CARMODY GROARKE

Power Hall and Decarbonisation Science and Industry Museum

24th August 2021
Design and Access Statement - Package 3b

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This document is intended to be read in conjunction with the following documents which form part of the submission: The Vision Document, Heritage Impact Assessment, M&E strategy report, Lightning protection report, plus various structural reports and methodologies.

1 Introduction

1.1 Project Aims

1.2 Works Packages

1.3 Project Team

1.4 Context

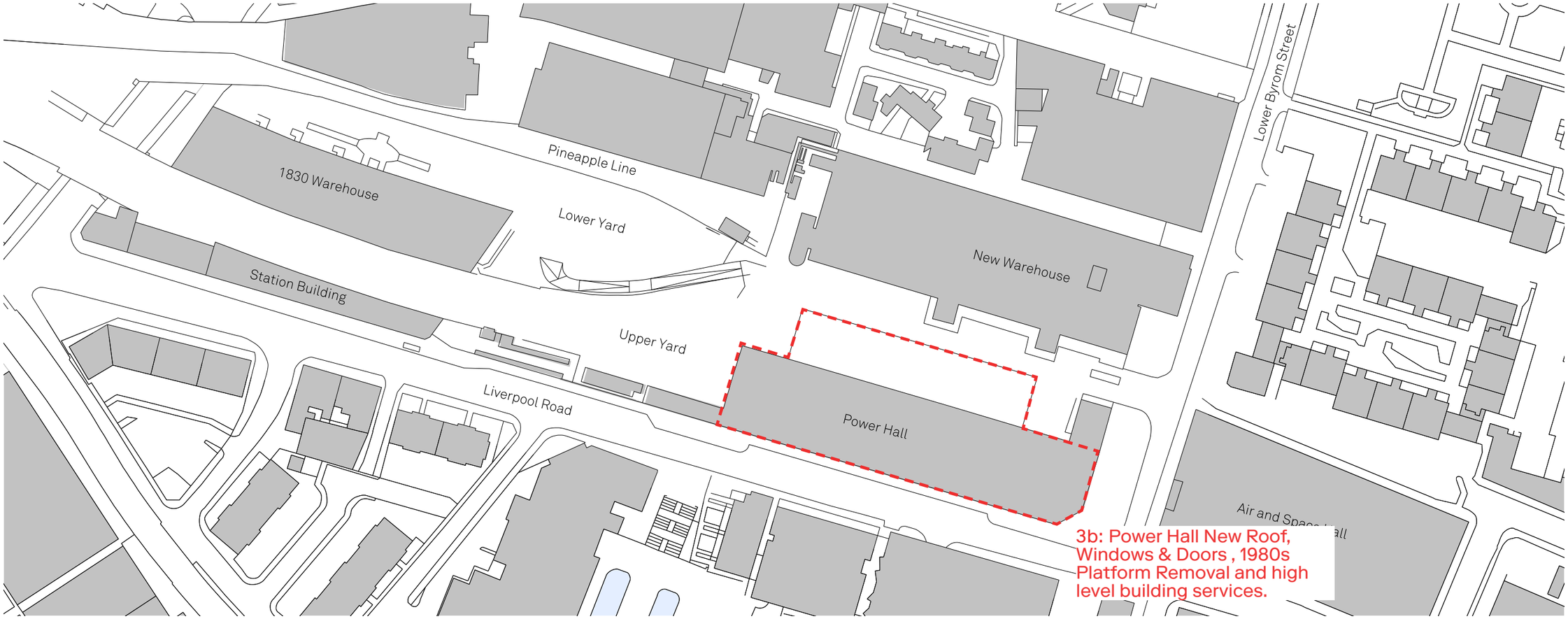
Introduction
This Design and Access Statement has been prepared to support one of several Listed Building Consent and/or Planning Applications in relation to a new *Power Hall and Decarbonisation* project at the Science and Industry Museum (SIM), Manchester site.

Overall project aims

- Re-open the Power Hall, which was closed to the public for repair work in 2018
- Create a new gallery design with a simple and clear circulation route in the Power Hall which is accessible for all
- Reveal the historic structure of the Power Hall and carry out essential repairs to future-proof the building for years to come
- Install new plant to the Power Hall which will allow recommissioning of some of the steam exhibits
- Install site wide plant to reduce the museum's carbon footprint. Part of a journey towards net zero carbon for the Science and Industry Museum



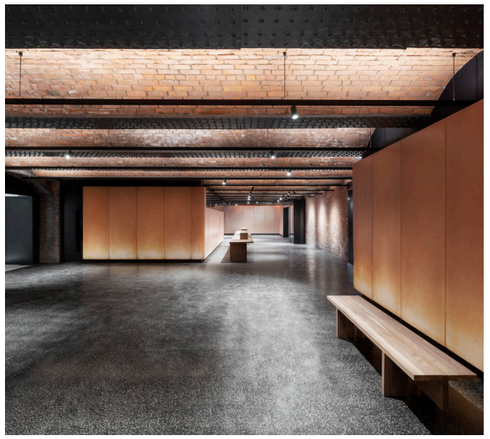
View of the proposed Power Hall concept



The Power Hall and Decarbonisation project is to be delivered as one project. However, the required Planning and Listed Building Consent applications must be split into several separate applications due to the different Listings of the buildings and the deadlines for the government's public sector decarbonisation scheme funding, requiring work to be completed this year. Splitting the consent packages will also allow construction work to start on site earlier and ensure we meet the government deadlines.

The table across details the timeline for the applications.

Works Package	Package Description	Planning and Listed Building Consent Applications	Submission Date
1A	• Water Source Heat Pump Network (External) • Water Source Heat Pump and associated plant in the Power Hall	• Application for Listed Building Consent for alterations to the Grade II Listed Power Hall for the creation of openings and the installation of plant plus the introduction of a services trench within its curtilage. • Application for Listed Building Consent for installation of a services trench within the curtilage of the Grade II Listed New Warehouse. • Application for Planning Permission for external works to the Boiler Room including removal of an external staircase and making good in addition to the installation of a new balustrade and new doors. • Application for Listed Building Consent for alterations to the Grade I Listed 1830 Warehouse for the creation of openings and the installation of pipework plus the introduction of a services trench and borehole cover within its curtilage.	Determined 02.07.21
1B	• Boiler House External Modifications (to facilitate installation of a new sub-station) • Pipework in the 1830 Warehouse (to facilitate installation of a new water source heat pump)		
2	Power Hall Roof Strip	Planning Permission and Listed Building Consent	Determined 29.07.21
3a	Power Hall structural roof repairs	Listed Building Consent	Submitted 06.08.21
3b	**Power Hall New Roof, Windows & Doors, 1980s Platform Removal (to allow early investigative work) and high level building services.**	**Planning Permission and Listed Building Consent**	**Submitted August 2021**
4	Power Hall Gallery Refurbishment	Planning Permission and Listed Building Consent	Winter 2021



Special Exhibitions Gallery at the Science and Industry Museum, Manchester



New Architecture Gallery at the Grade II* RIBA headquarters, London



Windermere Jetty Museum, Lake District National Park



Grade II listed Dorset County Museum, Dorchester



Masterplan for Grade I listed Tullie House, Carlisle.



Refurbishment of a Grade I listed artist's house, Norfolk

This statement has been prepared by Carmody Groarke on behalf of the Science and Industry Museum, Manchester, in collaboration with the design team:

Services Engineer – Max Fordham

Structural Engineer – Conisbee

Quantity Surveyor – Appleyard & Trew

Project Managers - Gardiner & Theobald LLP

Heritage Consultants - Donald Insall Associates

Planning Consultant - Deloitte

Carmody Groarke has extensive experience designing cultural projects within historic settings, these include:

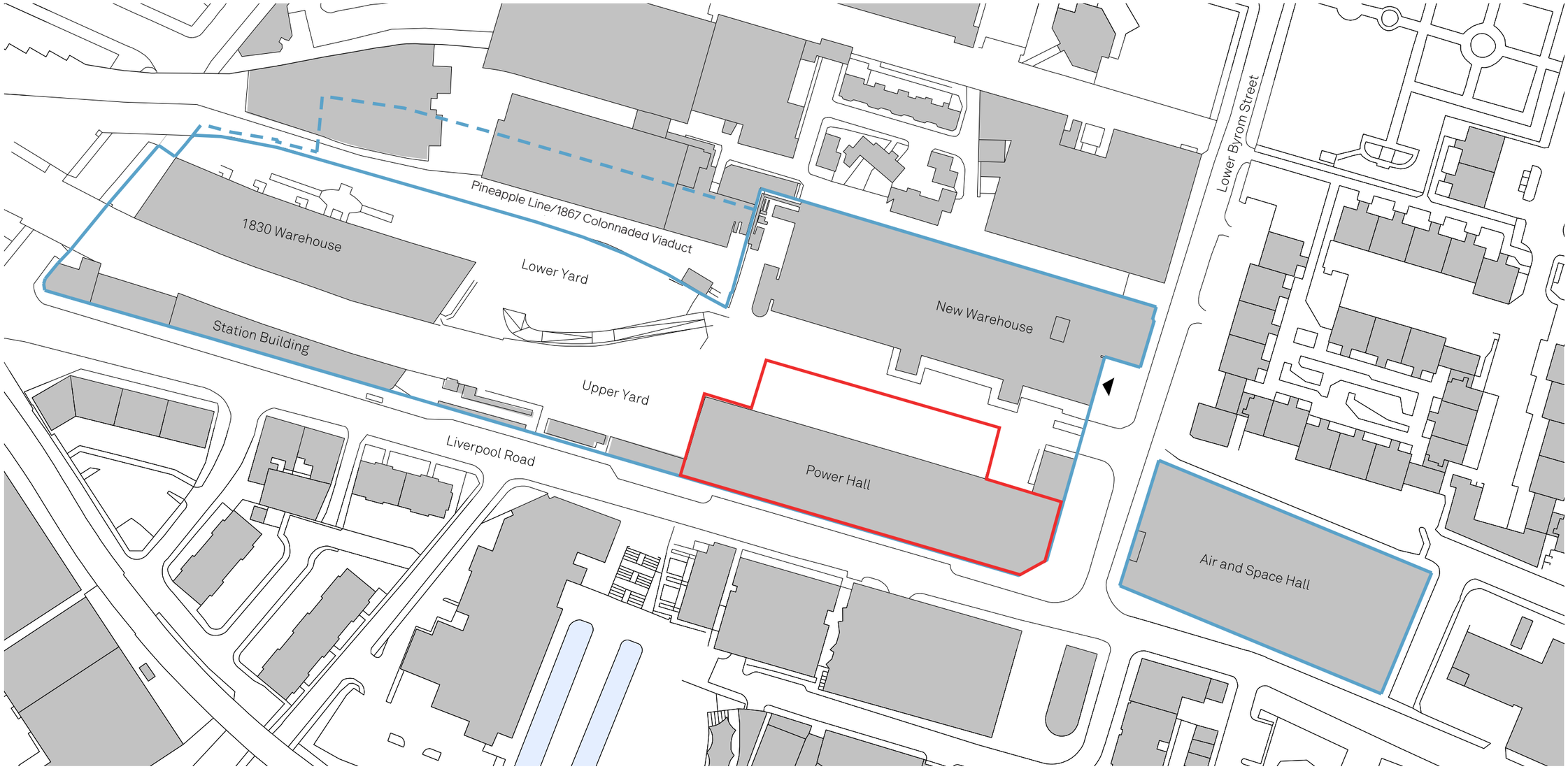
- Special Exhibitions Gallery in the grade II listed New Warehouse at the Science and Industry Museum
- New Architecture Gallery at the Grade II* RIBA headquarters, London
- Windermere Jetty Museum, Lake District National Park
- Grade II listed Dorset County Museum, Dorchester
- Grade I listed Tullie House masterplan, incorporating a contemporary vision for a Public Library, Museum and School of Art, Carlisle
- Refurbishment of a Grade I listed artist's house, Norfolk
- Grade I listed Abbot Hall Gallery masterplan, Cumbria
- Waddesdon Manor Pavilion, National Trust and Rothschild Foundation



Aerial photograph of Manchester city centre

The Science and Industry Museum is located within the Castlefield Conservation Area, an area with a mixture of visitor attractions, offices and residential uses. A number of new developments are proposed around the Museum boundary, including a new arts complex and mixed use development.

The Science and Industry Museum is situated on the site of a former railway station –Liverpool Road Station – which opened as part of the Liverpool and Manchester Railway in September 1830. The railway yard eventually fell out of use in the 1970s, was purchased by Greater Manchester County Council in 1978 and became the Museum's home in 1983.



The site is formed by a complex of railway structures and buildings and is regarded by Historic England as one 'of the most significant railway sites in the world':

- Grade I listed 1830 Warehouse, the first railway warehouse in the world.
- Grade I listed 1830 Station building, the oldest surviving purpose-built railway passenger station.
- Grade II listed 1830 Viaduct, brick railway viaduct connecting the two buildings.
- Grade I listed, Station Master's House,
- Grade II listed New Warehouse (Former Lower Byrom Street Warehouse).
- Grade II listed 1867 Colonnaded Viaduct (known as the Pineapple line), built in 1867
- Grade II listed Shipping Shed (known as the Power Hall), a transit shed added to the station in 1855.
- Grade II listed, Goods Office (New Warehouse).
- Grade II listed Air and Space Hall.

Key

SIM boundary

Planning Application boundary

2 History and Modern Interventions

2.1 History of the Power Hall

2.2 1980s Works

2.3 Historic Platform

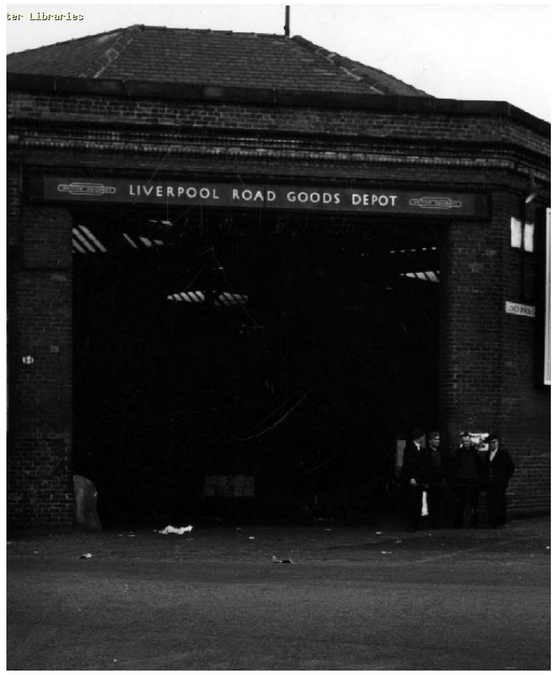
2.4 Modern Platform

2.5 Historic Roof and Modern Alterations

2.6 Historic and Modern Services



Exterior view of the Power Hall and external gantry, prior to restoration (SIM Archive, YA 1996.2130)



Exterior view of the Power Hall south-east, prior to restoration (Science Museum Group Collection)

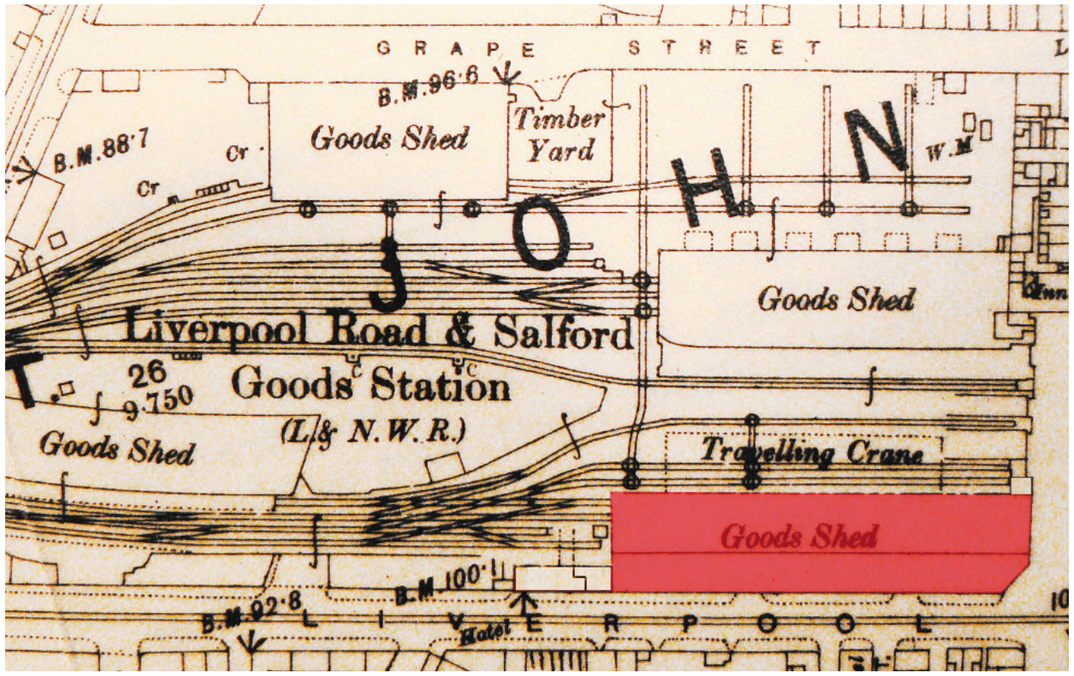
From Shipping Shed to Power Hall
The Liverpool Road Railway Station was the Manchester terminus of the first inter-city passenger railway network in the world. Opened in 1830, the station served passenger trains for just fourteen years, and when Manchester Victoria Station opened in 1844, Liverpool Road became a goods depot.

The Power Hall was built in 1855 to serve as a Shipping Shed for the London and North Western Railway company (LNWR). The building served the purpose of unloading goods from trains, which entered the building to the north of the platform, and immediately loading them in to carts and trucks, which lined up on the south of the platform, for distribution.

In the early 1860s, an office block was added to the south western corner of the Power Hall, and around 1881, the exterior gantry crane was installed in the North Yard, adjoining the northern elevation of the Power Hall. The building was used as a goods transfer shed until 1975.



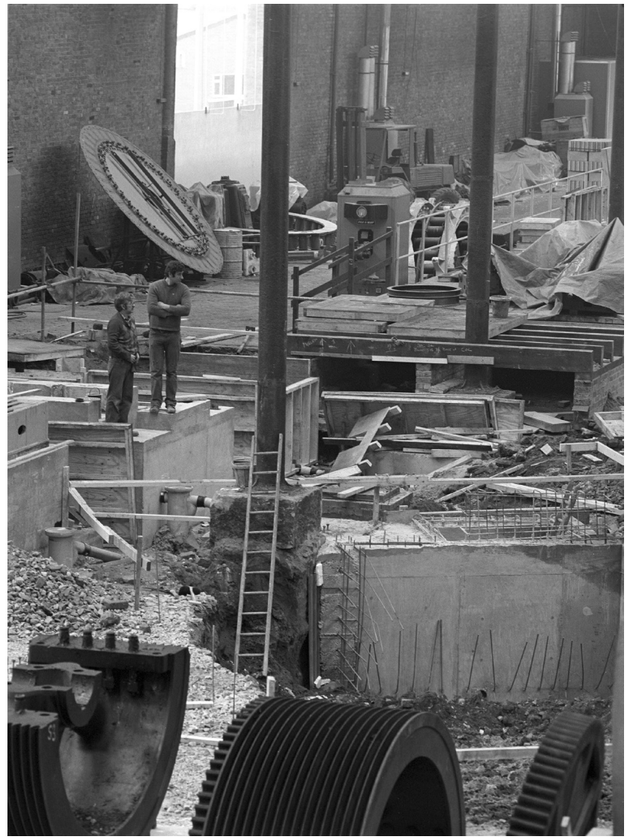
The Power Hall prior to restoration (MMU Visual Resources Centre)



Historic plan showing the historic configuration of the Science and Industry Museum site (Manchester Archives)



The Power Hall during 1980s restoration
(Science Museum Group Collection)



The Power Hall during 1980s restoration
(Science Museum Group Collection)



Today's Power Hall exhibition layout
(Science Museum Group Collection)

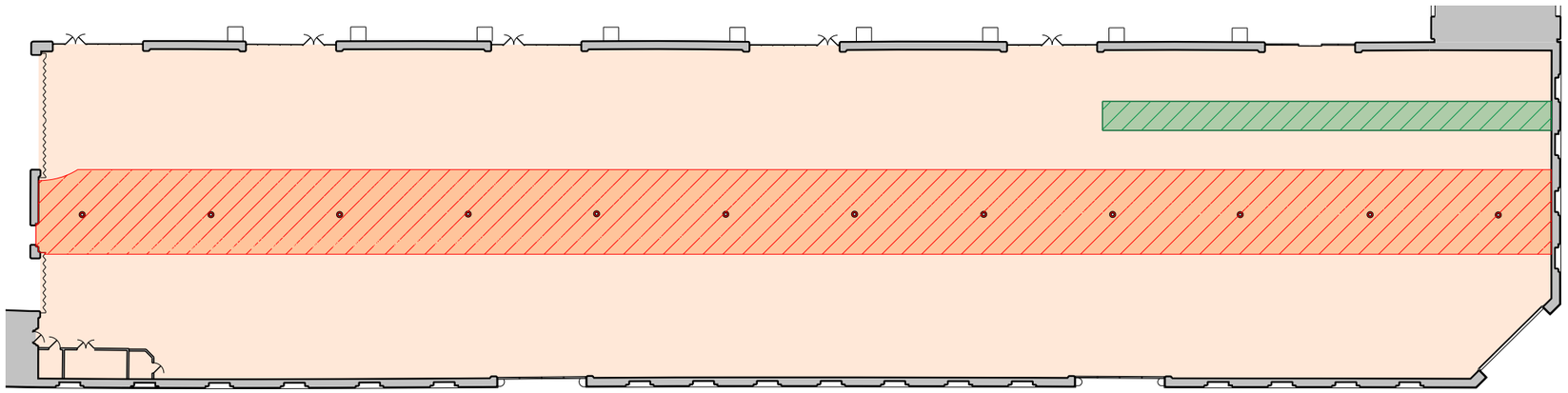
From shipping shed to Power Hall
Manchester City Council purchased the entire station site for £30,000 when it became disused as a goods yard. In 1979, the Power Hall underwent a rapid series of structural repairs to enable it to open to the public for a celebration of the 150th anniversary of the Liverpool Road Station in 1980. In the early 1980s, further alterations and extensions were carried out to convert the building into an exhibition space. When it opened to the public in September 1983 the former Shipping Shed was officially renamed the ‘Power Hall’.

The works carried out in the 1980s enabled the exhibition of a collection of steam, gas and electric engines as well as locomotives. Many of the machines were in working condition and tell stories of industry in Greater Manchester. A raised platform, which incorporated the existing loading stage, was built. The platform provided an ideal level for visitors to experience the exhibits at eye level. It was also during this period that the brick enclosure to house the beam engine was built.

The two-storey extension to the north east corner of the Power Hall was also added in the 1980s with the intention of housing visitor welcome facilities and orientation.

Refer to the accompanying Heritage Impact Assessment by Donald Insall Associates for further details of the Power Hall's history.

Historic Platform and Modern Alterations



Plan indicating historic platform configuration

A Central Platform
Historic photos of the Power Hall show the central platform running along the spine of the building, which was used by the workers who unloaded and loaded goods between trains and vehicles. The plan to the left shows the approximate extent of the platform before it was mostly dismantled as part of the 1980s works.

Most of the historic platform was unfortunately removed as part of the 1980s renovation works to convert the goods depot into the Power Hall exhibition space as it is today.



The Power Hall in 1978 prior to restoration
(Liverpool Road Station Society)



Unloading tobacco shipments in the Power Hall, 1934
(Science Museum LMR Collection)

Key

- Former extent of original loading platform
- Former extent of additional platform added in the early 20th century
- Ground level



View looking West along the modern platform of the Power Hall

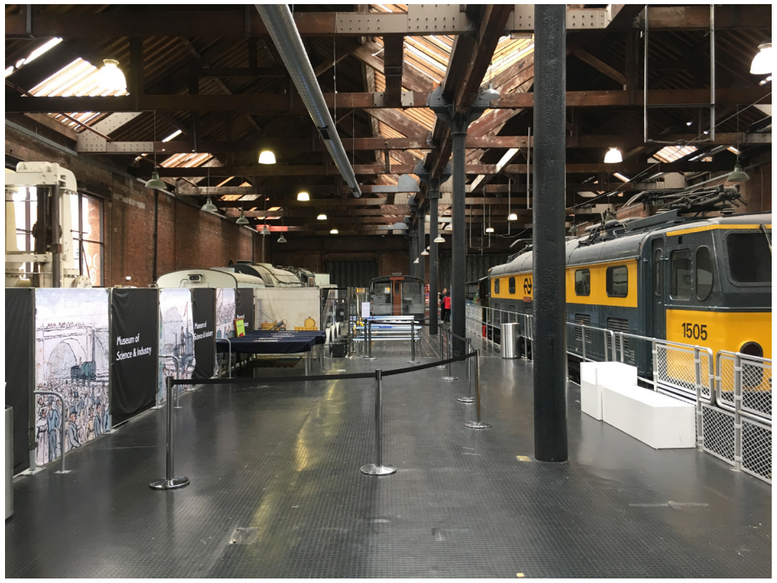


View under the 1980s platform showing concealed building services

1980s Platform

The modern areas of the existing platform consist of blockwork walls supporting a platform constructed from timber joists with a manufactured timber panel deck, which is finished with a rubberised floor finish. There are a number of services concealed in the void below the modern platform, which it has not been possible to survey due to limited access.

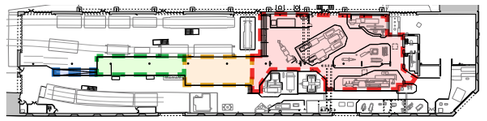
Adjacent to the area of entirely modern platform there is a portion of existing platform with historic decking boards that have been overlaid with the same rubberised floor finish to match the modern platform adjacent (orange area in the below diagram). Further investigations may be required prior to the Package 4 application to determine whether this area has modern or historic structure below the decking. An initial non-intrusive survey has indicated that there is modern brickwork beneath the historic platform (shown in green below).



View looking West along the modern platform of the Power Hall



Typical detail view under the 1980s platform



Plan showing existing platform areas

Key

- Modern platform area
- Historic timber decking with modern finishes over
- Historic platform
- Historic timber decking over modern structure



The Power Hall in 1979
(Science Museum Group Collection)



The Power Hall in 1978
(MMU Visual Resources Centre)

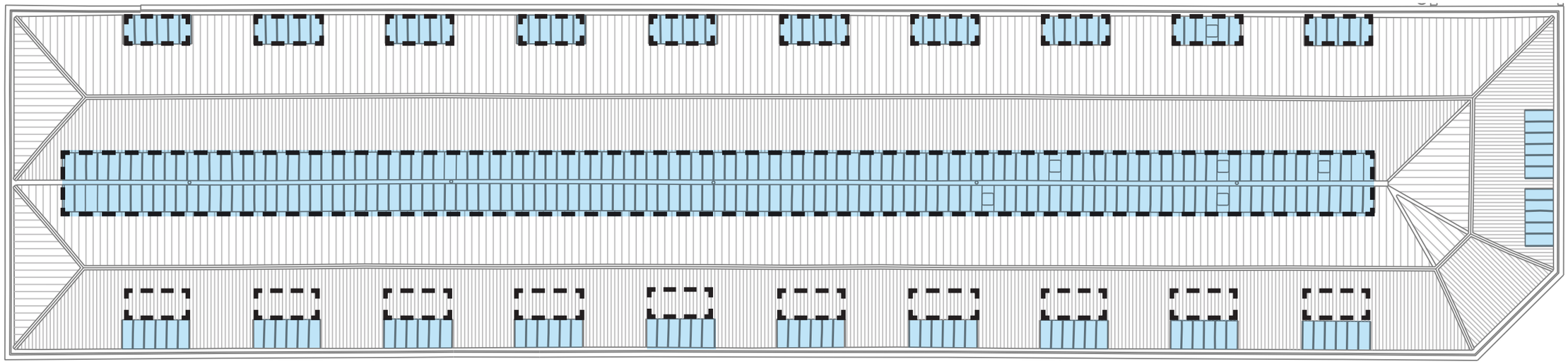


The Power Hall in 1978
(Science Museum LMR Collection)

Historic Roof

The historic images above show the appearance of the double pitched roof as seen from below. It was originally uninsulated and the underside of the roof slates and the battens were left exposed internally. The Power Hall is well daylit via rooflights that run almost continuously down the central valley and intermittently on the perimeter slopes.

It was originally a low technology industrial building with limited services with intermittent hanging pendant lights, probably introduced in the early 20th Century.



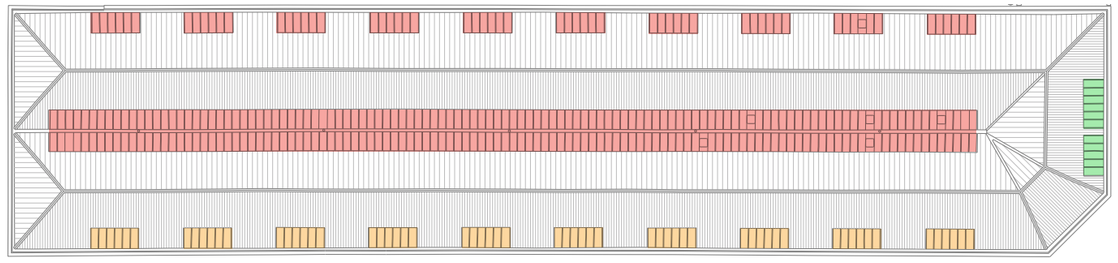
Existing roofplan with rooflight locations indicated

Rooflight locations
The locations indicated in green on the plan above show the positions of the original rooflights, which have been determined from the historic images and plans.

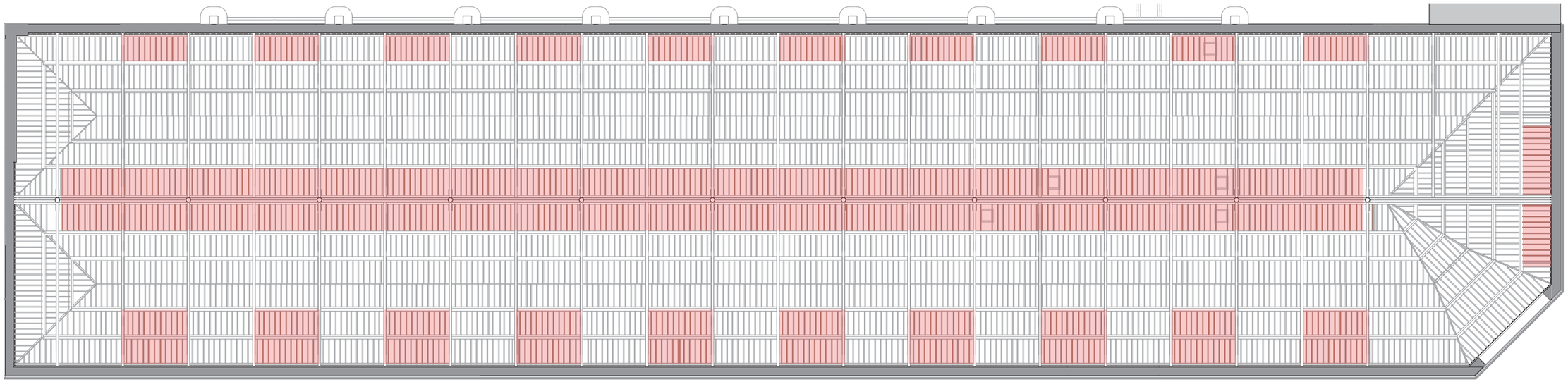
The orange areas show the current positions of the modern rooflights as they are today. The rooflights were reinstalled as part of the 1979 roof works at which point some of the positions were altered and new rooflights were introduced to the eastern slope.

Key

- Historic rooflight locations
- Current rooflight positions
- Moderate historic significance
- Moderate/low historic significance
- Neutral historic significance



Historic rooflight significance



Existing reflected ceiling plan with modern rafter locations indicated

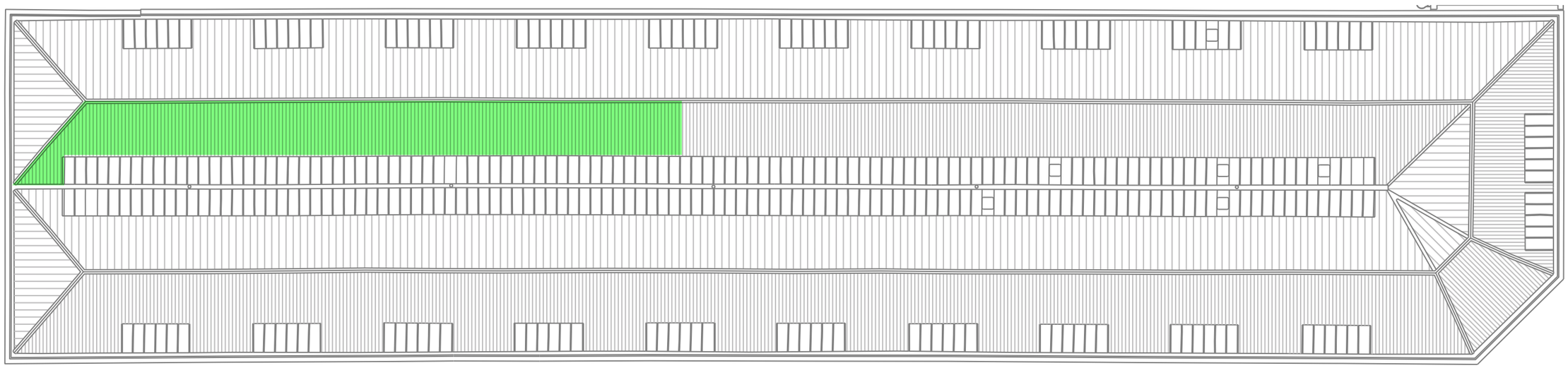
Location of modern rafters
The above drawing shows the areas where modern timber rafters have been installed. Historically there were no rafters directly below the rooflights, as can be seen from the historic images. These rafters were installed in the 1980s as part of the modern refurbishment works, the current rooflights are supported by these rafters. These modern rafters were not installed at the same centres as the historic rafters and visually therefore they are misaligned.



View showing modern rafters below rooflights and historic rafters above

Key

Modern rafters



Roof slates
The roof is finished with Welsh stone slates. Generally these are 12x24" slates, but there is one area laid in diminishing courses, as noted on the drawing above. It is assumed that these are likely to have been the original slates, reinstalled here when the roof was re-slated in 1979.

The other slated areas appear to have been sourced to match the finish of the historic slates from reclaimed sources.

The interface between the coursed slates and the standard slates is a weak point in the roof construction, as the slates can not be appropriately lapped at this point.



View along valley showing assumed historic slates on the left hand side

Key

Area of assumed historic slates



Roof gutter condition



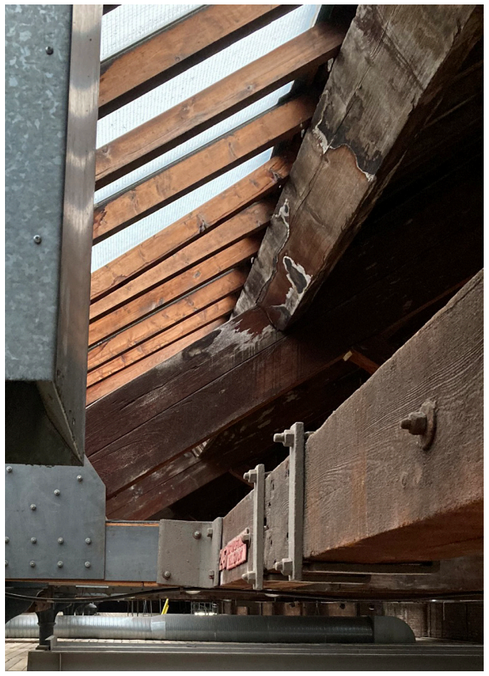
Roof gutter condition



Effloresence on exterior south facade

Roof Condition

- The existing roof is in poor condition and requires extensive refurbishment work. There are multiple areas of water ingress which will threaten the integrity of the timber structure if not addressed. The structure is understood to be in moderately good condition, with only local repairs required. Removal of the slate tile roof finish has been consented under 130614/FO/2021 and 130615/LO/2021 to allow the top side of the timbers to be inspected prior to the roof repairs applied for under Application 3a are undertaken.
- As identified within the application for Package 3a, some repairs to the truss ends are necessary. The Package 3a application proposes that splits in timbers will be addressed and repair and strengthening works are also proposed in order to stabilise the existing timber structure.
- The rooflights are attributed to leaks within the Power Hall, which is damaging both the brickwork and timbers. Replacement of these rooflights and minor modifications to the roof detailing are therefore required to protect the building structure and historic fabric.



Water damage to timber roof structure



Water damage to timber roof structure



Rotting timber where trusses meet masonry

Drainage System

- The building has a continuous perimeter gutter behind the brick parapet and a central valley gutter between the two roof pitches. Both of these gutters are of modern construction; lead lined at the perimeter, and aluminium lined to the valley on plywood/softwood supports. Both gutters were installed as part of the 1979 works.
- The original building was designed to utilise the central line of columns as internal rainwater down pipes to convey water from the central valley gutter. At the perimeter the rainwater pipes are located internally, against the perimeter wall.
- A CCTV survey has been undertaken to determine the capacity limitations of this system to allow new gutters and drainage design to be implemented.

Walls

- Due to the water ingress issues, both interior and exterior masonry walls are damaged and require localised repair with replacement and/or re-pointing required in areas. Please refer to the structural appraisal prepared by Conisbee and included with this application for more details.





The images of the existing Power Hall show the existing services as currently installed. Due to the nature of the building all services are exposed and therefore are highly visible within the space.

The building has evolved from a low technology industrial building to one that has a more complex use which comes with greater performance and servicing requirements as a space for exhibiting historic collections.

3 Design Proposals

3.1 Overview and Package 2 Works

3.2 Roof Proposals

3.3 Windows and Doors

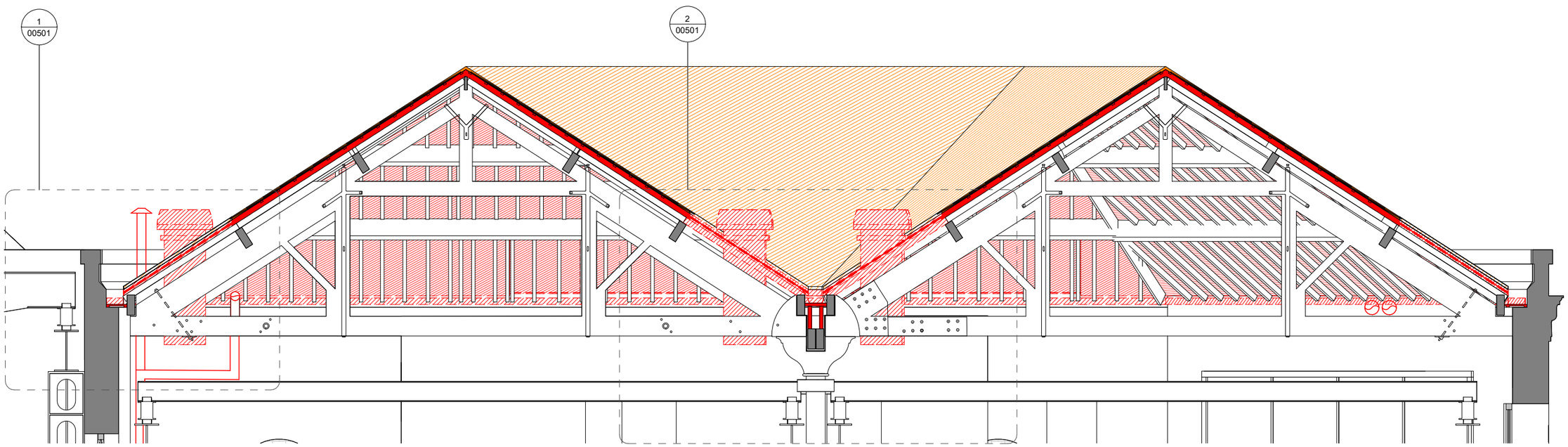
3.4 1980s Platform Strip Out

3.5 Fabric Repairs

3.1 Overview and Package 2 Works

3.1.1 Package 2 Works

3.1.2 Package 3 Overview of Proposals



Demolition drawing from Package 2 Application

Package 2 Demolition
The above section summarises elements which will be demolished or carefully removed and retained for re-use, as part of the consented Package 2 works. Planning application reference: 130614/FO/2021 and Listed Building Consent reference 130615/LO/2021.

- Existing roof slates are to be carefully removed and stored for re-installation over the new roof
- The existing build up of battens and counter battens over insulation backed plasterboard is to be removed
- The existing gutters are to be removed
- High levels services including the gas pipework and steam ducts are to be removed.
- All historic roof structure, including the rafters, trusses, purlins and beams, are to be retained.

The package 3 application is proposed as the next step following these works and the drawings reflect the stripped roof as the existing condition.

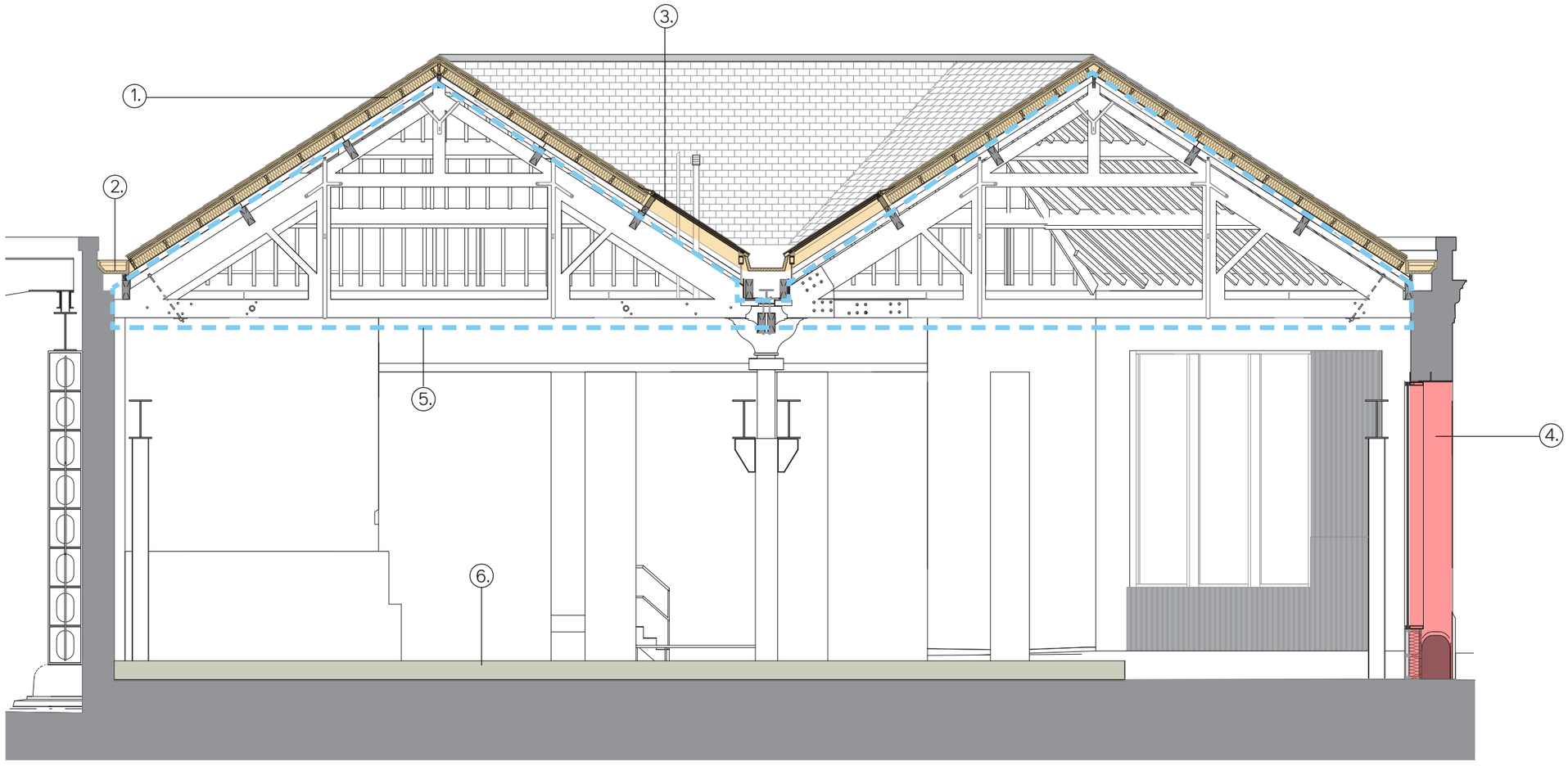


View along roof pitch showing historic roof structure

Key

Demolition

Stripped out and retained for re-use



Package 3 Works
The package 3 application covers the following proposed works:

1. A new roof build up, which increases the thermal performance of the roof, re-using the existing slates where feasible
2. New gutters will be installed to the perimeter and the valley
3. New double glazed rooflights will be installed with new supporting structure. The extent of the rooflights is proposed to be reduced
4. New double glazed windows and doors to replace the existing modern elements installed as part of the 1980s renovation works. New entrance doors to the North facade
5. Removal of existing high-level services and installation of new services including lightning protection, low energy lighting, fire alarm and containment for small power
6. Removal of the existing 1980s platform.

Key

- New roof and gutters
- New windows and doors
- Removal of existing and installation of new high level services
- Demolition of 1980s platform

3.2 Roof Proposals

3.2.1 Existing retained structure

3.2.2 Roof structure repairs

3.2.3 New roof build up

3.2.4 Rooflights

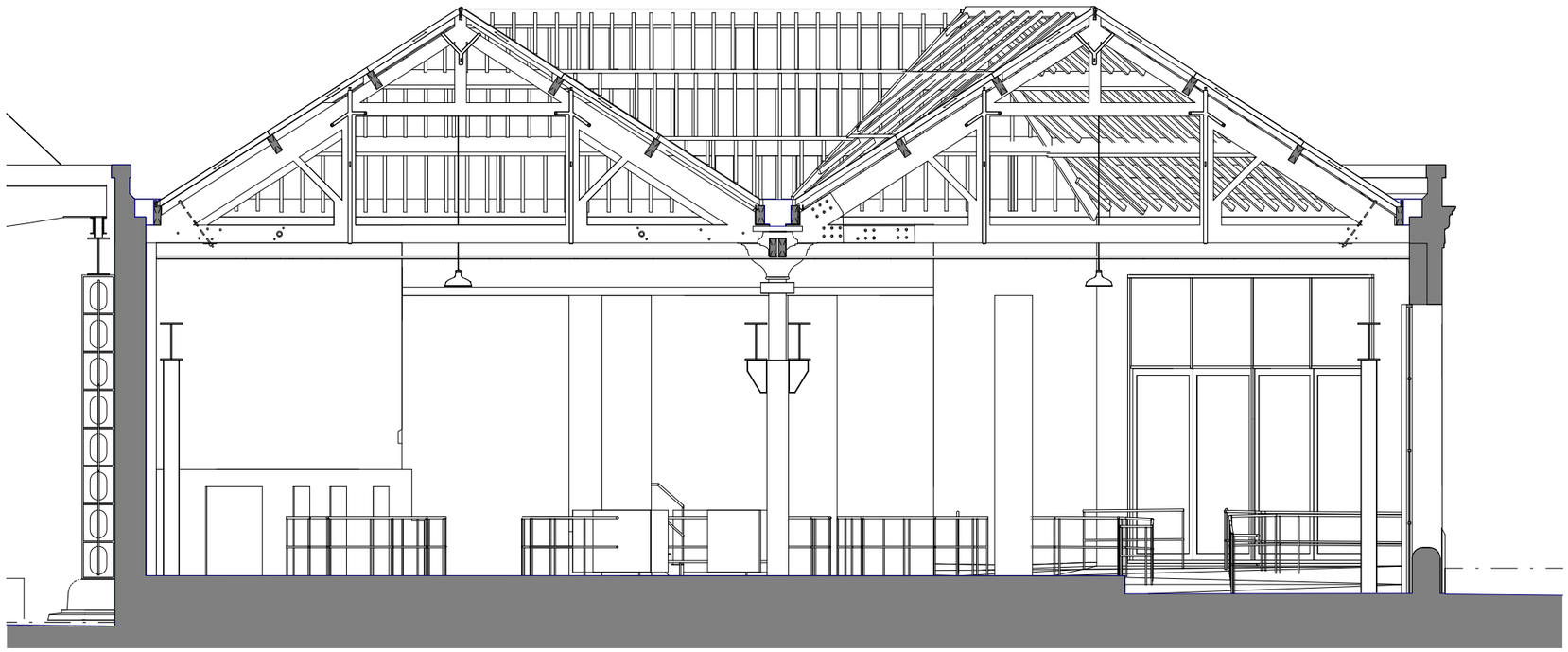
3.2.5 Slate Roof

3.2.6 New gutter proposals

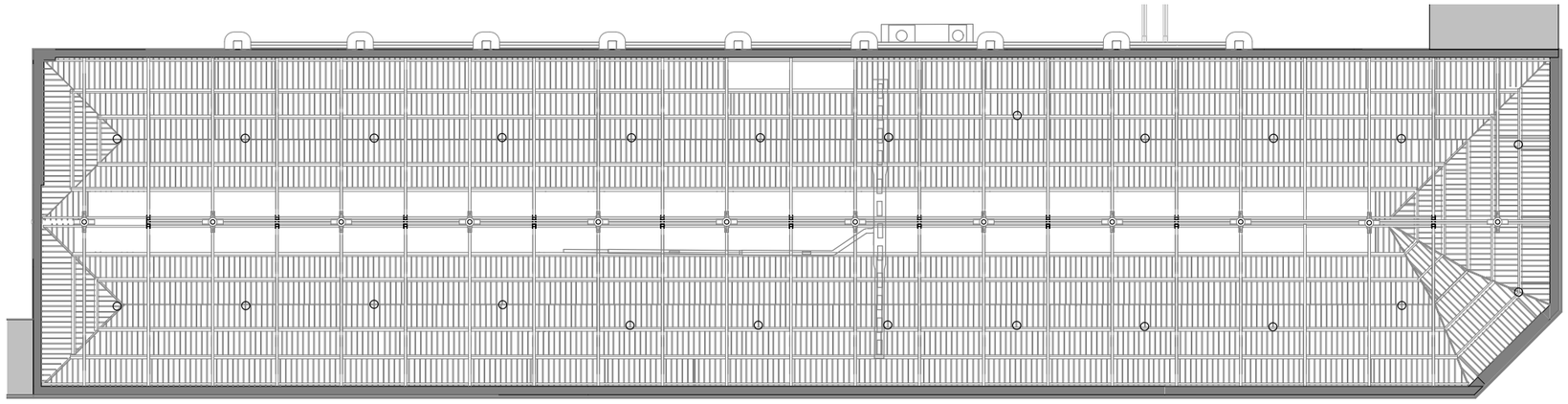
3.2.7 Roof maintenance access

3.2.8 Lighting and high-level services

3.2.9 Vents through roof



Existing section following consented roof strip out

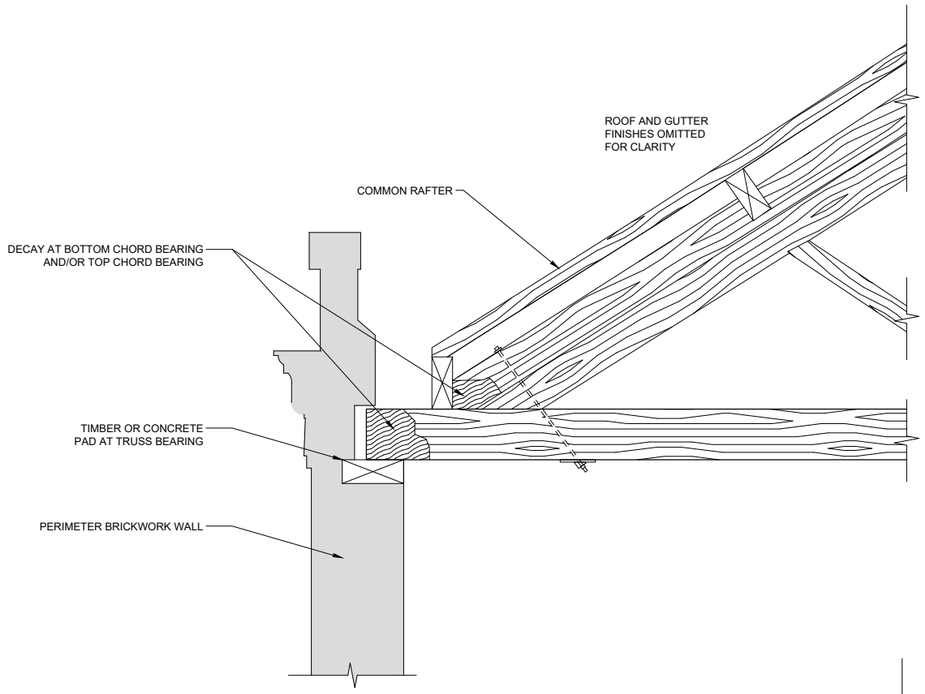


Existing RCP following consented roof strip out

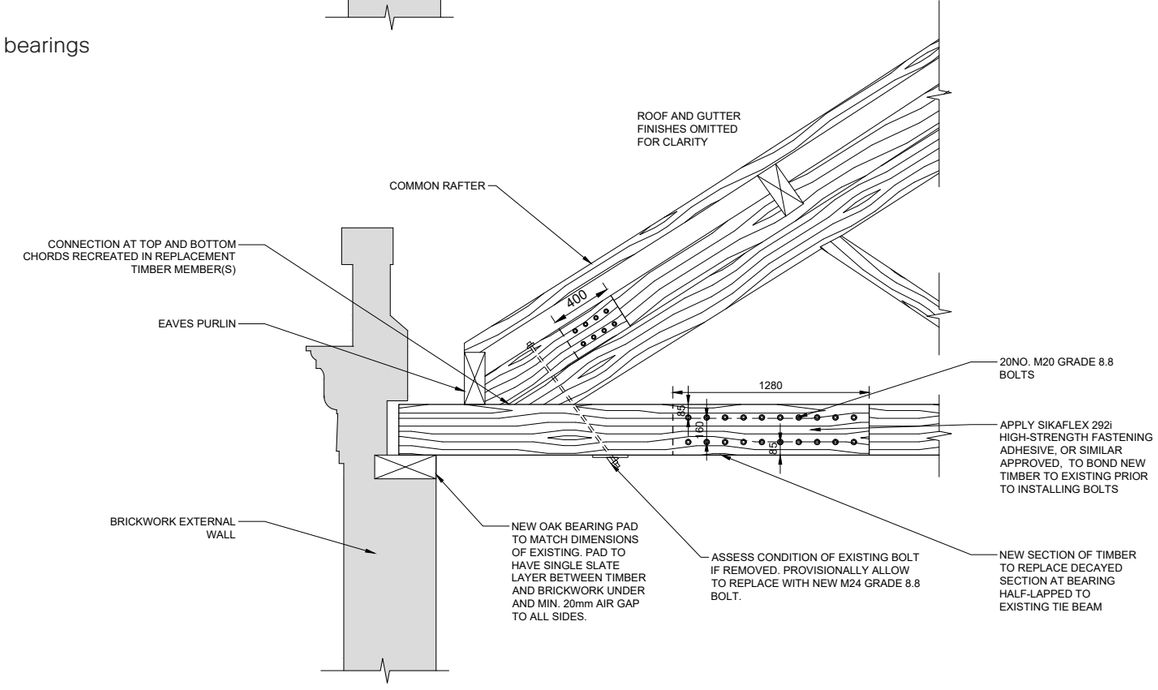
Retained Structure Following Package 2 Works
The package 3 application is a continuation of the previous Power Hall applications, which have been separated to allow for specific elements to be streamlined to meet the government's Public Sector Decarbonisation scheme grant administered by Salix.
The existing drawings on this page indicate the retained fabric following the package 2 roof strip out. All of the existing historic roof structure is retained as shown.



View along roof pitch showing historic roof structure



Typical timber decay at truss bearings



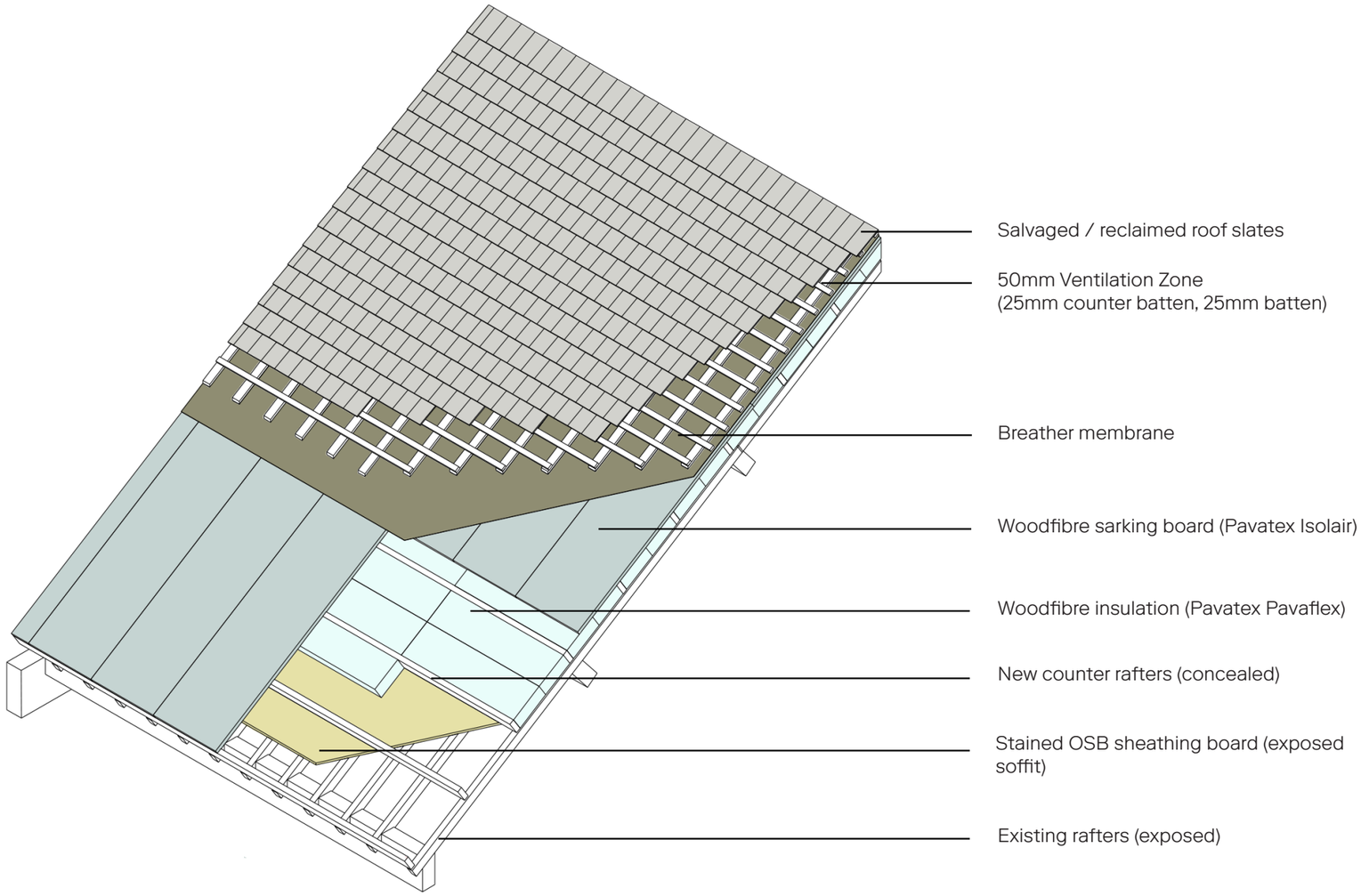
Proposed splice repairs at truss bearings

Structural timber repairs - Package 3a
A listed building application for the proposed repairs to the timber roof structure has been submitted as Package 3a to allow the procurement of some of the timber and steel required for these works to be advanced.

The approach to the proposed repairs to the timber roof structure avoids unnecessary physical intervention, entails minimally invasive repairs to avoid the loss of original fabric, adopts reversible repairs to avoid damaging the original fabric, uses like-for-like materials where appropriate to ensure compatibility, and results in historically distinct but structurally and aesthetically sympathetic repairs that will avoid confusing the historical record.

Refer to the Package 3a application (currently being determined) for further details

New Roof Build Up





Soffit finish - OSMO Wood Wax Finish in 3118 (Granite Grey)

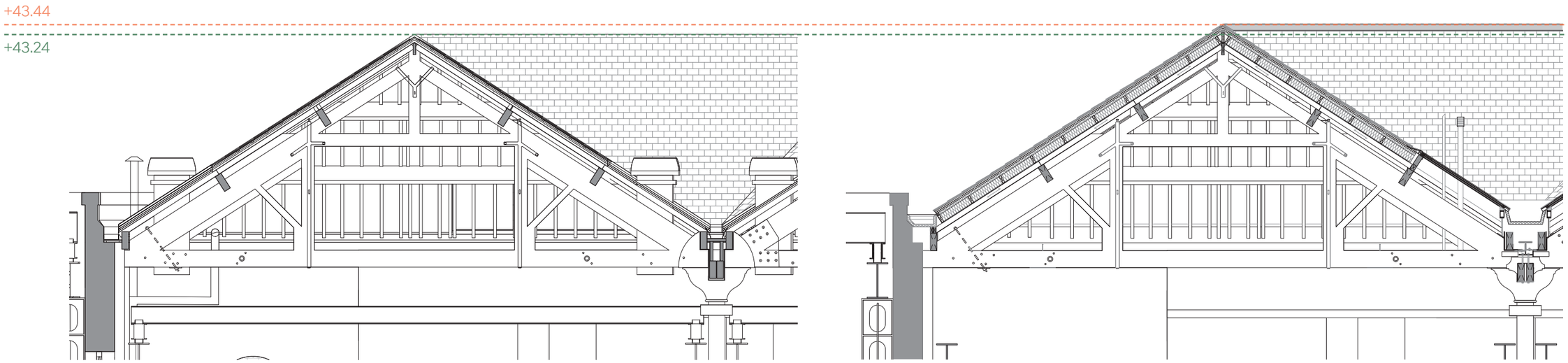
Roof Build Up

The existing roof build up (removal consented as part of planning application 30614/FO/2021 and Listed Building application reference 130615/LO/2021) was installed as part of the 1979 works and includes an 40mm insulation backed, paper faced plasterboard soffit finish which is visible internally. A new roof build up is proposed to improve the thermal performance of the building envelope.

The proposed roof build up balances the need to improve thermal performance (in relation to the government's public sector decarbonisation scheme funding grant) against the heritage status of the building. This improved performance forms part of an overall energy strategy for the building that sets a target U-value of 0.2W/m^{2}K for the roof element, which is lower than current Building Regulation requirements (that are not applicable due to listed building status). Please see Max Fordham's report submitted as part of this application for more details.

To achieve this U-value the roof will require thicker insulation than what was installed in 1979. Due to the historic significance of the roof structure, which has always been expressed internally within the building, the proposed approach is to insulate above the rafters (rather than between them) so that the roof structure remains fully expressed. Woodfibre insulation is proposed, in line with Historic England guidance, which recommends wood-fibre insulation as the most appropriate solution for insulating roofs in older buildings.

Above the existing rafters, a sheathing board is required, this is proposed as a dark stained OSB board, which acts as the structural deck to support the roof insulation and as a vapour control layer , which will also provide the necessary air tightness required for the new roof build up. A series of samples were installed on site to test different colour tones for the stained finish. The proposed colour (Osmo Wood Wax Finish in Granite Grey 3118) was selected as a dark finish was considered the most appropriate; providing a dark background to view the historic roof structure against and one which is most similar to the colour of slate (the original background).The dark stain helps to dematerialise the surface finish of the OSB such that its texture is not visible from ground level. This was discussed on site with officers from the Local Planning Authority on 14.07.21 and it was agreed that this colour was the preferred approach.



Existing roof section prior to the Package 2 roofstrip application (reference 130614/FO/2021 & 130615/LO/2021)

Proposed roof section

Ridge Height
The impact of insulating the roof above the rafters (rather than between) is a marginal increase in the ridge height of the building.

During pre-application discussions with officers from the Local Planning Authority it was considered that raising the ridge height marginally was preferable to installing insulation between or over the rafters, as this would conceal the historic roof structure from within the building.

The diagrams above show that the proposed increase to the ridge height equates to a 200mm increase (less than 2% of the overall average building height), which, given the scale of the building overall, is considered to be imperceptible.

Key

------ Level of historic roof ridge

------ Level of new roof ridge



Photo from 16th September 1978, showing the relationship of the central roolfights to the historic platform (Liverpool Road Station Society)



Photo from 7th September 1980, showing the relationship of the central roolfights to the historic platform (Liverpool Road Station Society)

Proposed rooflights extent

Whilst the rooflights formed part of the original design of the roof, bringing daylight into the working goods shed and therefore contributing to the aesthetic of the building interior, they are not original building fabric as they were replaced in the 1979 roof works (in similar locations to the original rooflights). The rooflights are at the end of their life and as noted earlier they have contributed to some of the water ingress issues that has resulted in damage to the structure and they therefore need to be replaced.

Within the overall brief to improve the thermal performance of the building envelope, as well as ensuring fully watertight construction, there is also a need to reduce the solar gains associated with the rooflights (to reduce overheating of the space below) and to reduce the level of UV (which is harmful to the historic collection below).

As identified in the supporting report prepared by Max Fordham the risk of overheating to the Power Hall can be be mitigated through a number of measures, which collectively provide a passive, compliant solution. These are:

- Providing effective cross ventilation, which will reduce the effect of overheating (when external temperatures are below internal temperatures i.e. night time cross ventilation)

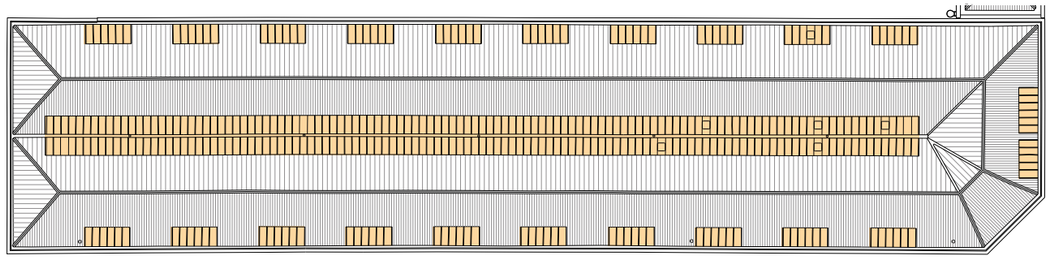
- Installing glazed elements with a G-value of 0.4 or less (to reduce the transmission of heat into the Power Hall)

- Reducing the area of glazing, particularly the rooflight area (which is the most significant contributor to overheating due to solar gains in the existing configuration). Replacing the rooflights with solid construction would also have the added benefit of reducing heat loss in winter.

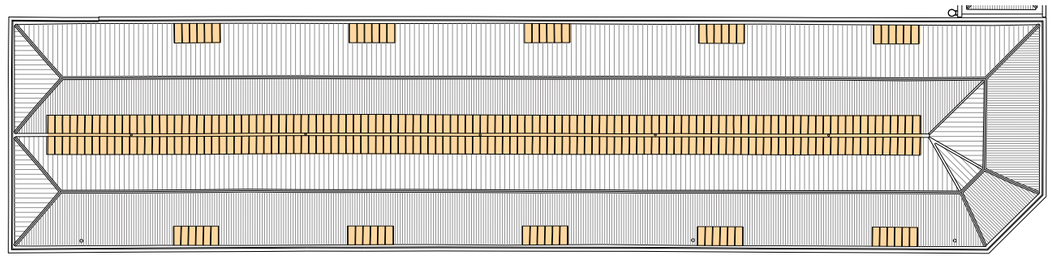
- Introducing external blinds; introducing internal blinds would not mitigate the heat gain (as they would not stop the penetration of solar radiation through the thermal envelope and in fact they would absorb the heat and then transmit it into the space) external blinds or solar shading could be designed to reduce the overheating caused by solar gain.

On balance introducing external blinds/ solar shading was not deemed to be a viable solution as they would have an adverse effect on the visual appearance of the roof, from both inside and out and they would add cost and significantly increase the maintenance liability for the Museum. Therefore preferred approach is the reduction of rooflight area, coupled with introducing cross ventilation and reducing the solar heat gain (g-value) of the glass to 0.4.

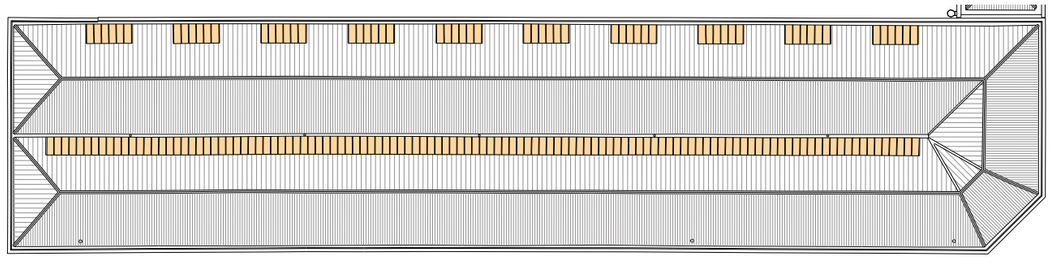
A number of options for the reduction of rooflight area have been explored as illustrated on the following page.



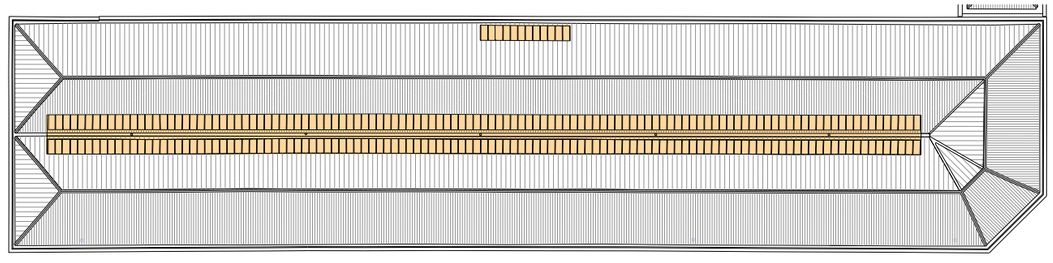
Existing roof plan



Option 1 - reduced extent of perimeter rooflights



Option 2 - Removal of south facing rooflights



Option 3 - reduction in perimeter rooflights, with removal of south facing perimeter rooflights

Key

Proposed rooflights

Proposed rooflights

Option 1. Reducing the extent of rooflights by fifty percent to the perimeter of the roof (removing the non-original locations of rooflights on the east facing section of the roof completely), maintaining the central spine of rooflights on either side of the valley, to concentrate daylight onto the historic central platform.

Appraisal: reduction in area of south-facing rooflight insufficient to reduce the impact of solar gain, requiring an increase in ventilation to mitigate the resulting overheating. The increase to the ventilation required to mitigate the overheating would result in a potential security risk, as the design relies on night time cooling and therefore openable rooflights would be required to achieve a more secure solution. The impact of openable rooflights represents significant maintenance and pest control challenges due to general weathering of actuator devices and the risk of birds getting in to the building . Introducing openable elements would change the aesthetic appearance of the rooflights, away from a patent glazing system, which references the historic condition. This solution is also not affordable, as the additional ventilation would impact the budget for the delivery of the Package 4 works.
Even with the potential for increased ventilation through the rooflights, the space would be uncomfortably hot due to the direct solar radiation entering through the rooflights. Therefore this option has been disregarded.

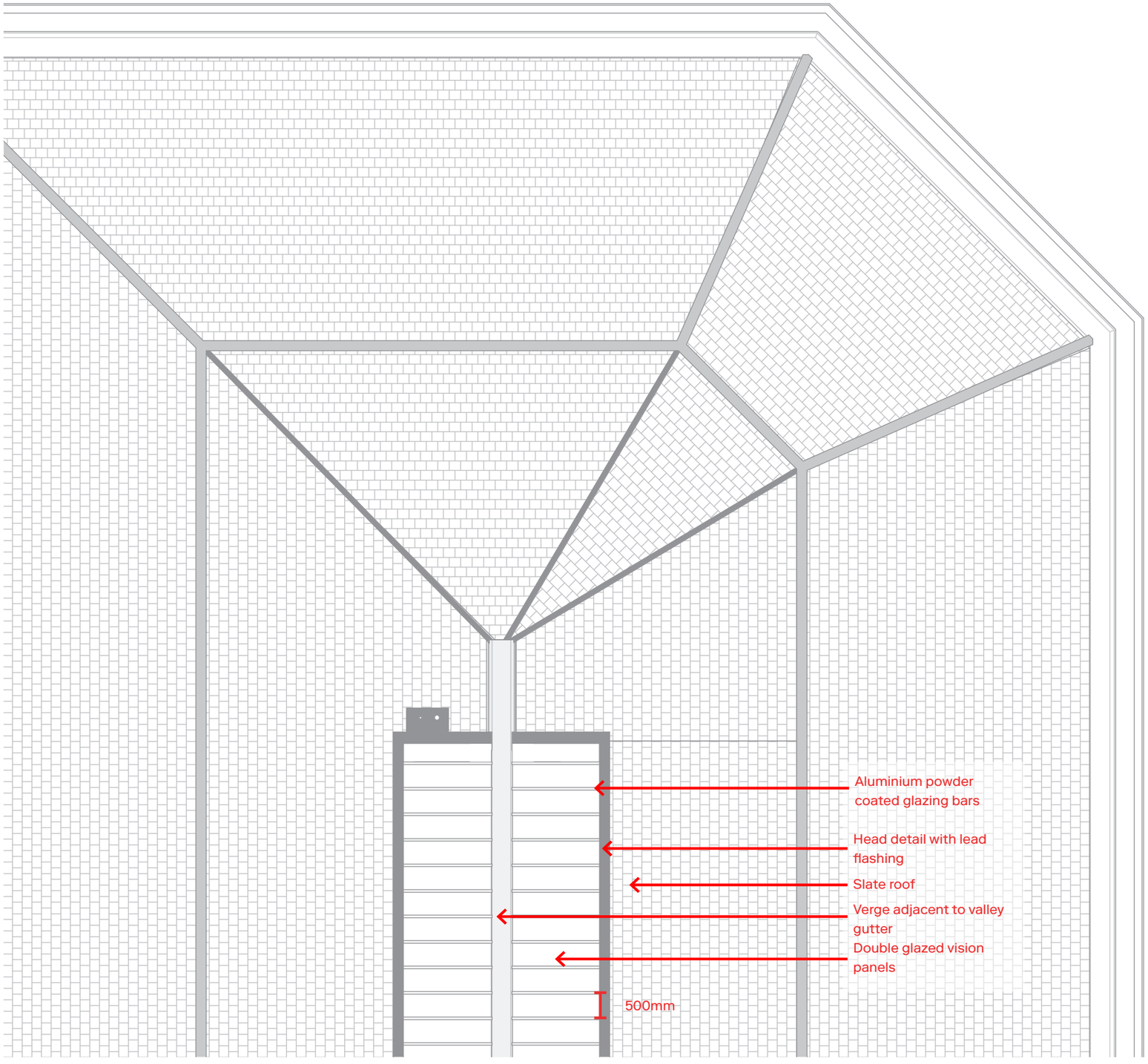
Option 2. Removing all the south facing rooflights (as these contribute most significantly to the solar gains and subsequent overheating) and the non-original east facing rooflights, maintaining only the north facing rooflights.

Appraisal: whilst removal of the south facing rooflights reduces the impact of the direct solar radiation entering through the rooflights it would still require additional cross ventilation to be provided via openable rooflights, which brings the same issues as noted in relation to Option 1. In addition, the resulting impact on the space would be significant as the central platform would no longer be evenly lit. This option has been disregarded on the basis that it doesn't achieve the ambition to eliminate the risk of overheating and the historically symmetrical space would become too unbalanced, which would not be acceptable in heritage terms.

Option 3. Retention of the full extent of the central spine of rooflights, on either side of the central valley, removing the south and (non-original) east facing perimeter rooflights with a single large rooflight on the north roof pitch.

Appraisal: this is the preferred option as it reduces the extent of south facing rooflights and their associated solar gains, whilst bringing emphasis to the original central loading platform and the location of the new visitor entrance to the building. With this option the extent of ventilation required to mitigate solar gains is manageable within the security requirements associated with night time cooling through the existing window and door apertures. The reduction in the extent of rooflights to the perimeter also brings significant maintenance benefits; as the perimeter of the Power Hall needs to be maintained by a mobile access platform and it is not possible to create a trafficable perimeter walkway. Reducing the extent of south facing rooflights also brings conservation benefits for the Museum collection, as it reduces the amount of UV light that is harmful to the paintwork of the Historic collection.

The selective retention of the rooflights along the central valley and over the new entrance would draw upon the original concept of the rooflight, using it architecturally in a new way for daylight and visitor orientation, dramatically illuminating the original central platform and entrance.



Detail of the proposed roof plan

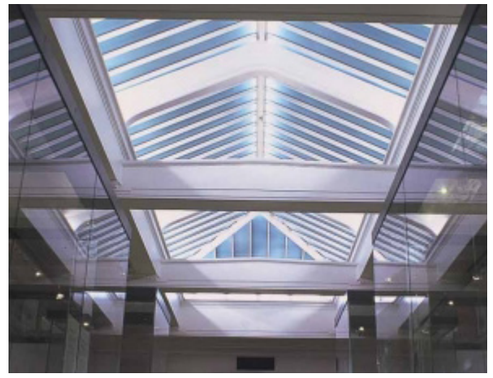
Rooflight type and layout
The proposed rooflights will be a thermally broken patent glazing system, similar to the historic roof glazing, with dark grey powder coated aluminium glazing bars.

The modern rafters added below the existing rooflights are being removed as part of the roof strip application (ref. 130614/FO/2021 and 130615/LO/2021)

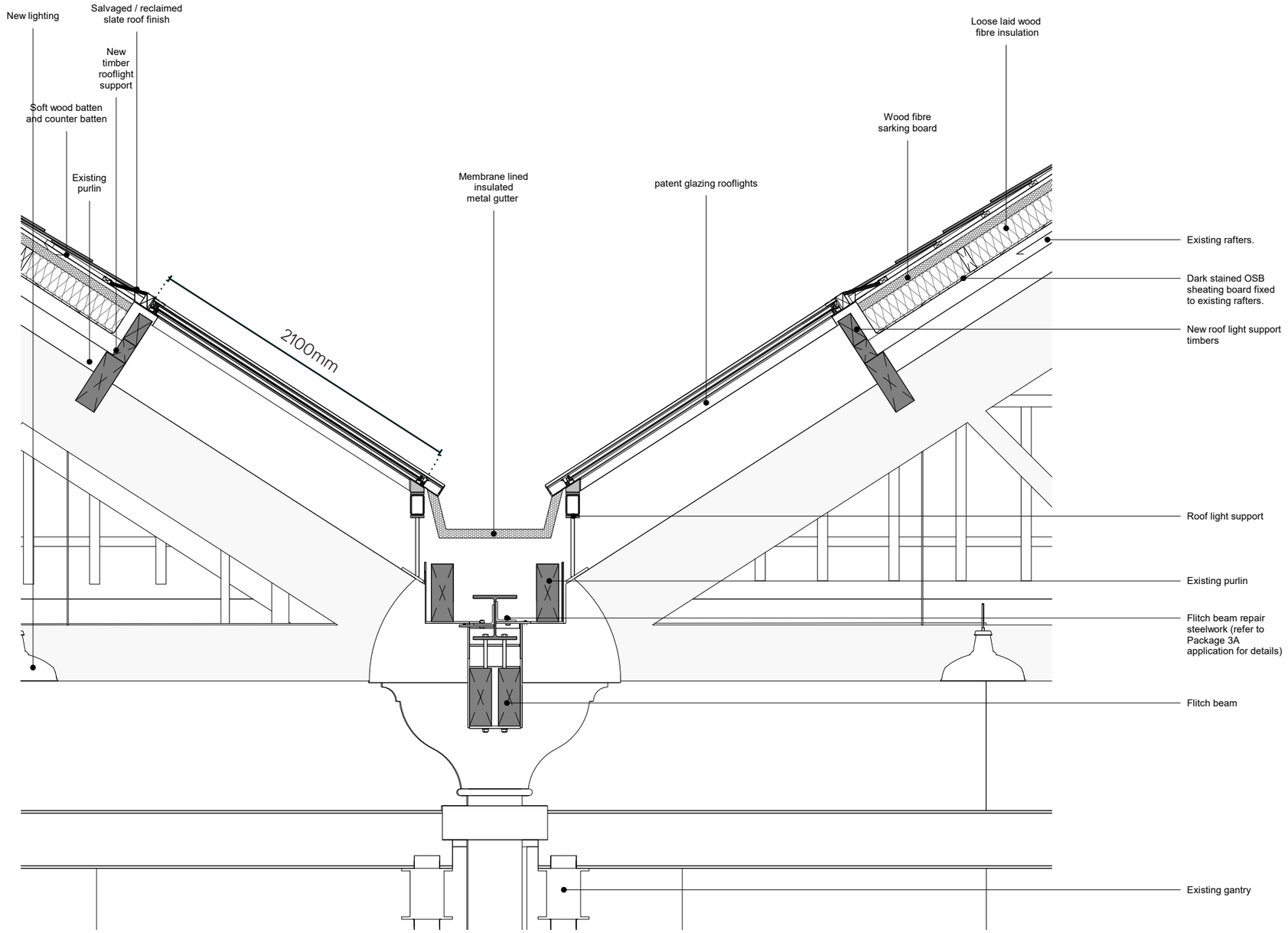
Whilst the existing rooflights have glazing bars at circa 1100mm centres, the new glazing bars will be spaced at 500mm centres to closely match the spacing of the historic rooflights. This spacing has been determined from historic images, see below.



1970's image of the Power Hall roof structure (Science Museum Group Collection)



Patent glazing at the V&A museum, London



Detailed section through proposed valley condition

Rooflight structure

The new rooflights are proposed to closely match the dimensions of the existing rooflights, taking support from the existing roof purlins. However, due to the increased depth of the roof build up, the details to fix the rooflights to the existing structure have been carefully designed to minimise the visual impact on the appearance of the existing structure.

New internal structure is required at the head of the rooflights; new timber sections will transfer the load down onto the existing timber purlins that span between the timber trusses.

Along the bottom cill of the rooflights a new steel beam is proposed, fixed to the top chord of the trusses via local support posts. This new steelwork also provides support to the valley gutter, which is effectively hung from the new steelwork. Both the steelwork and the underside of the gutter are proposed to have a dark painted finish, where the new steelwork has been designed to visually read as part of the rooflight system, with a similar scale and proportion as the glazing bars.



Clear glazing

Vanceva “Artic snow” (not proposed - considered to be too opaque)

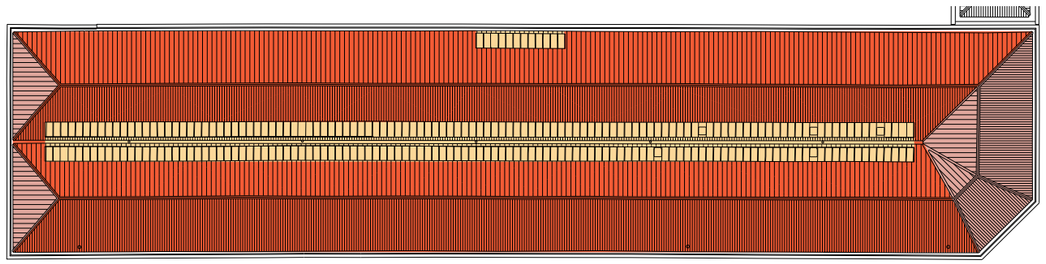
Vanceva “Cool white” (proposed)

Rooflight performance
The proposed rooflights are double glazed units achieving an increased thermal and structural performance from the existing single glazed, Georgian wired glass panels.

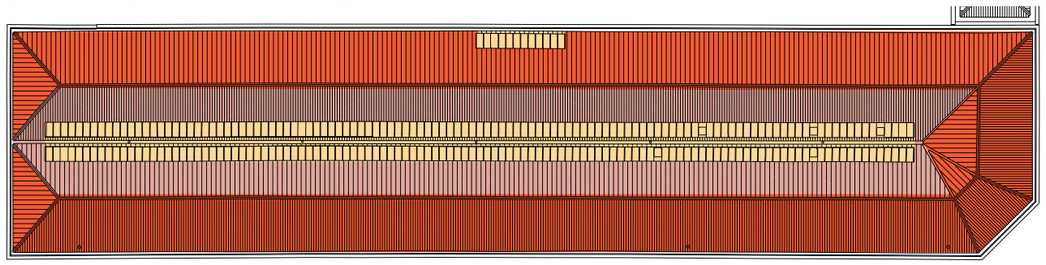
The proposed glazing specification uses reduced iron glass, which means it has a more neutral colour. The inner pane is proposed to be laminated glass to reduce UV radiation onto the museum collection below. The interlayer within this pane is proposed with a translucent white finish (Vanceva “cool white”). This 'milky' finish to the glass as shown in the adjacent photograph will ensure that any surface dirt that washes over the glass from the area of slate roofing above the rooflights will be less visible.

The glazing is required to achieve a CWCT Class 2 TN92 non-fragility rating for health and safety reasons, which is met through the laminated inner pane and toughened glass outer pane. Overall the rooflights will have a g-value of 0.4, to limit solar energy transmittance into the building in line with the need to reduce the solar heat gains associated with the overheating, as noted in the report prepared by Max Fordham that supports this application.

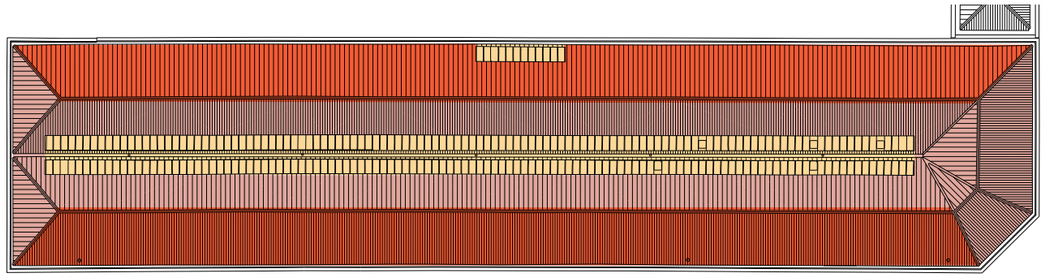
Rooflight details
The external detailing around the new rooflights (head and verge) will be traditional lead flashings, dressed onto the glass in line with the presumed historic details. Along the bottom edge of the rooflight the double glazed unit will have a stepped profile to reflect a traditional single glazed patent glazing rooflight detail.



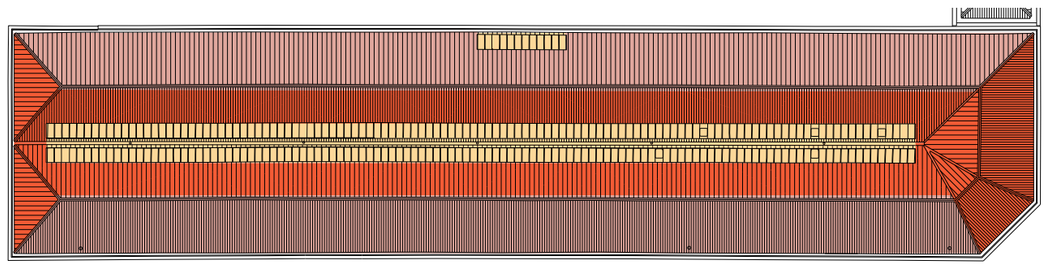
Proposed roof plan - 10% slate salvage



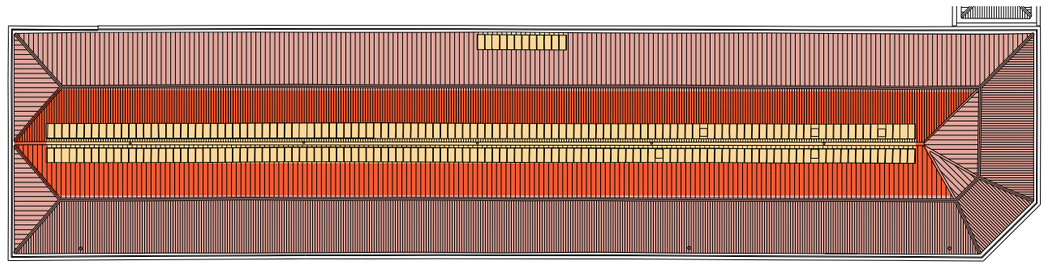
Proposed roof plan - 30% slate salvage



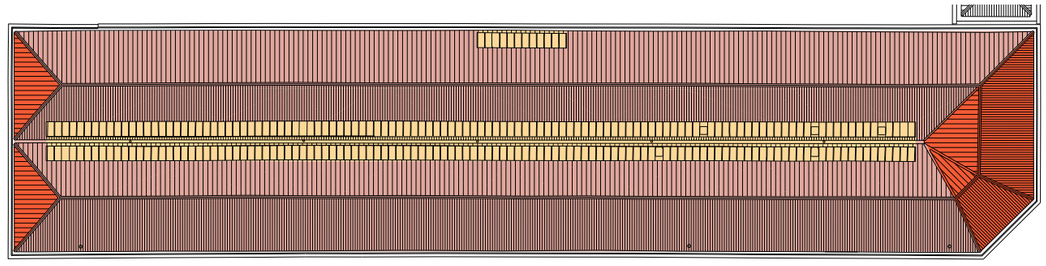
Proposed roof plan - 40% slate salvage



Proposed roof plan - 60% slate salvage



Proposed roof plan - 70% slate salvage



Proposed roof plan - 90% slate salvage

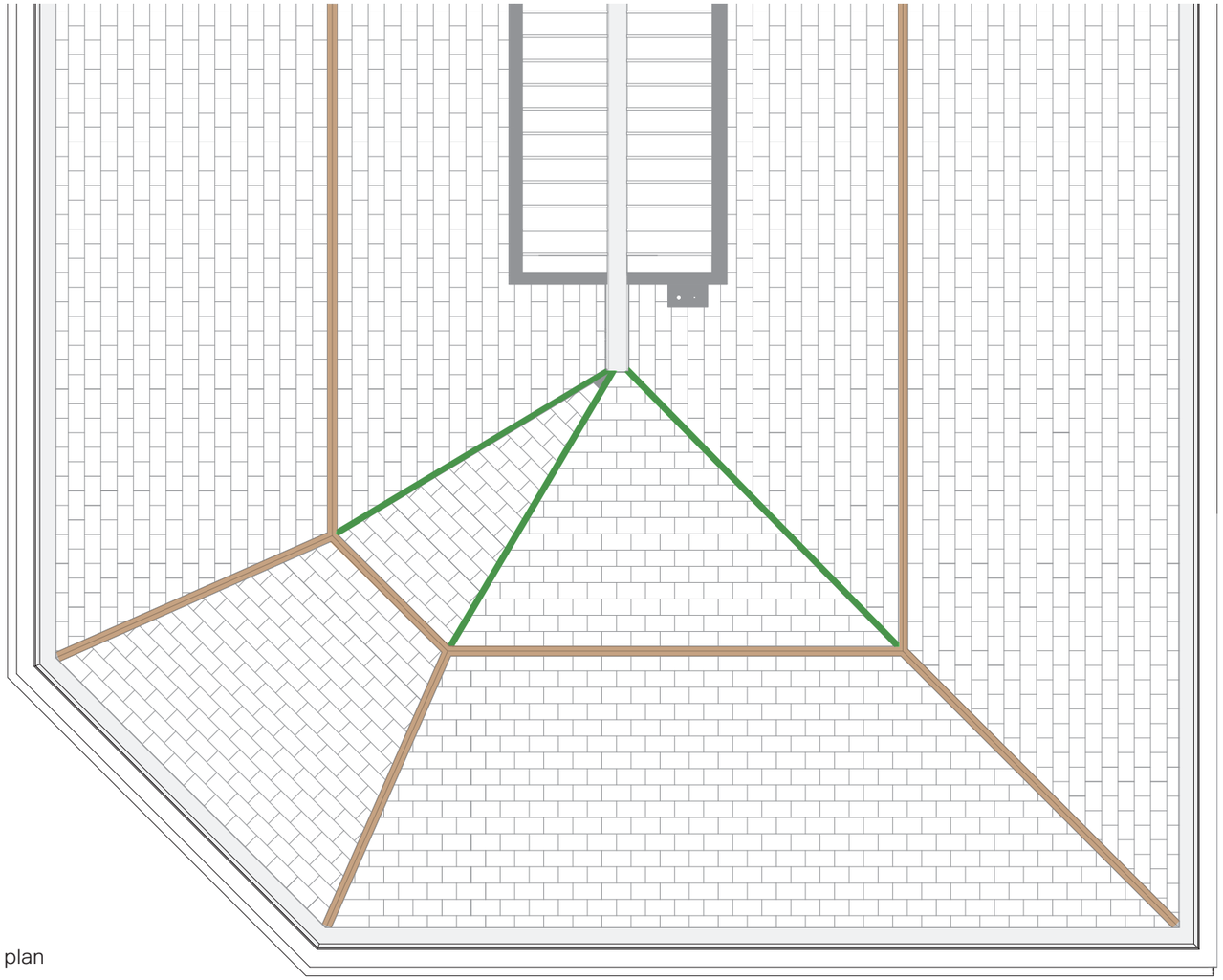
Roof slates
The existing roof slates will be carefully removed from the roof during the strip out in order to retain as many as possible for re-use.
As it is not possible to know at this point what percentage of slates will be salvageable, the above plans propose various layouts of retained slates depending on the level of salvage achieved.

The additional slates required to complete the roof finish will be from a reclaimed source to closely match the size, colour and texture of the existing slates. However, given the current variety in slate colours across the roof there will be some variation therefore the proposed approach is to locate slates with variations on different planes of the roof, where possible, so that these minor variations are imperceptible.

Key

Reclaimed slates

Salvaged slates



Detail of proposed roof plan

Ridge tiles
New Staffordshire blue clay plain angle ridge tiles are proposed to match the existing ridges, to form the ridge and the external hip junctions. All ridge and hipped tile junctions will be wet bedded with a suitable grade of mortar.

Valleys to roof hips
Due to the geometry of the existing roof, with an intersecting hip and chamfered corner to the east end of the building, there are three valleys running between the various roof intersections which are proposed to be lined in lead. Lead would have been used historically to resolve this awkward roof geometry and it remains the most practical solution for the roof today.

The slates will be carefully cut and mortar bedded to form a 125mm wide valley, which will be lined with Code 5 lead.



Proposed saffordshire blue clay ridge / hip tiles



Existing lead valley gulleys at the roof hips



Existing roof ridge tiles

Key

Existing lead valleys at the roof hips - proposed as plan

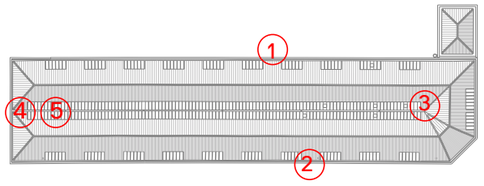
Existing roof ridge tiles - proposed as plan

Existing gutter condition and performance criteria

The client brief for the roof refurbishment works is to deliver watertight construction that protects the fabric of the listed building, with improved detailing that meets current regulations and best practice guidance and responds to anticipated climate change needs with regards to rainfall. Given the reasons for the closure of the Power Hall in 2018, due to the failure of the roof coverings and drainage system, it is crucial to ensure the new system is watertight.

The gutters in the central valley were replaced (as part of the 1980's refurbishment works) with aluminium box gutters, with lead flashings. The outer parapet was replaced as a lead-lined flat bed gutter with lead flashings. Since then, they have been patch repaired in multiple locations using felt and bitumen.

The key design requirements for the gutters are as set out in BS EN 12056-3:2000 (Gravity drainage systems inside buildings. Roof drainage, layout and calculation). This standard ensures that gutter capacity considers rainfall intensity (which takes into account the geographical location of the building and is estimated using local statistical rainfall data), the use of the building and its intended lifespan. The location and size of the existing rainwater pipes are also key parameters for the design. As the Power Hall is a Grade II listed building the design team's recommendation is to use conservative figures, based on a 500 year return period (i.e. a 500 year "storm" event) with a 20% margin applied to consider the anticipated impact of climate change throughout this period.





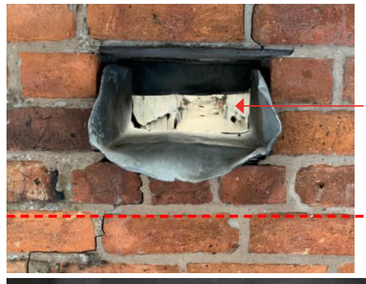
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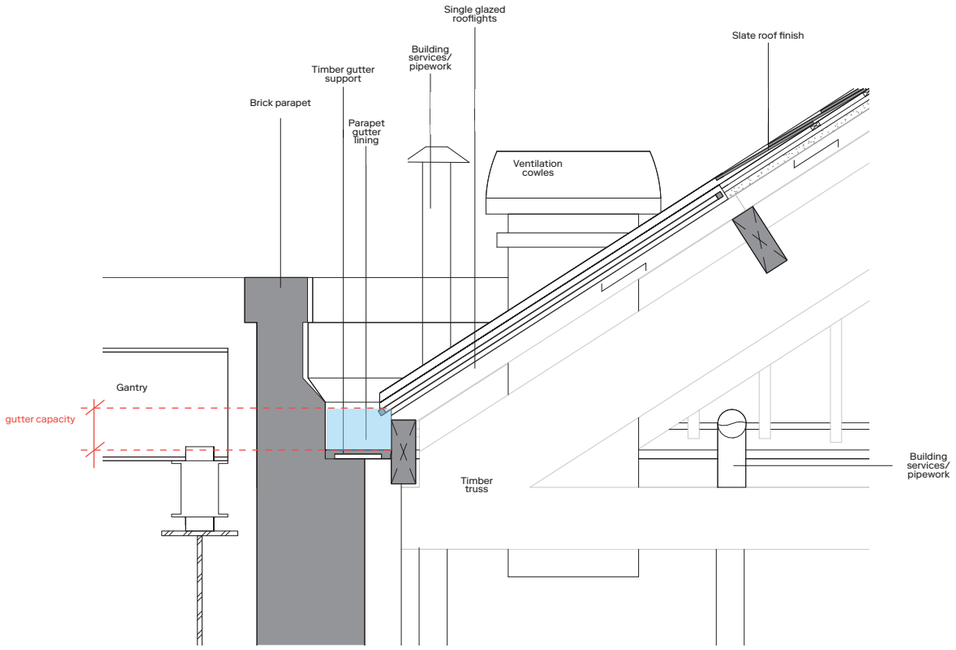


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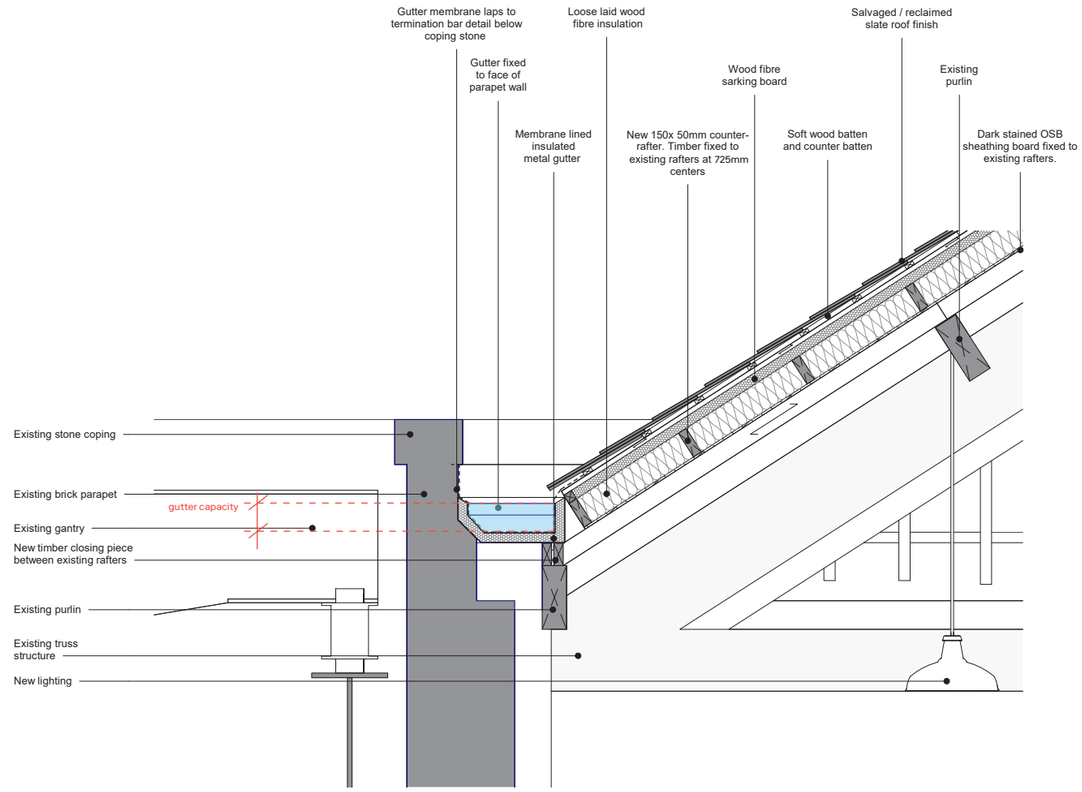
Option	1a: Lead gutters	1b: Lead gutters with T-Pren Joints	2: Membrane lined gutters	3: Membrane lined gutter with lead flashings
Advantages	**Heritage:** Lead is likely the material used for the guttering when the building was originally built **Longevity:** Robustly detailed gutters with drips can be expected to last 60-100 years **Craftsmanship:** Specialist skills would be required for the installation due to the traditional construction techniques.	**Heritage:** Lead is likely the material used for the guttering when the building was originally built **Capacity:** Due to requirements for drip details and falls along the gutter length, it is not possible to achieve the required capacity in the central valley without changing to a more visually intrusive flitch beam support strategy	**Capacity:** Due to the engineering and flush jointing system of a membrane lined gutter, a required increased capacity can be achieved. **Longevity:** Membrane lined gutters have a 40+ year lifespan and come with a 25 year guarantee. Improved detailing can be achieved, compared with the existing condition, which is critical for protection of the structure in perpetuity **Cost:** Reduced cost allows increased budget towards elements of the project with direct public benefit.	**Heritage:** Lead is likely the material used for the guttering when the building was originally built **Longevity:** Membrane lined gutters have a 40+ year lifespan and come with a 25 year guarantee, to ensure protection to the historic structure for many years to come.
Disadvantages	**Capacity:** Due to requirements for drip details and falls along the gutter length, it is not possible to achieve the required capacity in the central valley without changing the flitch beam support strategy **Buildability:** Due to the required shape of the parapet gutter to allow for the required drips, it would be very difficult to form the lead work at the deepest points, creating additional cost and programme risk. **Cost:** An increased cost will impact the budget which can be allocated to elements of the project which give direct public benefit. **Hot works:** Required as part of the construction of lead work details, this adds risk to historic timber structure	**Longevity:** T-Pren joints have a 10 year warranty, and are therefore not recommended by Lead Authority and RIBA due to their lack of longevity. They would also be required at least every 3m, Meaning 125+ joints will be prone to leakage in the future. This could result in further damage to the heritage fabric. **Cost:** An increased cost will impact the budget which can be allocated to elements of the project which give direct public benefit. **Hot works:** Required as part of the construction of lead work details, this adds risk to historic timber structure **Craftsmanship:** No specialist skills would be required for the installation due to the modern construction techniques.	**Heritage:** The use of modern materials does not match the would not match the original (though since replaced) finishes, however a similar slate grey colour can be specified, and the difference would not be visible except when on the roof.	**Cost:** An increased cost will impact the budget which can be allocated to elements of the project which give direct public benefit. **Capacity:** Using lead flashings reduces the gutter capacity compared to an integral membrane solution.
Conclusion	Lead valley gutter not feasible; insufficient depth achievable Lead parapet gutter not feasible; gutter proportions required to accommodate capacity requirements within existing building constraints are not buildable.	The number of joints are a significant risk. This option is not feasible due to the maintenance and cost liabilities and as it is not a tried and tested solution on a roof of this size.	Using modern materials is the preferred approach as it provides the most robust, cost effective and buildable approach.	Lead flashings are not feasible as they reduce the effective capacity of the gutters

Summary of options appraisal
The table to the left summarises the options considered for the Power Hall valley and parapet gutters, please see the appendix for the full gutter design development process.

Using a modern gutter system will provide a robust, buildable, maintainable and cost effective solution that will protect the historic building structure for years to come.



Existing parapet gutter detail (prior to consented roof strip)



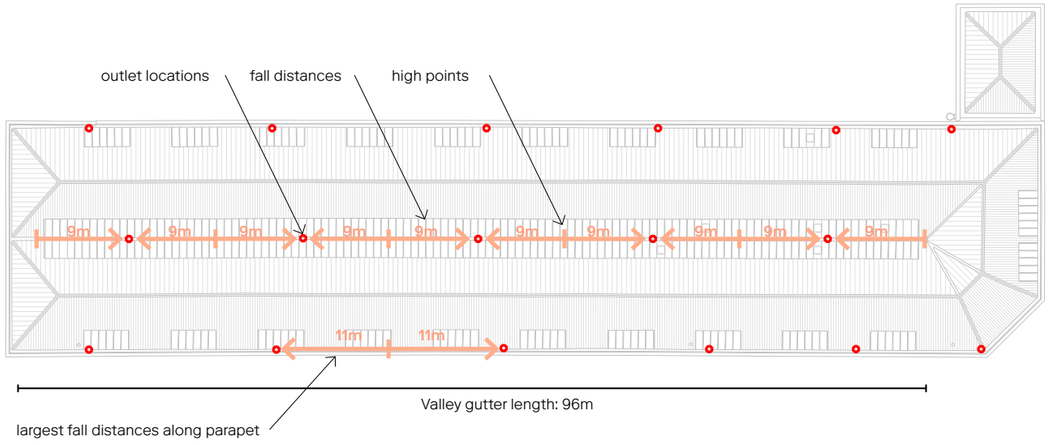
Proposed parapet gutter detail

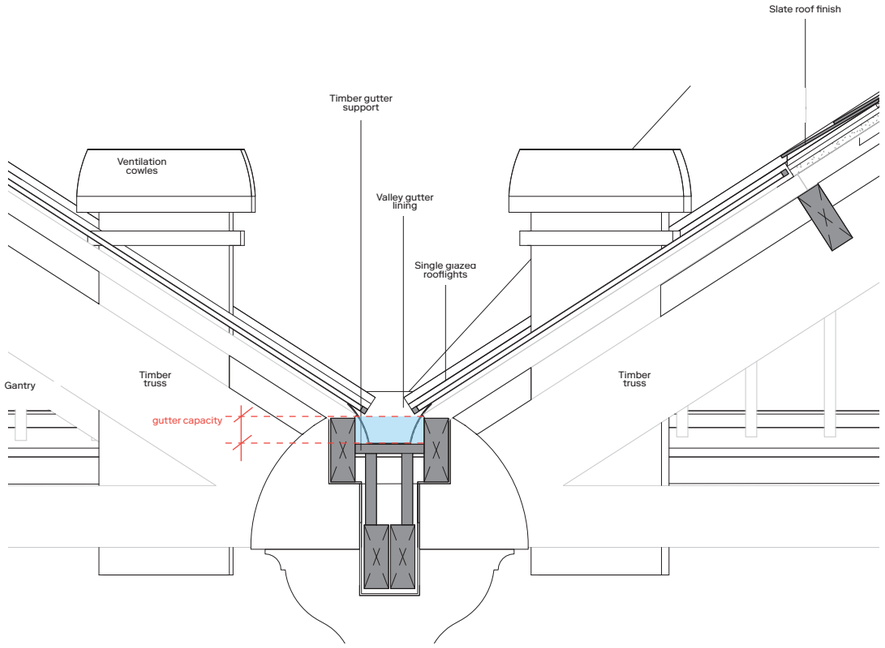
Parapet Gutter

The parapet gutter, shown above, runs along the perimeter of the building with a total length of approximately 267m.

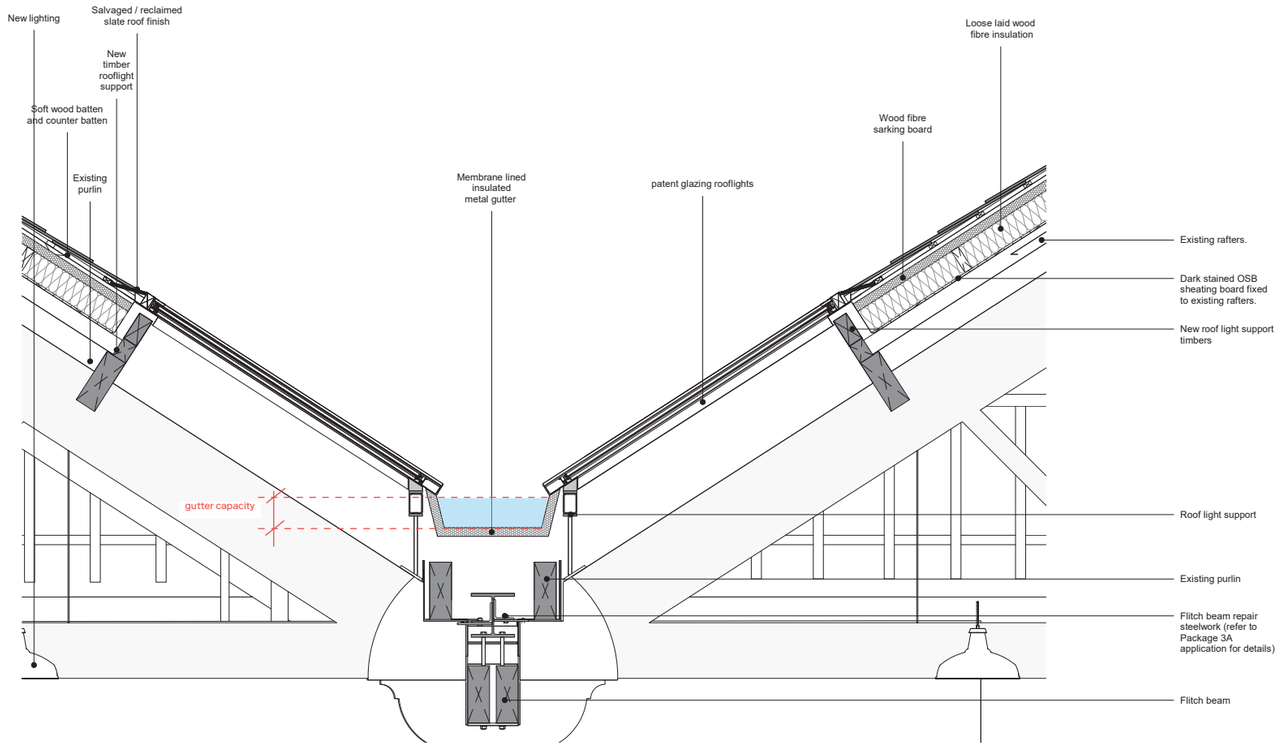
The existing lead lining is inserted between the brick parapet wall and a timber beam to the inside. The existing gutter capacity at the perimeter is not sufficient to meet current guidance. The increase in the roof build up depth allows the new gutter bed to raised up and a greater capacity to be achieved. This also allows for a wider, flatter gutter which will be easier to clean and maintain.

The insulated box gutter construction increases the thermal performance and reduces condensation risk. The modern gutter construction can be installed flat, which is of great benefit for the Power Hall roof which has 22m between rain water down pipes in some instances. Although not highly visible, the pvc membrane lining will have a lead grey colour finish to tie in with the dark grey tones of the roof.





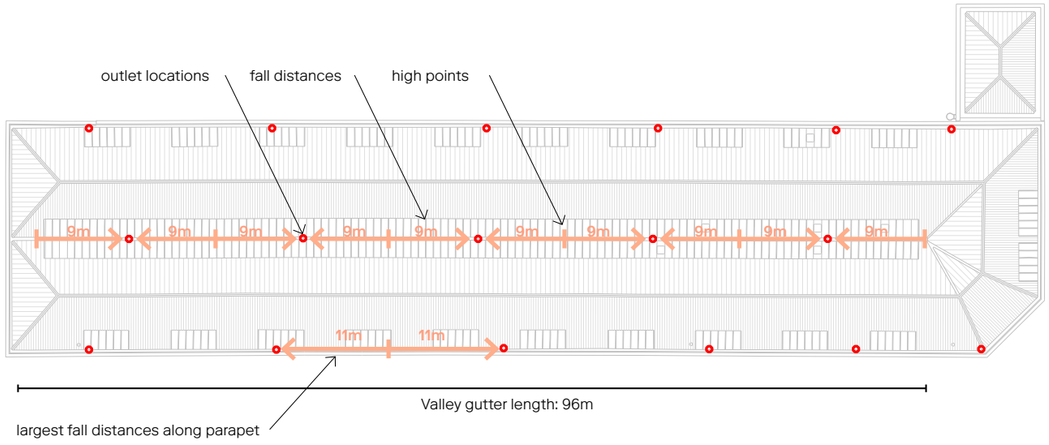
Existing valley gutter detail, prior to consented roof strip

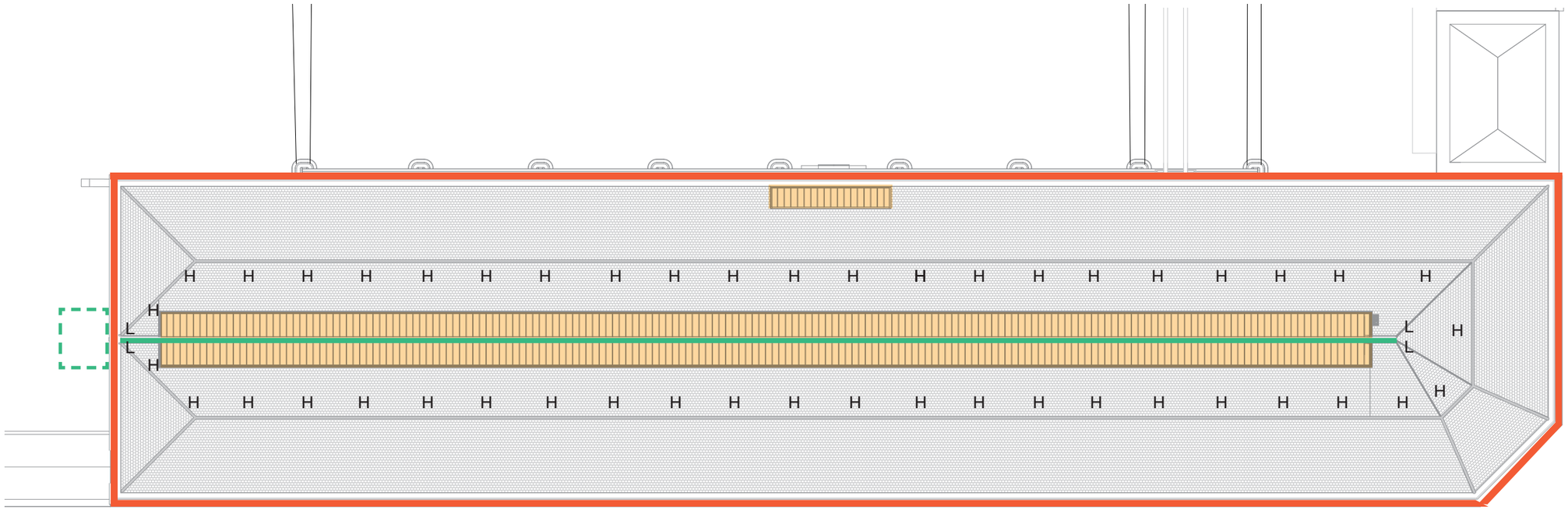


Proposed valley gutter detail

Valley Gutter
The existing aluminium lined valley gutter (with lead flashings), shown above, runs along the central spine of the building, with a total length of 96m. The gutter drains through the existing cast iron columns, with outlets at approximately 18m centres.

The proposed insulated membrane lined box gutter sits above the new flitch beam and the existing historic timber beams. The gutter is laid flat and utilises the existing outlets through the cast iron columns, therefore creating very limited visual change when seen from below. Internally the metal gutter will have a dark coating. The pvc membrane lining externally will have a lead colour finish to tie in with the dark grey tones of the roof.





Roof maintenance Option 1

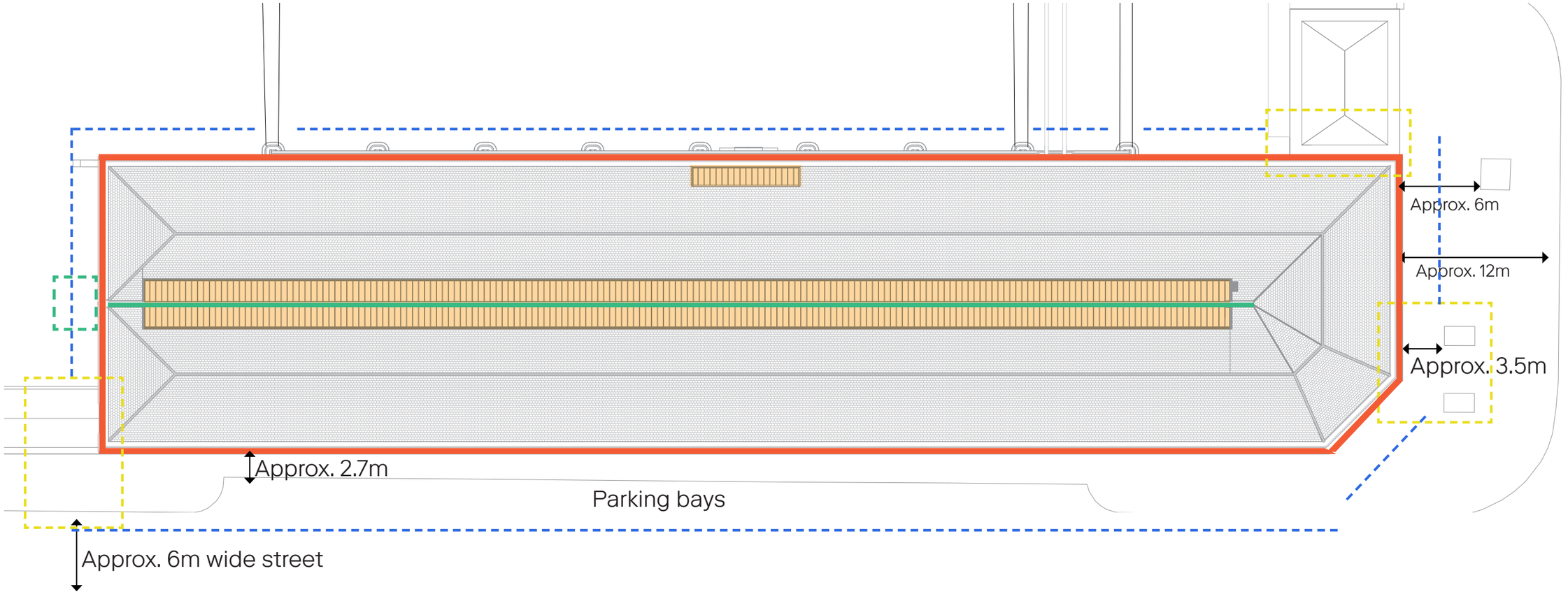
Access requirements
The roof access strategy is critical to ensuring long-term maintenance to the new roof works can be achieved, in order to protect the roof structure below. The proposed strategy has been considered from a site-wide perspective, where the museum's ambition is to ultimately unify the approach to access as far as possible, whilst respecting the heritage and individual attributes of each building respectively.

Some elements of the proposals for the Power Hall will require regular inspection and maintenance i.e. the new rooflights, gutters and roof penetrations. Whilst regular visual inspections can be carried out via drone, physical access will be required to undertake cleaning and maintenance of the gutters. A number of options have been considered in relation to providing the access up and on to the roof as required to facilitate this, but it should be noted that providing a trafficable perimeter gutter condition was ruled out at a early stage due to the existing geometry of the roof structure/parapet and due to the aesthetic impact of the associated safety measures i.e. protection barrier/handrails at the building perimeter.

Option 1. Access via temporary demountable platform with a fall arrest system in the central roof valley
This option would require the installation of 46 No. specialist roof hooks as indicated in the drawing above, which would allow maintenance operatives to access all of the roof areas as part of a fall restraint system. The hooks would be located within 1 m from the ridge, to allow the system to provide access to the central valley gutter using rope access techniques. Access onto the roof via the temporary removable platform would necessitate fixings to secure the platform for safe use.

Key

- Rooflights
- Trafficable gutter
- Perimeter gutter
- Zone for temporary access tower
- H Hook Point
- L fall arrest fixing point



Roof maintenance Option 2

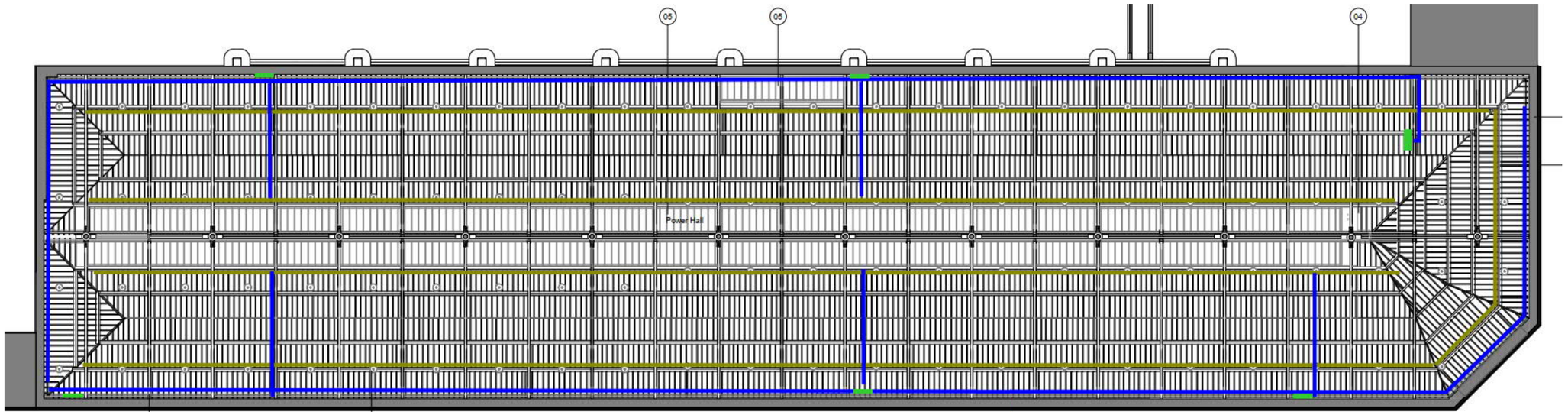
Option 2. Perimeter gutter access via Mobile Elevated Working Platform (MEWP) with a trafficable valley gutter accessed via temporary demountable platform.

This option requires close co-ordination of the valley gutter details to ensure that the central gutter is designed to be trafficable. A number of roof access points have been considered (including internal access via a roof hatch) but the proposed point of access is located in the same point as option 1, on the basis that the internal layout (with the large historic machines) is not yet known and indeed is limited by the position of the central loading platform. MEWP access to the perimeter provides the necessary access for visual inspections and cleaning (via mobile gutter vacuum) for these areas. If more significant maintenance is required to the roof surface beyond the scope of these works, this would be subject to localised scaffolding access (designed by the maintenance sub-contractor as required).

Roof access proposal
The proposed roof access solution is Option 2, as this option is considered to provide a better balance between safety, heritage / visual impact and cost (capital cost and ongoing maintenance costs associated with the access solution). This solution also has the benefit of the permanent removal of the non-original CAT-ladder to the north elevation of the building, which, prior to the installation of the temporary scaffold/roof protection, was previously the primary point of access for roof maintenance.

Key

- Rooflights
- Trafficable gutter
- Perimeter gutter
- MEWP Route
- Limited access



The overall approach to the M&E systems within the Power Hall building is to de-clutter and rationalise the new services installation. The existing structure should be able to be read clearly after the new installation.

There will be a new general lighting system installed at high-level as well as data, sub-mains and a new fire alarm system. There is also a requirement for lightning protection

Please refer to the Max Fordham M&E Strategy Report for full details.

Key

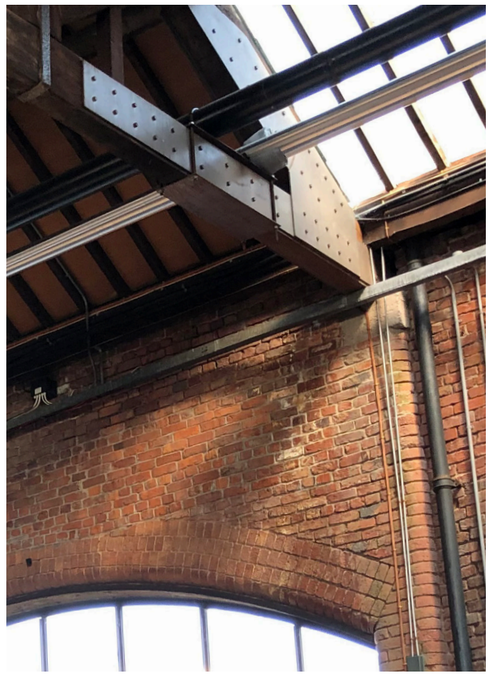
- Perimeter wall containment
- Containment for lighting along purlins
- Distribution boards (Final positions to be determined during package 4)



Existing cables clipped directly to timber structure



Existing services containment



Existing services cables and containment

Principles of services fixings

Adding fixings and attaching plant and fittings to historic buildings requires careful consideration and co-ordination. For the Power Hall project the design team have adopted a number of key principles:

- Avoiding fixings where they will be highly visible,using mortar joints to accommodate fixings so that they can be easily repaired in the future.
- Avoiding running containment or cables or sighting control gear in locations where they would be highly visible and where these are required they are to be specified to be a colour to match their surroundings to reduce their visual impact.
- Where new fittings need to be sited in visible locations, unnecessary fixings will be avoided and where possible will be designed so that they are fully reversible.

The fixings required for the new services at high-level within the Power Hall have therefore been carefully considered. As previously noted the primary containment for power, data and fire alarm cables will be located within two runs of containment at high-level around the perimeter walls. This new trunking is proposed to be hung from the eaves purlins in a similar way to the existing trunking. This approach will remove all of the existing cables, which are directly and frequently fixed to the existing timber structure, providing a de-cluttered and integrated appearance. The lighting containment is proposed to be fixed to the side of the lower roof purlins, with the light fittings directly fixed to this trunking. Dependant on the weight of the light fitting it may be necessary to install a number of discreet hooks into the existing structure to support the weight of the lighting.

The new aspirating fire alarm pipework will be fixed to the existing roof purlins where required, these will be fixed from above, to ensure fixings are not highly visible.

The new vents that are required to penetrate the roof in relation to the plant below are proposed to be supported via the east wall of the Beam Engine housing (part of the historic collection), which is modern brickwork. Where the vent pipes continue above the height of the Beam Engine enclosure additional support may be required from the adjacent truss. Here, fully reversible fixing straps around the truss structure are proposed in lieu of making direct fixings into the truss structure.

3.3 Windows and Doors

3.3.1 Site context

3.3.2 Historic depot doors

3.3.3 New windows concept

3.3.4 Proposed Upper yard windows

3.3.5 Proposed new entrance

3.3.6 Proposed Liverpool Road windows

3.3.7 Proposed South East chamfered corner window

3.3.8 Proposed rail doors



Various frame colours to the Upper Yard windows within the arched brick openings



Liverpool Road and South East Corner windows with window vinyl's

1980s Installed Power Hall Windows
The existing modern windows utilise a curtain walling type system and are single glazed. There are a number of different window systems used throughout the building, with different frame profiles and colours, which are visually incoherent.

The arched windows onto the Upper Yard to the North are predominantly read as a grid of mullions and transoms (subdivided by a low steel beam across the midpoint of each aperture) with glazed ventilation louvres, fixed glazed panels and fire escape doors. To the South the windows onto Liverpool Road have a square grid format, which in recent years has been 'decorated' with museum branded window vinyl's. On the South East chamfered corner a large sliding-folding door is installed, probably for the movement of exhibits, again decorated with signage/information and window vinyl's.

The overall effect is visually distracting given the variety in colour of the frames, various opening elements, visible ventilation and the low steel beams. In terms of historic significance this glazing it is neutral at best, with some detracting features.

New Window and Door requirements
The brief for the new windows and doors is driven by the requirement to improve the thermal performance of these elements (in-line with the site wide decarbonisation strategy), providing the necessary ventilation required to reduce the overheating and to enhance the aesthetic quality of the building through a coherent design strategy that respects the building's heritage. Coupled with this there is a need for the new entrance to the Power Hall to be clearly legible to visitors.

Whilst the existing apertures to the building on each elevation are quite different; with the large square apertures on Liverpool Road and the arched apertures to the Upper Yard and the anomalous chamfer window on Lower Byron Street, the ambition is to create a relationship between each of these locations.









1830 Warehouse The windows and doors to the 1830 Warehouse are not combined, with large painted timber panelled doors designed for goods access and multi-pane timber framed windows for daylight and ventilation. There is also some modern (frameless) glazing inserted into some of the larger carriage openings on the south elevation, as seen above.

Station Building The south facade of the Station Building onto Liverpool Road has a domestic scale, predominantly with white painted timber framed 9-sash windows with fine glazing bars and panellised doors, which gives the building the appearance of a refined Georgian terrace in contrast to the industrial aesthetic of the rest of the site.









New Warehouse The New Warehouse has a mix of white painted metal framed 'crittal' style glazing, and modern interventions such as the fully glazed stair towers and modern infills to some of the larger apertures. Historically these apertures would have been timber doors, but some of them have been infilled with timber framed multi-pane windows with obvious opening elements and others have frameless glazing (coupled with new masonry at the base). All of the modern interventions have a poor thermal performance as they are not thermally broken assemblies.



View of the Shipping Shed in 1978 (Historic England)



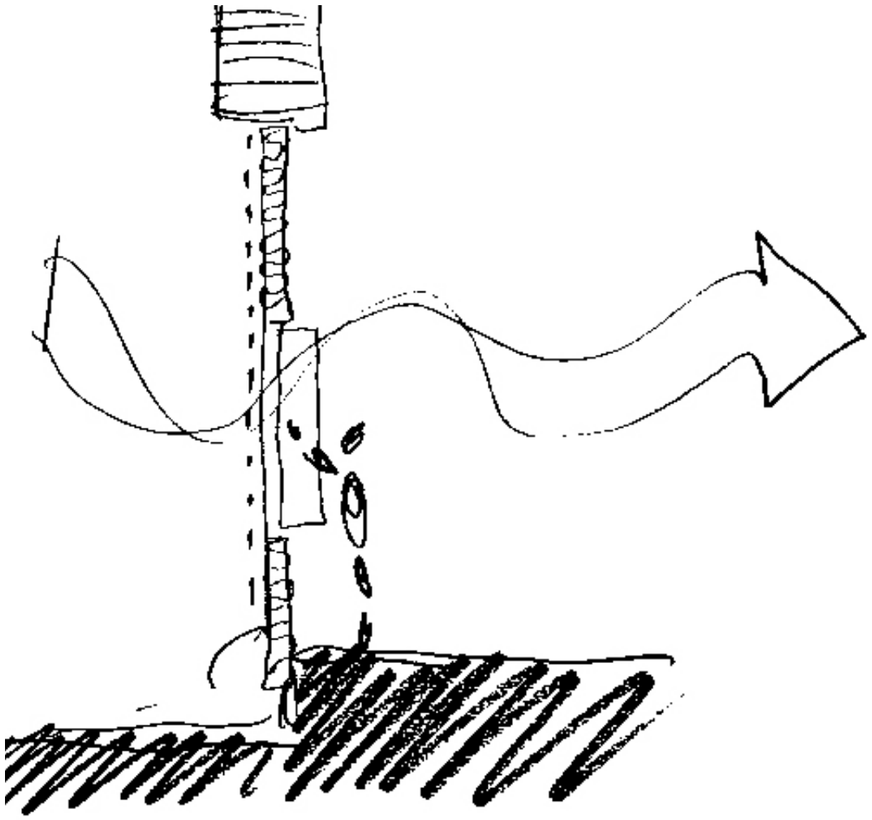
View of the Shipping Shed in 1978 (Historic England)

Historic Depot Doors
The images above show the 20th Century doors of the Power Hall whilst it was still in use as a goods depot in the 1970s.

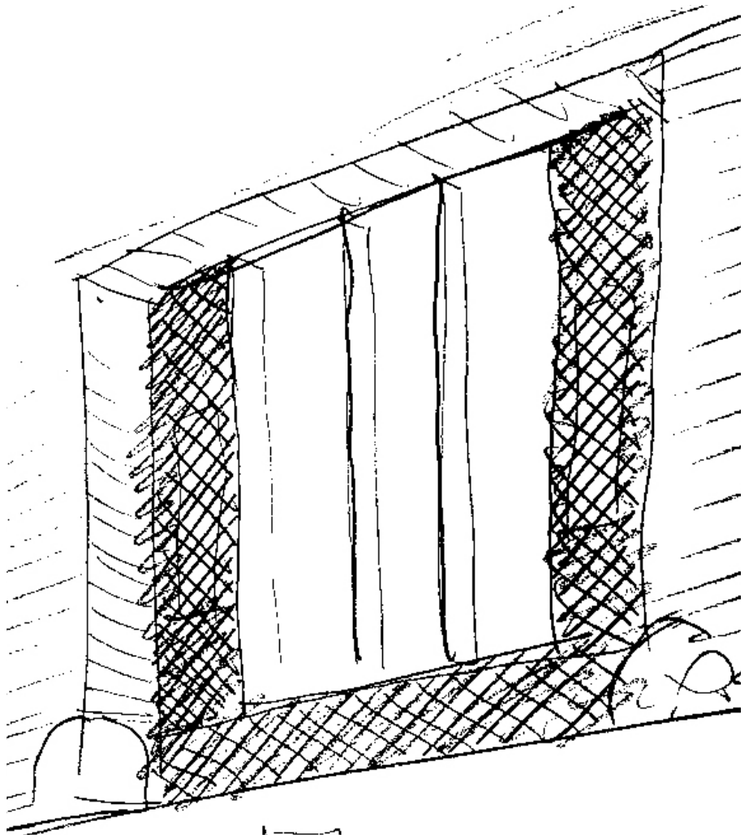
The doors were either inwards opening double doors or sliding doors depending on their locations, and they were constructed with a simple timber frame with cross-bracing and clad with vertical timber. As shown in the top right-hand photo the doors to the south had high level openings for illumination and ventilation and hit and miss timber panels below.

The doors in the north elevation featured no such openings and were solid cross-braced plank and rail doors. The glazing from the 1980s changed the original nature of these openings.

In total there are five variances in the design and form of the openings, given their different functions and roles within the building's envelope; some were designed to be public facing to the Liverpool Road frontage, whereas others such as the rail door openings were purely functional.



Sketch section showing the ventilation concept via solid opening panels



Sketch of window concept; framed views within a surround material

Fixed glazing with timber surrounds
The window concept proposes an assembly of fixed double glazed window panes within a timber and metal surround. This 'surround' deals with the need for ventilation (with pest control measures) and fire exit doors which creates a simple and coherent window design, representing the modern use of the building as a public exhibition space making the definition between entrances and windows clear.

Reference to the historic doors
The historic timber doors were used as a reference point in the design of the new windows and doors. The surround is proposed to be clad in vertical slatted timber, (internally and externally) referencing the historic materials used. Areas of hit and miss cladding are used to create ventilation zones which will be controlled with a Building Management System to use night time cooling to eliminate the risk of overheating.

This approach restores the solid to void ratio to the apertures, more in line with the original openings, where the timber 'cheeks' appear as partially open doors, through which the interior can be viewed from the outside and from inside, framing views outwards. The proposed use of timber allows the openings to be more carefully detailed, with the timber scribed to suit each aperture. Restoring something more akin to the original, solid panels reflecting the solid doors.

The intention is that through the use of the same palette of materials and glazing proportions each of the window apertures will relate together as a 'family,' in a similar way to the historic condition.

Reuse of steel
It is intended that the existing steel beams which span across the existing North facing window openings will be re-used to support the head of the new window glazing, in line with circular economy principles. These will be fully concealed within the timber linings to the window surround noted above.

Proposed Upper Yard Windows

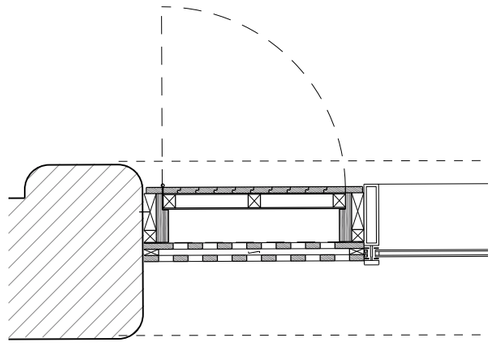


Typical North facade window view

Upper Yard windows
The surround is clad externally with vertical timber cladding. The areas where ventilation is required will be clad with hit and miss boarding to allow air to pass through, with pest control measures (insect screens) built into this assembly. At low level a 200mm metal plinth provides a robust detail to the base of the timber cladding in terms of weathering and the risk of physical damage. The external timber is proposed to be treated with a surface coating impregnation system to provide a consistently weathered appearance at an accelerated rate. Internally the surrounds are clad with vertical timber boarding finished with a wax oil stain, which will protect the timber from surface damage.

As previously noted, ventilation is required to provide thermal comfort within the space during occupation in the Summer months. Night time cooling, with opening vents linked to a Building Management System is key to this approach. The ventilation panels are located at a high level to ensure that debris doesn't collect within the build up and to ensure the ventilation strategy doesn't compromise the required building security.

The principle of glazed infill is entirely modern. The openings once contained solid timber plank and rail doors so the proposal is closer to the original condition.



Typical proposed window vent panel plan detail



Views of proposed new Power Hall entrance (floor finish shown indicatively)

New entrance
Creating a legible new entrance is a critical part of the brief. With the new entrance proposed at the centre of the building, and visitor flows from the New Warehouse being both from oblique angles and directly across the Upper Yard, the entrance needs to be visible and readable in both foreshortening and when seen obliquely, through the veil of the historic gantry.

A number of design options were explored to test how to make the entrance legible within this context, but the preferred option proposes a recessed door which, through modelling and shadows, will be subtly differentiated from the other windows, but maintaining a relationship to them via its proportions. This approach also ensures that the technology of the required automatic sliding doors is not foregrounded within the proposals.

Whilst this design will require a localised area of the historic cobbles to be carefully lifted and then subsequently reinstated, the landscaping and detailed design of the door assembly will be completed after some initial trial pits (to determine how the base of key existing windows is currently structured). Final co-ordination of the external landscaping and internal floor finishes will be part of the Package 4 proposals.



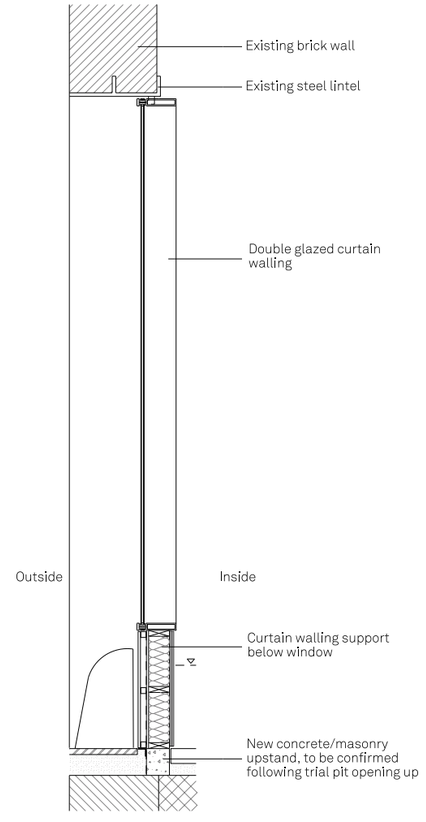
Proposed Liverpool Road Windows



Typical South facade window view

Liverpool Road windows
The proposed south facade windows, onto Liverpool Road, have a taller plinth in response to the presence of the historic carriage stones and to create a more robust base along the public foot way in response to the risk of vandalism and potential acts of terrorism (to avoid the need for bollards or planters to be retrofitted). The proposed robust metal plinth height mediates the datum of the existing brick plinth which steps along the gradient of Liverpool Road. The metal plinth then steps up to align with the cills of the adjacent blind windows.

Above plinth height there are three fixed glazed panels, with a hit and miss timber cladding either side, that relate through materials and proportions to the apertures on the north side of the building.



Typical window section detail

Proposed South East Chamfer Window



Proposed South East chamfer window view

South East chamfered corner window
The chamfered corner to the south east of the Power Hall is an anomaly of the original design, where the form of the building changes to acknowledge the street, rather than being dictated by the railway infrastructure. In effect this created an address for the new goods shed and gave it greater prominence along Liverpool Road.

The design proposals respond to this anomalous corner and the technical requirements of the brief. This includes the need for security, as previously mentioned in relation to the other windows along Liverpool Road, building signage and additionally the fire strategy, which dictates that a fire exit door is required at this end of the building.

The proposed design is intended to relate to the other window apertures through material and the proportions of the glazing. In particular this design echoes the rail door in its asymmetry and appearing as a door slid to one side, whilst allowing a fire door to be neatly integrated as a jib door. The large glazed window (4.3m x 4.5m) frames a clear view into the Power Hall as a "shop window" onto the collection, with subtle emphasis placed towards the main entrance to the Museum through its asymmetric positioning. This asymmetric arrangement also allows for the integration of Museum signage, to avoid the need for the previous window vinyl's, which would conceal views into and out of the building.

In summary, this design has a number of benefits over and above the technical criteria it inherently meets;

- Reflects the historic appearance of these openings, which once contained timber doors
- Subtly guides the eye to the Museum's entrance and dependant on the direction of approach would allow views into the Power Hall of the new boiler.
- It enables a neat signage solution, avoiding window stickers which would obscure views in and out and would clutter the windows
- It enables the neat integration of the fire escape, avoiding the need for unsightly fire escape ephemera.



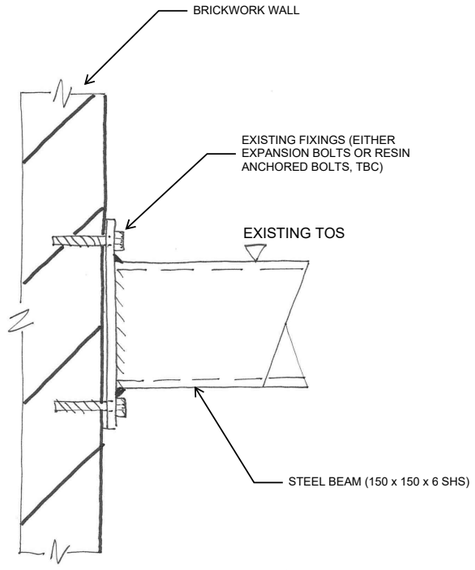
Concept design for the railway doors - to be developed and submitted as part of the Package 4 application

New railway door concept

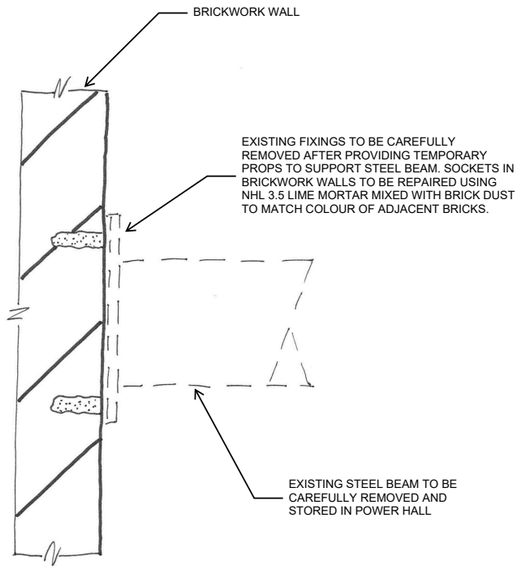
New rail doors are required to the West facade of the Power Hall to replace the existing concertina metal doors, which were installed as part of the 1980s works.

The outline concept design proposes two large sliding doors to the larger aperture, which would allow for the locomotive exhibits to be transported in and out of the building utilising the existing rail tracks. One leaf is proposed to be a fully glazed thermally broken door, which will improve the thermal performance of the building, whilst allowing views in and out of the Power Hall. The slatted timber cladding to the other leaf and to the smaller rail door aperture (which reference the historic doors, in line with the other door and window proposals) will also be thermally insulated.

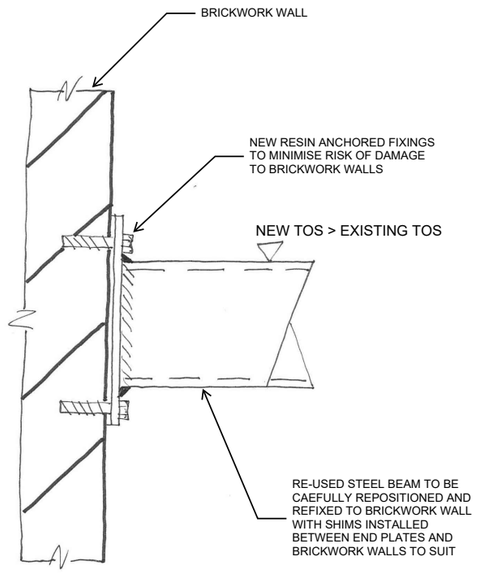
The application includes the removal of the existing doors to allow for further investigations such that detailed proposals for the new doors can be submitted as part of the Package 4 application.



EXISTING ARRANGEMENT



INTERIM ARRANGEMENT & REPAIRS



PROPOSED ARRANGEMENT

Structural strategy to raise the existing beams to the window apertures on the north elevation

Principles of fixing new windows and doors
As previously noted the existing beams along the north elevation will be raised up to just below the springing point of the arch. The adjacent sketches illustrate the key considerations associated with this approach. Raising the beam up provides support for the new windows and the timber surround infill. A similar approach will be adopted on the chamfer corner window where the existing steel beam will be removed and new steel structure (as indicated on the details drawings supporting this application) will be inserted.

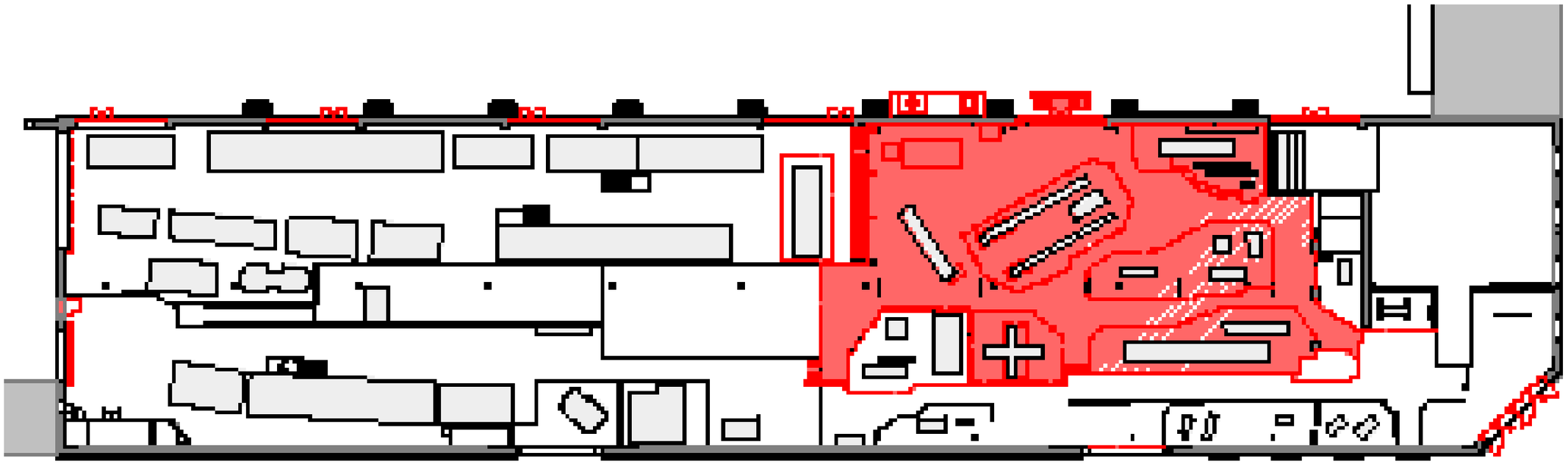
Where the new windows or doors, or the surrounding timber structure are secured to the existing brickwork this will be via fixings within the mortar joints, which can be easily repaired and re-pointed in the future. The number of fixing points will be determined by the specialist sub-contractor's, but the fixings will be limited as far as possible.

The fixing detail at the head of the Liverpool Road / Lower Byrom Street windows will also be subject to further specialist sub-contractor's input. The intention is to limit the number of fxings into the existing steel lintels to 4 no. per window (i.e. 1 per mullion).

The structural strategy and fixings associated with the window base details will be developed once the opening up works have been carried out on site, in line with the methodology agreed via an exchange of correspondence.

3.4 1980s Platform Strip Out

3.4.1 Proposed extent of demolition



Proposed ground floor demolition plan (historic collection shown indicatively, not part of this application)

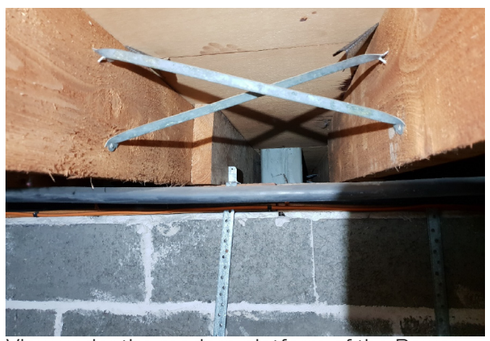
The demolition plan above shows the proposed area of modern platform to be removed. Removing this area of modern platform will allow the team to fully survey all the fabric below, ahead of developing a new exhibition design, which will be submitted as part of the Package 4 submission.



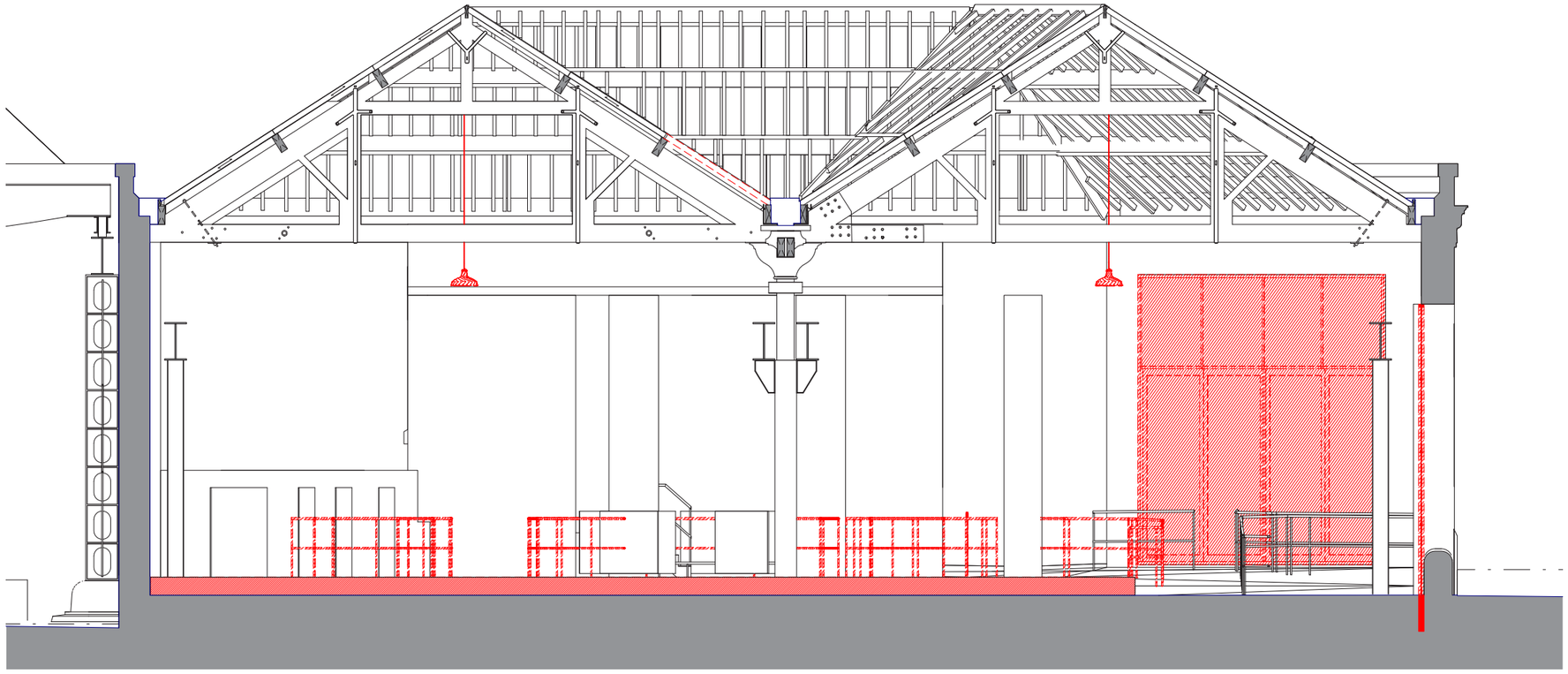
View looking West along the modern platform of the Power Hall



View showing the current steps and balustrades associated with the modern platform

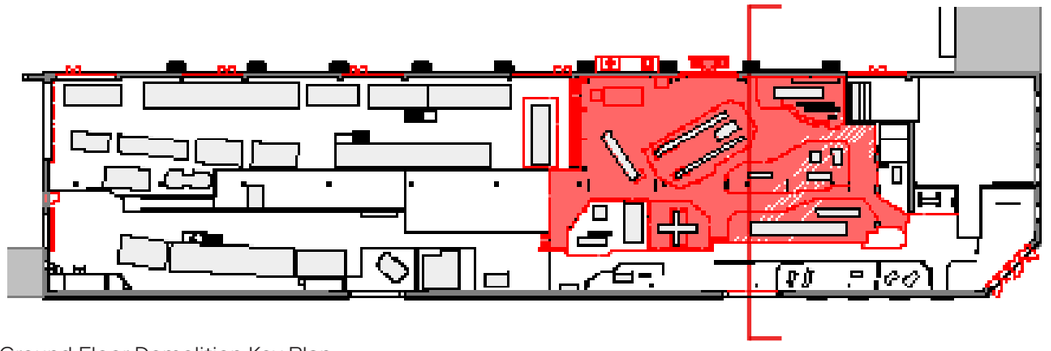


View under the modern platform of the Power Hall



Proposed demolition section - historic collection not shown for clarity

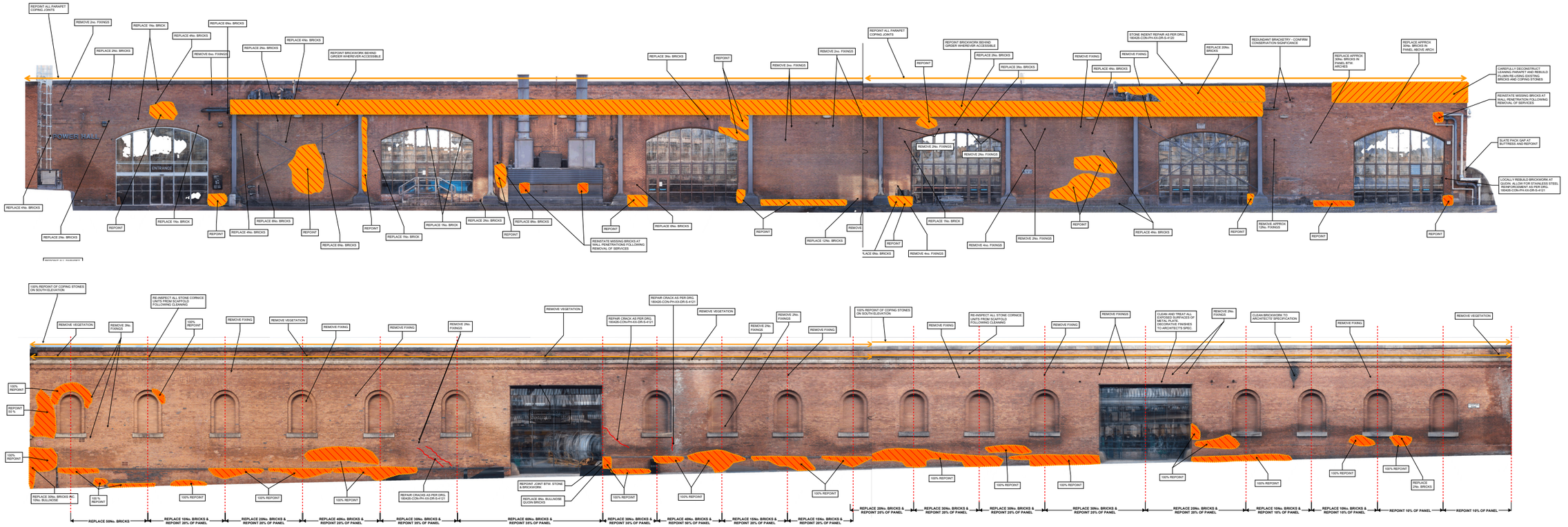
The section above shows the extent of the modern platform to be removed. This will include removal of the modern support walls, timber joist structure and surface finishes, as well as any railings or other items resting on the platform, which includes some redundant plant located on the north side of the modern platform. No exhibits or historic fabric will be moved or removed as part of this initial demolition work.



Ground Floor Demolition Key Plan

3.5 Fabric Repairs

3.5.1 Summary



Proposed fabric repairs to North and South elevations

Building fabric repairs
Conisbee Consulting Structural engineers carried out a detailed inspection of the Power Hall structure in 2019, with the aim of evaluating the condition of the building fabric, particularly the load bearing masonry and associated stone elements. A detailed report and drawings by Conisbee is included to summarise their assessment of the building fabric and the outline scope of repair works proposed, to support this application. Whilst remedial works in relation to the macro-stability of the structure are not currently anticipated, the proposed repairs have been developed on the basis of a minimally invasive approach, which retains as much of the original fabric as possible. This is in line with best conservation practice for a Grade II listed heritage asset such as the Power Hall. Where intrusive repairs are deemed necessary to maintain durability and structural performance they will be as sympathetic, transparent and honest as possible so as to allow the story of the Power Hall and its relationship to the Gantry and the wider site to be clearly read.
In summary the scope of the repair works includes:

- The majority of fabric repairs comprise replacement of excessively decayed bricks with matching new or reclaimed bricks, indent repairs to decayed stonework, crack repairs using stainless steel helical bars and repointing works.

- Diagonal cracking was observed in a number of locations, most typically around structural openings where stress concentrations arising from thermal or structural movement tend to become concentrated. None of the cracking noted appeared to exceed 3 – 4 mm in width and localised repair and reinforcement should be sufficient to stabilise these areas.

- The cementitious pointing has failed in some areas and now requires replacement with a suitably specified lime-based mortar with compatible characteristics to the historic mortar. This specification has been closely informed by the mortar testing data which has been undertaken.

- Reinstatement of the locally missing bricks in the north wall of the Power Hall which have been removed to accommodate M&E services penetrations.

- Typical repairs to locally defective areas of the cornice stonework at the east and south elevations, including the careful removal of locally defective stone and the insertion of matching stone set in lime mortar secured in place with hidden stainless steel dowels resin anchored into the existing stonework.

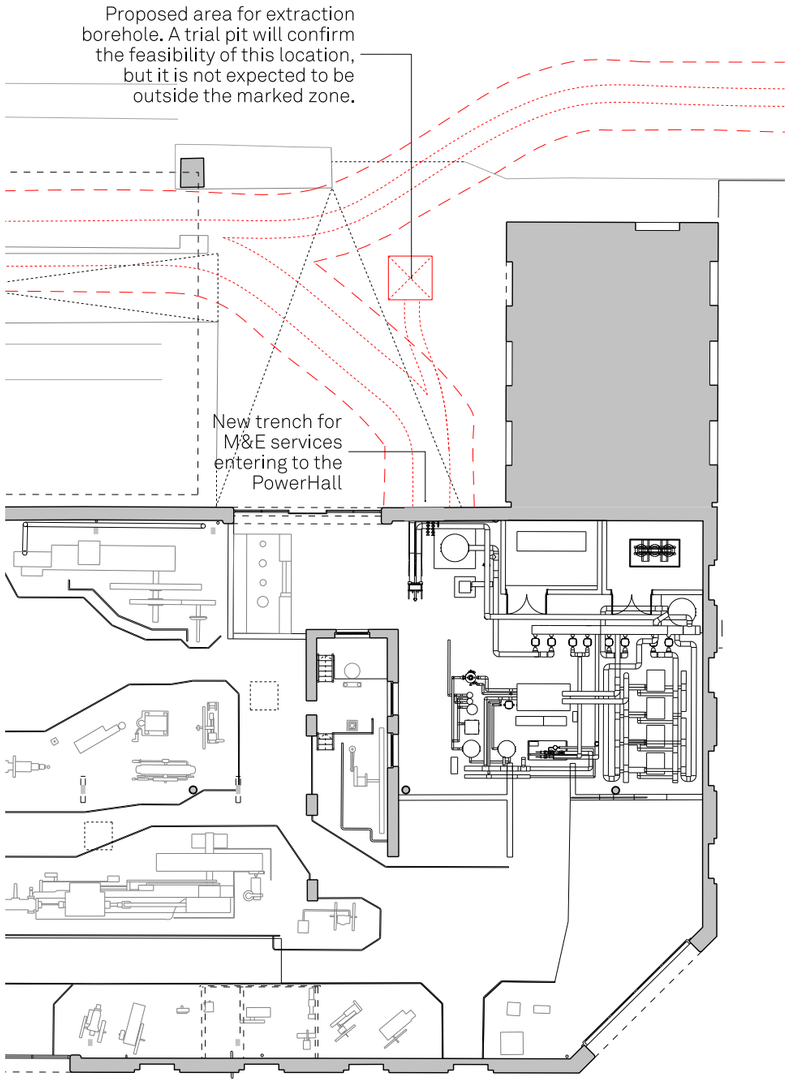
- To expose any defects that may be hidden behind the substantial historic build up of dirt and organic matter and thus clarify the full extent of necessary repairs it is proposed to clean and de-scale the stonework prior to a supplementary close up inspection. To assess the suitability of the cleaning method and to select the most appropriate technique it is proposed to clean a small trial area of the stonework by hand using a stiff nylon bristle brush and warm water: a very low impact manual technique that will cause negligible harm to the existing fabric. This is proposed to be agreed with officers via an exchange of correspondence prior to determination of this application.

  For further details please refer to the reports prepared by Conisbee, included as part of this application.

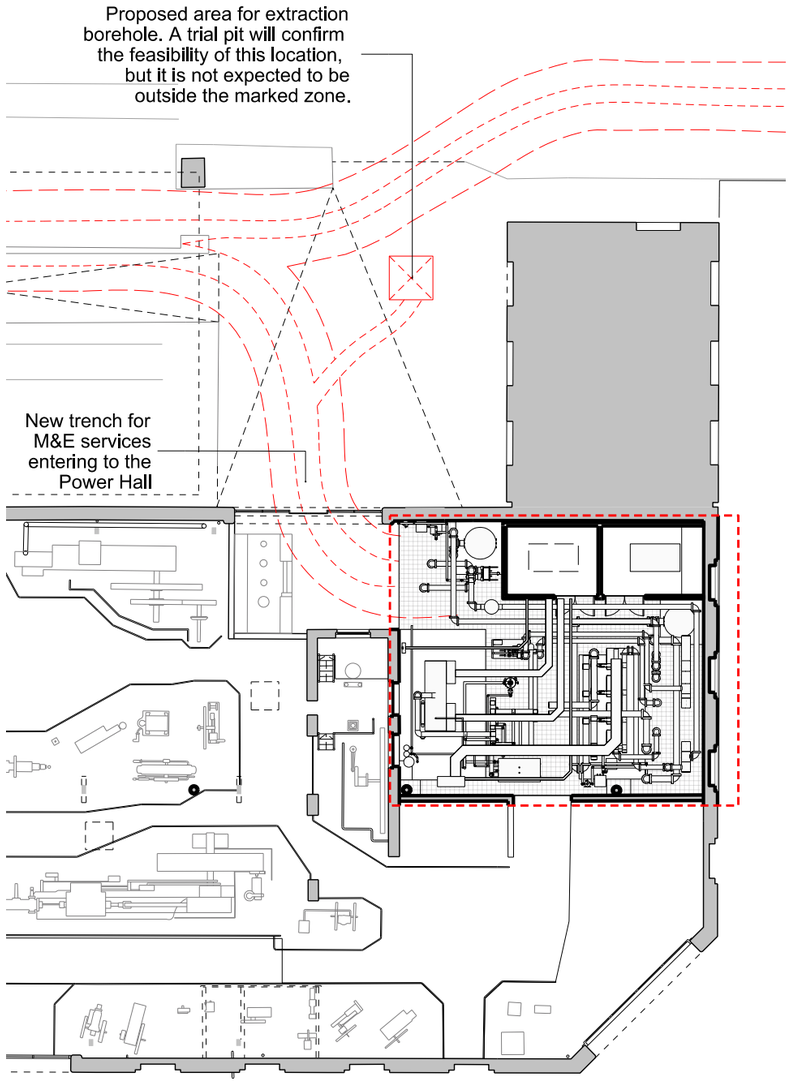
3.6 Alternative trenching route

3.6.1 Summary

Alternative trenching route



Trenching route - 130170/LO/2021 Consented drawing



Proposed alternative trenching route

Alternative trenching route summary
As part of the Package 1aii submission (Listed Building Consent reference 130170/LO/2021), a trench route for below ground services associated with the new plant (relating to the site wide decarbonisation strategy) was shown in the Upper Yard. An alternative route for the trench is now necessary to avoid a drainage run identified on site. The new route remains within the modern surface finishes of the Upper Yard and would be implemented in accordance with the conditions of the original consent with respect to the agreed methodologies. One of the benefits of this alternative route is that it is proposed to penetrate the Power Hall external wall below an existing window aperture, so any risk associated with making this penetration through the historic fabric is significantly reduced as the existing arch above deals with the majority of the masonry load.

4 Summary and Future Proposals

Package 4 Proposals
Whilst the site wide infrastructure works and new roof and windows and doors are being implemented the design team will be developing the proposals for the final package of works, which essentially relates to improving the visitor experience in and around the Power Hall. The client's brief is for this is to create a simple visitor experience, which is participative and engaging and interprets the collection. This will involve design proposals for the visitor routes, key narrative stories, key objects, objects to be moved, a strategy for the Historic Working Machines including a services strategy, new railway doors, interpretation, vistas, and signage / graphics. Improving accessibility will be key to this next stage of the project.



The intention is for the landscaping under the Gantry and around the new entrance to be improved to improve accessibility and allow consideration of a future use of the Upper Yard as a vibrant public space.

