JUNIPER STREET BUILDING 1 – ROOF CONDITION REPORT

NATIONAL MUSEUMS LIVERPOOL

AUGUST 2020

PURCELL

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JUNIPER STREET ROOF CONDITION REPORT

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1.0 CLIENT REQUIREMENTS AND SCOPE

1.1 Purcell Architecture Ltd were commissioned by National Museums Liverpool (NML) to carry out a roof condition survey at their collection storage facility located in Building 1, Juniper Street in Liverpool in July 2020 as the building has for some time suffered water ingress which jeopardises both the integrity of the building and the priceless collections held therein.

1.2 The agreed purpose of the survey was to evaluate and understand the extent and type of defects currently reducing the effectiveness of the roof and allowing water to penetrate the building.
On diagnosis of the defects the scope required that budget costs are identified for each of the required repairs which will enable NML to plan for immediate and future maintenance at Juniper Street, whilst also commenting on the overall condition and proposing maintenance activities that will prolong the life span of the roofs..

1. 3 The survey was undertaken visually, both from ground level, assessing the outlets, and via direct access to the various roofs of the building.

1. 4 Initial surveying was carried out on 6th August 2020 by Senior Architect David Clifton and Architect Sonoe Shimizu of Purcell's Manchester Studio. The weather was hot and dry.

1. 5 The Building is formed of 2 distinct parts, separated into the following elements:

- A taller 2 storey building consisting of 6 storage spaces, a loading bay, office and staff facilities. Several of the ground and first floor storage spaces have been retrofitted with steel framed mezzanines effectively creating a 4-storey building. There are 4 pitched roofs of steel trussed construction with Kingspan KS1000RW insulated panels which were installed in the late 1990s.
- A smaller, single storey building (attached) consists of two storage spaces. These spaces are covered in a lightweight steel truss system, and an asbestos sheet roof which has been covered in Kingspan KS1000RW and encapsulated from the underside to make safe. This work was carried out at the same time the taller building had its roof replaced.

1. 6 The following building elements were assessed as part of the surveying and reporting process:

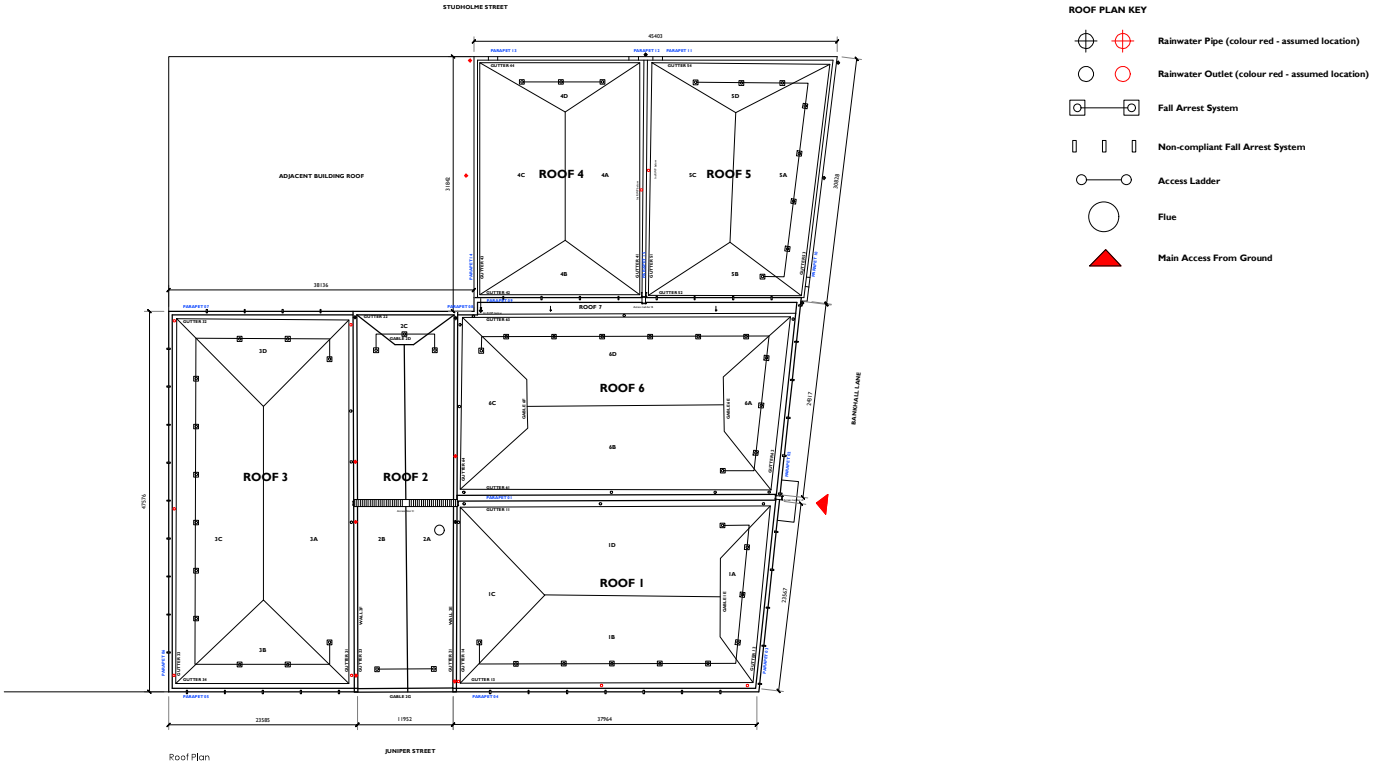
- Roofing sheets
- Parapets and copings
- Insulated gutters
- Rainwater outlets
- Ridge and hip flashings
- Lead flashings
- Visible rainwater goods (not including below ground drainage)

Recommendations for further survey/inspections were also recorded.

1.7 Limitation of the survey

The initial intention was to inspect each of the gutters and parapets, including those which required safe access via harnesses or mobile elevated working platforms (MWEP) for which we had made provisional budget allowances, however as the initial inspection progressed, it was felt that enough information had been gathered to allow completion of this exercise without the need to inspect all areas.

The initial survey was a visual, non-intrusive inspection where safe access was available. No opening up investigations were carried out and, for these reasons, it should not be assumed that every defect has been identified during this survey and provisional allowances should be made to cover other eventualities.



Roof Plan

As existing roof plan

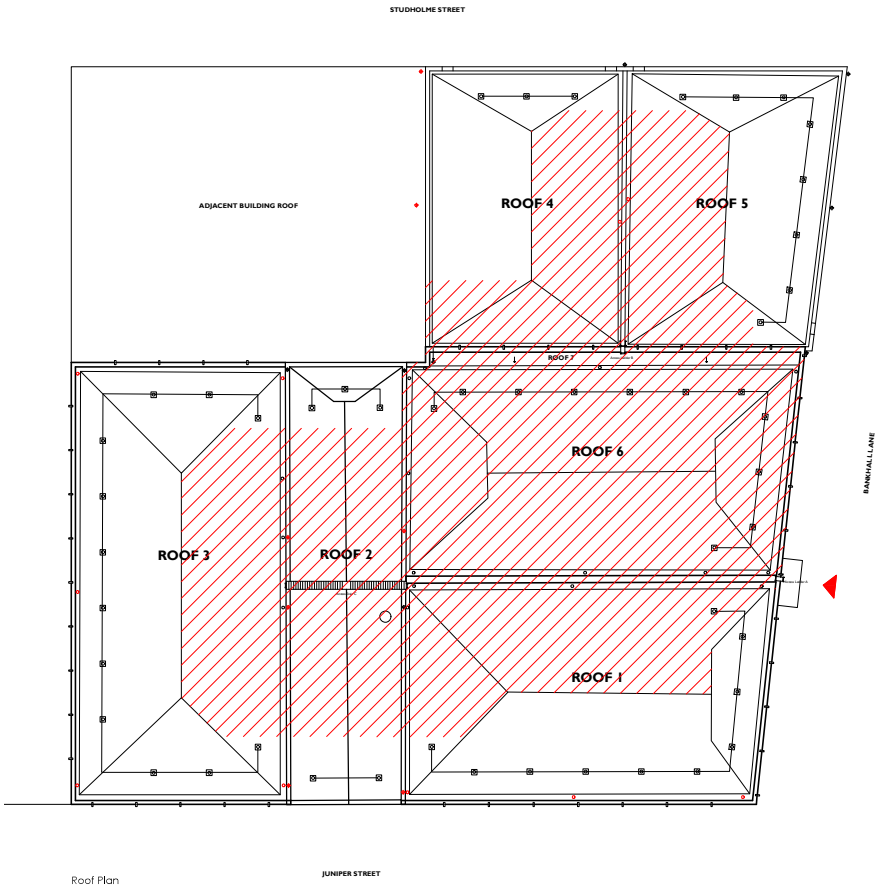
2.0 KEY FINDINGS

2.1 Access

Safe access, without the use of the fall arrest system or MEWP's was possible to all the internal abutment and valley gutters and some of the external parapet gutters, as indicated by the red hatching on the drawing below.

2.2 General Condition

The initial inspection identified that in general terms the condition of the roofs were consistent, both with what we would expect for the age of the roofs and with where water appears to have penetrated into the building. The condition was consistent across the buildings.
The overall condition of the roofs was good. We would expect these types of roofs to have life spans in excess of 40 years and they have currently been in place approaching 25 years. Now is the time to carry out some maintenance in order to prolong the life of the roof.



Areas of roof where the visual inspection was carried out

3.0 ROOF AREA A

3.1 General

As noted previously the taller building was entirely re-roofed in the mid 1990's. This consisted of removing the previous asbestos roofing sheets, and steel structure and providing a new insulated panel system on new a new steel frame, with integrated gutters and parapet copings.

Roof Area A consists of Roofs 1, 3 & 6 as indicated on the drawing below.

3.2 Roofing Sheets

The roofing sheets all appeared to be in good condition, there were no significant defects, or penetrations noted which would contribute to water ingress. [Photo 3.2.1]

However, the cut edges of the panels are beginning to show signs of age and some corrosion is visible which could be treated to prolong the life of the roof.

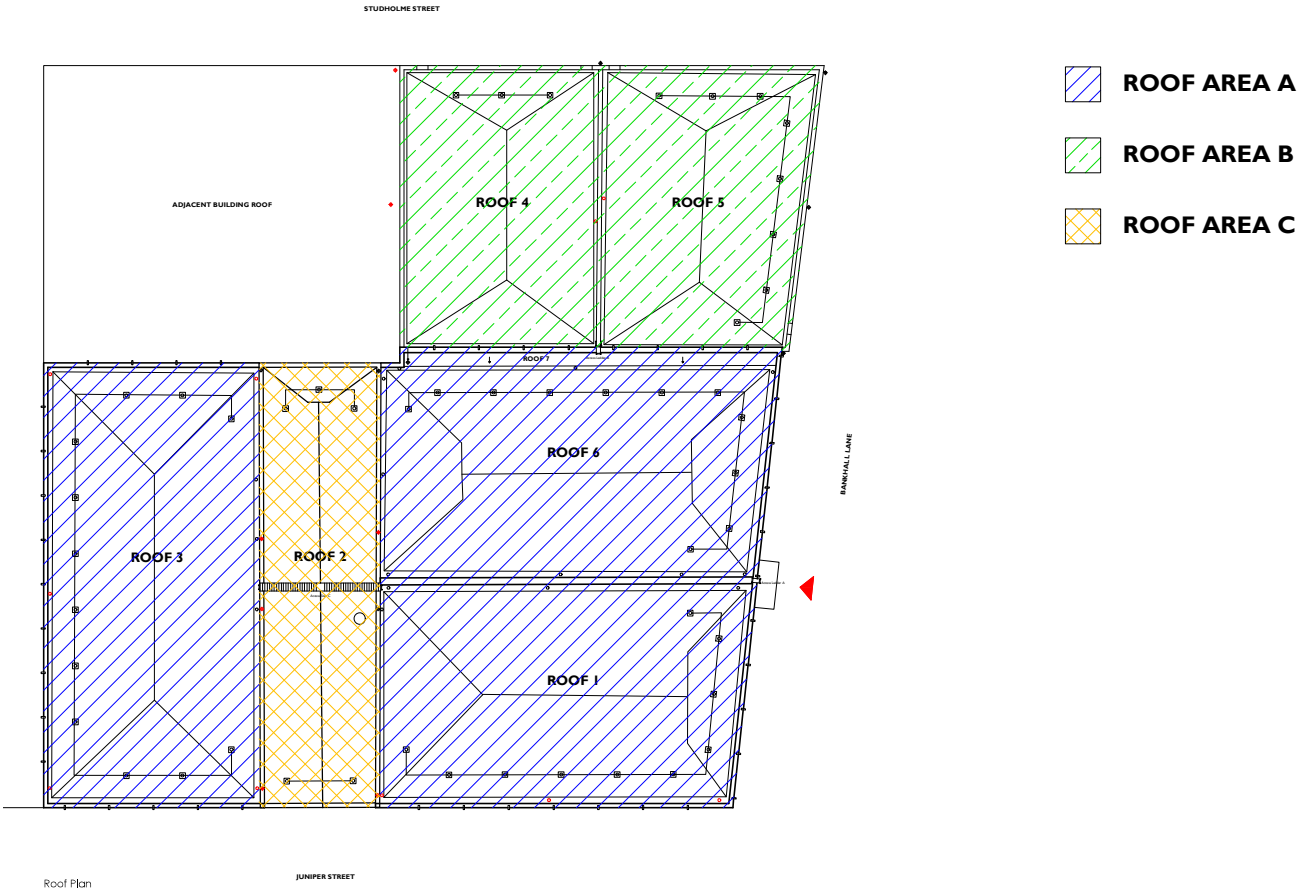
There were several areas where the edges of the panels have been depressed, likely due to being stood on during routine maintenance. This does not appear to be affecting the integrity of the system and cannot be seen unless on the roof. [Photo 3.2.2].

We noted a few isolated locations where the protective coating of the panels has been scratched, exposing bear metal below. In some locations this has begun to rust, and some remedial works should be considered. [Photo 3.2.3]

Aluminium panels are fixed down the steel roof structure with metal fixings. The fixings have self-sealing washers and waterproof caps, many of which have been lost or damaged. The corrosion to these fixings may be contributing to the high level of water ingress and further investigation by a specialist is required to confirm whether fixings should be resealed, replaced or covered by other maintenance works. [Photo 3.2.4]

3.3 Parapets and Copings

The external perimeter of the building has a concrete formed parapet which has been covered with a pressed metal coping, part of the Kingspan system installed in the late 1990's. Due to slight differences in the levels that the various roofs are set, the parapet heights differ around the building. In some locations aluminium cladding spans the gap between the coping and the gutter to maintain the waterproofing.



Roof Plan

In general, the copings and parapets are in good condition. Similarly, to the roofing sheets there are isolated locations where the protective coating has been scratched leading to rusting. [Photo 3.3.1]

There were a few more significant defects noted, these were all in locations where fixings have been made through the surface, for example at the location of the roof access ladder, significant openings and rusting in the metal sheets have developed, allowing water to penetrate through the coping. These sheets should be replaced/repaired. [Photo 3.3.2]

Aluminium coping sheets are fixed down to the structure of the parapet below and linked together using metal fixings. The fixings have self-sealing washers and waterproof caps, many of which have been lost or damaged. There is no obvious water ingress attributed to this corrosion, however repairs/ replacement would prolong the life span of the roof.

It also appears that some earlier remedial repair works have been carried out, attempting to seal the joints between the sheets. This sealant has failed/been picked away by seagulls. [Photo 3.3.3]

3.4 Insulated Gutters

The gutters to roofs 1, 3 & 6 are insulated aluminium parapet gutters, secured to a parapet with secondary steel from beneath. Gutter panels are approximately 3m in length and therefore there are multiple joints along each gutter run. At each joint, the panels are fixed together with rivets and sealed with a heat welded membrane laid over the joint. At almost every panel joint the waterproof membrane has failed, in some locations they have been lost altogether. We believe this is the primary cause of the water ingress into the building at Roof Area A and remedial work is required as a high priority. [Photo 3.4.1]

There was quite a lot of debris in the gutters and water is pooling in several of them. This is not considered to be a significant issue contributing to the water ingress, however the presence of the debris and water prevented full inspection of the condition of the panels. It is anticipated that similarly to the roofing sheets and parapet panels, there are areas of the gutters which have minor damage such as scratched protective coating. [Photo 3.4.2]

3.5 Rainwater Outlets

The rainwater outlets to Roof Area A direct all water to internal gravity-fed downpipes, through outlets in the base of the gutters. These outlets consist of preformed spigots with face plates which are fitted over and through a hole in the gutter. These outlets are fixed down and covered in a waterproof membrane as the gutter joints are. Similarly, to the gutter joints, almost every outlet is in poor condition, leaf guards are missing, and the waterproof membranes have failed. Remedial work should be carried out as a high priority. [Photo 3.5.1]

3.6 Ridge and hip flashings

Where roofing sheets meet at hips and ridge lines, the joints are filled with insulation (likely of mineral wool type), and a pressed aluminium flashing piece is used to cover the joint. As the roofing sheets are profiled, gaps between the sheet and the flashing pieces are filled with a preformed foam infill piece which prevents debris and insects from entering the void, they may also act to protect against driving rain from penetrating to the joint between the sheets.

Many of the foam fillers have been lost or decayed. We believe that this may be contributing to the water entering the building at high level, this would explain how the water appears to be entering above the line of the gutters in areas such as 1C, 3B and 3D as identified by NML during out walkaround the building. The width of the flashing sheets may also be the problem and only now the foam fillers have been lost has the issue become apparent [Photo 3.6.1]

Aluminium flashing sheets are fixed down to the roofing sheets with metal fixings. The fixings have self-sealing washers and waterproof caps, many of which have been lost or damaged. The corrosion to these fixings may be further contributing to the high level water ingress and further investigation by a specialist is required to confirm whether fixings should be resealed, replaced or covered by other maintenance works. [Photo 3.6.2]

There are a number of isolated locations where the flashing sheets have been damaged, likely due to being trodden on during routine maintenance. We do not believe that this is a cause of water ingress, however, may be prudent to repair. [Photo 3.6.3]

4.0 ROOF AREA B

4.1 General

The roof of the lower building was subject to 'encapsulation' in the mid 1990's. The procedure has been quite a common solution to making an asbestos cement roof safe, by over-boarding it with insulated composite panels and spraying the underside with a sealant to prevent any movement in the asbestos. It is unclear why the lower roof was not subject to the same, full replacement as the taller roof in the 1990's.

It appears that the original gutters, contemporary with the asbestos roof were retained, and that lead flashing was not renewed at the time the over-boarding was carried out.

The presence of concertina razor wire for security purposes made it difficult to access roof 4C and gutter 4.3, however an overall impression of the condition was noted. [Photo 4.1.1]

4.2 Roofing Sheets

The roofing sheets all appeared to be in good condition, there were no significant defects, or penetrations noted which would contribute to water ingress. [Photo 4.2.1]

However, the cut edges of the panels are beginning to show signs of age and some corrosion is visible which could be treated to prolong the life of the roof.

A few isolated locations where the protective coating of the panels has been scratched were noted, this has exposed bear metal and, in some locations, has begun to rust. Some remedial works should be considered. [Photo 4.2.2]

Aluminium panels are fixed down the steel roof structure with metal fixings. The fixings have self-sealing washers and waterproof caps, many of which have been lost or damaged. There is no particular evidence that this has allowed water to enter the building, however, repairing/replacing these fixings would prolong the life of the roof. [Photo 4.2.3]

4.3 Parapets and Copings

As Roof Area B was simply over-boarded, the parapets were not renewed or covered and remain as concrete weathered copings. The external perimeter of the building has a masonry formed parapet of varying height.

The parapets and copings look to be in generally good condition; however, some vegetation requires removing. [Photo 4.3.1]

Where on Roof Area A, aluminium cladding has been used to cover the masonry upstands, the same has not been carried out to Roof Area B. Instead the weathering is relying on lead flashings which appear to be contemporary with the asbestos cement roof. These flashings in places have been lost or are falling out of the mortar joints in the masonry which is allowing water to stream into the building in wet conditions, indeed from the inside daylight can be seen as some of the abutment locations where flashings have been lost. [Photo 4.3.2]

Additionally, as a result of the over-boarding exercise, these older flashings no longer achieve the required minimum 150mm upstand above the surface of the roof. Water is splashing off the roof, over the top of the flashings and saturating the masonry. Lots of mortar has been lost, contributing to the failure of the flashings and there is spalling of masonry. [Photo 4.3.3]

We are confident that this is the primary cause of water ingress into the lower building and would recommend that repairs are carried out. It would be worth carrying out some masonry maintenance, such as repointing to the parapet walls at the same time.

4.4 Gutters / Outlets

As noted above, the gutters to Roof Area B appear contemporary with the asbestos cement roof and we don't think they were renewed at the time the aluminium sheet roof was installed. These gutters are quite a lot lower than the surface of the roof and access is poor.

The gutters do not appear to have been cleaned out for some time, evident by up to 2 inches of sludge sitting in them, this may be a direct result of the proximity of the asbestos containing material which should have been concealed at the time the encapsulation was carried out. [Photo 4.3.1]

One rainwater outlet at the corner of gutters 42 and 43 appears to direct water into an internal down pipe in Room G.03. There are two other internal RWP's which are visible in rooms G.07 and G.08. This suggests there are outlets along Parapet 15 which we were unable to identify due to the thick sludge on the gutters.

We also suspect that there are external down pipes in the alley between this building and the neighbouring building, but the outlets were not visible.

All others exit horizontally through the parapet wall to hoppers and external down pipes.

All the outlets that were inspected were significantly blocked by sludge and debris and should be cleaned. A further inspection will be required after this has been carried out to determine whether there are any significant defects.

4.5 Ridge and Hip Flashings

A slightly different roof profile has been used for Roof Area B and the profiles are a lot smaller and the pitches steeper, we did not record any location where it was obvious compressible material has been lost.

5.0 ROOF AREA C

5.1 General

The Roof C is constructed at the same time as Roof Area A. The parapets are a few feet higher to this roof and 'clip-on' gutters are used rather than parapet or abutments. The water discharges from these gutters into the gutters of Roofs 1, 3 & 6.

No obvious defects were recorded however, the cut edges of the panels are beginning to show signs of age and some protection works would prolong the life of the roof.

6.0 RECOMMENDATIONS AND NEXT STEPS

6.1 The following commentary is provided as a guide by which the current snapshot of condition and need at Juniper Street may be developed into a meaningful programme of maintenance and repair over the coming period.

6.2 We have sought first to address the immediate need for rectifying the water ingress followed by addressing the issue of advisory maintenance to prolong the life of the roofs. In seeking appropriate repair solutions we have spoken with several organisations; Initially we spoke with Kingspan who were the supplier of the roof system used to replace Roof Area A and over-board Roof Area B in the late 1990's. We then spoke with HD Sharman, who are a supplier of specialist roofing repair products. Finally we spoke with a number of roofing contractors who routinely carry out these kinds of repairs.

6.3 We have prepared a short matrix of location, repair and priorities:

Priority 'A' items need to be addressed to halt the water ingress, ideally through the permanent repair suggested in the commentary, but as a minimum through temporary measures to secure the building fabric and protect the collections within.

Priority 'B' refers to repairs to elements of the roof which are not necessarily directly contributing to the current water ingress, but if undertaken will prolong the life of the roof.

Priority 'M' refers to basic maintenance activities which should be carried out as soon as possible and on a regular basis. Additional investigations should also be carried out as soon as possible.

6.3 A detailed plan should be compiled to fully programme and budget the repairs of the roofs by priority over the long term. We also recommend a costed running maintenance plan is produced. This will provide greater foreseeability of the resources needed to properly safeguard the building and its functions, as well as facilitating clear forward planning. A service contract with a roofing contractor might be a consideration.

6.4 To obtain the best value from access equipment such as MEWP/ Scaffolding, contractor prelims, approvals etc the starting point for each project should be to comprehensively schedule and cost all required works to an area to ensure that areas in need are not left wanting when adjacent elements have been addressed. It should be noted that any interior programmes of refurbishment should be coordinated with external defects to not lead to internal damage and abortive or repeat (and costly) phases of work.

6.5 Based on the findings so far and the following repairs are identified:

IMMEDIATE RESOLUTIONS

Roof Area A – Gutters/ Spouts:

The prevailing solution seems to be that wholly lining the existing gutters with a new system was the appropriate and common resolution for the gutter repairs, a suggestion by Kingspan that each of the joints could be individually repaired was not considered a feasible solution given the work required to prepare the existing gutters for this work, and that this type of repair appears to have been attempted without success in several locations on the roof. Sharman's has a product called Plygene (other systems are available), a membrane on a roll which is laid in the gutters and is fixed at the abutment under the flashing, and under the metal roofing sheets with a combination of mechanical fixings and hot air welds. The system would include the insertion of liners into the rainwater outlets are heat welded into place.

Roof Area B – Gutters/Spouts:

As noted earlier, roofs 4 & 5 were treated differently to the others, these were encapsulated and over-boarded. Failing lead flashing being the primary issue caused as a result of these not being renewed at a higher level when the height of the roof was lifted slightly. Our initial reaction was that renewing these flashings in lead is sound, however is not the most cost effective solution. Lead is expensive and usually used where a good quality aesthetic finish is preferred or when replicating significant historic detailing. The flashings to these roofs are not seen from anywhere and this is not an architecturally significant building. Another point to note is that when the encapsulation was carried out, it appears that a flashing which is supposed to conceal the edges of the existing asbestos sheets has been missed (the edges are visible). With this in mind, we propose that these gutters are lined in the same Plygene (or similar) system as to Roofs 1, 3 & 6. A steel flashing, to match the steel roofing sheets will be used to cover the edges of the new gutter lining, this will be more cost effective than using lead.

Roof 1, 3 & 6 Ridges & Hips:

The water ingress through at high level in the storage units, has been a little more difficult to diagnose. Our initial diagnosis that water is being driven under the flashings due to loss of compressible foam profile fillers is likely contributing to the problem, however is not the main issue, rather the problem is that the flashings are a little too narrow, or the panels under the flashings do not meet closely enough. The loss of the fillers has exposed this problem. Failure of the fixings may also be contributing to this water ingress [see also below], it was noted during the inspection that many of the metal fixings which secure the panels and flashings down have lost their protective caps and have begun to rust, over time movement in these failed fixings can allow water into the building.

The long term solution would be to remove and replace the flashings and all of the fixings. However in order to fully diagnose the problem, some shorter term measures could be undertaken, including; Replacing the foam profile fillers and encapsulating the bolts.

LIFESPAN EXTENDING RESOLUTIONS

Roof Areas A, B & C – Panels

The effectiveness of the protective coating of the steel panels deteriorates over time due to the weather and exposure to UV light. In addition to this the cut edges of the panels have exposed steel which suffers from water damage through capillary action. The long term effect of this is corrosion to the roof sheets. In the early stages of the aging process, the cut edges can be sealed to repair them and prolong the life of the roof. Once those repairs are at the end of their life span (or if they were not carried out in due time) a later repair to entirely recoat the roof can be carried out which will further prolong the life of the roof. Whilst not urgent, we feel that carrying out these 2 repairs over a period of several years would maximise the life span of the roof (approximately every 15 years).

APPENDIX A – PHOTOGRAPHS

3.2.1 – roof sheets in good condition (Roof A)

3.2.2 – depressed sheet edges due to being stood on

3.2.3 – protective coating removed and bare metal exposed (roof sheets)

3.2.4 – rusty fixings due to waterproof caps removed (roof sheets)

3.3.1 – protective coating removed and bare metal exposed (parapets and copings)

3.3.2 – parapet has corroded due to inappropriate fixings

3.3.3 – earlier remedial works in an attempt to seal the gaps (parapet joints)

3.4.1 – failed membrane at most joint locations

3.4.2 – water ponding which made it difficult to inspect the gutter

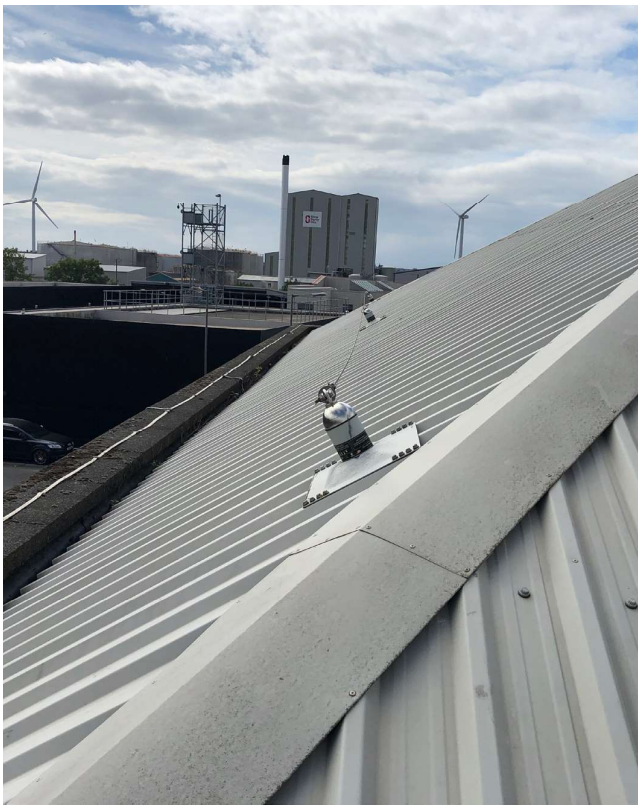
3.5.1 – rainwater outlet in poor condition, with missing leafguard

3.6.1 – Missing foam fillers at ridge lines

3.6.2 - rusty fixings due to waterproof caps removed (ridges)

3.6.3 – damaged or depressed flashings

4.1.1 – access was made difficult because of the concertina razor wire



4.2.1 - roof sheets in good condition (Roof B)

4.2.2 - protective coating removed and bare metal exposed (roof sheets)

4.2.3 - rusty fixings due to waterproof caps removed (roof sheets)

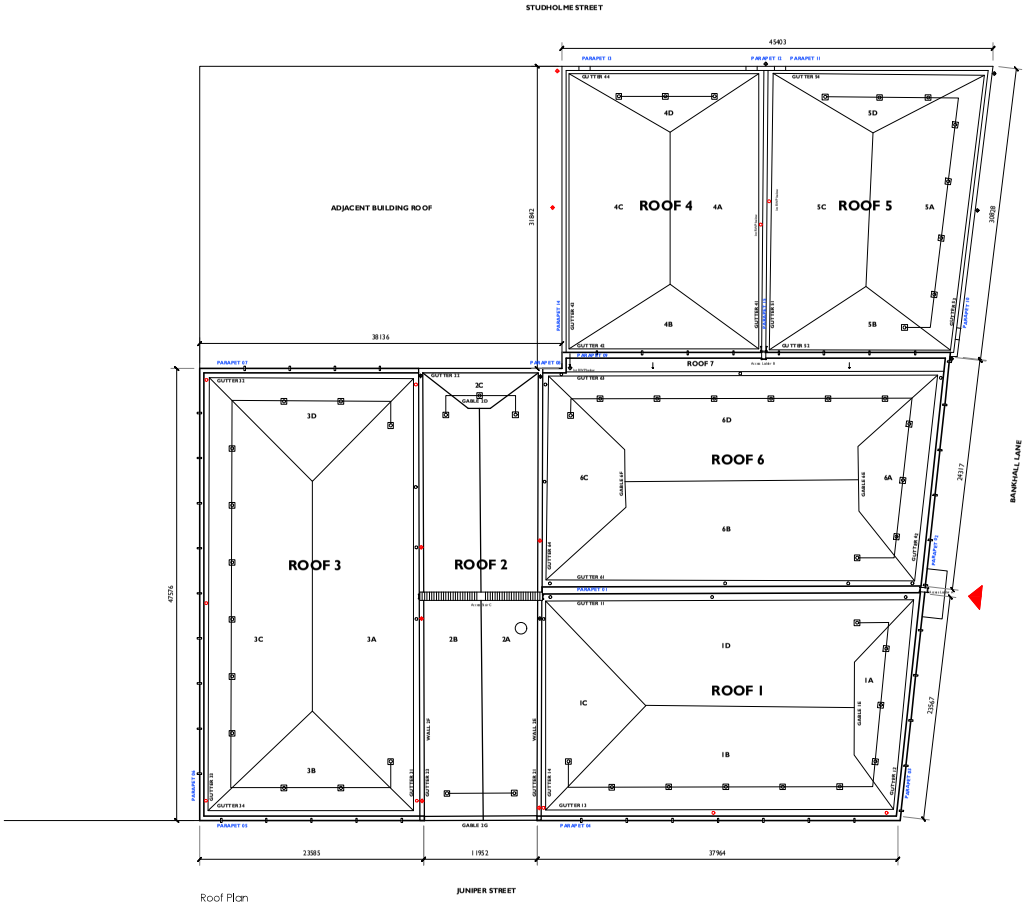
4.3.1 – vegetation needs to be removed from masonry parapet and copings

4.3.2 – failed lead flashings

4.3.3 – Spalling of masonry

4.4.1 – thick sludge in gutters

APPENDIX B – DRAWINGS

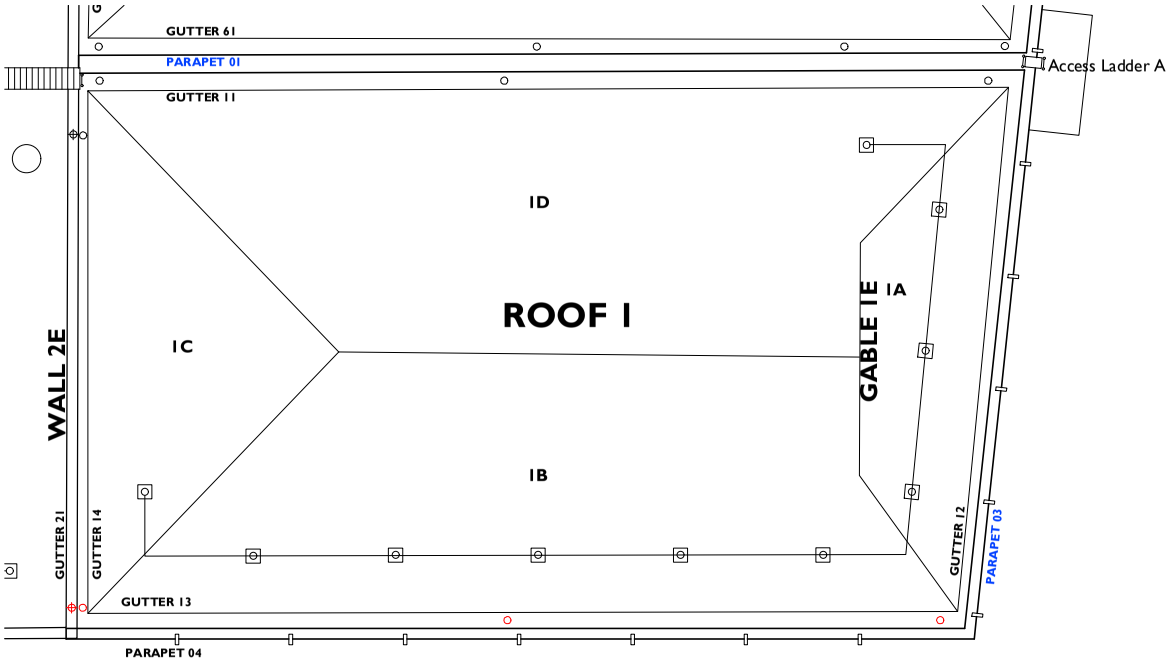


Roof Plan

ROOF PLAN KEY

- Rainwater Pipe (colour red - assumed location)
- Rainwater Outlet (colour red - assumed location)
- Fall Arrest System
- Non-compliant Fall Arrest System
- Access Ladder
- Flue
- Main Access From Ground

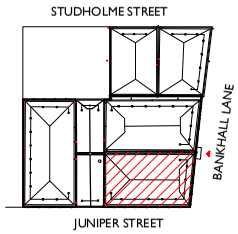
1 / 1000 Existing Roof Plan
1:500 @ A3

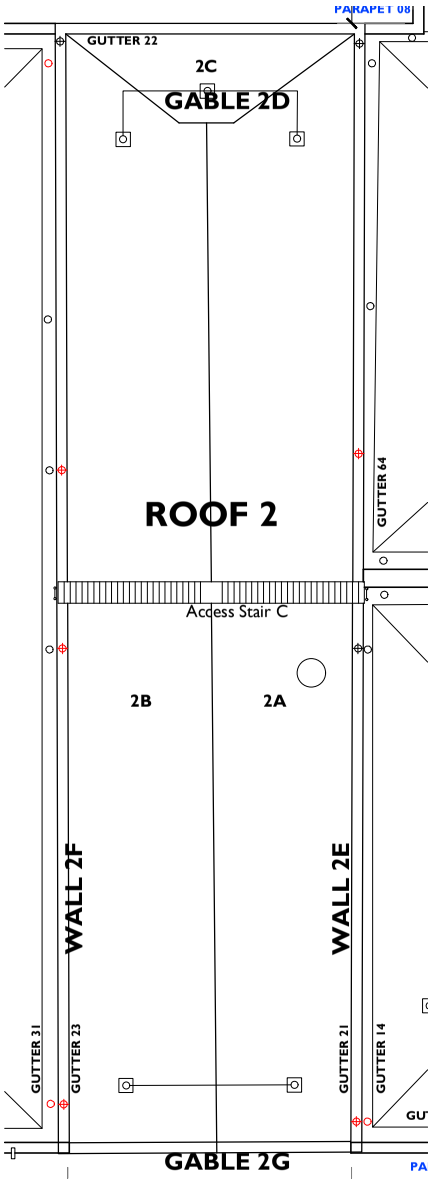


1001 **Existing Roof Plan - Roof 1**
1:200 @ A3

ROOF PLAN KEY

- Rainwater Pipe (colour red - assumed location)
- Rainwater Outlet (colour red - assumed location)
- Fall Arrest System
- Non-compliant Fall Arrest System
- Access Ladder
- Flue
- Main Access From Ground

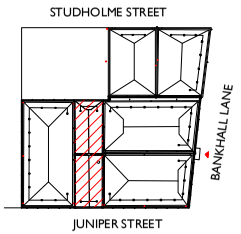


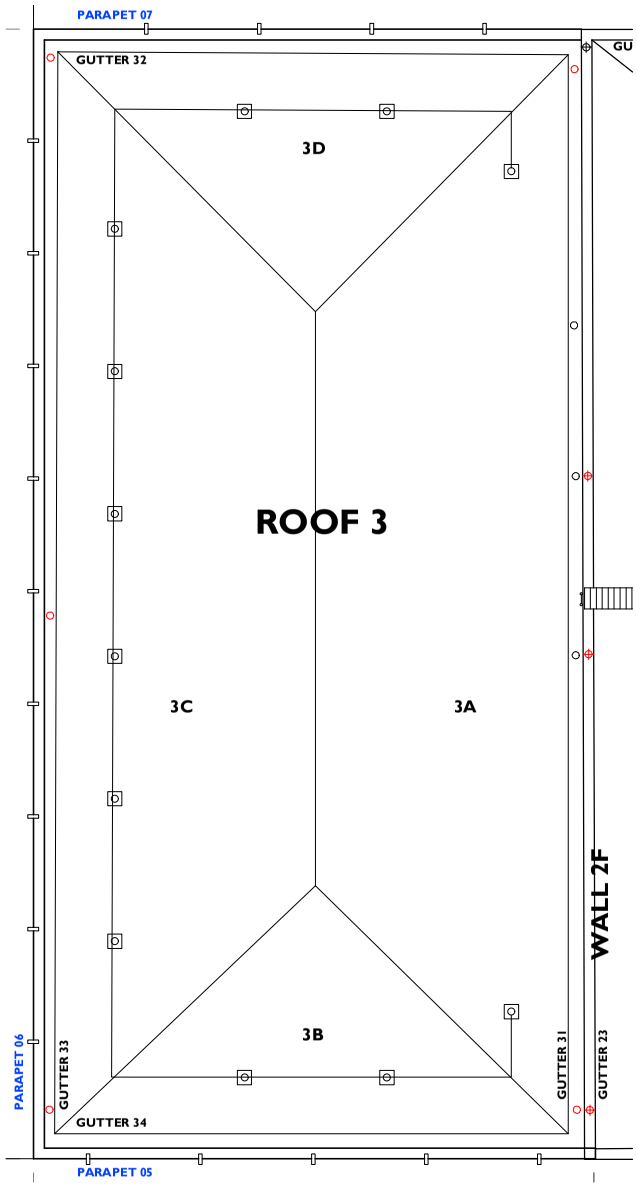


1 / 1002 Existing Roof Plan - Roof 2
1:200 @ A3

ROOF PLAN KEY

- Rainwater Pipe (colour red - assumed loc
- Rainwater Outlet (colour red - assumed l
- Fall Arrest System
- Non-compliant Fall Arrest System
- Access Ladder
- Flue
- Main Access From Ground

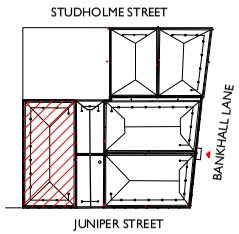


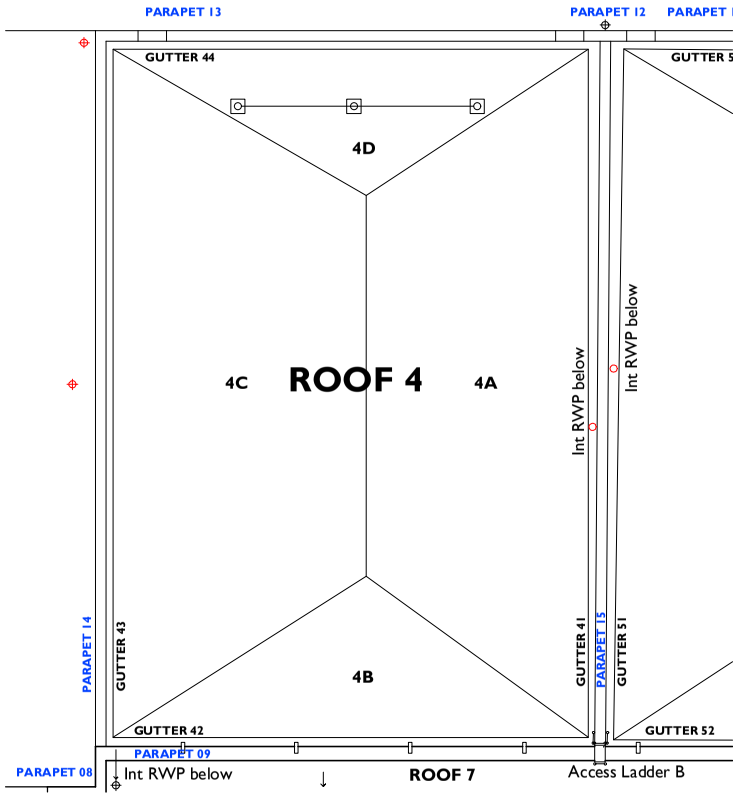


1 / 1003 Existing Roof Plan - Roof 3
1:200 @ A3

ROOF PLAN KEY

- Rainwater Pipe (colour red - assumed location)
- Rainwater Outlet (colour red - assumed location)
- Fall Arrest System
- Non-compliant Fall Arrest System
- Access Ladder
- Flue
- Main Access From Ground

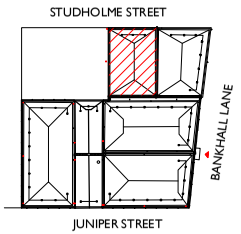


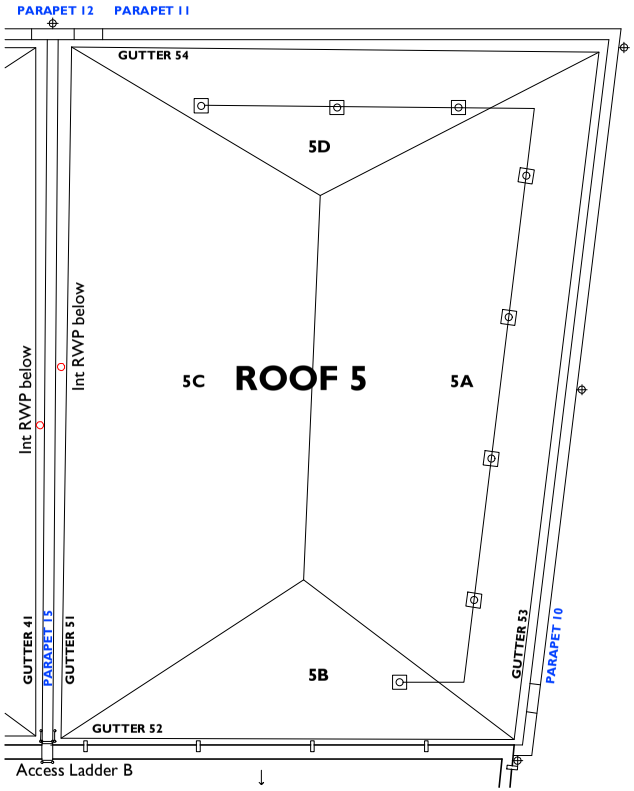


1 / 1004 **Existing Roof Plan - Roof 4**
1:200 @ A3

ROOF PLAN KEY

- Rainwater Pipe (colour red - assumed loc
- Rainwater Outlet (colour red - assumed l
- Fall Arrest System
- Non-compliant Fall Arrest System
- Access Ladder
- Flue
- Main Access From Ground

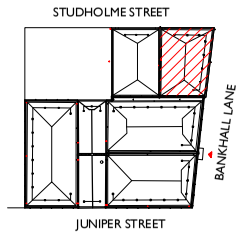


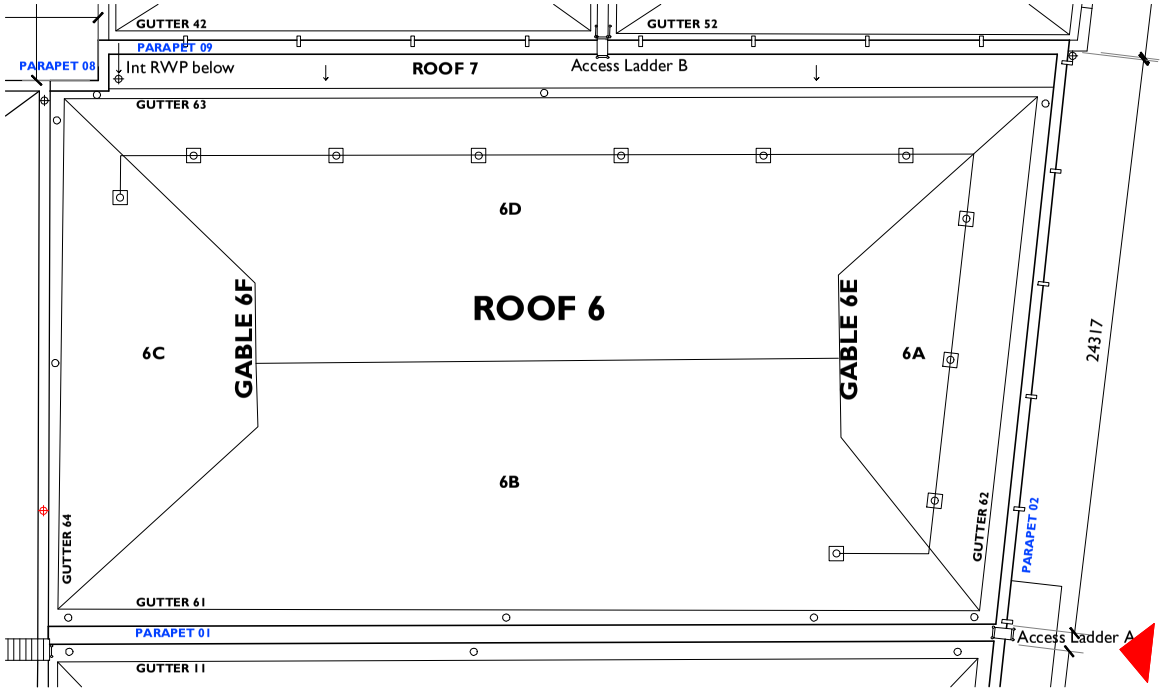


1
1005
Existing Roof Plan - Roof 5
1:200 @ A3

ROOF PLAN KEY

- **Rainwater Pipe (colour red - assumed location)**
- **Rainwater Outlet (colour red - assumed location)**
- **Fall Arrest System**
- **Non-compliant Fall Arrest System**
- **Access Ladder**
- **Flue**
- **Main Access From Ground**





1 / 1006 **Existing Roof Plan - Roof 6 incl Roof 7**
1:200 @ A3

ROOF PLAN KEY

- Rainwater Pipe (colour red - assumed loc
- Rainwater Outlet (colour red - assumed l
- Fall Arrest System
- Non-compliant Fall Arrest System
- Access Ladder
- Flue
- Main Access From Ground