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STRUCTURAL ENGINEERS REPORT

ON

REDUNDANT BARN & STORE BUILDING

POPLAR FARM

HUMBLETON ROAD

LELLEY

EAST RIDING OF YORKSHIRE

HU12 8SP.

September 2023

Job No. 23-9844

REV A : April 20204

## **STRUCTURAL ENGINEERS REPORT ON REDUNDANT BARN, POPLAR FARM, HUMBLETON ROAD, LELLEY, HU12 8SP**

### 1.0 INTRODUCTION

- 1.1 On the instructions of Mr Mike Carter we visited the site known as Poplar Farm, Humbleton Road, Lelley on 6<sup>th</sup> September 2023.
- 1.2 We were commissioned to carry out a visual inspection of the structural fabric to the existing Barn in order to confirm its current structural condition. It is understood that the intention is to convert the Barn into alternative habitable accommodation, although at this stage we have not had sight of any proposals. Likewise no details relating to the original construction, or any subsequent alterations were available at the time of our visit.
- 1.3 This report has therefore been prepared for inclusion within a planning application based solely upon the visual evidence available of the time of our inspection.
- 1.4 The Barn is a part two-storey building constructed in load-bearing masonry supporting a centrally ridged pantile covered roof. The southern end of the Barn is a full height open space with a mezzanine floor across the northern section.
- 1.5 This northern section has been subject to significant failure of the roof structure and this has resulted in previous reduction in height of the northern Gable. It is understood that this reduction in height was undertaken for safety reasons. The collapse of the roof structure limits the available access to the relevant part of the structure.
- 1.6 The Barn occupies a relatively level plot with hardstanding across the majority of the perimeter but with open gardens and fields across the northern face. Within the gardens there are a number of mature trees although these are generally some distance from the main load-bearing elements. There remain a series of stumps which are believed to relate to conifer trees which sit on a line is an extension of the Western addition. These stumps are substantial and the nearest is approximately 3 m from the northern Gable of the Barn.

- 1.7 Will also note that historically there was a single storey projection attached to the Eastern elevation which has subsequently been demolished. This is indicated by remnants of the original construction and flashing of the roof into the Eastern elevation of the Barn.
- 1.8 A vertical butt joint extends through the Eastern elevation along the line of the original projection coinciding with the internal wall of the Barn. Along the western face the vertical butt extends down to meet the edge of the doorway into the northern section, continuing through to lower level.
- 1.9 This report is confined to the structural aspects as detailed above. This report does not constitute a full building survey and excludes certain items such as those listed below:
- The decorative condition of the property
  - The condition of the property with respect to dampness, dry rot, timber infestation and the like
  - The condition of services
  - The condition of roof, floor, wall and ceiling coverings
  - The location of the property, its value and other aspects such as searches and boundaries, etc.
- 1.10 At this stage we have not undertaken any testing of materials, monitoring, breaking out or long term investigation. No inspection has been made of timber or other parts which were covered, unexposed or inaccessible, and no comment can be made on the condition or quality of such materials.
- 1.11 A summary of the principle defects and reconstruction works required as part of the proposed conversion are indicated on Dudley Consulting (Hull) Ltd drawing 23-8844 SK01 within Appendix A to this report

## 2.0 EXTERNAL OBSERVATIONS

### 2.1 EASTERN ELEVATION

As indicated in the introduction the roof at the northern end has completely collapsed and the Pantiles have been removed over the rear 4 m. Continued deformation runs through the roof with rippling of the ridgeline although the section to the southern end is relatively more true. There are a number of missing ridge tiles as well as ill-fitting Pantiles through the main body of the roof. Of more significance is a further failure of the roof at the junction with the original projection, with collapse of the roof over a significant area. This extends from the original ridge to the projection up to the internal wall line.

The brick coursing leading up to the northern Gable is relatively level but there is some rotation outwards to the eaves. This is in the region of 7 mm in an 800mm spirit level although the lower section of the wall is more true. No major stepped cracking or fractures were noted through the brickwork relative to the return although there are some damaged and ill-fitting bricks as a result of previous movement.

The rotational movement is more significant over the section leading up to the original projection where there are tie bars presumably coinciding with the first floor. The upper section of the wall planes outwards by some 15 mm in an 800mm spirit level but is again not reflected by major cracking damage. There are butt joints associated with possible infilled openings and the junction with the projection with weathering and erosion to the mortar joints. Generally this does not follow a pattern suggestive of significant continued movement.

The brickwork leading up to the internal wall associated with the projection does not exhibit significant out of level movement. The rotation towards the eaves is probably around 15 mm in an 800mm spirit level although the lower section below first floor level is more vertical. No significant cracking damage was noted through the brickwork but there is some displacement around deteriorating timber work and isolated pockets of weathered bricks.

Along the vertical joint between the northern and southern sections of the Barn there is a step outward which varies from low level up to around 15 mm. The brickwork to the northern section has rotated slightly outwards from lower level and continues through to the eaves in a comparable manner to that noted elsewhere. This eaves spread then extends through the majority of the elevation probably and exceeds 25 mm in an 800mm spirit level across the centre of the southern section reducing near to the junction with the internal wall and the southern return.

Within the main body of the brickwork the coursing is reasonably true and other than erosion of the mortar joints and damage to individual brick faces there is little to suggest an active structural issue. Slight cracking does occur above the doorway running through the mortar joints to higher level and this has a width of around 3-5 mm. From the weathering and discolouration to the crack edges, however, this does not appear to be recent.

Near to the return with the southern elevation the rotational movement relative to foundation level is only in the region of 5-7 mm in the 800mm spirit level. This level of rotation is over the full height of the wall and is again not reflected by major cracking damage. There is little settlement through the coursing and no major stepped cracking or fractures indicative of a foundation issue.

## 2.2 SOUTHERN GABLE ELEVATION

Historic alterations to the Barn included the provision of a substantial width opening through the elevation up to eaves height. Here steel beams have been provided over the opening to support the upper apex. These beams are of limited section and have suffered from some service deterioration. They have clearly deflected significantly towards the centre with resulting movement through the brickwork above. There are also indications of delamination of the steelwork and open jointing through the mortar directly above.

The timber frame associated with the first floor window opening has virtually perished and there is movement through the brick soldier arch over the opening, particularly the timber packing above the frame. When viewed from lower level there is significant bowing of the apex into the plane of the building by more than 100mm relative to the beams.

Cracking was noted through the brickwork to the eastern end running from the bearing through the brickwork towards lower level. It has caused individual bricks to snap with a width in excess of 5 mm. The general coursing through the pier, however, is relatively level with rotation relative to the foundations probably less than 25 mm up to the eaves. Weathering and discolouration of the crack edges suggest it is probably of some age.

The bearing at the western end is obscured by a climbing plant meaning an inspection of the brickwork is impractical. The general coursing suggest a small degree of settlement and rotation although this is not reflected by recent cracking damage where the brickwork could be viewed at low level.

### 2.3 NORTHERN GABLE ELEVATION

As indicated previously the roof over the more northern section has completely perished and there is a plastic sheeting over part of the roof and extending across the top of the wall as an inadequate weather projection. The Gable has clearly been reduced in height from the original ridgeline and there are indications of rotational movement through the upper apex section from eaves level. This is a continuation of rotation noted from lower level although here it is probably less than 7-10 mm in an 800mm spirit level.

Within this lower brickwork there is weathering and eroded joints as well as spalling to individual bricks. Cracking extends below the deteriorating timber frame to the first floor opening but this follows a predominantly vertical plane through weathered and open joints, with only nominal snapped bricks. The weathering clearly indicates this cracking is not of recent significance.

The upper visible section of wall is in relatively poor condition as a result of weather action and the previous safety measures. A climbing plant extends through to an open pocket above the brick soldier arch over the first floor opening but the rotation through the remaining apex section is within acceptable levels.

#### 2.4 WESTERN ELEVATION

The roof over the 'Open' Barn reflects the minor movement noted previously with the ridgeline relatively true. There are ill fitting Pantiles, but the algae growth and weathering suggest this movement is probably long-standing. Overall the deflection through the Pantiles is probably only in the region of 50 mm where it could be viewed from ground level.

The brickwork at the southern end remains reasonably level with some bowing of the wall into the plane of the building and associated movement towards the eaves. This is probably in the region of 15 mm in a 800mm spirit level and not reflected by major cracking damage through the horizontal joints. There is cracking above the infilled opening extending through the mortar joints, although this is clearly historic. The frame to that opening has deteriorated but the brick soldier arch is relatively true.

Across the central section the wall remains relatively vertical at low level although there is again some movement through the eaves. This is less pronounced than that noted previously and is not reflected by major cracking. Around the first floor opening there is deterioration of the frame, and an initially diagonal crack then runs through the mortar joints and snapped bricks to lower level. It has clearly been the subject of significant weathering. At the butt joint with the northern section there is minor displacement at the eaves but little at door head level to suggest a significant problem.

The roof over the northern section has collapsed up to the Gable with missing and dislodged Pantiles along the ridgeline near to the junction with the internal wall. The deviation through the roof is more pronounced than that noted at the southern end with the end 4 m of roof having completely failed.

A tarpaulin partially obscures the wall at the northern end, but the visible brickwork does not exhibit significant rotational movement, with the coursing reasonably true. Where the central section could be viewed relative to the first floor tie bar, and behind the climbing plant, there was again little to suggest an active problem in what is a 340mm width wall. Around the tie plate there is no significant cracking damage and little over the brick soldier arch to the door opening. Deterioration is evident through the timber work of the small first-floor window but otherwise through the masonry the damage is more weathering and erosion related.

### 3.0 INTERNAL OBSERVATIONS

#### 3.1 FIRST FLOOR LEVEL

The failure of the roof structure and the significant weather penetration through the roof along the Eastern elevation means that a full inspection of the structure was not considered safe. We would note that the original roof was of rafters supported on mid span purlins with collars and diagonal struts down to floor level. Steel ties then coincide with the eaves. There is significant deterioration and rot evident within the retained timbers to the roof structure and across much of the floor, particularly the eastern side.

Where the brickwork to the northern face could be viewed there is failure of the plaster finishes as a result of weather penetration and some damage across the brickwork. This remains limited with the rotational movement appearing to be comparable to that noted externally. The dwarf walls to both side elevations exhibit a small degree of spread with the plaster to the accessible Western elevation not exhibiting major movement.

Relative to the internal wall, where the plaster finish has been retained, there is little of major significance although there is slight separation cracking along the western end consistent with the door opening below. This is weathered and generally less than 2 mm in width. It is not reflected along the eastern side although there is cracking running from the purlin down to the deteriorating timber frame to the opening into the 'Open' Barn. Cracking then runs above this opening towards the centre consistent with deflection, and again is subject to notable weathering.

#### 3.2 GROUND FLOOR LEVEL

##### 3.2.1 NORTHERN GROUND FLOOR

The original floor consists of joists built into the side walls and supported on a substantial timber beam. This beam has 2No internal props with a further prop adjacent to the northern Gable. There are clear signs of infestation and deterioration within the

lower section of the props with infestation through the beams. As a result of the weather penetration through the roof there is complete failure of some joists built into the walls with rot evident over a significant number of further joists. This is most evident across the Eastern elevation.

The northern Gable exhibits a degree of rotation relative to ground level within the remaining plaster of around 5 mm in an 800mm spirit level. Through the remaining plaster there is no major cracking damage although extensive sections of the plaster have debonded as a result of weather penetration. Within the underlying brickwork erosion was noted.

Slight damage has occurred around the return with the Western elevation where there is only a limited nib to the side door opening. The timber work to this frame has deteriorated. Across the visible sections of the Western elevation the wall is reasonably vertical with no major stepped cracking suggestive of an active problem.

The Eastern elevation has been subject to the continued weather penetration with damage to the plaster and underlying brickwork. This brickwork is relatively vertical with only limited rotation relative to ground level. There has clearly been alterations as indicated by vertical joints in the blockwork presumably relating to historic openings. Where the timbers have been retained above the openings these have deteriorated.

Against the internal wall there is a vertical separation joint along the Eastern elevation which is only visible following failure of the plaster. Where the plaster is retained there is little of significance. The to the internal wall remains relatively level and true with only rotational movement, probably coursing in the region of 5 mm in an 800mm spirit level. Slight movement has occurred with the timber beam bears onto the wall and here there is clear infestation in the timber and damage to the packer. Further movement has occurred relative to deteriorating timber over the doorway through to the 'Open' Barn section with displaced bricks as a result of the poor quality of the previous alteration works.

### 3.2.2 OPEN BARN

The roof is constructed with rafters spanning onto mid height purlins which in turn are restraint by bespoke timber trusses. These trusses are equally spaced along the length of the Barn from the internal wall up to the southern elevation. Through the timber panelling below the Pantiles there is some staining and localised deterioration, including sections that appear to exhibit rot. Generally we were only able to carry out an inspection from floor level, but the main timbers did not exhibit major deterioration where they could be viewed, with little through the timber plates supporting the bottom boom of the trusses at the bearing into the wall.

Along the junction of the internal wall with the side elevations there is slight separation at the higher level running up through cracked bricks and plaster. This coincides with similar damage noted elsewhere but is probably historic. Generally the brick coursing does not exhibit significant cracking damage, but we would note deterioration within the timber work associated with the first floor opening and minor cracking to reflect that noted elsewhere. This includes slight damage running from the built in purlins through to lower level.

The Eastern elevation exhibits rotation relative to lower level particularly through the upper eaves. This is probably reflected by a limited degree of bowing with the movement of the upper wall generally around 15-20 mm in the 800 mm split-level. The lower walls reflect this rotational movement albeit to a relatively more limited degree.

Either side of the door opening the movement probably exceeds 20 mm locally but is not reflected by significant cracking damage through the brickwork suggestive of more recent rotation. There is cracking above the built in timbers over the doorway, including the original arch, extending from the bearing of the timber beam up to the plate under the truss above. The weathering and discolouration of the crack edges suggest this 3 mm cracking is not recent in origin.

The Western elevation also reflects the rotation noted externally with the movement in the region of 10 mm in an 800mm spirit level but not reflected by recent cracking

damage. There is deterioration within the timber work over the first floor window opening, extending through to rafters, and further cracking around the timber lintel over the door at lower level. Again cracking runs around the bearing through to the timber plates to the trusses above but is clearly long-standing. Where the lower wall could be viewed relative to stored materials there is a limited degree of movement but little of major significance.

The internal face of the apex over the southern opening reflects the deformation noted externally but within the remaining rendered finish there is little indication of significant recent movement. The lintel has clearly deflected towards the centre, and this has resulted in cracking running from the lintel through to the bearing of the purlin to the Western side. Generally however the cracking is relatively limited compared to the deformation of the wall.

The lower brickwork remains reasonably true with no major separation cracking at the interface between the piers and the side elevations. There is damage to the brickwork caused by inadequacy of the historic opening up works although this is localised and not of great significance. The piers are of relatively limited length but more than 600 mm internal projection.

Throughout the internal finish we noted indications of dampness with some effervescence and damage to historic finishes. Generally however this has not resulted in major erosion of individual bricks or associated mortar joints. The cementitious plinth has been partially provided over the lower level to the side elevations, presumably to protect against the dampness. Within this plinth there is little to suggest significant foundation movement.

#### 4.0 COMMENTS, RECOMMENDATIONS AND CONCLUSIONS

- 4.1 It is evident from our inspection of the main structural fabric of the Barn that it has only been the subject of relatively limited differential settlement and rotational movement during his lifetime. Generally the brick coursing to the main elevations appears reasonably true although there is some rotation relative the foundations and towards the eaves. Generally this rotational movement is in the region of 10-15 mm in an 800mm spirit level which equates to around 75 mm overall. The general walls are 340 mm in width and as a consequence this has not resulted in in any eccentricity relative to foundation level. Indeed through the general brick coursing we did not identify significant horizontal cracking damage suggestive of a recent or active problem.
- 4.2 It is equally evident, however, that the northern section of the Barn has been the subject of major failure of the roof structure with corresponding continued weather penetration through to the first floor. The end 4m of the roof have completely failed and been stripped of the Pantile finish. The remaining section up to the internal wall is in poor condition and as a consequence full replacement of the roof to this northern section will be required.
- 4.3 At the time of the failure of the roof it is understood that the apex to the northern Gable was reduced for safety reasons. This is relatively limited by comparison to the full height of the wall within which there is little evidence of significant structural movement. Rotation was noted relative to ground level but again this is limited by comparison to the width of the war. It is not reflected by major cracking damage other than associated with deteriorating timber work and openings. That cracking can be readily repaired as part of any conversion works.
- 4.4 Significant associated deterioration is noted through the first floor timbers with rot and failure of a number of joist ends. The main timber beam and internal posts are suffering from notable infestation with loss of section affecting the structural integrity. Bearing in mind the extent of replacement of the joists it is likely that the props will also require replacement. Providing that appropriate treatment can be given to the main timber

beam then it can potentially be incorporated within the conversion works subject to replacement propping.

- 4.5 Through the main roof to the 'Open' southern end we have highlighted the relatively true alignment of the external tiling. There is some staining and localised deterioration within the timber work to the wallplate and supports, but this appears significantly less pronounced than that noted above. The roof is reasonably true and can probably be retained within an open space subject to the findings of a specialist.
- 4.6 In addition to the deterioration within the timber work we have made a number of comments with regard to dampness and salt effervescence. These comments in no way constitute a report with regard to such matters, however, and we strongly recommend that specialist advice is obtained. The specialist should confirm the condition of the Barn with regard to dampness, timber deterioration and rot so that appropriate treatment can be incorporated within the conversion works to ensure that the long-term stability is not further compromised.
- 4.7 In terms of the main walls of the 'Open' Barn structure we have not identified significant deformation or signs of recent cracking damage. There is rotation relative to ground level but this remains limited by comparison to the height of the wall, as previously indicated. Other than repairs associated with deteriorating timbers the cracking can be raked out to a depth of around 35 mm prior to repointing with an appropriate sand/cement mortar. This is likely to be incorporated within the aesthetic treatment of the external elevations where isolated and individual weathered bricks may require replacement, along with appropriate repointing of the external brickwork.
- 4.8 The main concern with the southern 'Open' Barn is the support over the substantial opening through the Gable elevation. The support that has been introduced is of relatively slender section steels which have clearly deflected significantly towards the centre. This has resulted in movement through the upper brickwork and associated apex both vertically and horizontally. The scale of the movement is beyond normally accepted levels, but it is probable that this opening will be infilled as part of any conversion works. At that time we recommend that the support is replaced with a more

suitable section to suit the proposed openings. This will probably necessitate full rebuilding of the limited remaining apex, although the side buttressing piers are considered to be structurally adequate at this time.

- 4.9 We would however recommend that the vertical butt joints through the side elevations between the northern and southern sections are more adequately bonded. The provision of 'Helifix' type reinforcement within the mortar joints will help tie the sections together and limit further movement.
- 4.10 At the same time we recommend that the internal separation cracking between the side elevations and the internal wall is repaired in a similar manner, with 'helifix' type tie bars drilled through the external brickwork into the main body of internal wall to enhance the buttressing resistance. If further additional partitions can be incorporated within the 'Open' Barn area as part of the conversion that this will further enhance the lateral stability over the longer term.
- 4.11 It should be appreciated that the above comments have all been made following a single visual inspection of the Barn without the benefit of any long-term assessment, investigations or testing of the materials used in the construction. We are therefore unable to categorically state that the limited rotational movement and settlement noted through the main structural fabric has all ceased.
- 4.12 It is our opinion from the available visual evidence, however, that the principal structural fabric remains in an acceptably stable condition. A summary of the required reconstruction works is incorporated as Appendix A and as such we are satisfied that the Barn can be incorporated within a sympathetic conversion to alternative accommodation without the requirement for rebuilding more than 10% of the external walls.

**R F DUDLEY**  
**B.ENG C.ENG M.I.C.E.**

**For and on behalf of Dudley Consulting (Hull) Ltd**

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## **APPENDIX A**

Dudley Consulting (Hull) Ltd drawing 23-9844 SK01