

STRUCTURAL INSPECTION REPORT OF 1830 STATION BUILDING

at

Science and Industry Museum
Liverpool Road
Manchester
M3 4FP



for

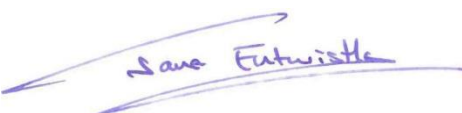
Buttress Architects Ltd.
41 Bengal Street
Ancoats
Manchester
M4 6AF

On behalf of

Science and Industry Museum
Liverpool Road
Manchester
M3 4FP

Contract No: 10539
Dated: 30 November 2020

1830 Station Building, Museum of Science and Industry, Manchester

Prepared by	Signature	Date
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Verified		
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Issue	Description	Date	Originator	Approved
01	First issue	30/11/2020	AW	JAE
02	Revised following damp and rot survey	08/11/2020	AW	JAE
03	Minor amendment to 3.2.18	06/01/2020	AW	JAE

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Whilst every effort has been made to fully inspect those parts of the building requested of us, no permanent or secured fixtures and fittings will have been removed. We will not have inspected woodwork or other parts of the structure which were covered, unexposed or inaccessible, and we are therefore unable to report that any such part of the property is free from defect.

Thomason Partnership Limited certify that they have carried out the work contained herein with due care and diligence to their best belief and knowledge based on the time and information available.

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THOMASONS

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Addendums to the report

Issue 02

Following the first issue of this report a damp and rot survey of the existing roof construction has been undertaken by Hutton+Roston Environmental Investigations Ltd. on the 9 November 2020. The concluding report “DETAILED TIMBER CONDITION SURVEY OF ROOF STRUCTURE” has been made available by the client for comment within this report. References to a timber survey of the roof construction has been removed from this report. Note that it is recommended that damp and rot timber surveys be undertaken to any element below eaves level.

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1.0 Introduction

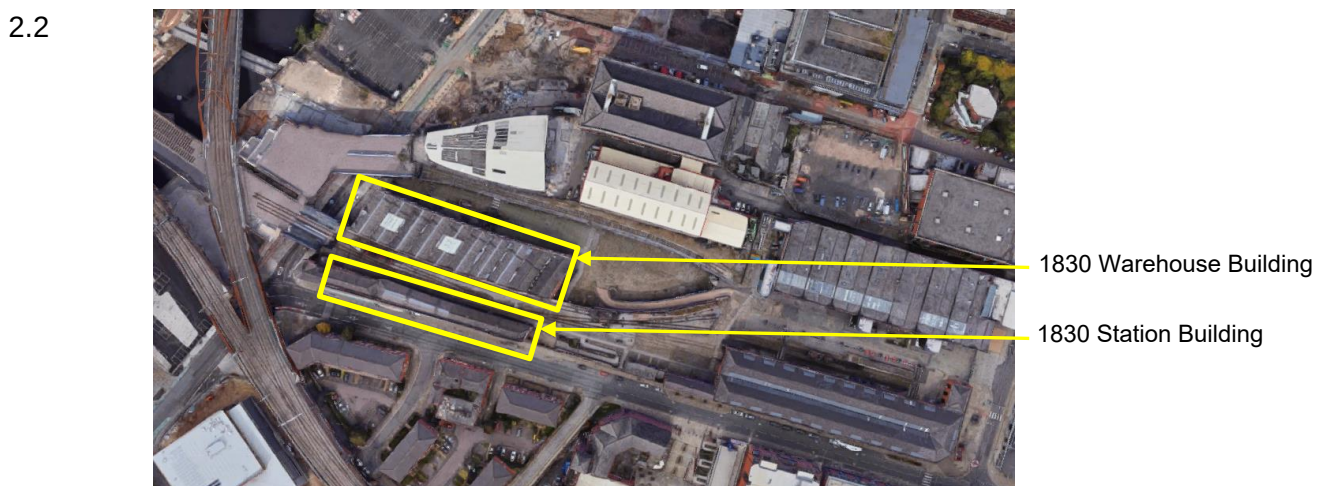
1.1 Thomasons was instructed by Buttress Architects Ltd. on behalf of The Museum of Science and Industry to inspect and report on the structural condition of the 1830 Station Building at the Science and Industry Museum (MSI), Liverpool Street, Manchester M4 6AF.

1.2 A representative of this practice visited the property on 4 November 2020 to undertake a non-intrusive visual inspection of building fabric and the internal structure.

1.3 The weather at the time of the inspection was mild and overcast with occasional rain showers.

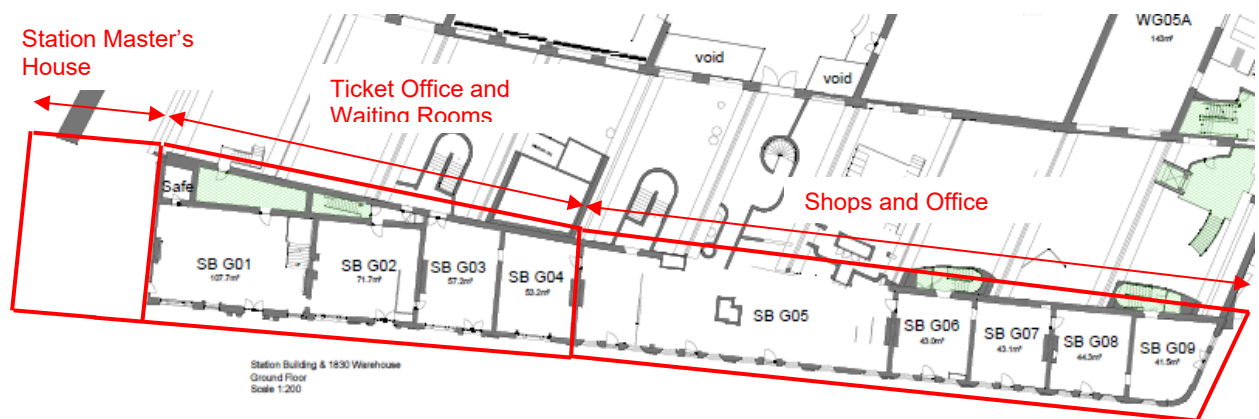
2.0 Background

2.1 The 1830 Station Building, Science and Industry Museum, Manchester comprises a Grade I listed former railway station and was built circa 1830 as part of the Liverpool to Manchester railway project. The Station Building formed the first passenger railway terminal in the world. The Station Building, and adjacent 1830 Warehouse Building, now forms part of the Science and Industry Museum. The rail tracks located at first floor are no longer connected to the main train line located to the south and west of the site.



Googlemaps aerial view of the 1830 Station Building and Warehouse Building, Liverpool Street, Manchester.

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Excerpt of ground floor plan from Buttress drawing 2723-010

- 2.3 The Station Building is located to the southern boundary of the MSI site.
- 2.4 The Liverpool Road Station (the Station Building) was the eastern passenger terminal of the Liverpool to Manchester Railway as engineered by George Stephenson and opened in 1830. The original station, which comprised Ticket Office and Waiting Rooms, was constructed adjacent to an existing 3 storey dwelling, with basement, which was later purchased by the railway company and served as the Station Master's House. Shops and offices were built to the east of the Ticket Office and Waiting Rooms.
- 2.5 In 1987 the shops and offices which formed the eastern third of the Station Building were demolished down to basement level, from the east end of the structure to the Waiting Rooms to the west of the site, and rebuilt after the building fell into disrepair following its closure in 1975.
- 2.6 This condition survey of the existing structure has been commissioned following water ingress into the structure had been noted in the Station Building and it was reported this has occurred over a period of years.
- 3.0 General Description**
- 3.1 All observations are made as the property is viewed from Liverpool Road, located to the south of the property.

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3.2 1830 Station Building

- 3.2.1 The Station Building comprises two storeys above street level with single storey basement over the full footprint of the building.
- 3.2.2 The overall building of approximately 90m long by 10m wide.
- 3.2.3 The north elevation of the building abuts the original viaduct and the railway above. The south elevation fronts onto Liverpool Road.
- 3.2.4 The ground floor of the Station Building is split into 9 distinct rooms primarily used for museum exhibits. The first floor of the Station Building comprises three distinct areas, the western third of the building comprised the original ticket office and waiting rooms; the central third of the building was reinstated as a platform to the adjacent rail track; and a more modern, glazed, office space was developed in the eastern third. The basement of the station building comprises thirteen rooms with solid masonry walls between and to the external perimeter.
- 3.2.5 The platform of the railway has been recreated including the timber boarding to the platform and cast-iron columns that support the roof construction.
- 3.2.6 Drawings prepared by Shepherd Gilmour Partnership Consulting Engineers for the reconstruction works to the shops and offices at the eastern end of the building have been made available for our use. The following descriptions are generally taken from the details included on their drawings.
- 3.2.7 It is understood that sections of the southern façade to Liverpool Road which was re-constructed where possible using reclaimed materials from the dismantling of the original structure. The south and west rebuilt façades of the structure comprised cavity masonry with a 215mm thick external leaf and 103mm thick internal leaf with a small cavity between. Much of the south façade included a rendered finish at ground and first floor. The external leaf at ground level comprises concrete blockwork with an internal leaf of brickwork.
- 3.2.8 The Station Master's House predated the remainder of the Station Building. The ticketing offices

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and waiting rooms were built adjacent to the Station Masters House. The rebuilt shops and offices to the eastern end of the structure abutted the waiting rooms and ticketing office.

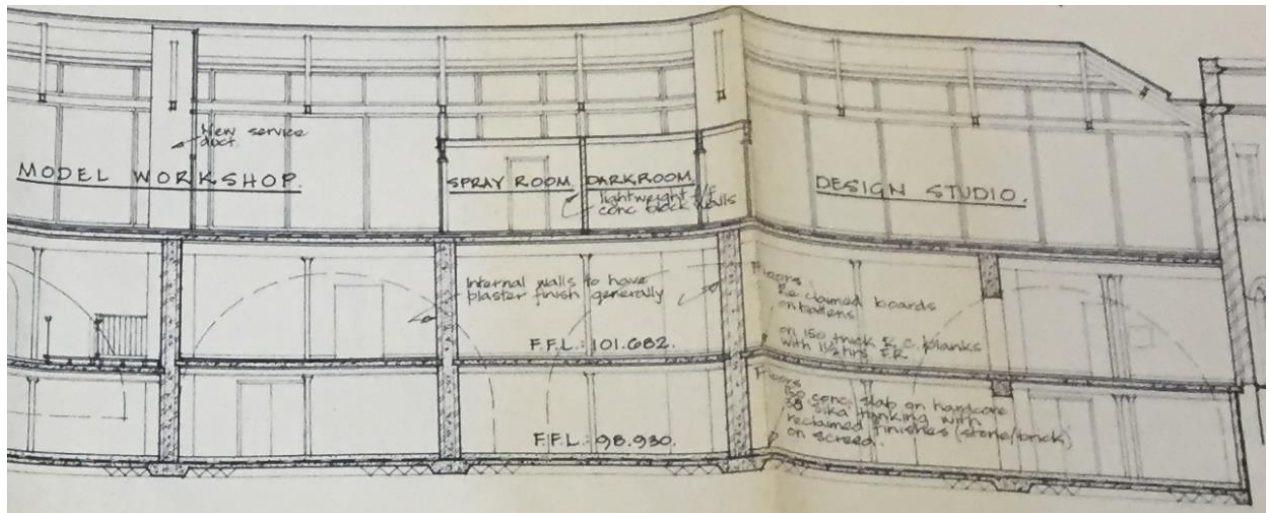
- 3.2.9 The front elevation of the building comprises a mixture of brickwork, render and stonework. Stonework typically frames external openings around windows and doors whilst rendered masonry forms the external detailing otherwise. The external south elevation on Liverpool Road at first floor is formed of red brickwork for approximately half the length of the elevation with the western end of the elevation formed of stone and render.
- 3.2.10 A parapet wall extends around the full perimeter of the roof of the building. The historic photographs of the building show this was a newer addition when the structure was rebuilt and continued the parapet detail that was present to the adjacent ticket office.
- 3.2.11 The roof construction comprised timber king post trusses, at 3.5m centres, spanning north south. The trusses were seated within the south external wall and supported on a continuous timber beam spanning between cast iron columns to the north elevation. Cast iron columns were positioned above the viaduct dividing wall forming the north elevation of the Station Building.
- 3.2.12 The first floor of the rebuilt areas of the Station Building comprises reclaimed timber boarding on timber battens, with insulation between, over asphalt on a screed, laid to falls, over a pre-cast concrete plank floor supported by a steel frame.
- 3.2.13 The ceilings throughout the rebuilt areas of the ground floor and basement levels of the building comprises timber boarding fixed to the underside of the concrete floor planks above.
- 3.2.14 The flooring throughout the rebuilt areas of the ground floor comprises a 150mm deep pre-cast concrete floor construction with timber boarding on battens over and timber boarding below.
- 3.2.15 400mm thick load bearing masonry walls to the east and western extents of the ground floor separate the current exhibit halls.
- 3.2.16 The flooring is supported by the perimeter masonry walls and downstand steel beams spanning east to west. The downstand beams are of an unknown size and are supported from the dividing

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walls spanning north south and internal cast-iron columns.

3.2.17 The cast iron columns at ground floor typically coincide with columns located in the basement.

3.2.18



Extract from Shepherd Gilmour Partnership drawings of the 1985 rebuild to the shops and offices

3.2.19 Masonry chimneys from fireplaces at ground level continue through the first floor to roof level.

3.2.20 The northern dividing wall to the viaduct comprise 500mm thick load bearing masonry wall.

3.2.21 The stability of the re-constructed structure is provided by diaphragm action of the floors transferring loads back to the load bearing masonry walls.

3.2.22 The openings above the archways that open up to the underside of the viaduct comprise steel beams over, supporting the floor above, and the archways are formed of brickwork to the underside of the steel.

3.2.23 The window and door frames comprise timber framework.

3.2.24 Drainage to the roof is provided by regularly spaced downpipes on the south façade of the building and an eaves gutter on the north elevation. The northern gutter is drained by downpipes that feed into the top of the cast iron columns. It is unclear if the columns are sleeved. The location and path of the drainage below the first-floor level is unknown.

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- 3.2.25 The Ticket Office and Waiting Rooms are understood to comprise of the original 1830 construction and were not rebuilt in 1987.
- 3.2.26 The external walls comprise solid masonry construction with timber windows and door openings.
- 3.2.27 The basement construction comprises solid masonry retaining walls with stonework floor finishes.
- 3.2.28 The floor construction is understood to comprise timber joists with timber boarding finishes and ceiling.
- 3.2.29 Floor joists span between external masonry and cast iron downstand beams, supported by columns, which align with the ironwork of the adjacent rebuilt shops and offices.
- 3.2.30 The roof construction comprises timber trusses spanning between north and south masonry walls. The truss profile differs from the rebuilt structure, utilising a braced queen post truss profile for the remaining trusses at the western end of the platform.
- 3.2.31 Windows to the north elevation of the ticketing office and waiting rooms have regularly spaced metal railings embedded in the stone sill and head units to the windows.

3.3 Station Master's House

- 3.3.1 The Station Master's House comprises an "L" shaped three storey dwelling of approximately 13m long by 12m wide, with a single storey basement over the full plan of the property.
- 3.3.2 The eastern party wall abuts the western end of the 1830 Station Building, the south elevation faces onto Liverpool Road, the west elevation faces onto Water Street and the north elevation faces the viaduct but is not connected to it.
- 3.3.3 The basement of the Station Master's House comprises of rooms now used as office and file storage space. The ground, first and second floors comprise office space.

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- 3.3.4 The roof comprised slate over a cut timber roof.
- 3.3.5 The ground, first and second floor construction is understood to comprise timber joists spanning north south with timber floor boards and carpet over.
- 3.3.6 Ceilings in the Station Master's House comprised painted plaster and skim finish
- 3.3.7 The walls of the structure comprise loadbearing masonry construction with internal studwork partition walls.

4.0 External Observations

4.1 Rebuilt Shops and Offices, South Elevation

- 4.1.1 The front elevation on Liverpool Road comprised a combination of stucco rendered masonry at ground level and rendered and exposed masonry at first floor level. The first floor of the façade comprised red brickwork. A brickwork parapet above first floor was separated with a stone string course. The top of the parapet comprised a stone coping.
- 4.1.2 The cracking defects to the exterior of the building were typically present in the rendered finish at ground floor. The defects noted below describe the patterns of damage but do not provide an exhaustive catalogue of the cracks that affected the front façade.

4.1.3



South façade as viewed from Liverpool Road



Eastern end of south façade

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- 4.1.4 The exposed brickwork was laid in a Flemish bond pattern with 10mm thick bedjoints. The brickwork was typically in good condition with no recorded defects. This section of the building was part of the 1980's re-construction works.
- 4.1.5 The masonry on the south east corner was constructed in a curved face and comprised a header bond masonry pattern. The brickwork was typically in good condition with no significant defects.
- 4.1.6 Vertical cracking was noted in the render finish between window and door openings at the springing point of the arch over the door and window openings. In general, the majority of the cracking was of equal width as the crack continued higher up the wall. The cracking typically originated from the upper corners of the window or door opening and extended horizontally to the adjacent opening. A vertical crack typically originated centrally on the horizontal cracks and extended vertically up to the stone course first floor level. No cracking was observed in the masonry or the stone course above first floor.

4.1.7



Cracking between window openings to south elevation



Cracking in render façade to south elevation

- 4.1.8 Previous façade repairs were identified in the render at first floor on the left half of the building, and full length of the ground floor. The crack repairs were generally of poor quality with loss of the fill material, of a colour not to match the surrounding render. The date of the repair works is unknown however they appear on the earliest google street view images from Liverpool Road dated July 2008.
- 4.1.9 The external rendered façade was typically plumb over a length of 1.0m without any significant

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out of plumb measurements recorded along the south elevation to the Station Building.

- 4.1.10 The wall profile stepped out at regular 7m centres forming a recess in which the rainwater goods of the south elevation were positioned. Restraint straps had been installed across the recess to support the rainwater pipes.
- 4.1.11 Movement joints in the external render were noted to the right-hand side of each rainwater pipe recess. The movement joint was filled with a flexible sealant. It is unclear if the movement joint continued into the underlying masonry. No movement joints were noted on Shepherd Gilmour Partnership drawings of the rebuilt section of the building. The spacing of the movement joints is excessive for a blockwork substrate to the render and thermal contraction is likely the cause for the cracking in the render.
- 4.1.12 Localised cracking was observed below ground floor windows. The cracks typically originated centrally below the windowsill or to the reveal at either side. The cracks extended vertically down to ground level. The cracking was typically 0.5-1.0mm in width and wider under the sill.

4.1.13



Cracking below ground floor windows



Cracking to window reveals at sill level.

4.2 Ticket Office and Waiting Rooms, South Elevation

- 4.2.1 The existing stonework and render around openings to the left-hand end of the front elevation showed varying degrees of erosion and spalling, typically close to ground level. Similar defects were recorded to the stone course located at the interface between ground and first floor.

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- 4.2.2 A void had formed below the western window of the Ticket Office on the front elevation. The timber packing that was present below the frames was missing and a 20mm gap had formed below. The rear of the stone sill was accessible from the gap between the frame and the sill.

4.3 Station Masters House, South and West Elevation

- 4.3.1 The western façade of the Station Master's House exhibited signs of erosion to brickwork units. The extent of the erosion to the face of units was not considered to be critical at this time.

- 4.3.2 Vertical cracking was noted at ground level extending approximately 1m from the south west corner of the building. The crack was hairline in width and terminated nine courses above the external paving level. It was noted that the crack extended through masonry units, including those laid as headers. The crack was wider at the base of the wall becoming narrower higher up the wall.

4.3.3



Western façade of the Station Masters House



Cracking in masonry to western façade

4.4 Station Building, North Elevation

- 4.4.1 The north elevation of the structure comprised the recreated platform and railway buildings, ticket office, waiting rooms, etc. The façade included the roof support columns, the exposed roof trusses, and the station buildings to the west of the platform.

- 4.4.2 The cast iron columns supporting the north end of the roof trusses all exhibited varying degrees of pitting from historic corrosion with some loss of section and local repairs. The damage to the

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columns all appears to be historic with the columns coated in a more recent paint repair which is, typically, in good condition. Rainwater goods on the north elevation fed into the top of the cast iron columns which served as rainwater pipes. It was not apparent whether the columns were lined internally.

4.4.3



Picnic area at first floor platform over the rebuilt shops and offices



Waiting rooms at the west end of the platform

4.4.4

The timber trusses were exposed in all but two locations to the far western end of the structure. The timber trusses had been previously repaired with the introduction of replacement members, possibly when the building was rebuilt, and reinforcement of the bearing to the south elevation. The timber trusses exhibited timber shakes, typically in the bottom chord, and central vertical members, this occurred on approximately 25% of the trusses to varying degrees. Generally, the timber members were in good condition with local defects.

4.4.5



King post trusses at first floor over the rebuilt section of the building



Queen post trusses to the western (not rebuilt) end of the platform

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- 4.4.6 The rebuilt shops and office structures to the western end of the building were typically in good condition with local erosion of the stonework around window and door openings.
- 4.5 Local defects were noted to windows to the ticketing office and waiting rooms. The metal railings, embedded in the stonework of the sill and head, over the windows of the station buildings exhibited a loss of section to the base of each vertical spur. The defect is assumed to be historic as the steel had been repainted and showed no further signs of corrosion or damage to the external face.
- 4.6 Local cracks in the stone sill were noted originating from the embedded uprights, of the railings over the windows, to the face of the stone unit and the joint between units. The defects were due to the corrosive expansion of the embedded railings.

5.0 Internal Observations

5.1 Rebuilt Shops and Offices

- 5.1.1 The basement of the structure encompassed the full floor plan of the building. The north south dividing walls between rooms aligned with those at ground floor. The walls were typically plumb with level bedjoints. The masonry units were in good condition with little damage noted. The walls were of solid construction as shown by courses of headers between stretcher bond masonry.
- 5.1.2 Each room had small recesses to the external wall approximately 1.2m above finished floor level. The recesses were typically 200mm deep suggesting the external wall is at least 4 courses thick. The recesses previously continued to ground level and once served as lightwells into the basement. These lightwells had since been closed up and were no longer present at the external pavement level.
- 5.1.3 Downstand beams, spanning east west, supported the ground floor construction in the original ticket office and rebuilt section of the building. The beams were supported by cast iron columns positioned centrally in each room under each beam. The columns aligned with the cast iron columns located at ground floor. The construction of the ground floor beams was understood to be steel as shown by the Shepherd Gilmour drawings of the rebuilt section of the building.

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5.1.4



Downstand beams and cast iron columns at basement level



Recess in basement wall

5.1.5 The flooring in the basement comprised stone slabs in most of the rooms. A brickwork tunnel had been recreated as part of an exhibit, parallel to the north elevation of the basement. The floor of the tunnel was formed of brickwork and the level was flush with the adjacent rooms.

5.1.6 The ceiling to the basement comprised timber boarding, spanning east west, parallel to the downstand beams. The boards were typically in good condition and showed no signs of warping or displacement. Water staining and some loss of paintwork were noted to the underside of boarding around downstand beams and centrally in the building footprint.

5.1.7 Loose and blown paintwork and staining to the ceiling boarding revealed water ingress to the floor void between the basement and ground floor. The source of the water ingress was not clear from the underside. The defects typically aligned with other signs of water ingress identified at ground floor level.

5.1.8



Loose paintwork to the ceiling in the basement



Loose paintwork to downstand beam

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5.1.9 The internal fabric of the ground floor typically comprised plastered masonry walls, timber floorboards over timber battens on concrete plank floors. The ceiling in each ground floor room comprised timber boarding spanning north south between the perimeter masonry walls and the downstand beams, spanning east west.

5.1.10



Exhibit hall at ground floor



Exhibit hall at ground floor

5.1.11 All re-constructed masonry walls to the east, south and west of each room were plumb. The wall along the north elevation of the Station Building was typically out of plumb by 10-15:900 at a height of 1.5m inclining south, into the room. Local defects were recorded in each room on the north elevation with water staining and blown finishes.

5.1.12



Electrical cupboard to south east corner

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5.1.13 An electrical cupboard in the eastern most room of the ground floor had water staining on the back wall. It was raining during the inspection and the wall was wet to the touch.

5.1.14 A note on the wall of the exhibit halls indicated that water ingress into the rooms had been a historic issue and not as a result of instantaneous failure or movement. A large area of the finishes were affected by water ingress local to the entrance hall.

5.1.15



Water ingress into entrance hall

5.1.16 In the central exhibit hall, the original passage under the viaduct provides access between the Station Building, to the south, and the Warehouse, to the north. The masonry was of rough finish where local demolition of masonry had left toothed masonry projecting from the face of the wall.

5.1.17 Water staining was noted at the head of the wall, and the masonry of the wall appeared wet. Water staining was noted in several locations along the north elevation. The defect was noted in the surround to the downstand beam, adjacent to the masonry, and the ceiling finishes alongside the wall.

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5.1.18



Water staining to masonry over viaduct arch



Water staining to masonry over viaduct arch

5.1.19

Water staining adjacent to the north wall extended into the room as far as the first internal downstand beam. The boarding to the ceiling showed loss of paint finishes due to water ingress and affected the top of the adjacent masonry.

5.1.20



Water staining and loss of finishes to ceiling



Water staining to wall finishes at ceiling level

5.1.21

The floors in each room were reasonably level. The level of the floor was recorded in each corner of the room and centrally, along with additional readings taken in larger rooms.

5.1.22

Door frames and windowsills were plumb and level, respectively. No internal defects were recorded to the openings and the doors all opened without rubbing against the frames.

5.1.23

The internal masonry walls to the glazed office space were recorded as plumb and the bedjoints within acceptable levels. No defects were recorded in individual units and the walls were all in typically good condition although some water staining was recorded around the timber hoppers around rainwater outlets.

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5.1.24 The trusses over the office space comprised king post timber trusses at approximately 3.5m centres. The trusses were generally in good condition with local defects recorded to individual truss members. Shakes in the timber members typically ran centrally along the member and occurred most often in the bottom chord and central vertical post. Some members of the truss have been replaced which was assumed to be done when the building was rebuilt. The southern end of the trusses was bearing on the external wall. The northern end of the trusses was supported from the external cast iron columns. The bearing to the south end of several of the trusses had been strengthened with steel plates installed to either side of the bottom chord and coach bolted through the timber. Local repairs to the timber members had also been previously completed. The location of the purlin had been relocated from the historical positions as indicated by the notches in the top chord not aligning with the purlin.

5.1.25 Water ingress was recorded to the finishes at eaves level to the south elevation and the timber at the bearing of the trusses was stained with repeated wetting and drying. Makeshift drainage had been installed to individual trusses on the south elevation to collect water that seeps into the room. Hoppers were located around the internal rainwater outlet which connected to the external rainwater pipes; the internal timber hopper surrounds were wet and stained.

5.1.26



Timber hopper units to drainage outlets behind the parapet

5.1.27 The flooring in the office space typically sloped down from both external walls to the centre of the room. The level of the floor finishes sloped down at a rate of 3-5:900 immediately adjacent to the south wall.

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5.1.28 A plant deck had been installed above the central part of the office space. Storage of boxes were also noted above the office. The construction of the floor supporting the ventilation equipment was obscured by boarding.

5.1.29



Ventilation over the waiting rooms at the western end of the Station Building

5.1.30 The central section of the first floor comprised the reinstated platform area currently used for picnicking with benches for seating. The floor construction comprised timber boarding over an unknown support. A trough formed of brickwork, immediately north of the platform timbers, was covered in timber boarding. It is understood that this trough collects the water from the rainwater goods and outlets to the lower floors.

5.2 Ticket Offices and Waiting Rooms

5.2.1 Similar defects as those recorded to the rebuilt section of the building were identified in the basement of the Ticket Office and Waiting Rooms. Local staining of the ceiling finishes was recorded as well as erosion of the masonry units to the perimeter walls.

5.2.2 The ground floor construction was assumed to comprise timber joists spanning between cast iron beams and the external perimeter walls. The floors in this area were reasonably level with no significant deflections recorded. The finishes in this area were also in good condition. Water staining in this area occurred at a noticeably lower extent to the rebuilt section of the structure although smaller areas of water ingress occurred.

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- 5.2.3 The extent of water ingress recorded to the north wall at ground of the Ticket Office was less than in the rebuilt section of the building with defects affecting more local points on the return walls to the northern ends typically at ceiling level.
- 5.2.4 The ceilings in the Ticket Offices at ground floor typically showed no signs of water ingress or other defects.
- 5.2.5 The first floor level of the Ticket Office and Waiting Rooms to the western end of the platform comprised four rooms, two storerooms and two exhibit halls. The roof construction over these buildings differed from the rebuilt section of the building to be queen post trusses at centres similar to the kingpost trusses. Similar repairs to that of the other trusses were recorded in this area.
- 5.2.6 The floors at first floor in this area were assumed to comprise timber joists spanning north south between external masonry and downstand beams. No significant deflections of the floors were recorded in these areas.
- 5.2.7 The first floor exhibition space was typically in good condition with local defects recorded to the walls around window and door openings and cracking following the edges of the plasterboard units to the ceiling. The south wall was recorded out of plumb by 15:900 adjacent to the Station Master's House. The other internal walls were reasonably plumb. Staining of the finishes was recorded under a CCTV camera where the cable work passed through the wall.
- 5.2.8 External cracking was noted in the sill and head of the windows to the Ticket Office on the north elevation where embedded metal railings were fixed over the windows. The railings exhibited historic corrosion since repainted with loss of section recorded to many of the uprights.

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5.2.9



Northern façade to the Waiting Rooms



Railings embedded in the stone sill

5.2.10 Internal cracking around window and door openings typically coincided with external metalwork for signs or fixings for external features. The cracks appeared to be typically caused by expansion of the embedded metal. Cracking to the internal finishes to the south elevation typically originates at the head of the window openings and coincides with slight out of plumb measurements of the wall at the higher level. This defect was more prominent above the Ticket Office where the spacing between return walls was greater.

5.2.11 Regular cracks in the ceiling, assumed to coincide with the supports in the roof space, persisted across the full area of the rooms. The pattern of the cracks typically followed straight lines intersecting other perpendicular cracks at irregular spacing. The cracks appear to follow the line of the edges of plaster board ceiling panels.

5.2.12



Cracking to the ceilings over the western Waiting Room



Cracking in the eastern Waiting Room

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5.3 Station Masters House

5.3.1 The basement in the Station Master's House showed extensive spalling and erosion to the face of the units. The face of the masonry units can be eroded by light rubbing of the surface by hand. The loss of section of each unit varied between 0-10% of the depth of the brick.

5.3.2



Erosion of masonry in the basement



Erosion of masonry in the basement

5.3.3 The floor construction comprised timber joists spanning north south with floorboards over and a carpet finish. The flooring at second floor noticeable sloped towards the centre of the office space in the south west corner of the building. The deflection of the joists was at a slope of 20:900 into the centre of the room. The space was densely populated with desks and office furniture.

5.3.4 Water ingress was recorded to the western curved wall of the Station Masters House. Water staining of the internal finishes was recorded at each floor with the extents of the defect increasing with each floor up the building. Cracking in the internal plasterwork typically exhibited water staining along the length of the crack and the surrounding finishes.

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5.3.5



Water ingress at second floor of the Station Masters House



Water ingress at first floor of the Station Masters House

5.3.6

The roof of the Station Master's House was observed from the first floor of the Station Building. The roof comprised of slates over cut timber rafters. The masonry of house was in good condition with no recorded defects although the walls had been previously repointed.

5.3.7



Station Master House roof construction



Roof transition between the Station Building and the Station Masters House

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6.0 Discussion

6.1 Rebuilt Shops and Offices

6.1.1 The rebuilt extents of the structure were generally in good condition with only local defects recorded to internal walls and the roof structure. The internal and external walls to the east, south and west were all reasonably plumb with deflection of the ground floor north wall being the notable defect recorded however this is suspected to be a historic defect and not progressive.

6.1.2 Water ingress at the platform level to the north elevation of the first floor and the eaves level at the south elevation was the main defect recorded during the inspection. It is suspected that the water ingress to the north elevation is due to leakage from the below floor level channel adjacent to the platform and also possibly related to leakage from joints of the down pipes integrated into the cast iron columns. Historic photos from the demolition and reconstruction of the Station Building show that the north wall of the structure remained and the structure above street level to the south was removed in its entirety. It is suspected that the displacement of the wall, recorded as part of the inspection, was a historic defect which may have predated the dismantling and rebuilding of the shops and office space. Historic photographs of the building show substantial timber shoring installed to the south elevation on Liverpool Road. The building as a whole may have rotated towards Liverpool Road and the north wall deflected as part of the distortion. The need to rebuild the shops and offices may have been related to this distortion. When the structure was rebuilt up against the existing north wall, the north south return walls may have been built up to the exposed face of the wall. It is suspected that effective tanking between the original and rebuilt building was not achieved during the rebuild.

6.1.3



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Shoring to the south elevation of the shops and offices prior to reconstruction

Historic photograph of the dismantling of the shops and offices

- 6.1.4 The other area of the structure that was adversely affected by water ingress occurred at the eaves of the first floor platform, office and station buildings. The roof construction is typical across the full extent of the first floor platform area of the building. The roof comprised slate finishes over timber rafters, supported by timber purlins and trusses. The construction of the roof changed slightly to the station buildings to the western end of the building where queen post trusses replace the king post trusses recorded to the eastern end of the structure. The trusses at first floor have been historically repaired which is assumed to have been undertaken when the building was reconstructed. The timber members of the trusses are typically in good condition with local defects recorded to the bottom chord and vertical prop. Splitting of the timber is assumed to be due to the shrinkage of the timber resulting from moisture loss. The parapet to the south elevation in the rebuilt section of the building was a new addition that was not present in the pre-dismantled state. The addition of the parapet appears to have prevented any overflow of the rainwater goods and allowed water to back up locally to the internal face of the parapet.
- 6.1.5 Water ingress at the eaves to the structure should be rectified to prevent further degradation of the trusses at their bearing ends. A survey of the roof timbers has been undertaken by a suitably qualified timber specialist and identified higher than average moisture content within the bearing of the roof trusses. Once reroofing works have been undertaken the masonry local to the bearing of the truss should be removed to either side of the timber to aid in drying out the existing timber. Lateral propping between the bottom chord of each truss is required to prevent rotation prior to the bearing being exposed, propping should be anchored to a suitably robust structural element such as a return wall. Once the moisture content has reduced to a desired level, to be indicated by the damp and rot specialist, the masonry around the bearing of the timber truss should be reinstated. Further water ingress to the eaves of the structure risks rotting and weakening of the timber bearing into the south wall.
- 6.1.6 The existing rainwater goods on the north elevation are susceptible to blockages due to the back fall from the head of the column to the underside of the gutter. It is unclear if the cast iron columns are lined and the historic damage to the columns appears to result from corrosion. The damage to the external surface of the columns appears to be historic given that the paint finish has not been damaged and no defects were recorded. It is unclear if corrosion of the internal

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surface had occurred. Further testing of the remaining column wall thickness is recommended to establish the remaining capacity of the column. Blockages or local fractures/defects in the rainwater goods could result in seepage of surface water into the north wall. A drainage survey should be conducted prior to the thickness testing to assess if the columns are internally lined. Any thickness testing should take the potential presence of internal lining into account when assessing the column thickness.

6.1.7 The inspection of the structure revealed local, but repetitive, defects to the external façade to the south elevation. The stucco render to the external façade of the south elevation requires remedial works to the cracking observed between the openings. The cracking is assumed to be as a result of thermal contraction of the blockwork substrate behind the render. The damage to the external render is assumed to be aesthetic only however it will allow water ingress into fabric of the building. This defect also occurs in multiple locations to the front elevation of the Ticket Office and Waiting Rooms.

6.1.8 Local cracking below the windows on the front elevation is likely due to thermal contraction of the external leaf of blockwork to the south elevation. It is suspected that a similar defect is present in the blockwork substrate to the render in each location of the cracking.

6.1.9 The defects recorded in the basement included the deterioration of the brickwork and the ingress of water into the ceiling void. Water ingress in the basement to the north wall is suspected to be a continuation of the defect recorded at first and ground floor. Water ingress to the south wall is expected to be from moisture seeping through the basement wall or from surface water at pavement level seeping through the bed joints within the depth of the pavement build up. Local intrusive investigations into the soffit of the basement are recommended to allow inspection of wall and floor construction at the interface of basement and ground floor. It is understood from the historic photos that the building was dismantled down to ground floor only, with the original 1830's basement walls being retained. It is unknown what waterproofing and tying in details were adopted when the superstructure was rebuilt adjacent to the existing viaduct.

6.2 Ticket Office and Waiting Rooms

6.2.1 The floor construction at each floor of the Ticket Office and Waiting Rooms was generally in

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good condition with local defects, typically adjacent to the north wall, where water ingress had been recorded. Such persistent water ingress could have a detrimental effect and give rise to potential rot of the floor joists adjacent to the wall may have occurred. A further intrusive inspection of the timber floor joists is recommended to establish the potential extent of the damage to the joists; a damp and rot survey should be undertaken by a suitably qualified timber specialist.

6.2.2 Spalled and eroded brickwork was recorded to the western end of the basement which appeared to coincide with walls that had been painted or rendered; it is possible that this defect has arisen due to inappropriate surface treatments trapping water in the masonry. The erosion to the face of the masonry units is not considered sufficient to be of structural concern however progressive erosion should be prevented to ensure the issue does not become a more structural matter.

6.2.3 The defects in the ceilings of the Waiting Rooms are suspected to be due to thermal movement of the individual plasterboard sheets. The space is heated but the walls are not insulated so there is the means for large variations in temperature of the space over time. It is also expected that if the plasterboard joints were not properly taped before the ceilings were skimmed that any minor thermal movement will manifest itself at these joints.

6.2.4 Local defects in the external walls are typically a result of corrosive expansion of embedded metalwork for signs and other historic furniture. Expansion of these items will continue if not treated and further corrosion prevented. This could compromise the integrity of the wall if the expansion is allowed to continue.

6.3 Station Master's House

6.3.1 The defects recorded to the walls of the Station Master's House are believed to be as a result of defective rainwater goods at roof level behind the existing parapet allowing water ingress into the fabric of the building. Cracking of the internal plasterwork has allowed a path for the water to the lower floors. Further water ingress may compromise the integrity of the structure and increase the potential for rotting of the timber roof and floor construction to occur. The internal timber elements of the structure should be assessed by a suitably qualified timber specialist once the cause of the water ingress has been addressed.

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- 6.3.2 The excessive deflections of the timber floor joists at first and second floor of the Station Master's House are assumed to be as a result of the excessive loading applied in this area from the office furniture in the rooms affected. The structure would have originally been designed as a dwelling and not for the loads imposed by office space or file storage. Continued application of higher than anticipated loads should be avoided until an assessment of the timber structure can be made to confirm whether it has already been strengthened and the apparent distortion now seen only cosmetic.

7.0 Recommendations

7.1 We recommend that intrusive investigations are undertaken to various locations in order to establish the full extent of the defects and the source of the water ingress into the structure. The investigations should also confirm whether the structure has been compromised by the water ingress.

7.2 The additional investigations are outlined below.

- Commission a condition survey and CCTV survey of the existing rainwater goods to the north and south elevations.
 - Jetting and clearing of debris are required to ensure the CCTV survey can be undertaken without obstructions.
 - Investigation into the extent that the existing cast iron columns are internally lined, and the condition of the liner should be undertaken.
 - Investigation into the remaining wall thickness to the cast iron columns should be undertaken should the internal linings to the columns not be continuous free for damage.
- Expose the drainage channel to the first floor platform to assess the potential drainage defects that may allow water ingress between the viaduct and the rebuilt structure.
- Locally expose the ceiling to the basement and ground floor at the position of local defects in the soffit where water staining is more prominent.
- Commission a survey of the existing rainwater goods to the Station Master's House and rectify the means of water ingress into the structure. Once the cause has been addressed the internal decoration and floor works should be undertaken.
- An intrusive investigation of the flooring in the Station Master's House should be undertaken where excessive deflection was recorded. Dependent on the findings in relation to capacity of the floor that is determined from this it may be necessary to reconsider how this space is utilized in order to reduce the loading to an acceptable level for the historic structure.

7.3 External embedded metal work to the north façade of the Waiting Rooms should be addressed by removing redundant fixings and filling the void with a suitable mortar and by cleaning and treating any fixings to remain.

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- 7.4 The local cracking in the external render is thought to be due to the thermal movement of concrete blockwork substrate. consideration should be given to the introduction of a formal movement joints in the render to allow future movement to occur. Alternatively, the existing cracks can be sealed with a flexible sealant if the existing defect is not considered to detrimental to the aesthetics of the building façade.
- 7.5 Whilst the recommendations above should be undertaken to assess the full extent of the water ingress and areas affected it is our assessment that the defects pose no immediate structural concerns as those identified appear to be historic and ongoing for a number of years.

THOMASONS