

ALAH

CONSERVATION ENGINEERING

Report Details

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1.0 Introduction and Context

- 1.1 Clach were commissioned by the Client, Ms. H. Gilbert (c/o Buttress Architects), to undertake a focussed inspection of an area of structural activity affecting the west gable of the above building.
- 1.2 The context for the survey is that prior appraisals by third parties had identified significant and deformation of the masonry skeleton over an opening to a bay window, although no intrusive investigations were carried out and they were unable to determine the cause of the problem, suspecting either deflection and/or decay of a timber bressummer at that location.
- 1.3 An Engineer from this Practice visited the property on the 10th November 2021 to undertake the appraisal, which included targeted minimally intrusive investigations via lifting of floorboards at first floor level and keyhole penetrations through modern plasterboard ceiling at ground floor level.
- 1.4 The survey lead and author of the report is a Conservation Accredited Engineer (CARE Ref: 64873212). Reference can be made to the register held by the Institution of Civil Engineers.
- 1.5 It should however be appreciated that further opening up may bring to light further hidden details which were not apparent at the time of the above investigation. Non-structural matters are not addressed unless they have a direct effect on the structure.
- 1.6 This Technical Note summarises the key findings and recommendations. It is not a full Stage 1 appraisal of whole structure, and we cannot warrant a 'clean bill of health' for the wider building.
- 1.7 This report has been prepared on behalf of the Client and their immediate advisors and it must not be reproduced in whole or part, or relied upon by any third party without the express prior written authority of Clach Conservation Engineering Ltd.

2.0 Form and Composition

- 2.1 *Shape* – Two storey brick masonry dwelling house, understood to date from around 1870. Grade II Listed (#: 1270537)
- 2.2 *Primary Structure* – Structural skeleton is solid brick masonry walling, the thickness appears to be one brick thick (ca. 230mm structural thickness, plastered on the hard to internal face) laid header-bond.
- 2.3 *Roofs* – The roof is likely to comprise a timber purlin roof with timber trusses spanning between loadbearing masonry walls, although the span configuration has not been confirmed. Slate cladding. The roof over the bay window is of slate clad timber monopitch roof construction.



Figure 1: G.A. view on W gable showing position of projecting bay window and area of structural activity overhead.

- 2.4 *Floors* – Midfloor is suspended timber construction. In the area of concern, the floor joists were determined to span towards the opening to the projecting bay window, where they are trimmed by a compact trimmer beam (Fig. 2). Ceiling spars then extend beyond to the bay window, spanning from an outer larger beam to the external walls.
- 2.5 *Structural Openings* – Openings in the masonry skeleton are typically lintelled with stone to the external face (possibly backed by timber safes to the rear), although larger spans are relieved by pointed brickwork arches overhead. The specific opening under consideration was investigated to determine form and composition, as recorded in Figure 2:

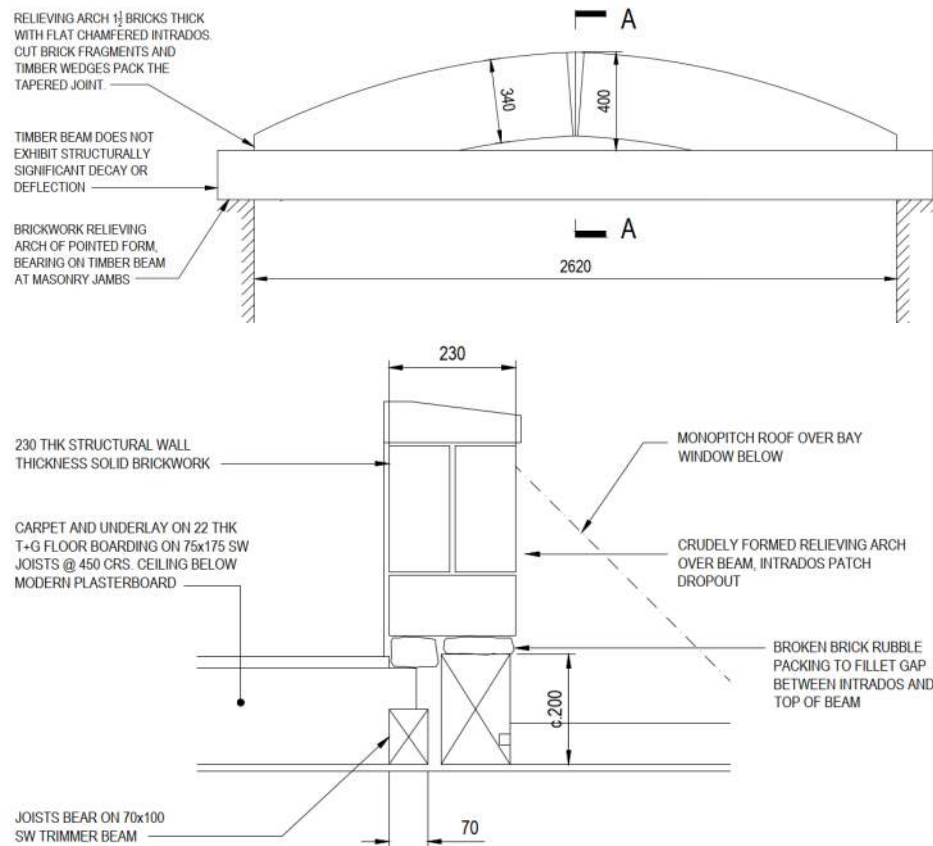


Figure 2: Form and composition of opening through W wall into bay window at midfloor (Extract from DR-S-100)

- 2.6 *Structural Reinforcement* – A chamfered brickwork buttress braces the outer corner of the projecting W gable.
- 2.7 *Foundations* - Foundations are likely to comprise spread masonry footings, founded at a relatively shallow depth, given the age of the building.
- 2.8 *Geological Setting* - Superficial Deposits - Glaciofluvial Sheet Deposits, Devensian - Sand and Gravel; Bedrock - Wilmslow Sandstone Formation - Sandstone; Boreholes – BGS borehole 100m due E of the building gives superficial deposits (sands, gravels, clay) to some 40-50' (12-15m) overlying sandstone bedrock; BGS borehole 75m due N of the building gives superficals to around 40-45' (12-14m). Given the depth to bedrock, it seems highly likely that foundations are formed in the superficial deposits.

3.0 Principal Interpretive Findings

- 3.1 The pattern of structural activity presented showing cranked geometry of the upper masonry tending down to the beamed opening, apparently level floor, square shape of the opening below (no significant deformation in the ceiling) and square / level geometry of the bay window structure itself is not consistent with differential settlement of foundations or ground subsidence (i.e. it does not fit a bottom-up deterioration mechanism diagnosis). Rather, the evidence points towards an issue at height within the superstructure, roughly at the level of the opening through the west gable to form the bay window (Figs. 3, 4).
- 3.2 Intrusive determination of the structural composition of the opening informs that the floor is carried by an under-sized timber trimmer joist, which does not seem to attract load from the wall above (Fig. 2; see DR-S-100, Appendix A). Indeed, owing to its compact section, it is insufficiently strong or stiff enough to offer a meaningful contribution to the support of the structure overhead.



Figure 3: External view on significantly cranked geometry of the masonry skeleton (central pier translated downwards)



Figure 4: Internal view on opening through W gable wall into bay window showing patent lack of distress.

- 3.3 The outer timber beam is larger than the trimmer joist, measuring around 200mm deep (its breadth could not be confirmed). We estimate the bending strength of this member to be around 8kNm.
- 3.4 However we estimate the load to the beam to be of the order of some 4-5 tonnes accounting for dead weight of the wall, ceiling/attic and roof load contributions. For a 2.65m opening, this gives around 35kNm bending moment, which grossly exceeds the bending strength of the outer timber beam.
- 3.5 Reconciling the absence of structurally significant deflection and/or decay affecting the timber floor, trimmer and bressummer beam with the significant deformation manifested in the masonry informs that the masonry superstructure is carried by the relieving arch, not the timber beams. This suggests that the timber beam has simply been a construction former on which to build the relieving arch. There is of course composite interaction at the bearings, where the vertical force component at each springing compresses the embedded timber beam ends.



Figure 5: Crudely formed relieving arch spreading on abutments owing to broken brick and timber packers to awkwardly tapering joint either side (see Fig. 6)

- 3.6 The relieving arch has been crudely made, with timber wedges in awkward-shaped joints as the arch tapers towards either end. This awkward packing arrangement appears to have squashed and progressively slipped (Fig. 5).
- 3.7 No evidence of spreading of the jambs was observed (Figs. 3, 4) and indeed constructive care has been taken to buttress the outer corner of the jamb proper.
- 3.8 This slipping / disruption of the tapered ends of the shallow relieving arch seems to be the root cause of the drop in the crown, i.e. abutment spread in a very localised sense, manifesting in downward translation of the pier over without symptoms of distress being witnessed further below.

- 3.9 The time taken for this inherent construction defect to manifest itself is highly unusual, and the reason(s) are not entirely clear. We suspect an initially long, slow continuous squashing of the timber packers, and as the leverage reduces (slight drop in crown hinge) the magnitude of thrust increases (a function of load and leverage), creating a progressive feedback loop which we are now seeing the acute latter stages of (Fig. 6).

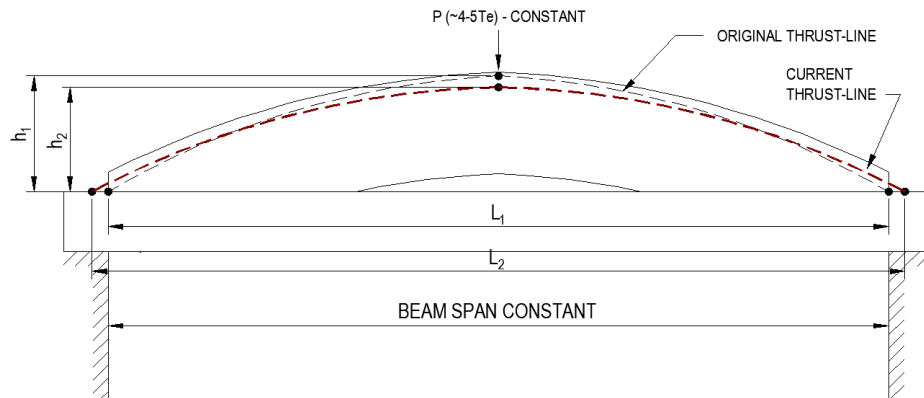


Figure 6: Possible 'feedback loop' structural deterioration process of increasing thrust and vertical slumping.

- 3.10 As a point of note, the original arrangement of the shallow, tapered relieving arch poorly packed on the timber beam is inherently defective, meaning the remedial solution to be adopted will incur a detail change. Philosophically the options are considered as follows:
- Remove the timber beam, remove the relieving arch, and replace with a deeper masonry arch to spring from the masonry abutments directly, with side-mounted wallplate to carry the floor/bay window roof structure;
 - Remove the timber beam, remove the relieving arch, and replace with a steel beam designed for sufficient strength and stiffness to design out the need for the relieving arch altogether, with the masonry spandrel rebuilt in a traditional solid walling pattern.
- 3.11 Our recommendation will be for Option B, as the height of the spandrel is dictated by the window cill height at first floor level, and in practical terms the construction of a new arch of new shape within these constraints would be very difficult and practically infeasible to achieve an effective repair which did not further deflect on load uptake.
- 3.12 In either scenario the wall above would need to be needle-propped with a temporary shoring system, and will be quite an invasive repair. However as the arch/beam detail is essentially hidden within the floorzone / bay roof void, we do not consider it to be of substantial harm to the special interest of the listed building.
- 3.13 At this time we do not believe the situation to be dangerous, although the problem is inherently progressive and so remedial intervention should be planned.

4.0 Review of Third-Party Prior Reports

- 4.1 The situation was appraised previously by two third party engineers, namely Blackett Ord Conservation Engineering Ltd (BOC) and Structural Surveys (SS), in April 2021 and July 2021 respectively.

BOC Report (April 2021)

- 4.2 BOC recorded the cranked geometry of the perimeter masonry skeleton, and reported the discord between externally observed deformation and internally observed symptoms of distress. They believed there to be a bressummer beam carrying the pier of masonry between the two first-floor windows over the ground-floor bay window opening, and attribute the structural activity to the deflection of this probable beam.
- 4.3 Based on the lack of internally witnessed symptoms of distress, they judged the movement to be historic, and recommended crack stitching of the masonry only.
- 4.4 The assumptions leading to their diagnosis were not intrusively validated.

SS Report (July 2021)

- 4.5 SS also suspected the presence of a timber bressummer beam, which they believed to be deflecting leading to the cranked geometry of the structure overhead.
- 4.6 They recommend the beam be replaced, with steelwork designed to carry the superimposed load without bending deflection, and recommend that the masonry be crack-stitched.
- 4.7 They did not attempt to determine whether the movement remained on-going, and the assumptions leading to their diagnosis and remedial intervention were not intrusively validated.

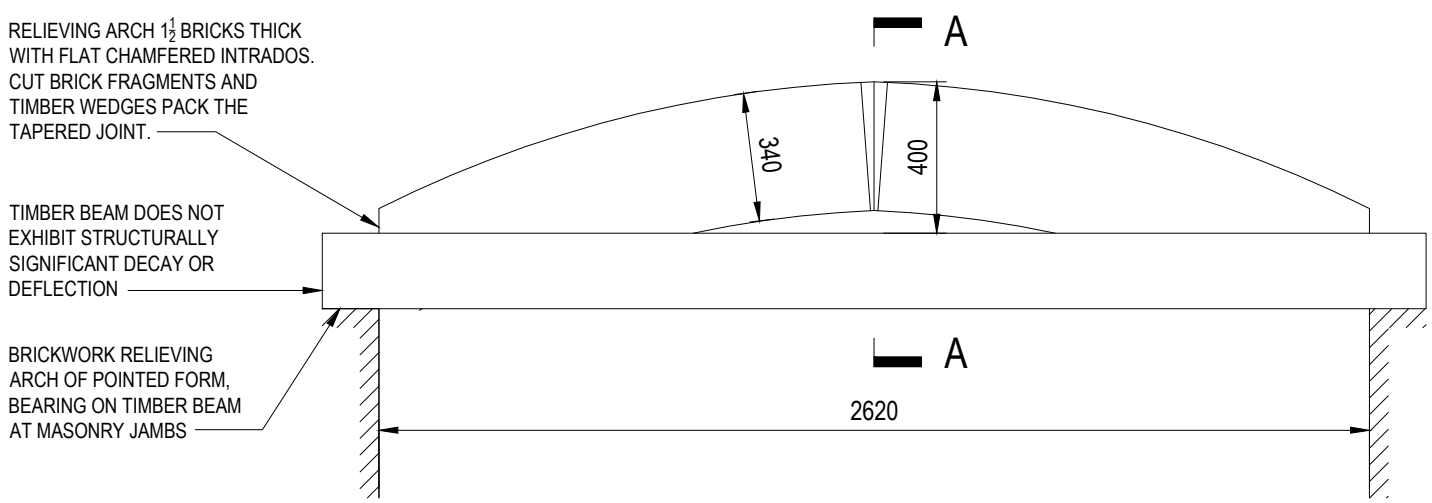
Commentary

- 4.8 In all cases (BOC, SS and in our present work) the movement mechanism is essentially the same, with the central pier of masonry suffering downward translation relative to the rest of the masonry skeleton.
- 4.9 However neither of the two prior engineering practices proved the assumptions leading to their various diagnoses as to the root of the problem. We have determined that the masonry pier bears in fact not on a timber bressummer, but rather a defective brickwork arch which used a compact timber beam as a construction former.
- 4.10 This informs that the situation is not historic/exhausted but remains on-going and inherently progressive. The remedial solution we propose is similar to that postulated by SS, although we have presented an evidence-based justification for the intervention.

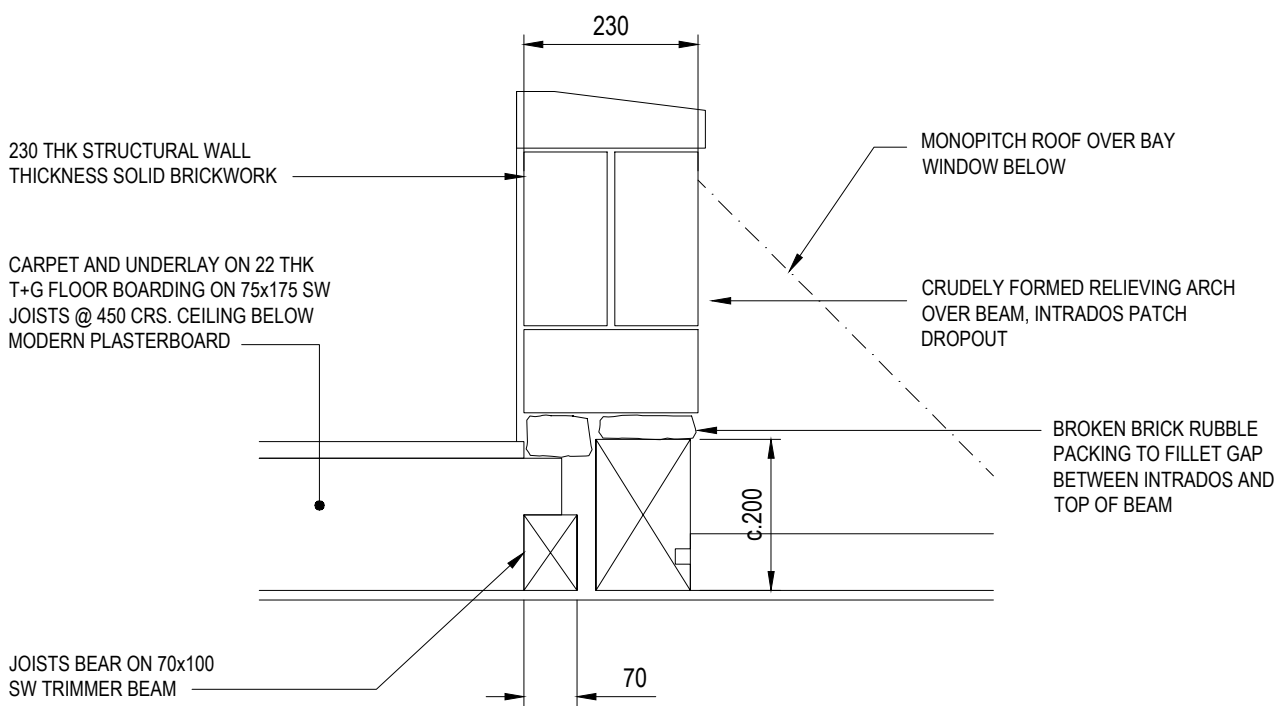
5.0 Summary and Recommendations

- 5.1 The west gable is suffering from slumping of superstructure masonry over the opening into the bay window below. The root cause appears to be an inherently defective relieving arch, which is sliding (abutment spread) on its support (the beam) at height within the structure.
- 5.2 We see no evidence of subsidence, structurally significant differential settlement or other bottom-up structural activity affecting the west gable.
- 5.3 We recommend propping to get the load out of the relieving arch, to allow its removal and similarly the beams below, for replacement with a competent steel beam of sufficient strength and stiffness to service the superimposed load without relieving arch contribution. Plain solid masonry would then reinstate the spandrel and support to the pier. The propping may be installed at the base of the gable peak to facilitate the reconstruction of the deflected masonry pier between the windows.
- 5.4 This remedial solution incurs a detail change from that currently existing, although as the detail is essentially hidden, we do not believe it to substantially harm the special interest of the listed building, and we have mitigated the loss of original form by accurately recording the original detail.
- 5.5 The above recommendations will require Listed Building Consent and either a Building Notice or Full Plans Submission with Building Control. Both temporary and permanent works will require detailed design.

**Appendix A: Survey Record Drawing (DR-S-100) and Details of
Structural Intervention (DR-S-110)**



DETAIL 01: ELEVATION ON OPENING TO BAY WINDOW
(APPROX. 1:10)



DETAIL 02: SECTION A-A THROUGH OPENING TO BAY WINDOW
(APPROX. 1:5)



IMAGE 01: EXTERNAL ELEVATION ON STRUCTURAL OPENING TO BAY WINDOW. NOTE THE SIGNIFICANT DOWNWARD CRANK OF FIRST FLOOR WINDOW OPENINGS, DOWNWARD TRANSLATION OF CENTRAL PIER OF MASONRY



IMAGE 03: VIEW OF RIGHT-HAND BEARING (AS VIEWED EXTERNALLY. SEE IMAGE 01) SHOWING TIMBER WEDGES AND CUT BRICK PACKERS TO AWKWARD TAPERED END OF RELIEVING ARCH. NOTE LOOSE CHARACTER OF CUT BRICK UNITS AS ARCH SLIDES ALONG BEAM.



IMAGE 02: EXTERNAL VIEW OF RELIEVING ARCH OVER TIMBER BEAM SHOWING AWKWARD FLAT CHAMFER OF INTRADOS. DROP-OUT OF INTRADOS AND PACKING UNITS BELOW CROWN.



IMAGE 04: VIEW OF LEFT-HAND BEARING (AS VIEWED EXTERNALLY. SEE IMAGE 01) SHOWING TIMBER WEDGES AND CUT BRICK PACKERS TO AWKWARD TAPERED END OF RELIEVING ARCH, SIMILAR TO OPPOSITE BEARING (IMAGE 03). TIMBER BEAM APPEARS IN SOUND TIMBER CONDITION.

GENERAL NOTES

- DO NOT SCALE FROM DRAWING. ALL DIMENSIONS ARE INDICATIVE AND SHOULD BE MEASURED UP ON SITE BY THE CONTRACTOR PRIOR TO FABRICATION.
- NO INTRUSIVE INVESTIGATIONS HAVE BEEN UNDERTAKEN TO PROVE EXISTING DETAILS. IF ON OPENING UP THE SITUATION VARIES, IF IN DOUBT ASK.
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
- ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY.

IMPORTANT TEMPORARY WORKS NOTE



GENERAL NOTES

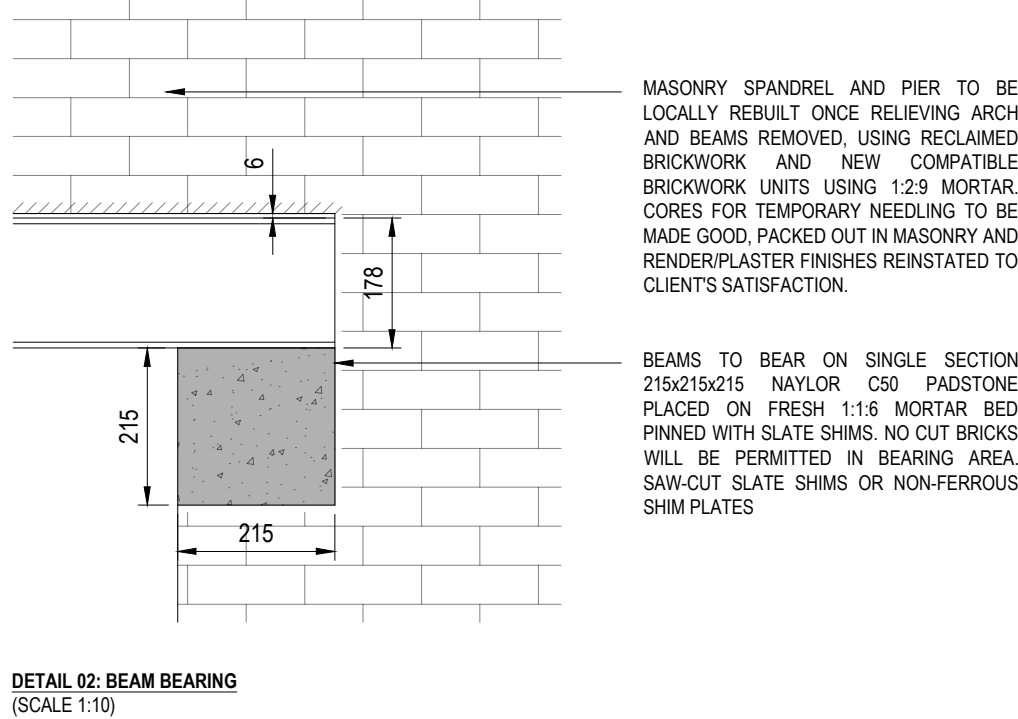
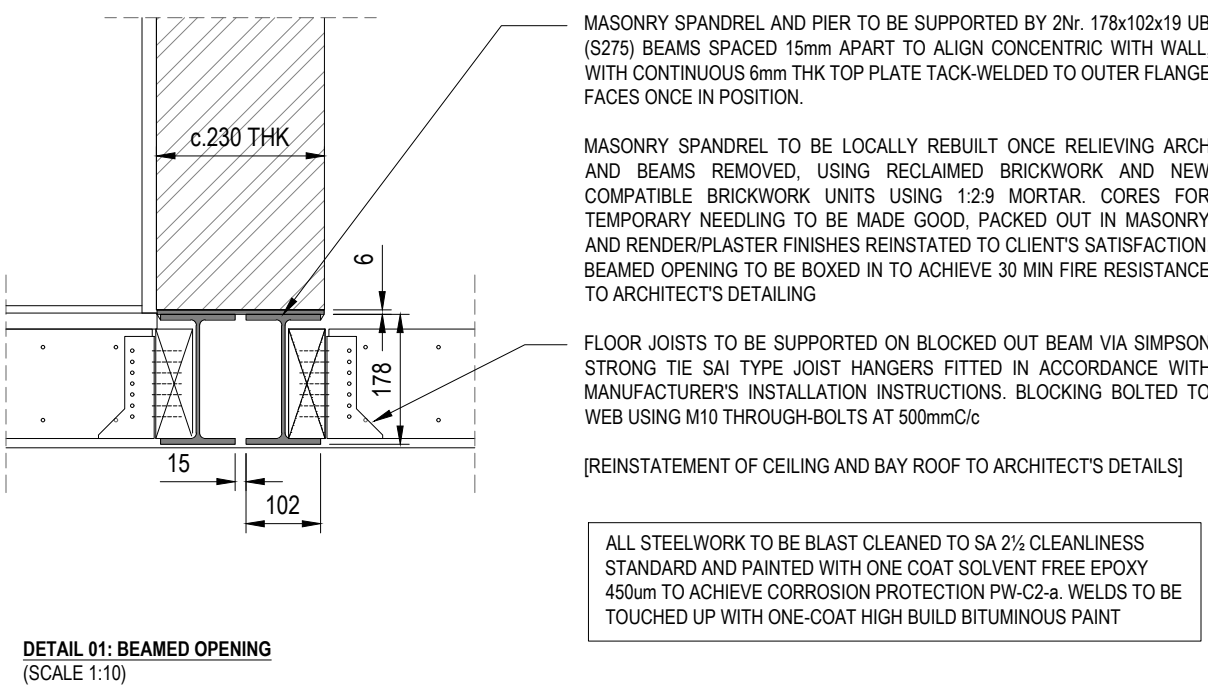
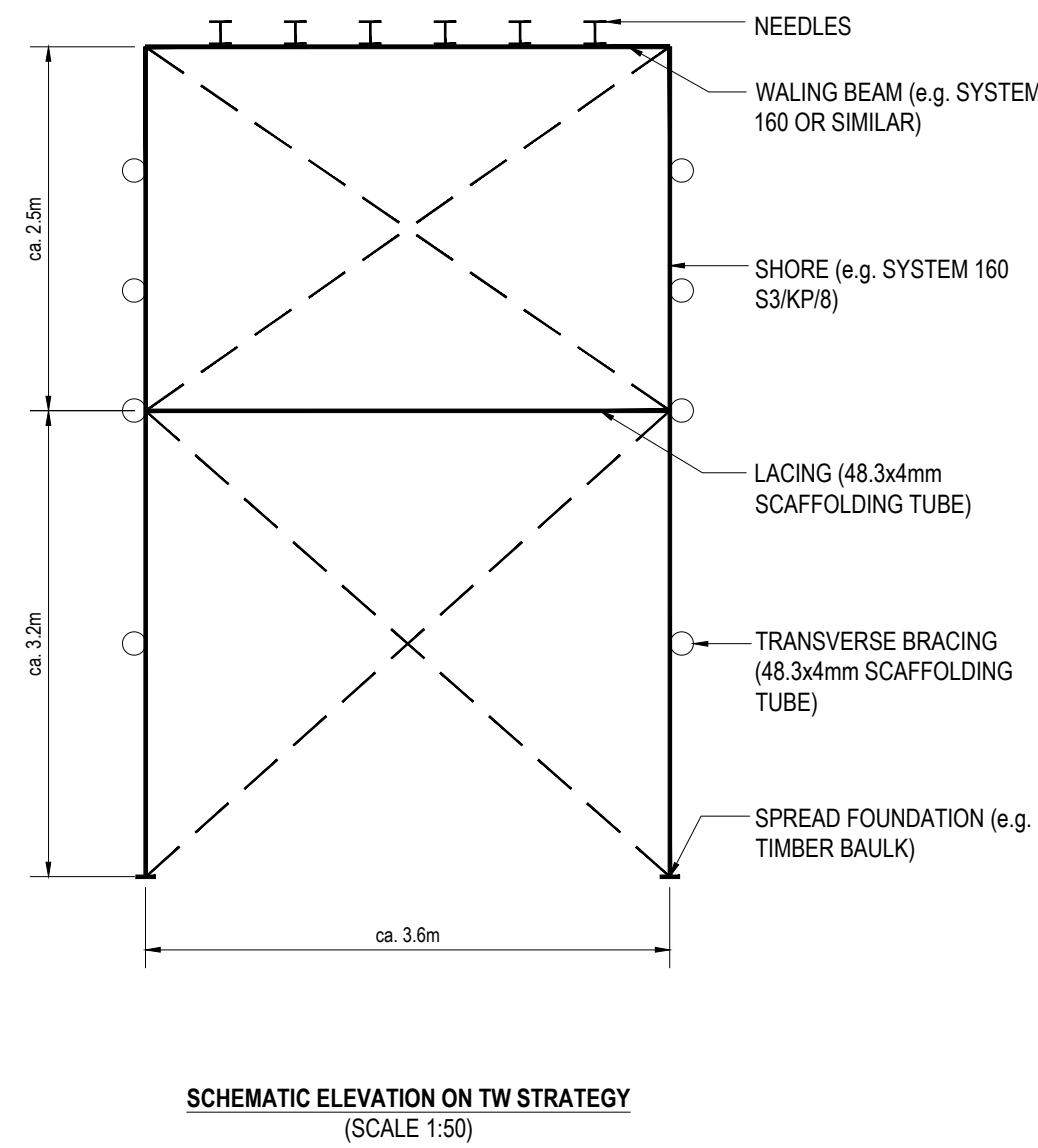
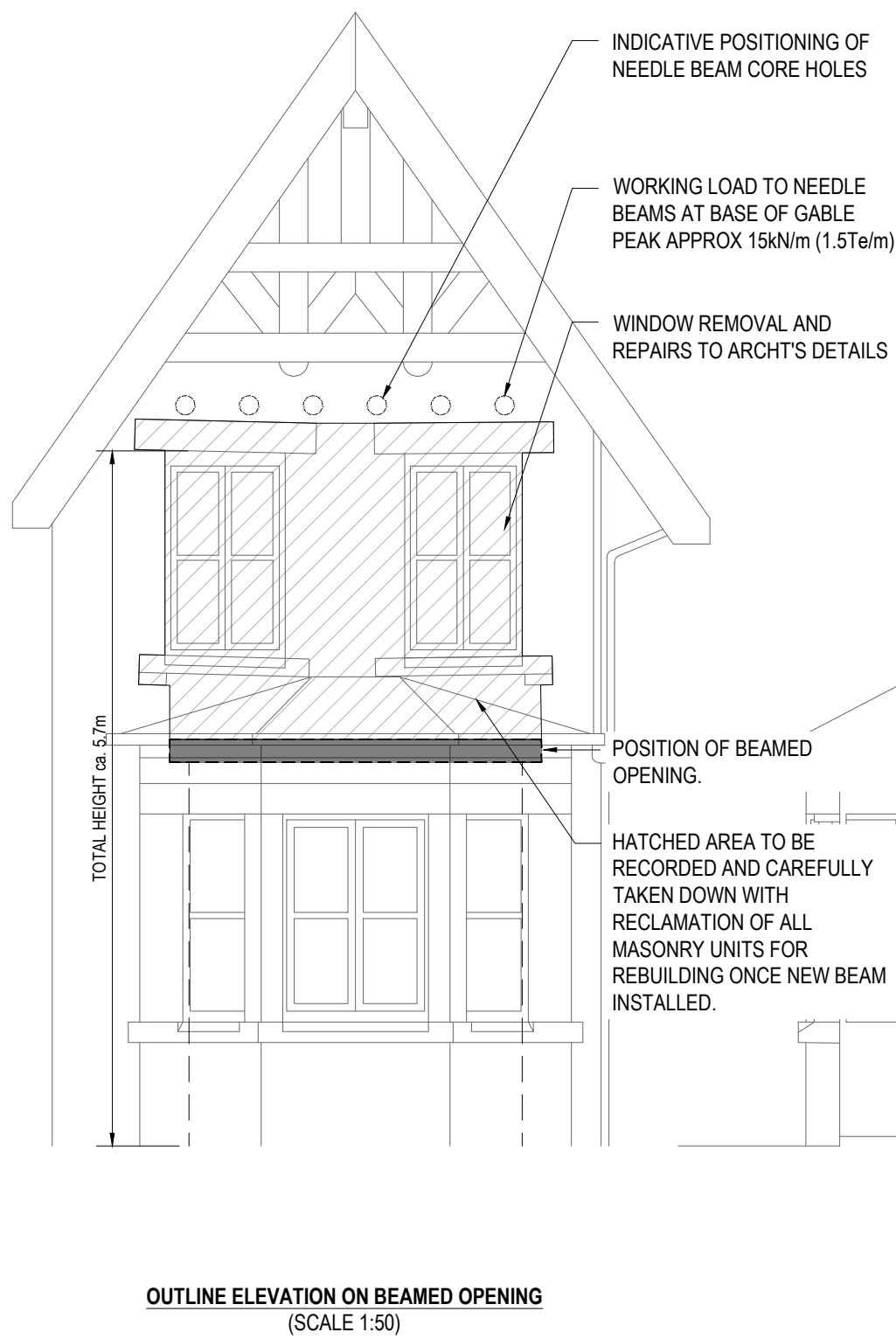
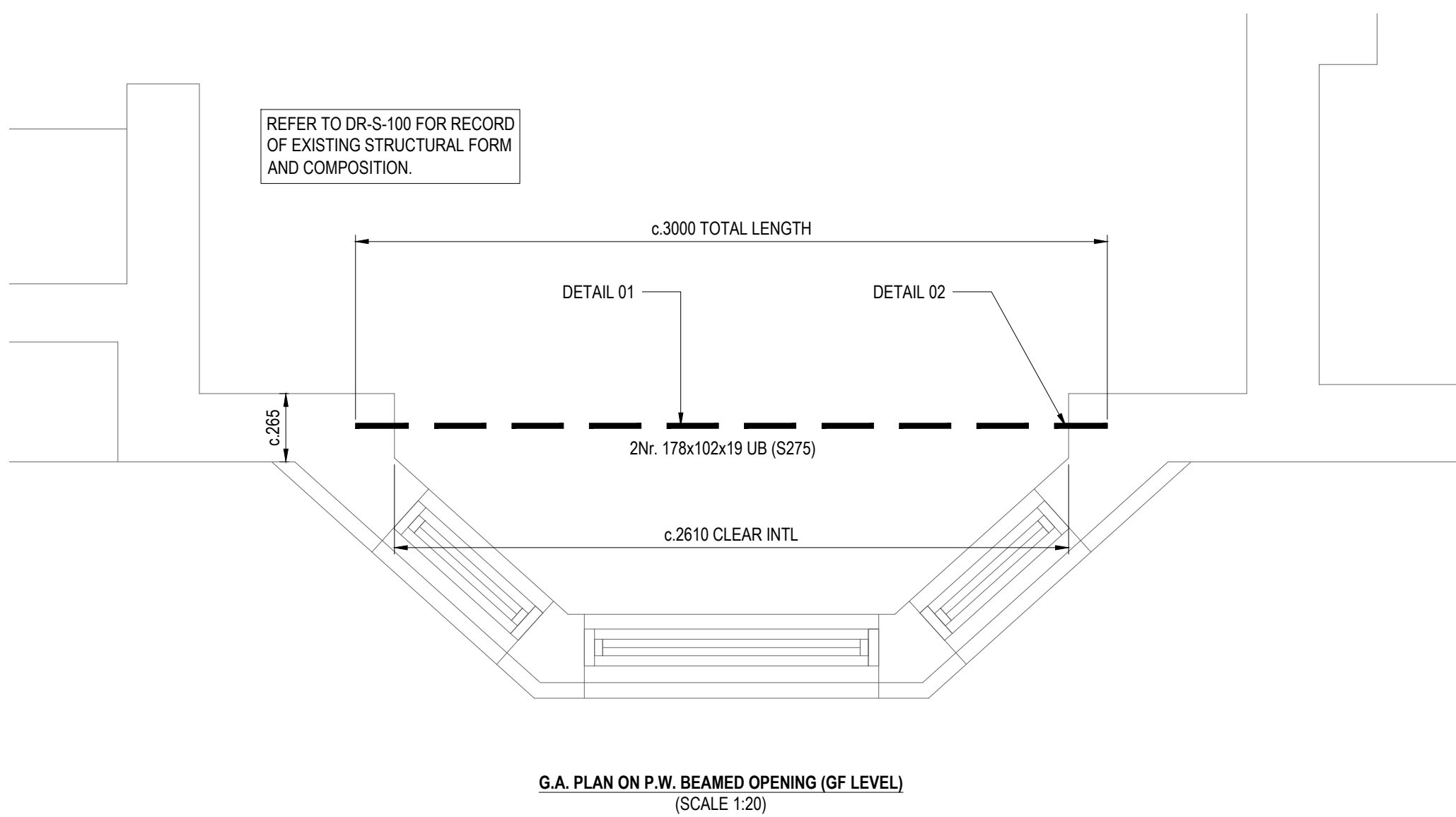
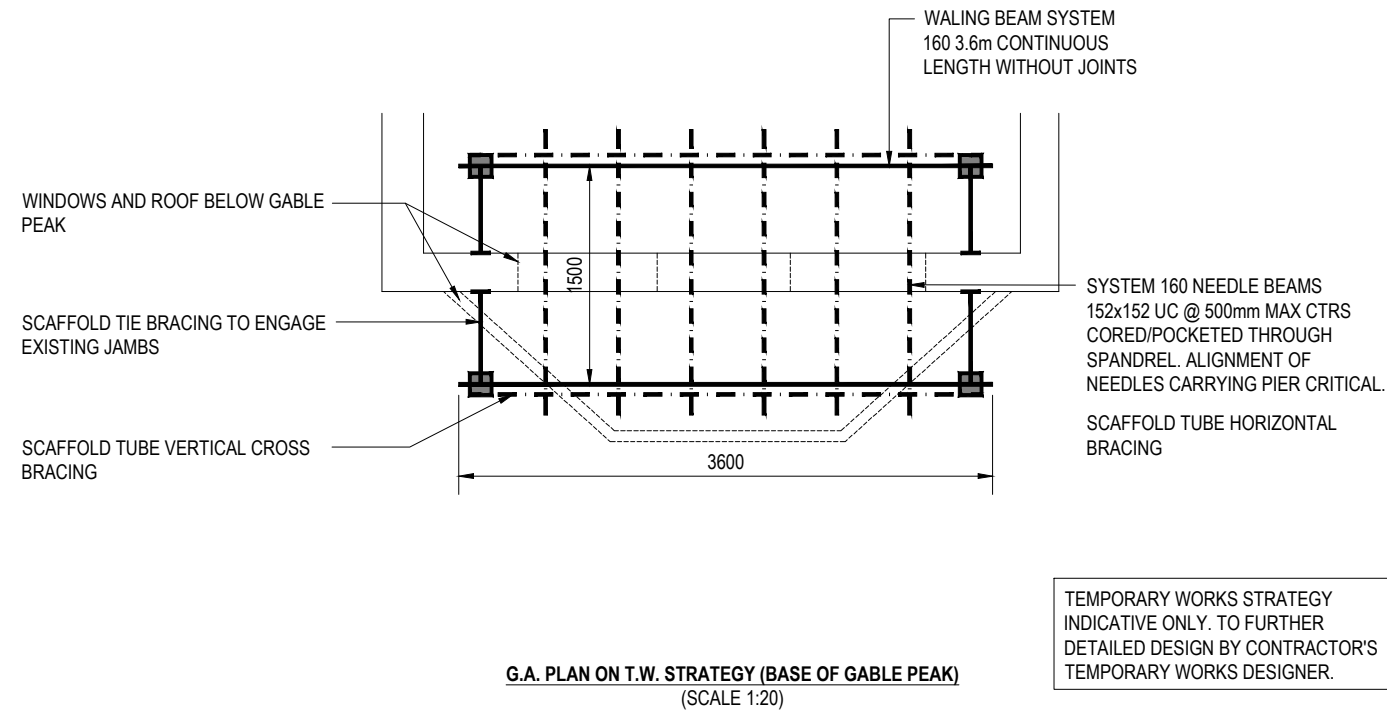
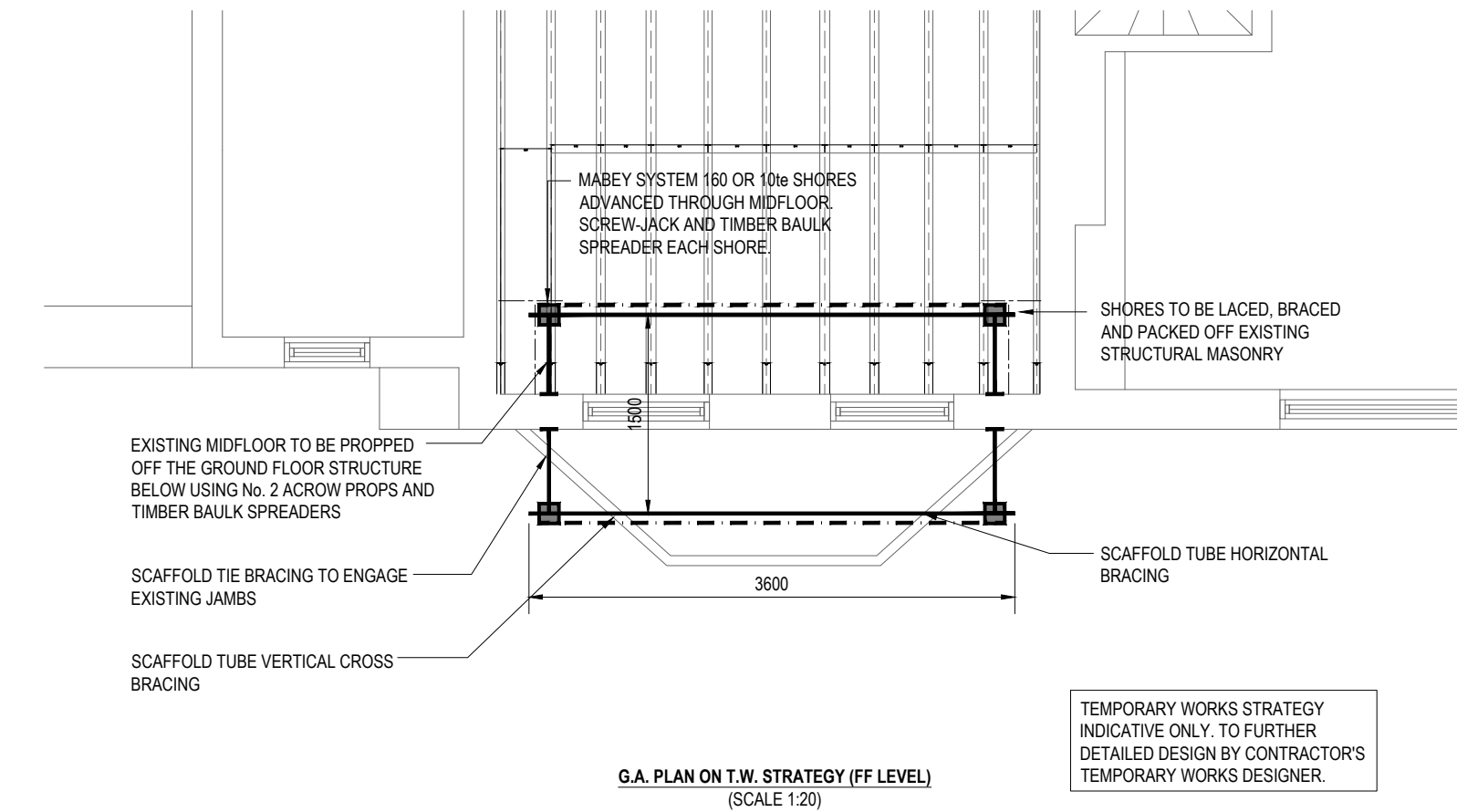
- TEMPORARY WORKS CONTRACTOR DESIGN REQUIRED
- ALL SCAFFOLDING AND TEMPORARY WORKS TO COMPLY WITH BS 5975:2008.
- TOTAL WORKING LOAD FOR TEMPORARY SUPPORT 6Tt.
- ALL DIMENSIONS ARE INDICATIVE AND MUST BE ACCURATELY MEASURED ON SITE PRIOR TO FABRICATION.

MASONRY

- TEMPORARY OPENINGS IN MASONRY RELY ON THE ABILITY OF MASONRY TO CORBEL OR ARCH ACROSS AN OPENING. THIS IS A FUNCTION OF SHAPE, WEIGHT AND THE TIGHTNESS OF COURSING. JUDGEMENT ON NEEDLE BEAM POSITIONING IS REQUIRED.
- TEMPORARY SHORES TO BE ON HAND IN CASE OF SLUMPING OF MASONRY DURING THE POCKETING WORKS. TO BE SHORED OFF THE WALL BELOW WHEN NOT BEING WORKED ON (I.E. OVERNIGHT).

ADJUSTABLE STEEL SHORES

- ALL ADJUSTABLE STEEL SHORES ('ACROW PROPS') TO CONFORM TO BS 4074:2000
- WORKING LOADS ARE GIVEN ON THE DRAWING. PROPS TO BE SCREWED THROUGH HEAD & BASE PLATES INTO TIMBER STRUCTURE, LATERALLY BRACED INTO FLOORZONE EACH DIRECTION TO ACHIEVE TWO-WAY RESTRAINT. PROPS TO BE SET PLUMB, AND CONCENTRICALLY LOADED, TO MOBILISE FULL BUCKLING STRENGTH.
- SUBSTRATE FOR PROPPING TO BE INTRUSIVELY PROVED ON SITE AND TO THE SATISFACTION OF THE TEMPORARY WORKS ENGINEER.
- ADDITIONAL ACROW PROPS AND TIMBER BAULKS TO BE ON HAND FOR AD-HOC PROPPING OF SECONDARY TIMBER ELEMENTS.



P02 | REVISED TEMPORARY WORKS STRATEGY

ALAH
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STATUS: APPROVAL

PROJECT: 807 WILMSLOW ROAD, MANCR.

TITLE: STRUCTURAL REPLACEMENT OF DEFECTIVE ARCHED OPENING

SIZE: A1
SCALE: AS SHOWN

DATE: 17.02.2022
AUTHOR: D.W.

071 - DR - S - 110 - P02

Appendix B: Historic England List Entry

Overview

Heritage Category: Listed Building

Grade: II

List Entry Number: 1270537

Statutory Address: 807 AND 809, WILMSLOW ROAD

Details

Pair of houses. Probably c.1870. Mostly brown brick in header bond, with some red brick, sandstone dressings, and some applied "half-timbering"; slate roofs. Irregular plan with tower to left and projecting wing to right (probably an early C20 addition). North German vernacular style. Two storeys except for 3-storey tower, 2:3:3 windows, with some red brick bands. The centre has a doorway to the left, with a trefoil stone head, a large 3-light casement to the right, and 3 windows at 1st floor (1, 2 and 1 lights) each under a gablet projected from the roof, the centre larger. The tower to the left has a canted bay window at ground floor, 2 single-light windows at 1st floor, another single-light window at 2nd floor under a projected steeply-pitched half-dormer roof, corbelled corners, and a tall steeply-pitched hipped roof (the return side has, inter alia, 2 similar gabled windows at this level). The wing to the right has (inter alia) a recessed canted bay window at ground floor, the upper floor carried on stone columns either side, a stone balcony with cast-iron railings to the left 1st-floor window, and ornamental half-timbering in the gable. Part of small but distinctive settlement (The Grove) said to have been built for immigrant North German community; rare example of domestic architecture reflecting cosmopolitan nature of C19 Manchester society. Forms group with items in The Grove (q.v.) and Nos 803-5 Wilmslow Road (q.v.).

