

STRUCTURAL ENGINEER'S REPORT

PROPERTY ADDRESS

Holt Hill
Green Street
Wrexham
LL13 9JF

CLIENT

Mr Chris Eaton
Holt Hill
Green Street
Wrexham
LL13 9JF

REPORT REFERENCE

21-6001-AC-01

DATE

10th June 2021

1.1 BRIEF

ADS Structural were requested by Mr Richard Grotta of Edward Architecture on behalf of Mr Chris Eaton, the owner, to undertake a structural inspection of the property known as Holt Hill in Green Street Wrexham. Over the last three months, Edward Architecture and their structural engineer's Struktura have been working on extending and repairing the property. As work progressed the property was found to be in poor condition resulting in a recommendation for the building to be demolished and rebuilt. Wrexham Council requested that a second report be prepared by a Conservation Accredited Structural Engineer. This report is prepared in response to that request.

1.2 BACKGROUND INFORMATION

This report has been prepared after much work has been undertaken on the site. Information has been provided by Edward Architecture that explains the sequence of recent events. The key points are as follows and a more comprehensive breakdown is given in appendix A, at the rear of this report.

The property had been unoccupied for 5 years prior to Mr Eaton purchasing it whereupon Edward Architecture (EA) developed a scheme to upgrade the property and provide an extension to the rear. A Heritage report was prepared by Mel Morris Conservation in January 2020 for Listed Building Consent and Planning approval. Subsequently, the condition of the high level walling was found to be in poor condition. A section 78 dangerous building notice was issued leading to a decision to dismantle the affected structural elements. After further investigation, a decision was taken to dismantle the roof. On the 4th May 2021 a section of the front wall failed falling inwards onto the first floor. The project's structural engineer, Struktura recommended that the building be demolished.

On the 6th May 2021 Nick Davies, Cadw inspector of Historic Buildings and Wrexham Council requested that Mr Eaton arrange for a second structural report to be prepared by a structural engineer experienced in Conservation.

2.1 DESCRIPTION OF THE BUILDING.

The building is a grade II listed house positioned on high ground close to the river Holt. The building was constructed at the end of the C17 and developed further in phases in the early to mid C18. It is two storeys high with a partial basement to the front left. The front elevation had a high parapet giving the impression that there was a third storey. Behind lay three duo pitched roof structures that were clad with Welsh slate. Two large timber trusses occur close to the spine wall. Timber rafters span between the ridge member, mid slope purlins and the external walls.

The load bearing structure is predominantly solid bonded masonry with some timber frame elements. The original mortar appears to be a sand-lime based mix. In 1720-1730 a ½ brick wide wall was added to the face of the front elevation. This facing brick is laid in a Flemish bond. The remaining external and most internal walls are of brick construction again set in a lime mortar. These other walls are bonded but have no recognisable consistent bond type.

On plan the house comprises 6 cells, 3 main rooms to the front with a central stair to the rear. A garage is located to the garden side rear and on the opposite side is the former dairy now the kitchen.

The history and phasing of the building have been covered in much detail by Mel Morris in a Heritage statement dated 20th January 2020. These details will not be repeated in this report but it is recommended that the reader looks specifically at the existing floor plans shown on page 16 of Mel's statement as this gives an indication of why certain construction details occur.



Photograph 1: View on west elevation (rear) of the property at the time of our visit.



Photograph 2: Site plan

Image courtesy of Google Earth pro

The building is located on high ground overlooking the flood plain to the river Holt. The front elevation faces the east

2.2 INSPECTION METHODOLOGY

The present condition of the building is such that we considered that safe access was available in only three areas at ground floor level. The whole of the roof, the tall front parapet wall and some of the upper storey masonry had been removed as noted in section 1.2 Furthermore a section of wall had recently fallen onto the first floor of the central front area causing it to partially collapse. This meant that the areas of the building that were considered safe to enter were limited to:

- The Kitchen, former dairy.
- The dining room.
- The garage.

All the remaining areas were inspected from the walkway on the perimeter scaffold that supported a temporary roof structure. The inspection was restricted to a visual examination of surface visible defects. Other parts of the structure, which were covered, unexposed or not visible from the walkway for instance, were not inspected and we are therefore unable to report that such parts of the structure are free of defects. The inspection was to comment on the cause of any defects and give recommendations for further investigation works and/or remedial works that were considered necessary. No comment is made on items, which are normally considered as non-structural unless they are considered to affect the structural integrity of the building (i.e., the condition of the fabric).

The inspection was been made on the 27th May 2021 by Anthony Clarke a chartered civil and structural engineer who is also a Conservation Accredited Engineer. The Conservation Accreditation Register for Engineers (CARE) identifies civil and structural engineers skilled in the conservation of historic structures and sites. Members have followed a rigorous approval procedure to confirm an appreciation of disciplines and interests extending well beyond their professional training as engineers and have demonstrated that they are fully conversant with conservation philosophy and methods applied to heritage projects.

2.3 DOCUMENTATION PROVIDED

The following documents have been provided by Edward Architecture for background information to this project.

- Architect's drawings 0759 - EA - A - PL01 to PL14
- Heritage statement by Mel Morris Conservation dated 24th January 2020
- Edward architecture site photographs dated 18th February, 18th March, 31st March and 21st April 2021
- Clutton Construction site photographs dated 21st and 26th April 2021 but some clearly have been taken at an earlier date.
- Emails from Cadw to Wrexham Council dated 6th and 11th May 2021
- Struktura report dated 31st March 2021
- Struktura report dated 5th May 2021
- Section 78 notice from Wrexham Council dated 30th March 2021

3.0 FINDINGS OF THE INSPECTION.

The reader is referred to sketches 21-6001-SK1 to SK8 upon which defects and observations have been recorded. These sketches should be read in conjunction with schedules 21-6001-RS1-4 upon which the following information is recorded: Recommendations for further investigation; areas of structure which can be retained; items that require repair or rebuilding.

4.0 DISCUSSION AND RECOMMENDATIONS

The conclusion of the Struktura report dated 5th May is that “the building was dangerous due to excessive decay of the timber framing elements and of the first floor members. Furthermore, they felt that the masonry walls were poorly constructed and had insufficient restraint and limited structural stability and robustness. They recommended that the building be demolished.” This conclusion was reached after virtually all of the roof framework was removed and the high level masonry taken down.

The owner Mr Chris Eaton has stated he valued this building to be of high importance which led him to purchase it knowing that it was in a state of disrepair. Mel Morris has confirmed that this building has specific significance to the village of Holt in her Heritage Statement.

We agree that the building's present condition is poor in areas but we do not agree that the remaining building is in such a state that it cannot be repaired. Having said this, we accept that this work is time consuming: Partially collapsed and defective structure will require propping before further investigations can take place. A detailed assessment of the timber elements within the building is required before conservation repairs can take place. There will be a higher than normal cost for these works.

We consider that all of the existing walls can be retained subject to completing the repairs shown on sketches SK 5-8. Their retention however requires the internal structure of the roof members, floor and internal walls to be stabilised so that they can afford the necessary lateral restraint to the external walls. To achieve this will require careful assessment of each element to decide the most appropriate repair. Some local rebuilding will be required. Looking at each element we would comment as follows:

4.1 OVERALL STABILITY.

The cellular nature of the walls helps in that this can create a robust structure as long as the wall junctions are tied together. In places such as the garage, there are straight vertical joints but referring to the heritage statement it is apparent that there are two period of construction and most probably two skins of masonry. Pattress plates with long bars anchored into the intersecting wall could afford this restraint. Their suggested locations are shown on the sketches. (Please note that the details shown are not to construction status but are in the author's opinion, sufficient for a quantity surveyor or experienced contractor's estimator to assess the likely cost of the repairs)

4.2 FRONT WALL

There are two aspects to the front wall that need consideration: The top storey and the general wall.

Looking at the front wall there is a distinct vertical bow: The wall has been identified by Mel Morris as being a later construction to the original house. It is formed in Flemish bond. Alternating courses of stretcher / header bricks. It is very common for Georgian buildings to be constructed with “snap” headers. We suspect that this is the case here, in that the headers do not penetrate the original wall. It is very unlikely that there are any ties between the newer wall and the backing wall. We suspect that the two walls will be operating independently. Again, pattress plates anchored into the cross walls will prevent further movement and could be assisted by stainless steel wall ties hidden behind the repointed bed courses.

The one area where there may be difficulty in proving stability relates to the front top storey. This wall is taller than the ridges of the three roof structures behind. The wall returns on the south side alongside the concealed valley and terminates at the chimney between bedroom 1 and 4. In the past the chimney structure has had to act as both a flue and a cantilever end pier. As a working chimney it has had three hundred years of use causing the mortar to degrade. Strengthening structure will be required to tie this masonry back to the pike of brickwork on the cross wall between the bedrooms. The introduction of bed joint reinforcement should help to transfer the loads back to the front wall and this new structure.

The front wall parapet then continues past the gable ends of the three roof structures. The ceiling profile to the three bedrooms follow the rafters as far as the intermediate purlin before going flat under the ridge. There is no facility to introduce bracing so we suggest that the ceiling zone is plated with ply to create a diaphragm behind the plaster. This needs design checking and will lower the ceiling slightly in each of the front rooms. The wall can then be tied to the roof plane.

The front wall appears to have terminated at the corner of bedroom 3. From the record photographs we can see that the original design had a reverse sloping roof part way up the parapet wall. This should be retained and perhaps the wall returned around the corner slightly to act as a solid end pier. Again, a design check is needed.

4.3 REMAINING EXTERNAL WALLS

The existing condition of the walls is such that the top courses are in variable condition from solid to weakened over 3 or 4 courses. On site checks could verify how much has to be dismantled before rebuilding. To enable a budget cost to be prepared, the approximate affected areas are shown on the elevation sketches SK5 -8.

We presume that all of the brickwork that was removed from the parapet and other walls were retained on site. The bricks should be placed on covered pallets that are blocked off the ground. All rebuilding work should be undertaken with a lime based mortar, ideally a hot lime mix for compatibility. The works should only be undertaken by masons experienced in working with this material as there are health and safety issues that need to be carefully considered.

4.4 ROOF STRUCTURE.

The primary support for the roof comprises two timber trusses, the spine wall between bedrooms 1 and 4 and two mid rafter purlins on each pitch. At the time of our visit all the rafters plus all the purlins except one line had been removed. One purlin was retained on the scaffold and the remaining timber was in piles on the garden by the south elevation. From the record photographs the roof appears to be very traditional with rafters pegged to the purlins which in turn sit onto the wall or are half lapped into the trusses. From the stock piles I could see that most rafters had evidence of flight holes from insect attack. There is also evidence of local decay of both the purlins and rafters. The timber was poorly stacked and was not covered but I did note that each element was labelled. We understand that there is a marking plan available which would uniquely identify each member on the roof. Without this plan it will be difficult to reconstruct the roof as it was before the dismantling process.

From a conservation point of view the reuse of much of this material is important. Rot usually occurs where it is embedded within walls, or at valley gutter and wall plate lines. Decayed wood will need to be cut out along with a margin of up to 300mm beyond the decay line. The cut face then needs to be treated with a suitable preservative. Wood boring insect attack can occur anywhere. A cursory inspection did not reveal active flight holes but given the amount of timber it is possible there is still some active holes and these will need treating with a contact insecticide. Our approach to the assessment and reconstruction of the various components would be as follows:

Main trusses: These frames have been retained insitu and an initial assessment by others have determined that they can be reused. We would agree that this is the case. We would recommend micro drilling be undertaken to confirm that critical bearings or joints are satisfactory. A detailed visual examination will be required of all retained timber.

Purlins: The defective area needs to be carefully assessed to determine the cut line. Repair will normally be by the introduction of a splice with new timber or alternately by strengthening the section using ply or stainless steel plates bolted / screwed to the retained section. This process is more satisfactorily achieved when the framework is insitu. Since the elements are in pieces at ground level it is going to be more difficult to reconstruct the roof and will have to be completed in stages.

An initial assessment of each member could be made whilst it is on the ground to determine the extent of any repairs. This will require selective micro drill testing to determine any cut lines. Dry assembly of the components at ground level would be useful. Some repairs could be made before lifting into place and others will have to be completed insitu at high level. Temporary propping of these non-assembled members will be required whilst the repair is determined and then instigated. Templates often have to be made to suit distorted roof structure and this can only be undertaken with the member insitu on the roof. We would suggest that the contractor who took the roof apart should be involved to help with reassembling the components. The repairs should only be undertaken by carpenters who are experienced in working with historic timber.

To assist with preparing the budget costs, please review figures 1 to 4 which show indicative repair principles.

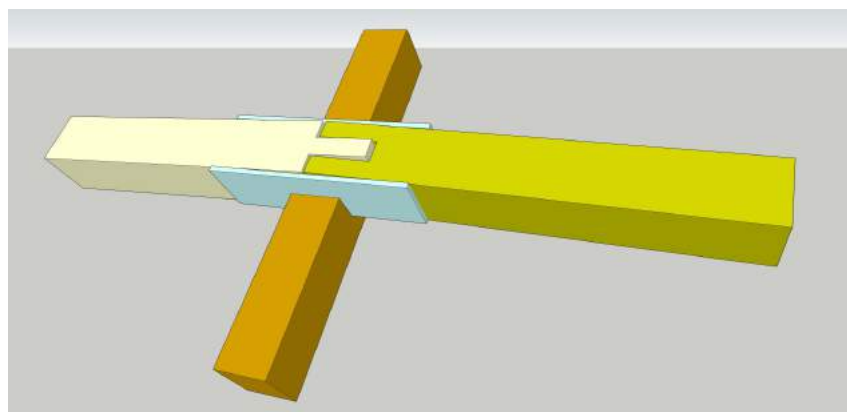
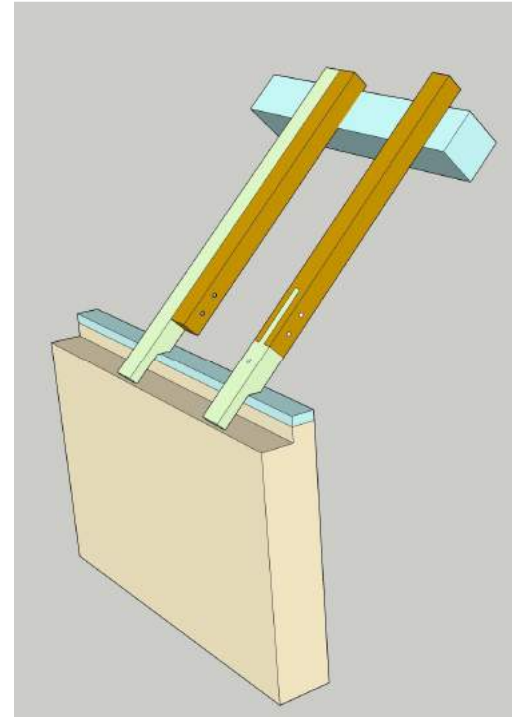


Figure 1: Ply splice plates can be used to repair the bridle connections of the purlins onto the trusses. Temporary propping of the purlins may be required and then ply plates could be coach screwed to the retained timber.

Rafters: An initial assessment can be made on each member to determine its suitability for reuse. We presume that all the timber that was removed is located in the stock pile. To facilitate re erection, we would suggest that rafters are separated into piles depending upon their location on each pitch. i.e., all zone one south pitch timbers are separated from zone 1 north pitch. All timbers should be carefully stacked in piles that are lifted off the ground and they should be covered. Each member can be classed as a) suitable for reuse; b) suitable for reuse if repaired and c) beyond repair so replace. In this way, one can quantify the extent of work and repair costs.

Figure 2: (Right) There are three options to repairing decayed rafter ends. 1) Where the rafter is hidden then cut back the defective end and then fix it to a new timber rafter alongside the original member. 2) Where rafters are exposed then a bridle joint is most effective as shown on the right member in figure 2. This requires the contractor to rout a slot in the existing rafter and then to cut a new section as shown to the right. 3) Form a traditional timber scarf joint on both sections of the new and old timber rafters.



Damaged areas of timber can be spliced or additional member added alongside the original. Repair of dowel holes and strengthening of ends damaged before or during dismantling will be required. All rafters will need to be refixed with timber dowels. An allowance for these repairs and new material will have to be determined on site. Examples of how the various roof and floor timbers can be repaired are shown in figures 2 & 3

4.5 FIRST FLOOR STRUCTURE

Sketches 21-6001-SK1 and accompanying schedule identifies the approximate extent of the damage. Beams and floor joists that have insufficient bearing can be repaired using an appropriate conservation splice or by the use of stainless steel flitch plates bolted to the sides of the beam. Hidden flitch plates can be created by routing out slots down the middle of the joist from above and then side fixing into the timber. This requires floor boards to be lifted above. This should be undertaken in a careful manner so as to cause the least disturbance / damage to the boards.

At the west side of the lounge there is a timber beam (schedule item 29) that was not accessible but needs careful consideration. This beam picks up the landing wall and first floor so is relatively heavily loaded. The floor appears to be falling suggesting that the beam is under-stress and / or sagging. When safe access can be provided then the beam needs a close

inspection together with a design check. At this stage it would be appropriate to allow for propping the beam to a solid point below. (This may require ground floor joists and boards to be locally lifted). As there is a wall over a replacement beam may be difficult so two new beams could be installed and fixed one each side of the existing timber member. The load could then be shared between the three members.

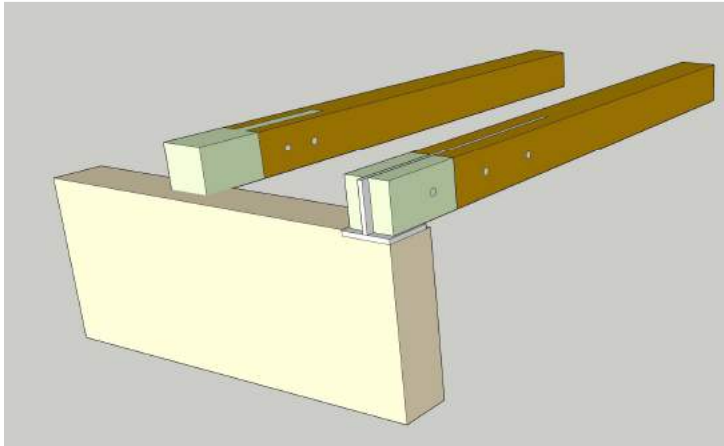


Figure 3: Two alternatives to a traditional timber scarf joint for repairing an exposed floor joist. The baseplate on the right example would only be needed if it was heavily loaded. Stainless steel plates should be used.

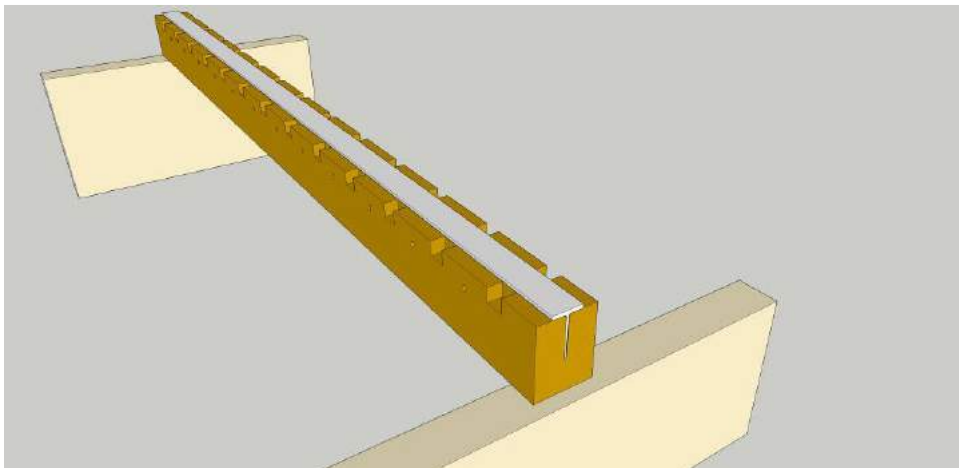


Figure 4: Concealed strengthening of a defective floor beam. (Floor joists not shown for clarity). Stainless steel section should be used set into a routed slot in the top face of the beam. Counter bore holes into the side of the timber beam and fix bolts to connect the two sections together. Insert pellets to conceal the bolt head or nut.

4.6 GROUND FLOOR STRUCTURE.

It is possible that the ground floor to all areas other than the kitchen are suspended timber floors. If this is the case then these joists also need checking and repairing as the first floor.

4.7 INTERNAL WALLS

The internal walls comprise a combination of timber frames, solid masonry walls and timber stud. Structure. A brief description of each wall is shown on the schedule 21-6001-RS-4. Wall L provides support for the purlins and will need local repair on the top courses along with rebuilding of the chimney stack 2. Wall M comprises a timber frame of two posts and deep cross member. Positioned under a valley line it has suffered with decay to the top face. A site photograph shows a very deep void at the head of one of the posts due to decay. The frame has brickwork below and so this connection is now less critical but all decayed material should be cut out and new sections spliced into place. Timber wall plates on walls P and T lie on the valley line and are likely to need replacement.

4.8 BASEMENT

Access into the basement was not possible during our visit so this will need a structural review at the next stage of the project when it is safe to access the area. One of the heritage statement photographs shows deep timber beams supported onto stone block walling. We would expect that the basement walls and floors will need some form of damp treatment which is beyond the scope of this report.

4.9 FOUNDATIONS

This appraisal has not included an assessment of the foundations to the building as this is outside of the agreed scope of works. There is very little evidence of cracking in the walls that would suggest that this is a problem. It is assumed that the project's current structural engineer has undertaken due diligence trial hole checks to confirm the condition and type of substructure is adequate. If not, then these checks will need to be undertaken.

5.0 CONCLUSIONS

This appraisal has reviewed the condition of the building known as Holt Hill. High level brickwork and virtually all of the roof has been removed prior to our visit. A previous review by the project's current structural engineer recommended that this building should be demolished and rebuilt. As this is a listed building the approach should be what can be conserved by repairing with minimal dismantling and rebuilding. This appraisal shows in outline an approach to retain much of the building's fabric and repair the remainder so as to avoid demolition. It is accepted that there is a cost to achieve this aim and that it will take time. The indicative details provided should be sufficient to enable budget costs to be determined. Suitable contingency sums should be included within these cost plans to allow for unforeseen work items. As work progresses so will the risk and these sums can be reviewed periodically.

Report prepared by:

A handwritten signature in black ink that reads 'Anthony M Clarke'.

Anthony Clarke BSc (Hons) CEng FStructE MICE Conservation Accredited Engineer

Consultant

For and on behalf of ADS Structural Ltd

We reserve the right to refuse copies of the report to be issued to any third party (other than any named previously). We also reserve the right to amend our opinions in the event that additional information is made available at some future date.

Appendix A

BACKGROUND INFORMATION

This report has been prepared after much work has been undertaken on the site. In order to understand the present condition, it is necessary to give a timeline of events leading up to the present. This timeline has been developed from information that has been provided by Edward Architecture (documents as noted in section 2,3 of this report).

It is noted that:

- The property had been unoccupied for 5 years prior to Mr Eaton purchasing it.
- Edward Architecture (EA) had developed a scheme for Mr Eaton to upgrade the property and provide an extension to the rear.
- As this is a listed property, Edward Architecture had arranged for a Heritage report to be prepared by Mel Morris Conservation in January 2020. This document presumably formed part of a Listed Building Consent and Planning approval applications.
- Work appeared to have started on site and quickly the extent of the building's condition became apparent. It has been suggested that the property had been neglected for about 60 years.
- EA were supervising the work. Photographs have been supplied to ADS that shown the extension progressing from the 18th February 2021 onwards.
- Site photographs by EA on the 18th March 2021 show that the roof was insitu and various defects were found with the brickwork. A decision was taken to dismantle the roof and the front parapet wall: This wall had been built to give the impression that it is a further storey high. To protect the building's fabric, a temporary over-roof was erected supported on a scaffold frame.

- On the 30th March 2021 Wrexham Council Building Control served a Section 78 dangerous building notice on Mr Eaton. This notice related to

Redundant Chimney to Gable & Parapet Wall to gable & Front.

The agreed action stated on the notice was:

Reduce the height of the redundant chimney and parapet walling to gable & front including the stone capping, saving them in order to rebuild like for like including any detailing over windows. Further remediation structural works maybe required following the Structural Engineers observations.

- On the 30th March 2021, Struktura visited the site and subsequently prepared a report recommending that
Most of the roof timbers have severe decay, loss of section or voids cut out within the section.
There are also serious defects with the detailing of the roof timbers with members such as ridge beams and purlins not being seated into the gable walls, therefore the roof as a whole is not stable.

We would recommend a new cut roof is installed, removing all roof timbers except the King Post truss to the Northern range which can be treated and replacing the old roof with a new cut roof with purlins and ridge constructed from Oak and new timber rafters. This new roof would be strapped back to the proposed re-constructed gables and gable parapet walls. Therefore, re-instating the overall stability of the roof.

With regards to the chimney to the southern elevation, this is in our opinion dangerous due to the excessive movement of the stack which can be moved by light hand pressure, under high wind loads we would consider this stack to be vulnerable to collapse and should therefore immediately be taken down to window head level and be re-built using existing bricks where possible.

- Site photographs by EA on the 31st March 2021 show that the slate covering had been removed revealing the timber roof structure. This comprised timber rafters pegged to a timber ridge beam and onto mid height purlins. The timberwork was distorted. Some deterioration is evident in the timber rafters .
- Site photographs by EA on the 13th April 2021 show the roof structure has been removed. In addition, the following is noted:
 - Moderate to severe deterioration of the timber is evident on the vertical posts and cross beam frame. (See ADS item 50 on SK2).
 - Poor bonding and poor mortar on the internal face of certain gable piked brickwork.
 - Deteriorated timber with abundant boring insect flight holes on purlins and beams. Large loss of corners to rectangular sections.

- Site photographs by EA on the 21st April 2021 show that the owner Mr Eaton had vacated the property but the photographer was able to walk around much of the property including the 1st floor. All the roof structure had been removed although some floor joists were propped. Chimney stacks had been dismantled to just above first floor level revealing severe cracking of the masonry. Debris from the walls that were being taken down was being removed from the floor structure.
- Further photographs were supplied and taken by the contractor Clutton construction that show:
 - the roof purlins are half jointed over the truss rafter chord. The purlins overlap at the same position with a one third / two third tenon splice. The rafter members are labelled presumably to suit a location marking plan.
 - Various photographs show decayed and damaged timber members. Large voids have developed at junctions where rot has set in.
 - Some floors have been overlaid with modern boards and packers over earlier floor boards.
- On the 4th May 2021 a section of the front wall failed falling inwards onto the first floor. Photographs show the debris.
- On the 5th May Struktura issued a structural report, concluding that:

The masonry is generally in very poor condition with widespread cracking and sagging as the embedded timbers and support timbers decay. There is minimal restraint at masonry interfaces due to uncoursed masonry and loss of mortar and there is evidence of excessive movement.

Under analysis the building would not be considered able to support the loads associated with a residential property based on current UK design standards.

The building is, in our opinion, dangerous due to excessive decay of the timber framing elements and of the first floor members. The masonry walls are poorly constructed and have insufficient restraint and limited structural stability and robustness.

We recommend that the building be demolished.

On the 6th May 2021 Nick Davies, Cadw inspector of Historic Buildings and Wrexham Council requested that Mr Eaton arrange for a second structural report prepared by a structural engineer experienced in Conservation. This report is prepared in response to that request.

Appendix B

Photographs

Typical photographs are included. A full set of digital copies are available upon request.



Photograph B1: (6734) View on the ceiling structure to the kitchen.



Photograph B2: (6724) Connection of the primary beam to the external wall cross beam within the kitchen. Note the splayed top face of the primary beam and notching in this beam and the cross beam.



Photograph B3: (6736) View on the collapsed floor over the lounge. Note the twist on the joist but the end grain of the joists appears satisfactory. Also note the steep fall across the door head to the study.



Photograph B4: (6749) Internal view of the first floor joists over the garage. Generally, the joists were in a satisfactory condition.



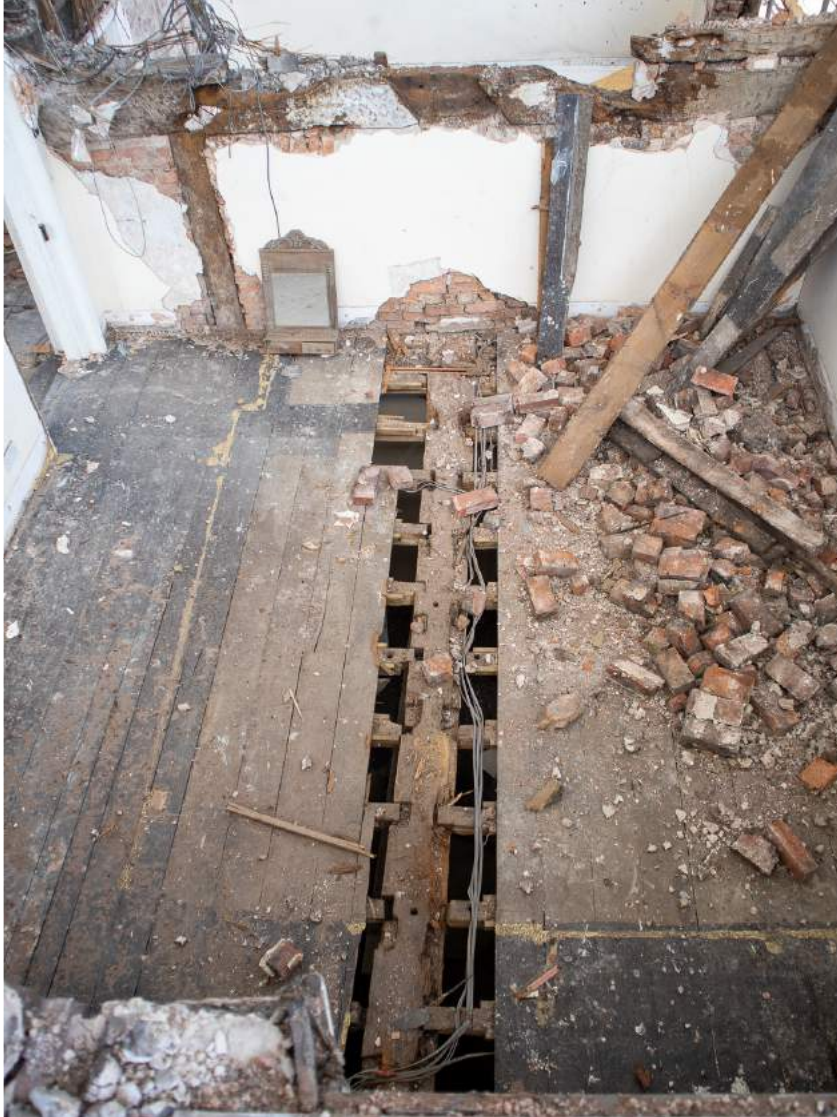
Photograph B5 (6768) showing the wide vertical fracture at the junction of the chimney stack 2 with bedroom 4. . Local rebuilding and strengthening will be required.



Photograph B6: (6772) View on truss 2 with Truss 1 in the distance. Note that the condition of the timber is generally satisfactory; the landing wall is solid bonded masonry and supports the overlapping purlins; the bathroom wall is stud construction running parallel with the truss.



Photograph B7: (6790) Roof truss 1. This truss appears to have been modified. It essentially is the same truss profile as truss 2 but has the additional cross and vertical members to support the reeds for the plaster on bedroom 1.



Photograph B8: (6784) view on the first floor beam over the study. Note that the joists have deep pockets and some appear to have little or no bearing. The floor joists in this room are generally wide and are probably original.

The timber structure on the far wall lies on a valley line and is in a poorer condition. The presence of brickwork infill makes this frame less critical so repair of decayed timber will be easier.

Appendix C

Sketches and schedules