

1830 Warehouse

Museum of Science & Industry, Manchester

Internal Structural Inspection Report

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Conisbee is a trading name of
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Registered in England No. 3958459

Ref: 220626/B Angus

Approved By: S Wilkinson

Status: For Information

Version 1.1

05 December 2022

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1.0 BRIEF

- 1.1 Conisbee were appointed by our client, the Science Museum Group to undertake a detailed visual inspection of the internal structure of the 1830 Warehouse in order to record the condition of the building fabric and structure, provide recommendations for maximum floor loadings, and to propose appropriate remedial solutions to address any notable defects or deterioration.
- 1.2 Simon Wilkinson and Ben Angus of Conisbee visited site on 19th July 2022 and carried out the visual inspection of the structure.
- 1.3 No fixtures or fittings were removed, or intrusive/destructive testing undertaken, however comprehensive photographs were taken for record purposes. A selection of photographs is included in this report – others are available on request.
- 1.4 Whilst our investigation work has been taken far enough to satisfy the requirements of the brief, it has, of necessity, not been exhaustive. The findings cannot therefore be warranted to apply to areas of the building not inspected or investigated.
- 1.5 The building fabric has been assessed as observed at the time of inspection and the condition may be subject to change between the time of recording and commencement of works on site.
- 1.6 This report is intended for the use of our client, the Science Museum Group, and no liability can be accepted for use by any third party.
- 1.7 In summary, the requirements of our involvement are three-fold –
 - Establish that these structures are, and will remain, suitable to support the floor, roof, and walls in its current arrangement.
 - Appraise the condition and material of the structure to understand what maintenance or remedial works are likely to be required in the short and long term.
 - Based on findings, give recommendations for maximum floor loadings (by level and by bay) in kilograms per square metre.
- 1.8 This report builds on the previous preliminary structural appraisal by Conisbee carried out in 2018 (180426 / S Brookes report), & Hutton & Rostron's November 2018 timber condition survey report of the roof structure (210.58). This report should also be read in conjunction with Conisbee's defects and loading plans in Appendix B & C.

2.0 PROPERTY TYPE, CONSTRUCTION & CONTEXT

- 2.1 The 1830 Warehouse is Grade I listed for its special architectural and historic interest. The identity of the architectural designer remains speculative with both George Stephenson and Thomas Haigh being suggested as candidates however it is known to have been constructed by contractor David Bellhouse Jr in 1830. It is thought to be the world's first railway warehouse building and also forms a contiguous part of the world's first railway station, located on the opposite side of the viaduct to the south.
- 2.2 The building is slightly curved on plan, presumably to follow the line of the railway viaduct to south to which it abuts. For the purposes of this report, the elevations are assumed to be orthogonal about the compass axis. The building has 4 main storeys (inc. basement) but with an intermediate 'mezzanine' floor between Ground and 1st at Bays 1 and 2, only. Working top down, the floors are identified as follows –
- Roof
 - 2nd Floor
 - 1st Floor
 - Mezzanine Floor
 - Ground Floor
 - Basement
- 2.3 At roof level, the building presents as 10 individual gable-ended bays each with dual-pitched roofs with ridgelines running approximately north-south. The building description presented in this report follows the internal structural layout which is formed of five double bays each separated by load-bearing brickwork walls. The bays are numbered from 1 to 5 running west to east for ease of reference.
- 2.4 The structure generally comprises load bearing red brick walls laid in lime mortar in Flemish bond which form the outer envelope with brickwork internal cross walls running north south and separating each bay. The internal structure within each bay (including the roofs) comprises traditional cut timber framing. Queen post trusses span between bay cross walls and beams and columns providing support at the central valley of each bay. The trusses support 2 no. purlins to each pitch supported on cleats and embedded in the gable wall masonry.

2.5 Dimensions of timber floor structure elements as follows (depth x width) –

Basement, Ground & Mezzanine members:

- Timber columns 240mm x 250mm (3.6m centres north / south, and 4m east / west)
- Timber beams 360mm wide x 360mm
- Floor joists 250mm x 145mm (typically 530mm centres)

First & Second floor members:

- Timber columns 240mm x 250mm
- Timber beams 350mm wide x 330mm
- Floor joists 250mm x 145mm (typically 530mm centres)

2.6 Dimensions of timber roof elements as follows (depth x width) –

Queen-post trusses:

- Principal rafters 210mm x 120mm
- Tie beam 350mm x 180mm
- Straining beam 220mm x 130mm
- Queen posts 190mm x 120mm
- Struts 80mm x 80mm

Principal members:

- Upper purlin 240 x 150mm
- Lower purlin 240 x 150mm

2.7 The vertical loads from the roof trusses are transferred to the cross walls, gutter beams, and regularly spaced timber columns down to 'yard level,' then into cast iron columns at basement level and ultimately the building's foundations. Similarly, floor loading in each bay transfers from the floor joists into north south floor beams and into the timber columns and cast-iron columns at basement level.

2.8 Externally the bays on the north-east elevation generally follow a pattern of having either one or two full height loading-bay openings in the brickwork with either single or paired window openings at first and second floor level. Hoisting equipment to lift goods into the warehouse at each level was installed at the top of each slot opening and although no longer operational, remnant elements are present in most bays.

- 2.9 Hutton & Rostron undertook a localised inspection of internal structural timbers at the south elevation of Bay 4 in November 2015. This report addresses distortion and cracking in replacement timber lintels, beams, and joists (installed in 1992) and also notes that cracking has occurred in surrounding masonry following drying shrinkage of unseasoned timber. Recommended remedial actions include moderating heating levels within the building to reduce excessive drying, and thereby permit slow partial rehydration and expansion of the affected timber.
- 2.10 Hutton+Rostron conducted a further damp and timber decay survey at the roof frame (only) on 6-7 November 2018. The findings of this survey have been taken into consideration in this report, but reference should still be made to their report, in conjunction with Conisbee's.
- 2.11 Extensive repair works are understood to have been undertaken in around 1992 as part of a project to convert the building into a gallery space. The full extent of these works cannot be fully confirmed through reference to archive materials but internally appears through visual inspection to have included extensive timber repair and replacement, including to the bearing ends of tie beams, principal rafters, and purlins together with replacement of roof finishes and leadwork externally. Internal frame repairs include fabricated stainless-steel flitches with through-bolted connections and scarf joints.

3.0 INSPECTIONS & REPORTING

- 3.1 Our inspection methodology involved a visual inspection of the internal building structure, gaining hands-on access wherever possible and using a ladder where appropriate, to record and photograph each individual defective or deteriorated item or area. This provided a comprehensive record of the condition of the internal frame. Photos from the visual inspection are found in Appendix A. For general location of the photos, refer to the annotated floor plans in Appendix B.
- 3.2 No safe access was possible to the highest parts of the roof structure for inspection of structure or finishes, however there was no obvious further deterioration or change over and above matters reported by Hutton & Rostron in these areas.

4.0 OBSERVATIONS

Annotated floor plans relating to the below observations are provided in Appendix B. Note that the measured survey drawings are reflected ceiling plans, and as such the observations noted on the plans refer to the structure above, as visible from that level (i.e. notes on first floor plan relates to the floor structure of the second floor as viewed from below). Conversely, the structure elements described in this report are referred to in their direct location (i.e., first floor structure described is the floor structure of the first floor).

4.1 TIMBER FRAME

- 4.1.1 Deflection of the bottom chord of the primary longitudinal roof trusses was noted in multiple locations, suggestive of under-sizing and/or overloading. The deflection is most pronounced at Bay 2, where there has been historic overloading of the trusses during goods movement into and out the warehouse. Significantly sized lifting beams are secured to the side of these tie beams and running north-south between trusses. In 2 No. locations, the tie beam (bottom chord) has actually snapped (see photos 21 & 22).
- 4.1.2 Square Hollow Section (SHS) steel columns (4No) have been installed in recent times to prop the failed trusses as well as the adjacent truss to the North, which receives the other end of the old lifting beam. Tracking the location of these SHS props through the floor, it was noted that the columns are sat on the boards between joists, and away from primary North-South beams.
- 4.1.3 The tie beam of a primary truss to the south of the two locations noted above has also failed (see photos 23 & 24). The failure in the southern truss is close to the position of a knot which is a natural weak point, as well as being close to the king post tension rod, from which the tie beam is effectively hung.
- 4.1.4 The floor levels vary within each bay, with distortions in the plane of the floor easily visible to the naked eye (see photos 17 & 18), as well as noted from the spot levels on the measured survey. This local change in floor joist level is dictated by the level of their bearings at cross beams and ultimately, the level of the column supports. The magnitude of this variation shows a higher depression in the upper levels, notably in two locations the south side of Bay 2 & 3.

- 4.1.5 The timber floor framing at in the old platform locations at ground and 1st floor, typically uses a single bolt side fixed plate / corbel onto which the 1st floor primary beam dead-bears (see photos 11 & 12). In various locations shown on the observation plans, shrinkage and frame racking has reduced the bearing of timber beam, with very little contact remaining in some locations.
- 4.1.6 Throughout the building there are locations where initial design, shrinkage and frame racking has resulted in floor joists with minimal bearing (see photos 3, 4 and 9). This is exacerbated at column locations, where the full depth bearing of the columns from above further reduces the bearing of the floor joists.
- 4.1.7 Various timber joists and isolated timber beams are noted to show cracking (both longitudinal and shear), at ground, mezzanine and first floor level (see photo 13). The majority of locations the beams do not appear to be at risk of progressive failure, however the capacity of the beam remains limited by the reduced cross section.
- 4.1.8 Reference should also be made to Hutton & Rostron's timber condition report on the roof frame, although most structural defects in that report were repaired in recent Urgent Remedial Works package.

4.2 BRICKWORK ENVELOPE

- 4.2.1 Various 'fine' to 'moderate' vertical and diagonal cracks were noted at the cross walls of the building, particularly beneath lintel bearings at door penetrations. Some of these cracks have been filled with a cementitious grout mix.
- 4.2.2 At the north elevation, the brickwork piers between the loading bays were previously observed to be bulging outwards, and to have relatively poor lateral restraint. The bulging is likely attributable to a combination of axial shrinkage of the internal frame, combined with irreversible expansion of the brickwork following firing. The joist direction at the north elevation is generally parallel to the wall and supporting beam embedment's are therefore intermittent. Some steel restraint tie straps had been installed but some had later been cut to install perimeter trench heating circa 1992. New stainless steel restraint ties were installed across Bays 1 – 4 at first and second floor levels during the recent works to address the issue.

4.2.3 The floor joists at each level largely run longitudinally, parallel, and clear of the north and south long elevations, bearing onto cross walls between each bay and perpendicular primary beams (ridge and valley). These north-south spanning primary beams bear into pockets in the wall and along with the cross walls, provide intermittent restraint to the long elevations. Shrinkage of the timber appears to have reduced the bearing length of these embedded beams, but not observed to a concerning degree.

4.2.4 Vertical and diagonal cracking was noted at various locations up the inside face of the piers (see photo 7 & 8) either side of the tall doors at the North elevation, which possibly suggests high localised stresses. Historic crack filling was evident suggesting that the issue may be ongoing.

4.3 MOISTURE INGRESS

4.3.1 Minimal historic staining at top floor level was noted, localised to the top and sides of the valley beams, suggestive of historic valley gutter blockage, rather than liner failure.

4.3.2 There appears to be a small risk of moisture ingress at roof level in Bay 4 where the lime mortar torching beneath the roof tiles is not well keyed into the timber battens. This has been noted by the Science Museum Group as a concern due to the falling mortar elements.

4.3.3 There appears to have been a history of water penetration via the gable ends and many of the purlin bearings have been repaired as a result of timber decay. Salt crystallisation on the internal surface of the gable brickwork is indicative of a history of wetting and evaporation. These repeated cycles of dissolution/crystallisation have caused stresses within the brickwork, causing some minor spalling of brick faces in these areas. The gable ends have recently been repointed in lime mortar externally which should reduce moisture penetration and provide accelerated drying as compared to the previous cementitious pointing.

- 4.3.4 The majority of the timber throughout the structure appears to be dry and without substantial historic or current decay – the majority of these issues were addressed in the early 1990s and then subsequently in the most recent works. There are a small number of locations at ground, mezzanine and first floor level where some deterioration is apparent that has not been previously addressed. These areas are currently dry but the extent of any loss of structural integrity can't be visually confirmed. Photo 10 shows a typical location in Bay 1 as viewed at ground floor.

4.4 METALWORK

- 4.4.1 Minor surface corrosion was apparent on the horizontal bearing face of the basement level cast iron column heads. No significant section loss was evident, and no remedial works are required, although the shoe is without weep holes and moisture could get trapped.
- 4.4.2 At basement level, there was moderate surface corrosion noted in Bay 1 where diagonal iron beams are embedded in the corners to support the primary timber floor beams (see photo 1). This has resulted in some minor spalling of brick faces in these areas. No significant section loss was evident.
- 4.4.3 A heavily corroded downpipe penetrates through the inside face of the South wall at basement level. There is no evidence of salt deposits or tide marks around the opening which may suggest the penetration does not pass through the full thickness of the wall, but the pipe itself is exhibiting moderate to high levels of corrosion and further investigation is warranted to determine its functionality.

4.5 FOUNDATIONS

- 4.5.1 Inspection at basement level showed variation in the cast iron column's foundations, with some on monolithic stone bases, some on cast concrete pads. The perimeter brick wall at basement level supports the north south floor beams and structure above, and also works as a retaining wall. The foundations to the wall are not visible onsite but assumed to be corbelled brick footings.

5.0 DISCUSSION

5.1 Following Conisbee and Hutton & Rostron's on-site inspection work, the assessment of the structure has adhered to the following process:

- Review historical and chronological context.
- Understand the performance of the structural system (construction, load transfer, stability).
- Review the condition of structural members and investigate the causes of any defects discovered.
- We have structurally modelled elements to aid our understanding of the structural behaviour of the frame and have undertaken a design check to assess its capacity and give recommendations for maximum floor loadings (by level and by bay) in kilograms.

5.2 Hutton & Rostron's 2018 timber species assessment provided the basis for our structural assessment of the frame –

- Roof framing - Softwood Scots pine (*Pinus sylvestris*)
- Posts/Columns - Hardwood Oak (*Quercus spp*) OR Hardwood Sweet Chestnut (*Castanea sativa*)

5.3 The broad approach of the loading assessment and repair recommendation work is to attempt to prevent future deterioration based on a minimum intervention approach in line with sound conservation principles. The aim is to retain as much of the existing fabric as possible and to incorporate good conservation maintenance, by repairing currently defective elements using compatible techniques and materials that will not compromise the long-term health of the building structure and decorative features.

5.4 Generally, the timber frame is sound and not unduly concerning from a structural perspective. The speed with which this building was erected is evident in the form of rudimentary jointing with initial limited bearing, which is exacerbated in some locations (primarily beneath columns) by unchecked drying shrinkage of the horizontal members.

- 5.5 The primary concern resulting from the axial shrinking, initial construction and supplementary repairs issues focuses on the limited bearing area of many of the timber beams and joists. Whilst in most cases the limited bearing does not appear to result from progressive movement, a repair in multiple locations to enhance the bearing would be recommended to enhance the load capacity and robustness of the structure.
- 5.6 It is evident that historic local overloading of the truss bottom chords in second floor Bay 2 is the cause of the additional, more pronounced deflection and tie beam failure. Semi-permanent propping in the form of SHS posts have been installed (likely in 1992) and serve to transfer the roof load to the floorboards and joists of the 2nd floor, and away from primary structure. The failure of the tie beam in this Bay 2 truss means that the post at this location will be receiving the majority of the roof load, and it is our opinion that the floorboards and joists under are not suitable to receive such loading in the long term. Whilst no failure is evident in the boarding, minor stress fractures were seen in the joist directly below the prop that is beneath the failed truss A repair should be implemented to re-establish the structural integrity of this tie beam thereby re-instating the original load path down the primary timber posts.
- 5.7 The truss bottom chord immediately to the south of the propped trusses has also failed with vertical cracking observed. The failure in the tie beam is close to the king post tension rod, which is the location of the greatest vertical load in the truss. As such a repair should be implemented to enhance the shear capacity of the tie beam and enhance the robustness of the truss.
- 5.8 Our on-site observations showed that the floor plates at each floor level and within each bay were at variable levels. Axial shrinkage of the timber columns will undoubtedly have affected the length of each column and consequently the bearing level of each primary beam, on-site review showed the magnitude of depression to be most pronounced at first and second floor level on the south side of Bays 2 & 3. New columns are observed directly beneath these depressions at ground floor level, and it is assumed that the additional axial shrinkage of the new columns along with the inevitable settlement during install has resulted in these locations having greater magnitude of depression.

- 5.9 Localised areas of brickwork and stonework joints at the inside face have been re-pointed using a modern conventional sand and cement mortar. The age of this work could not be confirmed however it is unlikely to post-date the known previous internal repair works undertaken in 1992 due to increased awareness of appropriate mortar choice and planning controls.
- 5.10 Various brick piers at basement level displayed vertical cracking adjacent to timber beam bearing, which possibly suggests high localised stresses. Historic crack filling is evident in some locations. Whilst the brick piers do not appear to be at risk of failing, providing re pointing and reinforcement across the cracks will tie the piers into the perimeter walls re-establishing the robustness of the structure.
- 5.11 At basement level, there was moderate corrosion noted in Bay 1 where diagonal iron beams are embedded in the corners to support the primary timber floor beams. This corrosion is to be expected as the masonry at this level retains the damp earth beyond. This has resulted in some minor spalling of brick faces in these areas. It appears that no significant section loss was evident, however this should be cleaned down to expose the degree of corrosion.
- 5.12 The majority of the timber throughout the structure appears to be dry and without substantial historic rot decay. However, for the small number of locations at ground, mezzanine and first floor level where deterioration due to moisture is apparent, it is recommended to have Hutton & Rostron inspect and report on the timber condition.

6.0 LOADING RECOMMENDATIONS

- 6.1 Annotated floor plans of the allowable imposed loading described below are provided in Appendix C.
- 6.2 Whilst this investigation has been taken far enough to inform the load recommendations, it has not been exhaustive and as such occurrences of localised hidden defects to the structure may be present, altering the localised structural performance. It is recommended that local checks should be made prior to positioning any high concentrated loads to ensure they do not overload areas with defects.

- 6.3 The vertical loads from the roof are transferred to the roof trusses and in turn are passed through the cross walls and through regularly spaced timber posts down to 'yard level' and into cast iron columns at basement level. The existing floor structure consists of timber joists which span onto primary timber beams and into the columns down to yard level. The lateral stability of the structure is maintained by horizontal loads being transferred through the plate action of the floor structure and into the brick walls in the longitudinal and transverse direction. Additionally, the timber structure provides a degree of sway frame stability due to its double height columns and bracing elements.
- 6.4 The analysis of the individual members determined that the capacity of a typical grid of timber joist, beams, and columns (sizes taken from the smallest observed on site) was limited by the primary timber beams (see photo 9) which ranged from 330mm x 340mm to 360mm x 380mm. The maximum allowable imposed load capacity assessed for the general floor grid is 2.5kN/m².
- 6.5 The above typical grid loading has been reduced in areas where defects are noted to have an impact on load capacity and robustness of the structure (i.e., notched ends of floor joists with minimal bearing). These areas have been assessed to have an allowable imposed load capacity of 1.5kN/m². If repairs are undertaken, the allowable imposed loads may be increased.
- 6.6 The stair wells, circulation spaces, and steel structure in bay 5 at ground, first and second floor level was constructed in the late 20th Century. These areas have been assessed as having an allowable imposed load capacity of 4.0kN/m². This is based on the observed structural layout, condition, and the assumed code requirements during the time of design / construction. The Eurocode (C35) and former British Standard requirements for load capacity of imposed loading stairs, landings in public, museum or institutional buildings is 4.0kN/m².
- 6.7 The basement level floor structure is observed to be typically a ground bearing brick floor. These are understood to be founded on the well consolidated made ground and the underlying dense gravelly sand. The basement is assessed to have an allowable imposed load capacity of 10kN/m².

7.0 RECOMMENDATIONS AND REPAIRS

- 7.1 The majority of the more minor defects affecting the durability of the structure can be addressed with relatively minor, yet carefully considered repairs. These should be approached by a specialist conservation repair contractor.
- 7.2 The overall structural stability of the internal timber frame is adequate, with the early 1990's repairs addressing the majority of major works. There are outstanding significant issues relating to the acceptability of the historic propping of such trusses in Bay 2; deterioration of adjacent truss; the limited bearing of a proportion of the floor joists onto floor beams; and the deflection of the primary transverse trusses.
- 7.3 Our outline remedial recommendations are as follows:
- 7.3.1 Minimal bearing –
- Ground floor (observed from basement). A primary beam splice is positioned at the edge of a cast iron column head plate. The connection should be reinforced to reduce eccentric loading of the cast iron column.
 - Ground floor structure (observed from basement) - Bay 1, 3 and 4. Floor joists have reduced bearing length on the floor beams in multiple locations. Continue to monitor the locations and avoid overloading the floor structure.
 - First floor structure (observed from ground) – Bay 2. Floor joists have reduced bearing length on the floor beams in various locations. Continue to monitor the locations and avoid overloading the floor structure.
 - Roof truss. A reduced bearing length of an upper beam at a primary roof truss in Bay 2. Install formal monitoring devices.
 - Where additional load capacity is required beyond that recommended, support brackets should be installed in locations of minimal bearing to enhance the robustness of the floor structure.
- 7.3.2 Heavily split mezzanine floor joists -
- Severe shrinkage of floor joists visible from ground floor level in Bay 2 has led to significant splitting. The joists should be replaced in the long term, like for like in both materials and dimensions.

7.3.3 Failed trusses, Bay 2 –

- Discuss with the Science Museum Group regarding their options for removing the propping.
- To facilitate removing the propping, the bottom chord of the truss should be strengthened across the length of the failed chord using new steel plate details. A repair detail would likely involve plates bolted either side of the bottom chord to span from primary valley beam to wall. Failure and significant bowing of existing bottom chords makes member recovery difficult. Careful consideration of temporary works would be required for all remediation options.
- The failure of the bottom chord of the southern truss in Bay 2 should be addressed using localised plate repairs.

7.3.4 Cracked basement and ground floor brick piers, Bay 1 & 2 –

- Whilst the brick piers do not appear to be progressively failing, diagonal and vertical cracking reduces the robustness of the structure and bearing capacity.
- Install monitoring devices across the cracks,
- Where additional capacity is needed in the floor structure, providing horizontal bed joint reinforcement and re-pointing should be carried out in the brick piers.

7.3.5 Moisture ingress -

- Maintenance of the valley gutters and hoppers serving the rainwater goods should be continued to ensure no gutter overtopping.
- Cleaning of the corroded elements at basement is recommended to assess to extent of section loss and confirm if measures are required to limit progressive corrosion.

8.0 APPENDIX A – PHOTOGRAPHS



Photograph 01: Looking at the southwest corner. corrosion in corner support to ground floor timber floor beam



Photograph 02 – Vertical cracking through a primary beam support pier at the South wall at basement level.



Photograph 03, 04: limited bearing of timber floor joist.

Note base of timber column above floor beam. This limited bearing has been addressed in various areas of the building, however, there remains floor joists which are at increased risk of end bearing / dynamic failure



Photographs 05 - Stepped cracking, mortar loss and historic re-pointing at the face and return of the piers.



Photograph 06 - Floor beam 'but' connection off centre overcast iron column. s. floor beam eccentrically loading cast iron plate.



Photograph 07 – A full height photo of a ground floor pier at the inside of the Northern elevation, showing the extent of vertical cracking evident through bricks.



Photograph 08 – A photo of a ground floor pier at the inside of the Southern elevation, providing limited lateral restraint to the head of the wall.



Photograph 09 – View of limited bearing of floor joist on floor beam, and brick cracking beyond.



Photograph 10 – View from ground floor level of degraded timber post and beam, H&R to review level of rot.



Photograph 11, 12 – View from ground floor (11) mezzanine (12) of east west beams with limited bearing on vertical plate. Vertical plate bolted to column using single M20 bolt. Shrinkage and frame racking has pulled the timber off this bearing and it now very little contact remains.



Photograph 13 – View from mezzanine floor level of cracking in floor joist.



Photograph 14 – Service penetrations in precast concrete planks observed from first floor. locally filled using resin / mastic, however minimal corrosion assumed based on staining.



Photograph 15 – View from first floor level of degraded timber post and beam, H&R to review condition of timber.



Photograph 16 – View from first floor level of diagonal cracking in floor beam.



Photograph 17, 18 – View from first (16) and second (17) floor level of general depression in floor level



**Photograph 19 – Steel props at second floor beneath roof truss ties.
Note props load onto second floor beams below (i.e., they are not over columns)**



Photograph 20 – A general view of the top floor of the building, showing typical arrangement of regularly spaced timber columns, block corbel heads and primary valley beams onto which the timber Queen post trusses sit.



Photograph 21 – Square Hollow Section columns (4No), serve to prop failed trusses at the East side of Bay 2.



Photograph 22 – The column head plates are pressed firmly to the underside of the trusses using a threaded plate separation system.



Photograph 23 – Roof truss to the south of propped trusses in Bay 2, with cracking of main tie.



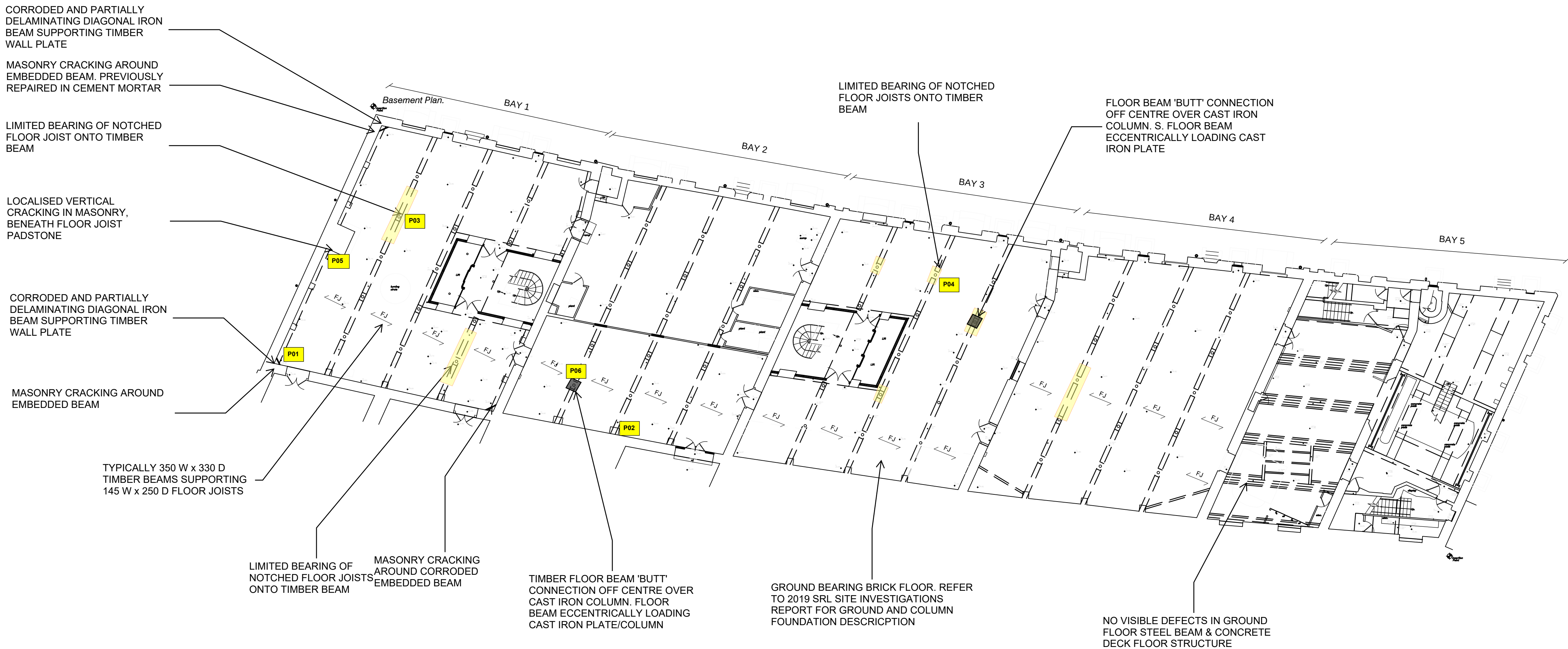
Photograph 24 – Close up of roof truss cracking, to the south of propped trusses in Bay 2, with cracking of main tie.



Photograph 25 & 26 – Roof truss in Bay 1 showing high level splitting in principal rafter.

9.0 APPENDIX B – DEFECTS PLANS

NOTE:
TIMBER STRUCTURE SHOWN IS AT HIGH
LEVEL □ REFLECTED CEILING PLAN □



GENERAL NOTES

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

STRUCTURAL CONSERVATION NOTES

- DRAWINGS ARE TO BE READ IN CONJUNCTION WITH CONISBEE'S STRUCTURAL ASSESSMENT REPORT.
- A SPECIALIST TIMBER DECAY SURVEY IS RECOMMENDED IN CERTAIN LOCATIONS TO FULLY QUANTIFY THE EXTENT OF REPAIR AND REPLACEMENT TO HISTORIC TIMBER STRUCTURE.
- DEFECTS AND OBSERVATIONS SHOWN ARE THOSE VISUALLY CONFIRMABLE ONSITE. FURTHER DEFECTS AND / OR WORK REQUIREMENTS MAY BECOME APPARENT FOLLOWING REMOVAL OF FINISHES AND OTHER INTRUSIVE INVESTIGATIONS.
- THE DESIGN INTENT IS TO RETAIN AND REPAIR AS MUCH EXISTING HISTORIC STRUCTURE AND FABRIC AS POSSIBLE. IT IS ANTICIPATED THAT TRADITIONAL CARPENTRY TECHNIQUES WILL BE USED FOR TIMBER REPAIRS SUPPLEMENTED BY STEEL PLATE OR BRACKET STRENGTHENING WHERE APPROPRIATE.
- WHERE REPLACEMENT IS REQUIRED, THIS WILL BE UNDERTAKEN ON A LIKE FOR LIKE BASIS AND INCORPORATE DISCRETE STRENGTHENING WHERE NEEDED.

DRAWING KEY

DEFECT PHOTO REFERENCE:

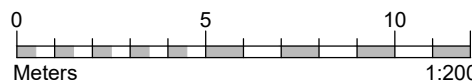
AREA OF LIMITED FLOOR
JOIST BEARING:

LOCATION OF ECCENTRIC LOADED
CAST IRON COLUMN:

LOCATION OF SUSPECTED TIMBER
DETERIORATION FOR H&R REVIEW:

ISOLATED TIMBER FAILURE NOTED:

P10



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P1 29.09.22 FOR INFORMATION BA SW

Rev Date Description Drawn Check

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Drawing Status INFORMATION

Project
SIM - 1830 WAREHOUSE
INTERNAL STRUCTURE

Date SEP 2022

Scale 1:200@A1

Drawn SW

Title
BASEMENT PLAN OBSERVATIONS &
STRUCTURAL DEFECTS

Engineer SW

Drawing No
220626-CON-XX-00-DR-S-1099

Project No
220626

Revision
P1

NOTE:
TIMBER STRUCTURE SHOWN IS AT HIGH
LEVEL (REFLECTED CEILING PLAN)

GENERAL NOTES

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STRUCTURAL CONSERVATION NOTES

- DRAWINGS ARE TO BE READ IN CONJUNCTION WITH CONISBEE'S STRUCTURAL ASSESSMENT REPORT.
- A SPECIALIST TIMBER DECAY SURVEY IS RECOMMENDED IN CERTAIN LOCATIONS TO FULLY QUANTIFY THE EXTENT OF REPAIR AND REPLACEMENT TO HISTORIC TIMBER STRUCTURE.
- DEFECTS AND OBSERVATIONS SHOWN ARE THOSE VISUALLY CONFIRMABLE ONSITE. FURTHER DEFECTS AND / OR WORK REQUIREMENTS MAY BECOME APPARENT FOLLOWING REMOVAL OF FINISHES AND OTHER INTRUSIVE INVESTIGATIONS.
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DRAWING KEY

DEFECT PHOTO REFERENCE:

AREA OF LIMITED FLOOR
JOIST BEARING:

LOCATION OF ECCENTRIC LOADED
CAST IRON COLUMN:

LOCATION OF SUSPECTED TIMBER
DETERIORATION FOR H&R REVIEW:

ISOLATED TIMBER FAILURE NOTED:

P10

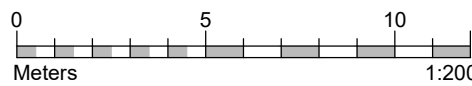
P10

P10

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P10



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P1 29.09.22 FOR INFORMATION BA SW

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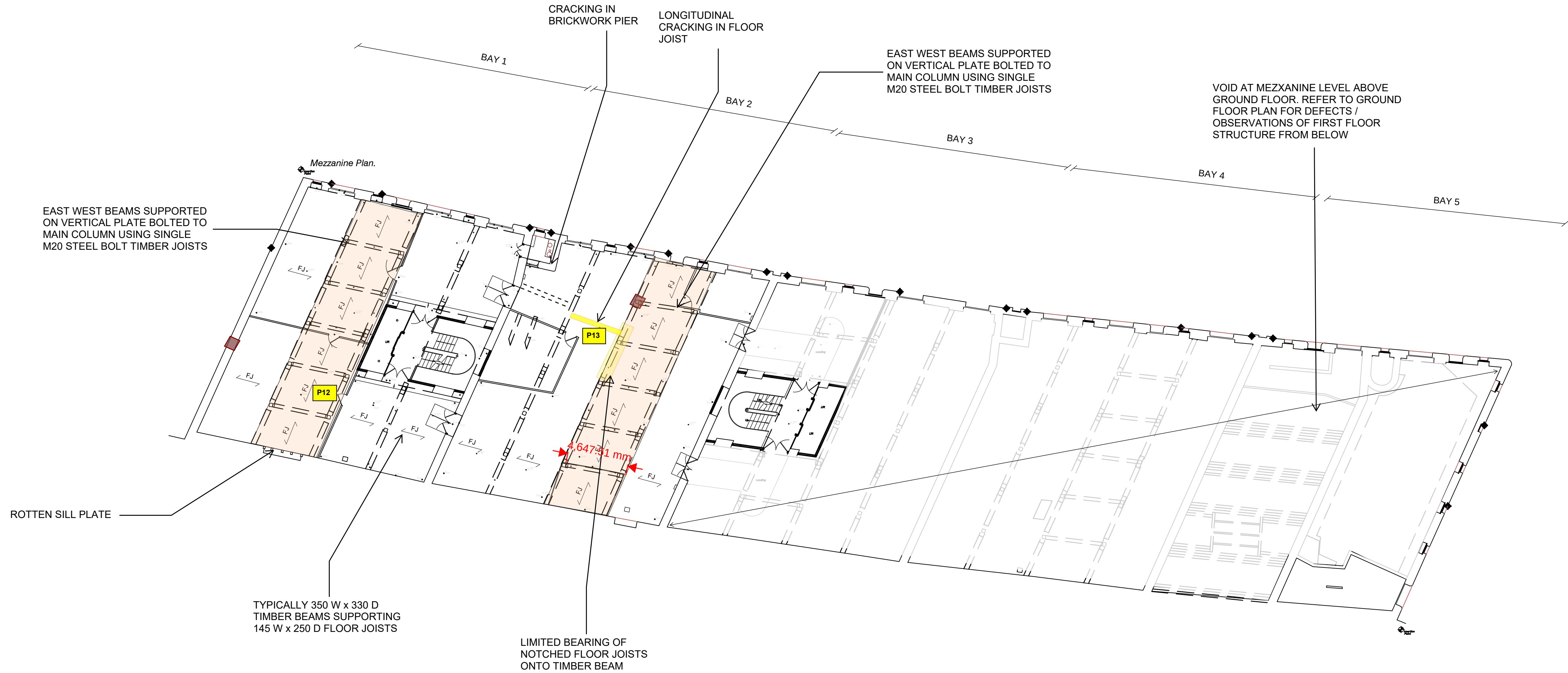
Drawing Status
INFORMATION

Project Date SEP 2022
SIM - 1830 WAREHOUSE Scale 1:200@A1
INTERNAL STRUCTURE Drawn SW

Title Engineer SW
GROUND FLOOR PLAN OBSERVATIONS
& STRUCTURAL DEFECTS oject No
20626

Drawing No Revision
220626-CON-XX-00-DR-S-1100 P1

NOTE:
TIMBER STRUCTURE SHOWN IS AT HIGH
LEVEL (REFLECTED CEILING PLAN)



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JOIST BEARING:

LOCATION OF ECCENTRIC LOADED
CAST IRON COLUMN:

LOCATION OF SUSPECTED TIMBER
DETERIORATION FOR H&R REVIEW:

ISOLATED TIMBER FAILURE NOTED:

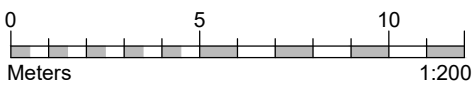
P10

P12

P13

P14

P15



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Drawing Status INFORMATION

Project
SIM - 1830 WAREHOUSE
INTERNAL STRUCTURE

Date SEP 2022
Scale 1:200@A1
Drawn SW
Engineer SW

Title
MEZZANINE PLAN OBSERVATIONS &
STRUCTURAL DEFECTS

Project No
220626

Drawing No
220626-CON-XX-00-DR-S-1101

Revision
P1

NOTE:
TIMBER STRUCTURE SHOWN IS AT HIGH
LEVEL (REFLECTED CEILING PLAN)

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DEFECT PHOTO REFERENCE:

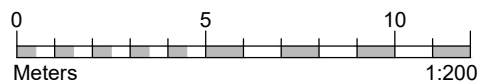
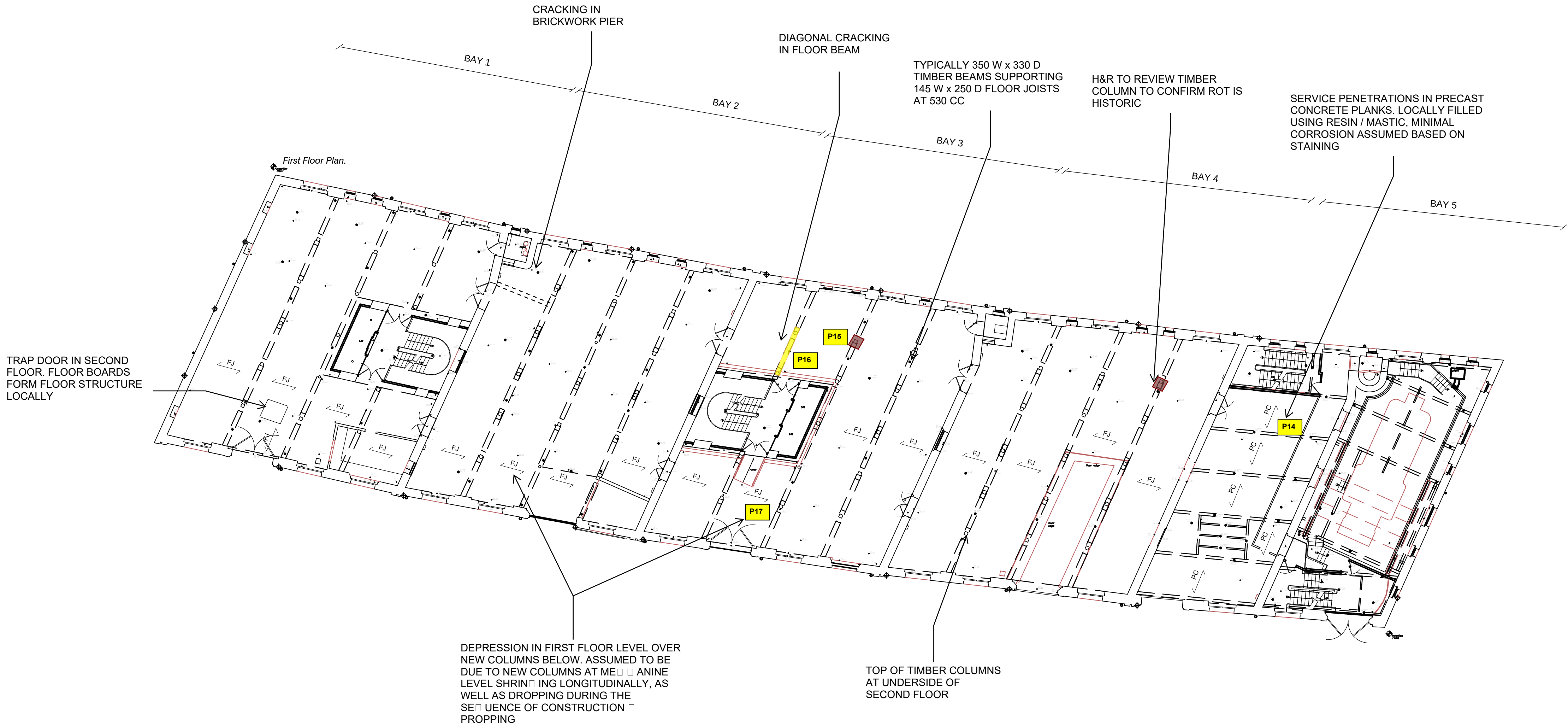
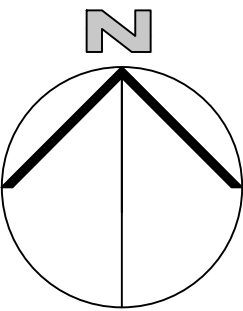
AREA OF LIMITED FLOOR
JOIST BEARING:

LOCATION OF ECCENTRIC LOADED
CAST IRON COLUMN:

LOCATION OF SUSPECTED TIMBER
DETERIORATION FOR H&R REVIEW:

ISOLATED TIMBER FAILURE NOTED:

P10



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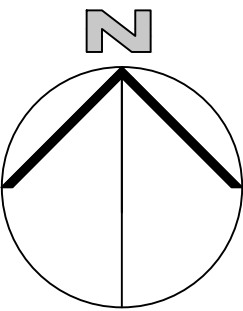
P1	29.09.22	FOR INFORMATION	BA	SW
Rev	Date	Description	Drawn	Check

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Drawing Status
INFORMATION

Project	Date	SEP 2022
SIM - 1830 WAREHOUSE INTERNAL STRUCTURE	Scale	1:200@A1
Title	Drawn	SW
FIRST FLOOR PLAN OBSERVATIONS & STRUCTURAL DEFECTS	Engineer	SW
Drawing No 220626-CON-XX-00-DR-S-1102	Project No 220626	Revision P1

NOTE:
TIMBER STRUCTURE SHOWN IS AT HIGH
LEVEL (REFLECTED CEILING PLAN)



GENERAL NOTES

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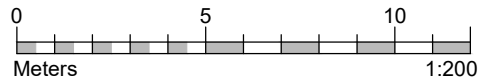
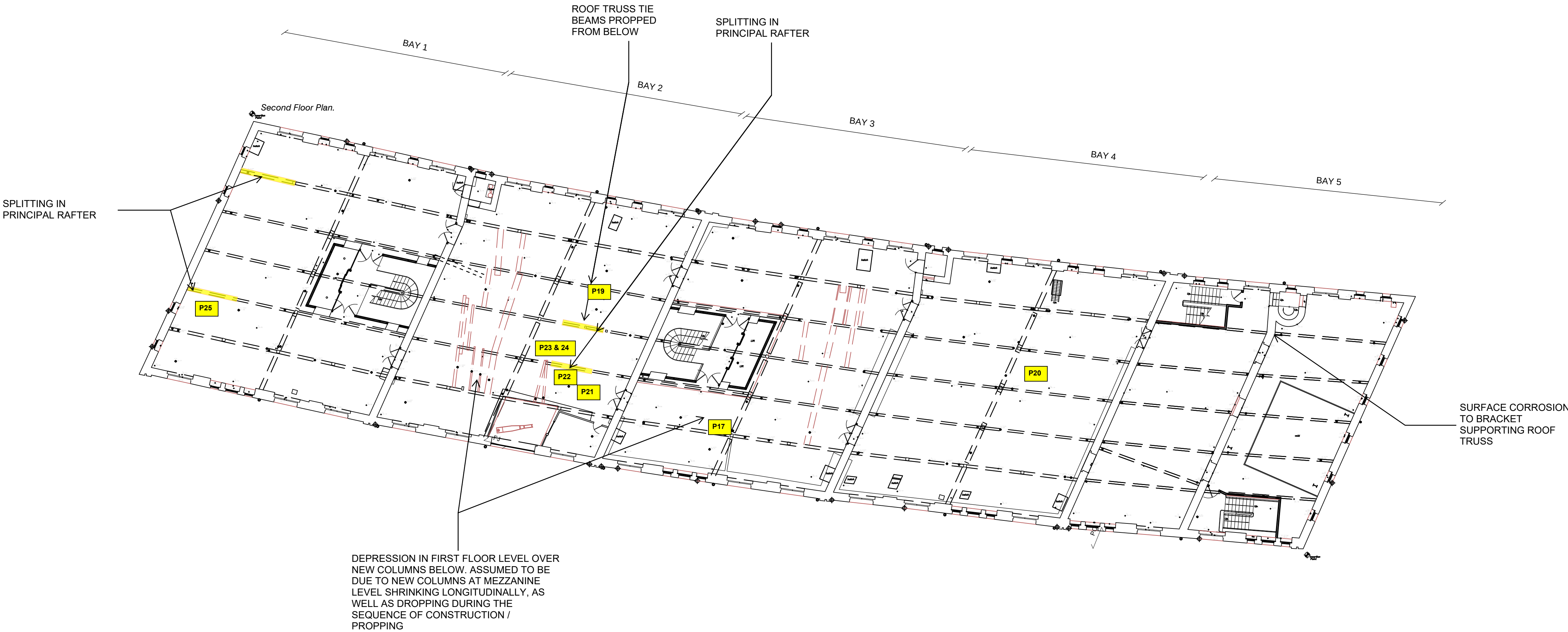
AREA OF LIMITED FLOOR
JOIST BEARING:

LOCATION OF ECCENTRIC LOADED
CAST IRON COLUMN:

LOCATION OF SUSPECTED TIMBER
DETERIORATION FOR H&R REVIEW:

ISOLATED TIMBER FAILURE NOTED:

P10



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P1	29.09.22	FOR INFORMATION	BA	SW
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Project	Date SEP 2022
SIM - 1830 WAREHOUSE INTERNAL STRUCTURE	Scale 1:200@A1
	Drawn SW
Title	Engineer SW
SECOND FLOOR PLAN OBSERVATIONS & STRUCTURAL DEFECTS	Project No 220626
Drawing No 220626-CON-XX-00-DR-S-1103	Revision P1

10.0 APPENDIX C – MAXIMUM LOADING PLANS

GENERAL NOTES

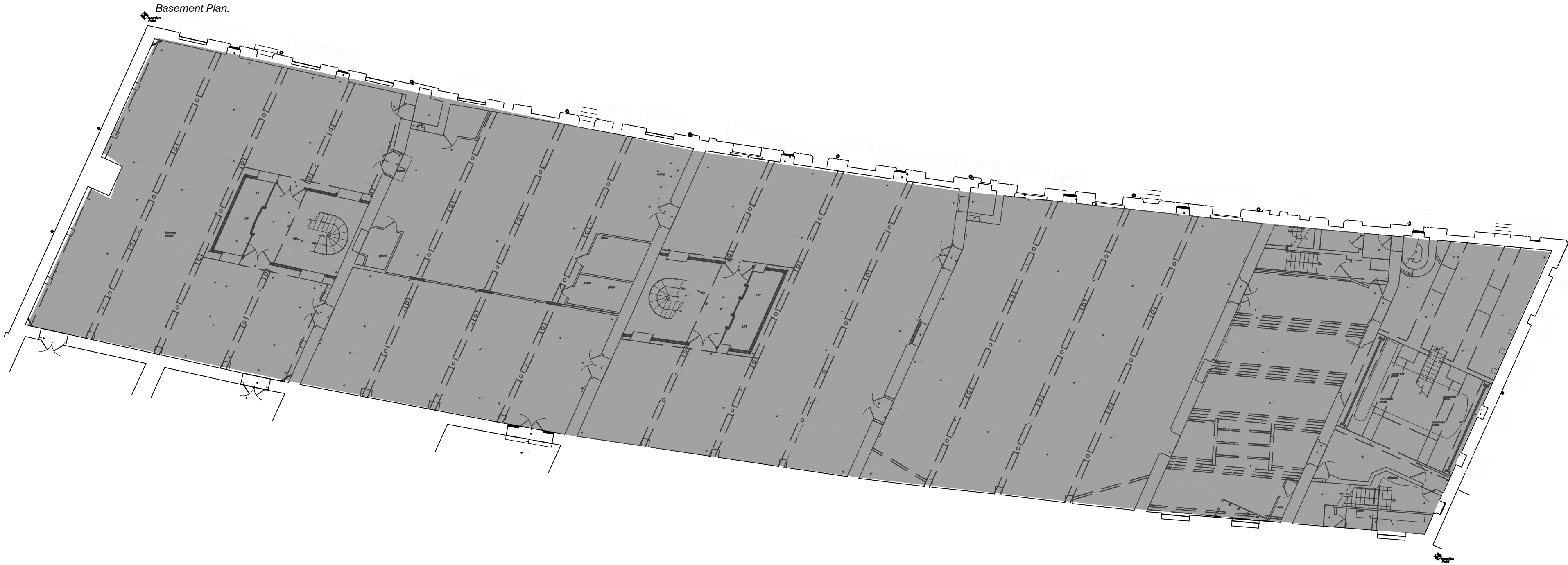
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LOADING NOTES

- SHOULD IT BE PROPOSED THAT THE LOADING BELOW IS EXCEEDED THEN CONISBEE SHOULD BE CONTACTED TO PROVIDE ADDITIONAL ADVICE. FURTHER CAPACITY MAYBE POSSIBLE BUT SHOULD BE INVESTIGATED ON A CASE BY CASE BASIS, FOR EXAMPLE CRANE LOADINGS.
- THIS AREAS ASSESSMENT LOADING DRAWING IS BASED UPON THE FINDINGS OUTLINED IN CONISBEE REPORT 220626/B ANGUS.
- THE STRUCTURE HAS ONLY PARTIALLY BEEN INSPECTED IN PART TO INFORM THESE RECOMMENDATIONS, BUT OF NECESSITY HAS NOT BEEN FULLY INSPECTED. AS SUCH NO LIABILITY CAN BE TAKEN FOR UNKNOWN LOCALISED DEFECTS, VOIDS OR DEVIATIONS TO THE STRUCTURE, AS WELL AS UNKNOWN BELOW GROUND SERVICES OR ANY OTHER UNKNOWN FEATURES NOT INSPECTED BY CONISBEE.
- LOCAL CHECKS SHOULD BE MADE PRIOR TO POSITIONING HIGH CONCENTRATED LOADS TO ENSURE THEY DO NOT LOAD AREAS NOTED WITH DEFECTS

ALLOWABLE IMPOSED LOADING SCHEDULE

1000 Kg/m2	
400 Kg/m2	
250 Kg/m2	
150 Kg/m2	



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Drawing Status INFORMATION	
Project	Date SEP 2022
SIM - 1830 WAREHOUSE INTERNAL STRUCTURE	Scale 1:200@A1
	Drawn SW
Title	Engineer SW
BASEMENT PLAN RECOMMENDED FLOOR LOADING	Project No 220626
Drawing No 220626-CON-XX-00-DR-S-10991	Revision P1