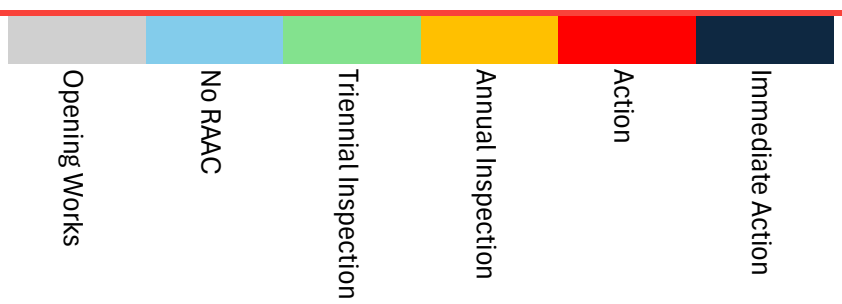
Detailed RAAC Inspection Report

Project Name:	NHS RAAC Inspections
Project Number:	UK0037298
Inspection Date:	18 Sep 24
Engineers:	#011, #012, #003, #025
Checker:	#011
Approver:	#002
Issue date:	11 Nov 24

NHS Board:	Lothian
Site Code:	S116H
Site Name:	Western General Hospital
Block Number:	5S
Block Name:	NTSU Block (Ward 1)
Discovery Report:	WSP-RP286-S116H-5S-Western General Hospital_NTSU Block (WARD 1)
Structural Engineers:	#015, #002
NHS Estates:	Connor Wilkie, Owen McCabe, Clive Armstrong

General Appraisal:	
Bearing Appraisal:	
Comments:	Planks are typically supported on 102mm wide steel longitudinal beams. Bearings are generally 40mm on one side and 50mm on the other. Only one layer of transverse reinforcement was located which was not located over the bearing. In some locations, no transverse reinforcement was identified. A number of these locations will be categorised as Red - Action required. Planks with large openings formed generally have 150x75 PFC trimming steel elements offering support to plank ends and edges. Smaller less significant openings are generally unsupported. Hairline cracking and isolated spalling were noted in several locations. A few locations were not accessible, particularly the skylights. The majority of the planks forming openings were categorised as Red -Action required. Planks forming the discrete gutter on the north and south elevations also require the remedial details recommended. It is anticipated the remedial details proposed will be required throughout the roofspace. Refer to the condition assessments and conclusions sections for further information.

Key



Introduction

This report has been prepared to record the findings of an appraisal of the roof structure at the noted address, which is made of RAAC planks. The appraisal takes into account both visual inspection and intrusive investigation.

A risk based approach was used to identify where the structure should be viewed. This began with a point cloud survey of the roof, which was subsequently overlaid with a plan of the floor below. Openings where then made in the ceilings from which to view locations where penetrations in the roof were identified as being present, and where plant is located above.

Several locations were also identified to intrusively investigate the plank bearings from above. These were generally chosen for practical reasons on site. The intrusive work involved removing roof finishes so that the width of bearings could be measured, and so that suitably placed reinforcement could be identified by locally cutting the planks.

In some locations, limited access was available due to servicing of the building, the placement of partitions, and due to the constraints of the building being live. This means that we may not have been able to collect a full data set at each location, for instance spans and plank depths. We have inferred that these remain relatively consistent by aggregating our observations across the site. For similar reasons, in some cases we only viewed openings from one or two sides.

For each location viewed from within the ceiling void, the RAAC has been placed in a risk category based on tables 3 and 4 of the IStructE guidance. That said, it has been necessary to apply judgement to some locations, as there are sometimes factors present that do not appear in the standard tables. Where appropriate we have also given weight to the reason damage or distress is evident and whether it is likely to re-occur.

A risk category, based on table 2 of the guidance, has been given to the plank bearings, albeit for the highest category we have adopted different colours and terminology to improve their clarity. We have used "red" when action is required and "black" when action is to be taken immediately. We have also provided a mitigated risk category based on the presence of factors that address potential causes of failure, or reduce the likely consequences of failure.

For practical reasons, we have not exposed reinforcement at every location, but have inferred our findings to be representative, based on the external appearance of what we see. If their manufacture and installation are similar, adjacent planks subjected to the same conditions, ought to behave in a similar manner. If they are dissimilar we ought to see differences in behaviour or condition.

Where appropriate we have made recommendations for repair or enhancement, and have referred to standard details that have been prepared on behalf of NHSScotland Assure. We have indicated a duration for acting on "red" items, this is based on the mitigating factors written in the report conclusions. However, our expectation is that a "reasonably practicable" time frame should apply. In practise this means, taking into account relevant factors. For instance, design and planning, re-routing services, decanting patients, complying with infection control processes, procuring remedials etc. This does not permit an indefinite period of time, but it does recognise the challenges of a healthcare environment and is intended to offer some flexibility. Key to this flexibility is a management strategy that is used to control spaces that contain RAAC. This should be a written document that provides mitigations against issues known to affect RAAC. For example, water ingress, overloading & unauthorised alterations. Health Boards are responsible for preparing this, although guidance has been provided via NHSScotland Assure.

Thus, our approach is risk based and evidence led. It is intended to provide a pragmatic model for applying the principles set down within the IStructE's guidance, while recognising the challenge of working within a healthcare environment. It relies on the active management of spaces by the Health Board and for this reason, over the longer term, Health Boards should plan to phase out RAAC within their estate.

Notwithstanding the above, Health boards may choose to place less reliance on active management by implementing a more extensive programme of enhancements, especially at the support bearings. The operational disruption this will cause will need to be managed in the short term.

This report is limited in scope to RAAC. It not intended to be an appraisal of the whole structure, nor is it intended to report on structural matters unrelated to RAAC. Should these services be required by the Health Board then a separate contract should be commissioned.

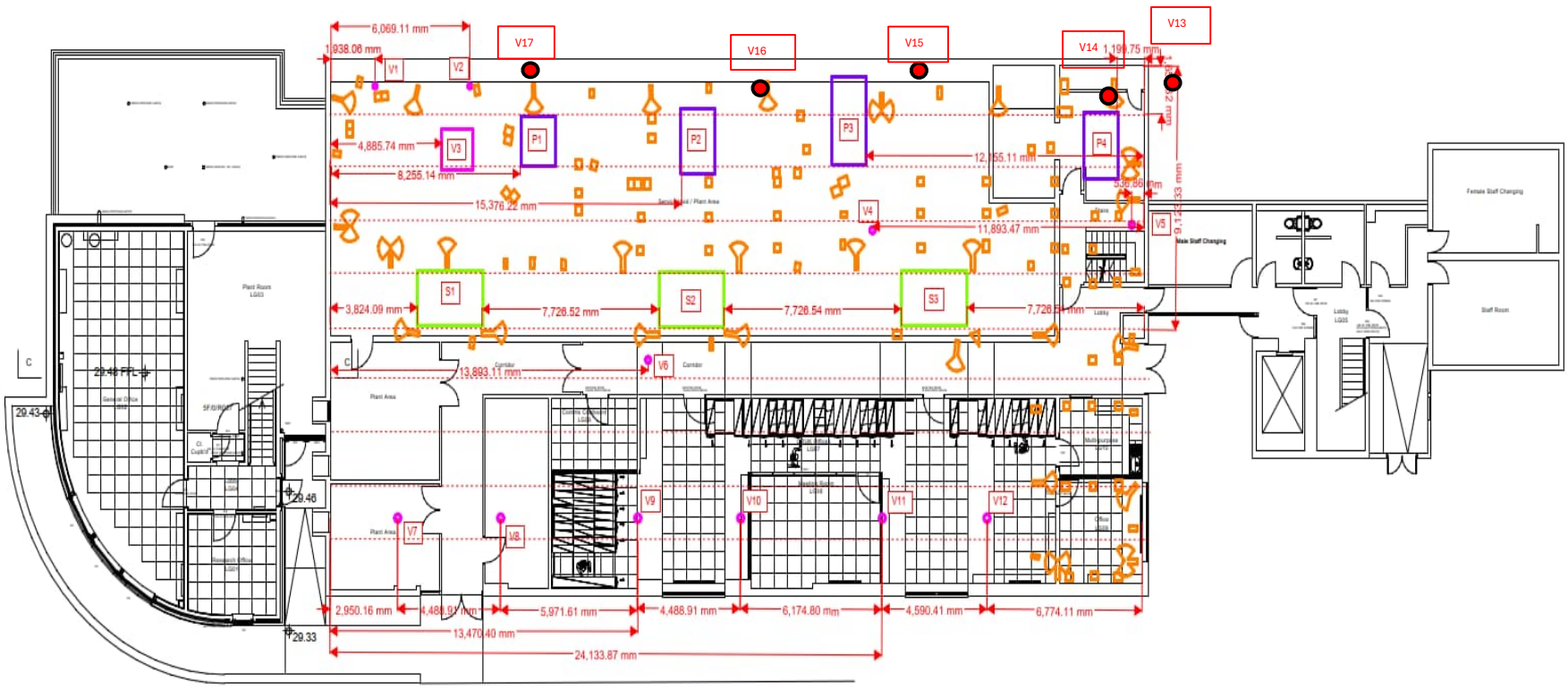
Our report reflects the building and its condition at the time of inspection, however if RAAC becomes wet or is overloaded it will become distressed, and its capacity will reduce. For this reason, the building fabric should continue to be managed and monitored after the works are complete. This must include maintenance of the rainwater goods and roof coverings, plus control of the load applied to the RAAC. Robust processes should also be in place for assessing and approving alterations. These requirements, and other relevant issues, should be written down in a management and maintenance strategy to be implemented by the Health Board.

The reader may not assume that locations not expressly described in this report are free from defects, damage and distress. Nor can it be guaranteed that RAAC is not present in locations that were not viewed.

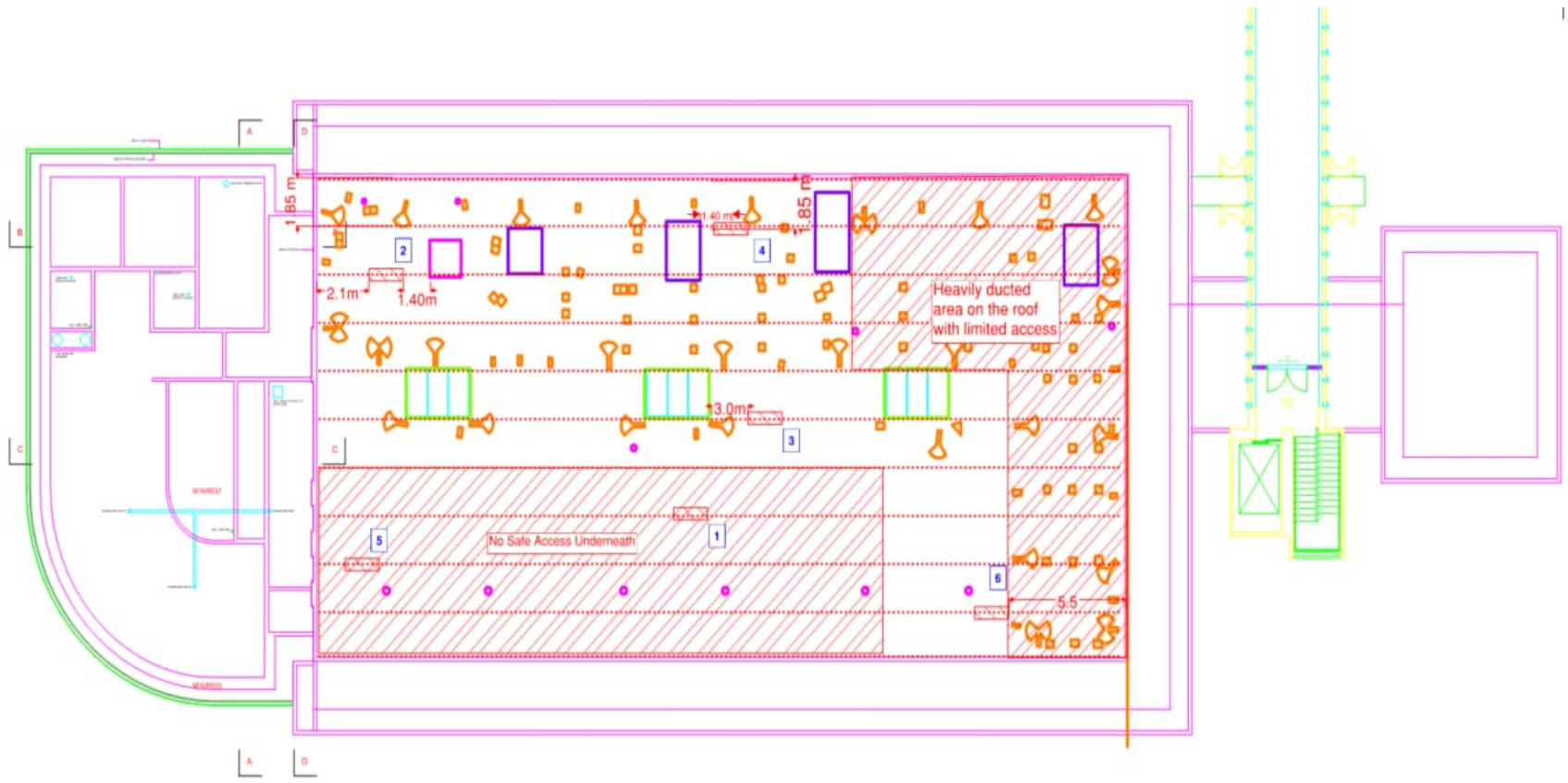
Disclaimer

Location Plan

Panel Condition Location Plan -



Bearing Condition Location Plan -



Panel Condition

Location	Slenderness			General Condition													Repair Detail		Comments
				Cracking				Spalling				Alterations							
	Span [mm]	Thickness [mm]	Span/Depth	Perpendicular [1]	Parallel [2]	Distance from Support [Edg]/[Mid]	Stress [3]	Modification [4]	Rebar Visible [R]/[NR]	Penetration [5]	Approx. Size [mm] [Dxxx]	Edge Modification [6]	Folded PLT [7]	Suspended Services [8]	Wet [9]	Deflection [10]	Risk Rating	Drawing No.	Detail No.	
P1	275	100	3	Yes	Yes	<500mm	No	Yes	No	Yes	600x1300	No	Yes	No	No	No		N/A	N/A	**(P1)** Remaining planks are trimmed and max 275mm long. Surface spalling damage 100mm long and 30mm wide. 2No. hairline cracks in adjacent full plank, not related to opening and covered in bearing condition assessment. Amber due to remaining plank length.
P2	N/A			No	No	>500mm	No	No	No	Yes	600x1800	No	Yes	No	No	No		N/A	N/A	**(P2)** Whole plank removed to form opening. All services are suspended on unistruts and the trimming steel present are 75mm wide PFCs.
P3	500	100	5	Yes	Yes	<500mm	No	Yes	Yes	Yes	600x1800 and 600x1300	No	Yes	No	No	No		N/A	N/A	**(P3)** Opening formed by whole plank removal in one bay and trimmed plank in second bay leaving 500mm long span.150x75 PFC trimming steel to support all edges. Hairline crack noticed in the remaining plank. Gutter plank locally broken out to install trimming steelwork, reveals longitudinal reinforcement top and bottom with ~20mm cover. See also V15. Amber due to remaining plank length.
P4	N/A			No	No	<500mm	No	Yes	Yes	Yes	600x1800	No	Yes	No	No	No		N/A	N/A	**(P4)** Whole plank locally removed to form opening. 150x75 PFC trimming steel to all edges. Minor cracking and spalling noted in adjacent planks.
Plank between Truss 1 and 2				Yes	No	<500mm	No	Yes	Yes	No	-	No	No	No	No	No		S-00001	4	**(Plank between Truss 1 and 2)** Transverse crack across width of plank, 1.8mm maximum crack width, within 500mm of support. No penetration but recorded. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
S1																		N/A	N/A	**(S1)** Skylight. No access to inside, limited visibility
S2																		N/A	N/A	**(S2)** Skylight. No access to inside, limited visibility
S3																		N/A	N/A	**(S3)** Skylight. No access to inside, limited visibility
V1				Yes	Yes	>500mm	No	Yes	Yes	Yes	~175mm DIA Opening, ~100mm DIA Pipe	No	No	No	No	No		S-00001	4	**(V1)** Penetration between 2 planks, opening impacts edge of each plank. Hairline to minor cracking observed, circa 240mm from the bearing. Another 0.7mm crack on the other side of the opening. 350mm long spalling damage, 175mm wide. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
V2	1290	100	13	Yes	Yes	<500mm	No	Yes	No	Yes	120mm DIA Opening, 100mm DIA Pipe	No	No	No	No	No		S-00001	4	**(V2)** Shallow surface spalling around opening. Hairline crack in one adjacent plank 240mm from bearing, 0.7mm crack in adjacent plank circa 150mm from bearing. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
V3	600	100	6	Yes	Yes	<500mm	No	No	No	Yes	1200x1300mm	No	Yes	No	No	No		N/A	N/A	**(V3)** 2 planks cut to form opening, leaving 600mm long planks supported by 150x75 PFC trimming steel to edges. Hairline cracks present at adjacent planks, but cut planks exhibit no obvious signs of damage.
V4				Yes	Yes	<500mm	No	No	No	Yes	~65mm DIA Opening, 60mm DIA Pipe	No	No	No	No	No		S-00001	4	**(V4)** Supported on longitudinal beams, no trimming present. No major cracking, no mositure and no spalling observed, 1No. hairline crack from edge of cored opening. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
V5	1818	100	18	No	No	>500mm	No	Yes	Yes	Yes	375mm DIA Pipe	No	No	No	No	No		S-00001	4	**(V5)** Plank spans between longitudinal beams, core at edge of plank. Spalling 200mm long and 30mm deep noted, 400mm from bearing. Longitudinal bars exposed within core. No trimming elements. No sign of mositure and distress. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.

Panel Condition

Location	Slenderness			General Condition													Repair Detail		Comments
				Cracking				Spalling			Alterations								
	Span [mm]	Thickness [mm]	Span/Depth	Perpendicular [1]	Parallel [2]	Distance from Support [Edg]/[Mid]	Stress [3]	Modification [4]	Rebar Visible [R]/[NR]	Penetration [5]	Approx. Size [mm] [Dxxx]	Edge Modification [6]	Folded PLT [7]	Suspended Services [8]	Wet [9]	Deflection [10]	Risk Rating	Drawing No.	Detail No.	
V6																		N/A	N/A	**(V6)** No access
V7																		N/A	N/A	**(V7)** No access
V8																		N/A	N/A	**(V8)** No access
V9																		N/A	N/A	**(V9)** No access
V10																		N/A	N/A	**(V10)** No access
V11																		N/A	N/A	**(V11)** No access
V12				No	Yes	<500mm	No	Yes	Yes	Yes	120~130mm DIA Opening	No	No	No	No	No		S-00001	4	**(V12)** No trimming elements present. 180mm long hairline crack from one side of the opening, 100mm long crack on the other side. Reinforcement bars exposed as spalling present on bottom face.Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
V13	3720	200	19	Yes	No	>500mm	No	No	No	Yes	170mm DIA Opening	No	No	No	Yes	Yes		S-00001	4	**(V13)** Gutter plank circa 200mm deep. Efflorescence noted in some areas. Hairline crack midspan ~0.3mm wide. Evidence of deflection midspan circa 20mm. No evidence of cracking at the ends. 100x75mm angle, 300mm long fixed to wall to support plank end, truss supports plank at other end. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
V14				Yes	Yes	<500mm	No	Yes	No	Yes	200x200 Opening, 200mm DIA Pipe	No	No	No	No	No		S-00001	4	**(V14)** Opening formed adjacent to longitudinal beam at end of span, no trimming elements present. Some efflorescence noted. Hairline to minor cracking propogating in several directions from opening, circa 350mm long. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
V15				Yes	No	>500mm	No	Yes	Yes	Yes	200mm DIA Pipe	No	No	No	No	Yes		S-00001	4	**(V15)** Gutter plank locally broken out to install trimming steelwork for opening P3. Reveals longitudinal reinforcement top and bottom with ~20mm cover. Downpipe circa 550mm from PFC installation damage noted and 1150mm from truss, hairline crack 175mm from opening.Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
V16				No	No	>500mm	No	No	No	Yes	200mm DIA Pipe	No	No	No	No	Yes		S-00001	4	**(V16)** Opening formed in gutter plank for presumed rainwater pipe. Although no water present during inspection, some evidence of effloresence and staining. Midspan deflection noted to plank, circa span/200. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
V17	3770	200	19	No	No	>500mm	No	No	No	Yes	200mm DIA Opening	No	No	No	No	No		S-00001	4	**(V17) ~**200 dia opening formed in gutter plank for presumed rainwater pipe, 70mm to long edge of plank one side, 170mm to other. Circa >500mm to plank support. Deflection mid span. Truss offers 75mm support to end of plank. Mitigated risk due to load capacity utilisation, dependent on active management strategy and remedial details being implemented in the short term future.
Gutter Plank (Near V1)	3725	200	19	Yes	Yes	<500mm	No	Yes	Yes	No	-	No	No	No	No	Yes		S-00001	4	**(Gutter Plank (Near V1)) 3725mm span.** Angle support 100x70mm 300mm long, 2 M20 bolts fixing to wall truss support at other end of plank. 1200mm long spalling from angle support, noteable damage and deflection of 20mm. Notable mortaring to underside, perhaps previous repair. Hairline cracks present. Bottom reinforcement exposed. Currently propped by timber shutter within span, hence risk rating mitigated to red.

Bearing Condition

Location Key:
1a1: location on the roof; position along the length of the support; position either side of the support

	Bearing Condition					Repair Detail	
Location	Bearing Width	Transverse bar location	Risk Rating	Mitigations	Mititgated Risk Rating	Drawing No.	Detail No.
1				Not inspected due to limited access beneath			
2a1	50			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
2a2	40			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
2b1	50	None Visible >100mm		Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
2b2	40			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4

Bearing Condition

Location Key:
1a1: location on the roof; position along the length of the support; position either side of the support

	Bearing Condition					Repair Detail	
Location	Bearing Width	Transverse bar location	Risk Rating	Mitigations	Mititgated Risk Rating	Drawing No.	Detail No.
2c1	50			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
2c2	40			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
3a1	102			free from cracks top and bottom; dry; 1 layer transverse rebar proven at 3b1, plus bar in longitudinal joints, bearing > 75, actively managed - refer to conclusions.			
3a2	102			free from cracks top and bottom; dry; 1 layer transverse rebar proven at 3b1, plus bar in longitudinal joints, bearing > 75, actively managed - refer to conclusions.			
3b1	102	75 From end of plank which overhangs beam by ~40mm		free from cracks top and bottom; dry; 1 layer transverse rebar proven at 3b1, plus bar in longitudinal joints, bearing > 75, actively managed - refer to conclusions.			
3b2	102			free from cracks top and bottom; dry; 1 layer transverse rebar proven at 3b1, plus bar in longitudinal joints, bearing > 75, actively managed - refer to conclusions.			
3c1	102			crack noted on top and bottom; dry; 1 layer transverse rebar proven at 3b1, plus bar in longitudinal joints, bearing > 75, actively managed - refer to conclusions.			
3c2	102			free from cracks top and bottom; dry; 1 layer transverse rebar proven at 3b1, plus bar in longitudinal joints, bearing > 75, actively managed - refer to conclusions.			
4a1	50			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4

Bearing Condition

Location Key:
1a1: location on the roof; position along the length of the support; position either side of the support

	Bearing Condition					Repair Detail	
Location	Bearing Width	Transverse bar location	Risk Rating	Mitigations	Mititgated Risk Rating	Drawing No.	Detail No.
4a2	40			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
4b1	50	85		Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
4b2	40			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
4c1	50			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4

Bearing Condition

Location Key:
1a1: location on the roof; position along the length of the support; position either side of the support

	Bearing Condition					Repair Detail	
Location	Bearing Width	Transverse bar location	Risk Rating	Mitigations	Mititgated Risk Rating	Drawing No.	Detail No.
4c2	40	No trans rebar seen at cut >100mm		Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Longitudinal bars pass over the supports in the joints between planks. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
5				Not inspected due to limited access beneath			
6a1	30			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
6a2	65			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
6b1	30			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
6b2	65	95		Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4

Bearing Condition

Location Key:
1a1: location on the roof; position along the length of the support; position either side of the support

	Bearing Condition					Repair Detail	
Location	Bearing Width	Transverse bar location	Risk Rating	Mitigations	Mititgated Risk Rating	Drawing No.	Detail No.
6c1	30			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4
6c2	65			Suspended services carried by the primary steel. RAAC is dry. Deflection not excessive. RAAC is free of spalls and full depth cracks. There are some hairline cracks on the soffit. Contemporary manufacturer's information suggests 100 thk RAAC, spanning 1.8m, likely has working load capacity in range of 2.2-3.0 kPa. Imposed load should be greater of: 0.4 kPa snow load, 0.6 kPa maintenance load and 0.9 kN, say 0.83 kPa [distributed over one plank]. Assuming 0.83 kPa, utilisation in the range 0.27-0.37 << 1 i.e. stresses are currently low. RAAC actively managed to ensure current conditions are maintained		S-00001	4

Conclusions

Panel Condition

The below is offered as a summary, we have documented observations made for each opening in more detail in the site markups.

Chipboard flooring provides access to the serviced area to the north, ducts limit access to a number of areas in this space. The roof space to the south was generally inaccessible with only a narrow walkway provided towards the apex of the roof.

Roof coverings were generally intact and therefore the planks were dry.
The roof make up was 10mm bitumastic roofing felt , 20mm cork, 20mm polystyrene type layer, Liquid bitumen tak coat and webbing.

Trusses span from the Northern external wall to the Southern external wall, 9 trusses were observed. Longitudinal beams are generally 178x120UBs at 1800mm centres, these are supported by the top chord of the truss. Generally the bottom flange of the longitudinal beam is bolted to the top chord of the truss. RAAC planks are 100mm thick and span over the longitudinal beams at circa 1800mm centres, confirmed by selected on-site measurements which appeared consistent across the roof space.

There is a discrete gutter on the northern and southern roof edges. It is believed this is formed by extending the RAAC planks circa 200mm over the last longitudinal beam and stopping before the external wall/ parapet. The base of the gutter is formed from a circa 200mm deep, 400mm wide RAAC plank which spans between the trusses. It is believed this is a cut plank due to the rough finish and lack of chamferred edge.

Reference to photographs from various periods suggest that the skylights were installed after the original construction of the building, circa 1984. It appears that the services were installed on the roof more recently, possibly within the last 5 years, it is thought the openings and trimming steelwork was also installed at this time.

The majority of these observations were noted in the original discovery survey report.

Panels viewed from the ceiling void fall into 2 broad categories:
1. Small openings without supplementary support.
2. Large openings with steel supplementary support.

The planks forming the roof structure observed are generally dry with no evidence of previous water ingress or excessive deflection. The planks forming the gutters at eaves level however did exhibit signs of notable deflection throughout and previous water damage in some locations. Minor spalling and hairline cracking were observed in several locations across the roof space, often as a result of the formation of an opening.

Supports to Openings and Services
Generally speaking, services are suspended on Unistrut sections which are fixed to the longitudinal UBs. Some crawl space light fixtures were supported directly by the RAAC panels.

Smaller vent openings are typically cored 200-250mm diameter openings for circular pipes to pass through. None of the openings observed were supported by additional steelwork, timber or straps. Vents 7 to 11 were not accessible due to a lack of attic floor boards in this area. It has been assumed these are similar to other vent openings and are cored through the planks and not supported by additional members.

Larger duct penetrations or openings are framed with 150x75 PFC trimmers which are bolted to the longitudinal beams, top flange aligned with top flange. Due to the span direction of the planks, these generally run down the edge of the planks. Most of the openings appear to have been formed by removal of a whole plank and trimming steel installed along the edge of the plank. Openings V3, P1 and P3 have cross trimmers which support plank ends, these are also 150x75 PFC elements. The planks that have been cut to form the opening and are generally 230mm to 500mm long between the trimming PFC and the longitudinal UB. As the trimmer supports one plank span only, up to 75mm of bearing could be provided, however this could not be confirmed from the underside.

The skylights were not visible at the time of the inspection, either due to the boxing and fireproofing, or from limited access. Based on observations around the roof space it is assumed whole plank spans have been removed between the longitudinal beams to form the opening, however could not be confirmed.

Damage and Stress
Several planks were noted to have hairline cracking around the openings, in both transverse or longitudinal directions with varying lengths. Some cracking was observed within 500mm of the bearings and some at midspan. Some of the cored openings displayed evidence of cracking propagating from the opening, widths were measured up to 2mm thick in isolated instances but most were hairline. Some of the cored openings have surface spalling damage, rebar was exposed in at least 1No. location. The larger openings that have been trimmed displayed evidence of hairline cracking to adjacent planks in some instances, cracking was noted both within and beyond 500mm of the planks end bearing. There was isolated instances of surface spalling.

The gutter planks were circa 200mm deep and spanned between the trusses (circa 3750mm spans). 20mm mid-span deflection was measured in several instances (span/187). Hairline up to 2mm wide cracks were noted across some planks at mid span or third span points. Some opening dimensions were more than half of the planks width (250mm opening in 400mm wide plank) and had no additional support. Some planks appear to have rotated, however this may be to form falls within the gutter. As noted on the markups, the first two plank spans to the north west corner of the roof had surface spalling which exposed rebar adjacent to the end of the plank and have been temporarily propped in 2 locations by timber studs and chipboard.

Conclusions

Although there was some evidence of previous water staining, no moisture or water ingress was observed at the time of the inspection.

Bearing condition

In the majority of locations that were inspected RAAC bearing widths were greater than the contemporary requirement [45 mm] and a quarter of the time they were also greater than the modern requirement [75 mm]. Nevertheless, in several locations they are less than both standards. In addition to this we did not find transverse bars over the support. For this reason, we have recommended remedial action be taken.

It is reasonable to ask why the roof has performed satisfactorily for a long time despite the bearings being found to be theoretically inadequate. In relation to this, we did find several mitigating factors that are likely explanatory.

For instance, the planks are dry and have not deflected excessively. Reinforcement, found in the joints between planks, was found to pass over the majority of supports expcept location 6, and working stresses in the planks are estimated to be low. We did not see full depth cracks expressed on the top of the planks.

Another factor, could be the toughness of the original tar finish that remains in-situ below the insulation. While you would not want to place structural reliance on roof finishes, the tar was bonded firmly to the RAAC and was found to be exceedingly difficult to remove during the opening works. Indeed, it had to be pre-weakened with saw cuts and even then proved exceedingly resilient.

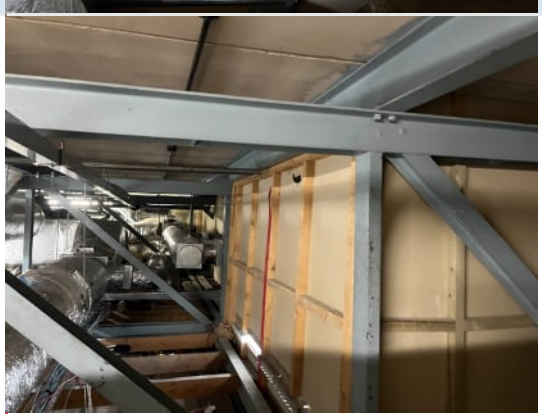
Notwithstanding this, since action has already been taken, in the form of a plan to actively manage the RAAC such that it's condition does not change, it is possible to temporarily down-grade the classification from black to red for a period of three months during which temporary repairs should be executed as soon as reasonably practicable.

If it is not possible to complete the works within this timeframe, or if the management plan cannot be implemented, then temporary props should be used to provide enhanced support to the plank ends.

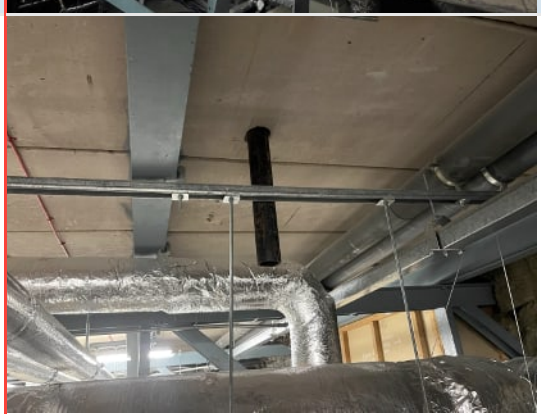
The management plan should ensure no new load is added to the roof, planks are kept dry, and no unauthorised penetrations are made. The processes for achieving this should be contained in a written document and conveyed to staff responsible for implementing the plan. If the plan is not in place then the red locations will move up a category.

It should also be noted, that during the winter season snow and ice should not be permitted to build up or drift on the roof.

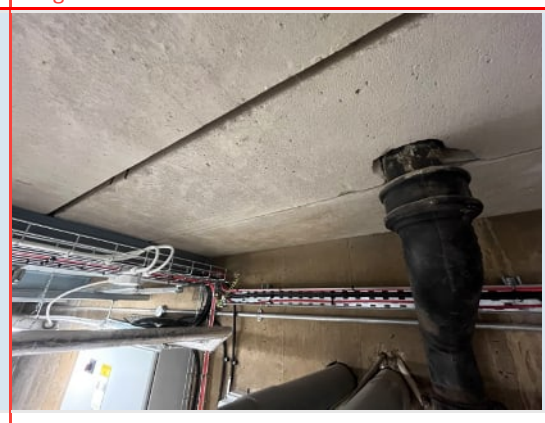
Panel Summary

Location	General Condition Code	Repair Detail		Image
		Drawing No.	Detail No.	
P1	AMB.1.2.Edg.4.NR.5.D600x1300.7	N/A	N/A	
P2	GRY.Mid.NR.5.D600x1800.7	N/A	N/A	
P3	AMB.1.2.Edg.4.R.5.D600x1800 and 600x1300.7	N/A	N/A	
P4	GRY.Edg.4.R.5.D600x1800.7	N/A	N/A	
Plank between Truss 1 and 2	RED.1.Edg.4.R.D-	S-00001	04	
S1	GRY	N/A	N/A	

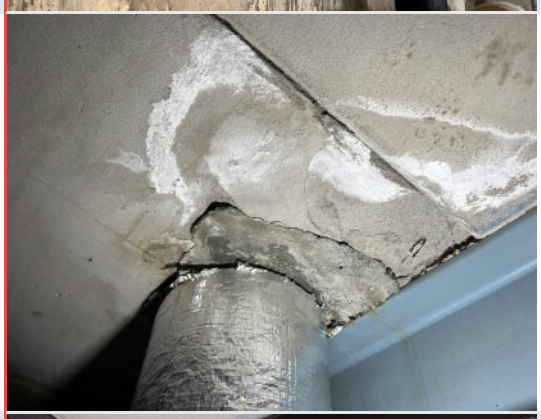
Panel Summary

Location	General Condition Code	Repair Detail		Image
		Drawing No.	Detail No.	
S2	GRY	N/A	N/A	-
S3	GRY	N/A	N/A	
V1	RED.1.2.Mid.4.R.5.D~175mm DIA Opening, ~100mm DIA Pipe	S-00001	04	
V2	RED.1.2.Edg.4.NR.5.D120mm DIA Opening, 100mm DIA Pipe	S-00001	04	
V3	GRN.1.2.Edg.NR.5.D1200x1300mm.7	N/A	N/A	
V4	RED.1.2.Edg.NR.5.D~65mm DIA Opening, 60mm DIA Pipe	S-00001	04	

Panel Summary

Location	General Condition Code	Repair Detail		Image
		Drawing No.	Detail No.	
V5	RED.Mid.4.R.5.D375mm DIA Pipe	S-00001	04	
V6	GRY	N/A	N/A	-
V7	GRY	N/A	N/A	-
V8	GRY	N/A	N/A	-
V9	GRY	N/A	N/A	-
V10	GRY	N/A	N/A	-

Panel Summary

Location	General Condition Code	Repair Detail		Image
		Drawing No.	Detail No.	
V11	GRY	N/A	N/A	-
V12	RED.2.Edg.4.R.5.D120~130mm DIA Opening	S-00001	04	
V13	RED.1.Mid.NR.5.D170mm DIA Opening.9.10	S-00001	04	
V14	RED.1.2.Edg.4.NR.5.D200x200 Opening, 200mm DIA Pipe	S-00001	04	
V15	RED.1.Mid.4.R.5.D200mm DIA Pipe.10	S-00001	04	
V16	RED.Mid.NR.5.D200mm DIA Pipe.10	S-00001	04	

Panel Summary

Location	General Condition Code	Repair Detail		Image
		Drawing No.	Detail No.	
V17	RED.Mid.NR.5.D200mm DIA Opening	S-00001	04	
Gutter Plank (Near V1)	RED.1.2.Edg.4.R.D-.10	S-00001	04