JOHN BROOKE &SONS LTD

Structural Report

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Project 4366-05

CHANGE OF USE TO WELLNESS CENTRE

Building 29

BROOKES MILL, ARMITAGE BRIDGE



Architecture
Project Management
Surveying
Planning
Conservation

HEPPENSTALLS
Chartered Architects & Surveyors

STRUCTURAL REPORT ON BUILDING 29 BROOKES MILL

1. INTRODUCTION

1.1. This report has been prepared to record the structural condition prior to considering the future use of the building in respect of a planning application for change of existing use to a Wellness Centre.

2. GENERAL DESCRIPTION

2.1. The property is situated within the Brookes Mill site on the south western boundary of the built area with adjoining woodland on the south west side and existing mill commercial buildings abutting the south east gable.

2.2. The building is approximately 35.6m long by 6.73 wide and is five stories high being approximately 13.5m high ground level to eaves. According to various publications the building was constructed on the Brookes Mill site in around 1830 originally and occupied as a hand loom shop to extend an earlier hand loom shop also on the south east side.



2.3. The storeys are generally 15 bays long and open plan and served by half space landing stairs at the North West gable. One of the 15 bays at the North West end now contains a hoist shaft with an exposed brick lift motor room rising above the steep slated roofline and ridge.

3. HERITAGE STATUS

3.1. Building 29 is within the curtilage of two listed buildings at the Brookes Mill site, the warehouse and clock tower, which are both listed as Grade II buildings. We have assessed the building as being of medium significance within the mill setting (see Heritage Statement)

4. DESCRIPTION OF STRUCTURE

Walls

4.1. The building is of typical early 19 century mill construction with solid slate walls faced each side with coursed natural stone and random rubble stone internally probably with occasional stone troughs and masonry dressing to the inner core. Each of the 15 bays has a single window in the north side each floor having continuous window cills with over sail and trough stone heads.

4.2. Whilst the window cills externally are positioned approximately 1200mm above floor level the inner stone flag cill is approximately 750mm above floor level leaving a narrow stone panel approximately 250mm thick and 450mm high beneath each window to the north side.



4.3. The wall thickness varies from 730mm on the ground storey 600mm on the second storey to 500mm on the fifth storey. The inner face stepping outwards at each subsequent floor level.

Floors

4.4. The upper floors comprise of principle timber beams approx. 250mmx125mm (10" x 5") built into and bearing onto walls central between each window at each storey the span varying from 5.25m to 5.65m with 90mm x 80mm (3.5" x 3") timber joists spanning between principle beams set approximately 1.94m apart (6' 4"). The floors are covered in a 20 mm thick diagonal hardwood overlay probably on to an original softwood boarded floor 30mm thick. The ceilings are underdrawn in a sheet material.

Roof

4.5. The roof structure is a symmetrical pitched roof approximately 30 degrees slope covered in slating (not inspected) having timber close coupled collar truss at each bay supporting In two lines of purlins to each slope and a ridge purlin. The rafters are underdrawn leaving the purlins exposed.



4.6. The roof is covered with stone slates having grit stone ridges and stone water tabling to verges with kneeler stones at the base of each verge. The gutters are moulded cast iron probably supported on brackets with two stone corbels at the head of each pier between windows.



4.7. The rainwater pipes are cast iron pinned to external walls through ears on the collars with bobbin spaces to the masonry walls.

5. OBSERVATIONS

Roof

5.1. Generally the roof construction appears satisfactory with the collar trusses being in satisfactory condition. A closer inspection of bearings, truss and purlin connections is advisable if major rehabilitation takes place.

5.2. I understand the roof has been reslated and slates refixed on battens and roofing underlay as previous maintenance.

Walls

5.3. There are signs of longstanding significant lateral movement to the masonry walls evidenced by obvious movement gaps between the floors and the wall face. The movement is visible particularly on the second and third floors, about mid height of the whole north and south elevations and is in the order of 30/40mm where a gap in the decoration exists as the walls have moved laterally outwards from the floor.



5.4. The vertical alignment is quite evident on the north elevation to the yard where it is possible to see a pronounced slight bulge along the line of the rainwater pipes which are fixed parallel to the outer wall face. We have not taken plumb lines or carried out a digital survey of the elevations, and I would suggest that should rehabilitation works proceed this should be carried out to more accurately assess the movement.

5.5. The outer movement of the walls is also evident at the masonry piers on the fourth floor where the stone piers between the windows appear out of plumb by up to 45mm in their height leaning inwards at the head, the wall having moved outwards at the lower cill.





5.6. It is not surprising that given the age of the building, the construction of the walls, the height, length and width of the structure, that lateral movement of the walls has occurred generally.

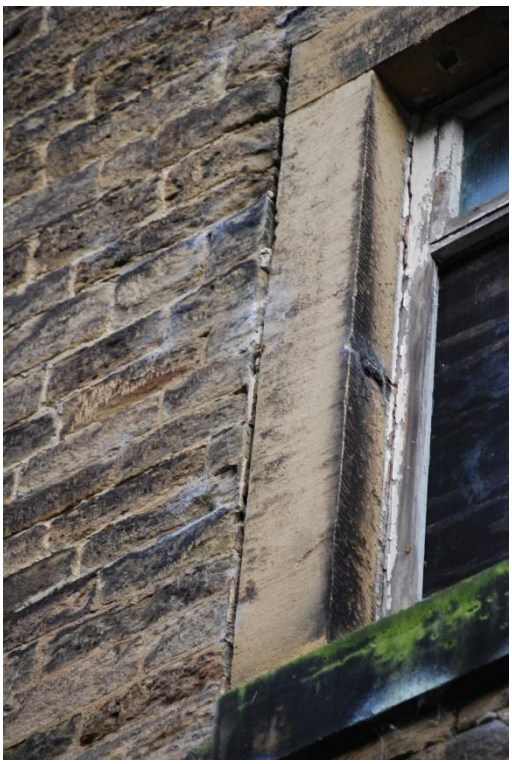




5.7. There are additionally signs of movement to the east gable particularly at the third and fourth floor levels where there are vertical cracks to the internal corners with each north and south wall. Some movement has also occurred to the floor construction where the floors at second and third floor have moved in an easterly direction probably due to the movement of the gable. This movement results in displacement of the masonry to the east side of the bearing of the floor beams on the north wall.

5.8. Externally, to the south elevation there are signs that the masonry outer leaf has migrated outwards particularly at the abutment with the stone jambs of the large windows at third floor level. There are signs that the main lateral movement is differential indicated by the raking cracks externally above the same third floor windows resulting in misalignment of the outer face each side of the cracks.





Floors

5.9. We have measured typical floor joist sizes and principle beam sections and prepared calculations and utilising maximum general bending stress of timber under British Standards and find the floor joists generally are able to carry 1.5kn/m2 plus self-weight with a deflection slightly in excess of an acceptable 360th of the span.

5.10. The main beams however in order for them to support the floor joists carrying 1.5kn/m2 deflect well in excess of 360th of the span and additionally the bending stress is almost double of that acceptable or alternatively the safety factor is reduced by 50%.

5.11. Currently the floors are deflecting approximately 45mm which is evident on inspection which amounts to 1/125th of the span ie almost three times the reasonable accepted deflection. Most definitely the floor joists need augmenting with supplementary beams in order to secure the long term performance of the floors and to relieve the loading on the existing beams.

6. SUMMARY

6.1. The floors of the building generally are in poor structural condition, with the timber secondary joists being only capable of supporting a safe superimposed loading of 1.5Kn/m2. In this situation the main timber beams are severely overstressed by at least 50% and this is confirmed by the current deflection of the floor beams which is approx. 45mm in a span of 5500mm a deflection of 1/120 rather than a reasonably acceptable 1/360 or less

6.2. Due to the building length and the lack of horizontal restraint from the timber floors the building is susceptible to lateral movement in accommodating the loads imposed on the walls ie wind and floor ie vertical loads.

6.3. In the medium term and continued current use it is likely that the building will deteriorate further although given its current age, approximately 185 years, a medium term classification maybe 15 to 20 years, however if the building is to be rehabilitated then the long term safety and stability must be resolved before any substantial investment is made.

7. PROPOSALS

7.1. There are many options for structural remediation of the building all with differing levels of intervention. These have been discussed with our client and as a result the scheme now proposed and as follows:-

7.1.1. The removal, in sequence, of all 4 upper floors and replacing with a composite concrete/metal deck reinforced floor plate supported on Universal beams at 4..00m centres on alternate masonry pier bays. The floor would be capable of a superimposed floor loading of 2.5 kN/m2 loading.

7.1.2. The proposed floor would comprise of a galvanised trapezoidal metal decking which would be spanning between 300mm deep Universal beams spanning between North and South walls onto newly formed grouted concreted bearings. To enable the design to accord with current

headroom the decking would be set on steel shelf angles with the top flange of the beam cast within the concrete.

7.1.3. The overall depth of the structural concrete floor would be approx. 120mm. The construction would give 60mins fire resistance and provided the exposed part of the UB has 60 mins intumescent paint applied the structural part of the floor would be 60 mins and able to act as a compartment floor in addition to stabilising the building in the long term

7.1.4. The concrete floor would be anchored into the North and South walls.

7.1.5. In terms of increase to the existing wall loadings the loads would be mitigated by offsetting the bearings on alternate piers with a pier supporting no more than 2 beam bearings.

7.1.6. Whilst we think that the existing foundation ground bearing is likely to be reasonable (bearing in mind the cut and fill of the site and local ground conditions), this would need to be investigated and confirmed in a geotechnical report.

7.1.7. Consideration should be given to grouting the masonry from the timber beam bearings once removed.

7.1.8. The concrete floors would futureproof the building allowing a future variety of uses.

7.1.9. The brick built hoist plant room at roof level is no longer required since any future new lift will be hydraulic ram and expansion pulley type with ground floor plant room. From historic photographs there appears to have originally a fireplace on each loom floor served by a chimney stack which has probably been removed in the mid-20th century when the hoist was introduced.