

Essential Repairs to the Roof

1830 Warehouse

Science & Industry Museum

Design and Access Statement



Prepared by:
Studio Downie Architects LLP
March 2023

CONTENTS:

SECTION 01/ page 3

Introduction

SECTION 02/ page 5

The Site and Its Context

SECTION 03/ page 8

Analysis and Approach

3.1: Valley Gutters

3.2: Bay 4 Roof

3.3: Truss Chord Repairs

SECTION 04/ page 31

Summary of Proposed Schedule of Works

APPENDIX:

- **Appendix A Structures Report**

- A.1: Conisbee 220626_1830_Warehouse_Structural_Appraisal
- A.2: Hutton & Rostron 210-58 SIM 1830 Warehouse Rpt 111018 CW “Investigation of Lime Torching to the Underside Of The Roof in Bay 04 of the 1830 Warehouse”
- A.3: Conisbee Structural Note

- **Appendix B Method Statements**

- B.1: Methodology for Valley Gutters
- B.2: Methodology for Bay 4 Roof
- B.3: Methodology for Truss Chord Repairs
- B.4: Methodology for Temporary Works
- B.5: Methodology as General Summary

- **Drawings**

- Studio Downie Architects Drawings - architectural and general arrangement
- Conisbee Drawings - structural repairs

SECTION 01 / INTRODUCTION:

- This Design & Access Statement report has been prepared on behalf of the Science and Industry Museum (SIM) Manchester for proposed works which are part of a large capital spend by the museum on their estate of historic buildings. This includes an important programme for inspection, repairs and maintenance to bring the buildings back to where they should be and to ensure their continued enhancement and long term well being as an important part of the visitor experience.
- As part of this programme Studio Downie Architects LLP have been working with SIM and coordinating a team of experienced consultants and specialists to provide a series of Conditional and Measured surveys for the Grade 1 1830 Warehouse. The team has developed a detailed understanding of the historic building through their history, construction details and current maintenance/defect issues and its importance within the wider context of Manchester's townscape setting.
- Studio Downie's varied experience includes historic buildings on challenging landlocked city sites and sensitive protected landscapes.
 - The Grade 1 Parker Library, Corpus Christie College, Cambridge
 - The Grade II* Royal Geographical Society, London
 - The Cass Sculpture Foundation, South Downs National Park.
 - The Grade 2 Lyme Regis Museum, Unesco World Heritage Site
 - The Grade II Stanley Building, Kings Cross, London awarded best Heritage-led project, London Planning Awards.

Executive Summary

- There is a priority for essential conservation works during the Summer of 2023. From October 2023, the 1830 Warehouse will be used for staff offices and temporary events and so repairs are needed for staff and visitor safety.
- The design team have undertaken a review of the client ‘as built’ information, client records, client surveys; a visual record of what’s there now; an assessment of historical significance focused on the specific alterations, and including identifying repairs to the fabric.
- The client liaison with internal stakeholders, e.g. operations, commercial events and parallel works activities is important to the successful project delivery.

The Scope of Works

- A summary of the works is set out below:
 - Reprofile valley gutters to Bay 1-4, and Bay 5, to coordinate with rainwater calculations
 - Replace torching to Bay 4
 - Bay 2 and Bay 1 truss repairs (see Conisbee Structural Report)
- The intention is to avoid the need for full scaffolding. Temporary Works design may be required for certain aspects, e.g. Bay 4.
- The works to the cracked truss timbers and associated requirement to back-prop may be best to carry out whilst the building is not in heavy use. One of the cracked trusses is also not currently propped so if repairs are not planned soon, temporary support would need to be considered.

Process

- This application for Listed Building Consent brings forward the scope of works to the roof level of the 1830 Warehouse.
- The client, Deloitte, SDA, HCUK, (and Conisbee in part) attended a site meeting on 17/01/2023 with MCC Planning Officers and the Conservation Officer to give an overview of the defects and the general approach.
- The early discussion on site with MCC Conservation Officer, established their understanding of the defects and how the situation will be improved with the proposed repairs, to help identify what is of special interest to inform the level of detail of the proposals before going too far.
- Feedback from the meeting established:
 - The approach to the valley gutters was appropriate and team should progress design.
 - Bay 4 roof - it is preferable to insulate the roof above the rafters as the parapets are not affected; more research is necessary to uncover how torching became as it is and the likely impact to the historic fabric if it is removed; options should be explored on what can be achieved using traditional construction methods to the soffit on a risk based approach reviewed with SIM/MCC.
- Following further research and review of options to Bay 4 a preferred approach was identified by the Museum (option 6). A follow-up site meeting on 08/03/2023 with MCC Planning Officers, SDA, Conisbee and Client discussed the preferred approach to Bay 4 and Bay 2 Truss repairs.
- Feedback from the meeting established:
 - All agreed that option 6 for Bay provided a good balanced solution.
 - The quality of the lime plaster finish should not be too smooth. The contractor would undertake samples of the lime plaster finish for review on site.
 - Repair work to restore the structural functions of the truss in a more permanent manner, and to remove temporary supports. The proposal to bolt steel plates on the outside of the trusses would result in the minimal loss of historic fabric.
- **Conclusions**
 - Stabilise and preserve the historic structure.
 - Upgrade 1990’s installations to valley gutters and replace the lime torching to Bay 4
 - This approach while adjusting the relatively unseen roof appearance provides major improvement to the weatherproofing of the building and therefore conserving the historic fabric of the structure below, protecting it from rainwater ingress and resultant damage.
 - Reduce overheating the interior from solar gain, absorb internal heat gain.

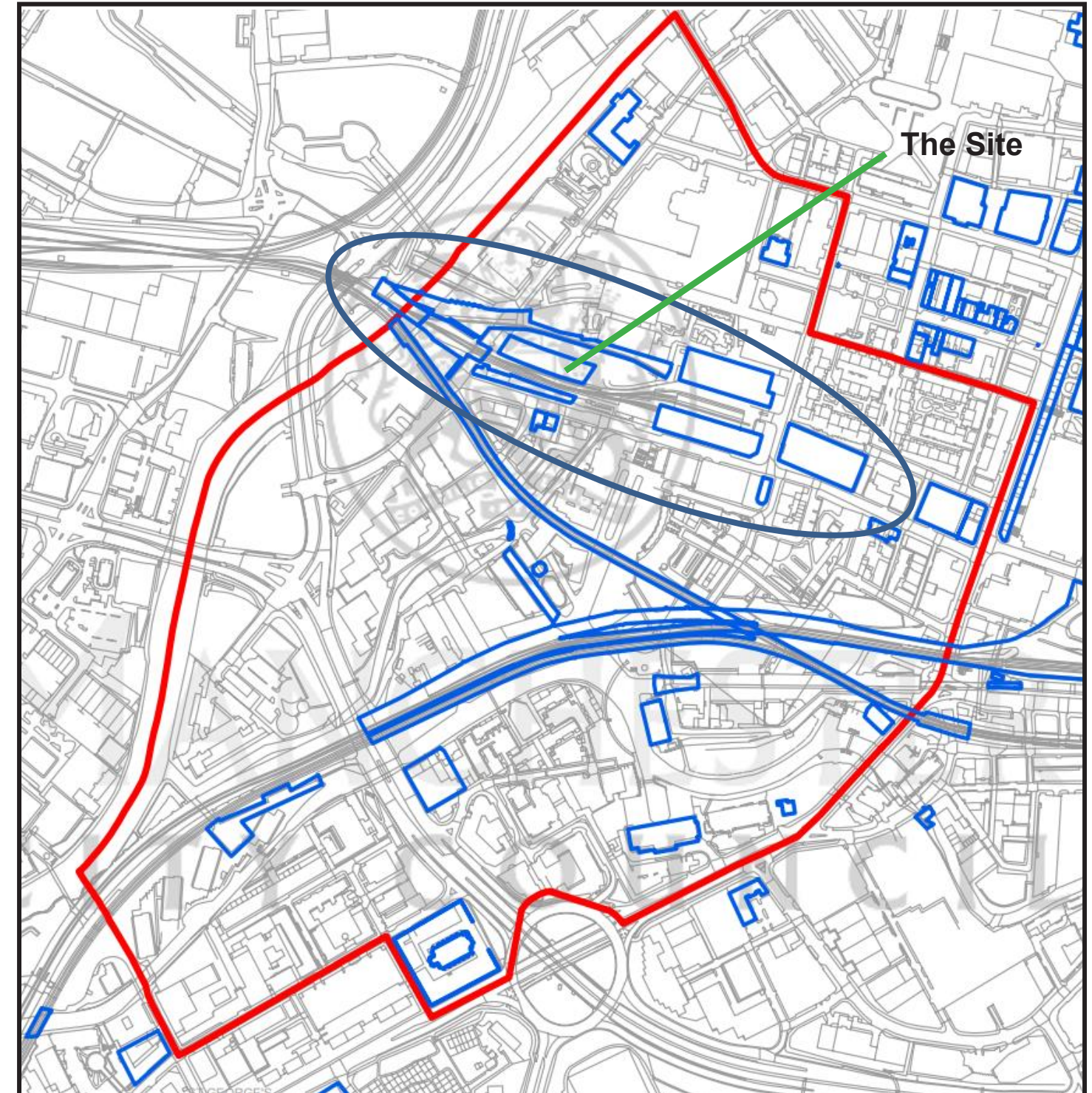
SECTION 02 / THE SITE AND ITS CONTEXT:

The buildings and the site

- As the world's oldest surviving passenger railway station and the world's first railway warehouse, the western end of the site has been extensively researched.
- Located within the Castelfield Conservation Area the large and complex former "Liverpool Road Railway Station" site contains a significant collection of Grade I and Grade II listed buildings.
- A Conservation Management Plan commissioned by the Museum, who are the owners of the site sets out policies which form a framework of philosophy and priorities for repair and conservation.

Planning, Heritage & wider context

- The 1830 Warehouse is a Grade I listed building, it sits within the Castelfield Conservation Area and is close to a number of other listed buildings and structures including the former Liverpool Road railway station and station masters house (Grade I) and the elevated track and viaduct between those two that links the bridge over the River Irwell to the Station and Warehouse.
- The building has a brick envelope with timber frame internally, reinforced at basement level with steel and iron columns. The elevation has several types of opening which are explained in the HCUK heritage assessment.
- There have been phases of alterations to the 1830 Warehouse born out of a necessity to adapt to the needs of changing warehousing methods to transfer goods from track into the building. The most recent phase of the adaptation relates to changes brought about by its change of use to a museum.
- The Bays are numbered 1 – 5 from west to east on plan. Defects were previously found to be present in the valley gutters, truss chords to Bays 1 and 2, and failing areas of the torching applied in Bay 4. Further investigation has been undertaken and preliminary liaison with MCC Planning Authority and Conservation Officer to understand the scope for replacement. With the risk of further damage to the fabric from failing weather protection and possible structural movement it is important to undertake the repairs as soon as possible.



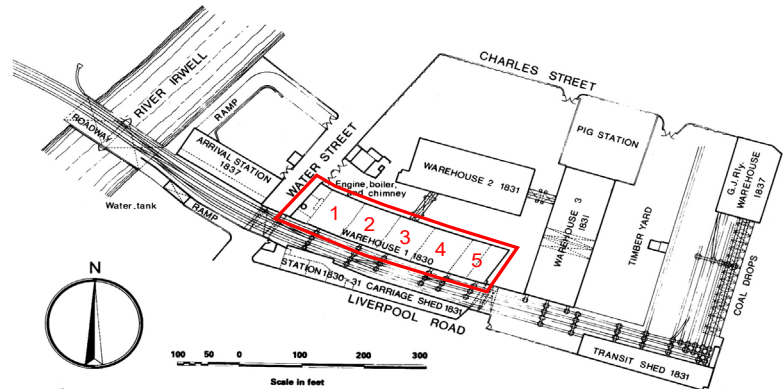
Castelfield Conservation Area

Bays to the building

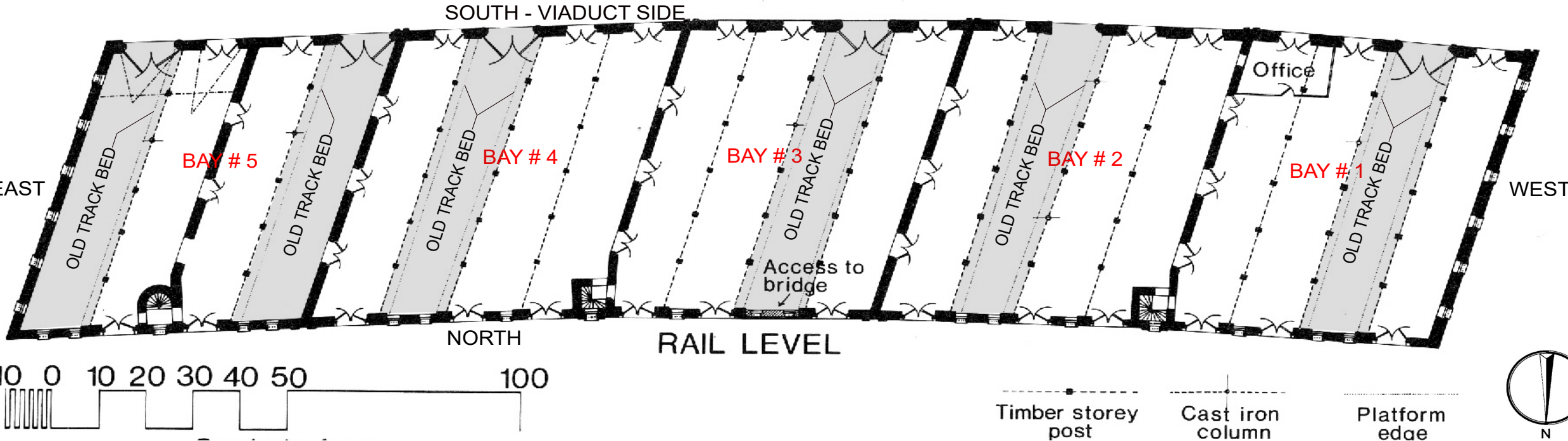
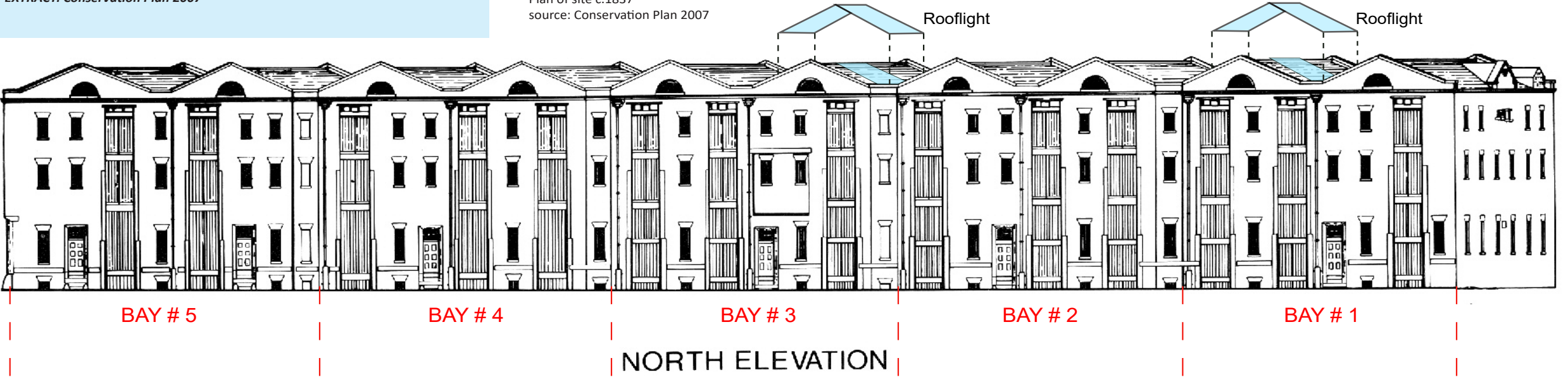
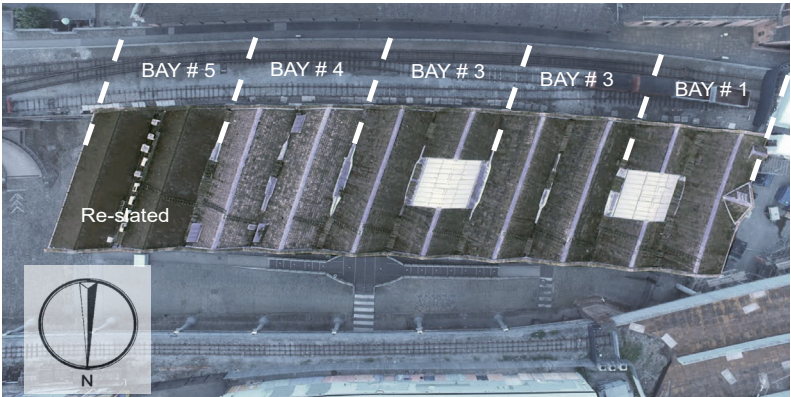
Description of 1830 warehouse

It is timber framed (with cast iron columns in the basement) with brick walls and a slate roof (with some glazing). Stone is used for the sills and lintels, cornice and coping blocks for the gable ends. It is of five storeys (including the basement), but presenting only two to the southern (rail) elevation. The main northern façade is characterised by the strong vertical lines of the brick pilasters and the vertical lines of the loading doors. The transverse gable roofs end in gables with stone copings, linked by short flats; the gables are accentuated by lunettes above the moulded cornice. The loading bays are surmounted by openings for the hoist jibs, which remain in varying degrees of repair.

EXTRACT: Conservation Plan 2007



Plan of site c.1837
source: Conservation Plan 2007



Heritage Category: Listed Building.

Grade: I. List Entry Number: 1282991. Date first listed: 08-May-1973.

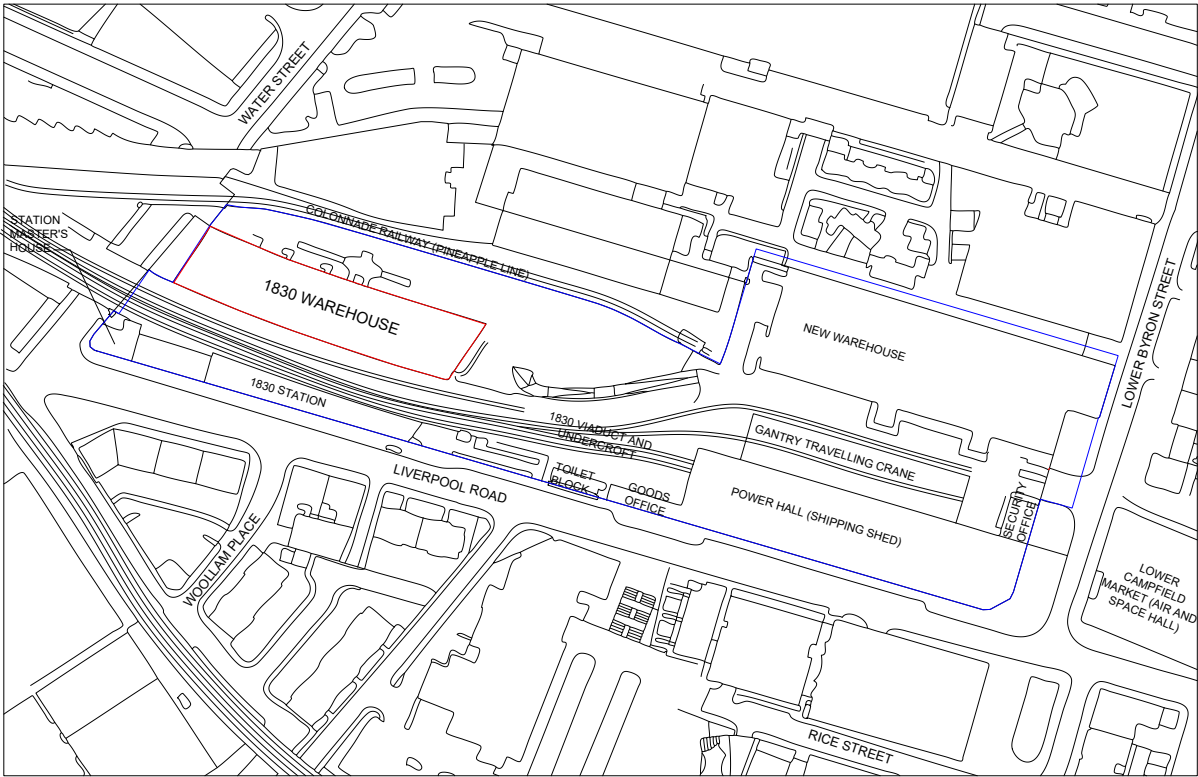
Statutory Address:
OLD WAREHOUSE TO NORTH OF FORMER LIVERPOOL ROAD RAILWAY STATION, LIVERPOOL ROAD.

Details MANCHESTER

SJ8297 LIVERPOOL ROAD 698-1/18/208 (North side) 08/05/73 Old Warehouse to north of former Liverpool Road Railway Station

GV I Listing NGR: SJ8299097886.

Railway warehouse. c.1830, together with Liverpool Road Railway Station (q.v.), by George Stephenson and his son Robert; altered. Red brick in Flemish bond, with sandstone dressings and slate roofs. Long slightly curved plan, convex to the railway line and concave to the rear. Three storeys but presenting only 2 storeys to the raised level of the track, 10 individually gabled bays arranged in pairs, with slotted pilasters between each pair and at both ends, a moulded stone cornice (carried round the whole), a small lunette on the cornice in the centre of each bay, and stone gable copings linked by short flats. In each pair of bays (except the 5th pair, at the right-hand end), one bay has a segmental-headed wagon archway with stone surround, 3 small segmental-headed barred windows above the archway with linked sills and wedge lintels (except the 4th bay where the wagon entrance has been raised so as to leave only the heads of the windows) and one 2-stage loading slot to left or right, and the other bay has 2 loading slots. The last pair of bays both have the wagon-archway form. The right-hand loading slot in the 3rd bay has a hoist pulley over the lintel, and apparently altered brickwork over the other loading slots suggests that all were formerly equipped with similar hoists. The left hand return wall has (inter alia) a small pediment to the centre, with an oculus; the 3-storey 6-window right-hand return wall has a doorway with stone surround at the left end of the ground floor, 2 segmental-headed doorways at 1st floor level, and narrow rectangular windows diminishing in the height. The 3-storey rear, with cornice and lunettes like the front, and pilasters which have small windows, has 3-stage loading slots arranged singly or in pairs corresponding to those at the front, with hoists over all except one at the west end and 2 at the east end, doorways with stone surrounds next to the single slots, and small rectangular barred windows with wedge lintels. Interior: timber construction visible.



Location Plan

Photogrammetric survey of the existing elevations



South Elevation



East Elevation



North Elevation



West Elevation

SECTION 03 / ANALYSIS AND APPROACH:

This section sets out the proposed scope of works.

3.1: Valley Gutters

3.2: Bay 4 Roof

3.3: Truss Chord Repairs

3.1: Valley Gutters

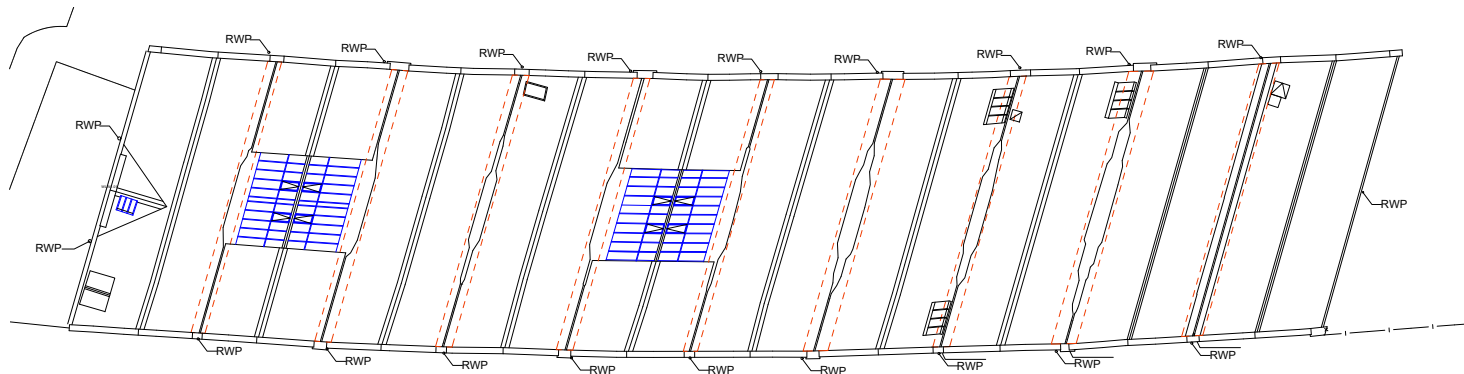
Valley Gutters

Summary of existing condition

- There are two gabled pitched slate roofs per bay and the valley gutters occur between each roof situated either above a valley beam or above a brick cross wall (the cross walls divide the bays). The rainwater sheds down the slope of the slate roof and is collected in the valley gutter. Each valley gutter has a high point in the middle and drains to both the north and south via a catchpit to a chute through the external brickwall and outflows above and into external hopperheads above the rainwater downpipes which drain to the ground drainage system. Bay 5 is slightly different in that the chutes have been replaced with two drain pipes flowing above into the hopperhead.
- The gutter detail as observed on site is narrow and deep as it is constricted where the valley gutter drops between the twin valley purlins. At the cross wall, the valley purlins are encased by brickwork at the upper part of the cross wall. The valley purlins are located above key structural elements of the valley beam or the brick cross walls.
- Currently there are drip trays with buckets installed under four valley gutters above the valley beams. Suspected water ingress above the cross walls is hidden from view. The current profile has several risks including blockage, overtopping, reverse falls due to structural settlement.
- It is apparent from archived articles that the Museum undertook an initial 5 year plan to stave off dilapidation. The valley gutters seem to have been replaced in works during 1970's and again in works during 1990's.

Need for repairs

- The current context is one of increased intensity of rainfall with heavier downpours and stronger storms. The existing valley gutter profile is creating risks which result in leaks which are visibly damaging the structural fabric and without rectification to the valley gutter will contribute to damage to the fabric.
- The first risk is blockage. Unseen blockages leads to rainwater backing up. Several blockages have occurred previously and although the valley gutters were thoroughly cleared during the last phase of work, the valley gutters are highly susceptible to recurring blockages due to the narrow, deep valleys and due to the lack of safe access for visual inspection, the blockages are unobserved until it's too late and water is leaking internally causing damage to fabric and the interior.
- The second risk is overtopping. The rainwater appears to track over the top of the lead and membrane interfaces to track internally. Additionally, due to the narrowness of the gap between the slates at each end, water could over shoot to the opposite slope and track below slate laps.
- The third risk is contributory factor noted that some of the valleys have a reverse fall in their flow. This is observed to occur as a result of historical structural settlement.
- The risk of overtopping at the brick cross walls with water tracking into the brickwork is a probability and would cause damage to difficult to access structural timbers and will percolate through the brick resulting in mortar loss, loose brickwork at high level and potential delamination to of brickwork faces with the risk of fragile falling debris to staff and visitors.
- There is a need is to increase the flood capacity of the valley gutters and to reprofile them to create wide clear drainage for rainwater which will reduce the risk of rainwater ingress. Rainwater calculations have analysed the preferred 'flood level' to inform the detail.
- This approach while adjusting the relatively unseen roof appearance provides major improvement to the weatherproofing of the building and therefore conserving the historic fabric of the structure below, protecting it from rainwater ingress and the resultant damage.



Plan of the roof with valley gutters highlighted with dashed red outline



View of a valley gutter from above



View of a valley beam gutter from below

Twin Valley Purlins

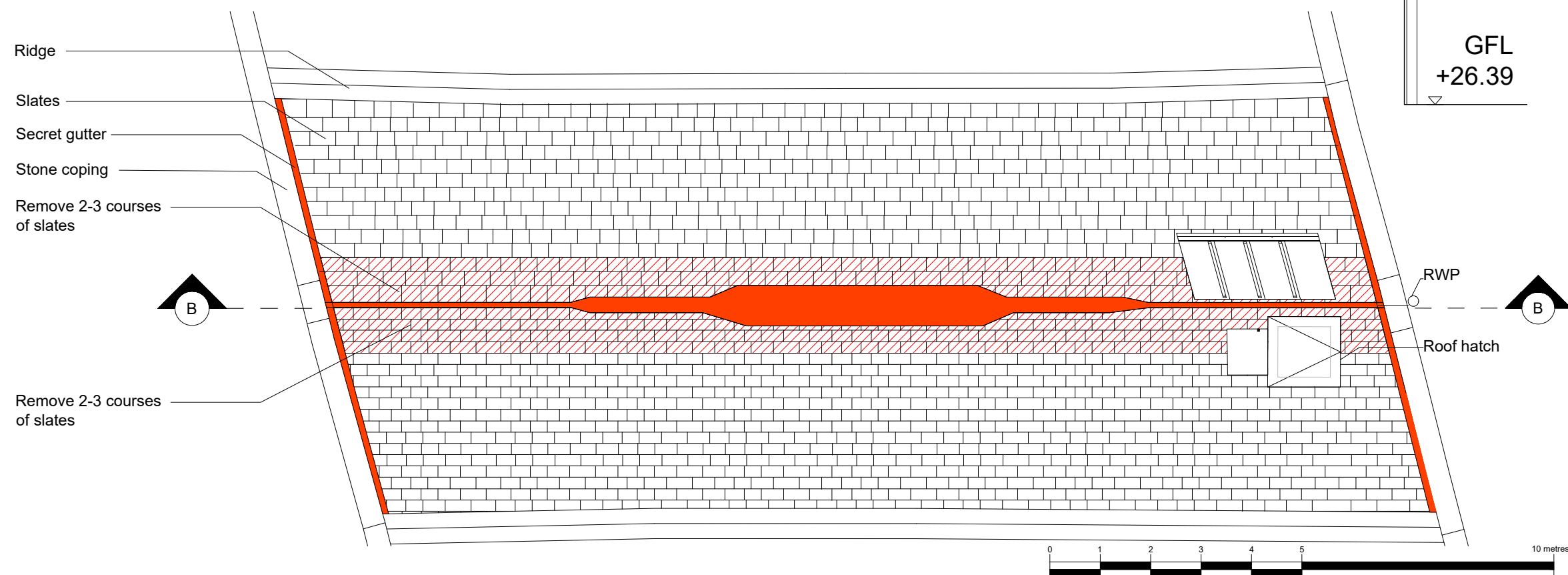
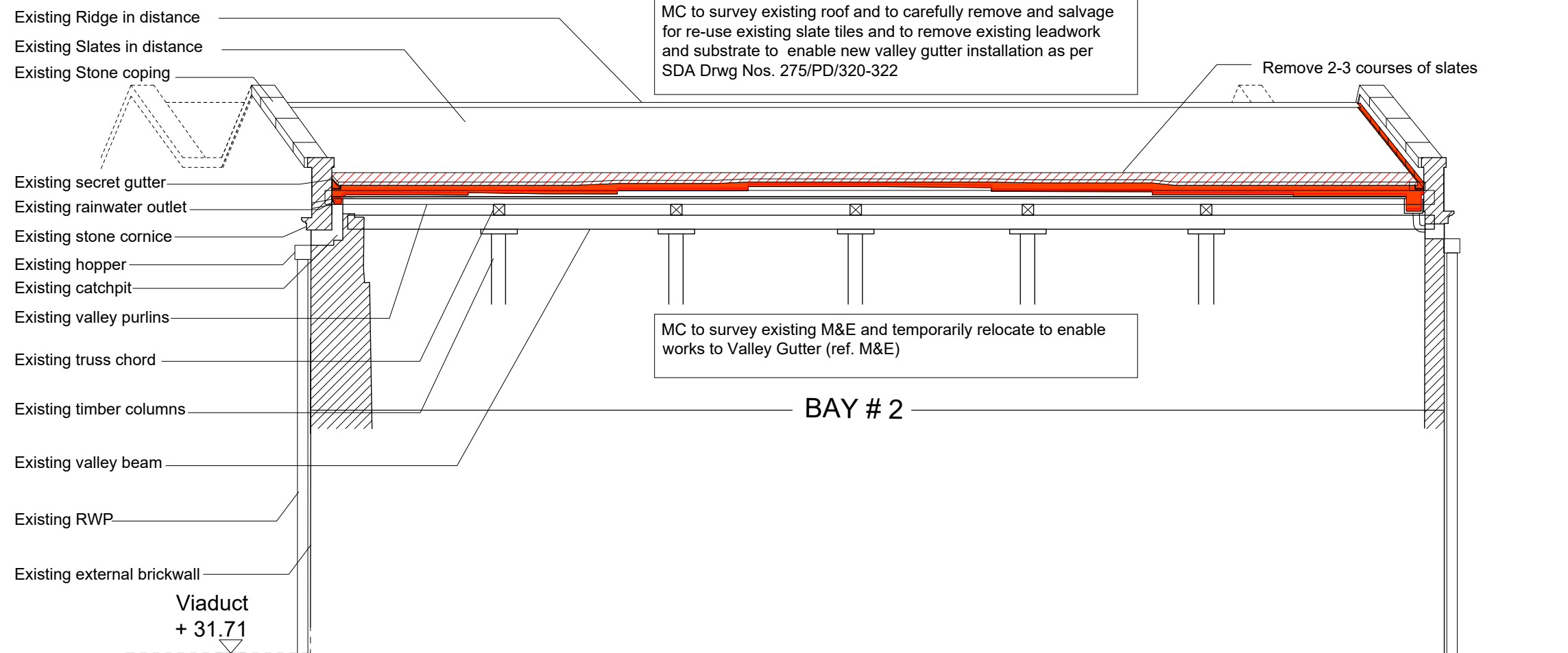
Valley Beam

Truss Chord

Rafters

Proposed solution

- The proposed solution is to create a deep sided tapered gutter detailed in accordance with traditional lead sheet detailing. This approach while adjusting the relatively unseen roof appearance provides major improvement to the weatherproofing of the building and therefore conserving the historic fabric of the structure below, protecting it from rainwater ingress and resultant damage.
- Replace and re-profile the 1990's valley gutters to accommodate current predicted rainwater calculations. Peter Deer & Associates have calculated rainwater parameters for 1 in 200 year return period plus 30% climate change allowance to inform the flood level design for the valley gutters. Raise the middle of the valley by adjustment to roof finishes above the existing structure. Raise the ends of the valley gutter above the valley purlins to maintain a wide valley gutter and to avoid dropping into the narrow space between the valley purlins and line the wide valley with leadwork to flash over where the slates have been removed. Line with lead sheet using traditional stepping drip detail following the Lead Sheet Association guidelines. Retain perimeter chute level and retain existing chute opening through the external wall for the lower chute to avoid enlarging the opening through the fabric of the external wall for the lower chute.
- The works will involve the removal of the 1990's valley gutter leadwork, plywood trays and carefully de-slating 2-3 courses. The slates will be set aside for checking for re-use. The new valley gutter will be installed in accordance with Lead Sheet Association details with a build-up of new insulation, weatherproof breathable membranes, and re-slating with re-use of existing salvaged slates. The continuous eaves ventilation will be replaced like for like. The leadwork will be removed to the chute and replaced. The secret gutter at the parapet will be adapted to the chute. Localised leadwork detailing will be installed to the bottom edge of existing rooflights and dormers. New trace heating will be installed to the base of the valley gutter with the cableways sensitively set-out and connected up internally.
- Any brick repairs required when uncovered will be carefully undertaken and repointed with lime mortar. There will be new chutes formed to Bay 5 to match the existing details to Bays 1-4.
- The internal linings will be locally replaced like for like.
- The works to the valley gutters require both internal and external access. A simple scaffold can be established on the viaduct to minimize height and to reduce materials. Internally, there are several existing live services distributed along the underside of key structural members and valley beams which will require identification and validation to enable the contractor to relocate temporarily without disrupting essential services.
- **Methodology of proposed solution (ref to Appendix B.1).**

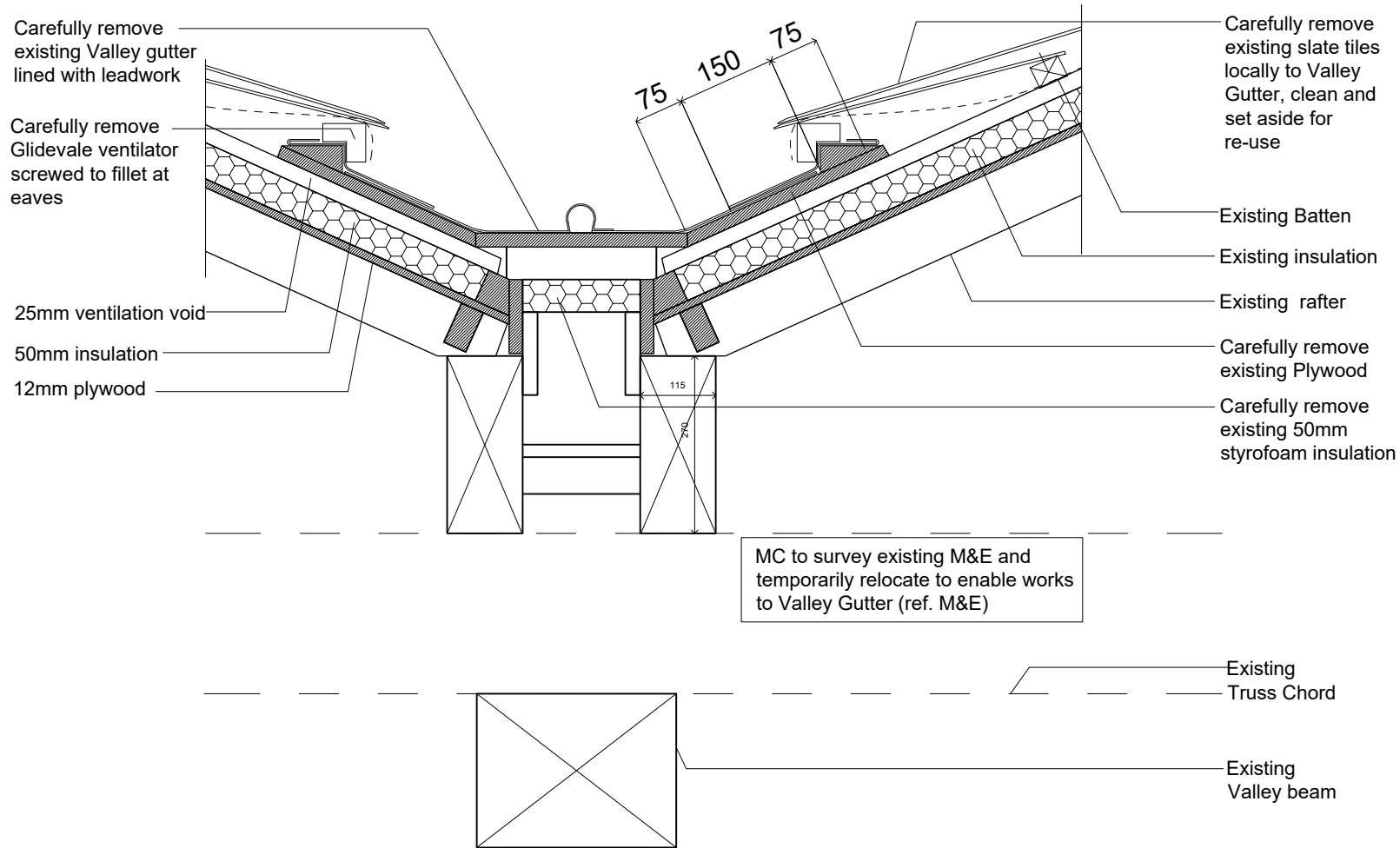


KEY

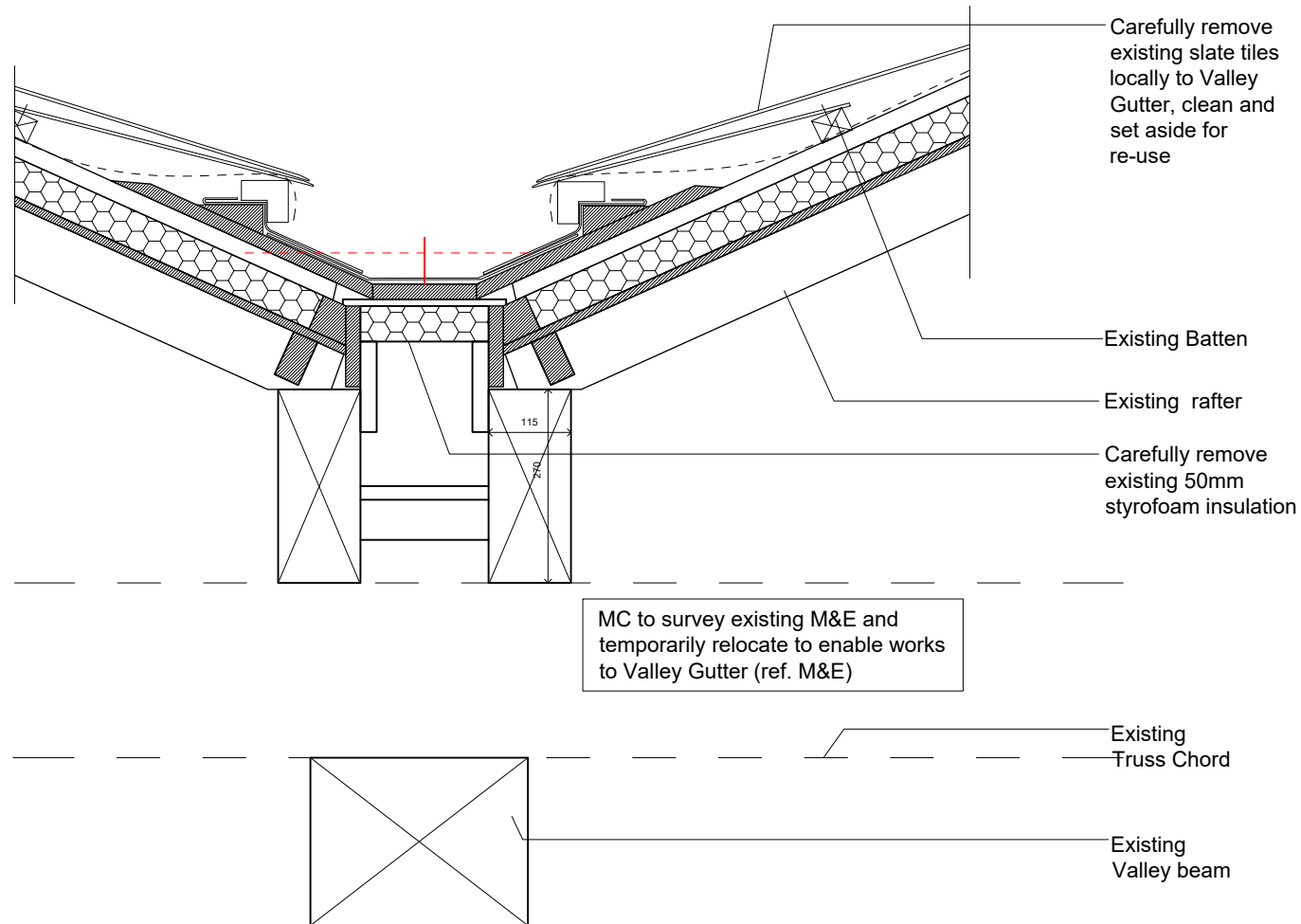
- Existing Lead to be removed
- Existing Slates to be removed

INDICATIVE NORTH 	
BASED ON MEASURED SURVEY BY GREEN HATCH	
JOB TITLE Essential Repair: 1630 Warehouse Science & Industry museum M3 4FP	JOB NO. 275
DRWG. TITLE Valley gutter: Existing Bay 02 GA sectional elevation + plan	STATUS Planning
DRWG. NO. 275 / PD / 120 (A1 ORIGINAL FORMAT)	REV: 1:400@A3 1:200@A1
Scale: 1:400@A3 1:200@A1	DATE: 16/02/23
Studio Downie ARCHITECTS LLP info@studiodownie.com	Drawn by: JJP 2023

VALLEY GUTTER: EXISTING: BAY 02 GA SECTIONAL ELEVATION + PLAN 1:400 @ A3 1:200 @ A1

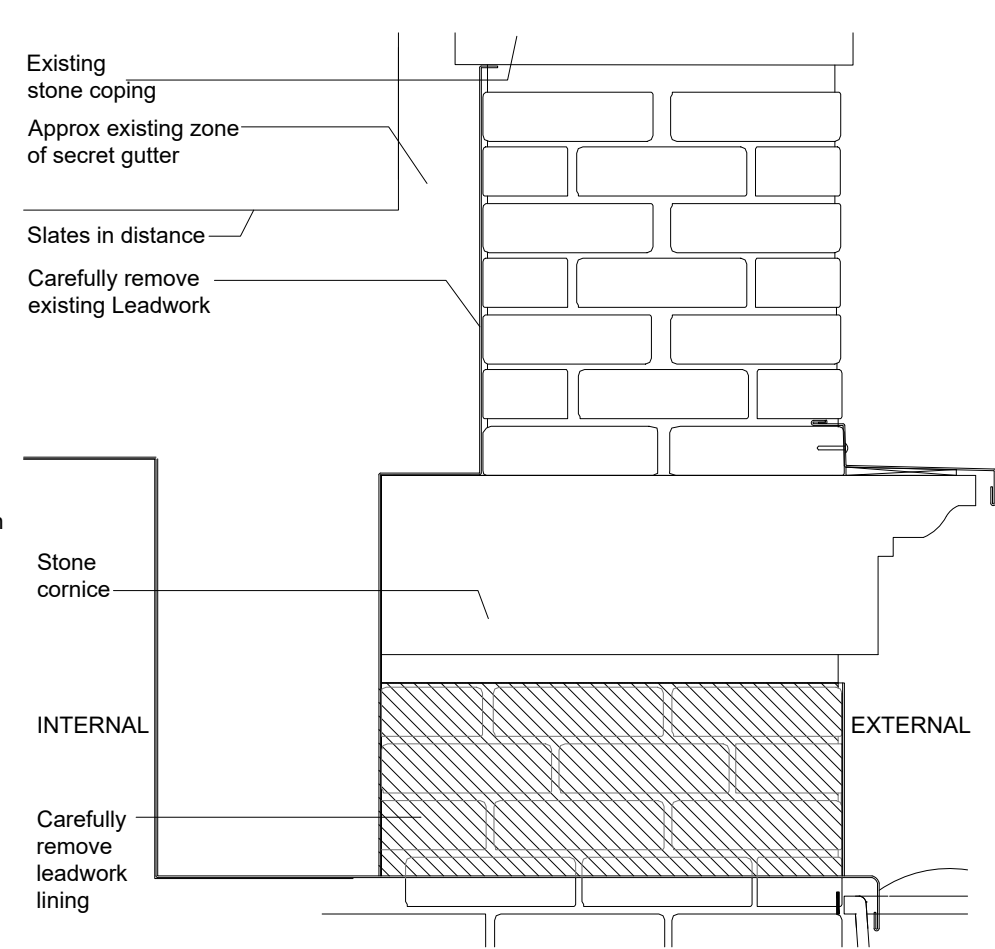


DETAIL 1: VALLEY GUTTER ABOVE VALLEY BEAM

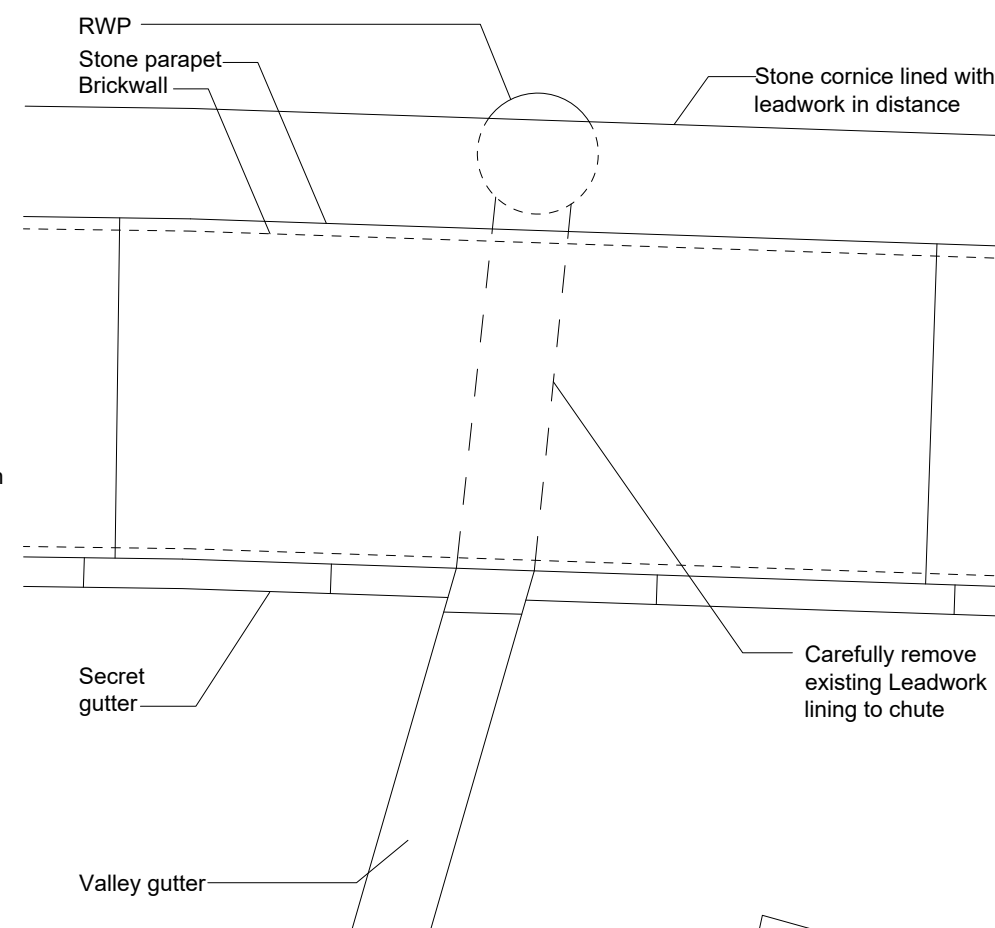


DETAIL 2: VALLEY GUTTER ABOVE VALLEY BEAM

VALLEY GUTTER: EXISTING TYPICAL DETAIL OVER VALLEY BEAM 1:5 @ A1 / 1:10 @ A3



DETAIL 3: CHUTE DETAIL 1:100

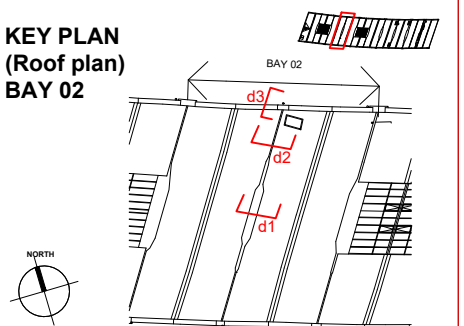


DETAIL 4: ROOF PLAN

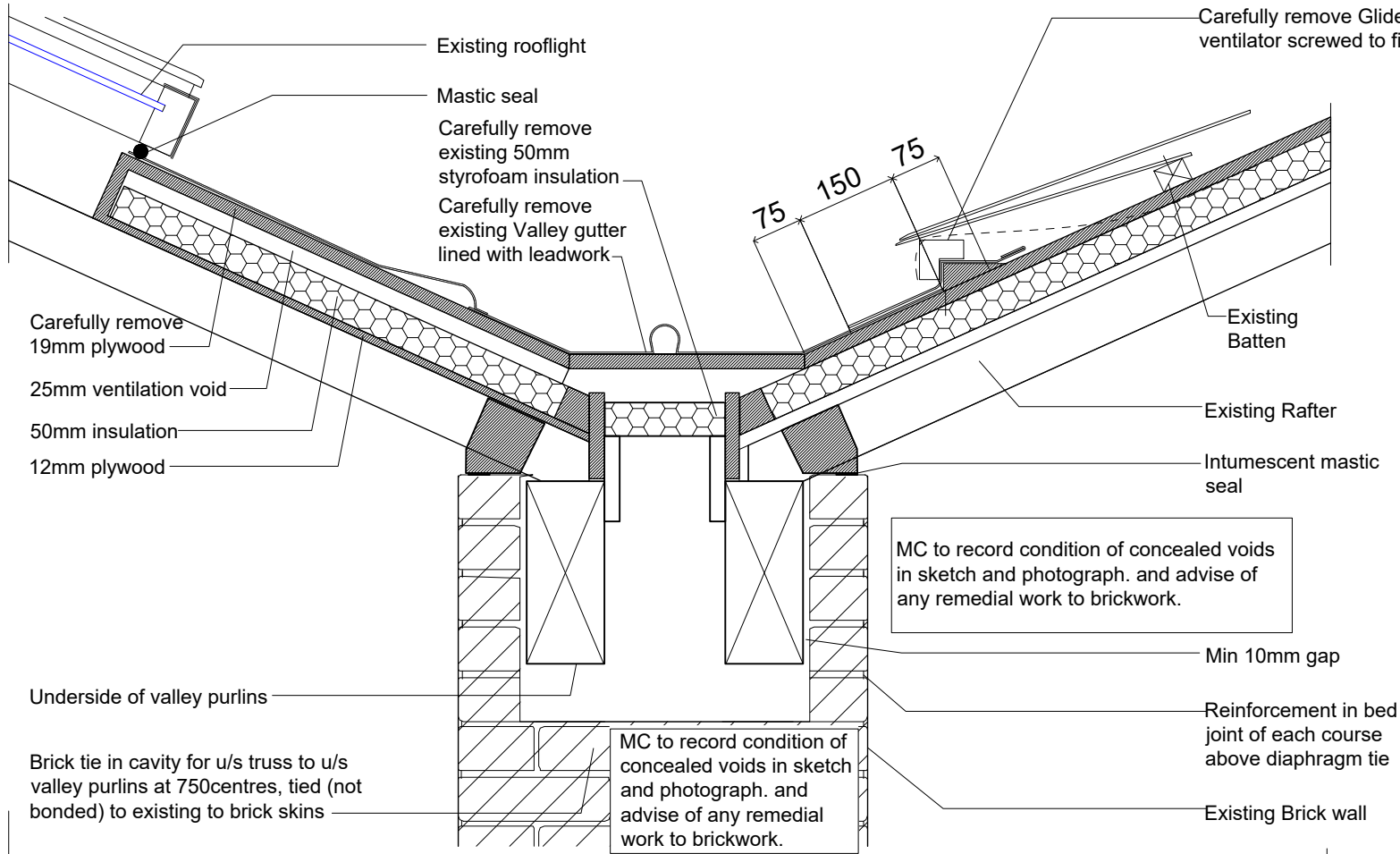


MC to survey existing roof and to carefully remove and salvage for re-use existing slate tiles and to remove existing leadwork and substrate to enable new valley gutter installation as per SDA Drwg Nos. 275/PD/320-322

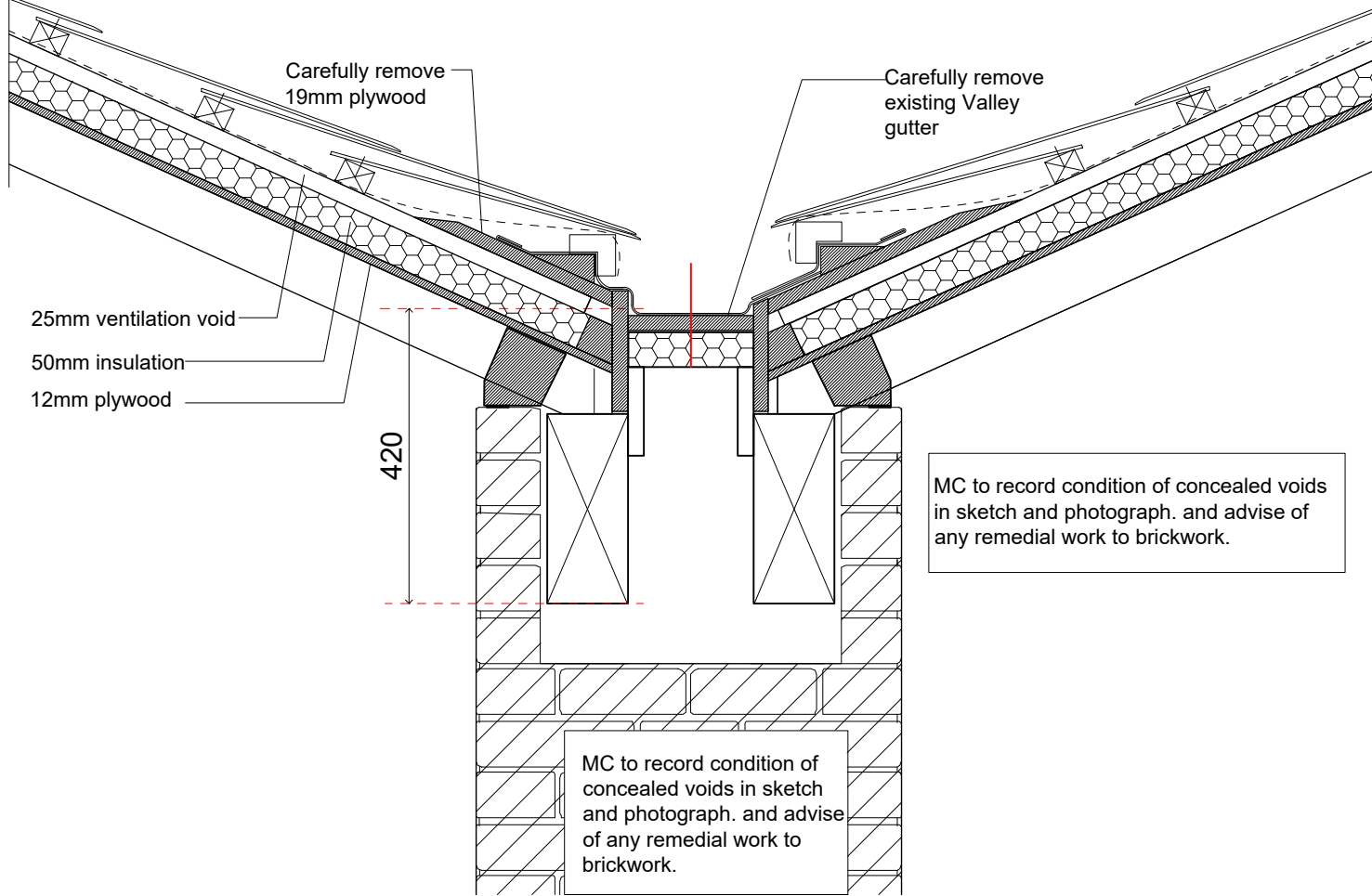
KEY PLAN
(Roof plan)
BAY 02



BASED ON MEASURED SURVEY BY "SITECH SURVEYING SERVICES"				
JOB TITLE Essential Repairs, 1830 Warehouse, Science & Industry museum M3 4FP	JOB NO. 275	DRWG. TITLE Valley Gutter: Existing typical detail over Valley Beam	STATUS Planning	
DRWG. NO. 275 / PD / 121 (A1 ORIGINAL FORMAT)	REV. 15@A1 1:10@A3	DATE: 16/02/23	Drawn JP	
All dimensions to be checked on site by the Contractor and confirmed with the Architect prior to construction. Do not scale off this drawing.				

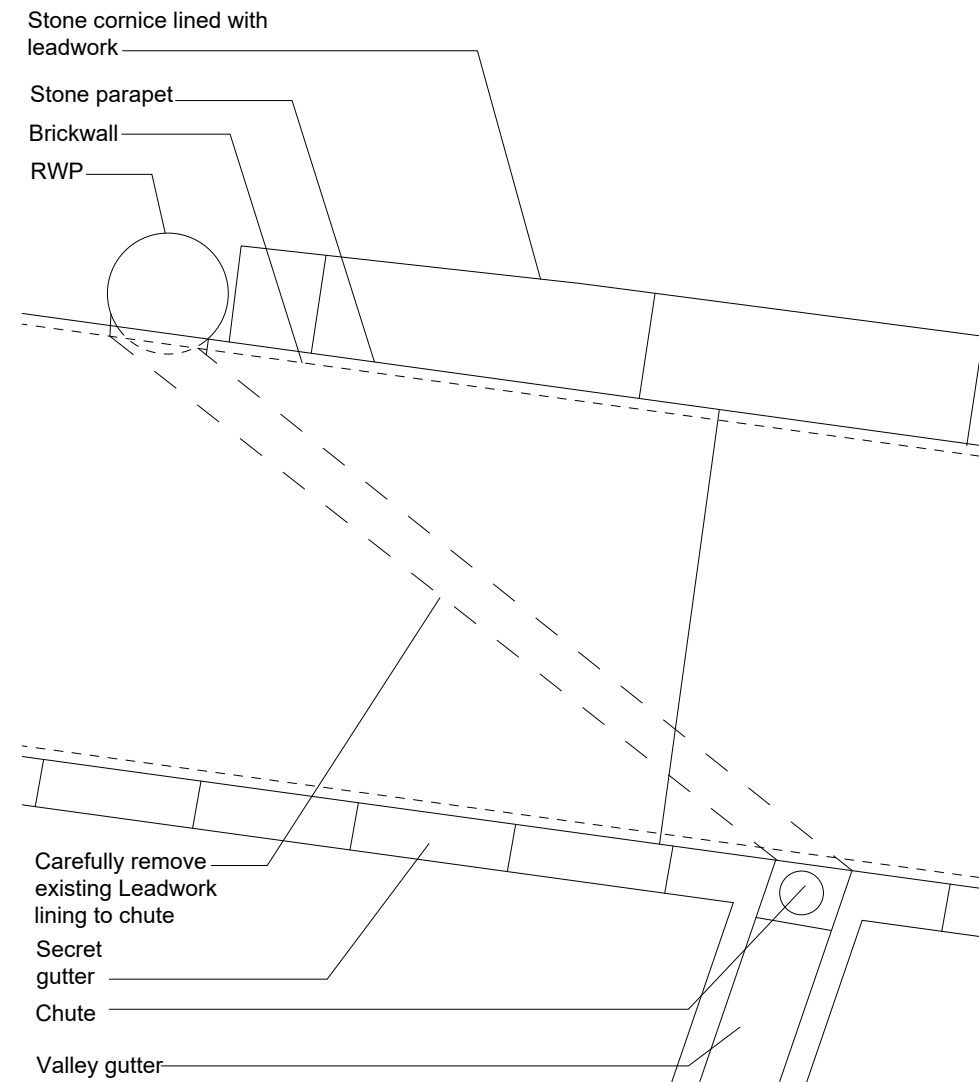


DETAIL 1: VALLEY GUTTER ABOVE BRICK CROSS WALL_ROOFLIGHT INTERFACE



DETAIL 2: VALLEY GUTTER ABOVE BRICK CROSS WALL

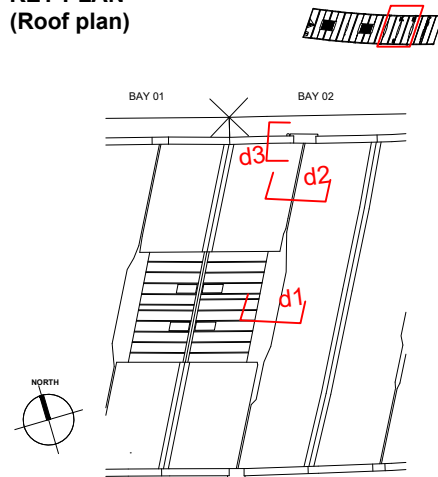
VALLEY GUTTER: EXISTING TYPICAL DETAIL OVER BRICK CROSS WALL 1:5 @ A1 / 1:10 @ A3



DETAIL 3: ROOF PLAN

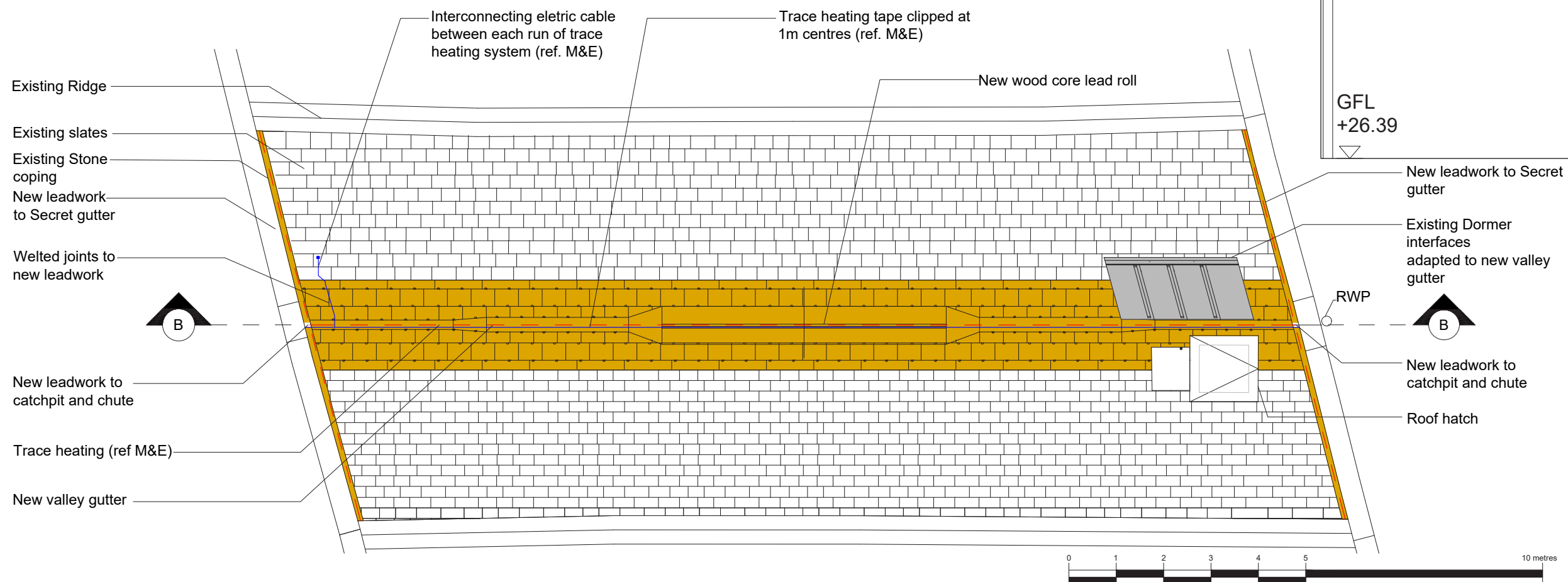
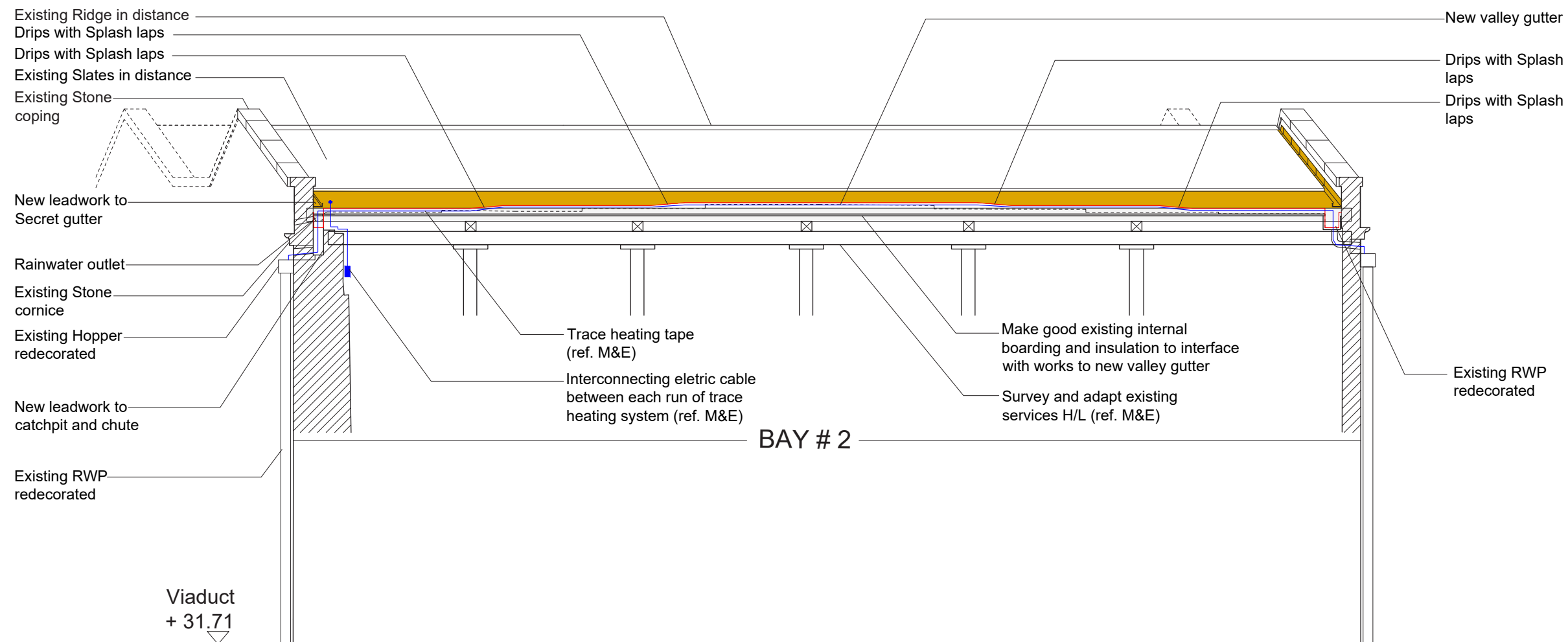
MC to survey existing roof and to carefully remove and salvage for re-use existing slate tiles and to remove existing leadwork and substrate to enable new valley gutter installation as per SDA Drwg Nos. 275/PD/320-322 .

KEY PLAN
(Roof plan)



BASED ON MEASURED SURVEY BY "SITECH SURVEYING SERVICES"				
JOB TITLE	JOB NO.	DRWG. TITLE	STATUS	
Essential Repair, 1830 Warehouse, Science & Industry museum M3 4FP	275	Valley Gutter: Existing typical detail over brick cross wall	Planning	
		DRWG. NO.	REV:	SCALE:
		275 / PD / 122		1:5@A1
		(A1 ORIGINAL FORMAT)		1:10@A3
Studiodownie	TEL: +44 (0) 20 7299 7766	Drawn By:	DATE:	
ARCHITECTS LLP	info@studiodownie.com	JP	16/02/23	



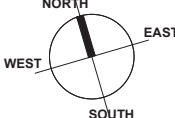


KEY

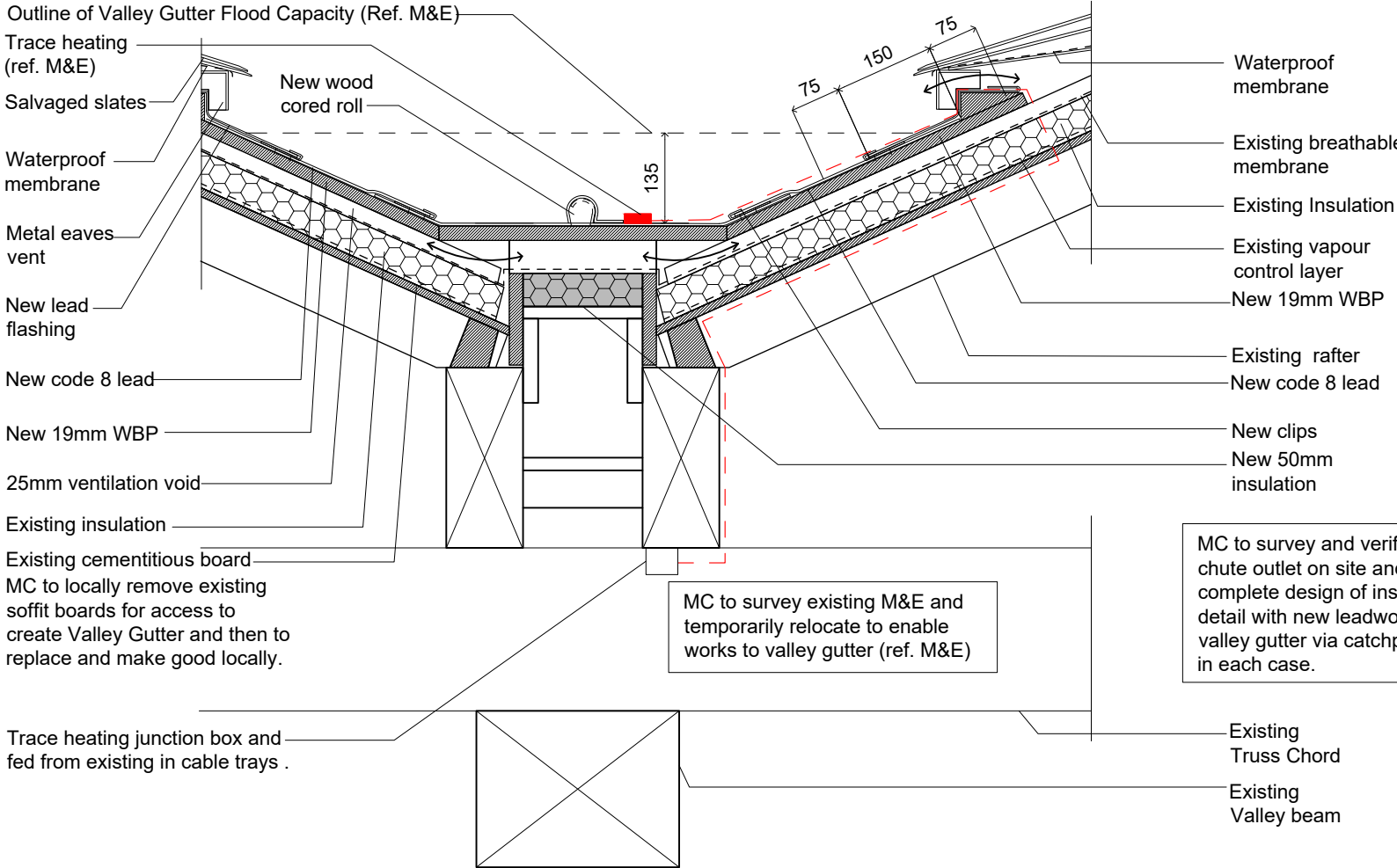
Existing retained lead

New lead

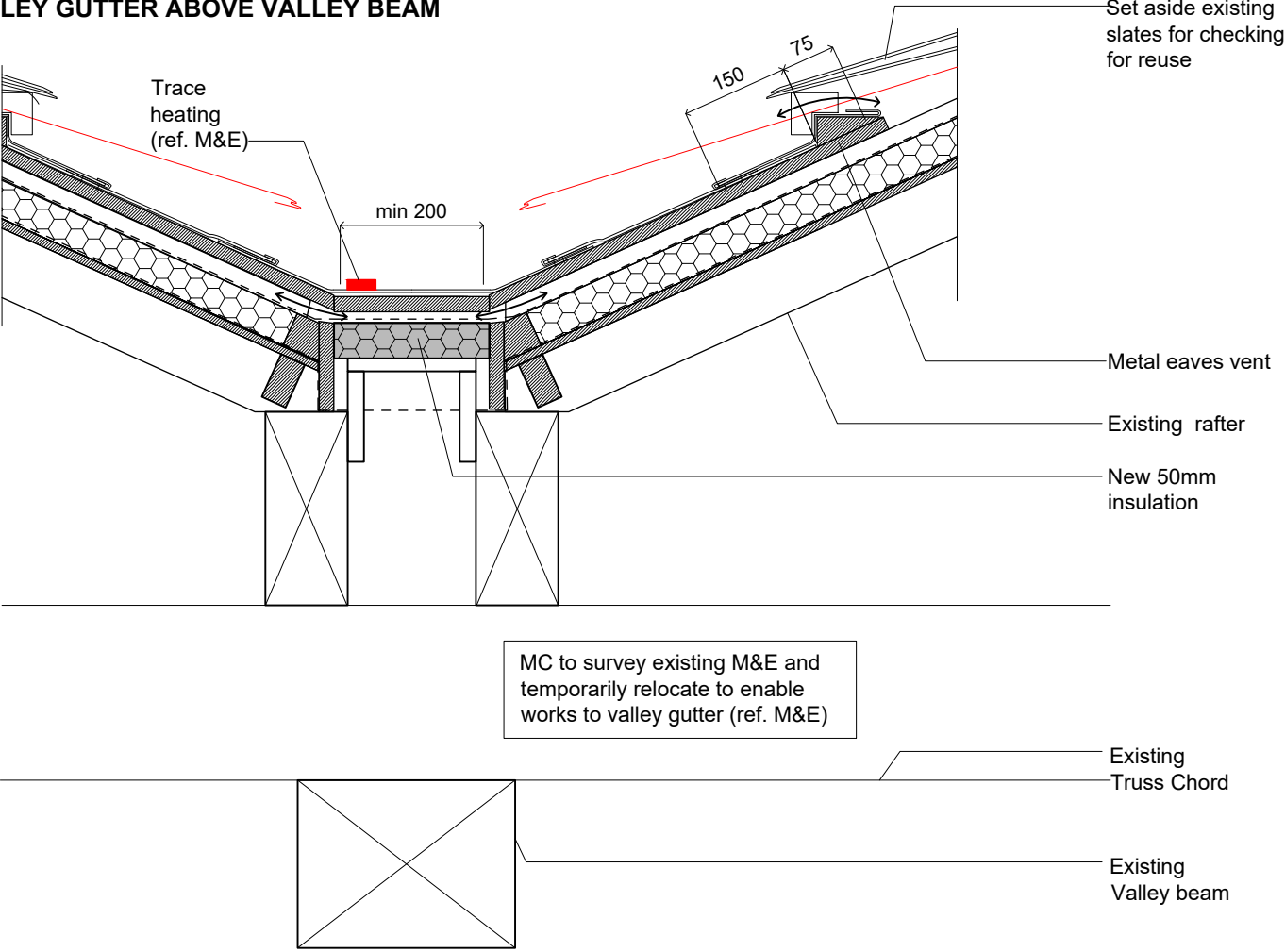
This drawing illustrates one of the Valley Gutters at Bay 2 but illustrates the general typical principles for all valley gutters

INDICATIVE NORTH			
			
BASED ON MEASURED SURVEY BY GREEN HATCH			
JOB TITLE	JOB NO.	DRWG. TITLE	STATUS
Essential Repair 1830 Warehouse, Science & Industry Museum, M3 4FP	275	Valley Gutter: Proposed works to Bay 02 GA sectional elevation + plan	Planning
		DRWG. NO.	REV.
		275 / PD / 320	SCALE:
		(A1 ORIGINAL FORMAT)	1:400@A3 1:200@A1
Studiowornie	TEL: +44 (0) 20 7299 7766	All dimensions to be checked on site by the Contractor and confirmed with the Architect prior to construction. Do not begin if this drawing is not sealed off	Drawn by: DATE:
ARCHITECTS LLP			JP 2023 16/02/23

VALLEY GUTTER: PROPOSED WORKS TO BAY 02 GA SECTIONAL ELEVATION + PLAN 1:400 @ A3 1:200 @ A1

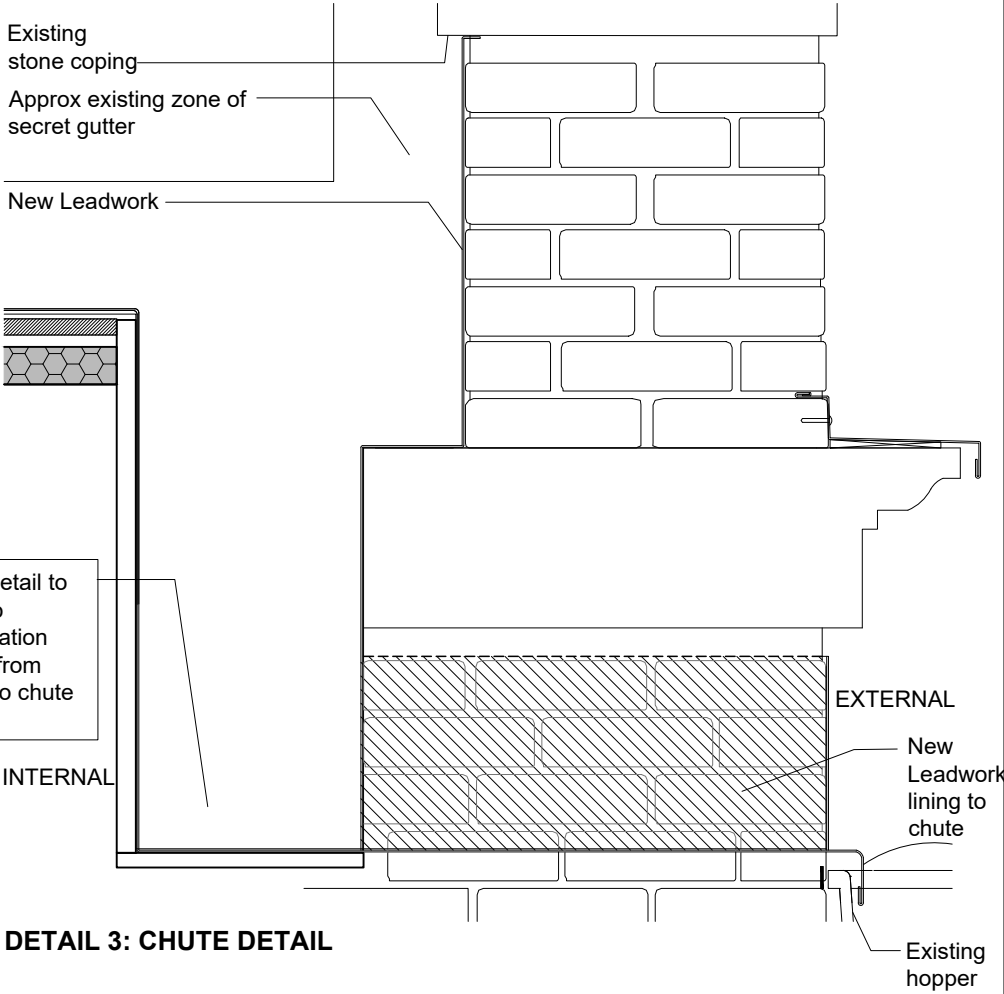


DETAIL 1: VALLEY GUTTER ABOVE VALLEY BEAM

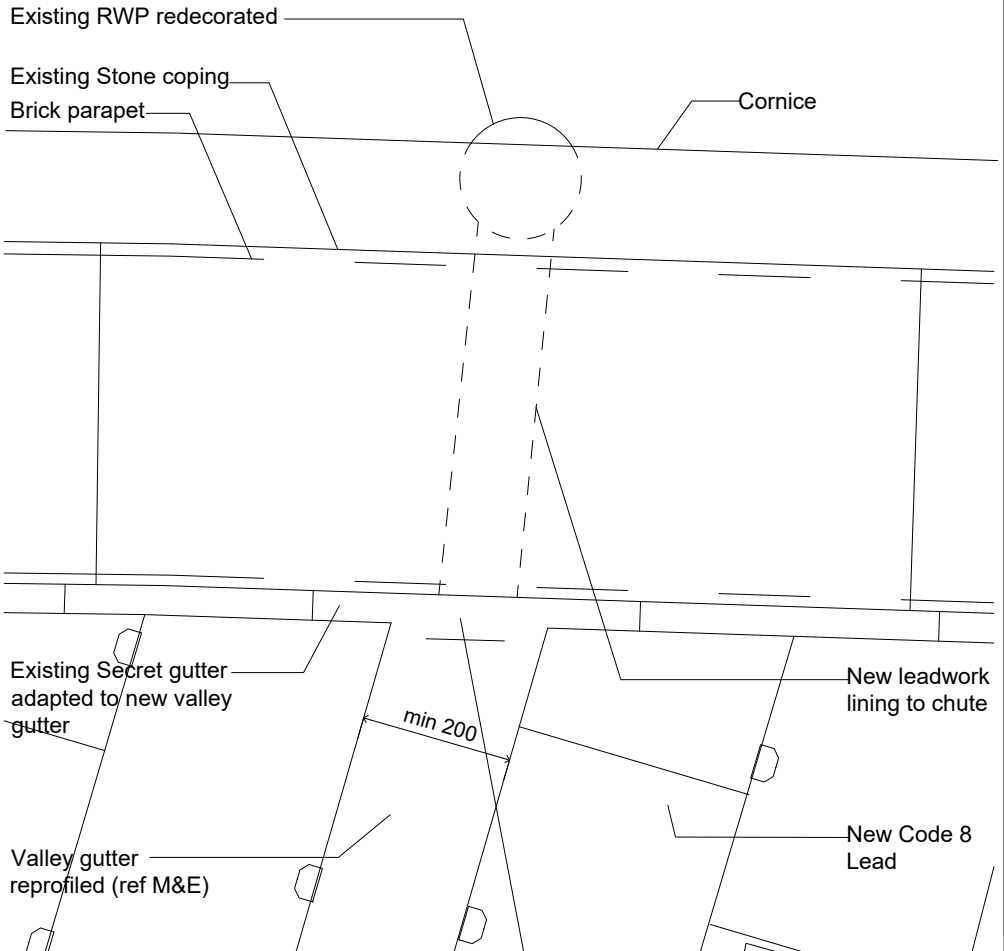


DETAIL 2: VALLEY GUTTER ABOVE VALLEY BEAM

VALLEY GUTTER: PROPOSED WORKS TO TYPICAL DETAIL OVER VALLEY BEAM 1:5 @ A1 / 1:10 @ A3



DETAIL 3: CHUTE DETAIL



DETAIL 4: ROOF PLAN

KEY PLAN (Roof plan) BAY 02

BASED ON MEASURED SURVEY BY "SITECH SURVEYING SERVICES"

JOB TITLE	JOB NO.	DRWG. TITLE	STATUS
Essential Repair 1830 Warehouse, Science & Industry Museum, M3 4FP	275	Valley Gutter: Proposed works to Typical Detail over Valley Beam	Planning

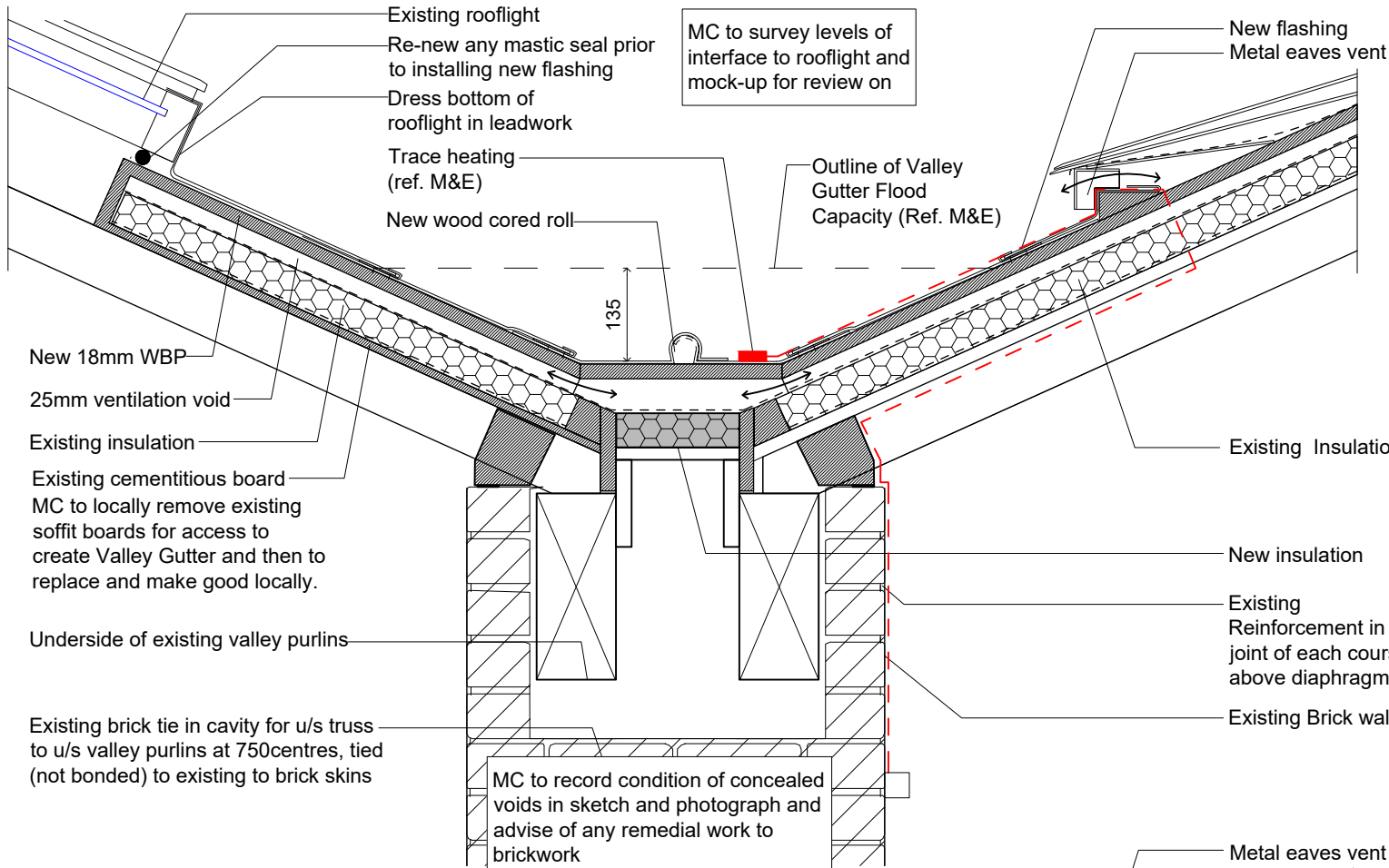
DRWG. NO.	REV.	SCALE:
275 / PD / 321 (A1 ORIGINAL FORMAT)	JP	1:5@A1 1:10@A3

DATE: 16/02/23

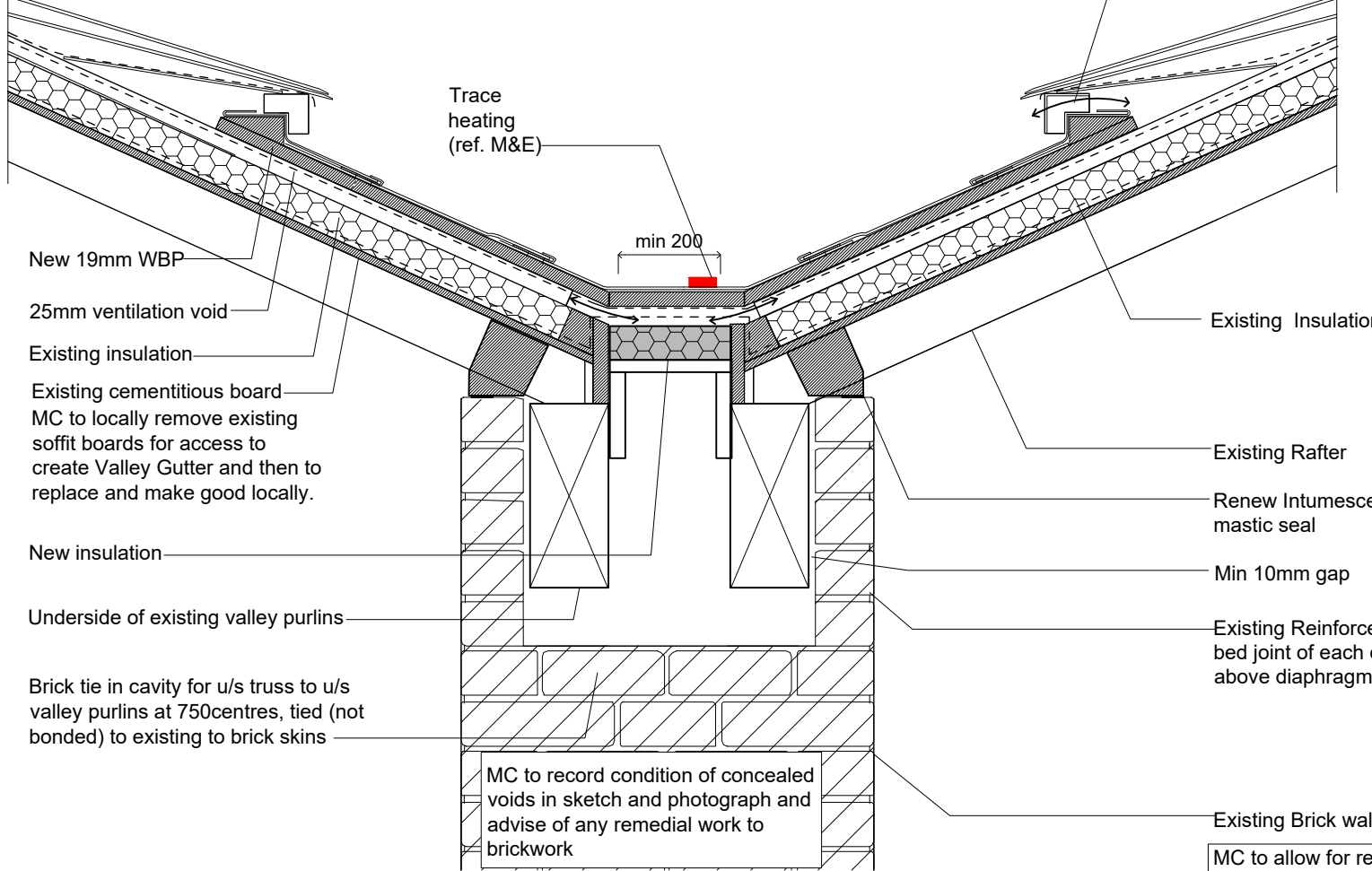
Architects: **STUDIO DOWNE** ARCHITECTS LLP
TEL: +44 (0) 20 7259 7788
info@studiodowne.com

Drawn by: JP

All dimensions to be checked on site by the Contractor and confirmed with the Architect prior to construction. Do not scale off this drawing.

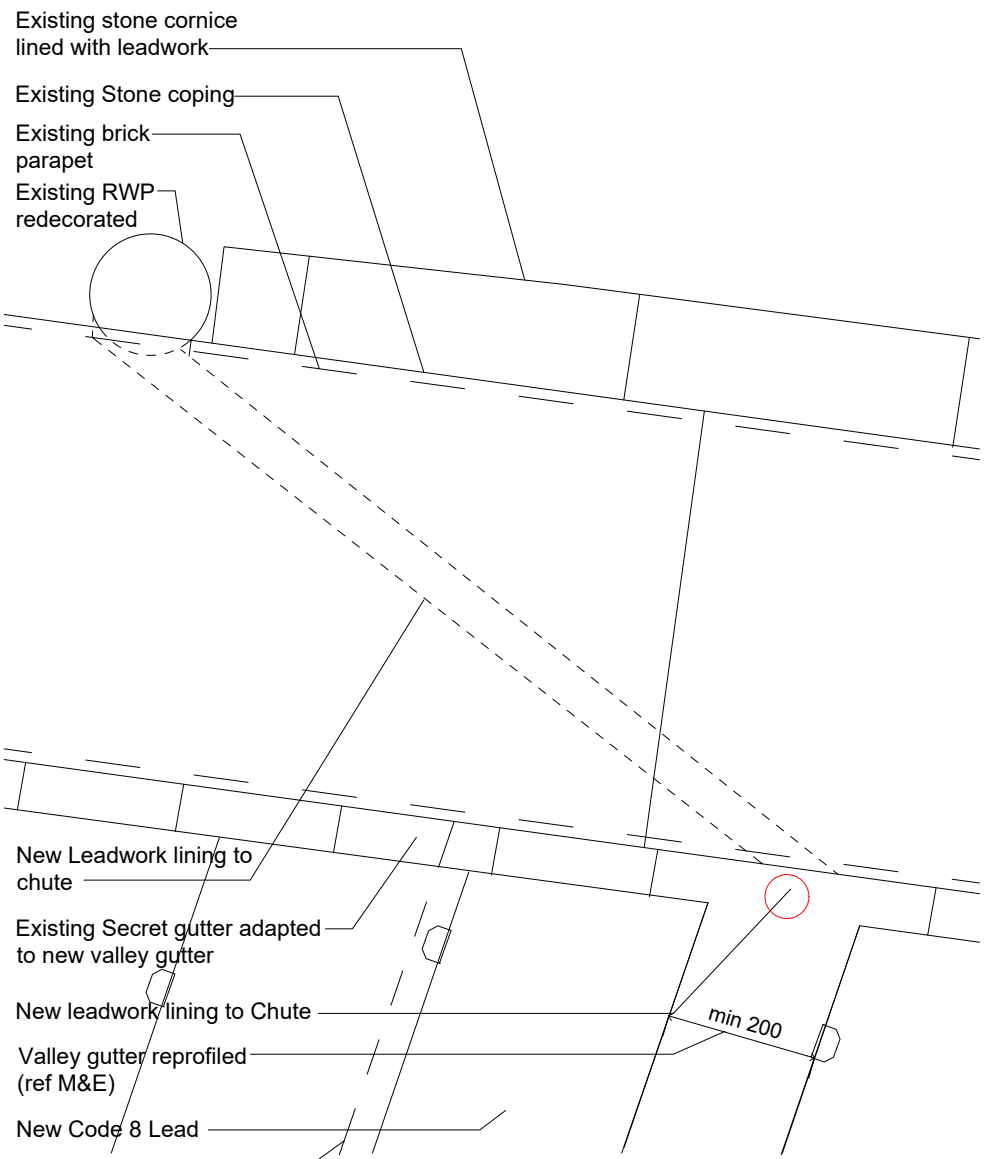


DETAIL 1: VALLEY GUTTER ABOVE BRICK CROSS WALL_ROOFLIGHT INTERFACE



DETAIL 2: VALLEY GUTTER ABOVE BRICK CROSS WALL

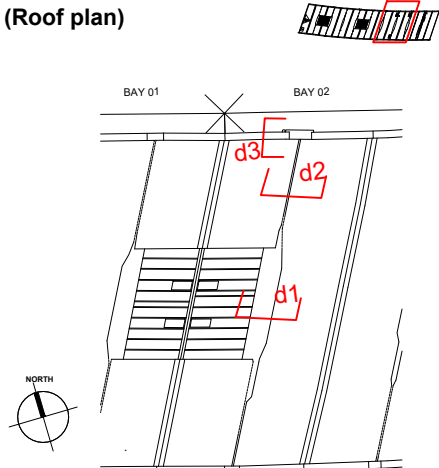
VALLEY GUTTER: PROPOSED TYPICAL DETAIL OVER CROSS WALL 1:5 @ A1 / 1:10 @ A3



DETAIL 3: ROOF PLAN

MC to survey and verify detail to chute outlet on site and to complete design of installation detail with new leadwork from valley gutter via catchpit to chute in each case.

KEY PLAN (Roof plan)



BASED ON MEASURED SURVEY BY "SITECH SURVEYING SERVICES"

JOB TITLE	JOB NO.	DRWG. TITLE	STATUS
Essential Repair 1830 Warehouse, Science & Industry Museum, M3 4FP	275	Valley Gutter: Proposed Work to Typical Detail over Brick Cross Wall	Planning
		DRWG. NO.	REV:
		275 / PD / 322 (A1 ORIGINAL FORMAT)	1:5@A1 1:10@A3
Studiosdownie Architects LLP	TEL: +44 (0) 20 7259 7788 info@studiosdownie.com	DRWN. BY: JP	DATE: 16/02/23

3.2: Bay 4 Roof

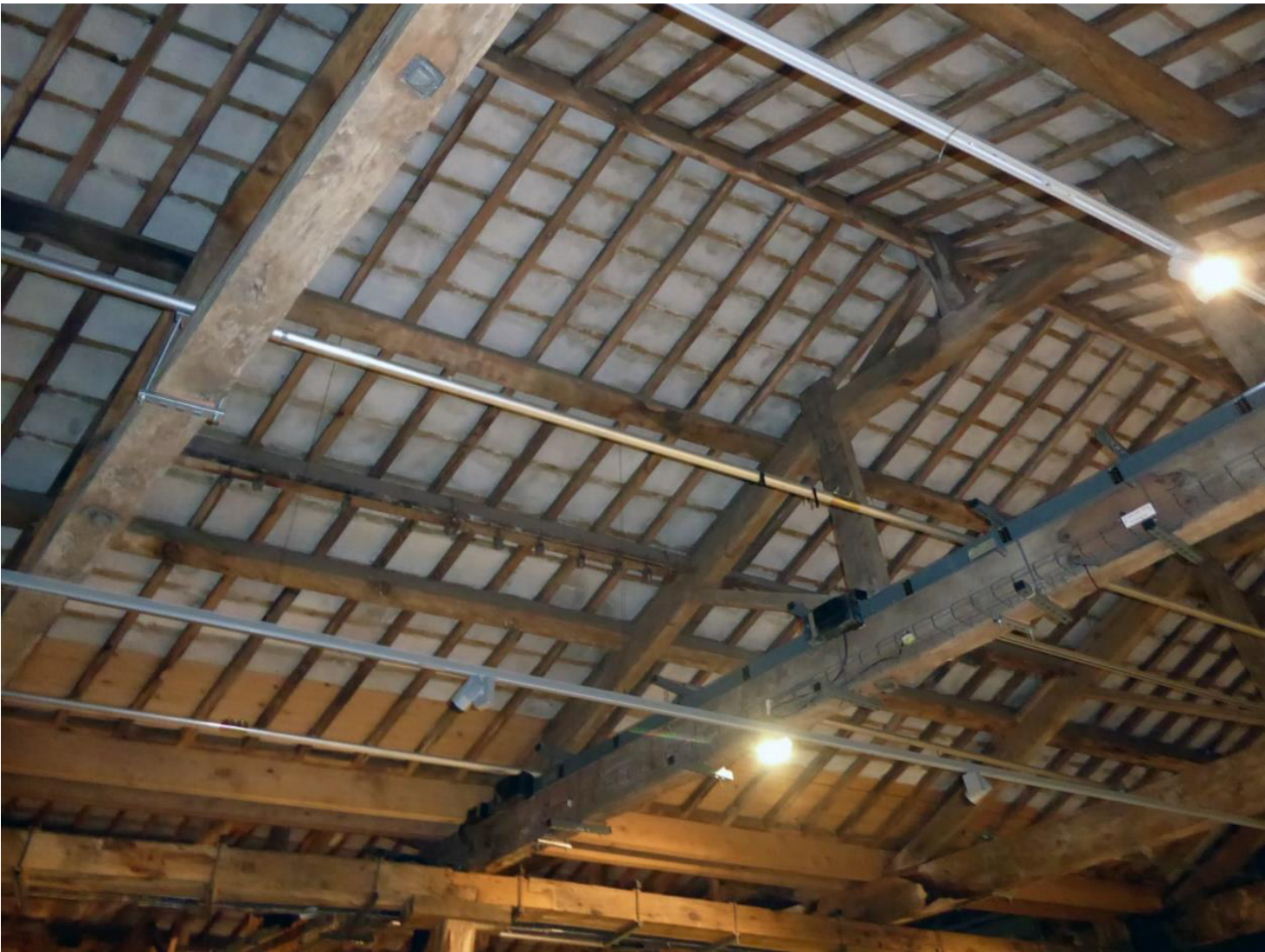
Bay 4 Torching

Summary of existing condition

- The torching is the lime and fibre mixture applied directly to the underside of roof slates as a wet mortar between the slate battens. As there is no insulation within the build-up this is a ‘cold roof’ and there is a noticeable drop in temperature within Bay 4. Weathering and loose or dislodged slates above cause moisture ingress and temperature fluctuation which contributes to the torching de-bonding and failing.
- Following review of the archives, it is understood that the existing torching to the internal face of the roof of Bay 4 was applied during the last major refurbishment of the roof finishes c.1993.
- The client archive information indicates that 1990’s works replaced previous slates with second hand slates.
- The client archive shows that Bays 1, 2, 3 were all torched before the 1990’s and the images show them to be very degraded. From a heritage perspective it raises the interest of the finish to Bay 4 and highlights the significance of Bay 4 torching independent of its current poor application. Historically, the torching approach would have been a logical technical solution for providing a dry, clean, cool interior for valuable commodities as torching was the means to do this prior to the invention of bituminous membranes. There was a conservation decision for the ongoing retention of Bay 4 as ‘the warehouse’ in the 1990’s.
- Following the Hutton & Rostrun report, “Investigation of Lime Torching to the Underside of the Roof In Bay 04 of the 1830 Warehouse, 11 October 2019” it was established that the roof finishes to Bays 1, 2, 3 and 5 now consist of a 50mm rigid extruded polystyrene foam insulation with a cementitious board beneath which is applied over the rafters in Bays 1, 2, 3 and 5, creating a warm roof. Counter battens may have been fitted over the insulation and screwed into the rafters which support the battens and slates. The height of these roof finishes have been raised but concealed behind the historic brick parapet and a ‘secret gutter’ formed of plywood and lined with lead sheet has been created at the perimeter of the roof where it abuts the brick parapet.
- In Bay 4, the main aesthetic is the individual squares of plaster visible within individual slate battens and rafters as well as the contrasting texture of the plaster. This is a curated aesthetic finish and is open to a number of options which need to understand the need for warm and dry space, managing the heritage asset and viability of the asset.
- Areas of the ceiling have debris netting to catch the falling debris of the torching.

Need for repairs

- The current environmental context is to increase energy efficiency, to reduce overheating the interior from solar gain, to absorb internal heat gain to avoid energy wastage, and to coordinate improvements to the valley gutters to increase flood capacity to manage the increased intensity of rainfall with heavier downpours and stronger storms.
- The current use of the warehouse to hold temporary events has the potential to increase the levels of humidity and water vapour through intermittent or irregular levels of high occupancy.
- Hutton & Rostron’s investigation and analysis concluded that the preparation of the mortar and its application are wholly inadequate and likely relate to a misinterpretation of the specification by an inexperienced tradesperson and go on to state that ultimately, further areas of torching which are currently ‘sound’ are likely to fail and the museum should expect similar instances of falling material in the future.
- The torching provides a breathable thermal mass which is porous and allows the exchange of moisture and humidity. The roof surface is slate with a differential porosity which, except for gaps in the slate, creates an impervious layer. Over time, moisture will move to the upper surface of the torching and can become trapped by the slate, the result will be collections of moisture with the potential to carve their way through the top surface creating fissures leading to fragmentation over time which will create a fragile, crumbly ceiling surface. Additionally, there is the risk of moisture ingress where the torching is not well keyed into the timber battens.
- It is important to retain the breathability of the fabric. The lunettes to Bay 4 are infilled with close-boarded timber panels.



Internal view of the torching.



Example images of the existing roof above the Bay 4 Torching. The archive drawings indicate that second hand slates were laid in the 1990’s when the existing torching was installed.

Strategic option risk review

- Torching was historically applied to the underside of slates to protect the interior from wind and water ingress. The torching would have been regularly maintained and repaired to keep in good condition, and needed checking for damage after storms.
- There is an immediate health and safety issue with parts of the torching failing and protective sheeting has been installed in some areas to protect occupants from falling debris.
- The museum is concerned that internal finishes with natural lime putty may - however well applied by a skilled installer - de-bond over time and along with additional regular maintenance regimes would make their investment in the space for events unviable and ultimately make their sustainable use of the 1830 warehouse infeasible. To assist in the museum's assessment we have considered options to be reviewed by the museum in order to establish a preferred approach.
- The parallel scope of works to re-profile the valley gutters will mean that three areas of the existing 1990's torching will be removed equating to approx. 20% of the torching at low level.
- In considering the appropriate solution the museum needs to consider a risk based approach: short term repairs and to forward plan for the appropriate long term solution and to balance a conservation approach with a long-term sustainable approach.
- The strategic review by the museum considered the following:

Retaining the torching (option 1-4):

- Minimise scope to like for like localised repair (least risk to programme and budget but ongoing risk of materials falling); or
- Fully remove torching and replace with an insulated lime product. * this sub-option requires a temporary over-roof.
- Considerations included:
 - Like for like repairs will not usually require listed building consent. Does not improve the situation. It conserves the 1990's restoration.
 - A risk is achieving an adequate bond between new and existing torching. Risk of future de-bonding and issues related to moisture ingress or condensation (as the building is heated).
 - The Museum misses an opportunity to improve thermal efficiency.
 - Risk of future de-bonding and issues related to moisture ingress or condensation (as the building is heated).
 - This approach will require extensive on site testing to establish sound areas can be maintained and to isolate fragile material for replacement, and this process brings the risk of dislodging slates above.
 - Fully removing the torching allows the Museum to replicate the historical approach and to use latest lime products which provide some insulating properties with traditional techniques of application to the underside of the torching.
 - However well applied this will require ongoing and longterm maintenance.
 - Due to the way that the torching binds the slates, a lot of careful preparation works needs to be undertaken from the underside. The methodology may require slate removal to ensure the slates are completely and very carefully cleaned of the existing torching before slates are relaid to enable the new torching to be applied. This process would require a temporary roof to provide weather protection.

Change to breathable structural insulation (options 5-7): * this option requires a temporary over-roof.

- Internal lime plaster finish (least risk in terms of planning matters and providing a long term solution); or
- Self-finished solid boards.
- Considerations included:
 - Installing new insulation above the rafters is a sustainable approach to provide insulation and weather proofing membranes below the slates to enhance the interior environmental conditions and to reduce heat loss and is therefore energy efficient. It will require de-slating the roof and temporary works above to provide weather protection during the works.
 - The internal soffit can be either finished with lime plaster or self finished sarking boards. While distinct from the historical finish the conservation officer was supportive of insulating the roof and changes in profile to the valley gutters and it was felt that a traditionally applied internal finish would be supported by the conservation officer.
 - A lime plaster finish which would replicate the warmth and textural variation of the historical lime finish. It is an aesthetic choice but also an appropriate use of natural material which will continue the use of breathable materials to the roof build-up which is important to dissipate the risk of condensation.
 - Additional short cross battens would replicate the historical pattern of the original timbers and create smaller workable zones to assist with quality control.
 - A self finished board installed over the rafters would provide a robust internal finish.
 - The cementitious board (used in Bays 1-3 and Bay 5) is not as breathable and careful product selection will be required to minimise the risk of condensation whereas a narrow sark board with penny gap detail would be permeable.
 - Aesthetically, a plasterboard board will be similar to the Bays 1-3 interior providing a flatter, even surface which is more modern looking without the character of variation in hand applied natural lime.
 - Other breathable boards are available but they have a more rustic finish and introduce a new materiality which may not be appropriate. This would present a planning risk as it moves away from the historical finish.
 - A narrow sarking board with penny gap detail has historical precedent but is a significant visual change.
- Procurement reviewed the above options: the relatively limited pool of specialists able to repair or to install new torching may limit the pool of available specialist subcontractors which may provide upward pressure on pricing with the limited availability putting pressure on programme and delivery timescales.
- Client investigations to test the removal of the torching have been undertaken to assess the careful methodology required to maximise retention of the slates above for re-use. The methodology will require very careful tapping away in situ to avoid dislodging or fracturing of the slates. Once the torching has been removed, the roof can be de-slatted and each slate numbered to identify its position, then cleaned, checked and re-used.
- A summary of the key considerations is set out on the following page.

Table comparing strategic option risks and mitigation with client input to review:

Type	Build-up	Risk	Mitigation
Option 1: Leave as existing.	Install full debris netting across the entire ceiling. Requires fixing into structural members of roof.	- Risks: material continues to crumble or delaminate and fall; reputational and potential for physical harm; does not reduce energy use. - Ongoing Health & Safety risk, has potential commercial harm too (loss of income).	Mitigation: avoid retaining the existing; creates difficult interface with valley gutter proposals. Consider option 2.
Option 2: Patch repair existing torching.	- Analysis of existing samples shows the preparation of the mortar and its application are inadequate. - Currently 'sound' areas of torching are deemed likely to fail and to fall in the future. - Removing loose or brittle areas requires a very careful and time-consuming test and removal of areas of the torching.	Risks: any retained, currently sound area may also be inadequately mixed; the use of wet lime relies on hydration and dehydration with new plaster may not be well bonded into retained adjacent areas; ongoing health and safety risk as option 1; traditional torching will not reduce energy use.	Mitigation: avoid retaining the existing; creates difficult interface with valley gutter proposals. Consider option 3.
Option 3: Replace torching 'like for like'	- Carefully remove the torching. - Re-apply modern insulated lime torching mix rigorously following the manufacturer's method of application.	- Risks: in time external damage to slate can weaken the torching; traditional lime will not reduce energy use. - Potential to create same problem with Health & Safety risk we have now (failing torching) in the medium to long-term.	Mitigation: insulated lime products may provide some reduction in energy loss; creates difficult interface with valley gutter proposals. Consider option 4.
Option 4: Encapsulate torching.	- Encapsulate existing retained sound parts of torching. Torching would need patch repair as option 1. - Install wood fibre insulation below the battens and between the rafters. New breathable lime plaster beneath and visible to the interior.	Risks: with the encapsulated torching above active as a weathering barrier, this may increase damage due to condensation; debonding torching will continue into in an inaccessible cavity; visually different characteristics - loss of historic aesthetic/change in visual appearance.	Mitigation: avoid encapsulation; creates difficult interface with valley gutter proposals. Consider option 5.
Option 5: Remove torching, re-slate and insulate between the rafters. Wood fibre / lime plaster hybrid.	- Strip the roof slate covering. Remove torching. - Retain existing slate roofline but install a vapour permeable membrane and re-slate. - In between the battens and rafters install natural hemp fibre or sheep's wool insulation and apply a lime coat to the internal face using a board to provide a key in between insulation and lime finish.	Risks: limited thermal improvement will be determined by depth of the rafters. A thermal bridge will occur between slate and top of rafter. Visually different characteristics - loss of historic aesthetic/change in visual appearance.	Mitigation: avoid thermal bridges by adapting build-up; creates difficult interface with valley gutter proposals; requires temporary roof. Consider option 6.
Option 6: Raising the roofline behind the parapet - internal natural lime finish.	- Strip the roof slate covering and install insulation from above the rafters. - Install tongue and groove high density water resistant wood fibre insulation fixed to battens over the rafters, vapour permeable membrane, counter batten over membrane to create ventilated air space, re-slate. - Allow leadwork detailing of new leadwork valley gutters. - Allow lime plaster coat internally. This could potentially be an insulating lime plaster product. Thin-coat mesh enforced natural lime plaster. - Potential to reduce overheating the interior from solar gain, absorb internal heat gain.	- Risks: risk of unevenness in rafters and limited tolerance may increase roof heights and change external visual character. - Provides the best compromise solution offering a fully weatherproof design, retaining the historic spirit, but creates a safe environment and one that can meet sustainability dries in reducing energy needs, effectively future-proofing.	Mitigation: install battens over rafters; requires temporary roof; applies a natural lime finish which could de-stabilise with age. Consider option 7.
Option 7: Raising the roofline behind the parapet - internal board finish.	- As option 6 but install plasterboard internally instead of natural lime. There is the option to do an option 8 like option 7 but with a board similar to bays 1-3&5, whilst this would keep all bays similar, it would deviate further from the historic nature of this space. - Sub-option: Subsequent research considers narrow sarking boards. Provides stable board to interior with possibility to apply natural coloured papers.	- Risks: visual character changes from original torching finish; archives show parts of the roof had been installed with narrow board sarking but it was in poor condition and areas had been torched over suggested that it was self finished sarking boards had been ineffective as a weatherproof treatment in isolation. - Sub-option of sarking boards potentially a slightly better option for the client in terms of a durable long-term finish but one that deviates from the historic spirit of the space that option 6 provides.	Mitigation: apply natural breathable layers with modern techniques. Consider option 6.

Preferred option

- The Bay 4 torching installed in the 1990's is defective and rather than to replace it with a better mixed lime plaster there is the opportunity to upgrade the roof with insulation to reduce energy use in coordination with new valley gutter detailing which should support the long-term sustainable use of the building for important revenue earning events with lower energy costs sympathetically adapting the historic building.

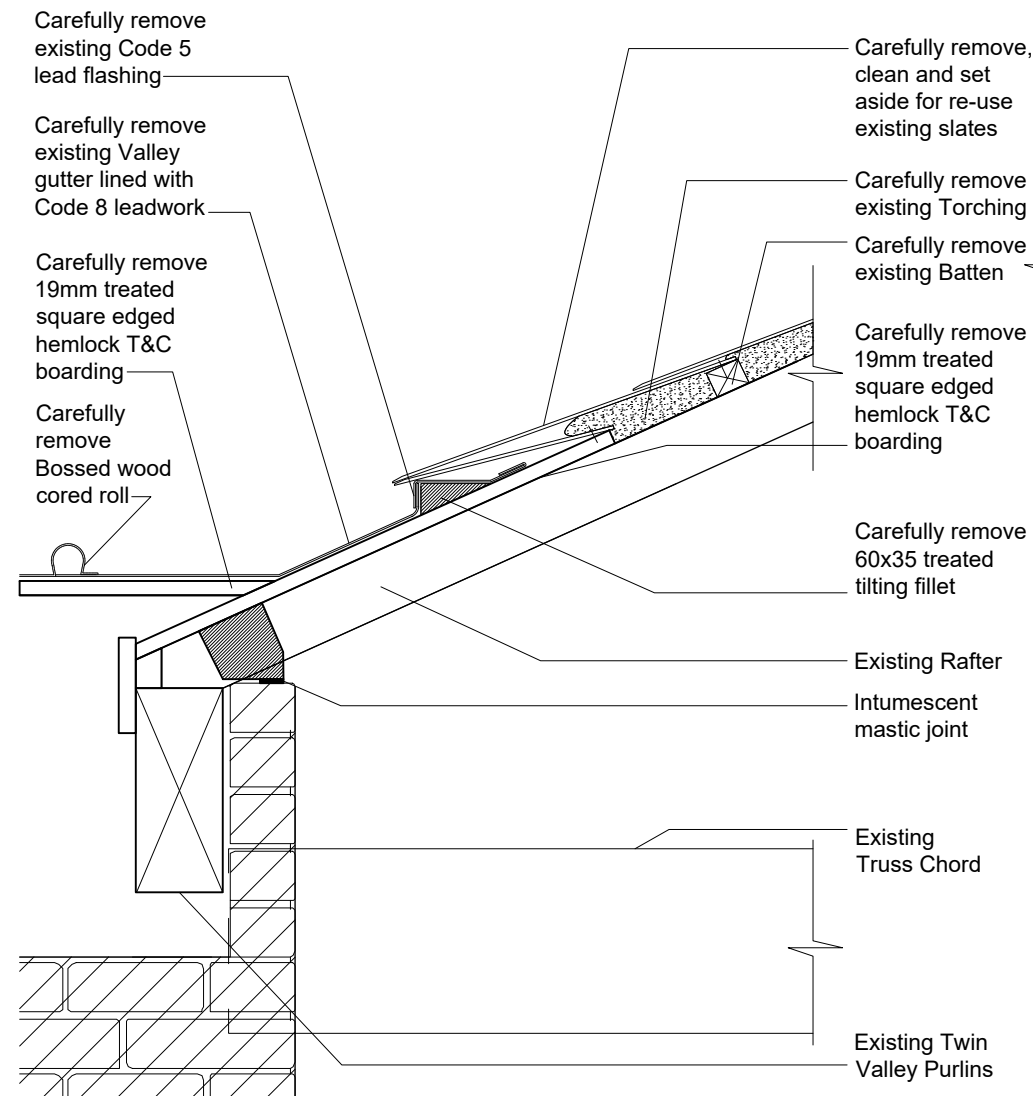
- Following feedback from specialists, they noted that Option 6 would certainly be the best performing in terms of thermal performance, acoustics, and moisture buffering and would also be the most breathable solution. As lime is highly alkaline it is also naturally mould resistant. The fat lime plaster recommended is a Natural Hydraulic Lime (NHL) based which cures with water, therefore exposure to heat from internal operations and events would not be an issue. The recommended woodwool as a base board as the rough surface so the board allows the lime plaster to form a mechanical key into the crevices of the woodwool anchoring it in place.

Option 6: Raising the roofline behind the parapet - internal natural lime finish.

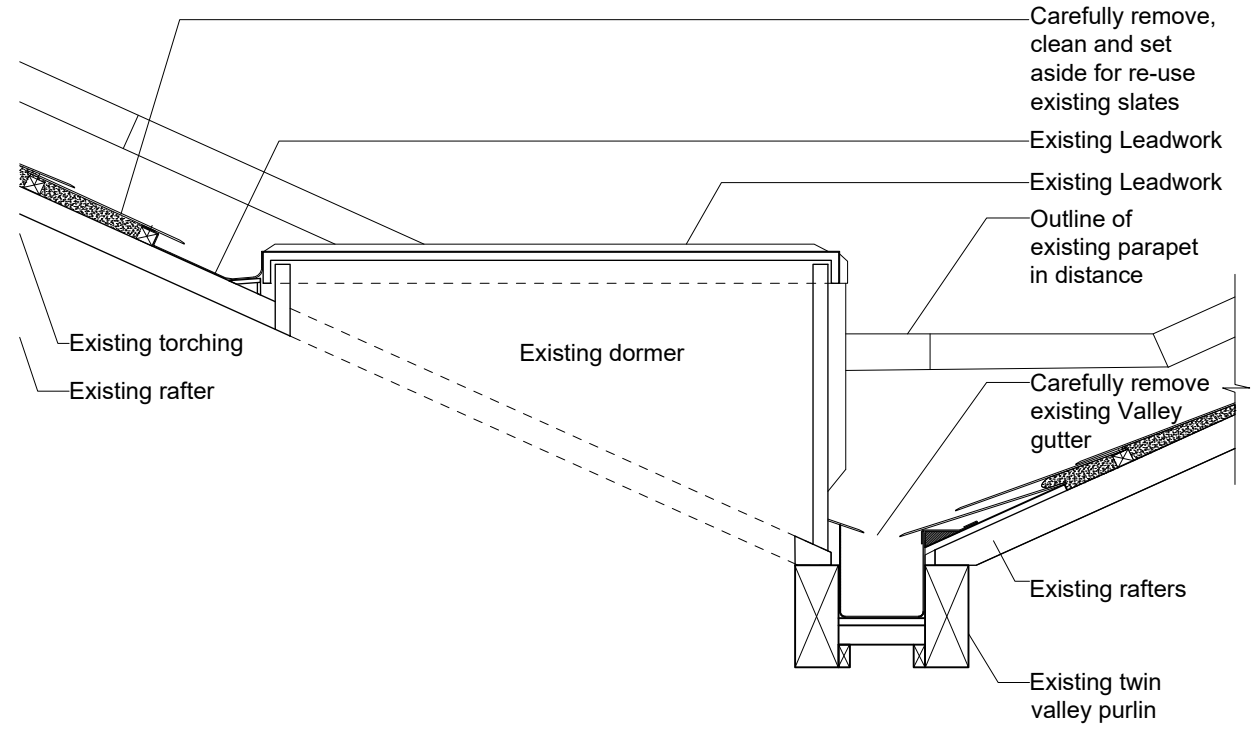
- Strip the roof slate covering and install insulation from above the rafters.
 - Install tongue and groove high density water resistant wood fibre insulation fixed to battens over the rafters, vapour permeable membrane, counter batten over membrane to create ventilated air space, re-slate.
 - Allow leadwork detailing of new leadwork valley gutters.
 - Allow lime plaster coat internally with a mesh enforced natural lime plaster.
 - Potential to reduce overheating the interior from solar gain, absorb internal heat gain.
 - Requires scaffold and temporary roof.
 - Risk of unevenness in rafters and limited tolerance may increase roof heights and change external visual character.
- The works would require closing the upper level of Bay 4, carefully removing the 1990's torching between each square of the battens. This should be progressive and work to one slope of one gabled bay and then complete the gabled bay. Works should remove torching around the valley gutter first to enable the option for a reprofiled valley gutter.
- The temporary works will need to maintain weather-tightness and breathability.
- During de-slating each slate will be inspected for re-use and catalogued with its position, the salvaged slates will be set slates aside for re-use. The aim is for maximum retention of existing slates. Any broken slates will be replaced with like for like reclaimed slates, and insodoing some careful mixing of varied colour may need to be undertaken when reinstating the slates to avoid visible new patches of slate.
- The installation will comprise new eco-friendly and breathable wood fibre insulation, weatherproof breathable membranes, new treated slate battens, re-slating with salvaged slates.
- The valley gutters will be detailed in lead consistently as mentioned in Section 3.1. The existing internal visual detail to the underside of the valley gutter will be installed with traditional penny gap softwood timber finish to match the existing.
- Internal battens to be added in between the rafters to match the existing visible arrangement and to keep lime working areas smaller.
- Generally, the internal finish would be a lime putty carefully applied to a suitable substrate in between the existing rafters. This will retain the natural colour and subtle textural variations .

Proposed approach

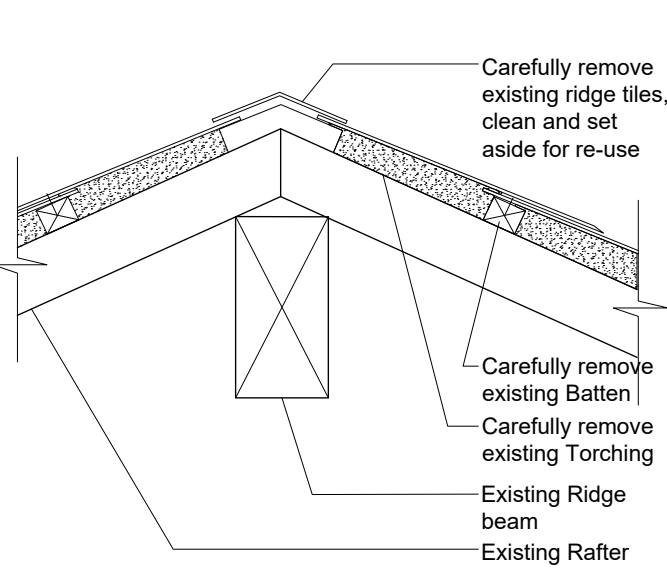
- The proposed approach is to remove the torching and to re-slate and to install a warm roof build-up with internal lime plaster finish. The proposal is detailed as Option 6 - **Refer to Methodology Appendix B.2.**
- Client investigation on site and detailed design development in close consultation with heritage specialists and manufacturers of traditional natural products has informed option development.
- The quality and authenticity of new materials is essential to match the robust fabric of the existing building. Selection of sustainably sourced and produced materials is assessed as the specification is developed.
- Care is being taken to ensure that the replacement material aligns with the SMG Sustainability Policy. Throughout the process, we have embedded the sustainability strategy into the approach, e.g. minimising temporary works, applying conservation detailing, new product selection, design and detail interfaces to manage increasing precipitation and stronger storms due to climate change, minimising waste and reusing the salvaged slates where possible.
- The opportunity to upgrade the roof with insulation will reduce energy use and in conjunction with new valley gutter detailing will support the long-term sustainable use of the building for important revenue earning events with lower energy costs while sympathetically adapting the historic building. It is a necessary and important change which will contribute to long term wellbeing of staff and visitors. Through adapting the building to change, the design allows for future resilience to achieve the balance of conservation and energy efficiency so that the building can continue in use.



DETAIL 1 VALLEY GUTTER OVER BRICK CROSS WALL

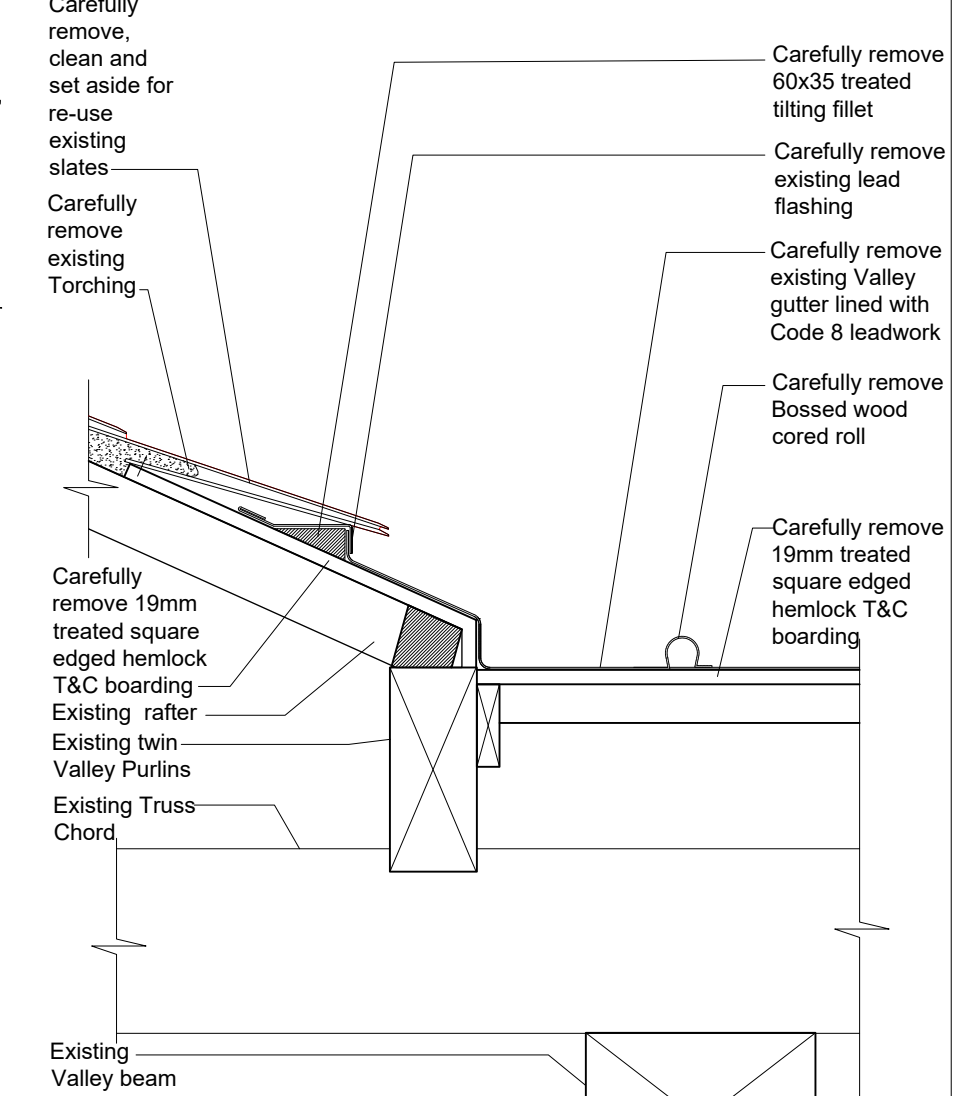


DETAIL 4 DORMER SECTION 1:10

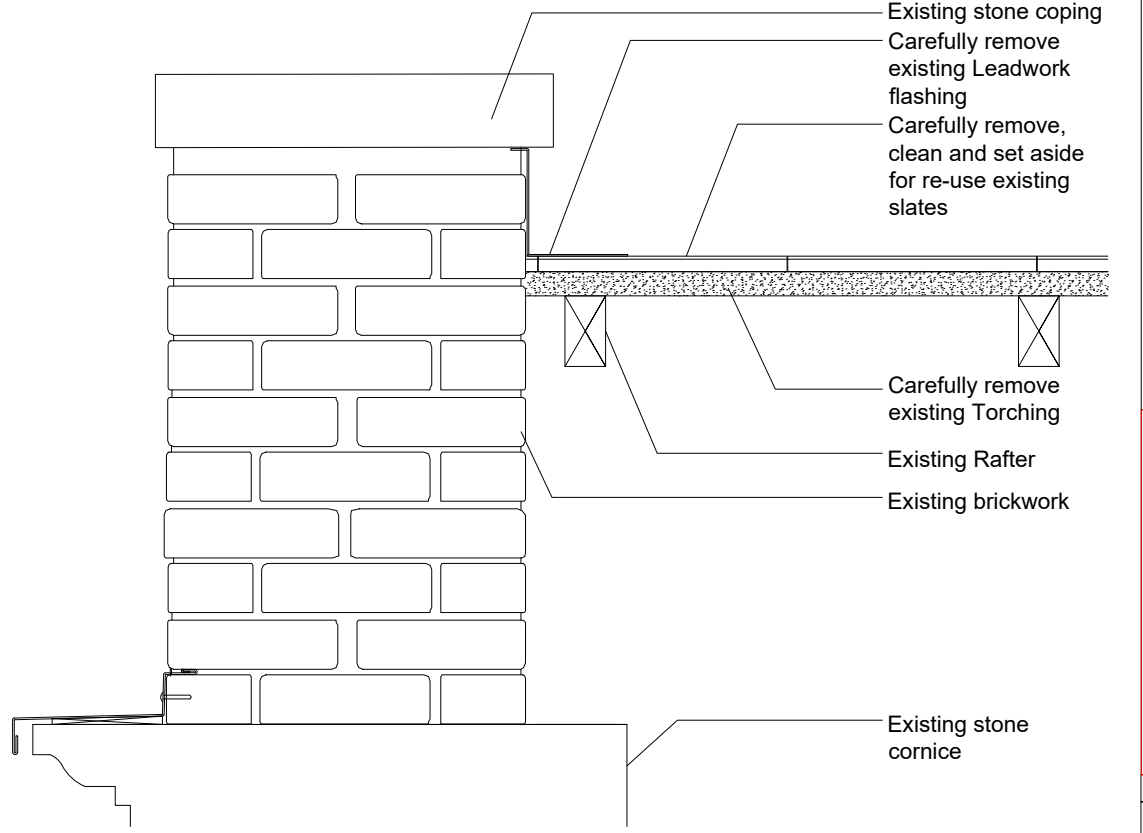


DETAIL 2 RIDGE

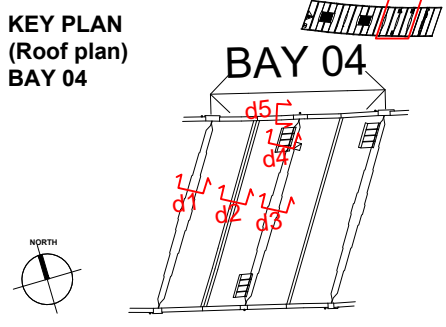
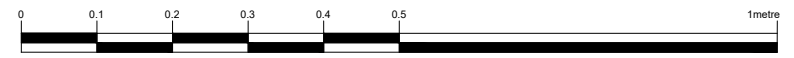
Temporary Works
(Ref. SDA Drwg No. 275/PD/03)



DETAIL 3 VALLEY GUTTER OVER VALLEY BEAM

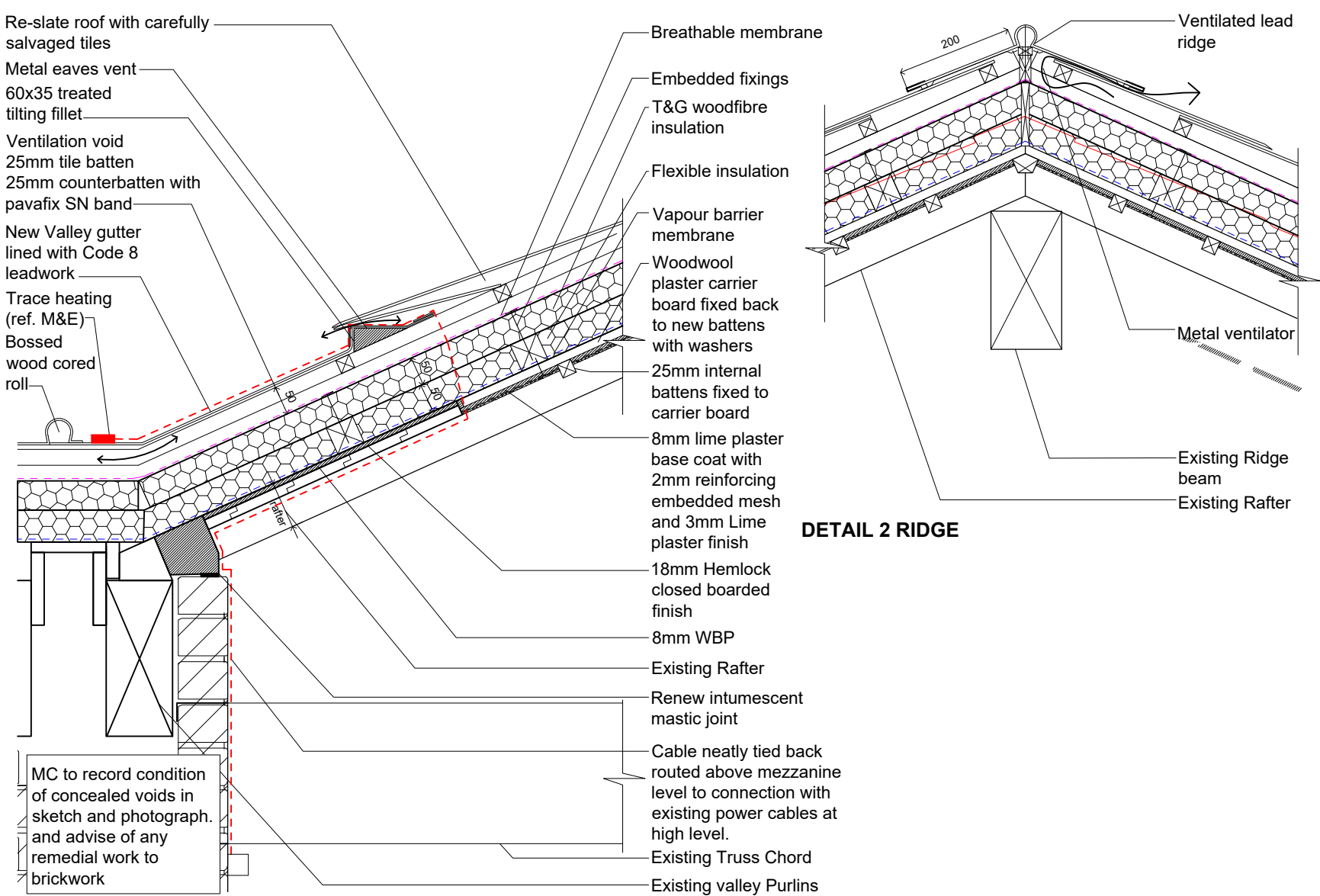


DETAIL 5 SECRET GUTTER

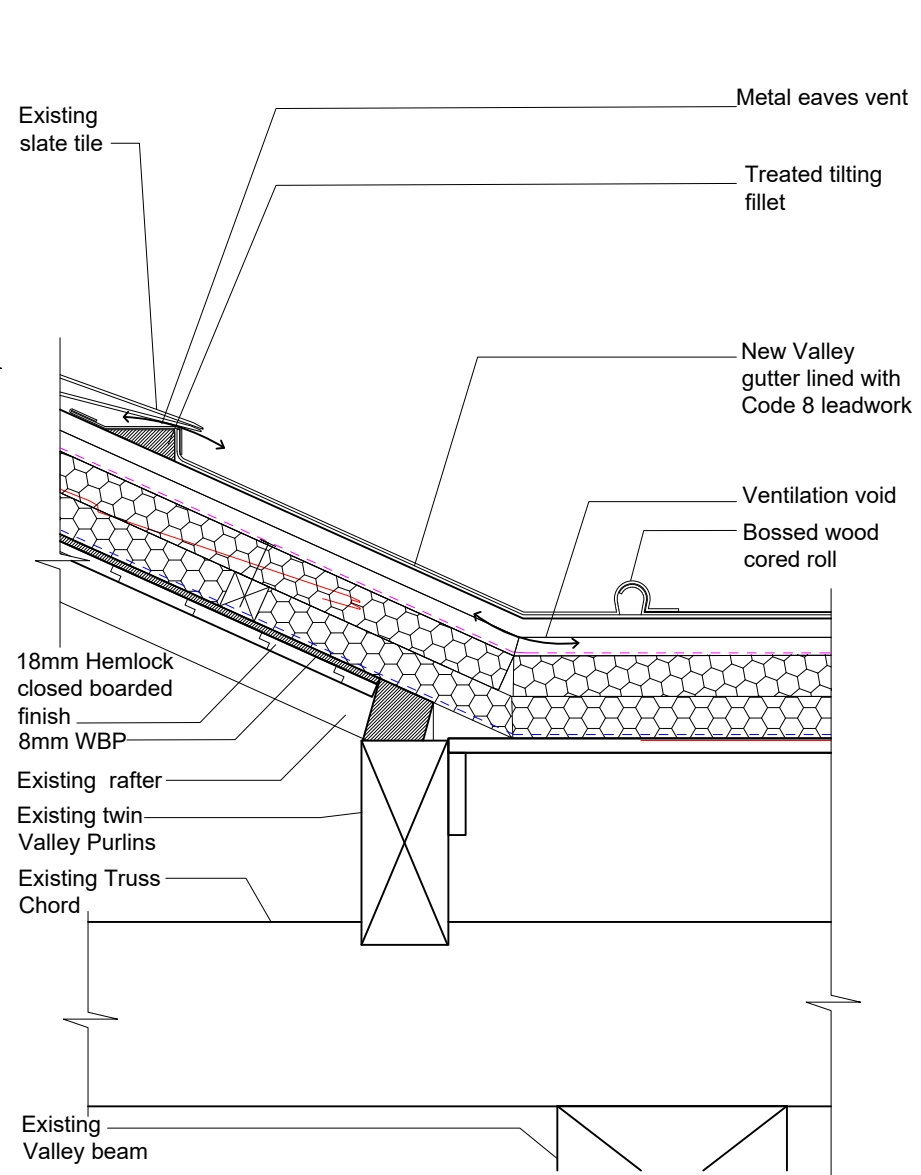


BASED ON MEASURED SURVEY BY "SITECH SURVEYING SERVICES"				
JOB TITLE Essential Repair, 1830 Warehouse, Science & Industry museum M3 4FP	JOB NO. 275	DRWG. TITLE Bay 04 Roof: Existing detail	STATUS Planning	
		DRWG. NO. 275 / PD / 130 (A1 ORIGINAL FORMAT)	REV: 23	SCALE: 1:5@A1 1:10@A3
Studiodownie ARCHITECTS LLP		TEL: +44 (0) 20 7299 7766 info@studiodownie.com	Drawn by JP	DATE: 16/02/23

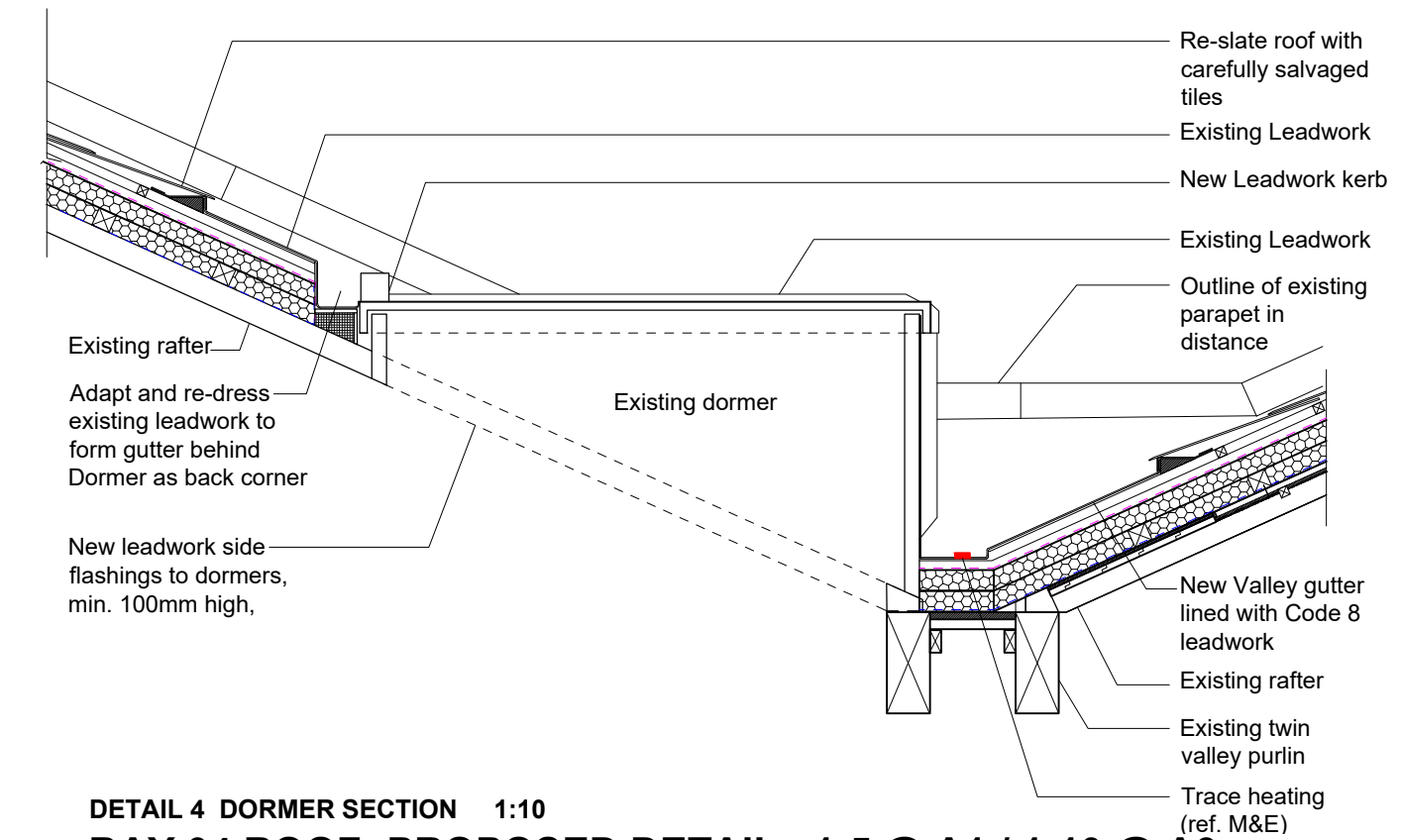
BAY 4 ROOF: EXISTING DETAIL 1:5 @ A1 / 1:10 @ A3



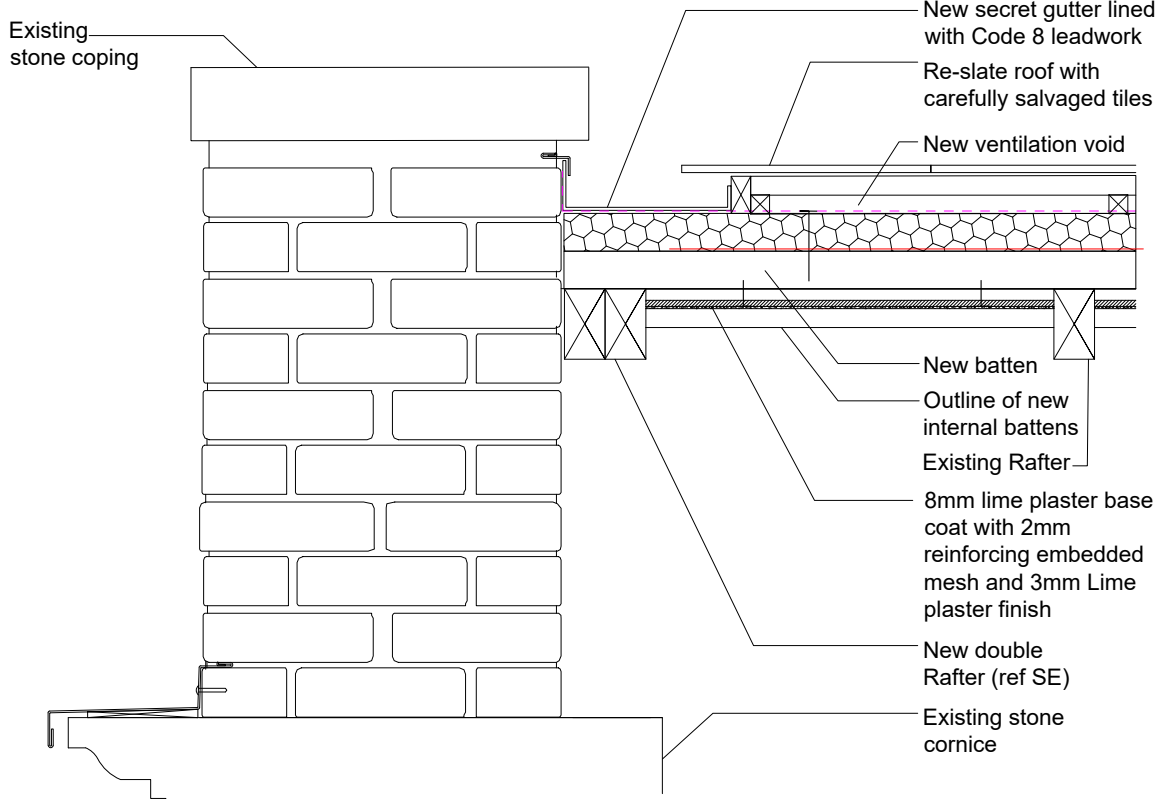
DETAIL 1 VALLEY GUTTER OVER BRICK CROSS WALL



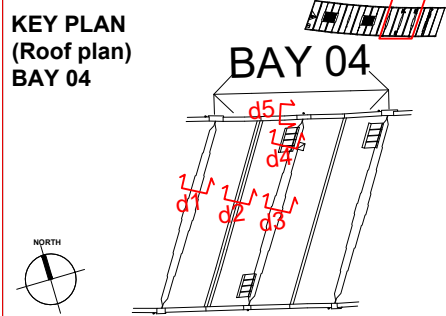
DETAIL 3 VALLEY GUTTER OVER VALLEY BEAM



DETAIL 4 DORMER SECTION 1:10
BAY 04 ROOF: PROPOSED DETAIL 1:5 @ A1 / 1:10 @ A3



DETAIL 5 SECRET GUTTER



BASED ON MEASURED SURVEY BY "SITECH SURVEYING SERVICES"					
JOB TITLE	JOB NO.	DRWG. TITLE	STATUS		
Essential Repair 1830 Warehouse, Science & Industry Museum, M3 4FP	275	Bay 04 Roof: Proposed detail	Planning		
		DRWG. NO.	REV:	SCALE:	
		275 / PD / 330		1:5@A1	
		(A1 ORIGINAL FORMAT)		1:10@A3	
Studiodownie		TEL: +44 (0) 20 7299 7766	All dimensions to be checked on site by the Contractor and confirmed with the Architect prior to construction. Do not scale off this drawing.		Drawn by: JP
ARCHITECTS LLP		info@studiodownie.com			DATE: 16/02/23

3.3: Truss Chord Repairs

Truss Chord Repairs

Summary of existing condition

- Deflection of the bottom chord of the primary longitudinal roof trusses was noted in multiple locations, suggestive of under-sizing and/or overloading. The deflection is most pronounced at Bay 2, where there has been historic overloading of the trusses during goods movement into and out the 1830 Warehouse. In 2 No. locations, the tie beam (bottom chord) has actually snapped.
- Square Hollow Section (SHS) steel posts (4No) have been installed (likely in 1992) to prop the failed trusses as well as the adjacent truss to the North, which receives the other end of the old lifting beam. Tracking the location of these SHS props through the floor, it was noted that the columns are sat on the boards between joists, and away from primary North-South beams.
- The tie beam of a primary truss to the south of the two locations noted above has also failed. The failure in the southern truss is close to the position of a knot which is a natural weak point, as well as being close to the king post tension rod, from which the tie beam is effectively hung.

Need for repairs

- Semi-permanent propping in the form of SHS posts have been installed and serve to transfer the roof load to the floorboards and joists of the 2nd floor, and away from primary structure. The failure of the tie beam in this Bay 2 truss means that the post at this location will be receiving the majority of the roof load, and the floorboards and joists under are not suitable to receive such loading in the long term. Whilst no failure is evident in the boarding, minor stress fractures were seen in the joist directly below the prop that is beneath the failed truss. A repair should be implemented to re-establish the structural integrity of this tie beam thereby re-instating the original load path down the primary timber posts.
- The truss bottom chord immediately to the south of the propped trusses has also failed with vertical cracking observed. The failure in the tie beam is close to the king post tension rod, which is the location of the greatest vertical load in the truss. As such a repair should be implemented to enhance the shear capacity of the tie beam and enhance the robustness of the truss.
- Due to the nature of repairs it was felt a splice repair would be too intrusive with quite complex temporary works. The best technical solution is to overplate rather than cut out the historic timber. This would reduce the loss of fabric and would avoid risk of temporary works to cut out key structural elements of the roof which could cause further harm.

Proposed solution

- Bay 2:
 - Repair damaged bottom chords of 3no. trusses with spliced timber repair or bolted overplate. Temporary support required during works.
 - The failure of the bottom chord of the southern truss in Bay 2 should be addressed using localised plate repairs.
 - To facilitate removing the propping, the bottom chord of the truss should be strengthened across the length of the failed chord using new steel plate details. A repair detail would involve plates bolted either side of the bottom chord to span from primary valley beam to wall. Failure and significant bowing of existing bottom chords makes member recovery difficult. Careful consideration of temporary works would be required for all remediation options.
- Bay 1:
 - Bolt/resin repair to split in truss top chord.
- Refer to Methodology Appendix B.3.



Square Hollow Section columns (4No), serve to prop failed trusses at the East side of Bay 2.



Close up of roof truss cracking, to the south of propped trusses in Bay 2, with cracking of main tie.



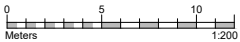
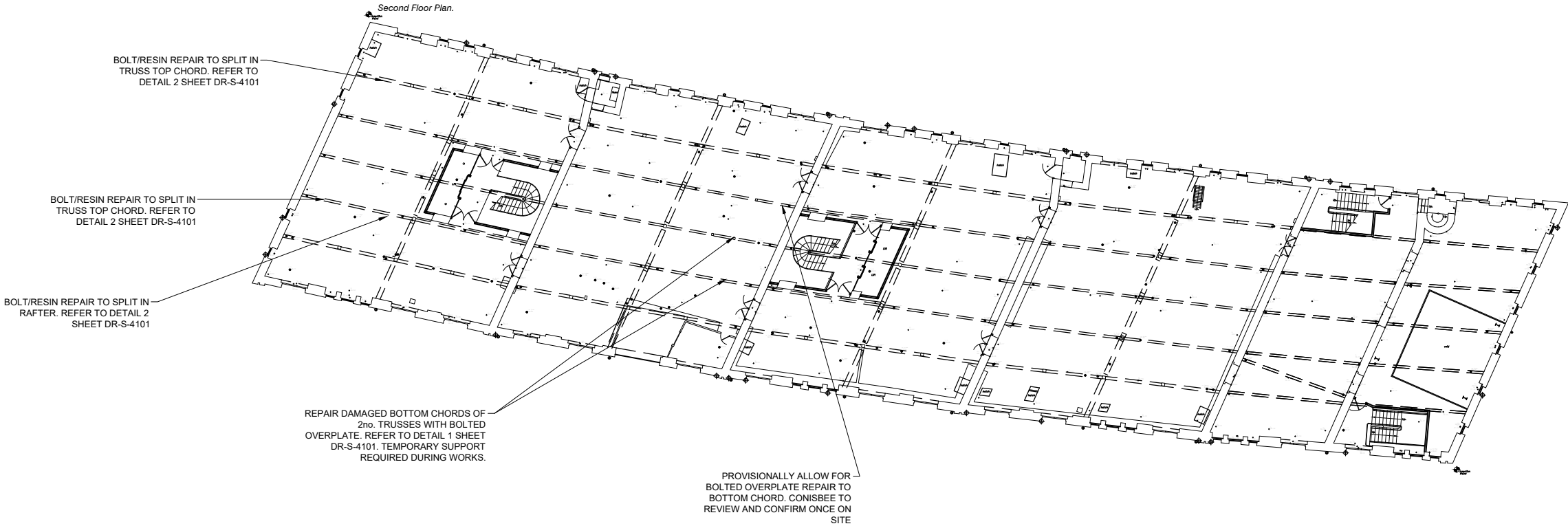
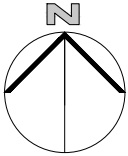
Roof truss in Bay 1 showing high level splitting in principal rafter.

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS
2. DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY.

STRUCTURAL REPAIR NOTES

1. THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND INSTALLATION OF TEMPORARY WORKS. THEIR PROPOSALS MUST BE SUBMITTED TO THE STRUCTURAL ENGINEER SUFFICIENTLY IN ADVANCE OF THE WORKS STARTING TO PERMIT COMMENT. UNDER NO CIRCUMSTANCES SHOULD ANY STRUCTURAL ALTERATIONS BE CARRIED OUT PRIOR TO THE STRUCTURAL ENGINEER COMMENTING ON THE CONTRACTORS TEMPORARY WORKS PROPOSALS.
2. REPAIR DESIGNS SHOWN INDICATE PRESCRIPTIVE METHODOLOGIES AND MATERIALS TO BE USED.
3. REFER ALSO TO CONISBEE STRUCTURAL SPECIFICATION.



NOT FOR CONSTRUCTION

T1	10.02.23	TENDER ISSUE	HM	SW
P2	31.01.23	PRELIMINARY ISSUE	HM	SW
P1	06.12.22	PRELIMINARY ISSUE	SW	SW

Rev	Date	Description	Drawn	Check
-----	------	-------------	-------	-------

conisbee Consulting Structural Engineers
Consulting Civil Engineers

London • Cambridge • Norwich
1-5 Offord St London N1 1DH
Telephone 020 7700 6666
www.conisbee.co.uk

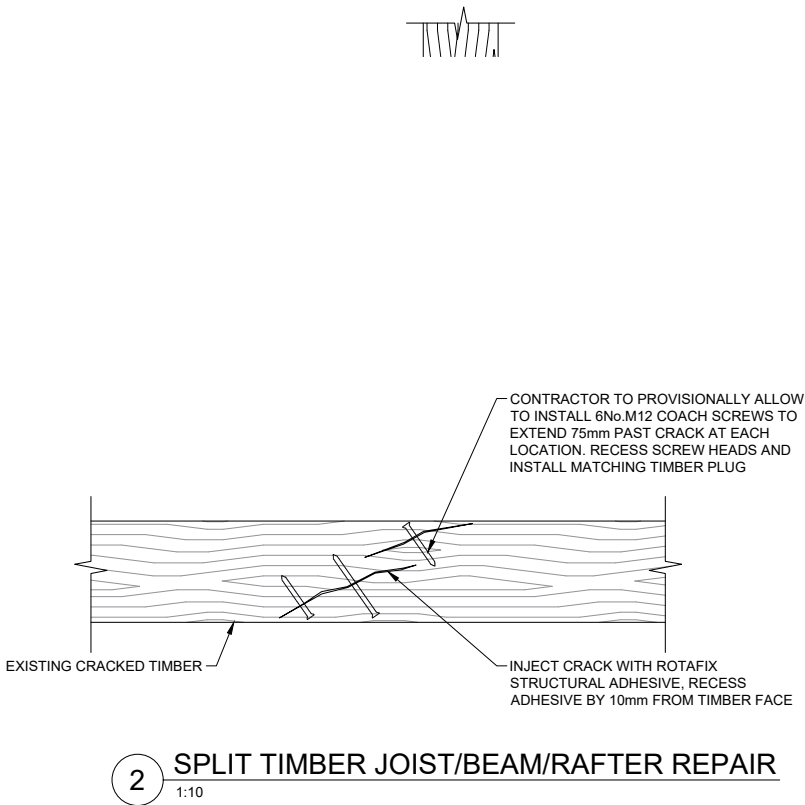
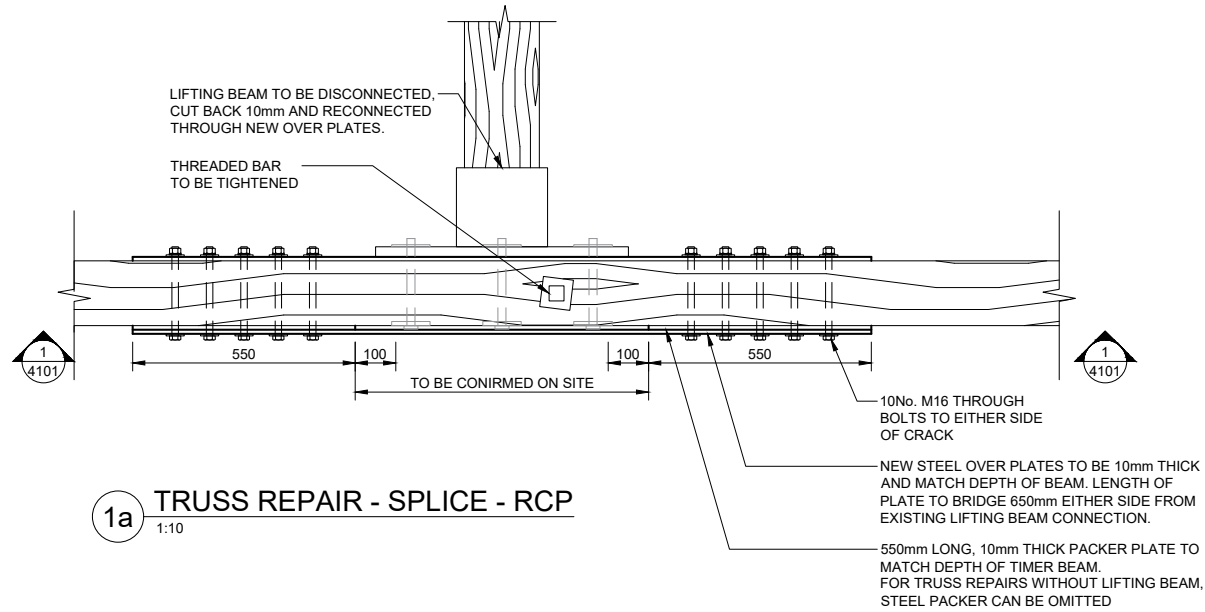
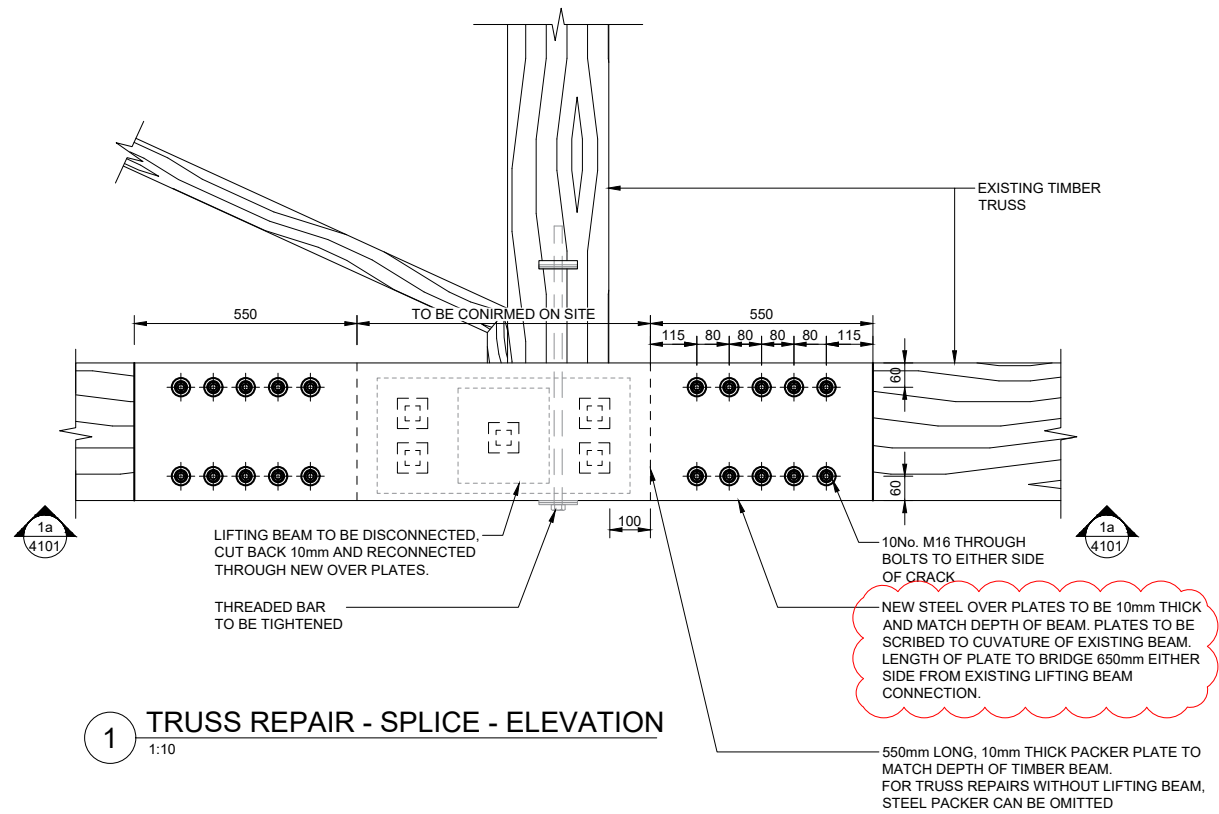
Drawing Status TENDER	
Project	Date FEB 2023
SIM - 1830 WAREHOUSE ESSENTIAL WORKS & REPAIRS	Scale 1:200@A1
	Drawn HM
Title	Engineer SW
SECOND FLOOR PLAN STRUCTURAL REPAIRS	Project No 220627
Drawing No 220627-CON-XX-02-DR-S-1103-LP 2123	Revision

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS
2. DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY.

STRUCTURAL REPAIR NOTES

1. THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND INSTALLATION OF TEMPORARY WORKS. THEIR PROPOSALS MUST BE SUBMITTED TO THE STRUCTURAL ENGINEER SUFFICIENTLY IN ADVANCE OF THE WORKS STARTING TO PERMIT COMMENT. UNDER NO CIRCUMSTANCES SHOULD ANY STRUCTURAL ALTERATIONS BE CARRIED OUT PRIOR TO THE STRUCTURAL ENGINEER COMMENTING ON THE CONTRACTORS TEMPORARY WORKS PROPOSALS.
2. REPAIR DESIGNS SHOWN INDICATE PRESCRIPTIVE METHODS AND MATERIALS TO BE USED.
3. ROTAFIX RESIWOOD TIMBER ENGINEERING SYSTEM OR SIMILAR & APPROVED TO BE USED FOR ALL RESIN/ADHESIVE BASED REPAIRS.
4. BOLTS TO BE GRADE 8.8
5. STEEL PLATES TO BE S355
5. REFER ALSO TO CONISBEE STRUCTURAL SPECIFICATION.



NOT FOR CONSTRUCTION

T2	13.03.23	TENDER ISSUE	KDE	SW
T1	10.02.23	TENDER ISSUE	KDE	HM
Rev	Date	Description	Drawn	Check

conisbee | Consulting Structural Engineers
Consulting Civil Engineers

London • Cambridge • Norwich
1-5 Offord St London N1 1DH
Telephone 020 7700 6666
www.conisbee.co.uk

Drawing Status	
TENDER	
Project	Date FEB 2023
SIM - 1830 WAREHOUSE	Scale 1:10 @ A1
ESSENTIAL WORKS & REPAIRS	Drawn KDE
Title	Engineer HM
TYPICAL STRUCTURAL REPAIRS	

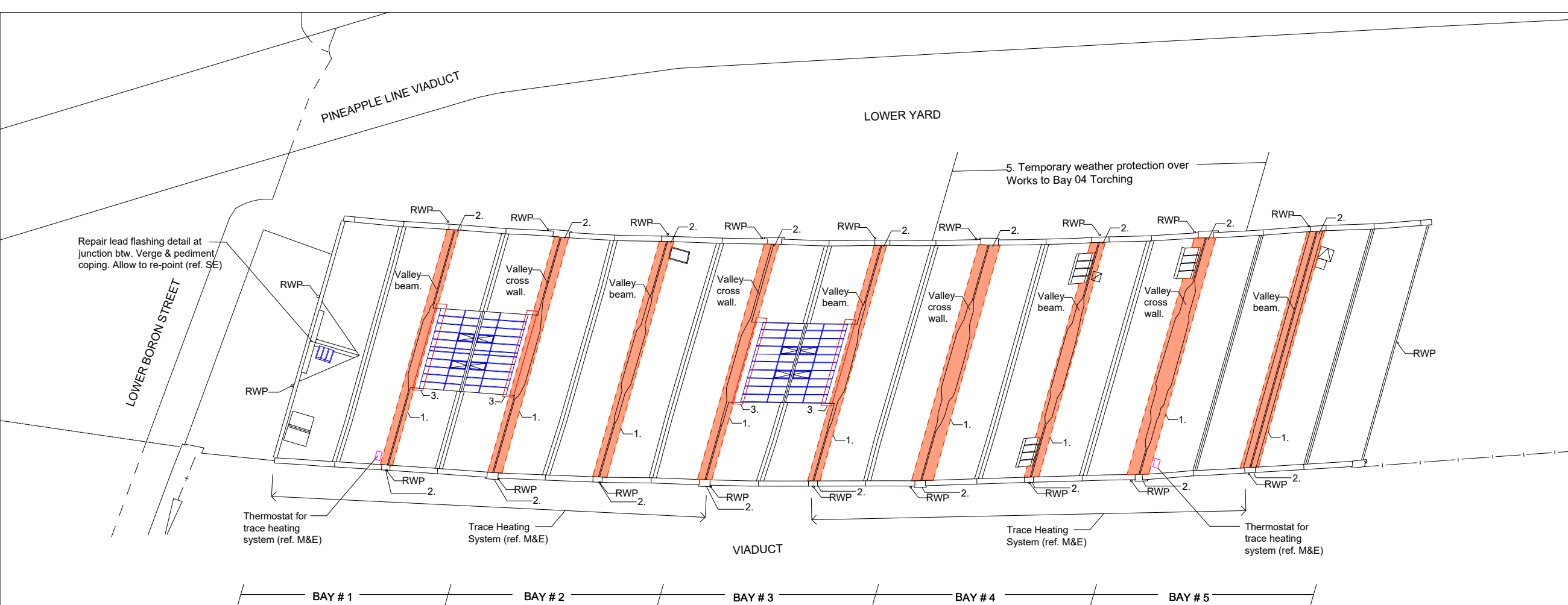
SECTION 04 /
SUMMARY OF PROPOSED SCHEDULE OF WORKS:

Proposals

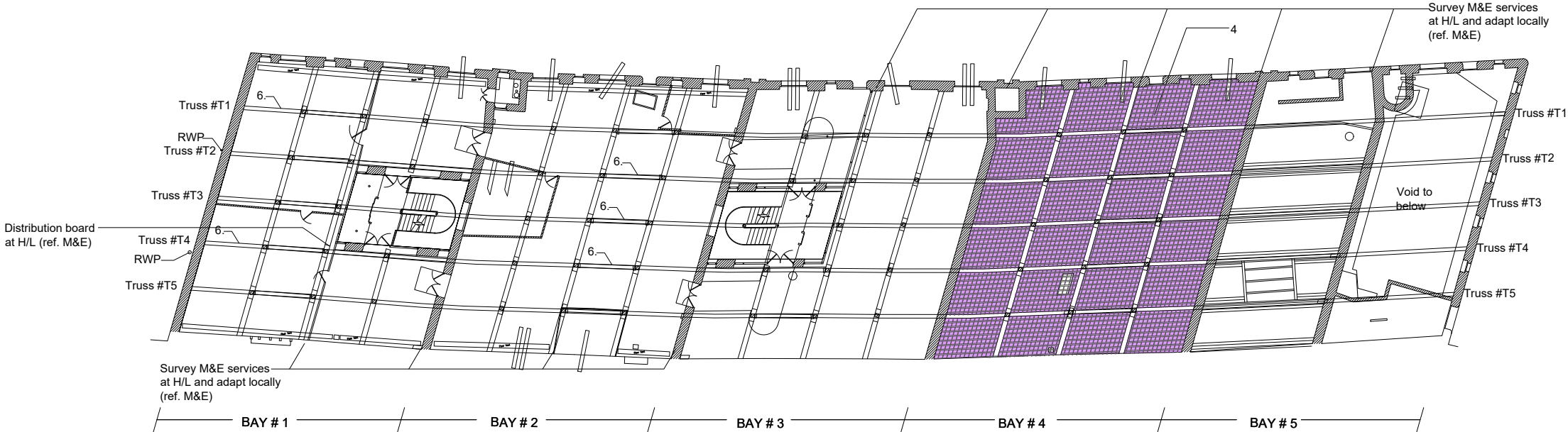
- The following pages provide a summary of the scope of works and general arrangement drawings.

Roof Repairs

	DEFECTIVE CONDITION	APPROACH TO PROPOSED REPAIR SOLUTION	KEY DRAWINGS
	The valley gutters installed in the 1990's are leaking in places due to a range of factors including the narrow, deep profile; reverse falls due to structural settlement; blockages overtopping interface in waterproofing details; materials are in poor condition due to water ingress.	Replace and re-profile the 1990's valley gutters to accommodate current predicted rainwater calculations. Raise the middle of the valley by adjustment to roof finishes above the existing structure. Raise the ends of the valley to maintain a wide valley gutter and to avoid dropping into the narrow space between the valley purlins. Line with lead sheet using traditional stepping drip detail following the Lead Sheet Association guidelines. Retain perimeter chute level and retain existing chute opening through the external wall for the lower chute. The works will involve the removal of the 1990's valley gutter leadwork, plywood trays and de-slating 2-3 courses. The slates will be set aside for checking for re-use. The new valley gutter will be installed in accordance with Lead Sheet Association details with a build-up of new insulation, weatherproof breathable membranes, and re-slating with salvaged slates. The continuous eaves ventilation will be replaced like for like. The leadwork will be removed to the chute and replaced. The secret gutter at the parapet will be adapted to the chute. Localised leadwork detailing will be installed to the bottom edge of existing rooflights. New trace heating to base of valley gutter. Any brick repairs required when uncovered will be carefully undertaken and and repointed with lime mortar. The internal plaster linings will be locally replaced.	275/PD/120 Valley Gutter: Existing Bay 2 GA sectional elevation + plan 275/PD/121 Valley Gutter: Existing Typical Detail over Valley Beam 275/PD/122 Valley Gutter: Existing Typical Detail over Brick Cross Wall 275/PD/320 Valley Gutter: Proposed Works to Bay 2 GA sectional elevation + plan 275/PD/321 Valley Gutter: Proposed Works to Typical Detail over Valley Beam 275/PD/322 Valley Gutter: Proposed Works to Typical Detail over Brick Cross Wall
	Bay 4 torching installed in the 1990's is not properly mixed and loose pieces of varying sizes are falling out and dropping to the floor.	The approach is to remove the 1990's torching and install insulation to the roof similar to what has been installed in the Bays 1-3 and Bay 5. New weatherproof breathable membranes will be installed. Behind the parapet, the roofline will be raised by between 25mm and 100mm. The works will involve the removal of the 1990's torching, de-slating the salvaged slates and setting slates aside for checking for re-use. The installation will comprise new eco-friendly and breathable wood fibre insulation, weatherproof breathable membranes, new treated slate battens, re-slating with salvaged slates. The valley gutters will be detailed in lead consistently as mentioned above. The internal finish would be a lime putty carefully applied to a suitable substrate in between the existing rafters.	275/PD/130 Bay 04 Roof: Existing detail 275/PD/330 Bay 04 Roof: Proposed Works
	Truss chords are cracked in both Bay 1 (2no.) and Bay 2 (3no.).	Bay 1: Bolt/resin repair to split in truss top chord Bay 2: Repair damaged bottom chords of 3no. trusses with spliced timber repair or bolted overplate (TBC). Temporary support required during works	220627-CON-XX-02-DR-S-1103 SECOND FLOOR PLAN STRUCTURAL REPAIRS 220627-CON-XX-ZZ-DR-S-4101 TYPICAL STRUCTURAL REPAIRS ROOF DETAILS SHEET 1



ROOF PLAN



REFLECTED CEILING PLAN

PROPOSED WORKS TO EXISTING BUILDING: ROOF PLAN & REFLECTED ROOF 1:400 @ A3 1:200 @ A1

SCHEDULE OF WORKS

WORKS TO VALLEY GUTTERS:
Ref. SDA Drwg Nos. 275/PD/120-122, 320-322

1. Remove valley gutters and associated leadwork, de-slate locally and set aside for checking for re-use. Install new valley gutter (ref M&E calculations) to new profile in accordance with Lead Sheet Association details. Install new insulation, membranes, and re-slate with salvaged slates. Allow for continuous new eaves ventilation detail. Remove temporary drip trays.

2. Remove leadwork to chute, reprofile to outlet, adapt outlet and install new leadwork in accordance with Lead Sheet Association details.

3. Adapt bottom edge of existing rooflights to new valley gutter detail.

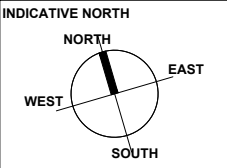
WORKS TO BAY 4 TORCHING:
Ref. SDA Drwg Nos. 275/PD/130, 330

4. Remove torching, de-slate and set aside for checking for re-use. Install new insulation, membranes, and re-slate with salvaged slates. Allow for internal lime plaster finish.

5. MC to provide temporary external weather protection for the duration of the works.

INTERNAL TIMBER REPAIRS:
Ref. Conisbee Drwg 220627-CON-XX-02-DR-S-1103 and 220627-CON-XX-ZZ-DR-S-4101

6. Repair to Bay 1 and Bay 2 trusses (ref SE). instruction.



BASED ON MEASURED SURVEY BY GREEN HATCH, 2018				
JOB TITLE Essential Repair 1830 Warehouse, Science & Industry Museum. M3 4FP	JOB NO. 275	DRWG. TITLE Proposed Works to Existing Building: Roof plan & Reflected Roof	STATUS Planning	
		DRWG. NO. 275/ PD / 714 (A1 ORIGINAL FORMAT)	REV:	SCALE: 1:400@A3 1:200@A1
Studiowonie ARCHITECTS LLP		TEL: 044 (0) 20 7299 7766 info@studiowonie.com	Drawn by: JP	DATE: 10/02/23



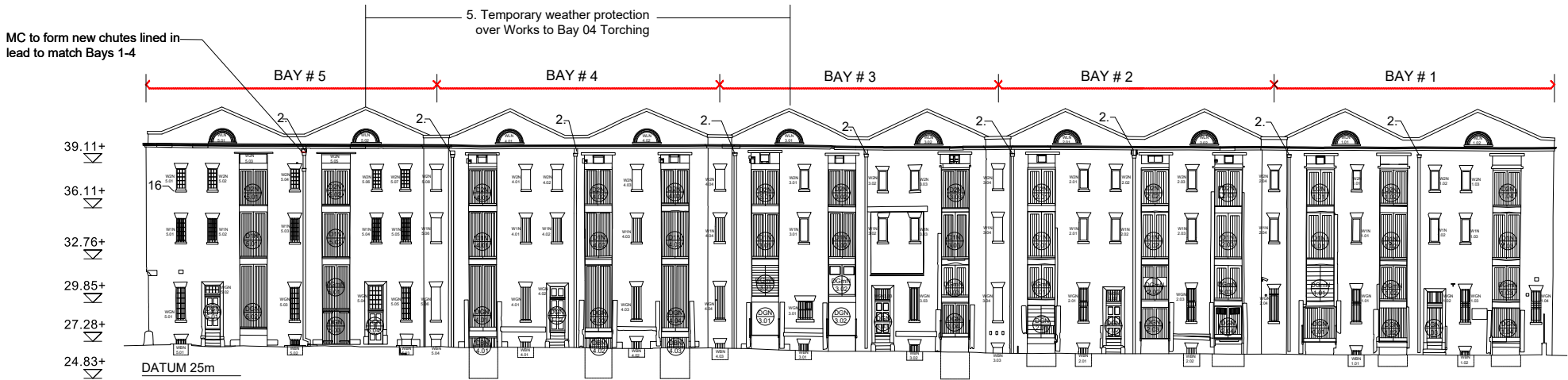
SCHEDULE OF WORKS

WORKS TO VALLEY GUTTERS:
Ref. SDA Drwg Nos. 275/PD/120-122, 320-322

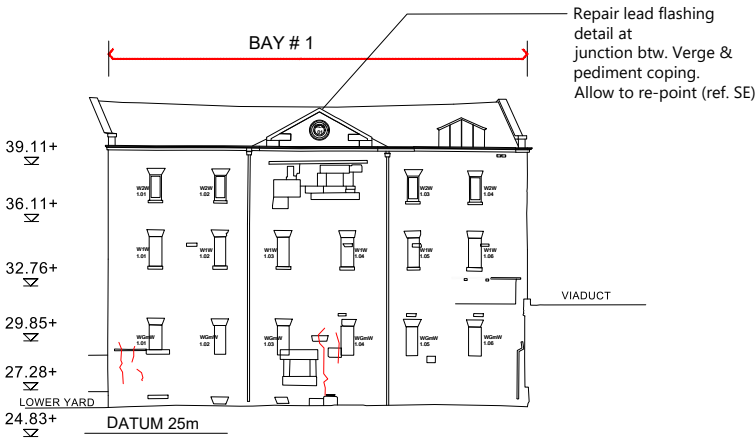
2. Remove leadwork to chute, reprofile to outlet, adapt outlet and install new leadwork in accordance with Lead Sheet Association details.

WORKS TO BAY 4 TORCHING:
Ref. SDA Drwg Nos. 275/PD/130, 330

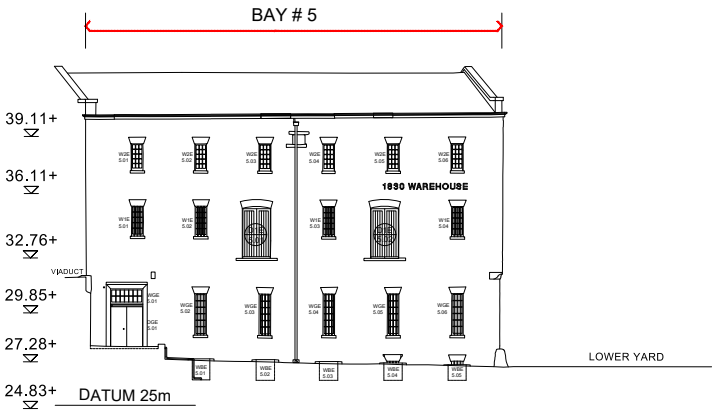
5. MC to provide temporary external weather protection for the duration of the works.



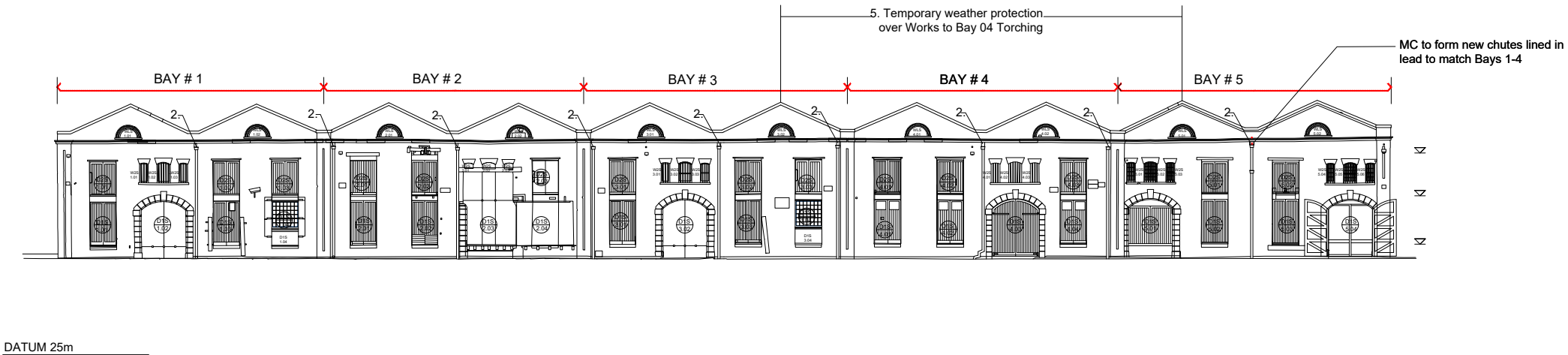
NORTH ELEVATION



WEST ELEVATION.



EAST ELEVATION



SOUTH ELEVATION

PROPOSED WORKS TO EXISTING BUILDING: EXTERNAL ELEVATION 1:400 @ A3 1:200 @ A1



BASED ON MEASURED SURVEY BY GREEN HATCH, 2018				
JOB TITLE Essential Repair 1830 Warehouse, Science & Industry Museum: M3 4FP	JOB NO. 275	DRWG. TITLE Proposed Works to Existing Building: External elevation	STATUS Planning	
		DRWG. NO. 275/ PD / 721 (A1 ORIGINAL FORMAT)	REV: 1:400@A3 1:200@A1	SCALE: 1:400@A3 1:200@A1
Studio Downie ARCHITECTS LLP		TEL: +44 (0) 20 7299 7766 info@studiodownie.com	Drawn by: JP	DATE: 16/02/23

APPENDIX:

- **Appendix A Structures Report**
 - A.1: Conisbee 220626_1830_Warehouse_Structural_Appraisal
 - A.2: Hutton & Rostron 210-58 SIM 1830 Warehouse Rpt 111018 CW “Investigation of Lime Torching to the Underside Of The Roof in Bay 04 of the 1830 Warehouse”
 - A.3: 220627- 1830 Warehouse - Structural Note
- **Appendix B Method Statements**
 - B.1: Methodology for Valley Gutters
 - B.2: Methodology for Bay 4 Roof
 - B.3: Methodology for Truss Chord Repairs
 - B.4: Methodology for Temporary Works
 - B.5: Methodology as General Summary
- **Drawings**
 - Studio Downie Architects Drawings - architectural and general arrangement
 - Conisbee Drawings - structural repairs

- **List of Drawings**

Studio Downie Architects Drawings - architectural and general arrangement

Location Plan

275/PD/001 Location Plan

Site Plan

275/PD/002 Site Plan

Existing General Arrangement Drawings

275/PD/014 Existing Building: Roof Plan and Reflected Roof Plan

275/PD/020 Existing Building: External Elevation

275/PD/050 Existing Building: Internal Elevation GA

Valley Gutters

275/PD/120 Valley Gutter: Existing Bay 2 GA sectional elevation + plan

275/PD/121 Valley Gutter: Existing Typical Detail over Valley Beam

275/PD/122 Valley Gutter: Existing Typical Detail over Brick Cross Wall

275/PD/320 Valley Gutter: Proposed Works to Bay 2 GA sectional elevation + plan

275/PD/321 Valley Gutter: Proposed Works to Typical Detail over Valley Beam

275/PD/322 Valley Gutter: Proposed Works to Typical Detail over Brick Cross Wall

Bay 4 Roof

275/PD/130 Bay 04 Roof: Existing detail

275/PD/330 Bay 04 Roof: Proposed Works

General Arrangement

275/PD/714 Proposed Works to Existing Building: Roof Plan and Reflected Roof Plan

275/PD/721 Proposed Works to Existing Building: External Elevation

275/PD/751 Proposed Works to Existing Building: Internal Elevation GA

Conisbee Drawings - structural repairs

220627-CON-XX-02-DR-S-1103 SECOND FLOOR PLAN STRUCTURAL REPAIRS

220627-CON-XX-ZZ-DR-S-4101 TYPICAL STRUCTURAL REPAIRS ROOF DETAILS SHEET 1