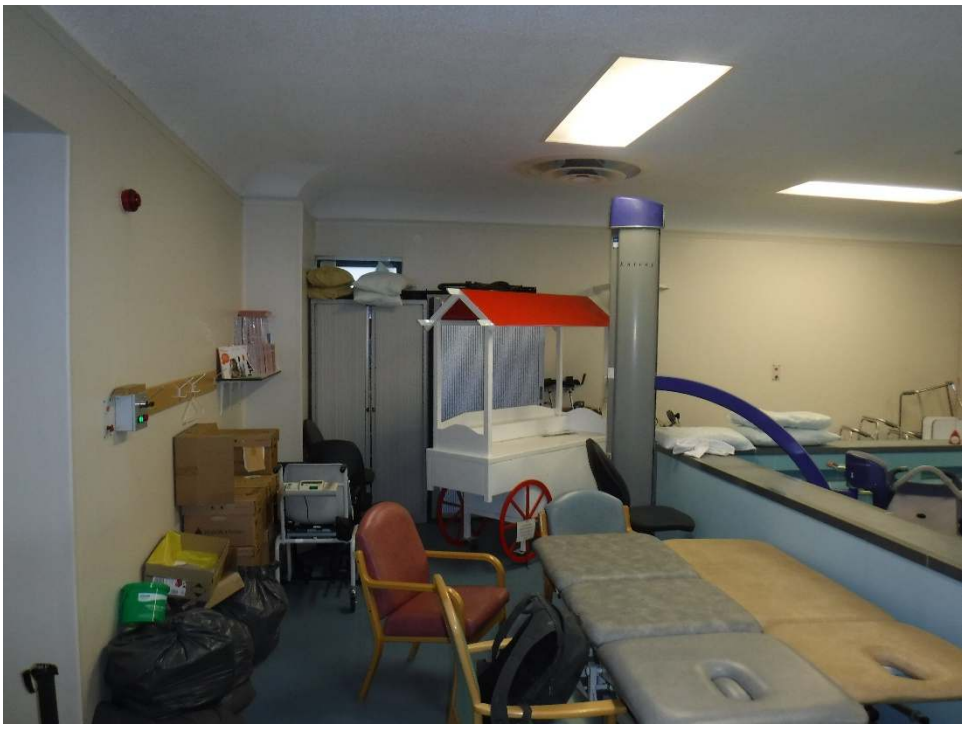
For EM scanning, a Proceq Profometer 630AI was used.

To undertake breakouts, a handheld combi-hammer was used with chisel point and drill bits following GPR scan and mark out of reinforcement location within the planks. The breakouts were then repaired with a suitable structural repair mortar.

During the works, social distancing and COVID-19 related protection measures were used at all times.

Hyrotherapy Room (Soffit and pool wall)

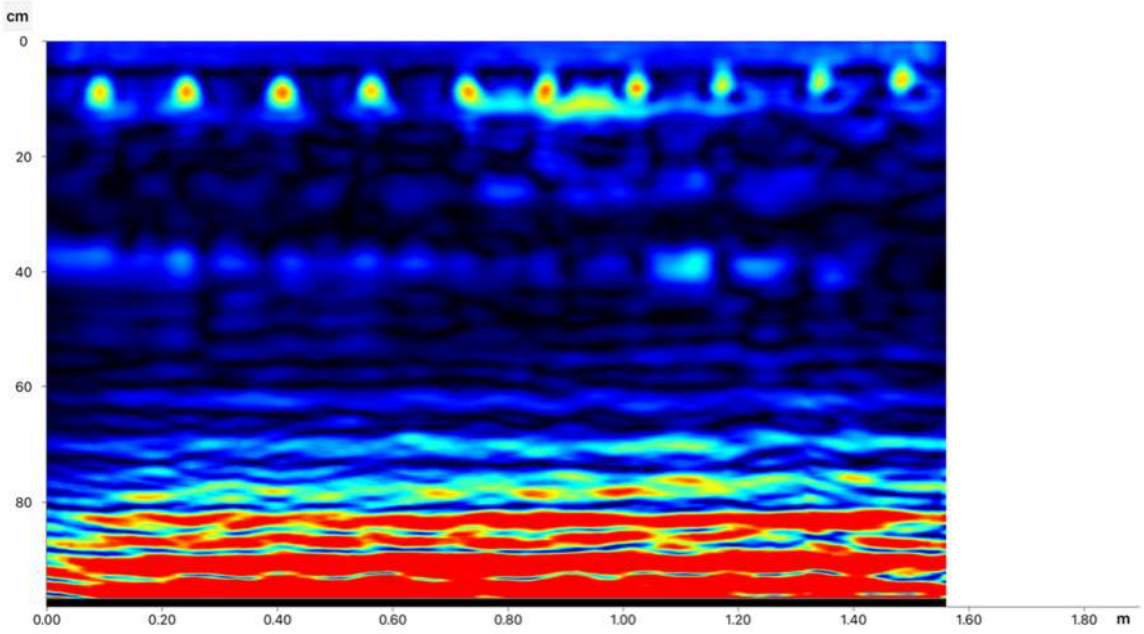
Within the former Hydrotherapy room, it was originally assumed that the soffit above the pool was constructed of RAAC planks. Bi-TAS was therefore tasked with scanning the soffit to establish construction and also the walls of the former pool to determine construction type.



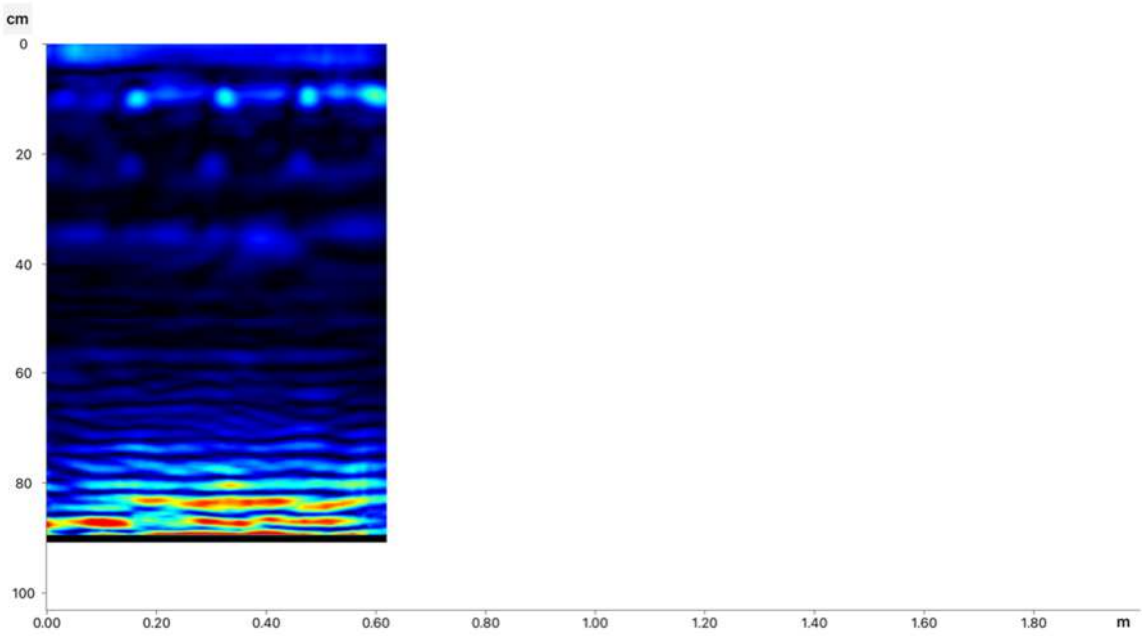
Photograph 001 – General view of Hydrotherapy room

Photograph 002 – General view of Hydrotherapy room

Photograph 003 – General view of Hydrotherapy room



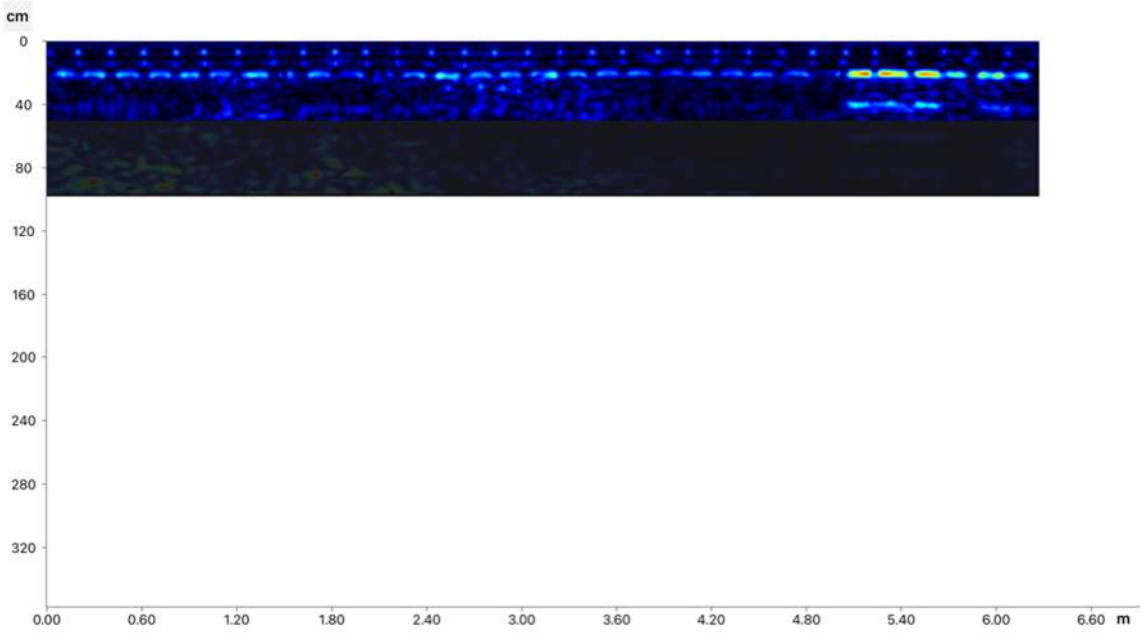
GPR scan along face of wall showing vertical bars and thickness of wall (including finishes)



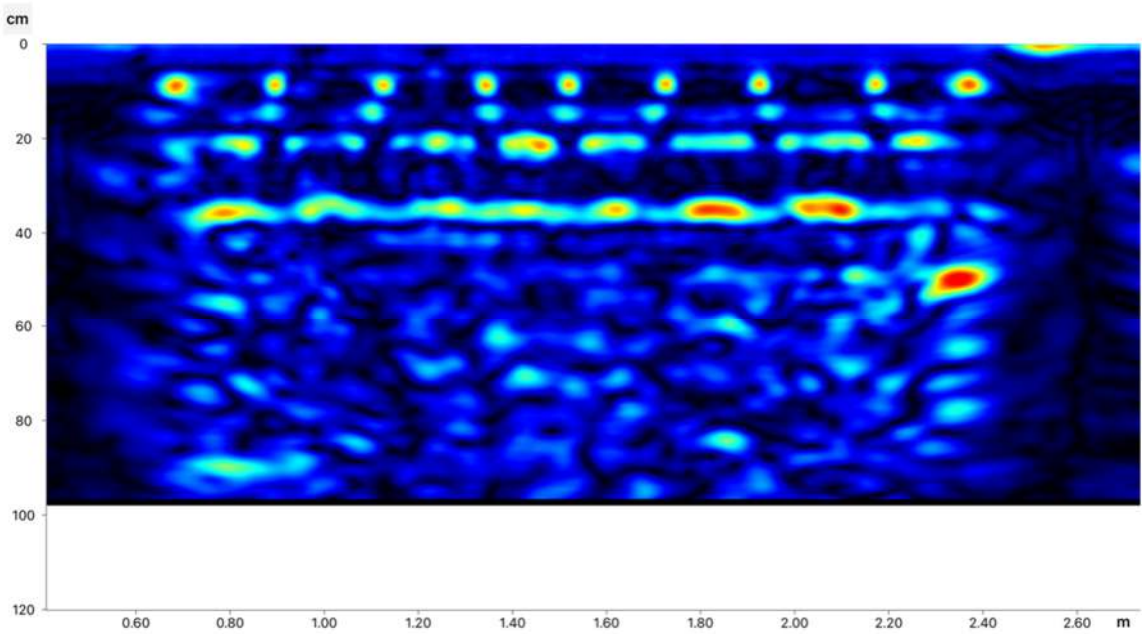
GPR scan up face of wall showing horizontal bars and thickness of wall (including finishes)

Hydrotherapy pool walls:

- Uniform in construction – RC wall.
- 300mm thick plus finishes.
- Two layers of uniform reinforcement. Horizontal and vertical bars at 150mm centres to both layers.
- Bars were detected as 8-10mm in diameter.



GPR scan to soffit of hydrotherapy room showing bars in X direction



GPR scan to soffit of hydrotherapy room showing bars in Y direction

Photograph 004 – Breakout to soffit of hydrotherapy room

Soffit slab above Hydrotherapy room:

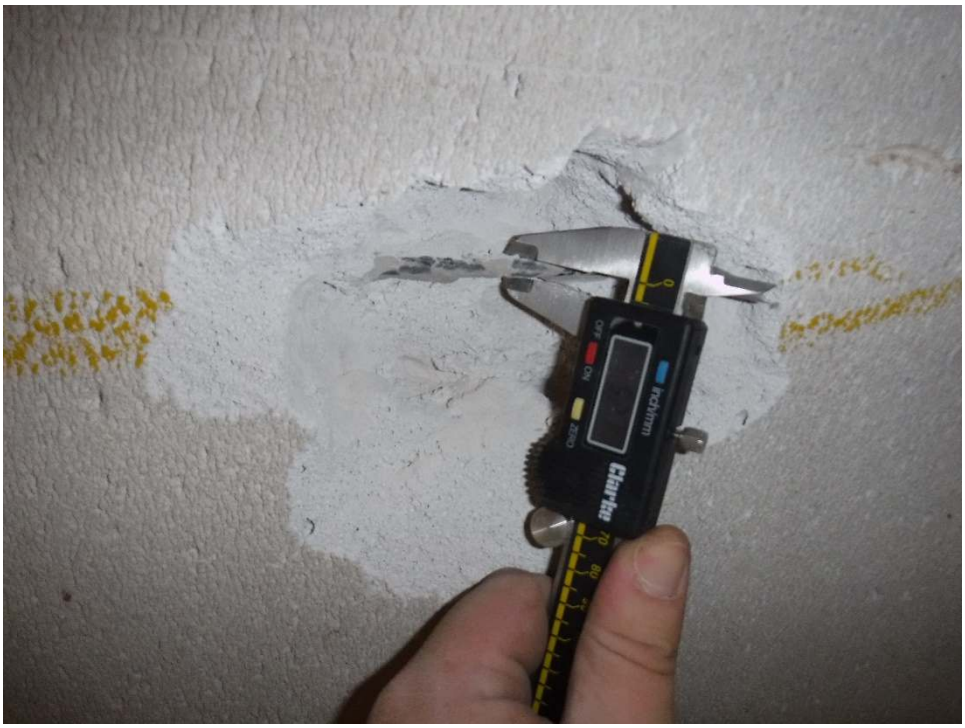
- Appears to be RC slab with finishes above and below.
- 200mm thick RC slab with two layers of reinforcement.
- Breakout and scanning confirmed bars as 8mm diameter in both directions, standard metric spiral bars.
- Bars were at 200mm centres in both directions to both layers.

Plant area

Directly above the Hydrotherapy room, a plant area between roof slab and soffit slab was located. The soffit of the plant area (below roof level) was constructed of RAAC planks.

Scans and intrusive breakouts were undertaken to the RAAC planks to establish construction and reinforcement layout.

Photograph 005 – General view to soffit above plant area



Photograph 006 – Breakout to RAAC planks above plant area

Photograph 007 – Breakout to RAAC planks above plant area

Photograph 008 – Breakout to RAAC planks above plant area

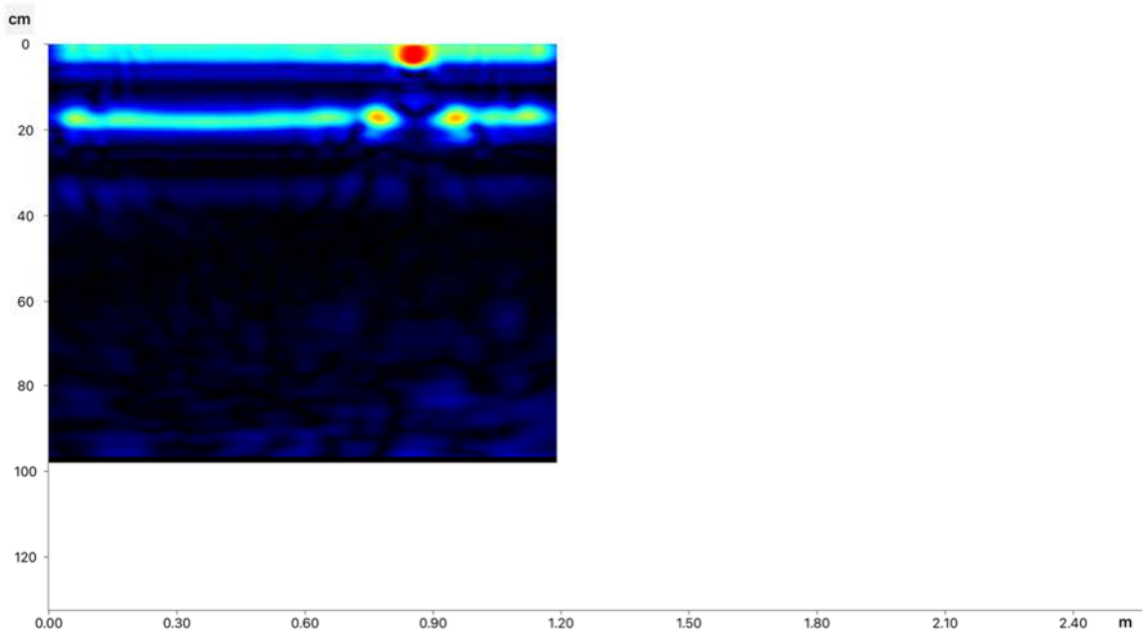
Photograph 009 – Breakout to RAAC planks above plant area

RAAC planks above plant area:

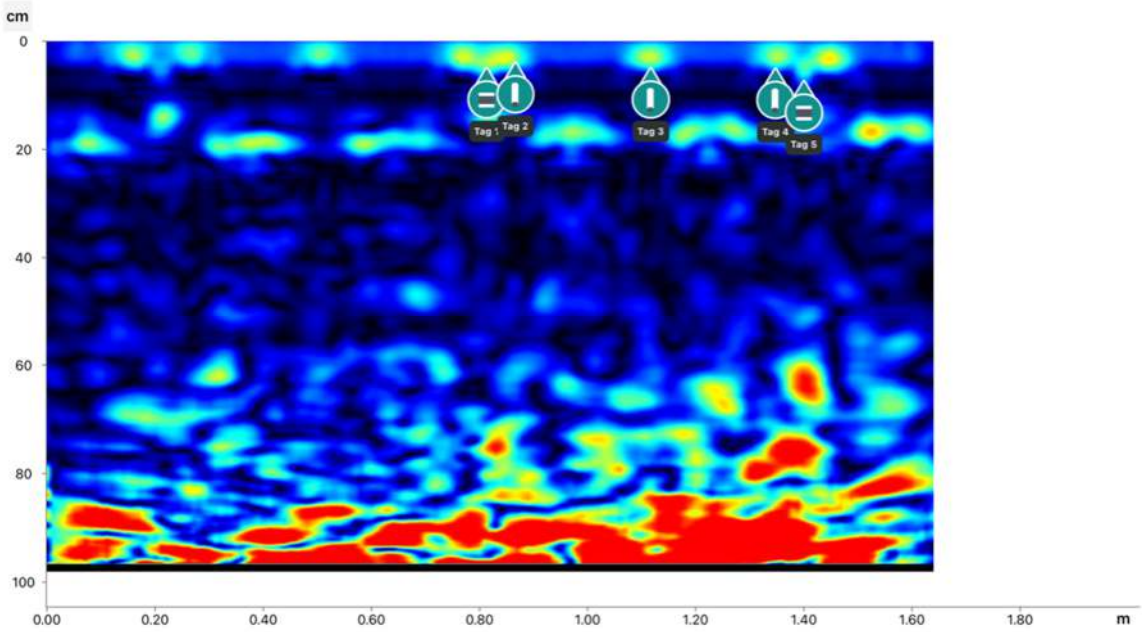
- Reinforcement broken out in good condition with no signs of corrosion or rust staining.

- Reinforcement broken out was all 5-6mm diameter in both directions, smooth round bars.
- Scans showed that longitudinal reinforcement carried on towards end of plank (impossible to scan end of plank to confirm as bearing on steel beams) so likely reinforcement extends into bearing areas at ends of planks.
- Planks contain two layers (top and bottom) longitudinal bars at 250mm centres within the planks. Cover to these bars was low, but typically around 25mm from top and bottom). Each plank was approximately 600mm wide and contained 3 no. longitudinal bars per layer.
- Transverse bars were 900mm centres, two layers (top and bottom at these points) with low cover of 20-25mm.
- Planks were 200mm thick with finishes to roof above on top. Finishes were an additional 100-120mm thick.

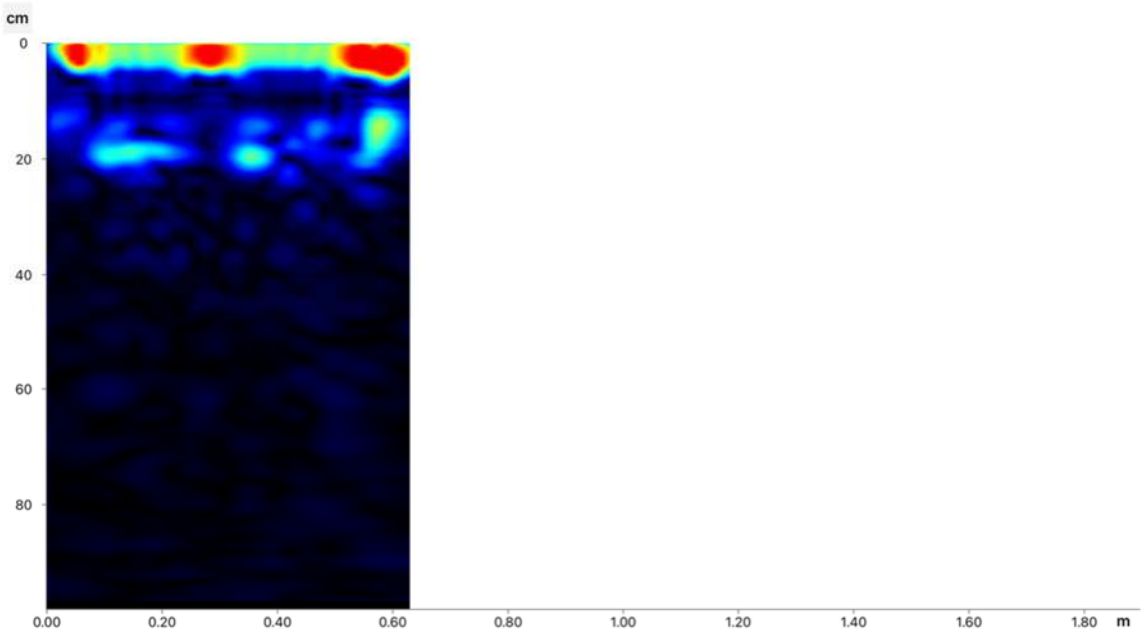
Extensive and widespread scanning was undertaken to the planks in the plant room, and to avoid repetition a selection of scan images have been included in the report to reflect findings.



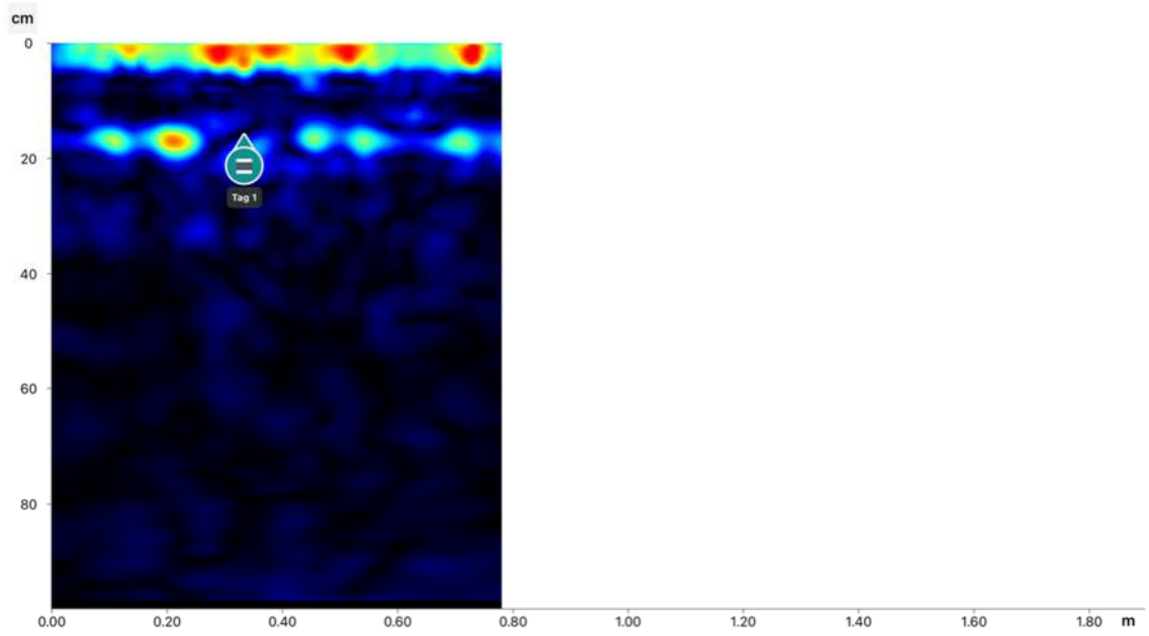
Typical GPR scan along plank showing transverse reinforcement at 900mm centres (top and bottom)



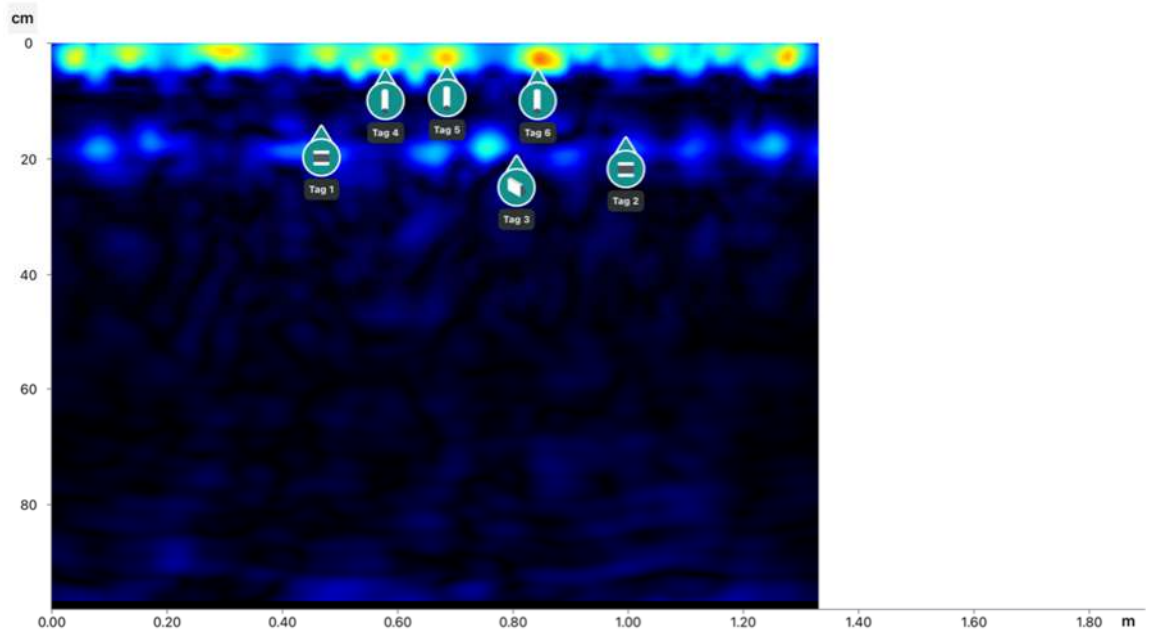
Typical GPR scan across soffit of planks showing longitudinal bars (plank edges and bottom layer of bars marked) at mid-span



Typical GPR scan across plank at end showing reinforcement continuing towards bearing zone at end of plank



Typical GPR scan across plank at end showing reinforcement continuing towards bearing zone at end of plank



Typical GPR scan across soffit of planks showing longitudinal bars (plank edges and bottom layer of bars marked) at mid-span

Roof level

From discussion with Clancy and the Hospital, it was requested that Bi-TAS undertake further scanning to the roof areas from above to establish (if possible) whether other areas of the building were constructed of RAAC planks. The areas to be scanned were agreed with Clancy prior to undertaking.

The scan data is subject to the level of insulation and finishes potentially causing interference to the scanning process.

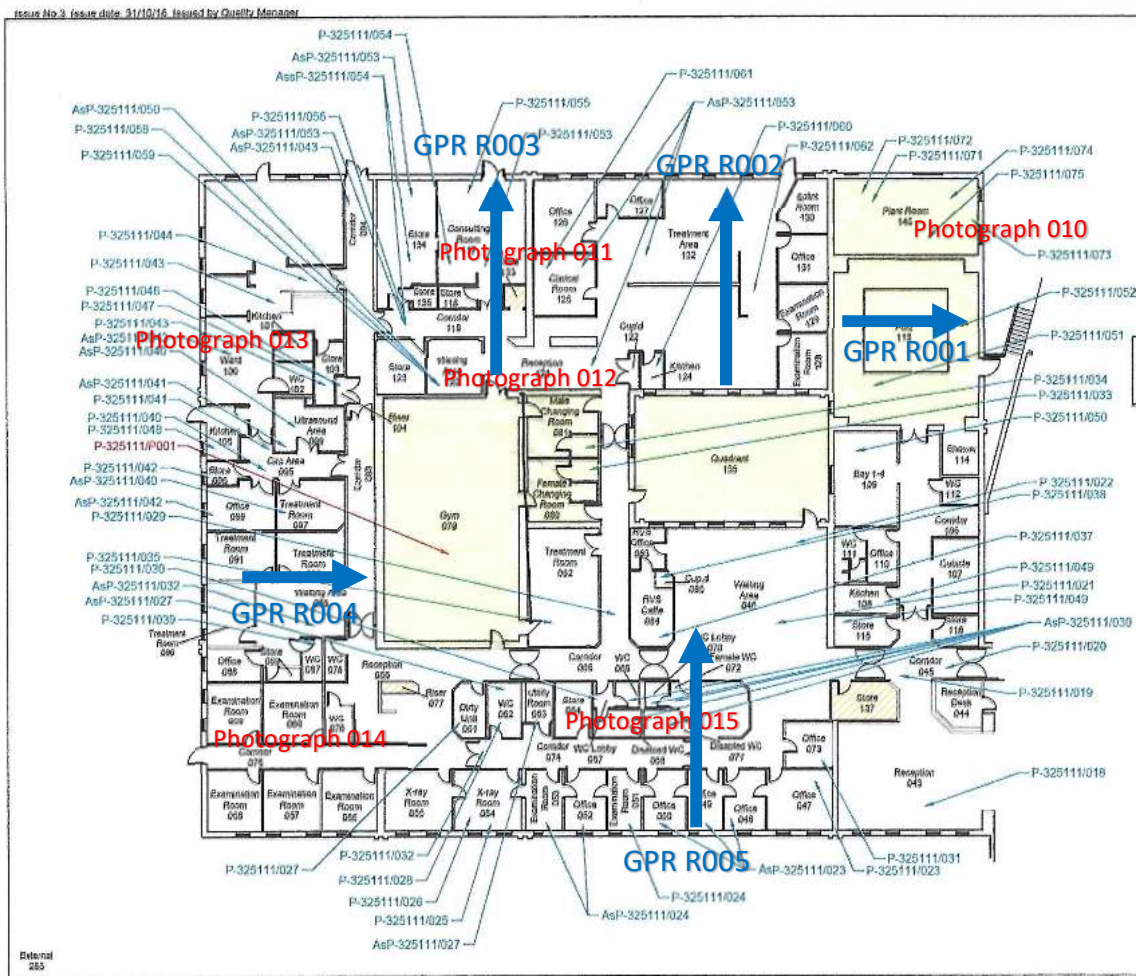


Figure 003 – Plan of building (areas scanned marked with direction). Span direction opposite to direction of scan.

Photograph 010 – General view over roof

Photograph 011 – General view over roof

Photograph 012 – General view over roof

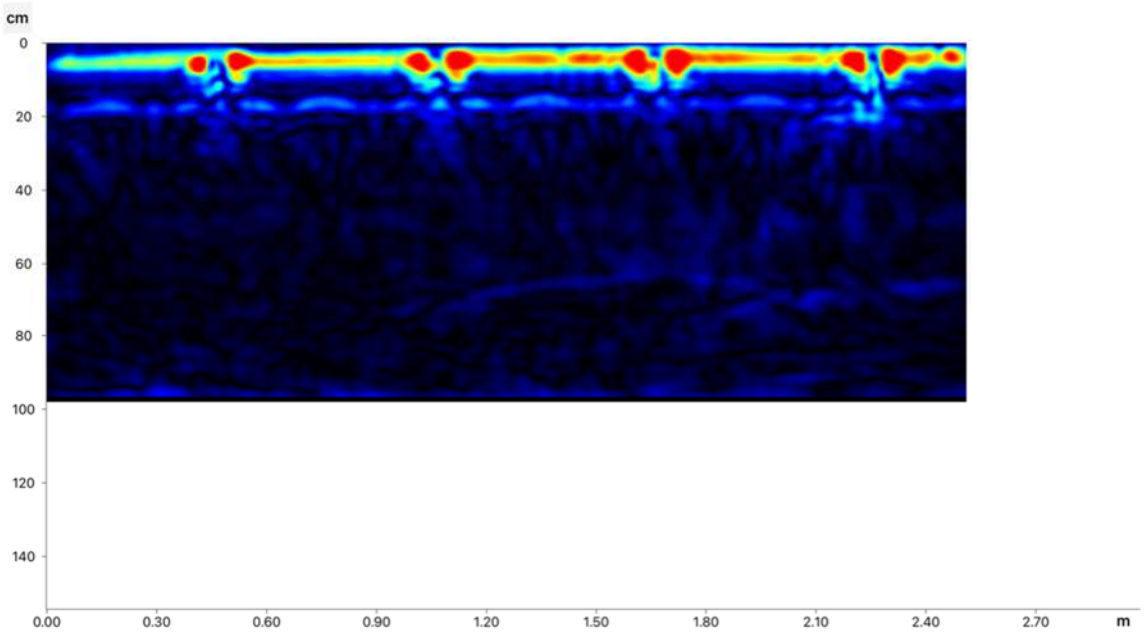
Photograph 013 – General view over roof

Photograph 014 – General view over roof

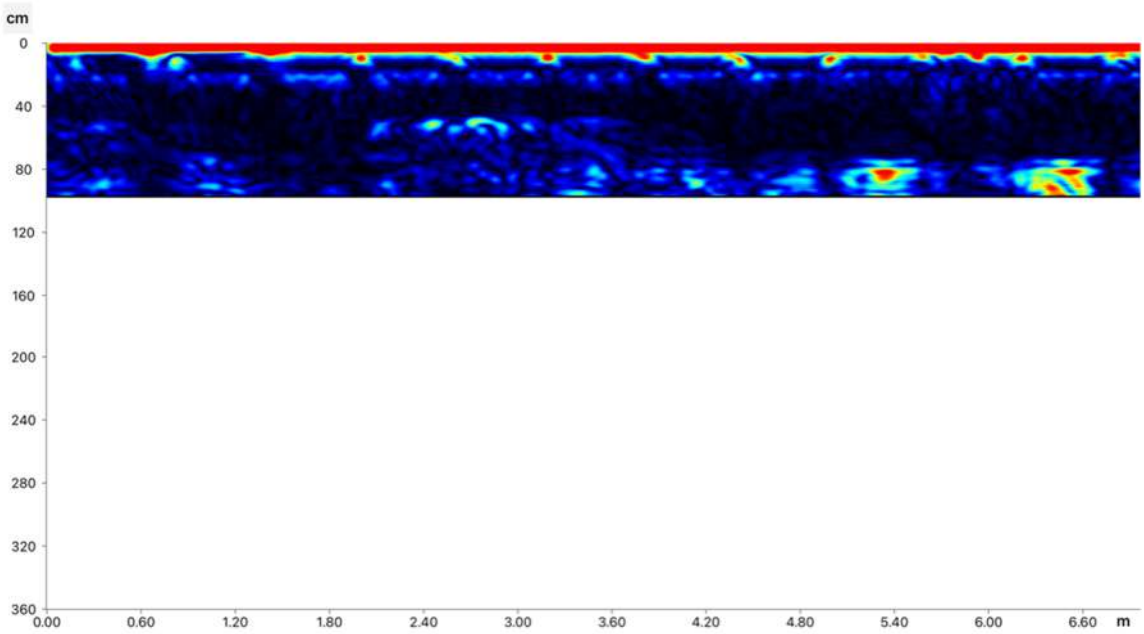
Photograph 015 – General view over roof

The GPR scans from above showed evidence of uniform construction with the findings from the RAAC planks below.

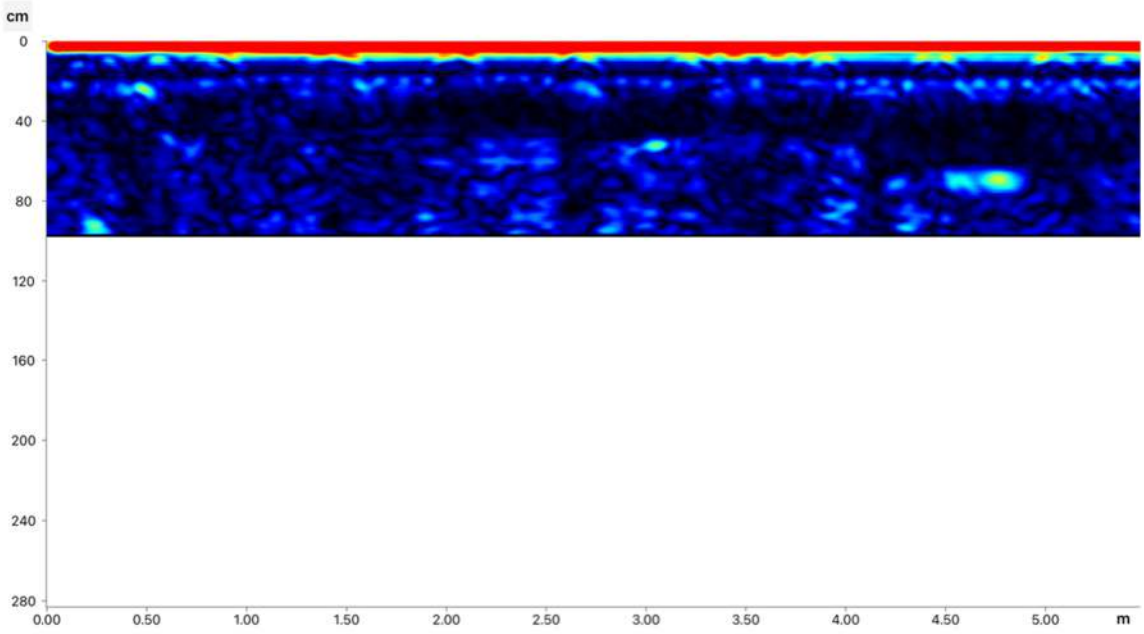
The scans showed the orientation of the planks (opposite direction to the arrows on Figure 003 above).



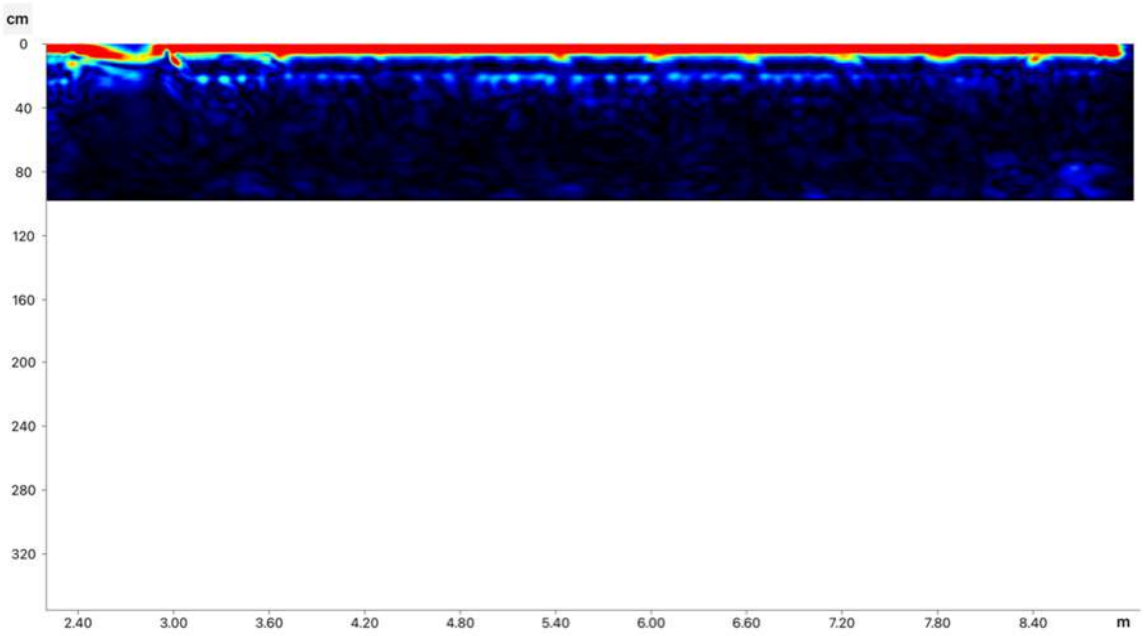
R001 – Showing cross section of RAAC planks beneath



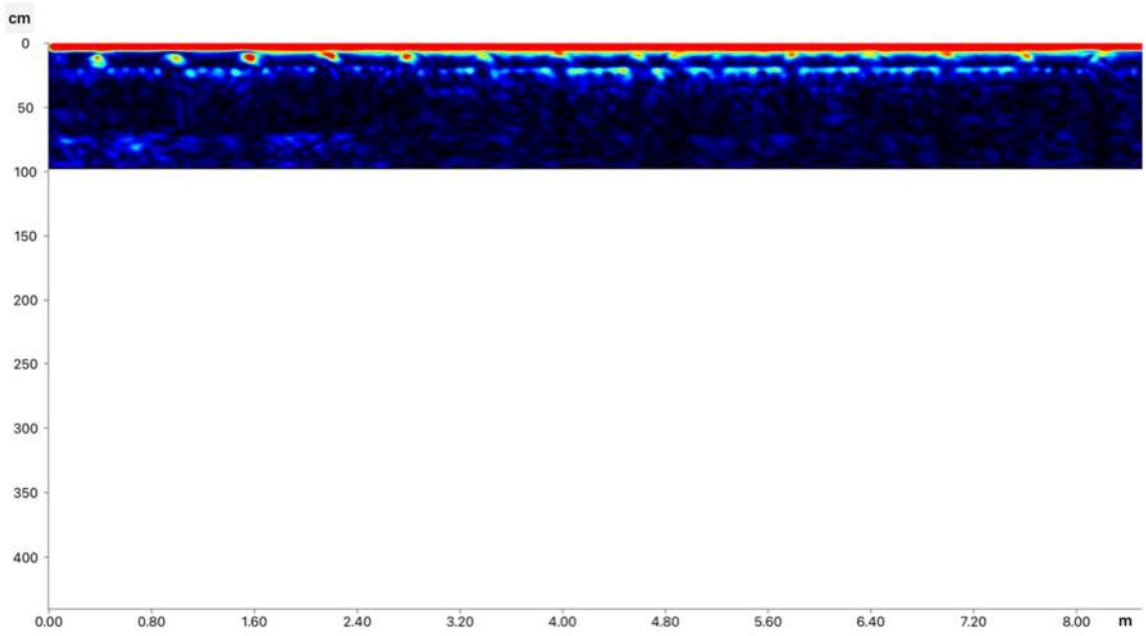
R002 – Showing cross section of RAAC planks beneath



R003 – Showing cross section of RAAC planks beneath



R004 – Showing cross section of RAAC planks beneath



R005 – Showing cross section of RAAC planks beneath