

21008 Warwick Mill, Middleton, M24 1AZ
January 2022 Structural Appraisal Report

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Non-technical Summary

Warwick Mill was constructed in circa 1908 as a cotton mill. The building is Grade II listed.

The existing building is generally five storeys high. The structure comprises load-bearing masonry perimeter walls, cast-iron columns and steel floor beams (tbc by investigations) with jack-arch masonry spanning between the beams. The building has spread footings.

It is proposed that the building be converted to residential apartments, an additional penthouse storey be added and two large atriums be cut in the floor plates to provide light down the building.

MHA visited the property and viewed areas of the structure that were exposed. Intrusive structural investigations are proposed to commence in the near future.

MHA visited Oldham Archives and viewed the record drawings of the mill from the time of its original construction.

Based on site observations, the record drawings and structural literature, MHA's preliminary structural assessments show the proposed works to be structurally feasible and not detrimental to the robustness or the performance of the listed building. More detailed assessments will be undertaken upon completion of the intrusive superstructure and substructure investigations.

It is proposed that the robustness, load-capacity and load-distribution of the floors be improved by the installation of a reinforced concrete structural topping over the masonry jack-arch floors. The lateral stiffness of the building will be improved by the provision of steelwork cross-bracing, concealed in partitions, between selected bays of cast-iron columns.

The proposed new roof over the atria is to be formed with a transparent Ethylene Tetra Fluoro Ethylene (ETFE) single ply membrane, supported by new steel beams spanning the width of the atrium, that bear onto cast-iron columns (recycled for the top storey from the partial demolition of the floor plates to create the atria).

The new penthouse storey is to be formed from light steel gauge walls and roof construction, bearing onto the existing roof jack-arch floor with the proposed structural topping.

At Lower Ground Floor (LGF) Level, a new centrally located enlarged opening is to be formed in the external wall to create a new main entrance to the property. The opening is to be formed with two steel box-frames, side by side. The box-frames allow the loads from above to be spread along the existing footings in a load-path similar to the existing condition.

Similar twin new steelwork box-framing is to be installed for the new bike store opening at LGF level on grid 2, for the new car entrance at LGF level on grid 2/E-F, and for the multiple storey opening in the rope-race wall on grid 15.

To maximise the preservation of the listed building and to minimise the environmental impact of building works (in terms of embodied carbon), the structural objective is to maximise the retention of the existing structure. Structure is to be exposed, expressed and enjoyed in the atrium and the soffit of the jack-arch floors around the perimeter of the building.

To the west of Warwick Mill is a vacant and dilapidated office building called London House, constructed in circa 1970. It is proposed that this building be demolished and replaced by a new residential tower, 10 storeys high, with a stepped profile. It is proposed that this be constructed using reinforced concrete flat-slab construction with reinforced concrete cores. Storey-high reinforced concrete walls at Upper Ground Floor (UGF) level act as deep cantilever beams to transfer loads where the columns in the residential units above UGF do not align with the columns in the LGF car park.

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1.0 Introduction

Warwick Mill was constructed in 1908 as a cotton mill. The building is Grade II listed.

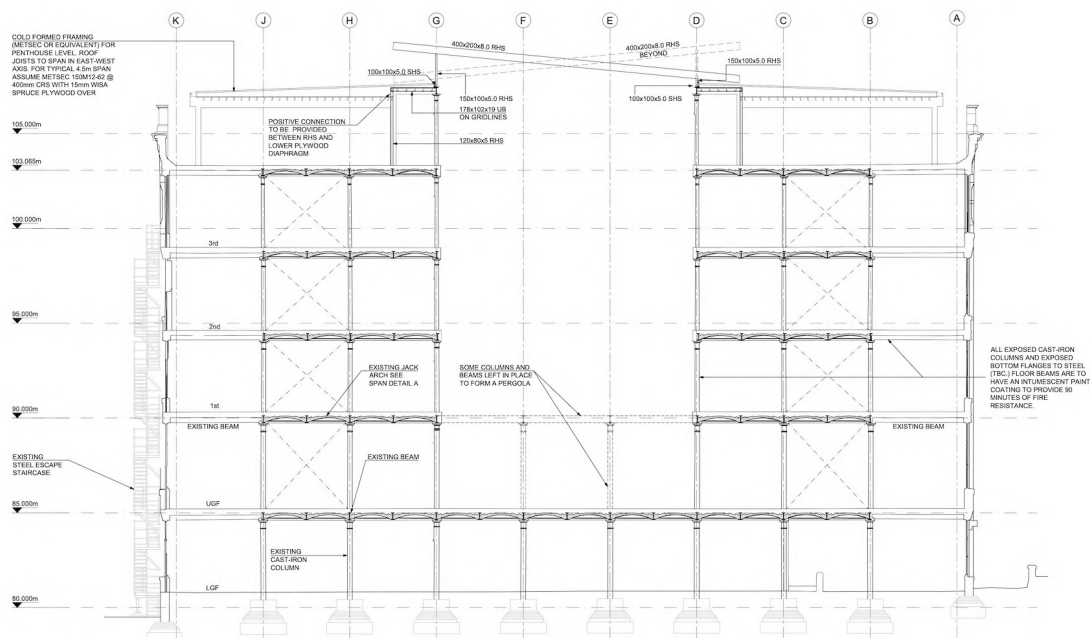
The existing building has five main storeys and the main floor plates are approximately rectangular, at around 80m x 42m. In addition, the building has a basement area in the southeast corner. The Lower Ground Floor (LGF), steps up around 650mm on the western section (less than half of the floorplate), with the step occurring between grids 6 & 7.

The structure comprises load-bearing masonry perimeter walls, cast-iron columns and steel floor beams (tbc by investigations) with jack-arch masonry spanning between the beams. The building has spread footings.

In the northeast corner of the building is a large water tower, square on plan, which extends above the main floors. The tower now houses telecommunications equipment (mobile phone masts).

Wince Brook is located along the southern boundary to the site.

It is proposed that the building be converted to residential apartments, an additional penthouse storey be added, and two large atriums be cut in the floor plates to provide light down the building. The below drawing extract shows the typical proposed structural cross-section.



Intrusive structural investigations are proposed to commence in the near future.

Based on site observations, the record drawings and structural literature, MHA's preliminary structural assessments show the proposed works to be structurally feasible and not detrimental to the robustness or the performance of the listed building. More detailed assessments will be undertaken upon completion of intrusive superstructure and substructure investigations.

It is proposed that the robustness, load-capacity and load-distribution of the floors be improved by the installation of a reinforced concrete structural topping over the masonry jack-arch floors. The lateral stiffness of the building will be improved by the provision of steelwork cross-bracing, concealed in partitions, between selected bays of cast-iron columns.

The proposed new roof over the atria is to be formed with a transparent Ethylene Tetra Fluoro Ethylene (ETFE) single ply membrane, supported by new steel beams spanning the width of the atrium, that bear onto cast-iron columns (recycled for the top storey from the partial demolition of the floor plates to create the atria).

The new penthouse storey is to be formed from a light steel gauge walls and roof construction, bearing onto the existing roof jack-arch floor, with the proposed structural topping.

To the west of Warwick Mill is a vacant and dilapidated office building called London House, constructed in circa 1970. It is proposed that this building be demolished and replaced by a new residential tower, 10 storeys high, with a stepped profile. It is proposed that this be constructed using reinforced concrete flat-slab construction with reinforced concrete cores. Storey-high reinforced concrete walls at Upper Ground Floor (LGF) level act as deep cantilever beams to transfer loads where the columns in the residential units above UGF do not align with the columns in the LGF car park.

This structural appraisal is to demonstrate to the Planning Authority that the proposed use and structural alteration work will not be detrimental to the structural integrity of the mill or compromise its Listed status. Close cooperation with the Planning Authority, English Heritage and the Approved Building Regulations Inspectors is envisaged.

The information contained in this note is based upon:

- GMA Architect's drawings
- Oldham Archives' record drawings from the original construction
- RSK's – Phase 1 – Preliminary Risk Assessment dated December 2021
- A site visit.
- Preliminary designs and calculations.
- British Geological Survey (BGS) maps and borehole logs.
- Record survey drawings.
- Previous planning applications on Rochdale Council's planning portal website.
- Historical Structural Steelwork Handbook by BCSA.
- Structural Appraisal of Iron-Framed Textile Mills by the Institution of Civil Engineers (ICE)
- Structural Renovation of Traditional Buildings – by Ciria Report 111

- Appraisal of Existing Iron and Steel Structures – SCI 138
- Department of Transport BD21
- The Building Regulations and BCA Technical Guidance Note 21
- IStructE Paper – Investigation, appraisal, and reuse of a cast-iron structural frame – Feb. 1998
- Record photographs

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2.0 The site and existing structures

2.1 Site history

Warwick Mill is a typical early 20th Century Edwardian cotton mill located on Oldham Road. It was constructed to a standard design, by G. Stott of Joseph Stott & Son Architects in circa 1908.

Record drawings from the original construction are contained in Oldham Archives. A selection of the drawings is provided in Appendix A.

The engine house (in the southeast corner) powered the looms and heavy textile machinery in the mill, via a rope race linked at each floor with flywheels and drive shafts. Originally to the east of the engine house there used to be a boiler house and to the south of the boiler house a large brickwork chimney, both now demolished. Rough brickwork is visible on the eastern face of the engine room as evidence of where the boiler house used to abut.

We understand that the building ceased to be used as a cotton mill in 1965. After this date it was used as a warehouse storage facility, with lifts installed during this period. It is now vacant and falling into disrepair.

A single-storey building, on the northeast part of the site and facing onto the roundabout, was originally constructed as offices for the mill. The building is rectangular on plan and is referred to as The Lodge. The building later became a fireplace showroom and then vacant, as the rest of the site.

Warwick Mill, including The Lodge, is grade II listed. The listing was made in 1979.

With reference to the historic Ordnance Survey (OS) maps contained in RSK's Preliminary Risk Assessment report (Phase 1), dated December 2021, show that in 1848 the whole site was parkland (Little Park); in 1894 'Park Mill / Irk Mill' was located on the western part of the site (now London House); In 1955 the bulk of Irk Mill, on the western side, was used for furniture production with the remaining part on the eastern side used for Weatherproof works; the main western part of Park Mill / Irk Mill remained until after 1966, but before 1977, when it was replaced by London House; the eastern 'works' part of the original Park Mill / Irk Mill site appeared to remain until post 2006 and has since been demolished.

2.2 Existing construction

Based on a site visit, record drawings and structural engineering texts on cotton mill construction, the structure to the mill is relatively transparent and clear. The structure is also highly repetitive.

Some historic floor investigation openings (understood to be from circa 2015) were still exposed on site.

Specialist intrusive superstructure and substructure investigations, including laboratory testing, are due to commence in the near future, which will provide greater certainty on the existing construction. These works will include metallurgy testing of the floor beams; establishing any general loss of floor beam sections due to corrosion; wall thickness determination of cast iron columns, including establishing if the central void is off-centre; metallurgy testing of cast-iron column samples; condition and metallurgy testing of arch tie-bars; determining connection details; mortar testing, including in areas of water ingress; brick compressive testing; establishing density of assumed ash build-up over jack-arches; ground investigations via trial pits, window samples and rotary boreholes into the coal measures at depth.

The typical suspended floor construction to the main floor plates consists of metal beams (at approximately 2.2m centres), with brickwork jack-arches spanning between the beams. This 'fireproof' construction was widely used after several disastrous fires in all timber floor mills. The main roof construction appears to be of similar construction.

The floor beams are assumed to be steel, but this will be confirmed by the proposed investigations. Site measurements of one accessible exposed section suggest it to be a 356x152mm (14"x6") steel beam, to British Standard 4, 1903. During this period, steel was commonly used for floor beams. The record drawings viewed at Oldham Archives do not state the section sizes of the typical floor beams. Drawings for the Boiler House, since demolished, state 'rolled steel beam' for the roof sections.

The brickwork jack-arches spring from the lower flange of the supporting metal beams. The bottom of the lower flange is therefore visible and exposed. From record drawings (see Appendix A) and from site measurements, it appears that the brickwork thickness at the springing point of the arches is 215mm, which reduces to 150mm thick and then 102mm thick at the crown. The soffit is a smooth and continuous arch. The detailed dimensioned section on drawing 20 in Appendix B shows the assumed arch construction and photos 6-9 in Appendix E shows the 'saw-tooth' top surface to the jack-arches.

The mortar composition to the jack-arches (and elsewhere) will be determined by laboratory testing. Where long-term water ingress has occurred at the underside of roof level, it appears that some of the mortar has been lost, suggesting that the mortar may have a high lime content, slowly being eroded by the water. The span direction of the jack arches is generally in a north-south axis, except for the first bay adjacent to the north elevation (grids A-B) and adjacent to the southern elevation (grids J-K). The span direction was presumably switched against these elevations so that beam positions correlate with the window piers

and so that arch thrust forces are not applied to these walls. Metal tie bars (presumably steel – tbc) are present between the lower part of the beams, to reduce out-of-balance arch thrust forces. Generally, two tie-bars are provided for each beam span, but only one central bar is provided for the spans adjacent to the north and south elevations (see existing GA drawings in Appendix B). It is proposed that the condition of some tie bars be investigated, where embedded in the brickwork jack arches and connected to the beams, especially in the locations where water ingress has occurred.

A dark-grey fill material has been observed on site, on top of the brickwork jack arches. This is presumably an ash material, which was a commonly used construction detail in cotton mills of this era. Timber boarding was visible on top of the fill material in the location of exposed investigations. We understand that stone flags are present elsewhere on site.

The external masonry walls are formed from a red brick with some sandstone detailing. The walls are load-bearing, supporting the perimeter floor beams. An original record drawing shows (in Appendix A) the thickness of the supporting brickwork piers to progressively reduce up the building, from 838mm (33”) at LGF level, to 483mm (19”) at 3rd floor level. The drawing also shows I-section metal lintels over the window openings (we have read that these lintels are in poor condition along the southern elevation, but this has not yet been observed by MHA). The brickwork appears to be in good condition and does not seem to absorb much water, as is typical for dense engineering or semi-engineering bricks.

Based on the original record drawings and site observations of one exposed 3rd floor level column head, it appears that the cast-iron columns are vertically tied-together via joining cap and base plates, with 4 bolts. Floor beams are seated on a top ‘capital’ bearing surface, with the core of the column passing through the centre. The beams also are bolted to the column via projecting cast-iron fin plates. The column diameters and wall thicknesses vary, reducing in size higher up the building. The columns also taper upwards over each storey height, bar at LGF level. The assumed column dimensions are shown on drawing 30 in Appendix B, based on the observed column head (see photo 12 in Appendix E) and column record drawings (in Appendix A).

Record drawings show the Lower Ground Floor slab to be ground bearing, possibly of relatively thin construction (approximately 100mm by scale from the record drawings). It is not known if this has been recast at any point during the operational life of the building. It is proposed that investigations be undertaken to establish the typical slab construction and build-up below.

Original record drawings show the cast-iron columns to typically bear onto a 1.22m x 1.22m x 0.61m deep pillar stone, that bears onto brickwork that corbels outwards (over a depth of 0.61m), which in turn bears onto a 0.61m deep concrete pad. The foundations are expected to be around 2.4m square on plan, with a formation level of around 2.5m below the LGF slab level.

Original record drawings show the external walls to also have brickwork corbels (over a depth of 0.56m) with a 0.61m deep concrete strip footing below. The foundation width is expected to be around 1.85m, with a formation level of around 1.75m below the LGF slab level.

2.3 Lateral stability

The existing building is generally stabilised via the deep floor plate diaphragm action transferring lateral forces to the perimeter external walls and the perimeter stair core brickwork walls. Some dividing masonry walls at LGF level also contribute, by propping the upper ground floor plate.

The brickwork walls transfer the lateral loads down to foundation level. Although the main elevations are regularly perforated by window openings, we presume that some small Vierendeel moments are accommodated around the openings on the long elevations. The building has of course been present on the site for over one hundred years and there are no obvious signs of structural distress caused by lateral loadings.

2.4 Ground Conditions

The British Geological Survey (BGS) records for the site, see Appendix F, indicate that the site is likely to be underlain by Alluvium and Glaciofluvial Sheet Deposits (Sand & gravel) over Coal (Pennine Lower Coal Measures Formation).

The alluvium presumably stems from the Wince Brook.

The BGS records show a fault line in the coal bedrock in a north-south axis, located on the western side of the site (London House part).

RSK's Preliminary Risk Assessment (Phase 1) states that the site is in a Development High Risk Area for coal mining. The Coal Authority Mining Report, appended to RSK's report, indicates that unrecorded shallow mining works may have occurred within the site. Due to the industrial history of the site, the nearby Wince Brook and the coal below the site, RSK have recommend that contamination testing be undertaken as part of the Phase 2 works. Also, that a Coal Mining Risk Assessment be undertaken.

RSK report that the Alluvium thickness is expected to be up to 3m, the Glaciofluvial Sheet Deposits 10 to 15m and the Pennine Lower Coal Measures Formation greater than 50m. Considering the depth of the footings to the cast-iron columns, it is conceivable that they bypass the Alluvium and bear onto the Glaciofluvial Sheet Deposits. Groundwater is estimated to be located at a depth of 2m below ground level.

Based on Zetica's publicly available unexploded ordnance (UXO) risk maps, the site is located in an area with low potential for wartime bombs to be present.

With reference to the Environment Agency Flood Map (see Appendix F), the western part of the site is located within Flood Zone 3 (area at risk of flooding from river).

3.0 Structural Proposals

Preliminary calculations have been undertaken to assess the likely capacity of the existing structure to accommodate the proposed loading, the proposed alterations and new build structures. These calculations will be reviewed and amended following the completion of the structural investigations.

3.1 Change of Use and Floor Capacity

The existing main Warwick Mill building was of course designed to accommodate textile machinery and was construction was completed in 1909.

The proposed residential loading of the upper floors to the Mill is certainly less than the historic applied machinery loadings. The Historical Structural Steel Handbook lists the design loading guidance at various points in history. Appleby's Handbook of Machinery, dated 1903, lists workshops and light warehouses to be designed for a live load of 6.0kN/m^2 to 7.2kN/m^2 (125 to 150lbs/sq ft). For comparison, it lists work rooms, light business premises etc to be designed for a live load of 4.3kN/m^2 to 4.8kN/m^2 , but the design loading for the mill floors was likely to be higher.

Preliminary calculations for the proposed dead loading, including structural topping, with an applied live loading of 3kN/m^2 (for corridor zones and for residential zones with a partition loading) show that the assumed 356x152mm typical floor beams are likely to accommodate the new applied (lesser) loading.

A concrete reinforced structural topping is proposed on top of the brickwork jack-arches, refer to the detail at the bottom of drawing 200 in Appendix C, in lieu of the existing ash fill. The proposed density of the foamed concrete topping is to match the density of the ash fill (to be determined by investigations). The composite action between the structural topping and the floor beams will increase its loading capacity and reduce live load deflections. Also, the loading capacity of the brickwork jack-arches will also increase due to composite action.

It should be noted that the strength of fire-proof floors can be underestimated by typical structural engineering calculations. Secondary beneficial loading capacity effects, for example the masonry arches acting as folded plates in combination with the beams, are difficult to accurately quantify.

The proposed new loadings onto the third-floor structure from the cold-formed metal (Light Steel Gauge) penthouse structure will be relatively light and will be regularly distributed onto the floor via the cavity Party Walls and internal load-bearing partitions. Further checks will be undertaken following the structural investigations, but this is assumed (reasonably) at this stage to be feasible.

3.2 Cast Iron Column Checks

With reference to section 3.1, the applied vertical loadings into the cast-iron columns (and therefore foundations) will be reduced relative to the assumed original design loading.

Based on the column dimensions on the original record drawings (reproduced on MHA's drawing 30 in Appendix B), preliminary column checks have been undertaken for the proposed loadings using cast-iron column formulas. The Gordon Rankine formula is commonly considered to provide the most accurate estimate of cast iron columns of this era. This formula is used by the Highways Agency in their publication The Assessment of Highway Bridges and Structures document BD/21 and recommended by the ICE document Structural Appraisal of Iron-Framed Textile Mills document.

The preliminary column checks have found that the loading into the columns to be acceptable. Checks have been undertaken for each floor level and consider pattern loading and eccentric column loadings. The most critical columns were found to be for the upper storeys with edge or corner loading around the proposed new perimeters for the atria.

Car parking is proposed on the western half of the mill at LGF level. Robust vehicular protection should be imperative to all LGF columns (including during construction) in the parking zone, as an impact could cause failure of the relatively brittle columns and could be catastrophic (refer to HSE MISC157).

3.3 Large Floor Plate Cut-Outs and Lateral Stability

The proposed new atria floor cut outs at 1st, 2nd and 3rd floor levels reduce the ability of the existing floor plate to transfer lateral forces between masonry shear walls on grids 2 and 15 (a span of around 80m). The proposed reinforced concrete structural topping and the additional cross-bracing provide the necessary diaphragm action and stability.

The reinforced concrete structural topping requires movement joints to limit shrinkage and thermal cracking. Proposed movement joint locations are shown on MHA's proposed GAs, in Appendix C. The topping cannot therefore span the 80m long-direction of the floor plate as it will be broken at joint locations.

It is proposed that regular cross-bracing bays on grids 4, 6, 8, 9, 11 & 13, between grids B & C and grids H & J be provided.

The regularity of the cross-bracing bays minimises the axial compressive and tension loads applied to the existing cast-iron columns, to keep within acceptable preliminary limits.

Reinforced concrete shear walls are proposed in a north-south axis at LGF level (grids 8 & 9), to prop the UGF level floor plate and allow the new cross bracing to terminate at UGF level.

There is a 1.6m high parapet to the perimeter of the building. The effective increase in building height, due to the penthouse storey is therefore relatively minor. The increase in lateral loading on the building (due to the wind) is not significant. The proposed new braced bays provide additional lateral stiffness to the building.

Where new openings are proposed in the main masonry shear walls, these have been designed to provide lateral stiffness appropriate to the applied lateral loads.

Along the grid D and grid G edges to the proposed new atria, the thrust from the jack arches will not be countered by the adjacent span (as it will be removed). The condition of the tie bars along these edges will therefore be critical and will be assessed as part of the intrusive investigations. If deemed appropriate, additional arch ties will be provided, or the thrusts will be countered by the proposed reinforced concrete encasement to the edge beams.

3.4 Meeting the Disproportionate Collapse Requirements of the Building Regulations

Part A3 of the Building Regulations contains clauses to limit the extent of structural failure that could occur in the event of an accident. These clauses were composed following the partial collapse in 1968 of a 22-storey tower block in Canning Town called Ronan Point, where a progressive collapse of floors occurred following a gas explosion. The mill building of course predates the Building Regulations.

With reference to Table 11 of Part A3 of the Building Regulations, the existing building consequence class is '2b' (Upper Risk Group) or even class '3'. Consequence Class 2a includes industrial buildings not exceeding 3 storeys; with 5 main storeys the original industrial original use of the mill clearly exceeds this class.

The proposed use of the building (residential buildings greater than 4 storeys but not exceeding 15 storeys) will be under building consequence class '2b'.

If the mill were a new-build project, class '2b' requires either effective horizontal and vertical ties; the notional removal of columns not resulting in the collapse of an excessive floor area; or 'key elements' being designed to accommodate a large loading (based on a gas explosion – we understand that the building will not be serviced by gas).

The framing of the existing mill structure offers some horizontal tying via the bolted connections to the columns, and vertical tying via the cap-plate to base-plate cast-iron column connections. Where the floor beams meet the brickwork external piers (for example on grids A, K, 2 & 15), vertical tying is not provided.

Based on published guidance (Building Control Alliance, BCA, Technical Guidance Note 21 and NHBC equivalent), where a material change of use occurs (such as conversion to residential) and where a building did not previously comply with A3, it should be not more unsatisfactory in relation to A3 than before the work was carried out.

The proposed reinforced concrete structural topping will improve the robustness of the mill building against disproportionate collapse. The tying of the floor will be improved, and the topping will also be connected to the external masonry walls via resin-set dowel reinforcing bars. In the event of an accidental loss of a vertical support, the reinforced topping may assist the structure by working as a membrane in catenary to prevent a significant disproportionate collapse.

3.5 Additional Penthouse Storey

The additional single storey penthouse storey to the main mill building is designed to be lightweight and non-combustible.

The new storey will meet the tying requirements of Building Regulations A3.

The proposed new roof will be supported by light steel gauge (cold-formed) joists spanning generally in an east-west axis. The joists are to be supported by regular load-bearing light steel gauge studwork, along Party Wall lines and internal partition lines. Initial analyses indicate that the original structure with the new reinforced concrete structural topping at 4th floor level is able to support the lightweight construction of the new penthouse. Further calculations will of course be undertaken following the intrusive structural investigations.

The penthouse storey structure is to be stabilised by a horizontal plywood diaphragm directly on top of the roof joists and by plywood sheathing (potentially combined with light steel gauge cross-bracing flats) to the stud walling.

3.6 Atrium Roof

The proposed atrium roof is to be an uninsulated and of super lightweight construction, utilising a single layer of transparent Ethylene Tetra Fluoro Ethylene (ETFE). The ETFE is to be supported by deep RHS sections, at approximately 3.3m centres, spanning approximately 13.6m over the atria. The beams cantilever around 2m beyond each support point.

The roof beams alternate their pitch, providing a warped and stable double-curvature profile to the ETFE.

The roof beams are supported at the low end of the pitch via cast-iron columns, recycled from the creation of the voids for the atria, or via recycled beams spanning between the columns. At the high end of the pitch, the beams are supported by new stub steel sections on top of the cast-iron columns (on grid) or via a RHS triangulated frame (where off-grid).

3.7 New Box-Frame Openings

Where significant new openings are required to the load-bearing masonry, it is proposed that these be formed by the provision of twin steel box-frames, side-by-side. These box-frames provide sway stiffness and allow the existing load-paths to mostly be retained (bar the loading reduction due to the removed brickwork). Significant foundation works are not required, as threshold sections spread the vertical loads back along the existing footings.

At LGF level, a new centrally located enlarged opening is proposed to be formed in the external wall to create a new main entrance to the property (on grid A, either side of grid 8). The envisaged preliminary structure is shown on SK13 in Appendix C.

The temporary works required to form the main entrance opening will be significant and need to be designed by a Chartered Structural Engineer (or

Chartered Civil Engineer with structural experience) and installed by a competent and experienced contractor. The proposed sequence is likely to include the forming of pockets (via the careful removal of facing bricks and coring internally) for needle supports; the creation of temporary foundation bases, possibly combined with the coring of openings for counter needles; installation of needles and dry-packing; installation of suitably design props between the needles and the foundation supports, including hydraulic flat-jacks; pressurising the flat-jacks to transfer the vertical loads to the new propping; suitably propping the adjacent UGF level beams; grouting the flat jacks; careful demolition of the masonry to form the new opening; installation of the new steelwork (preloaded tbc), including connections to floor beams; dry-packing and anchoring; careful and gradual lowering and removal of the temporary propping; removal of needles and making good of brickwork (to match existing).

LGF level openings are also required on grid 2/C-F, as shown by the preliminary proposal on SK15A in Appendix C. The openings are for access to the proposed bike store and for the vehicular entrance to mill. The necessary temporary works sequence will be very similar to the description in the above paragraph for the main entrance frame.

A multiple storey opening is required in the rope-race wall on grid 15. The structural proposals are detailed on the plans and the sectional elevation on drawing 202 in Appendix C. This twin box-frame has an internal RHS vertical support line, located on a proposed apartment partition line, to keep the section sizes of the beams from becoming too large. The necessary temporary works to form the openings will follow the principles described above for the main entrance frame, with back-propping continuing down to suitable foundations, combined with counter needles supported on the brickwork below the frame. The small adjacent floor infill will be formed from composite steel beams and decking.

3.8 Engine Room

It is proposed that the window openings to the western elevation of the Engine Room be lowered to ground level. Preliminary calculations show the openings to be feasible, with the remaining masonry piers acting as propped vertical cantilevers.

A new mezzanine structure is proposed over part of the footprint to the Engine Room. The applied loadings are likely to be significantly less than the original applied loadings from the plant and therefore at this stage it is assumed that these can be accommodated in the slab construction. This will be explored during the investigation works for verification.

3.9 The Loom

The proposed 10 storey residential tower to the west of Warwick Mill, called The Loom, is to replace the London House office block that currently occupies the site. The Loom has a single storey structure at first floor level (UGF in the Mill), called the podium, with a garden area, that abuts Warwick Mill.

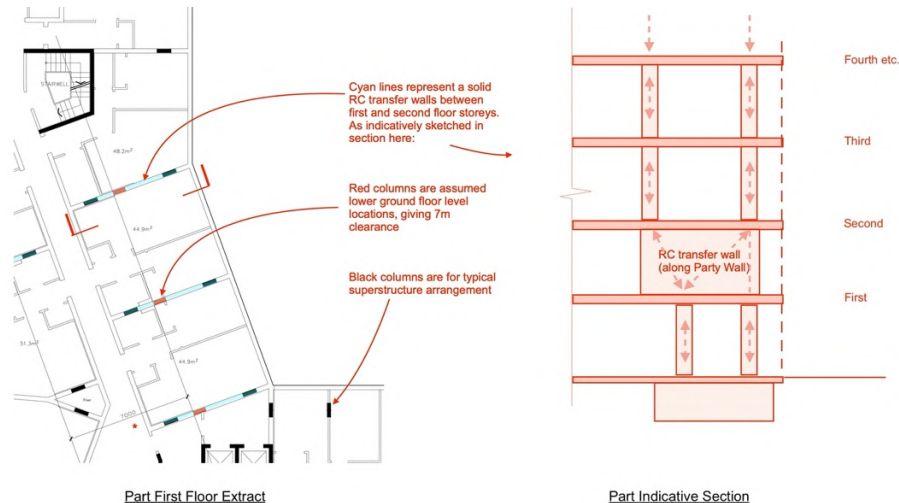
The lowest storey of The Loom is generally at the existing ground level.

A matrix of several potential structural superstructure solutions, along with the approximate embodied carbon of each, have been put forward by MHA for consideration. The design team have decided that a reinforced concrete (RC) flat slab solution, along with RC cores, is the preferred structural solution.

The apartment layouts at first floor level and above are to be consistent, bar some cutbacks to the upper storeys. A preliminary potential framing arrangement is shown on the drawings in Appendix D. A slab movement joint is proposed through all of the floor plates to minimise the effects of shrinkage, temperature variations and creep. The RC columns are to be 'blades', generally located on the Party Wall and partition lines.

The Loom is to be stabilised by the RC walls to the stair and lift cores as well as the additional RC walls shown on the drawings. This will be verified by in-depth analysis in due course.

At ground floor level, car parking is required under The Loom tower and therefore typical upper storey framing cannot be continuous down to this level, as vehicular access would not be possible. It is proposed that a central one-way aisle width of 6m, plus clearance of 0.5m to columns, be achieved by in-plane storey-high RC walls at first floor (podium) level (along Party Wall lines), acting as deep beams and transferring the columns to inset locations, as indicatively illustrated below for an earlier scheme:



This is a structurally efficient method of achieving the necessary column transfer.

The podium structure (first floor level) is to also be formed from RC, with RC upstands at the perimeter. The vertical loading applied to the Warwick Mill structure will be minimal and the podium will in general be supported by new walls and columns.

The proposed foundation solution to The Loom will be determined following the ground investigations, especially considering the expected fault in the coal bedrock. To reduce the risk of differential movement a piled-raft structure may be appropriate.

3.10 Construction Sequence

The final construction sequence will be determined at a later stage alongside the chosen main contractor. Enabling works will be necessary to make the building safe as a construction site.

It is anticipated that the installation of the proposed reinforced concrete (RC) structural topping will be one of the first items of structural works. Initially it is proposed that this be undertaken on a bay-by-bay basis, with a robust crash-deck below supported on the beam lines below. The top surface of the vaults is likely to require some watering before the placing of the concrete. Continuity of steel reinforcement will be provided across all day-joints. As experience and confidence is gained by the contractor in the proposed construction method, the extent of the crash-deck propping may be reduced (or suitable safety netting provided) and larger pour areas considered.

Once the topping works are completed, the new stabilising cross-bracing should be installed along with the LGF RC shear walls.

The atria can then be formed, using suitably back-propped crash-decks. The works are to be carefully undertaken, to not damage the brittle cast-iron columns and the floor beams which are needed to be recycled for the new roof level supports.

With the atria formed, the centre of the building will be exposed to the weather. The next anticipated works are the forming of the roof over the atria. This roof is to be laterally restrained by the light steel gauge penthouse structure in the permanent condition and therefore temporary lateral bracing will be required.

For the mill building, the formation of the box-frame openings and the installation of the penthouse level can then be progressed.

4.0 Heritage and Sustainability

The underlying principle behind the proposed works has been the conservation of the listed structure and safeguarding the building for the long-term.

The necessary proposed conversions are sympathetic to the original building and are minimal interventions. The proposed demolition works are minimised but allow the project to be viable. It is proposed that some steel and cast-iron sections removed during the forming of the atria be recycled for the new main roof supports.

Much of the rope race is to be retained, as an important historical feature.

The cast-iron and steel beams are to be retained and expressed, as are the perimeter jack-arch barrel vaults.

The proposed works will be designed to minimise the environmental impact and make the most use of sustainable materials. Of course, maximising the retention of the existing structure minimises the embodied carbon use in the structure.

The environmental impact of a potential reinforced concrete (RC) structure for The Loom may be minimised with the specification of recycled by-product materials, typically ground granulated blast furnace slag or pulverised fuel ash, as a partial replacement for Portland cement. The replacement materials are by-products from steel production and from power stations. These mixes are more durable and have less of an environmental impact than just using ordinary Portland cement. For The Loom foundations and ground floor slab, these replacement materials will be used instead of around 50% of the cement content used in a traditional concrete mix. Cement replacement will be utilised in the superstructure frame too, but the amount specified will need to work with the contractor's proposed curing and propping schedule, as the concrete does take longer to cure.

Embodied carbon assessments of the structure alone indicate flat slab floor structure for The Loom to have less environmental impact than a steel solution. This rating improves further when the inherent fire protection of the flat slab RC structure is taken into consideration.

Almost 100% of reinforcement steel used in the United Kingdom is manufactured from scrap metal, albeit some of which is imported.

5.0 Fire

Table A2 of Part B of the Building Regulations states that a 90-minute period of fire resistance is required for blocks of flats where the top floor is below 30 metres above ground level.

For the typical floor plates, just the bottom flange of the floor beams will be exposed for the perimeter bay of vaults. Elsewhere a ceiling structure will be present that can provide the required fire resistance.

The fire resistance to the perimeter bay of floor beams is not easy to assess, as the brickwork jack-arches will act as a heat-sink. Further assessments will take place at the next stage, including discussions with the fire consultant (Jensen Hughes). At this stage, conservatively it has been assumed that a 90-minute intumescent painted protection will be applied to all exposed bottom flanges where a suitable fire-resistant ceiling is not present.

Cast iron can sometimes perform better than steel in a fire, however to achieve a 90-minute period of fire resistance additional protection will certainly be required. At this stage, we again conservatively assume that a 90-minute intumescent painted protection will be applied to all exposed cast-iron columns.

6.0 Health and Safety

It is possible for a competent and suitably experienced contractor to build the proposed works in accordance with Construction (Design and Management) Regulations and industry best practice.

7.0 Conclusions

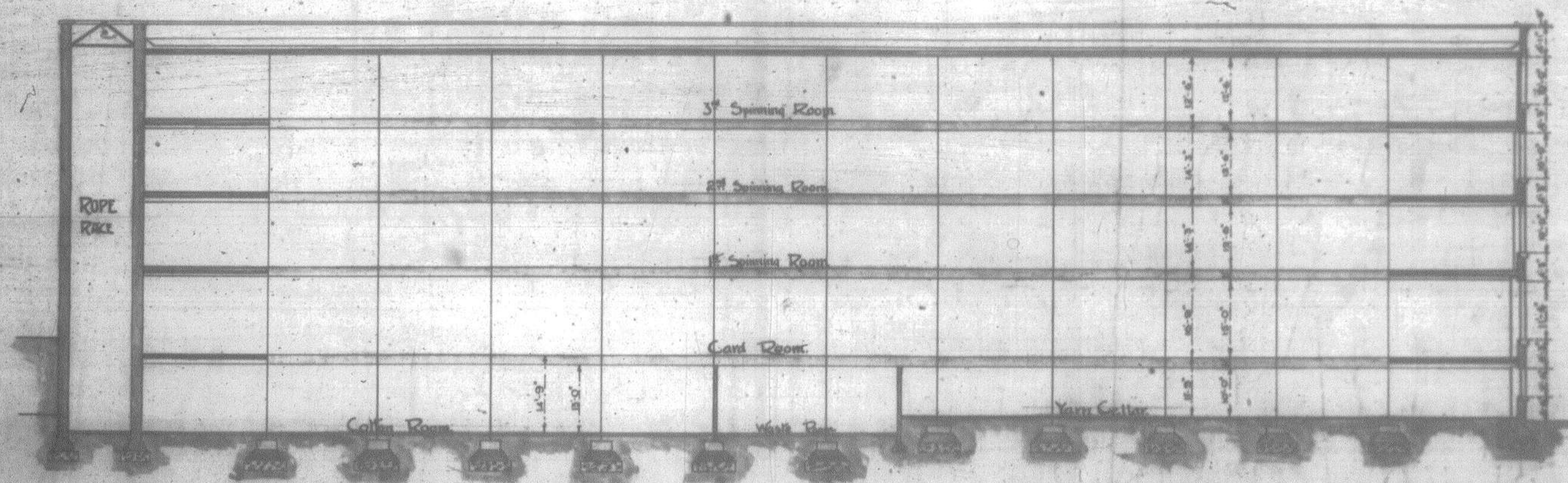
MHA's preliminary structural assessments show the proposed works to be structurally feasible and not detrimental to the robustness or the performance of the listed building. More detailed assessments will be undertaken upon completion of the intrusive superstructure and substructure investigations.

Improved floor diaphragms, via a reinforced concrete structural topping, and additional lateral stability bracing are required for the mill.

A reinforced concrete framed flat slab structure is proposed for The Loom building.

Appendix A – Selected Record Drawings from Oldham’s Archives

— MESSRS THE WARWICK MILL CO^{LTD} —
 — MIDDLETON —



1515-34-1
 BOROUGH OF MIDDLETON
 RECEIVED
 20 OCT 1907
W. Booth

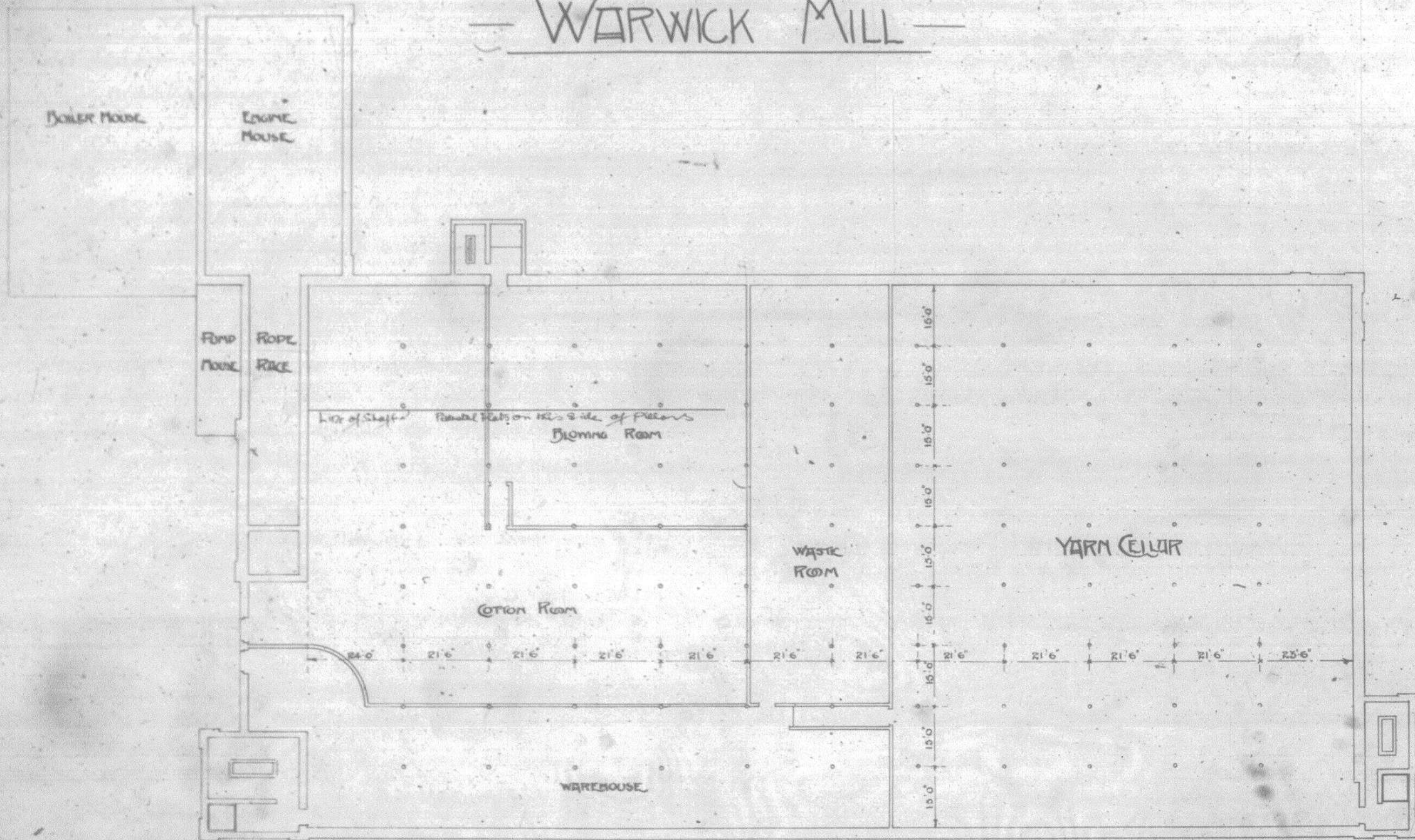
— LONGITUDINAL SECTION THRO' MILL —
 BOROUGH OF MIDDLETON
 WORKS APPROVED
 11 NOV 07
R. Booth CHAIRMAN

— SCALE 16 FEET TO AN INCH —

— OCT 1907 —
 JAMES SMITH & SON, ARCHT.
 34 CRESS STREET, MIDDLETON

D-5235/89/10

— WARWICK MILL —



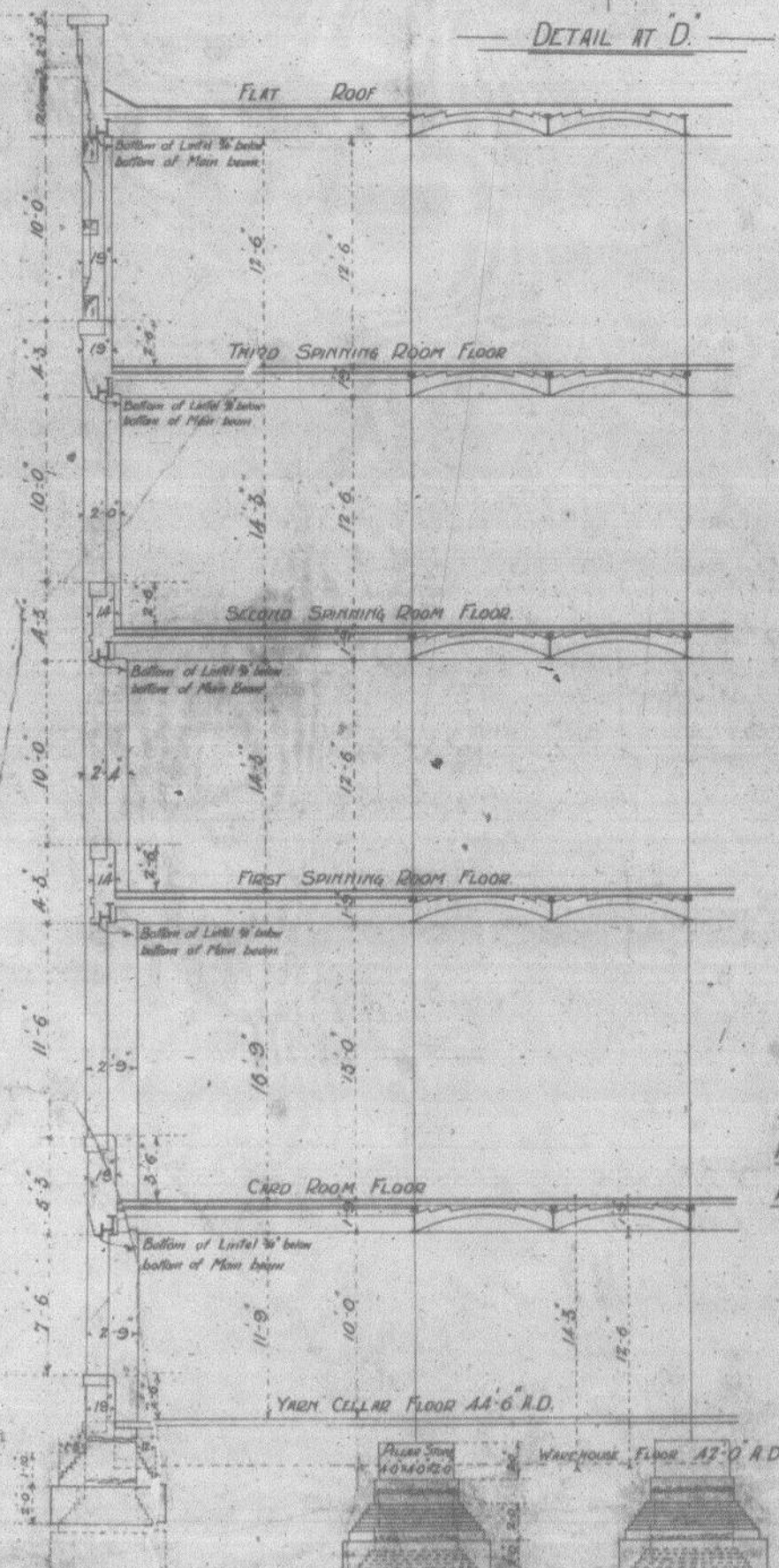
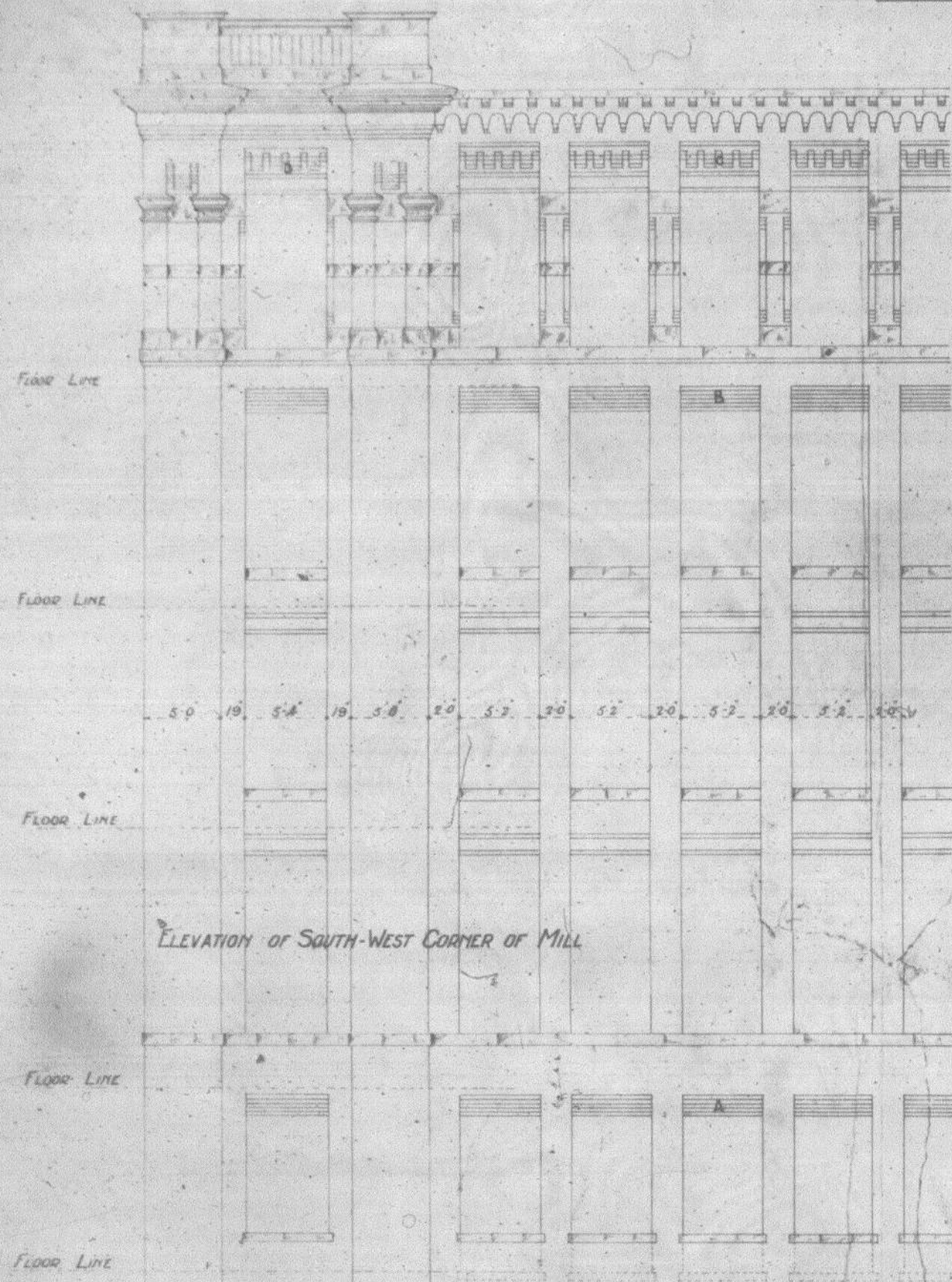
— CELLAR PAN —

— SCALE 16 FEET TO AN INCH —

Joseph Stoll & Son Architects
- Dec: 1907 - 34 GREG ST OLDHAM

WARWICK MILL

SCALE 4 FEET TO AN INCH



DETAIL AT D.

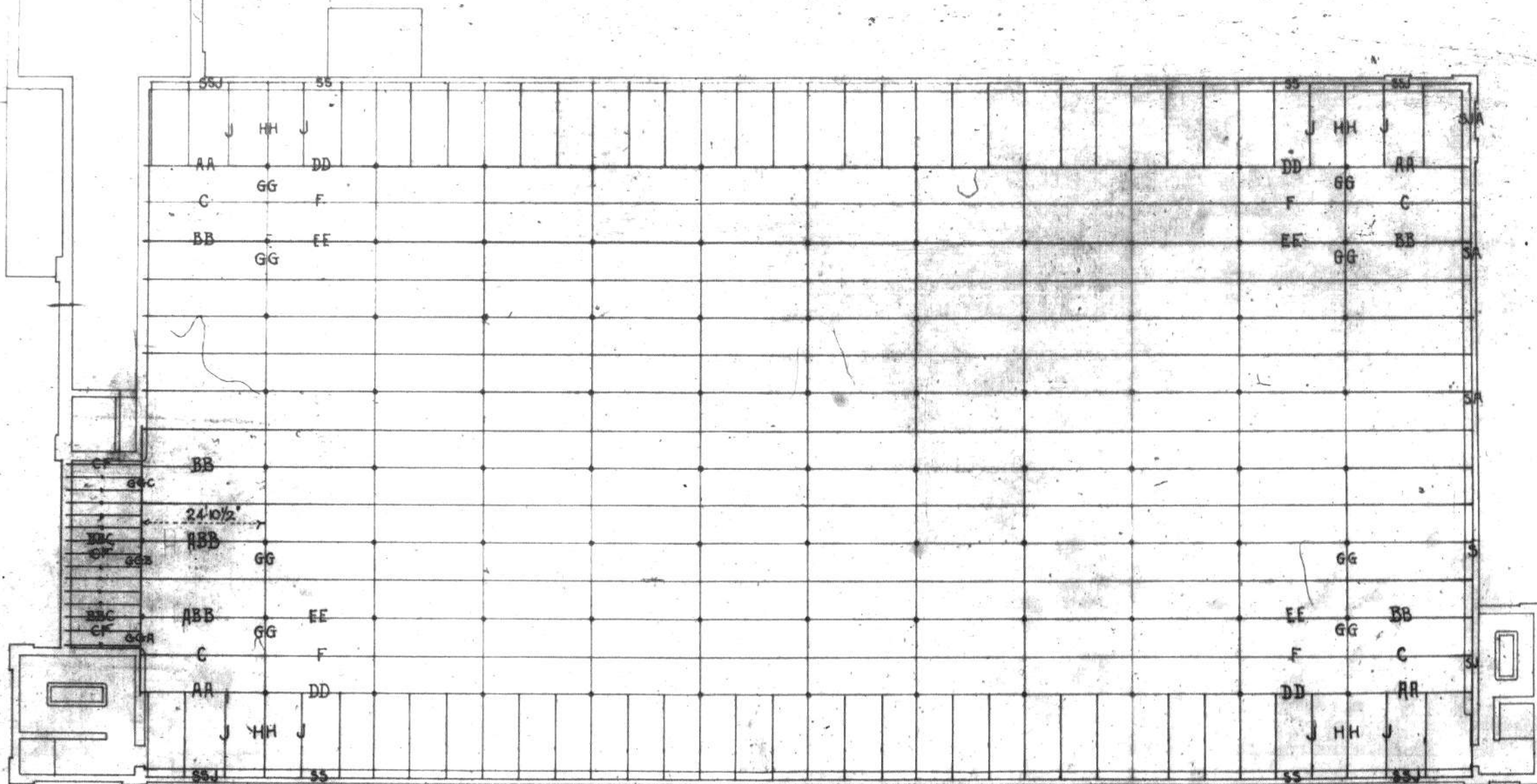
DETAIL AT C.

DETAIL AT B.

DETAIL AT A.

THE ABOVE DETAILS OF OVERSAILERS
TO CELLAR, SECOND & THIRD SPINNING
ROOM WINDOW HEADS TO BE STRICTLY
ADHERED TO

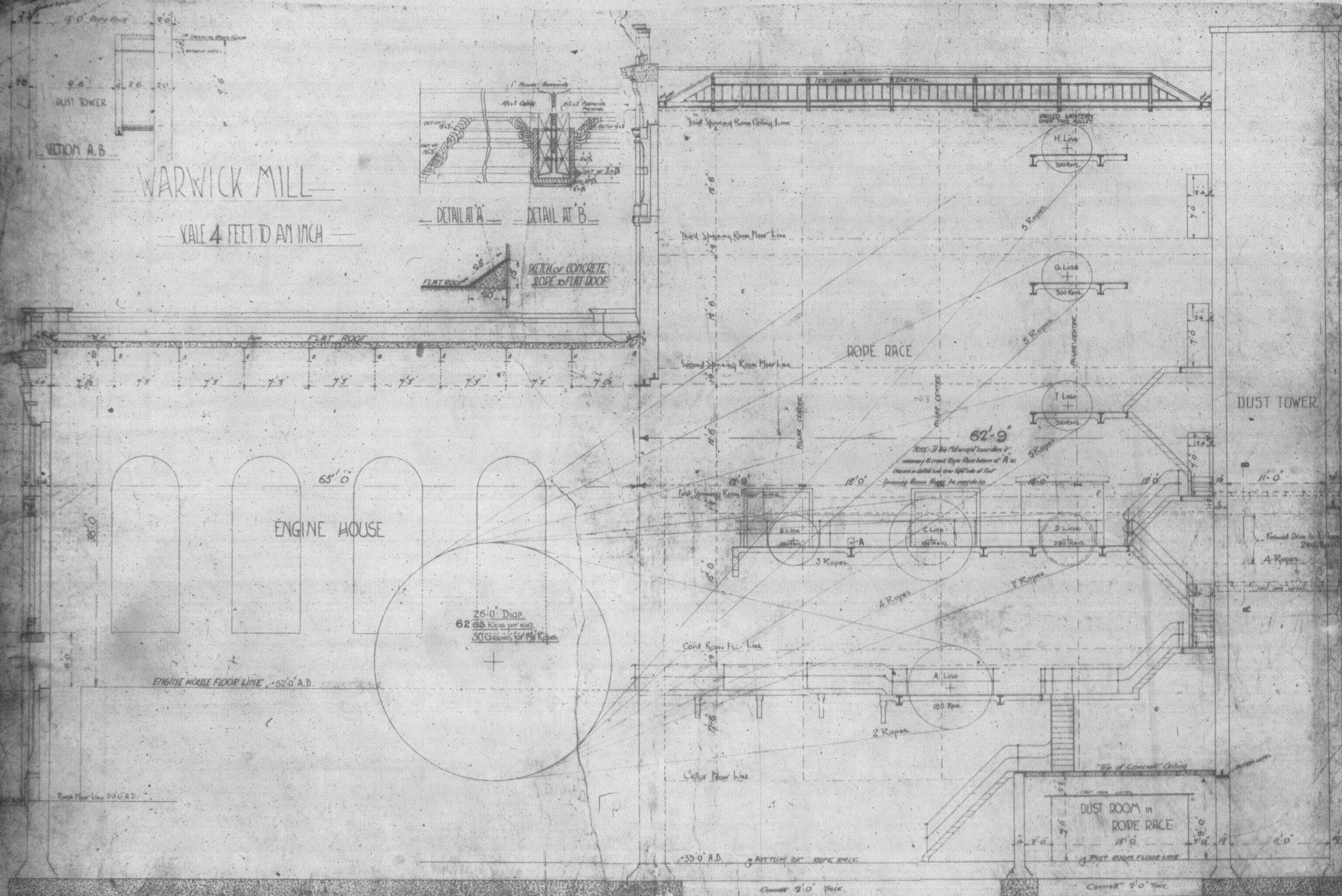
WARWICK MILL



Key Plan of Girders in 3rd Spinning Room Floor and Roof.

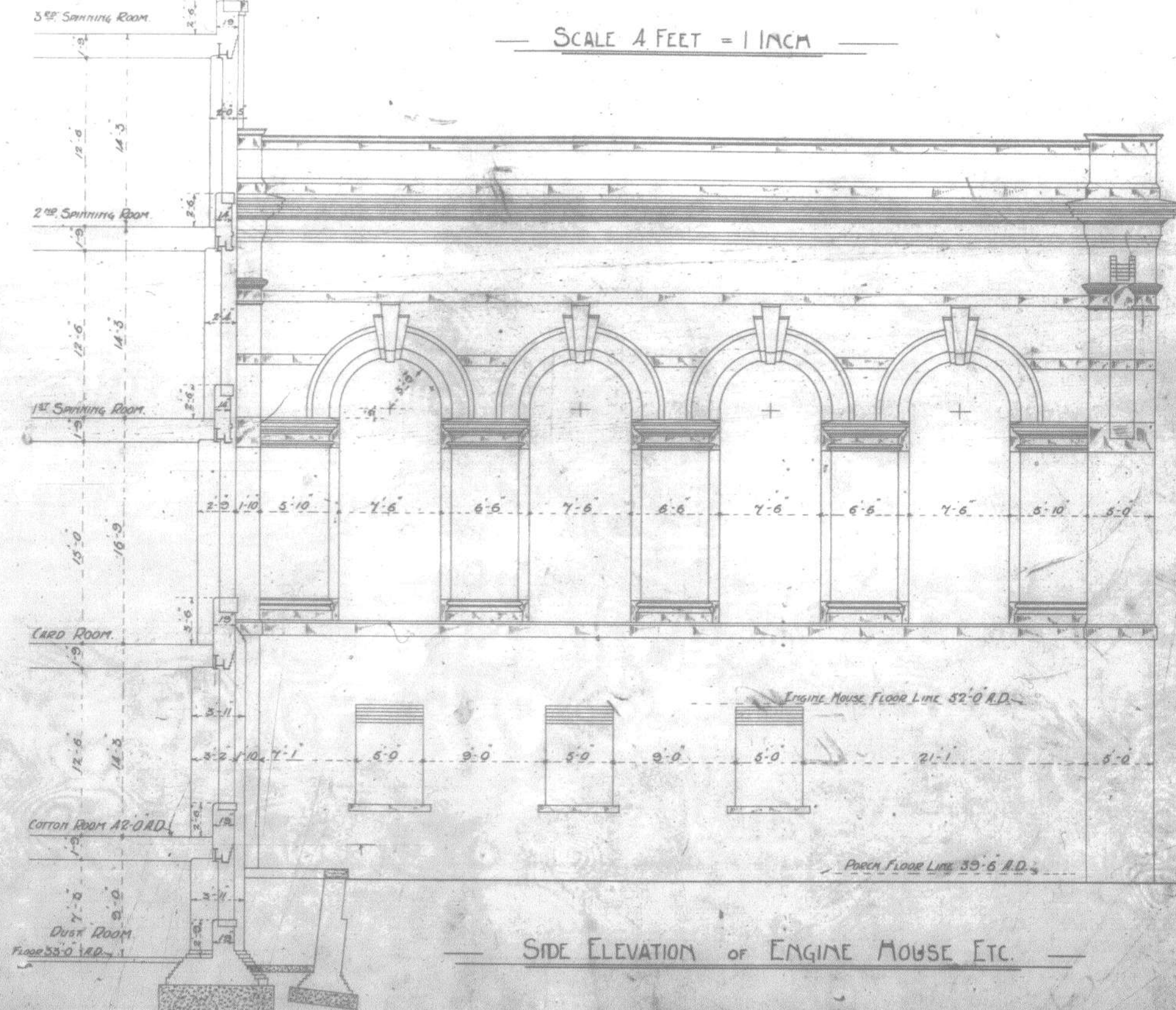
SCALE 16 FEET TO AN INCH

SCALE 4 FEET TO AN INCH



WARWICK MILL

SCALE 4 FEET = 1 INCH

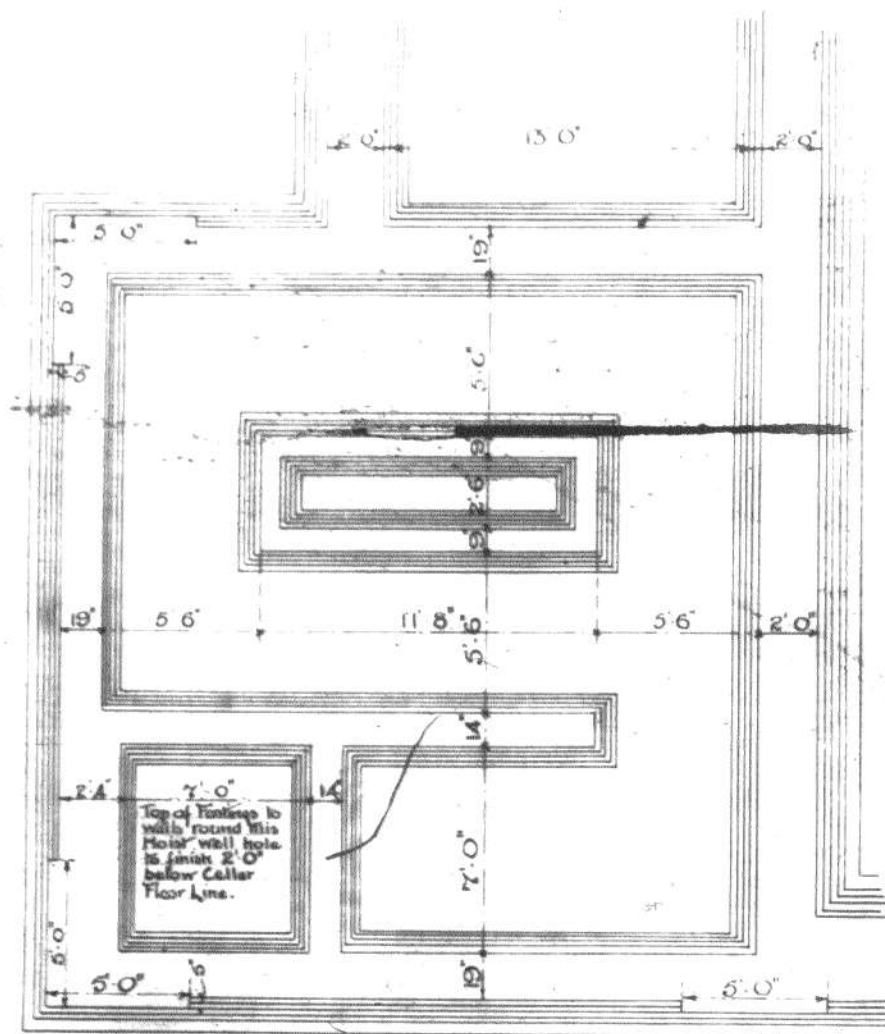


SIDE ELEVATION of ENGINE HOUSE ETC.

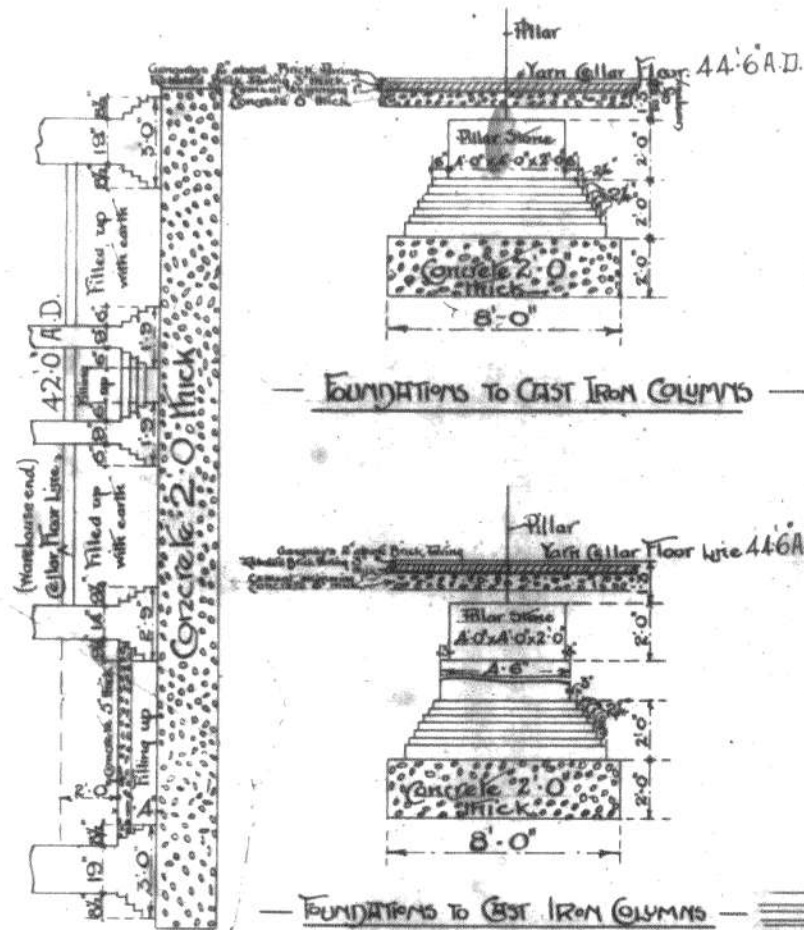
JOSEPH STOTT & SON, ARCHITECTS.
JUNE 1908, 54 Clegg Street, Oldham.

WARWICK MILL—MIDDLETON—

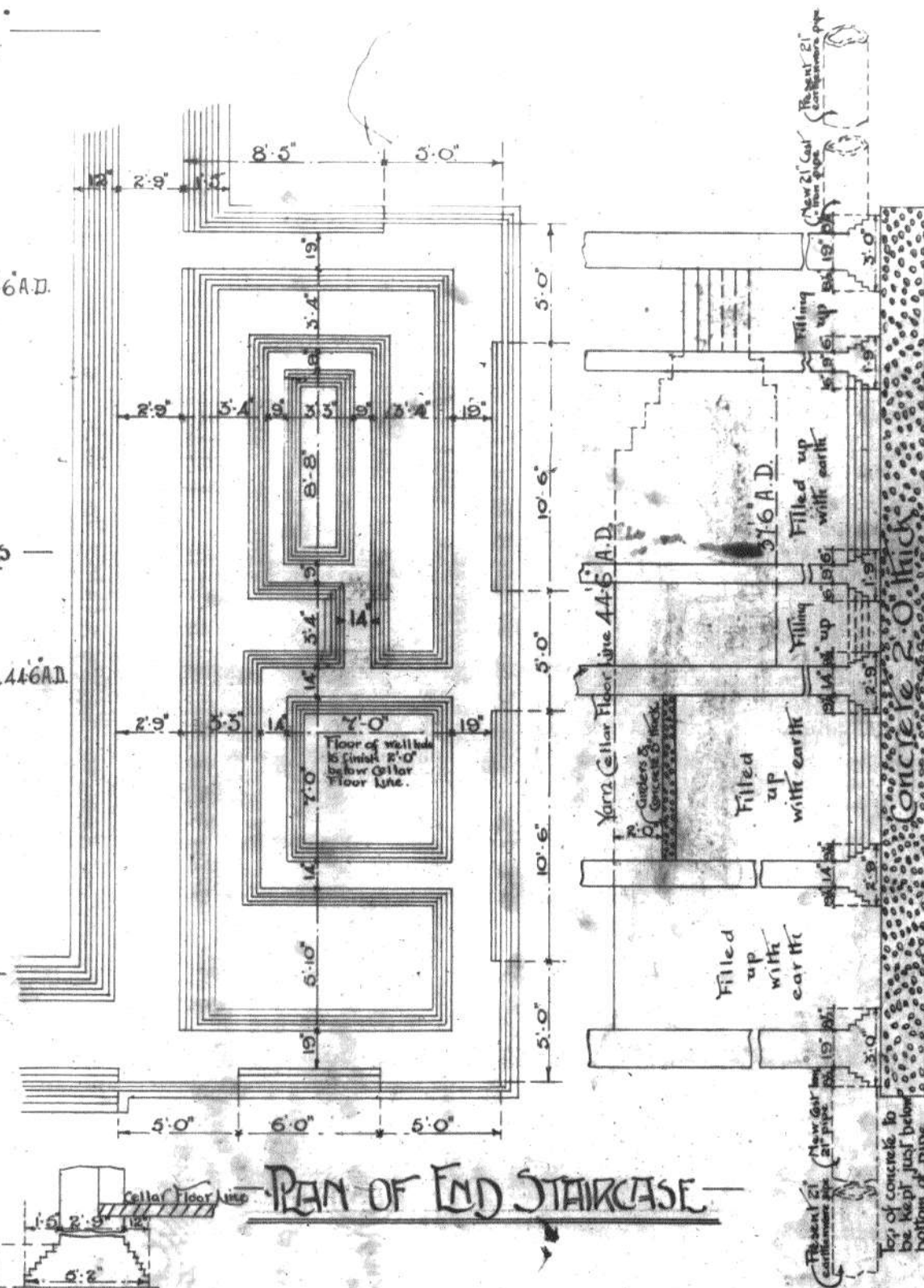
DETAILS OF FOUNDATIONS TO WALLS AND PILLAR STONES.



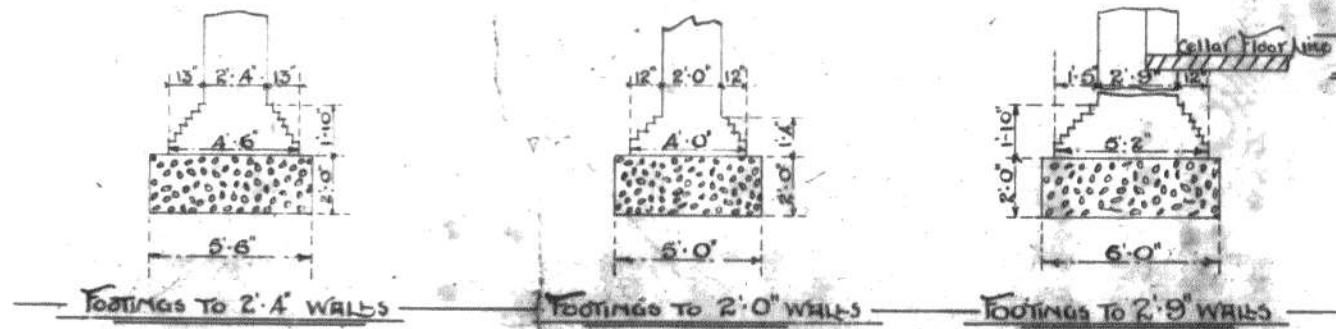
PLAN OF MAIN STAIRCASE



FOUNDATIONS TO CAST IRON COLUMNS REQUIRING BRICK PIERS BETWEEN FOOTINGS AND PILLAR STONE.



PLAN OF END STAIRCASE



NOTE—ABOUT 8'0" OF THE PRESENT 21" CARTHENWARE PIPE DRAIN WHERE SAME PASSES UNDER END STAIRCASE AND WOMEN'S GUESTS TO BE TAKEN UP AND REPLACED WITH NEW CAST IRON PIPE.

SCALE 4 FEET TO AN INCH

DETAILS OF CAST IRON PILLARS - LITALE

Top of Third Spinning Room Pillars
to be turned to receive roof of another
Storey of Pillars is required.

Nº 28 Pillars required to this detail
Estimated Height 30m by 15m
Thickness of Metal 3/4

68
Nº 68 Pillars required to this detail
Estimated Height 30m by 15m
Thickness of Metal 3/4

Third Spinning Room Floor Line
Transverse Beam

Third Spinning Room Floor Line
Transverse Beam

Nº 22 Pillars required to this detail
Estimated Height 12m by 17m
Thickness of Metal 1

68
Nº 68 Pillars required to this detail
Estimated Height 12m by 17m
Thickness of Metal 1

Second Spinning Room Floor Line
Transverse Beam

Second Spinning Room Floor Line
Transverse Beam

Nº 22 Pillars required to this detail
Estimated Height 15m by 23m
Thickness of Metal 1 1/4

68
Nº 68 Pillars required to this detail
Estimated Height 15m by 23m
Thickness of Metal 1 1/4

First Spinning Room Floor Line
Transverse Beam

First Spinning Room Floor Line
Transverse Beam

No 22 Pillars required to this detail

Estimated Weight 25 Cwts 2 Qrs 23 Lbs

Thickness of Metal 1 1/2"

First Spacing Beams - Floor Line

Transverse Beam

No 22 Pillars required to this detail

Estimated Weight 25 Cwts 2 Qrs 23 Lbs

Thickness of Metal 1 1/2"

Ironfounder not to proceed with too many Pillars
until he has ascertained the exact number of
Pillars of each kind that will require Pedestal Flats.

Cord Beams - Floor Line

Transverse Beam

No 12 Pillars required to this detail

Estimated Weight 25 Cwts 2 Qrs 23 Lbs

Dimension A 13'-9"

Thickness of Metal 1 1/2"

No 10 Pillars required to this detail

Estimated Weight 20 1/2 Cwts.

Dimension A 11'-3"

Thickness of Metal 1 1/2"

Cellar - Floor Line



Pillars with small Brackets to receive Transverse Beams.



68

No 68 Pillars required to this detail

Estimated Weight 25 Cwts 2 Qrs 23 Lbs

Thickness of Metal 1 1/2"

First Spacing Beams - Floor Line



68

No 68 Pillars required to this detail

Estimated Weight 25 Cwts 2 Qrs 23 Lbs

Thickness of Metal 1 1/2"

Build Rooms - Floor Line



No 38 Pillars required to this detail

(Estimated Weight 25 Cwts 2 Qrs 23 Lbs)

Dimension B 13'-9"

Thickness of Metal 1 1/2"

No 30 Pillars required to this detail

(Estimated Weight 20 1/2 Cwts.)

Dimension B 11'-3"

Thickness of Metal 1 1/2"

Cellar - Floor Line



JOSEPH STOTT & SON ARCHITECTS

DEC 1907. 34 CLEGG ST OLDHAM

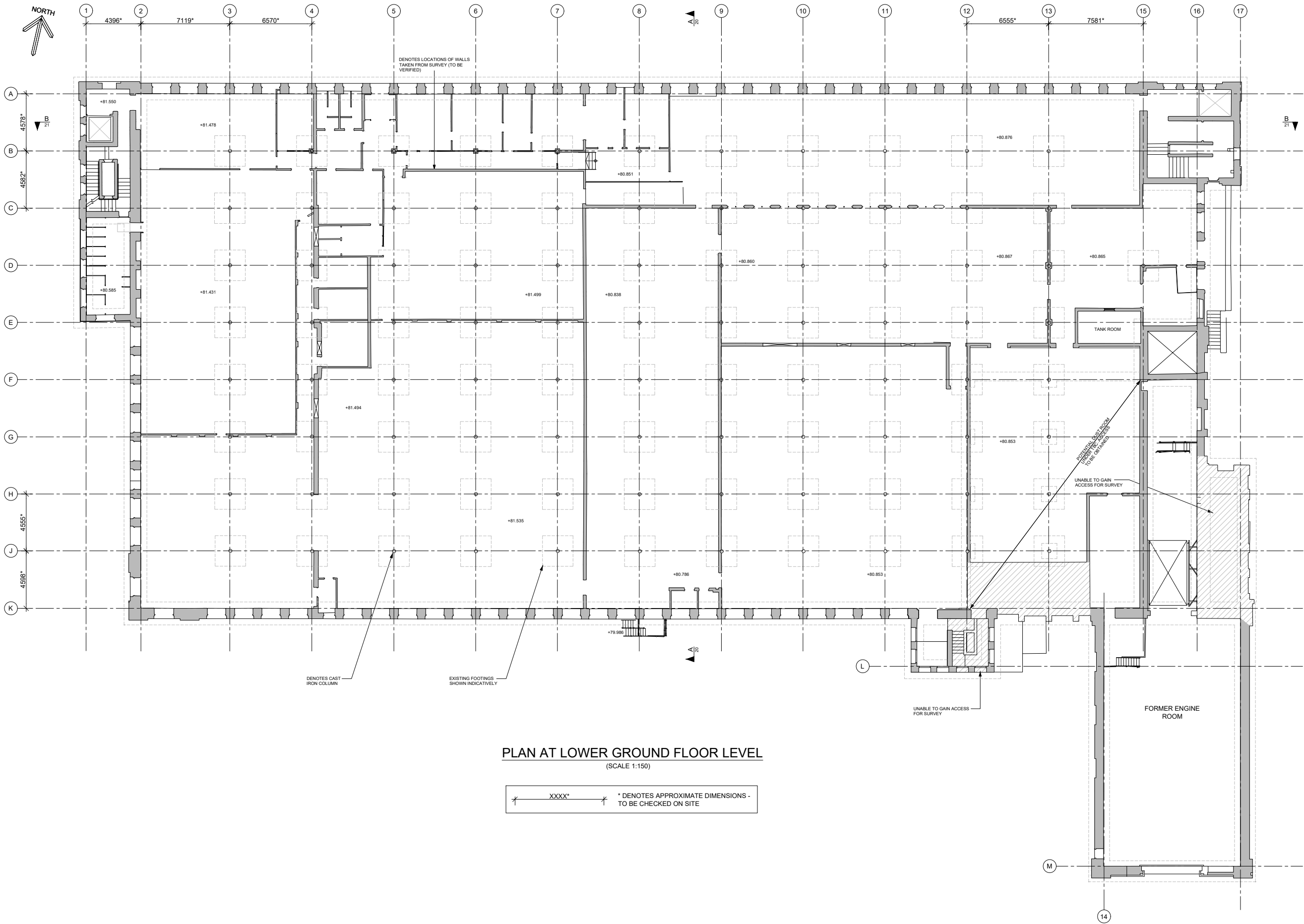
MESSRS THE WADWICK MILL CO LTD

Details of Small Bracket on pillar head to receive
Transverse Beams - Full Size -



Appendix B – MHA's Existing Structural GAs and Sections

10	Existing Lower Ground Floor GA
11	Existing Upper Ground Floor GA
12	Existing First Floor GA
13	Existing Second Floor GA
14	Existing Third Floor GA
15	Existing Main Roof GA
20	Existing Section A-A
21	Existing Section B-B
30	Existing Column Details



- NOTES
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 2. Do not scale off this drawing.
 3. All dimensions are to be confirmed on site by the contractor.
 4. Refer to MHA drawing 130 for all general notes.
 5. Data shown is from historic site surveys. The locations of all structure is to be checked on site.

P3	14/07/23	PJD	RD	DRAWING TEMPLATE CHANGED
P2	24/01/22	PJD	RD	SPOT LEVELS ADDED
P1	17/11/21	PJD	RD	PRELIMINARY ISSUE
Rev	Date	Drawn	Checked	Amendments

Status
PRELIMINARY

MHA STRUCTURAL DESIGN

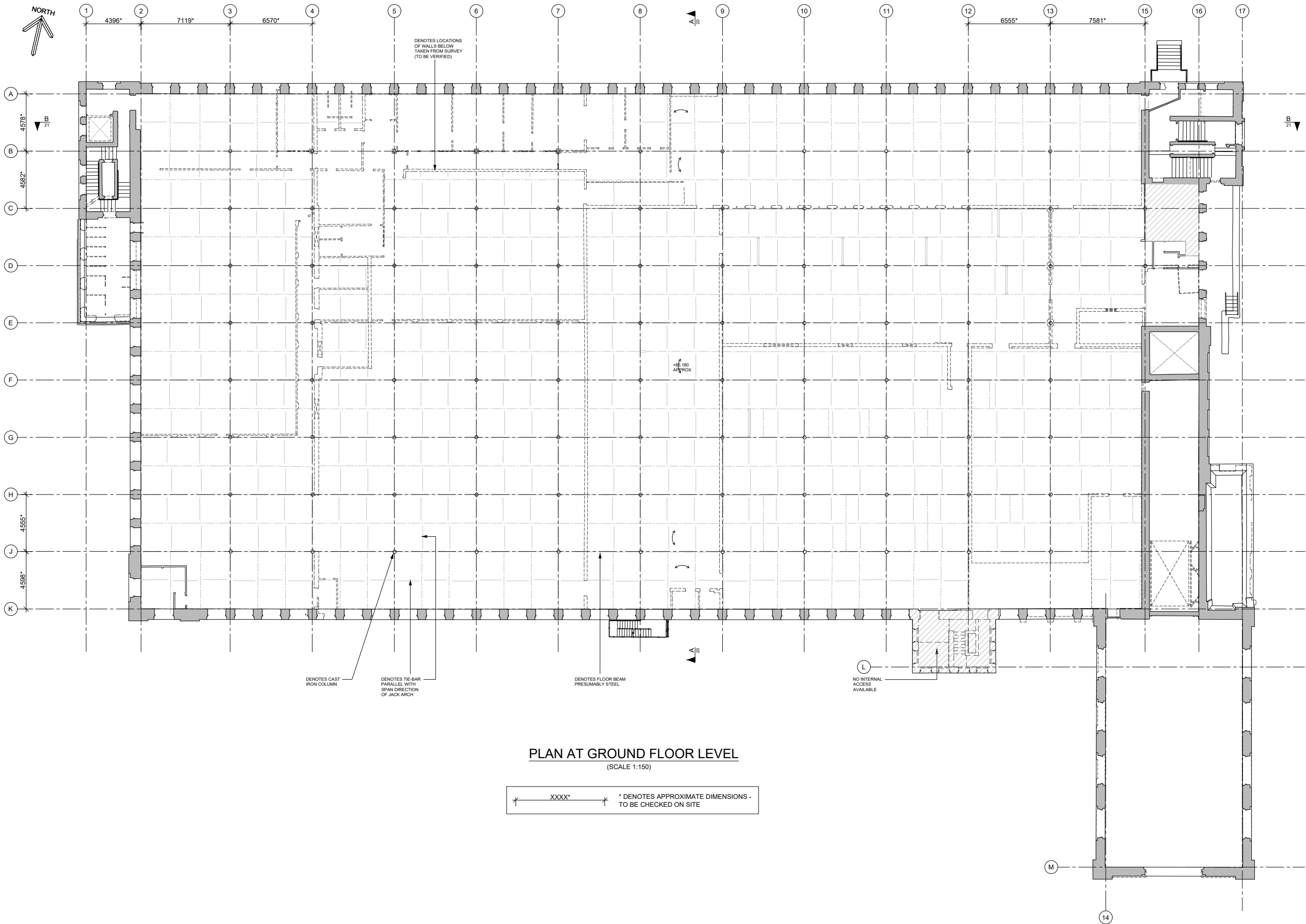
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Cambridge
+44 (0)1223 776340
mhastructuraldesign.com

Project Title
**WARWICK MILL
MIDDLETON
M24 1AZ**

Drawing Title
**EXISTING STRUCTURAL
LAYOUT AT LOWER
GROUND FLOOR LEVEL**

Drawing No.
21008-10

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 10	Revision P3



- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
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P3	14/07/23	PJD	RD	DRAWING TEMPLATE CHANGED
P2	24/01/22	PJD	RD	SPOT LEVELS ADDED
P1	17/11/21	PJD	RD	PRELIMINARY ISSUE
Rev	Date	Drawn	Checked	Amendments

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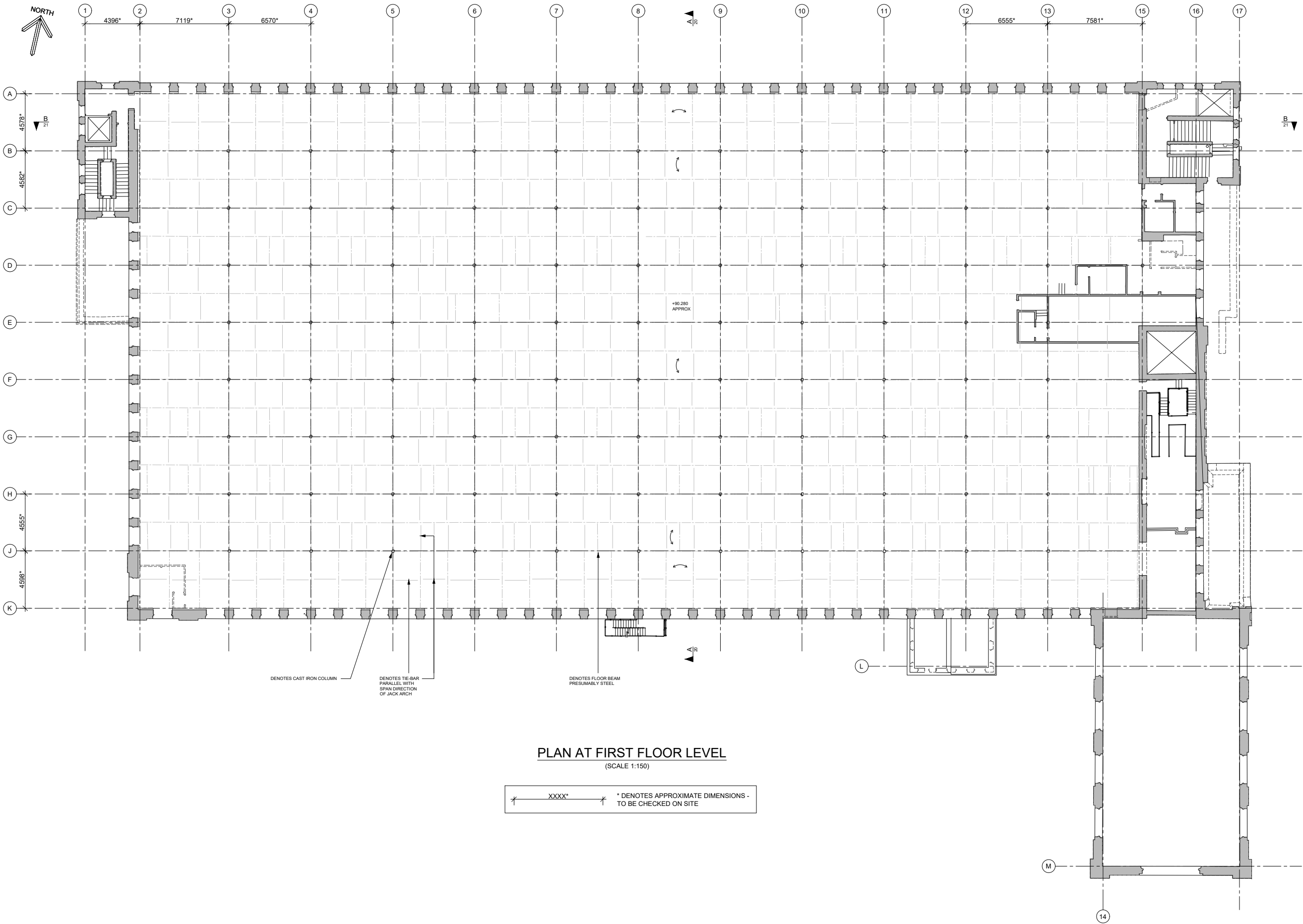
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Project Title
**WARWICK MILL
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M24 1AZ**

Drawing Title
**EXISTING STRUCTURAL
LAYOUT AT UPPER
GROUND FLOOR LEVEL**

Drawing No.
21008-11

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 11	Revision P3



PLAN AT FIRST FLOOR LEVEL
(SCALE 1:150)

XXXX" * DENOTES APPROXIMATE DIMENSIONS - TO BE CHECKED ON SITE

- NOTES
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P1	17/11/21	PJD	RD	PRELIMINARY ISSUE

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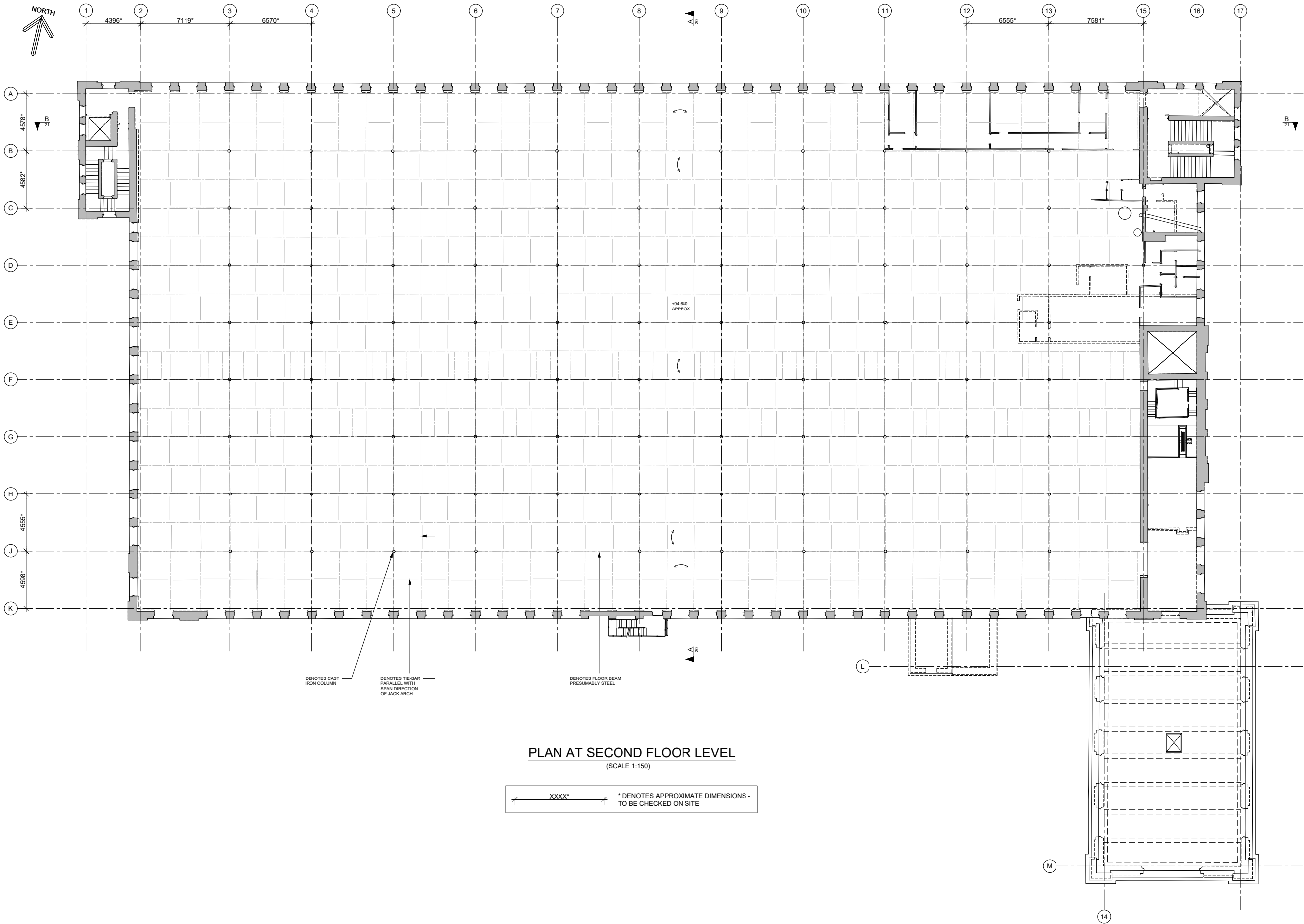
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Project Title
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Drawing Title
**EXISTING STRUCTURAL
LAYOUT AT FIRST
FLOOR LEVEL**

Drawing No.
21008-12

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 12	Revision P3



NOTES

1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
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4. Refer to MHA drawing 130 for all general notes.
5. Data shown is from historic site surveys. The locations of all structure is to be checked on site.

Rev	Date	Drawn	Checked	Amendments
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P2	24/01/22	PJD	RD	SPOT LEVELS ADDED
P1	17/11/21	PJD	RD	PRELIMINARY ISSUE

Status
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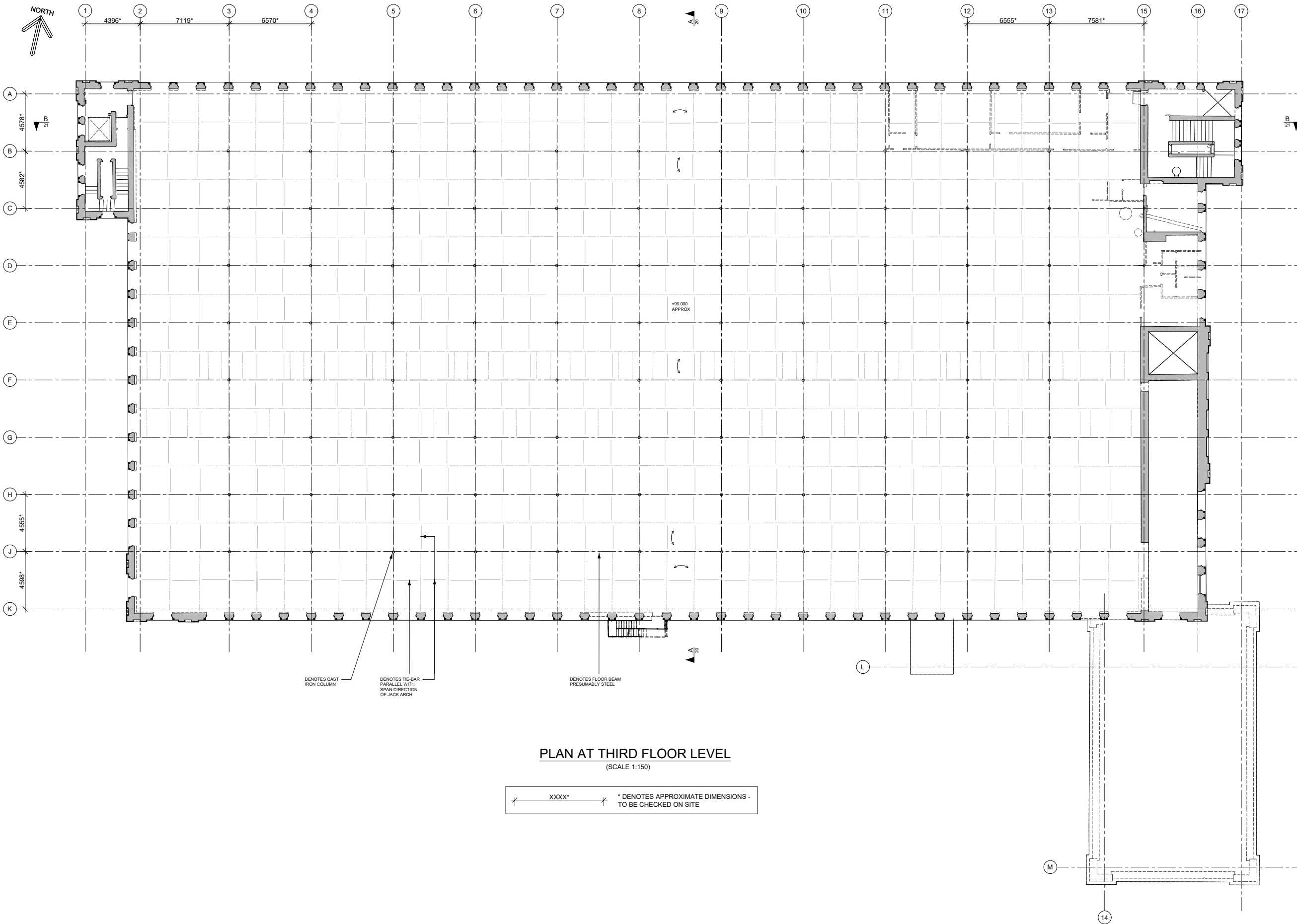
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Project Title
**WARWICK MILL
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M24 1AZ**

Drawing Title
**EXISTING STRUCTURAL
LAYOUT AT SECOND
FLOOR LEVEL**

Drawing No.
21008-13

Scale	Drawn	Checked
1:150 @ A1	PJD	RD
Project No.	Drawing No.	Revision
21008	13	P3



- NOTES
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P2	24/01/22	PJD	RD	SPOT LEVELS ADDED
P1	17/11/21	PJD	RD	PRELIMINARY ISSUE

Status
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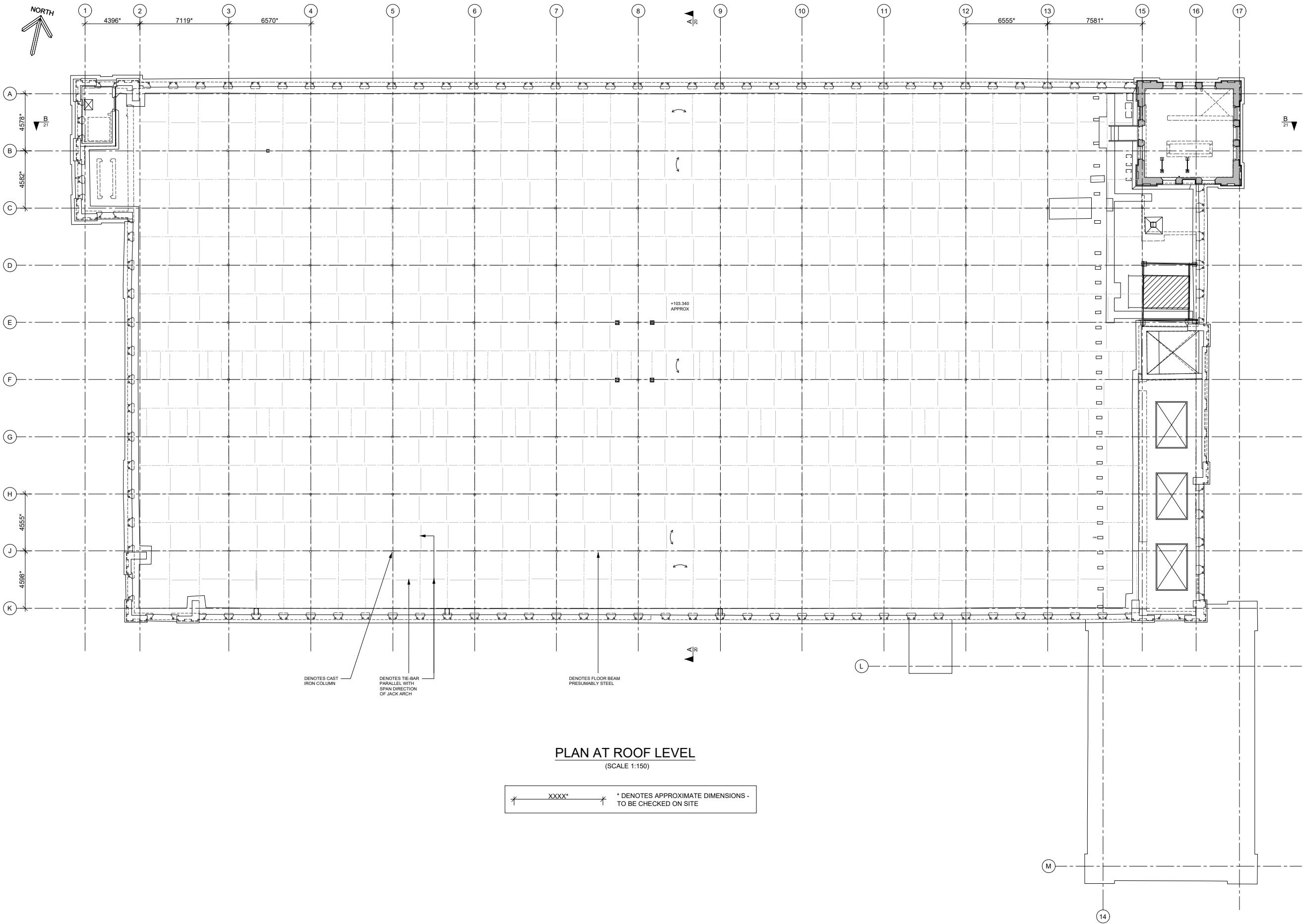
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Project Title
**WARWICK MILL
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M24 1AZ**

Drawing Title
**EXISTING STRUCTURAL
LAYOUT AT THIRD
FLOOR LEVEL**

Drawing No.
21008-14

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 14	Revision P3



- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
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P2	24/01/22	PJD	RD	SPOT LEVELS ADDED
P1	17/11/21	PJD	RD	PRELIMINARY ISSUE

Rev	Date	Drawn	Checked	Amendments
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MHA STRUCTURAL DESIGN

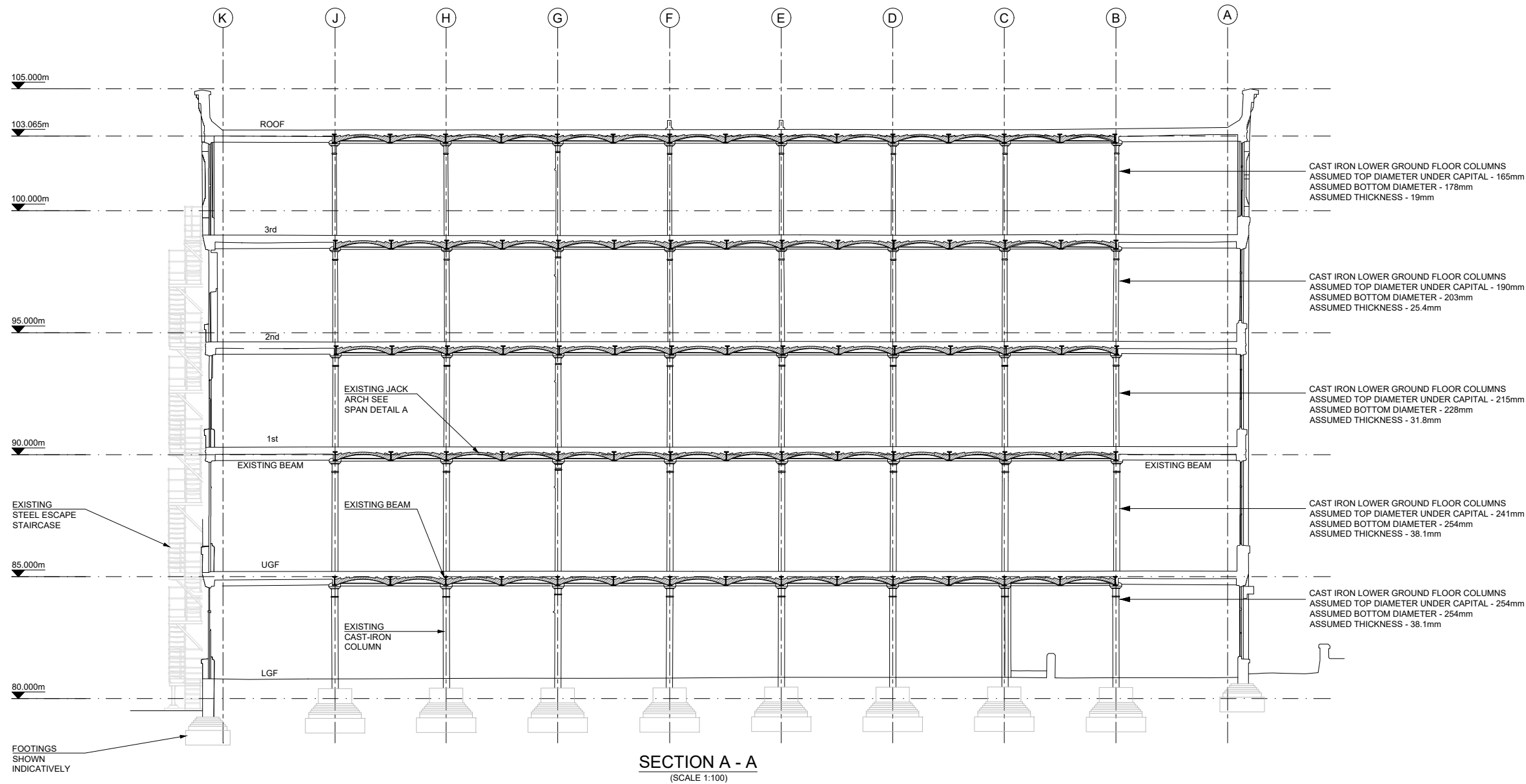
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Project Title
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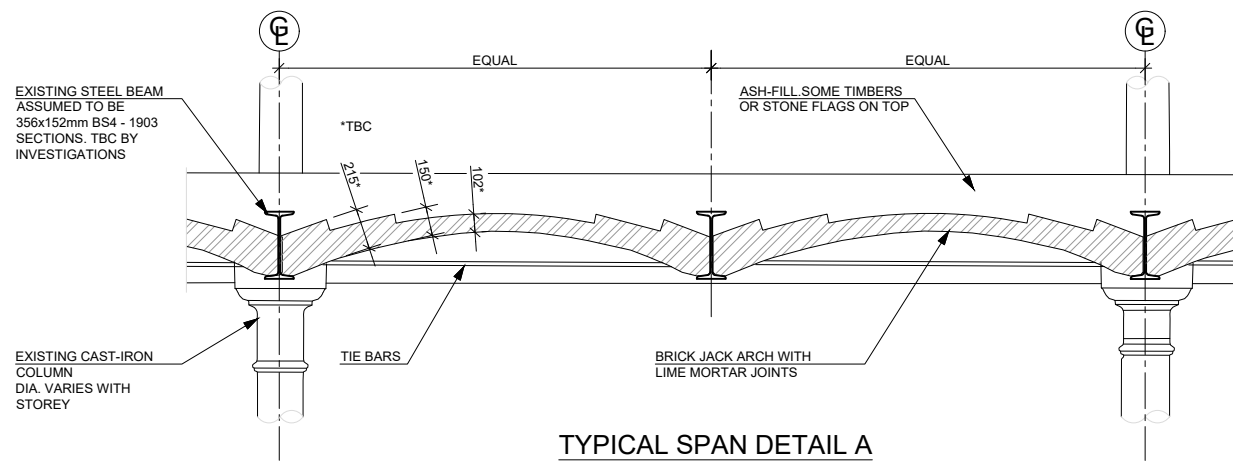
Drawing Title
**EXISTING STRUCTURAL
LAYOUT AT ROOF LEVEL**

Drawing No.
21008-15

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 15	Revision P3



SECTION A - A
(SCALE 1:100)



TYPICAL SPAN DETAIL A
(SCALE 1:20)

- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
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P3	14/07/23	PJD	RD	DRAWING TEMPLATE CHANGED
P2	24/01/22	PJD	RD	RE-ISSUED AS P2
P1	17/11/21	PJD	RD	PRELIMINARY ISSUE

Rev	Date	Drawn	Checked	Amendments
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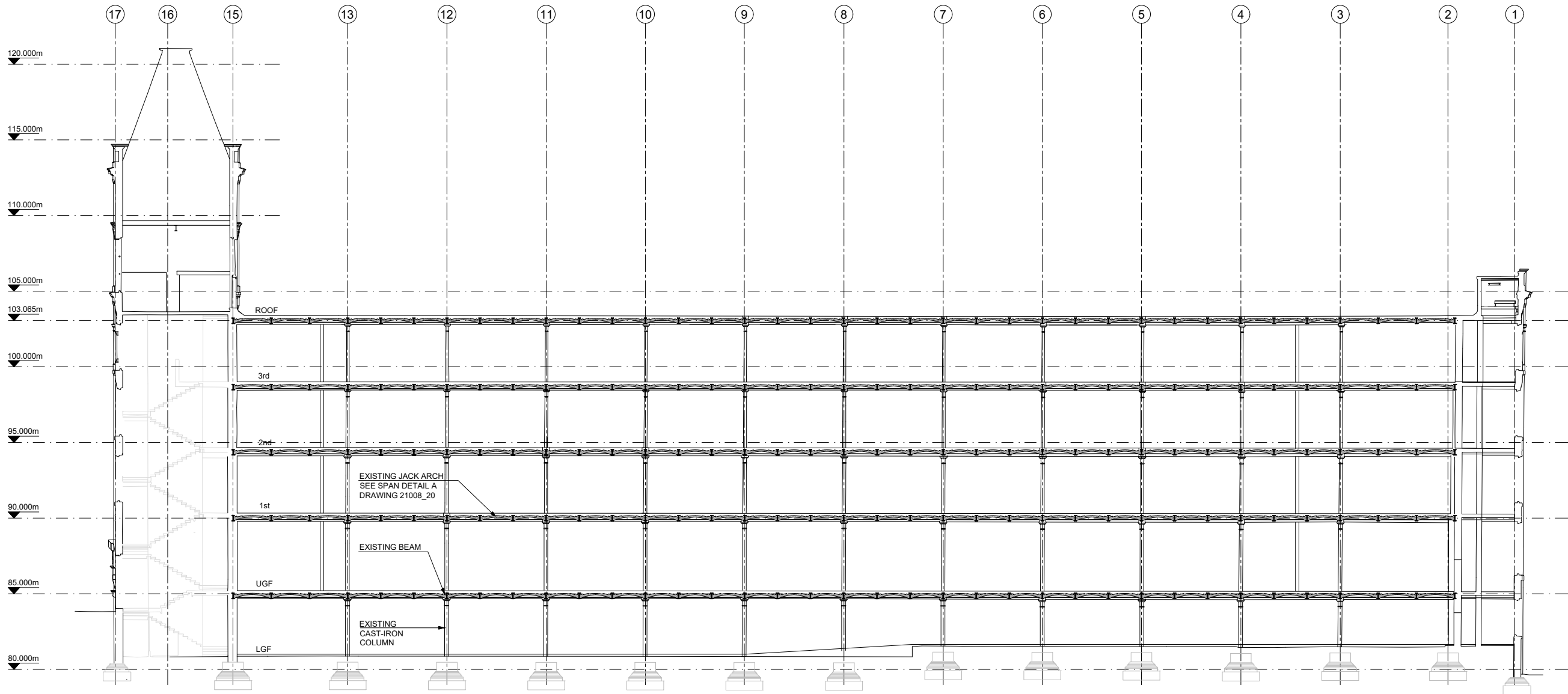
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Project Title
WARWICK MILL
MIDDLETON
M24 1AZ

Drawing Title
EXISTING SECTION A - A

Drawing No.
21008-20

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 20	Revision P3



SECTION B - B
(SCALE 1:150)

FOR ASSUMED COLUMN SIZES REFER TO
DRAWING 21008_20

- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
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P3	14/07/23	PJD	RD	DRAWING TEMPLATE CHANGED
P2	24/01/22	PJD	RD	RE-ISSUED AS P2
P1	17/11/21	PJD	RD	PRELIMINARY ISSUE

Rev	Date	Drawn	Checked	Amendments
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DESIGN**

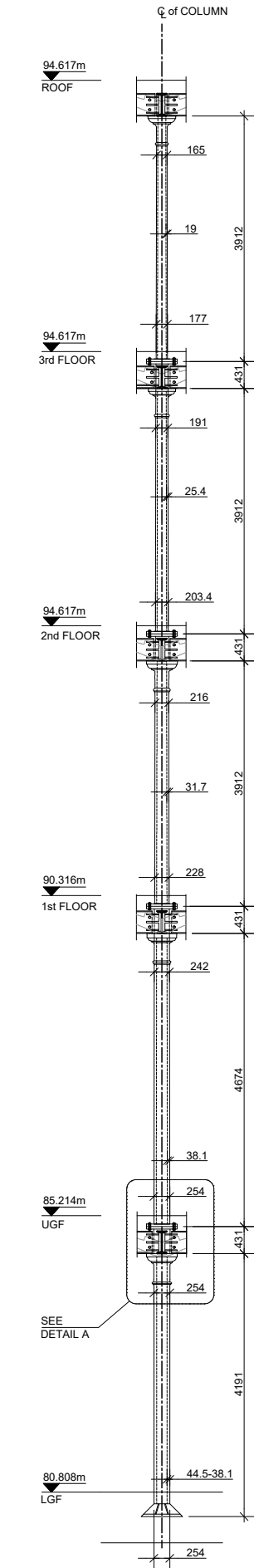
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Project Title
**WARWICK MILL
MIDDLETON
M24 1AZ**

Drawing Title
EXISTING SECTION B - B

Drawing No.
21008-21

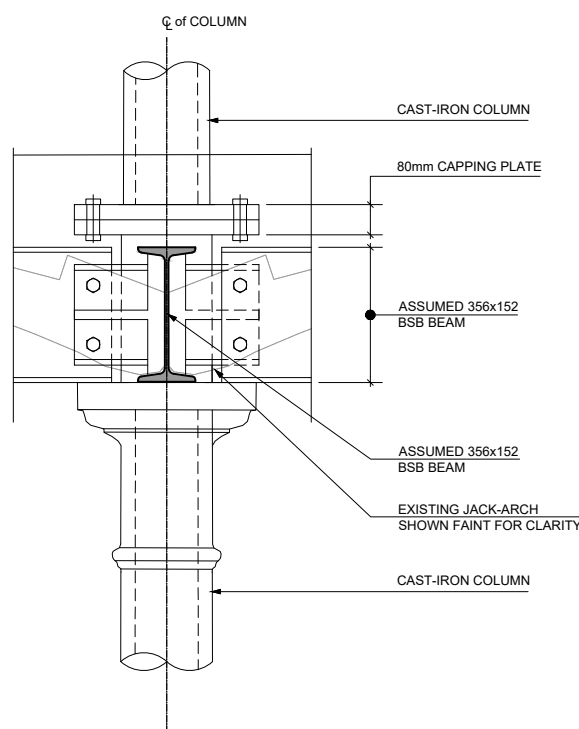
Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 21	Revision P3



EXISTING COLUMN ELEVATION

(SCALE 1:50)

ALL DIMENSIONS TO BE VERIFIED ON SITE



DETAIL A

(SCALE 1:10)

NOTES

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P2	24/01/22	PJD	RD	RE-ISSUED AS P2
P1	17/11/21	PJD	RD	PRELIMINARY ISSUE

Rev	Date	Drawn	Checked	Amendments
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Project Title
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M24 1AZ

Drawing Title
EXISTING COLUMN
DETAILS

Drawing No.
21008-30

Scale
1:150 @ A1

Drawn
PJD

Checked
RD

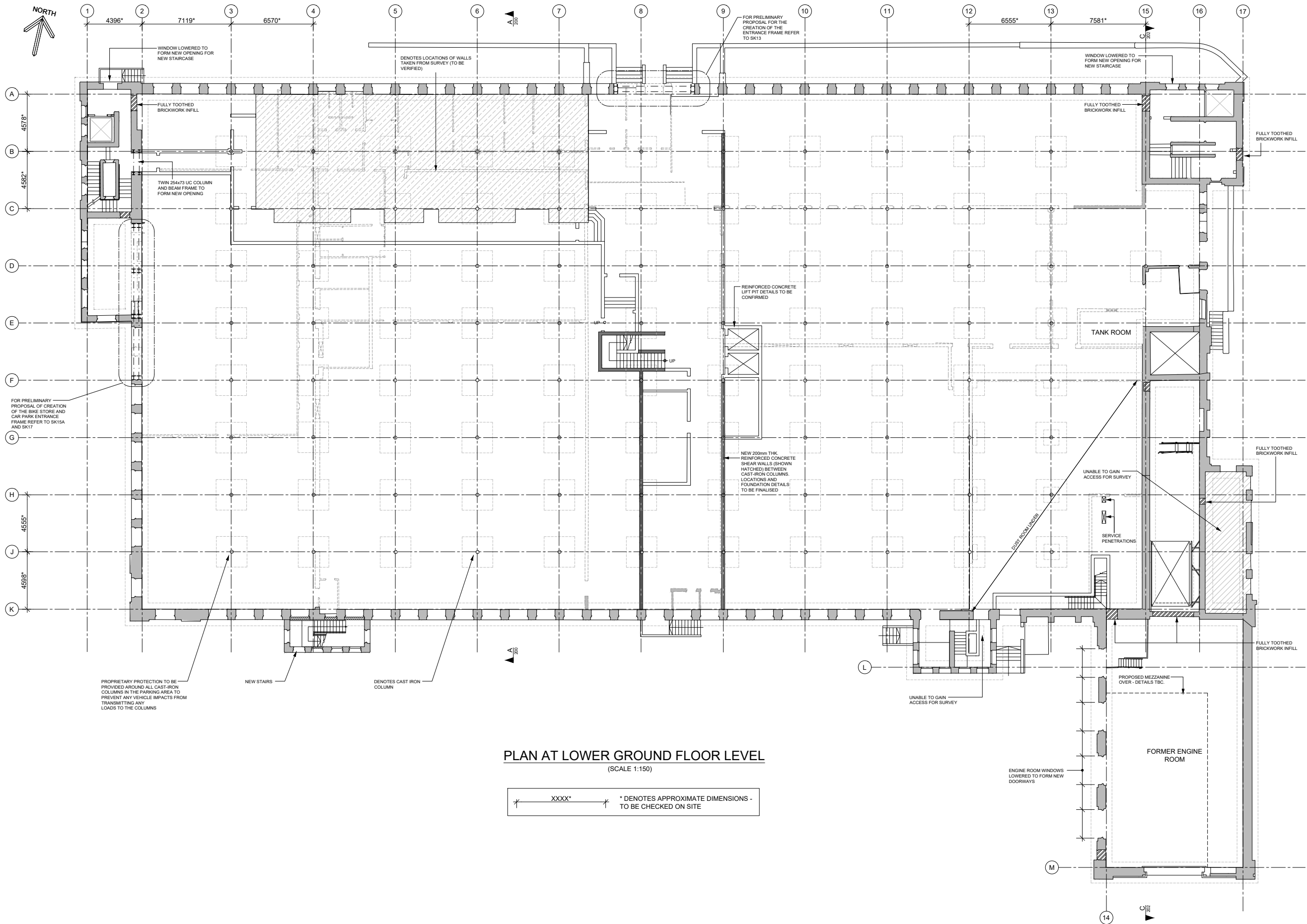
Project No.
21008

Drawing No.
30

Revision
P3

Appendix C – MHA’s Preliminary Proposed Structural GAs and Sections

120	Proposed Lower Ground Floor GA
130	Proposed Upper Ground Floor GA
140	Proposed First Floor GA
150	Proposed Second Floor GA
160	Proposed Third Floor GA
170	Proposed Fourth Floor GA
180	Proposed Roof GA
200	Proposed Section A-A
202	Proposed Section C-C



- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
 2. Do not scale off this drawing.
 3. All dimensions are to be confirmed on site by the contractor.
 4. Data shown is from historic site surveys. The locations of all structure is to be checked on site.

P3	14/07/23	PJD	RD	FURTHER UPDATE TO ARCHS DETAILS
P2	24/01/22	PJD	RD	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT
P1	21/10/21	PJD	RD	PRELIMINARY ISSUE
Rev	Date	Drawn	Checked	Amendments

Status
PRELIMINARY

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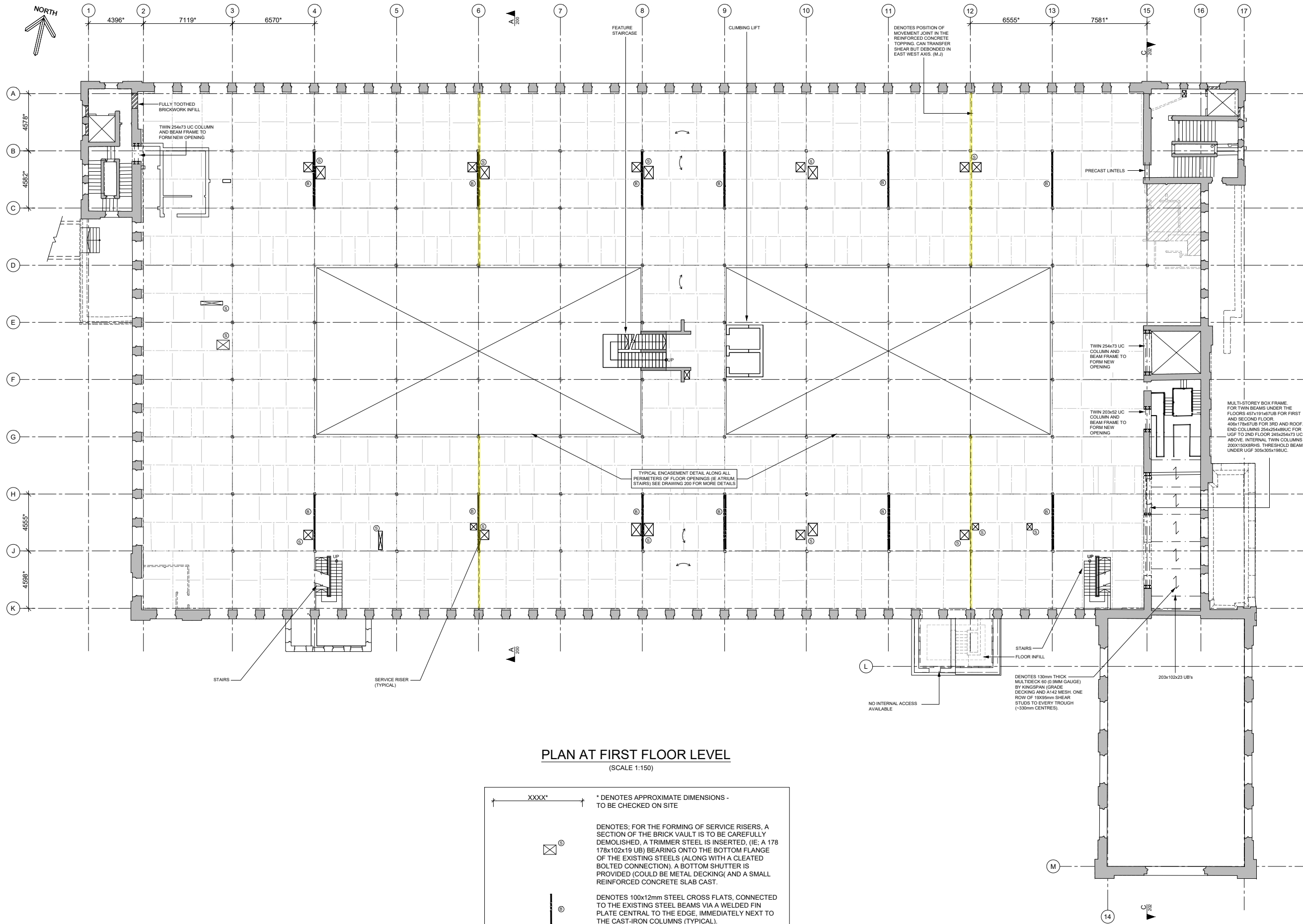
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Project Title
**WARWICK MILL
MIDDLETON
M24 1AZ**

Drawing Title
**PROPOSED STRUCTURAL
LAYOUT AT LOWER
GROUND FLOOR LEVEL**

Drawing No.
21008-120

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 120	Revision P3



- NOTES
- This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
 - Do not scale off this drawing.
 - All dimensions are to be confirmed on site by the contractor.
 - Refer to MHA drawing 120 for all general notes.
 - Data shown is from historic site surveys. The locations of all structure is to be checked on site.

P3	14/07/23	PJD	RD	FURTHER UPDATE TO ARCHS DETAILS
P2	24/01/22	PJD	RD	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT
P1	21/11/21	PJD	RD	PRELIMINARY ISSUE

Rev	Date	Drawn	Checked	Amendments
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Status
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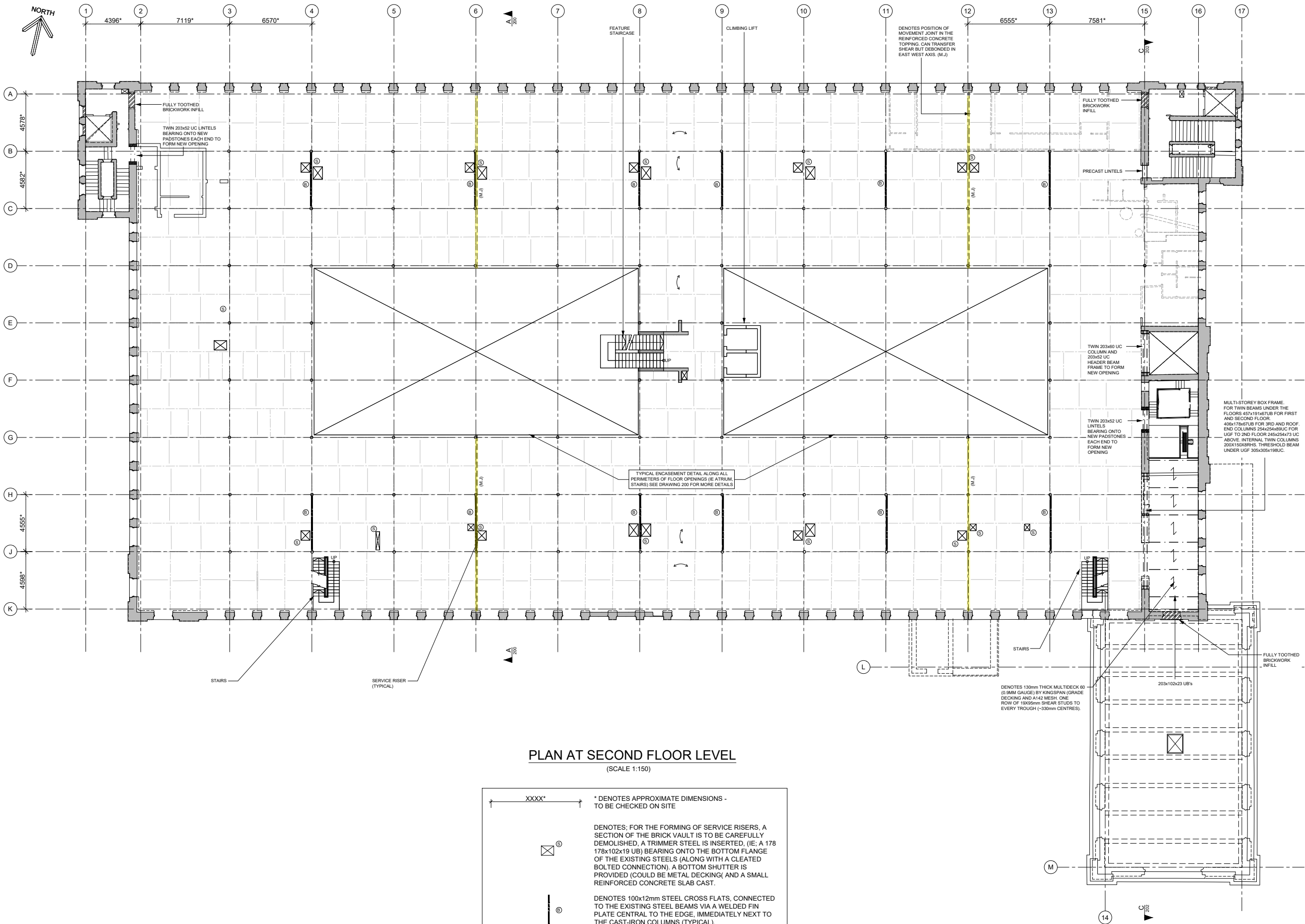
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Project Title
**WARWICK MILL
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M24 1AZ**

Drawing Title
**PROPOSED STRUCTURAL
LAYOUT AT FIRST FLOOR LEVEL**

Drawing No.
21008-140

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 140	Revision P3



- NOTES
- This drawing is to be read in conjunction with all relevant architects' engineers' and specialists' drawings, bills of quantities and specifications.
 - Do not scale off this drawing.
 - All dimensions are to be confirmed on site by the contractor.
 - Refer to MHA drawing 120 for all general notes.
 - Data shown is from historic site surveys. The locations of all structure is to be checked on site.

Rev	Date	Drawn	Checked	Amendments
P3	14/07/23	PJD	RD	FURTHER UPDATE TO ARCHS DETAILS
P2	24/01/22	PJD	RD	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT
P1	21/10/21	PJD	RD	PRELIMINARY ISSUE

Status
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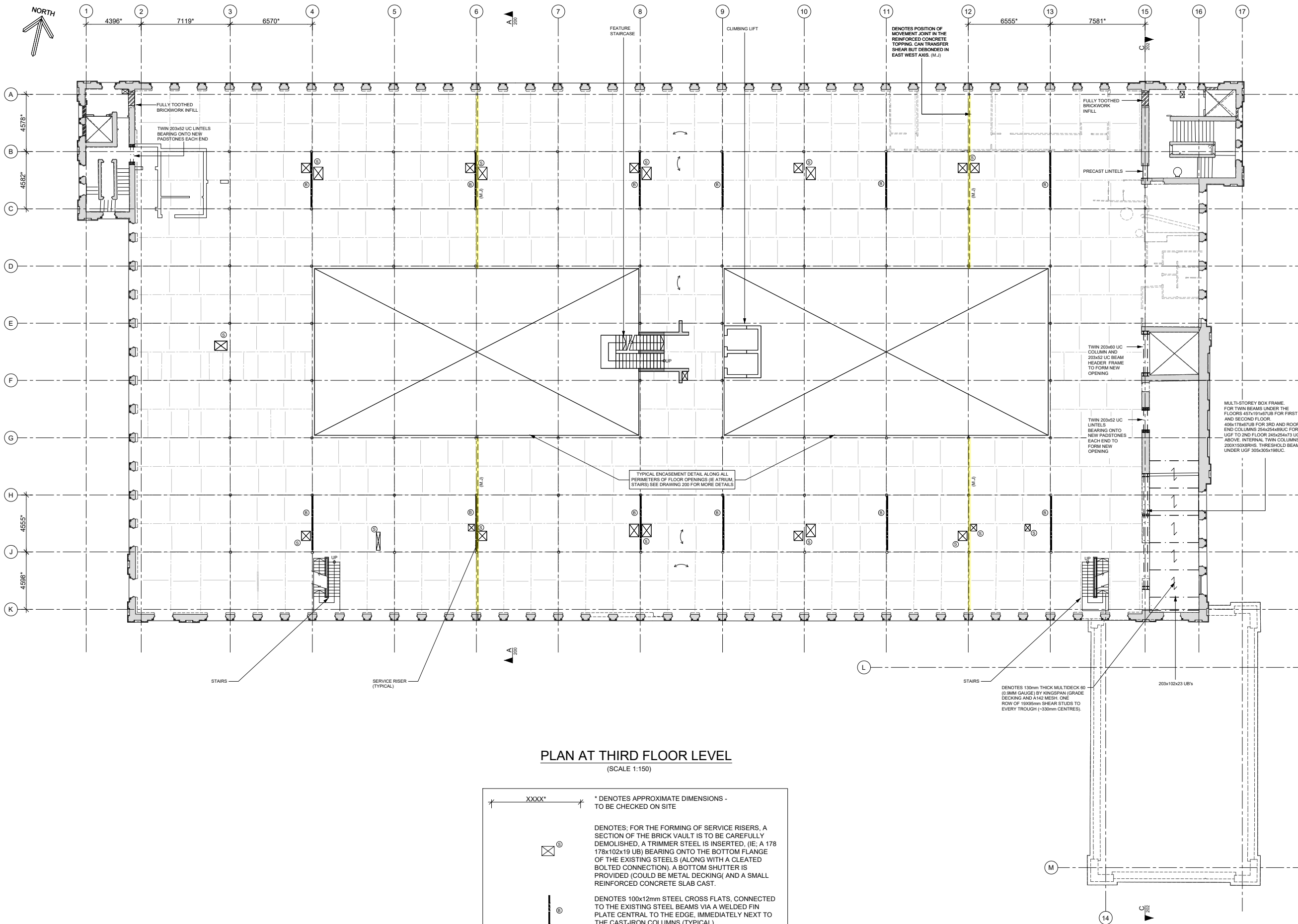
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Project Title
**WARWICK MILL
MIDDLETON
M24 1AZ**

Drawing Title
**PROPOSED STRUCTURAL
LAYOUT AT SECOND
FLOOR LEVEL**

Drawing No.
21008-150

Scale	Drawn	Checked
1:150 @ A1	PJD	RD
Project No.	Drawing No.	Revision
21008	150	P3



PLAN AT THIRD FLOOR LEVEL
(SCALE 1:150)

XXXX"

* DENOTES APPROXIMATE DIMENSIONS - TO BE CHECKED ON SITE

DENOTES: FOR THE FORMING OF SERVICE RISERS, A SECTION OF THE BRICK VAULT IS TO BE CAREFULLY DEMOLISHED, A TRIMMER STEEL IS INSERTED, (IE: A 178 178x102x19 UB) BEARING ONTO THE BOTTOM FLANGE OF THE EXISTING STEELS (ALONG WITH A CLEATED BOLTED CONNECTION). A BOTTOM SHUTTER IS PROVIDED (COULD BE METAL DECKING) AND A SMALL REINFORCED CONCRETE SLAB CAST.

DENOTES 100x12mm STEEL CROSS FLATS, CONNECTED TO THE EXISTING STEEL BEAMS VIA A WELDED FIN PLATE CENTRAL TO THE EDGE, IMMEDIATELY NEXT TO THE CAST-IRON COLUMNS (TYPICAL).

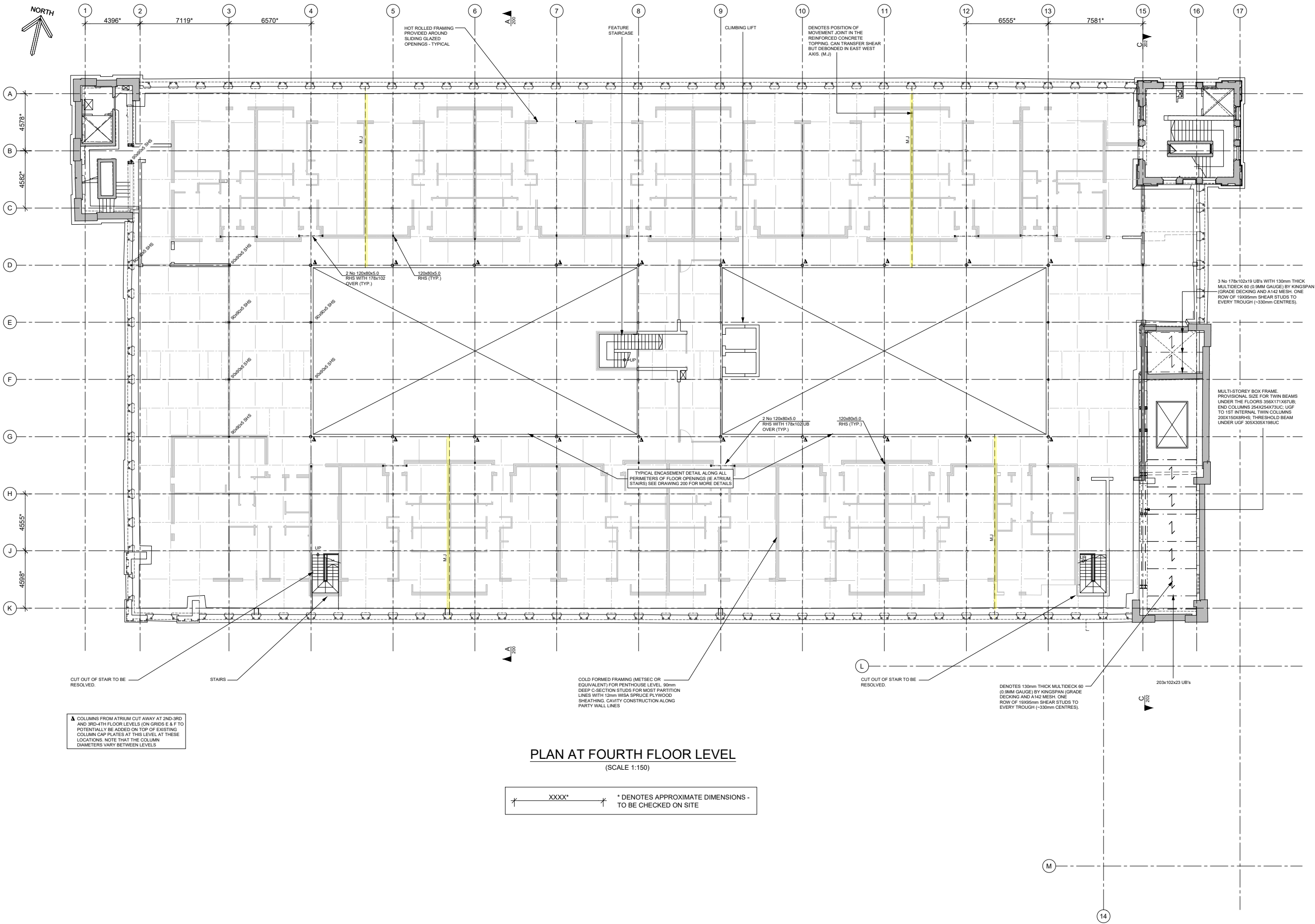
- NOTES
- This drawing is to be read in conjunction with all relevant architects' engineers' and specialists' drawings, bills of quantities and specifications.
 - Do not scale off this drawing.
 - All dimensions are to be confirmed on site by the contractor.
 - Refer to MHA drawing 120 for all general notes.
 - Data shown is from historic site surveys. The locations of all structure is to be checked on site.

Rev	Date	Drawn	Checked	Amendments
P3	14/07/23	PJD	RD	FURTHER UPDATE TO ARCHS DETAILS
P2	24/01/22	PJD	RD	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT
P1	21/10/21	PJD	RD	PRELIMINARY ISSUE

Status				
PRELIMINARY				
Project Title				
WARWICK MILL MIDDLETON M24 1AZ				
Drawing Title				
PROPOSED STRUCTURAL LAYOUT AT THIRD FLOOR LEVEL				
Drawing No.				
21008-160				
Scale				
1:150 @ A1				
Project No.				
21008				
Drawing No.				
160				
Revision				
P3				

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- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
 2. Do not scale off this drawing.
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 4. Refer to MHA drawing 120 for all general notes.
 5. Data shown is from historic site surveys. The locations of all structure is to be checked on site.

P3	14/07/23	PJD	RD	FURTHER UPDATE TO ARCHS DETAILS
P2	24/01/22	PJD	RD	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT
P1	21/10/21	PJD	RD	PRELIMINARY ISSUE

Rev	Date	Drawn	Checked	Amendments
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Status
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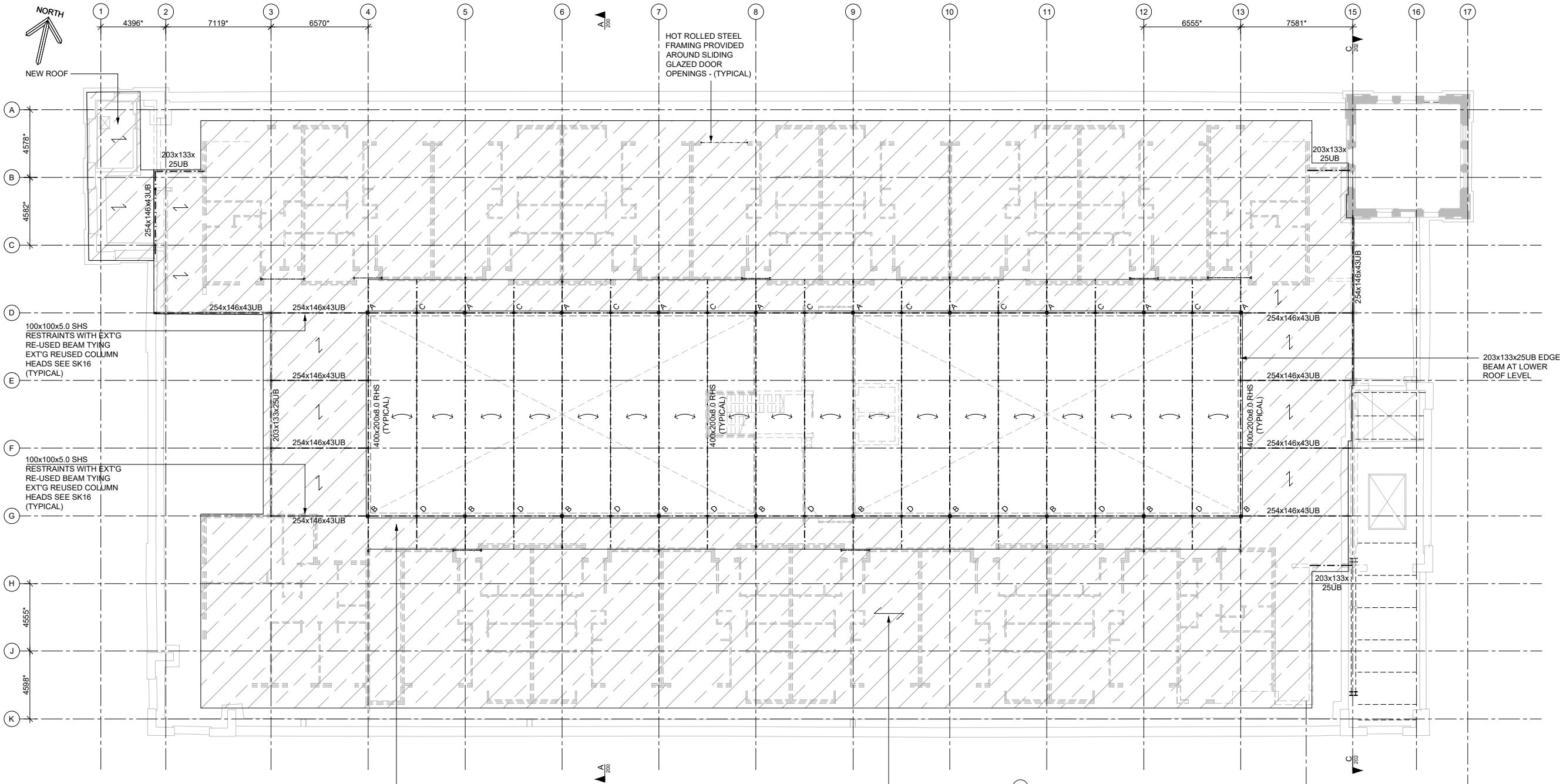
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Project Title
**WARWICK MILL
MIDDLETON
M24 1AZ**

Drawing Title
**PROPOSED STRUCTURAL
LAYOUT AT FOURTH
FLOOR LEVEL**

Drawing No.
21008-170

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 170	Revision P3



- COLUMN TYPES
- A DENOTES EXT'G RE-USED COLUMN
 - B DENOTES EXT'G RE-USED COLUMN WITH 100x100x5.0 SHS STUB COLUMN OVER
 - C 150x100x5 RHS TRIANGULAR SUPPORT FRAME AT HIGH LEVEL WITH RE-CYCLED BEAM BELOW
 - D DENOTES ROOF BEAM BEARING ONTO RECYCLED BEAM
- ↔ DENOTES SINGLE ETFE LAYER

ROOF BEAMS ALTERNATE BETWEEN HIGH AND LOW SUPPORTS PROVIDING A WARPED ROOF PROFILE

PLAN AT ROOF LEVEL

(SCALE 1:150)

XXXX' * DENOTES APPROXIMATE DIMENSIONS - TO BE CHECKED ON SITE

COLD FORMED FRAMING (METSEC OR EQUIVALENT) FOR PENTHOUSE LEVEL. ROOF JOISTS TO SPAN IN EAST-WEST AXIS. FOR TYPICAL 4.5m SPAN ASSUME METSEC 150M12-62 @ 400mm CRS WITH 15mm WISA SPRUCE PLYWOOD OVER

- NOTES
- This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
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 - All dimensions are to be confirmed on site by the contractor.
 - Refer to MHA drawing 120 for all general notes.
 - Data shown is from historic site surveys. The locations of all structure is to be checked on site.

P3	14/07/23	PJD	RD	FURTHER UPDATE TO ARCHS DETAILS
P2	24/01/22	PJD	RD	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT
P1	21/10/21	PJD	RD	PRELIMINARY ISSUE

Rev	Date	Drawn	Checked	Amendments
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Status
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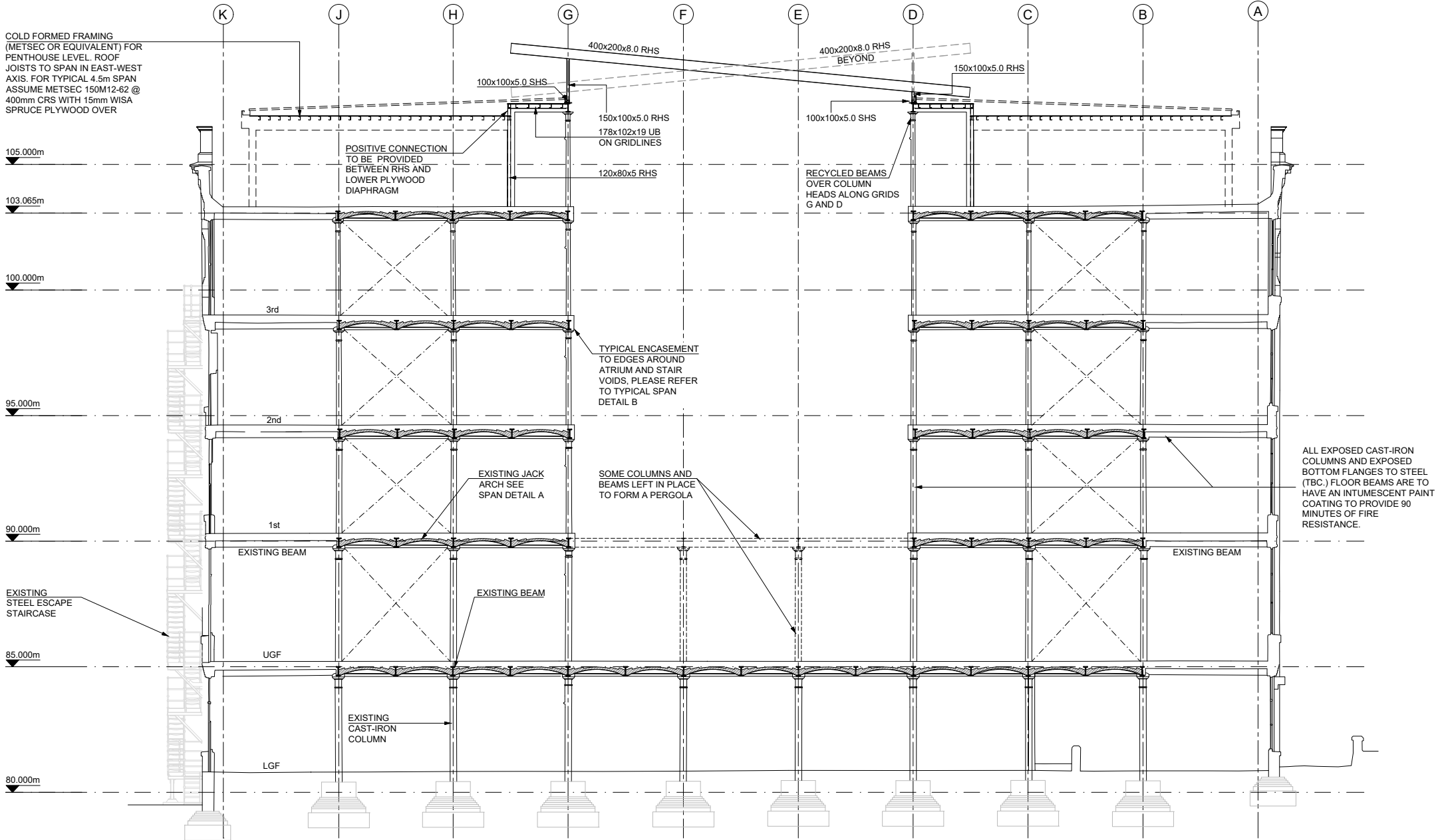
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Project Title
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M24 1AZ**

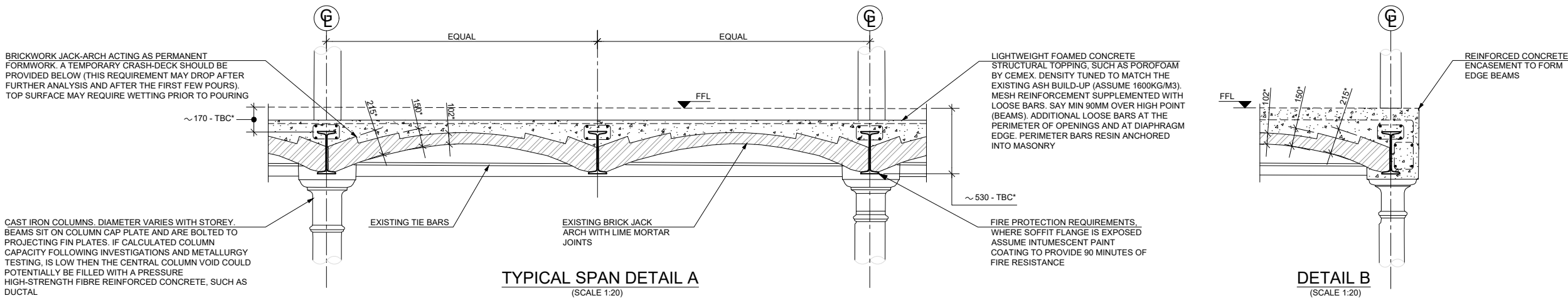
Drawing Title
**PROPOSED STRUCTURAL
LAYOUT AT ROOF LEVEL**

Drawing No.
21008-180

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 180	Revision P3



SECTION A - A
(SCALE 1:100)



TYPICAL SPAN DETAIL A
(SCALE 1:20)

DETAIL B
(SCALE 1:20)

- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
 2. Do not scale off this drawing.
 3. All dimensions are to be confirmed on site by the contractor.
 4. Refer to MHA drawing 130 for all general notes.

P3	14/07/23	PJD	RD	FURTHER UPDATE TO ARCHS DETAILS
P2	24/01/22	PJD	RD	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT
P1	21/10/21	PJD	RD	PRELIMINARY ISSUE

Rev	Date	Drawn	Checked	Amendments
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Status
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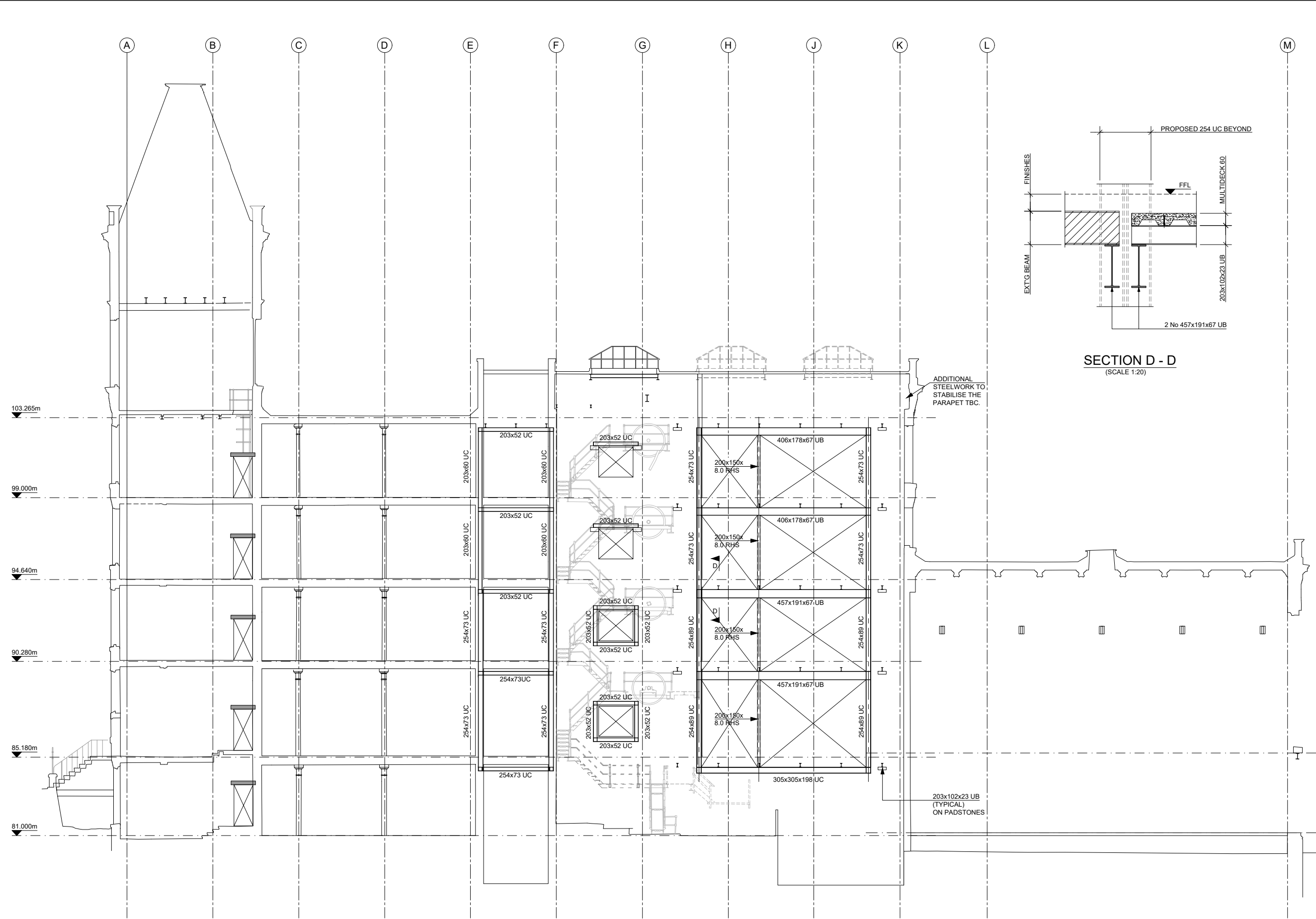
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Project Title
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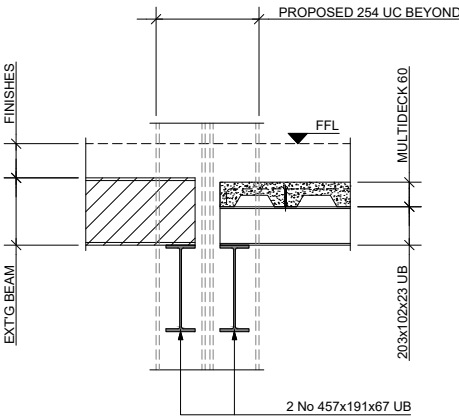
Drawing Title
PROPOSED SECTION A - A

Drawing No.
21008-200

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 200	Revision P3



SECTION C - C
(SCALE 1:100)



SECTION D - D
(SCALE 1:20)

NOTES

1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
2. Do not scale off this drawing.
3. All dimensions are to be confirmed on site by the contractor.
4. Refer to MHA drawing 130 for all general notes.

P3	14/07/23	PJD	RD	FURTHER UPDATE TO ARCHS DETAILS
P2	24/01/22	PJD	RD	UPDATED TO SUIT LATEST ARCHITECTS LAYOUT
P1	21/10/21	PJD	RD	PRELIMINARY ISSUE
Rev	Date	Drawn	Checked	Amendments

Status
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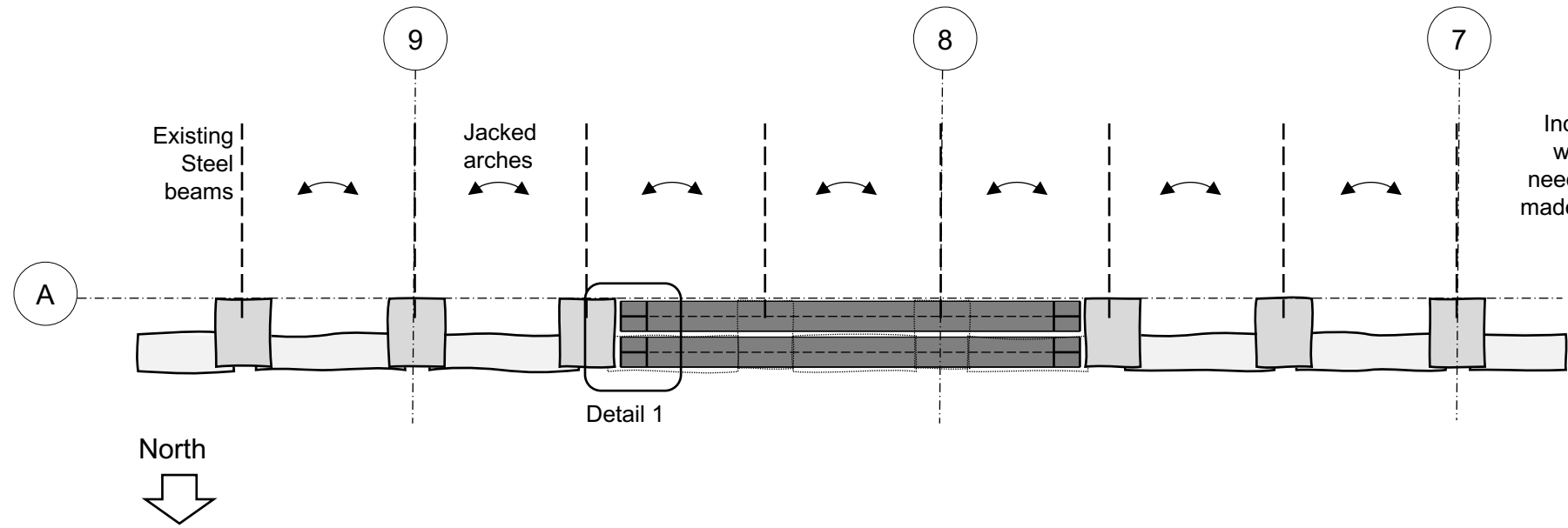
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Project Title
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MIDDLETON
M24 1AZ

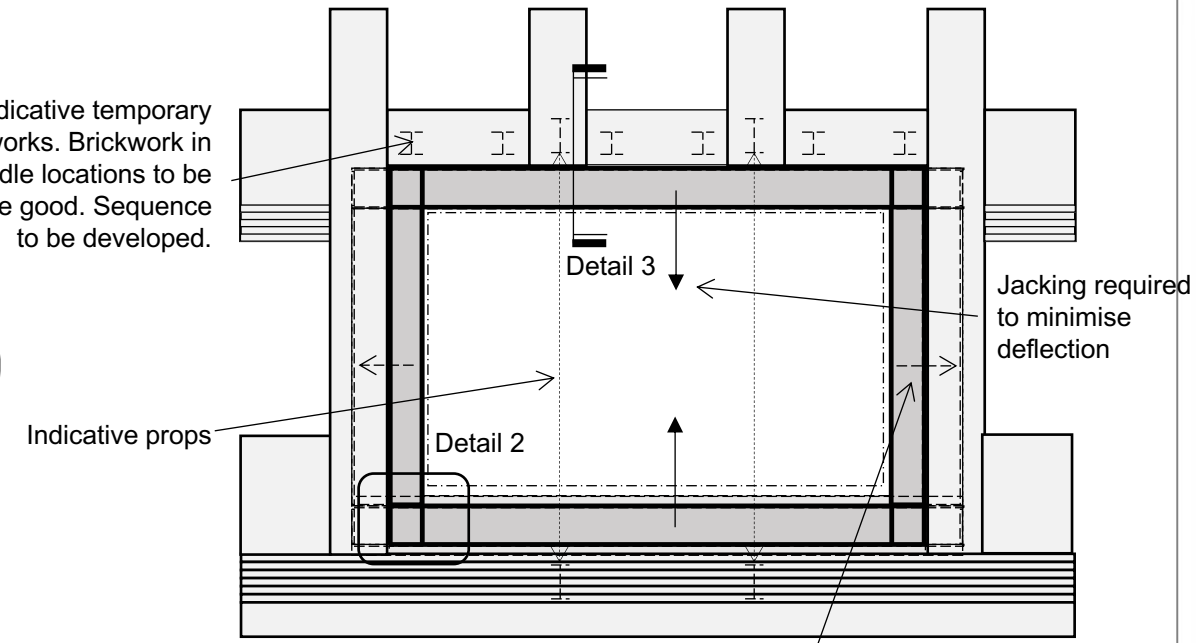
Drawing Title
PROPOSED SECTION C - C

Drawing No.
21008-202

Scale 1:150 @ A1	Drawn PJD	Checked RD
Project No. 21008	Drawing No. 202	Revision P3

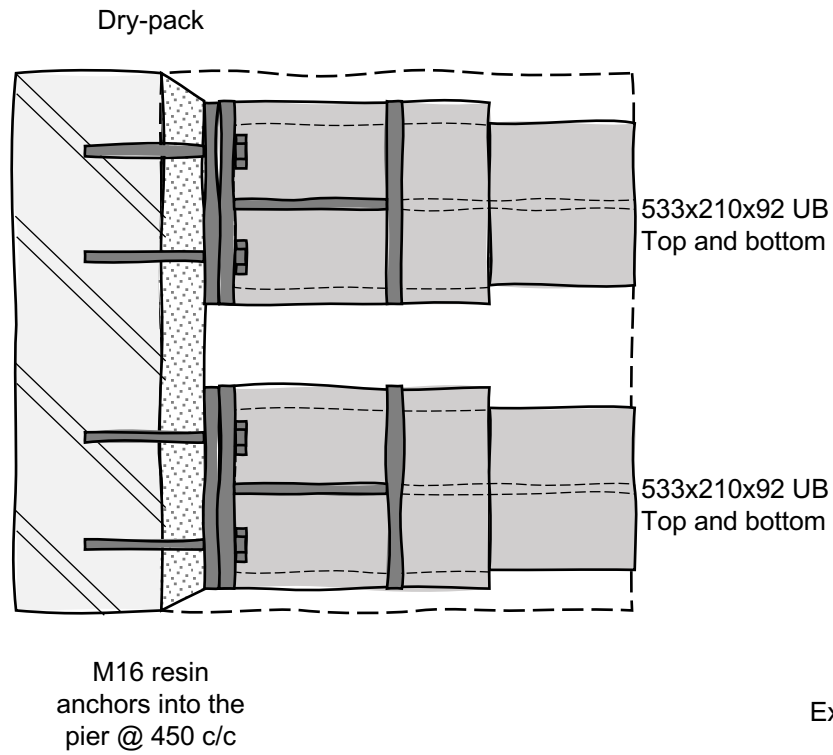


PLAN

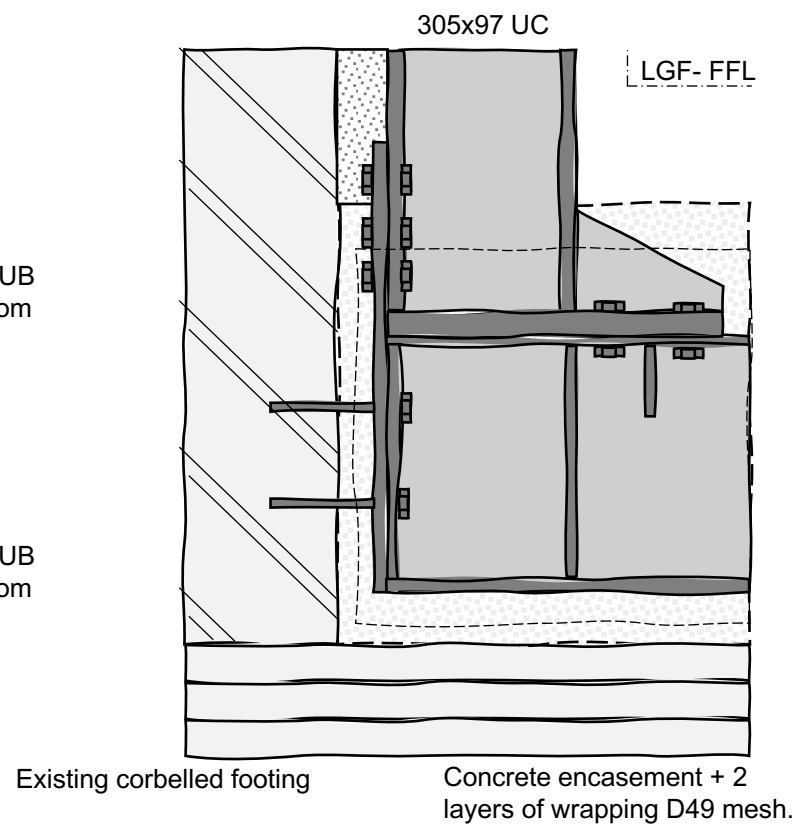


ELEVATION

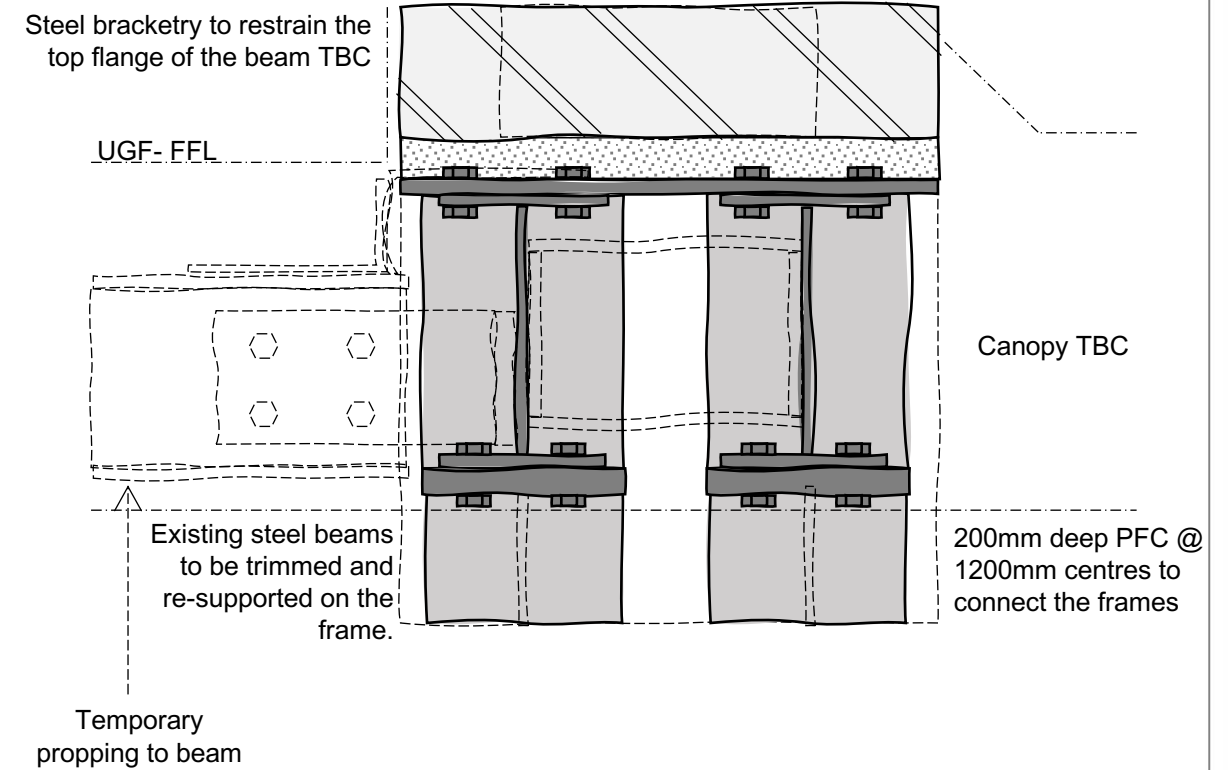
If frame is to be positioned within pier then column size will increase to 305x305x118UC. Temporary works will also be more complicated and more expensive



DETAIL 1



DETAIL 2



DETAIL 3

- Notes
1. This drawing is to be read in conjunction with all architect's and engineers drawings and specifications.
 2. Do not scale this drawing. All dimensions and levels to be confirmed on site.
 3. All steel to be s355.

Rev.	Date	Drawn	Checked	Amendments
A	07.23	MC	RD	FORMATTING
Status				
PRELIMINARY				

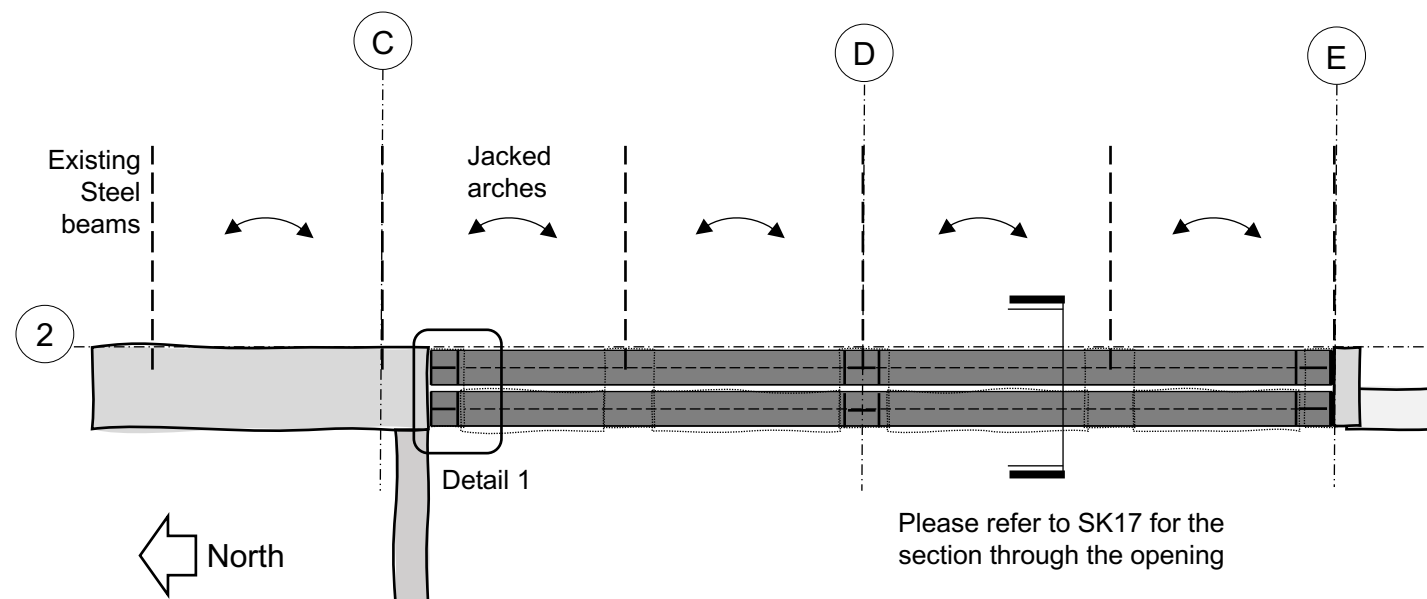
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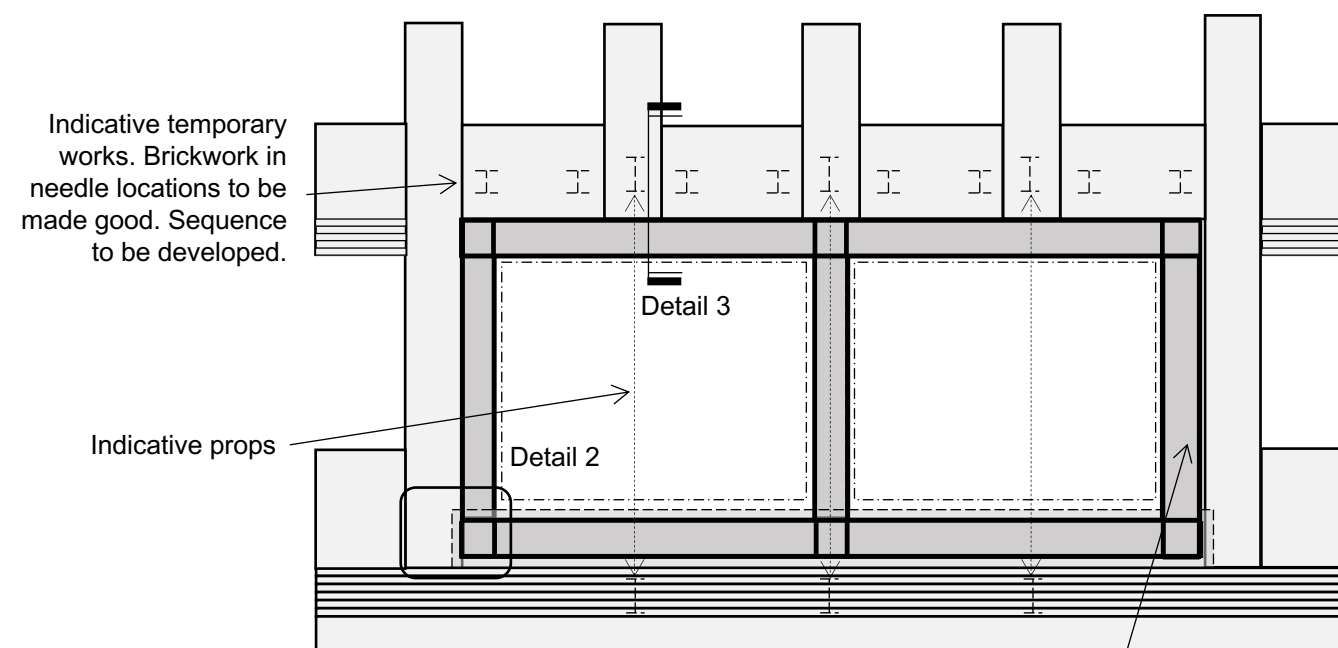
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Job Title Warwick Mill, Middleton, M24 1AZ		
Drawing Title Entrance Frame		
Job No./Drg No. 21008 / SK13	Revision A	Scale @ A3 NTS

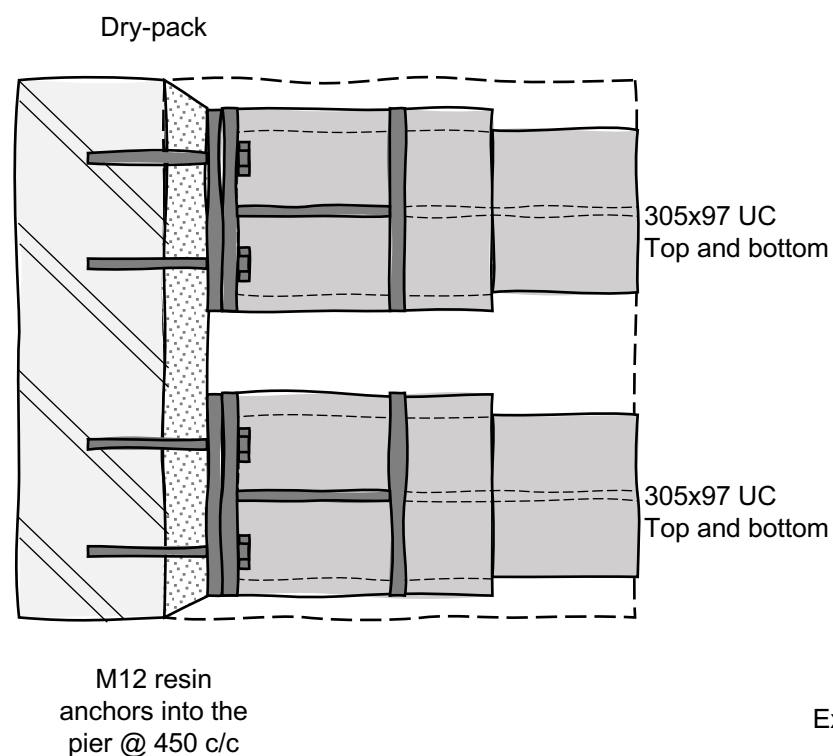


PLAN

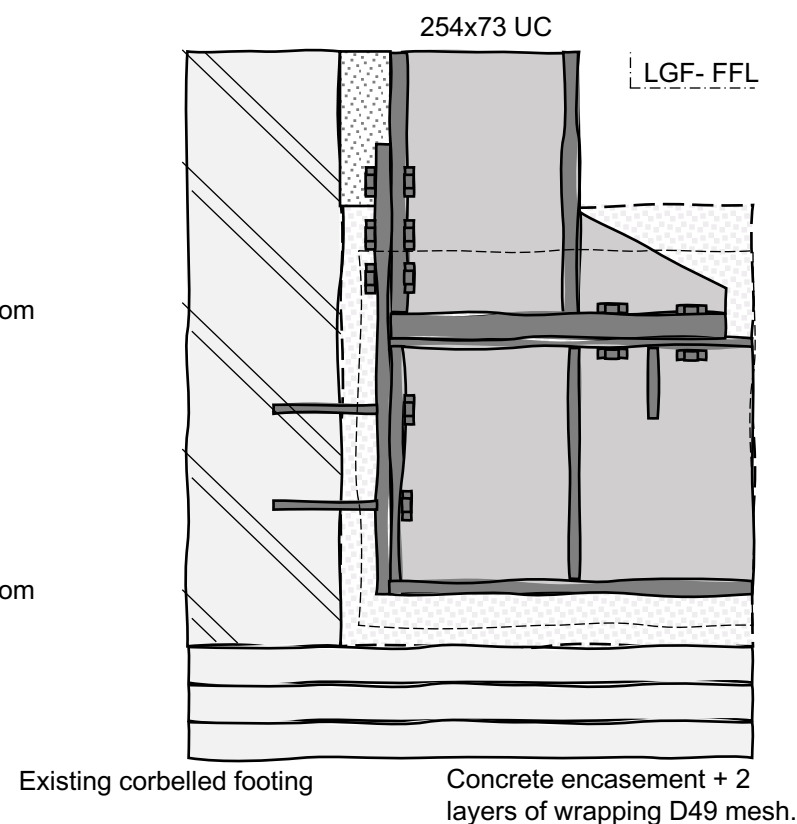


ELEVATION

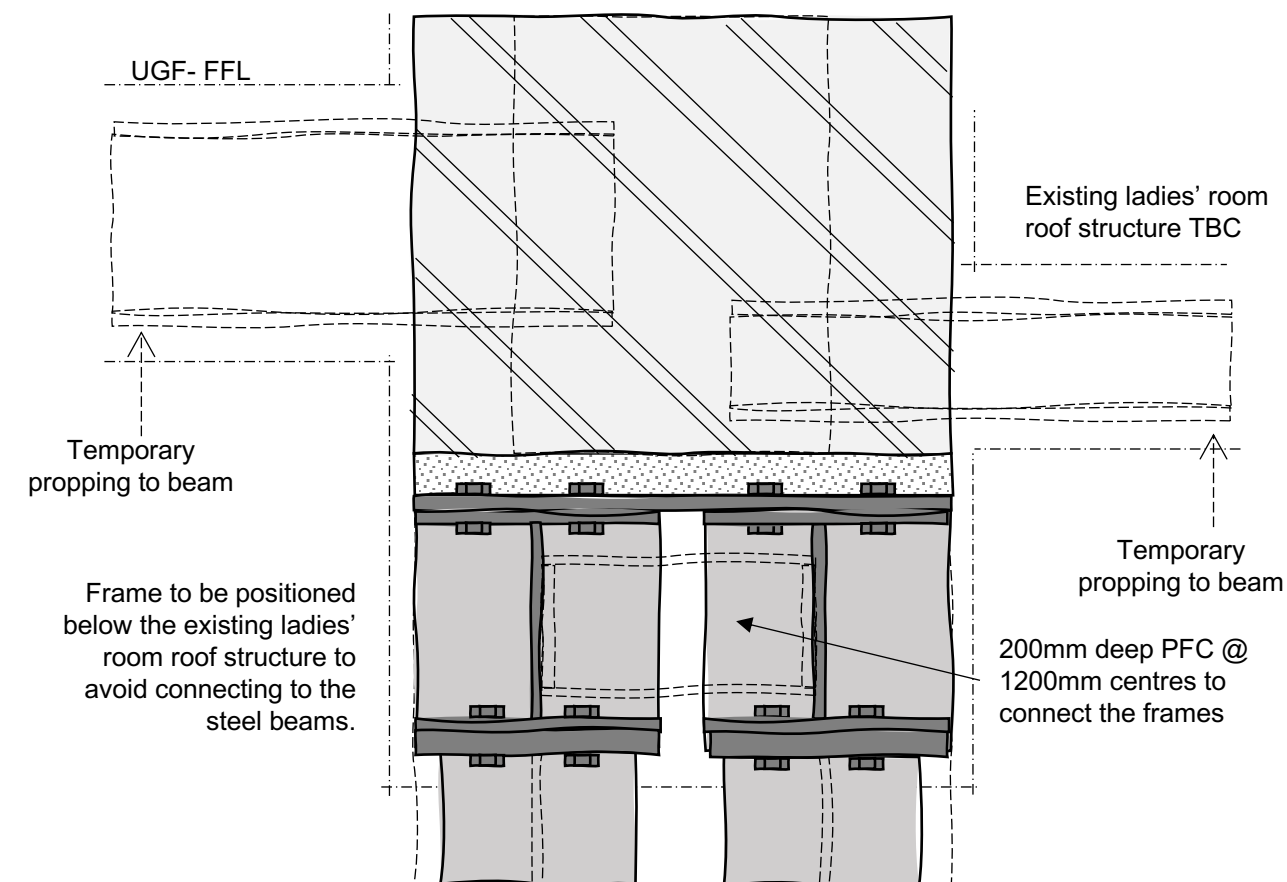
If frame is to be positioned within piers then temporary works will be more complicated and more expensive.



DETAIL 1



DETAIL 2



DETAIL 3

Notes

1. This drawing is to be read in conjunction with all architect's and engineers drawings and specifications.
2. Do not scale this drawing. All dimensions and levels to be confirmed on site.
3. All steel to be s355.

Rev.	Date	Drawn	Checked	Amendments
A	07.23	MC	RD	FORMATTING
Status				
PRELIMINARY				

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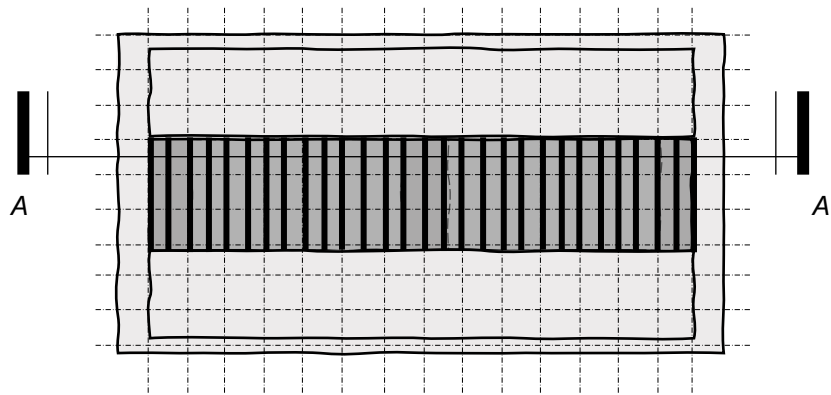
Job Title
Warwick Mill, Middleton, M24 1AZ

Drawing Title
Bike Storage Frame

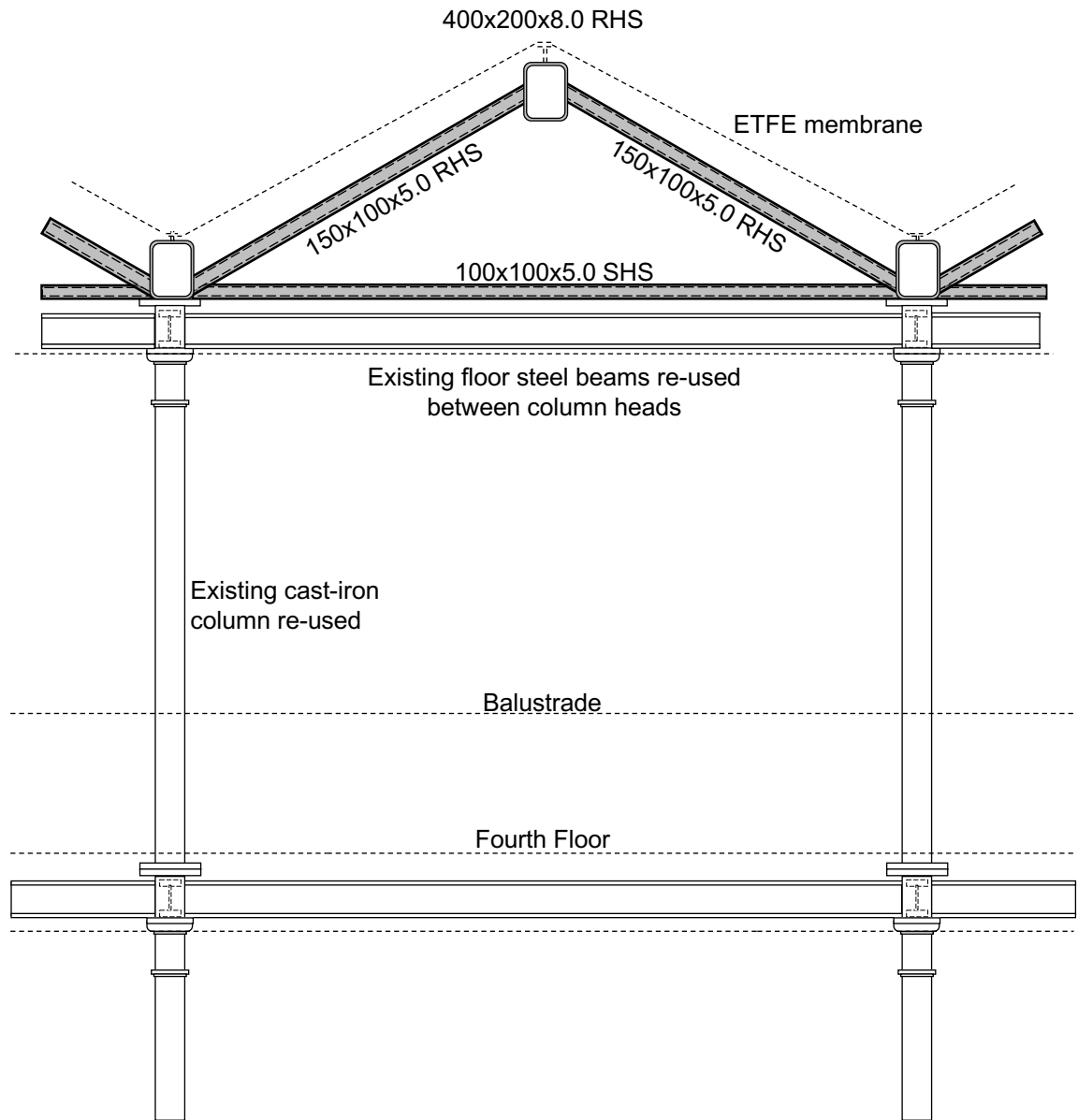
Job No./Drg No.
21008 / SK15

Revision
A

Scale @ A3
NTS



Plan



Typical Longitudinal Section A-A

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B	07.23	MC	RD
A	02.22	MC	RD
Rev.	Date	Drawn	Checked

Project
Warwick Mill, Middleton, M24 1AZ

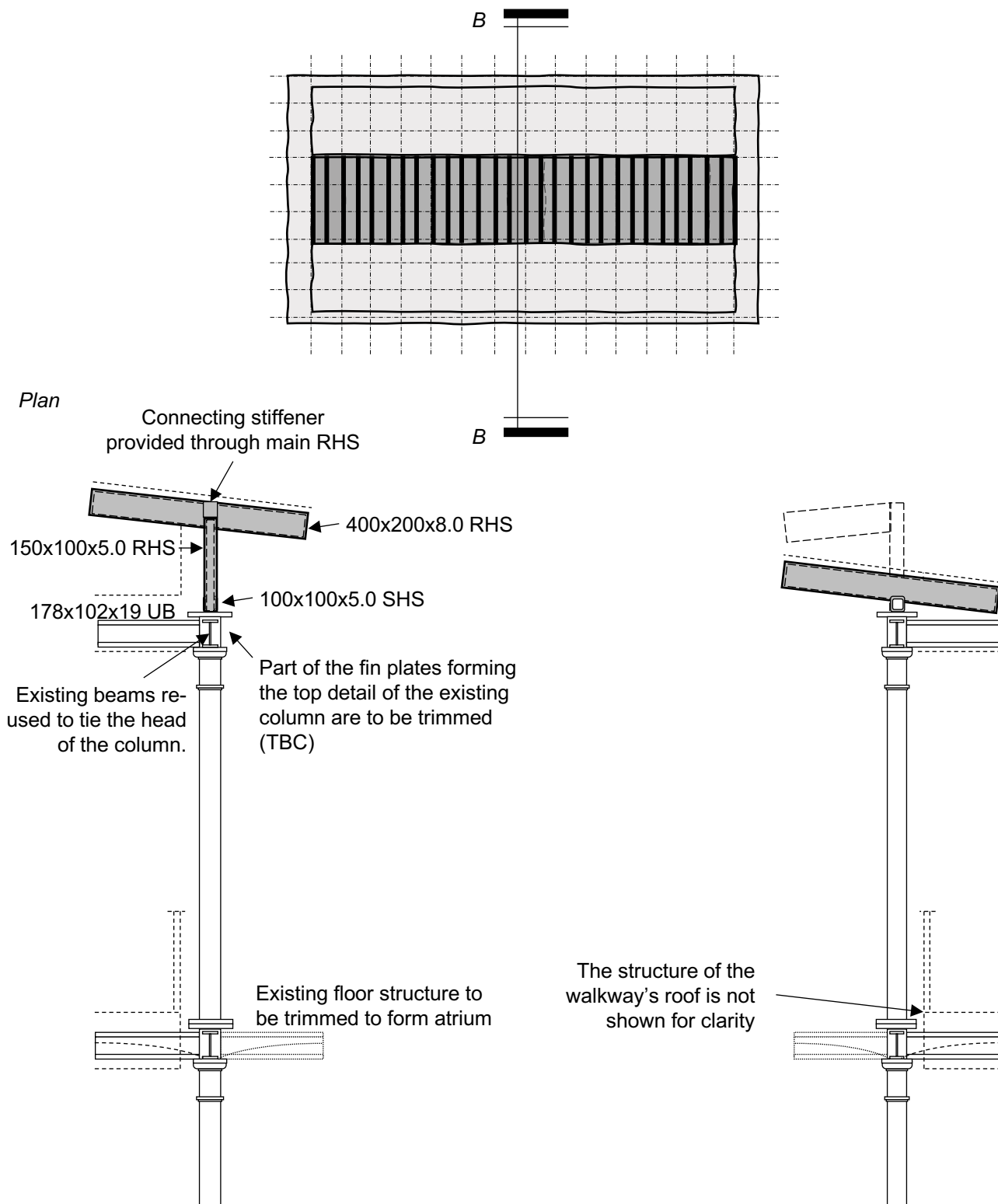
Title
Saw Tooth Roof - Sheet I

Job No./Drg No.
21008 / SK16

Status
Preliminary

Revision
B

Scale: A4
NTS



Typical Cross Section B-B

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B	07.23	MC	RD
A	02.22	MC	RD
Rev.	Date	Drawn	Checked

Project
Warwick Mill, Middleton, M24 1AZ

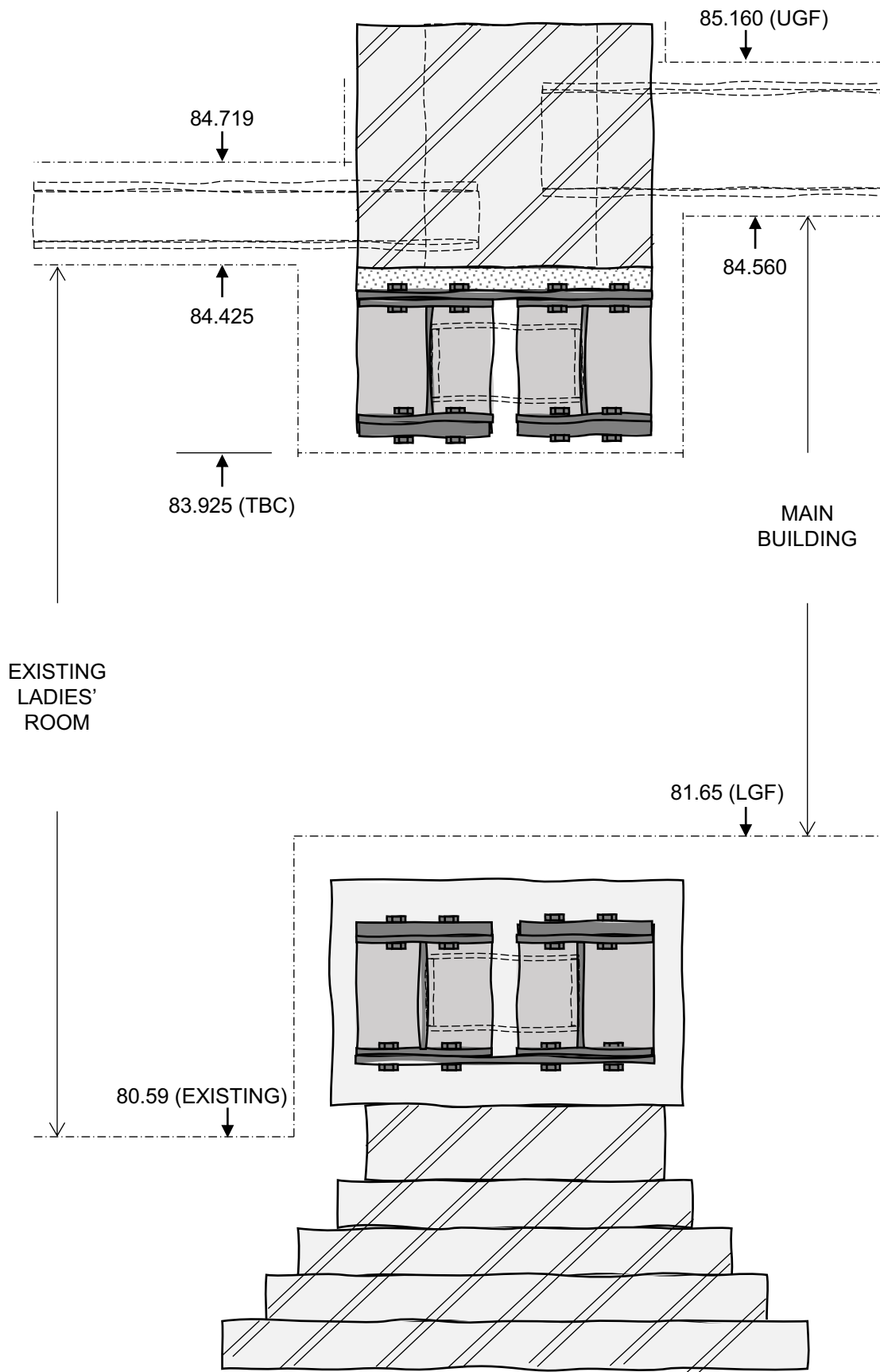
Title
Saw Tooth Roof - Sheet II

Job No./Drg No.
21008 / SK16

Revision
B

Status
Preliminary

Scale: A4
NTS



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B	07.23	MC	RD
A	02.22	MC	RD
Rev.	Date	Drawn	Checked

Project
Warwick Mill, Middleton, M24 1AZ

Title
Bike Storage Frame - Section

Job No./Drg No.
21008 / SK17

Revision
B

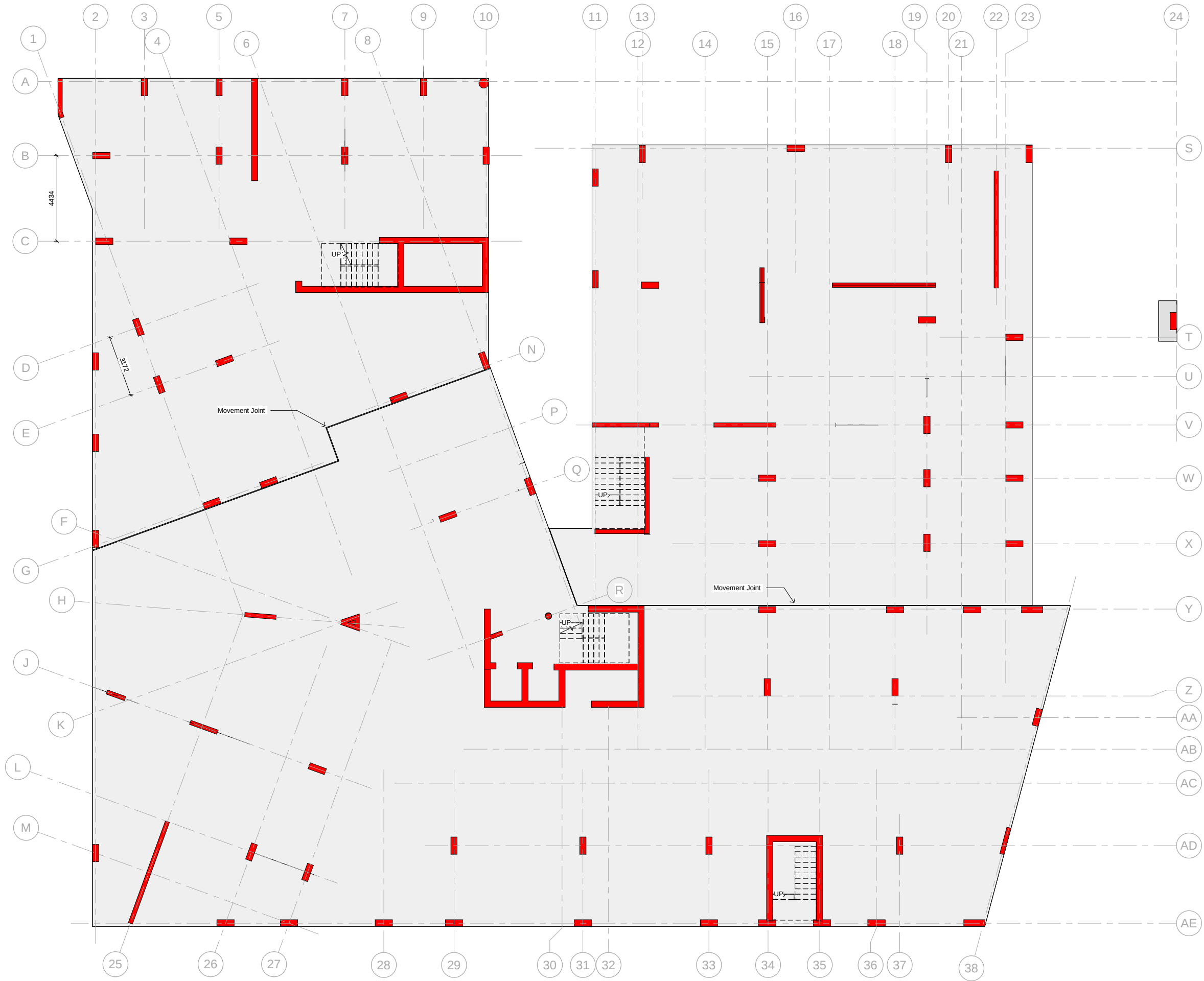
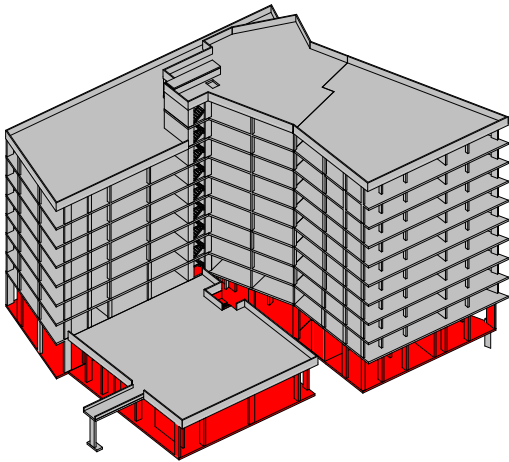
Status
Preliminary

Scale: A4
NTS

Appendix D – MHA’s Preliminary Structural Drawings for The Loom

530	Proposed Ground Floor GA
540	Proposed First Floor GA
550	Proposed Second to Seventh Floor GA
560	Proposed Eighth Floor GA
570	Proposed Nineth Floor GA
910	3D Views

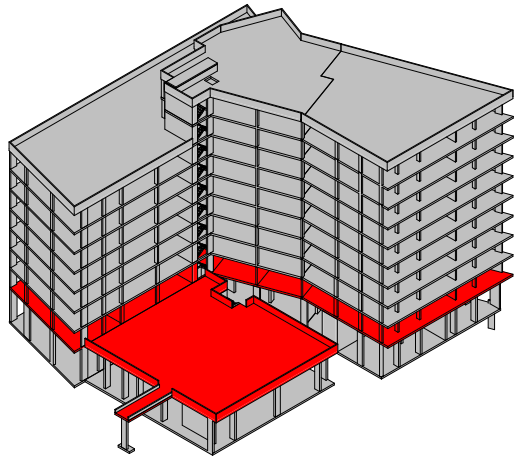
- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
 2. Do not scale off this drawing.
 3. All dimensions are to be confirmed on site by the contractor.



Note: Foundation scheme to be designed following ground investigation.

Rev	Date	Drawn	Amendments
Status			
PRELIMINARY			
Project Title			
Warwick Mill - The Loom Middleton M24 1AZ			
Drawing Title			
Proposed Ground Floor			
Drawing No.			
21008-530			
Scale	Drawn	Checked	
1 : 100	RF	RD	
Project No.	Drawing No.	Revision	
21008	530		

- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
 2. Do not scale off this drawing.
 3. All dimensions are to be confirmed on site by the contractor.



For connection to upper ground floor
of Warwick Mill. Refer to drawing 130

Preliminary analysis shows a 250mm reinforced concrete slab thickness,
except for the longer-span bays between grids 31-34 where a slab thickness
of 325mm is required.

External slabs 325thk, depending on landscaping loadings.

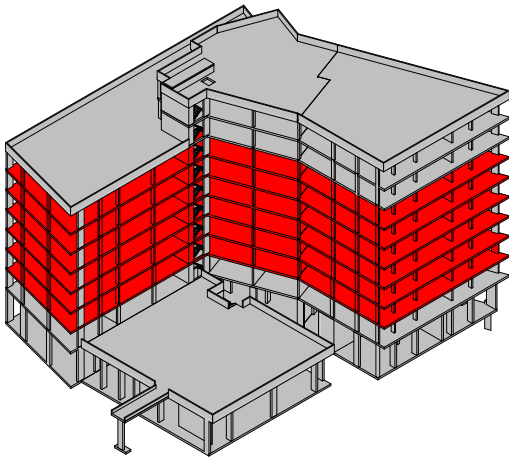
Rev	Date	Drawn	Amendments
Status			
PRELIMINARY			
Project Title			
Warwick Mill - The Loom Middleton M24 1AZ			
Drawing Title			
Proposed First Floor			
Drawing No.			
21008-540			
Scale	Drawn	Checked	
1 : 100	RF	RD	
Project No.	Drawing No.	Revision	
21008	540		

NOTES

1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.

2. Do not scale off this drawing.

3. All dimensions are to be confirmed on site by the contractor.



Preliminary analysis shows a 250mm reinforced concrete slab thickness, except for the longer-span bays between grids 31-34 where a slab thickness of 325mm is required.

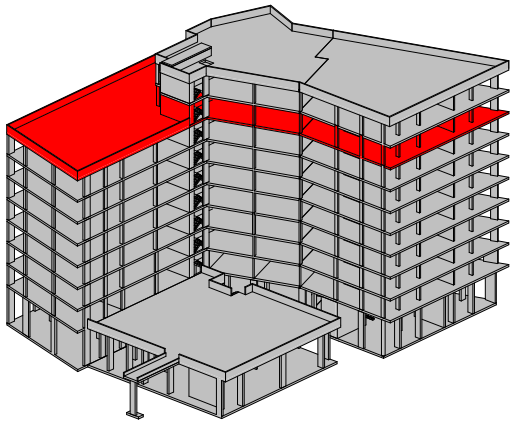
Rev	Date	Drawn	Amendments
Status			
PRELIMINARY			
Project Title			
Warwick Mill - The Loom Middleton M24 1AZ			
Drawing Title			
Proposed Second to Seventh Floor			
Drawing No.			
21008-550			
Scale	1 : 100	Drawn	RD
Project No.	21008	Drawing No.	550

NOTES

1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.

2. Do not scale off this drawing.

3. All dimensions are to be confirmed on site by the contractor.



Preliminary analysis shows a 250mm reinforced concrete slab thickness, except for the longer-span bays between grids 31-34 where a slab thickness of 325mm is required.

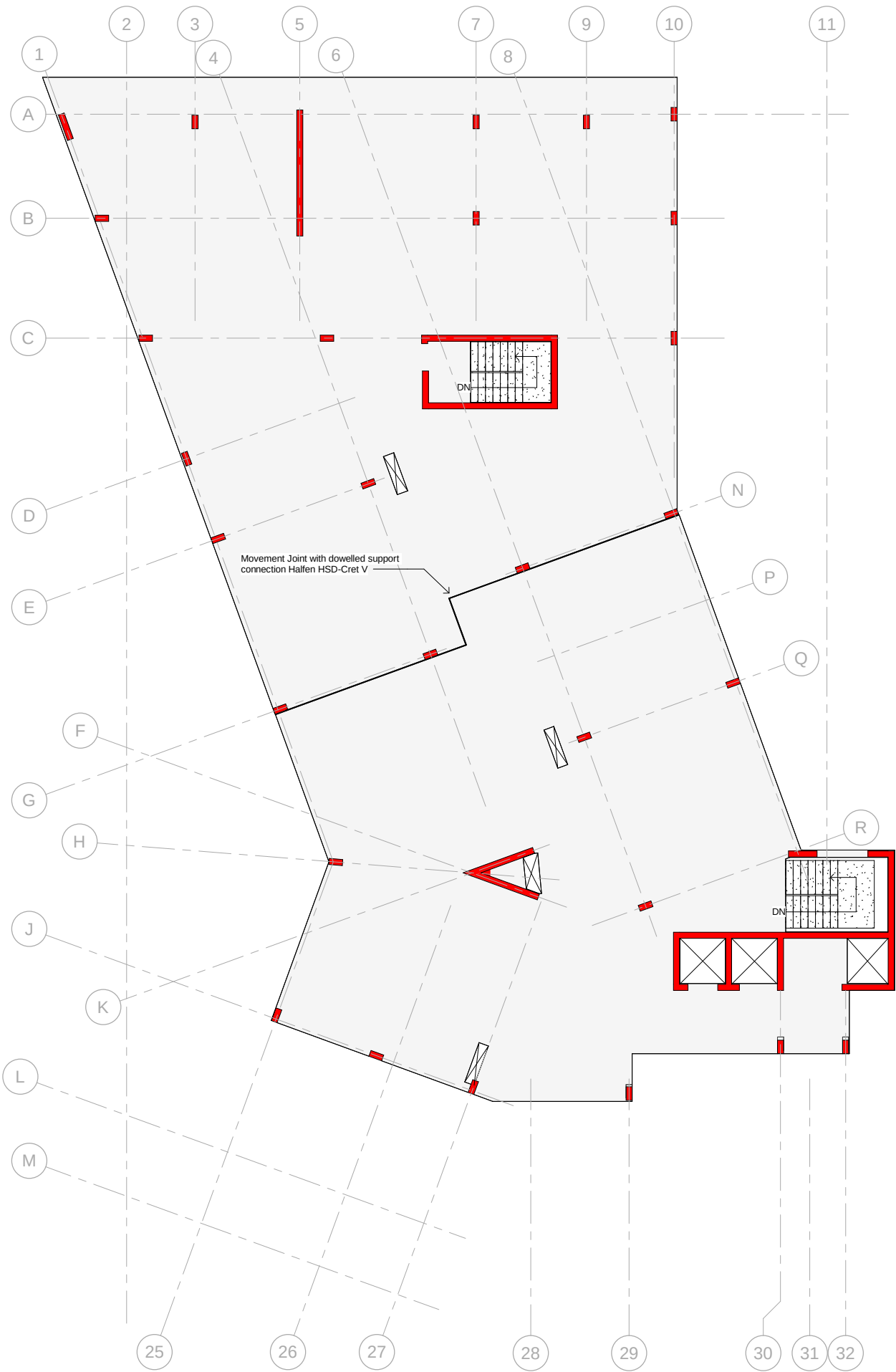
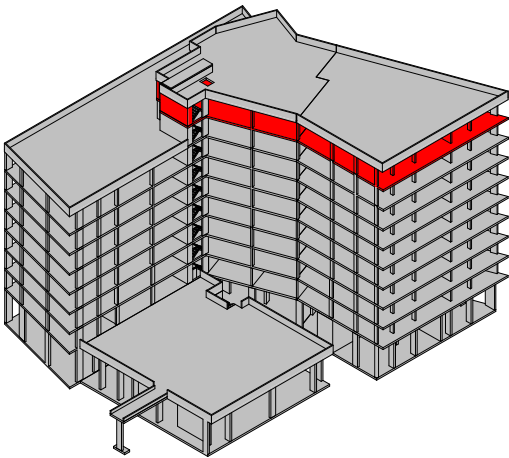
Rev	Date	Drawn	Amendments
Status			
PRELIMINARY			
Project Title			
Warwick Mill - The Loom Middleton M24 1AZ			
Drawing Title			
Proposed Eighth Floor			
Drawing No.			
21008-560			
Scale	Drawn	Checked	
1 : 100	RF	RD	
Project No.	Drawing No.	Revision	
21008	560		

NOTES

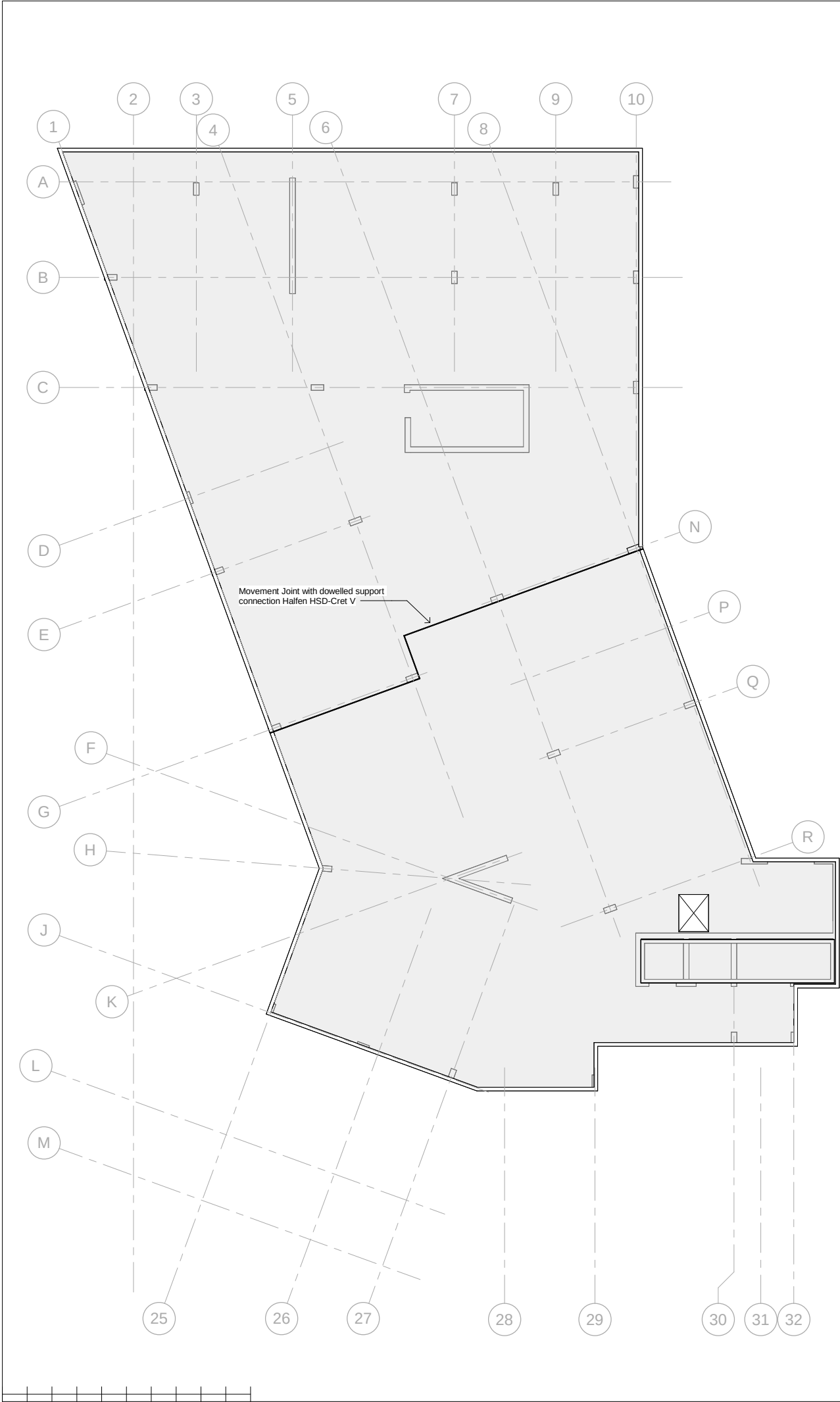
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.

2. Do not scale off this drawing.

3. All dimensions are to be confirmed on site by the contractor.



Rev	Date	Drawn	Amendments
Status			
PRELIMINARY			
Project Title			
Warwick Mill - The Loom Middleton M24 1AZ			
Drawing Title			
Proposed Ninth Floor			
Drawing No.			
21008-570			
Scale	Drawn	Checked	
1 : 100	RF	RD	
Project No.	Drawing No.	Revision	
21008	570		



Notes

1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
2. Do not scale off this drawing.
3. All dimensions are to be confirmed on site by the contractor.
4. The contractor is, at the outset, to establish with the local authority their requirements for inspection of the works and adhere to these.
5. The structure is designed for the final condition. The contractor is responsible for the temporary stability of the structure and the design, installation and maintenance of temporary works.
6. All temporary works are to be designed by a chartered structural engineer (or chartered civil engineer experienced in building structures) employed by the contractor.
7. The contractor is to produce an erection sequence method statement. Method statements for sequencing of work and detailed statements for key elements of work are to be submitted to the CDM coordinator.
8. Generally, only known holes and pockets with dimensions greater than 150mm are shown on these drawings. For confirmation of smaller holes, inserts and fixings refer to architect's, services engineer's and builderswork drawings.
9. All proprietary products are to be used strictly in accordance with manufacturers' details and requirements.
10. All waterproofing details are to the architect's specification.
11. For earthing/lightning protection requirements refer to services engineer's drawings.

Excavations and earthworks

12. Foundation details are dependent on site findings. Formation scheme to be developed following ground investigations.
13. The contractor is to ensure that existing foundations are never undermined.
14. Before starting the work, the contractor is to check for any services that could be damaged by the excavations.
15. Allow for pumping out water from all excavations.

Concrete

16. All superstructure slab concrete is to be grade C35/45 to EN 1992-1-1 2004 (unless noted otherwise).
17. All superstructure concrete for columns and walls is to be grade C50/60 to EN 1992-1-1 2004 (unless noted otherwise). If there are any doubts with regards to the contractor's quality control procedures to ensure this strength of concrete is used in the columns and walls, the contractor should consider using this strength concrete in the slabs too (the potential economies of using C50/60 in the slabs to be investigated during Stage 3).
18. Foundation Concrete mix is to use cement replacement to comply with Table D2 of BRE Special Digest 1.
19. Superstructure concrete to use cement replacement wherever possible to comply with the contractor's desired curing times.
20. High tensile bar reinforcement is to be high yield steel deformed bars complying with BS 4449.
21. All super-structure concrete surfaces are to have a 'plain' finish in accordance with latest national structural concrete specification.

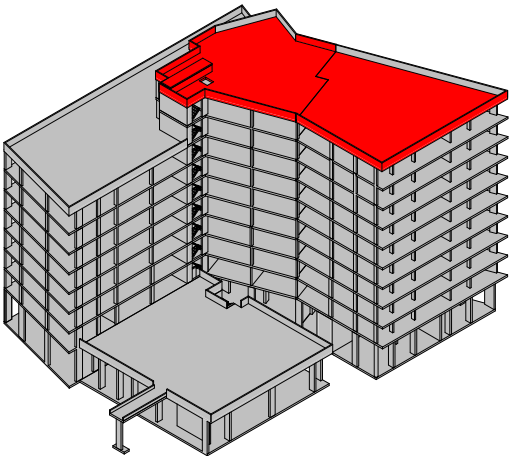
General Metalwork/Secondary Steelwork

22. The contractor is to design & detail all general metalwork, in accordance with design intent details, & all secondary steelwork/framing to support ceiling, lifts, plant platform, wind posts, shelf angles & access walkways including the connections onto the primary structure.

Contractor Designed Portions

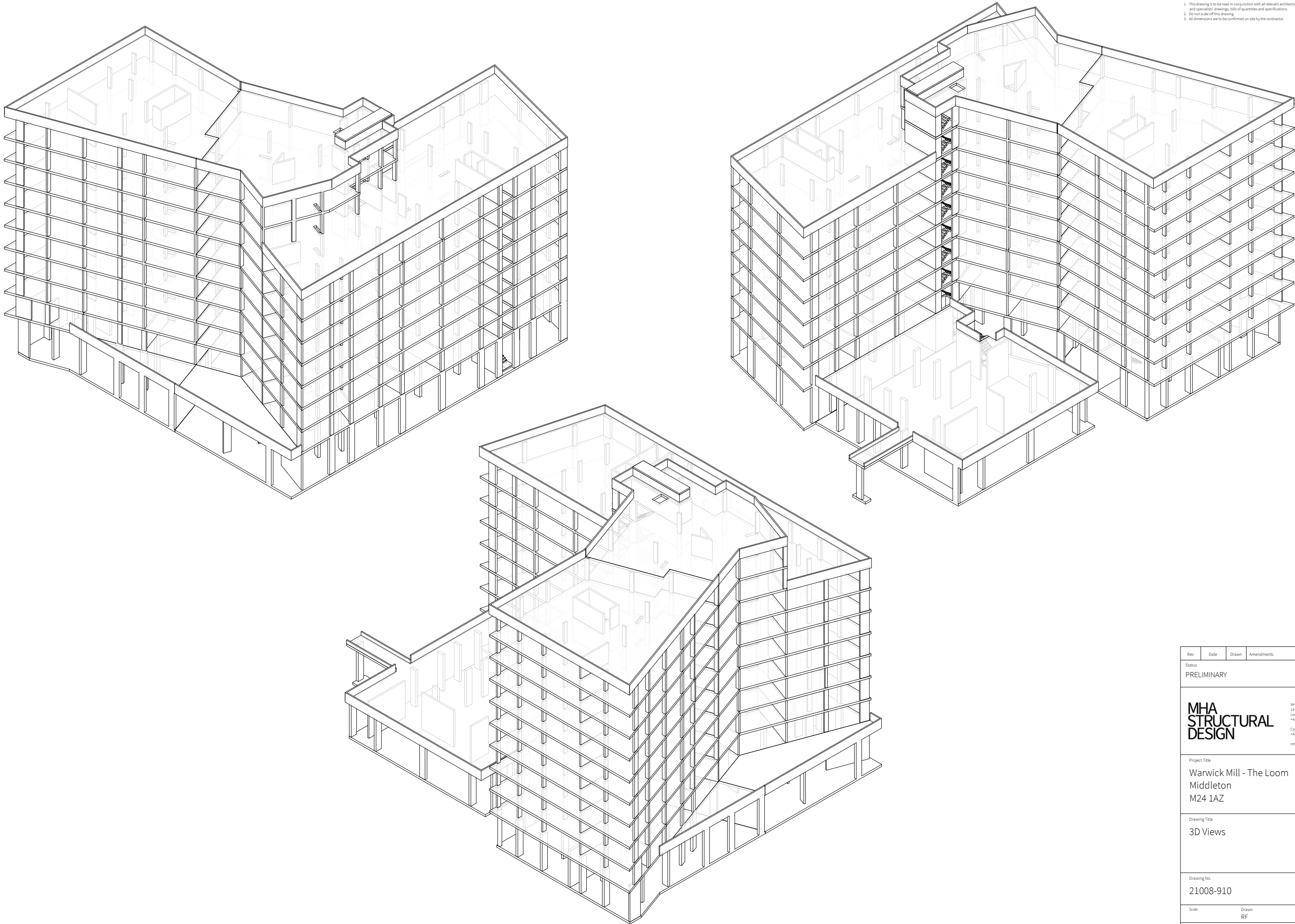
23. Piling.
24. Temporary works.
25. Glazing.
26. Cladding.
27. Balustrades.
28. Thermal breaks.
29. Movement joints.

The contractor is to provide bar bending schedules and reinforcement drawings for the rc frame and sub-structure, from MHA's design. Refer to typical details & estimate on drawing 500.



Rev	Date	Drawn	Amendments
Status			
PRELIMINARY			
Project Title			
Warwick Mill - The Loom Middleton M24 1AZ			
Drawing Title			
Proposed Roof			
Drawing No.			
21008-580			
Scale	Drawn	Checked	
1 : 100	RF	RD	
Project No.	Drawing No.	Revision	
21008	580		

- NOTES
1. This drawing is to be read in conjunction with all relevant architects', engineers', and specialists' drawings, bills of quantities and specifications.
 2. Do not scale off this drawing.
 3. All dimensions are to be confirmed on site by the contractor.



Rev	Date	Drawn	Amendments
Status			
PRELIMINARY			
MHA STRUCTURAL DESIGN MHA Structural Design LTD 14-18 Old Street London, EC1Y 9BH +44 (0)207 375 6340 Cambridge +44 (0)1223 776340 mhastructuraldesign.com			
Project Title			
Warwick Mill - The Loom Middleton M24 1AZ			
Drawing Title			
3D Views			
Drawing No.			
21008-910			
Scale	Drawn	Checked	
	RF	RD	
Project No.	Drawing No.	Revision	
21008	910		

Appendix E – Site Photographs



Photo 1- Aerial Photo of the site (from Bing Maps)



Photo 2 – View of the Mill from Oldham Road



Photo 3 – View of the southern elevation



Photo 4 – Looking east across London House's car park



Photo 5 – View of typical floorplate (first floor)



Photo 6 - Historic investigation (still open) to expose the top of the brick jack-arches (first floor)



Photo 7 - Historic investigation (still open) to expose the top of the brick jack-arches (first floor)



Photo 8 - Historic investigation (still open) to expose the top of the brick jack-arches (first floor)



Photo 9 - Historic investigation (still open) exposing the half-brick crown of a brick jack-arch (first floor)



Photo 10 - Typical jack-arch soffit. Note tie bars (also sprinkler pipes)

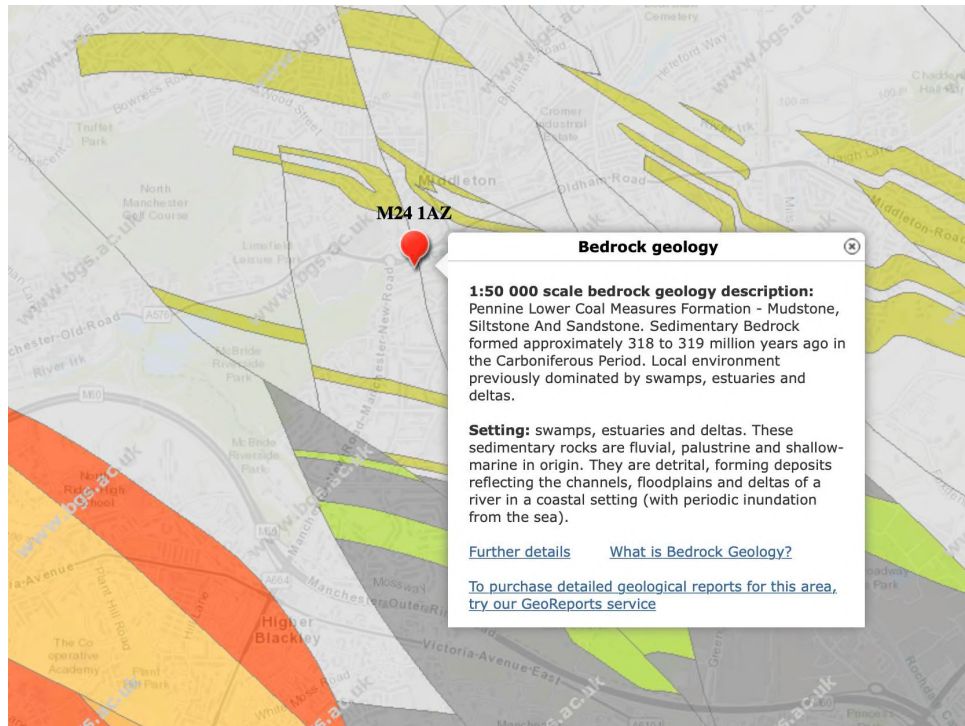


Photo 11 - Soffit to roof structure (photo at 3rd floor level) by the southern elevation (water ingress appears to have eroded mortar)

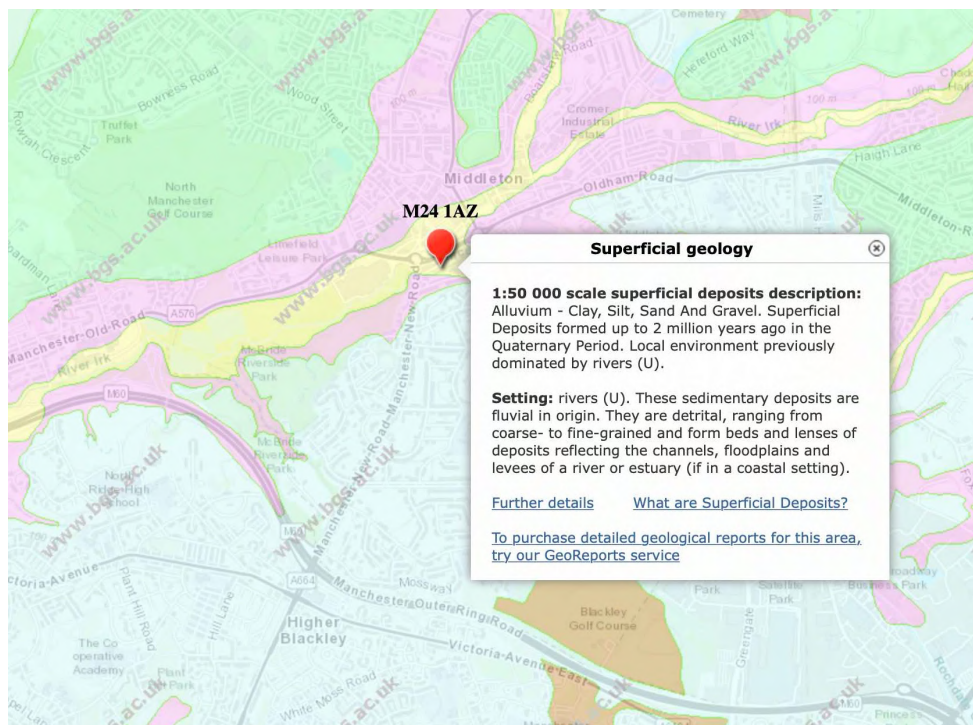


Photo 12 - Exposed column head detail at 3rd floor level

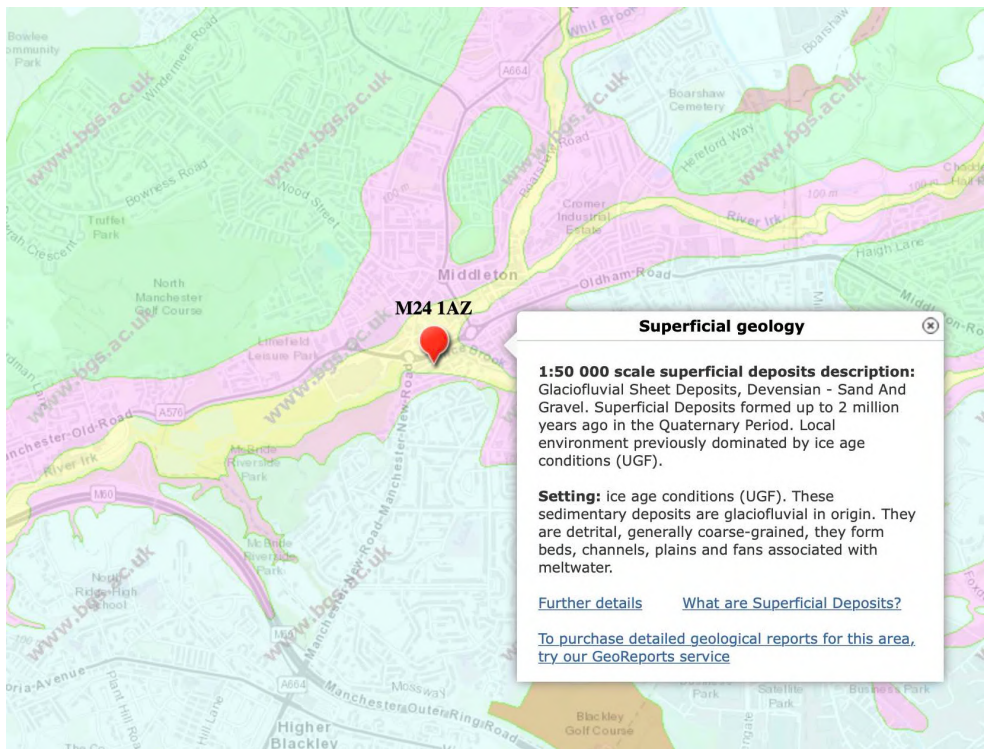
Appendix F – Soils Information



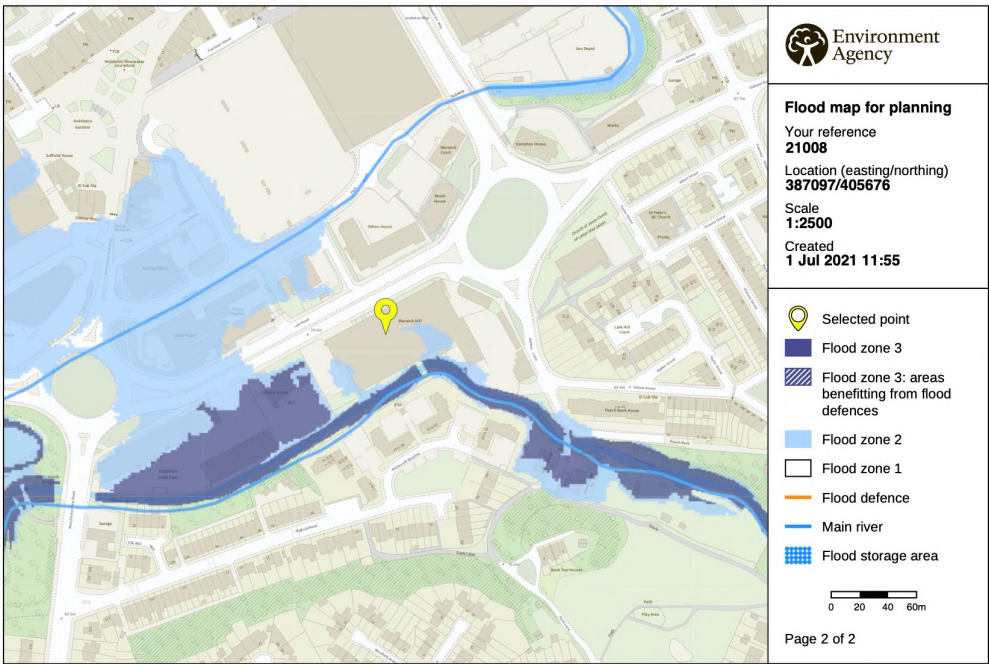
British Geological Survey (BGS) map, showing the bedrock geology as being Coal, with a known fault



British Geological Survey (BGS) map, showing the underlying superficial deposits to be Alluvium.



British Geological Survey (BGS) map, showing the nearby superficial deposits to be Sand & Gravel.



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Environment Agency's Flood Map