Appendix II

Site Investigation - STRESS Heritage Engineering

Site Investigation – Church Farm Cottage



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Structural Repairs and Specialist Services Ltd.

Authored by: Anna Stevens

STRESS
Heritage Engineering

Project Precis

Client	**Sedgwick Repair Solutions**
Site Address	**Church Farm Cottage** **2 Blacksmiths Lane** **Abbotsley** **Cambridgshire.** **PE19 6UG**
Investigation date	**18th November 2019**
Carried out by	[redacted] ***Conservation and Heritage Manager*** [redacted] ***Heritage Repair Technician***
Photographs	**All photographs are by [redacted] and [redacted] unless otherwise stated.**

Document Status & Signatures

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Signed on behalf of Structural Repairs and Specialist Services Ltd (SUK)	
Prepared by:	[redacted] *MSc Building Conservation*
Reviewed by:	[redacted] *Senior Engineering Manger*

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Site Investigation

Introduction

Church Farm Cottage is a grade II listed C17th Century timber framed building that was reported to be suffering from subsidence. A survey of the building a was conducted in April 2019 and it was identified that a site investigation should be carried out in relation to sections of the timber frame to ascertain if the condition of the frame was a contributory factor.

Based on the areas outlined in the survey a site investigation was carried out on 18th November 2019. The weather was damp and overcast but dry.

Scope of Site Investigation

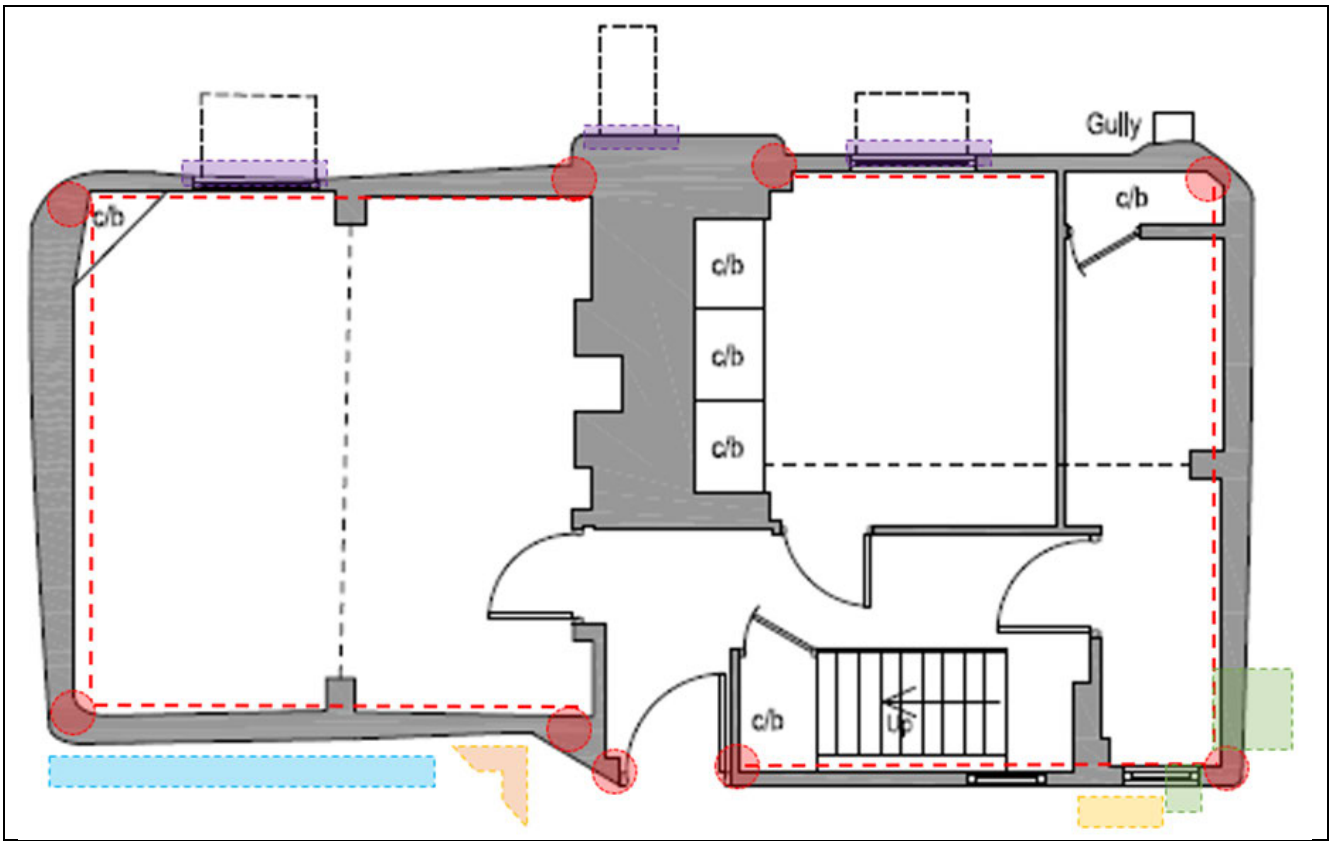
The scope of the site investigation was set out in the Site Survey Report as laid out in Appendix C of the document (Stevens, 2019).

The areas covered by the survey were: -

- The Sill Beam
- The Primary Timbers
- The Buttresses
- Concrete apron Western Elevation
- Pebbled area to the left of the front door

General observations

- The sloping floor in the first-floor Northern bedroom has become sufficiently pronounced that the tenants have moved into the smaller first-floor Southern bedroom.
- Flaring observed along the ground floor is an indicator that the sill beam may well be rotted sufficiently that it is rolling out from the wall. This is particularly significant at the Northern elevation where there is also strong evidence for the rotting out of the sill beam towards the Western(rear) elevation.
- The hard-cementitious render is in extremely poor condition throughout and is acting like a 'waterproof' coat that is retaining moisture within the structure at all levels.



The sill beam	• On all elevations to determine the condition • To determine the depth relative to the ground level on the Western elevations • To establish the extent of previous repairs to the sole plate and materials used in the repairs
The primary timbers	• The corner posts of the North and Eastern Elevations • The outshot timbers either side of the front door • The outshot timbers above the door
The Buttresses	• To determine if they are tied into the main structure above and below ground level
Concrete apron Western elevation	• To ascertain the depth of the concrete apron and if this covers the sole plate
The pebbled area to the left of the front door	• To ascertain if a French drain has been installed at this point.

FIGURE 1 – APPENDIX C - SCOPE OF SITE INVESTIGATION

The Sill Beam

During the initial survey it was noted that the surrounding ground height varied around the perimeter of the building. Good practice is that the Sill Beams should be above ground level usually supported on a plinth of stone or brick. It would be expected that single sections of timber would make up each individual elevation to ensure the structural integrity of the main timber frame. This Sill beam then supports all other structural elements such as the main corner posts and bays. Church Farm Cottage is a small structure which was likely to have been of full timber construction with the brick-built chimney added later.

The Sill beam was visually inspected on all elevations where exposed and, moisture readings obtained at various points.

Observations

The sill beam would appear to have been repaired on numerous occasions through the life of the property. It is likely that the surrounding ground levels have raised overtime resulting in the sill beam having been replaced with brick in some areas and partially replaced at a higher level than the original. From the observations along the plinth differing materials have been used in the construction and or repair. Both brick and pebble were found to have been used. On the South West corner, the render had completely failed exposing a bituminous material that had been applied to the plinth.



FIGURE 2 – PLINTH MATERIALS

Western Elevation

The sill beam along the Western elevation was covered by hard cementitious render with only an end grain section of the timber visible at the corner junction with the Northern Elevation. This timber appeared to be sitting on a brick pad and was level with the surrounding ground. It could not be ascertained if this was an original timber, but the location would indicate that this was a replacement which had been installed at a different level which was higher than the original.

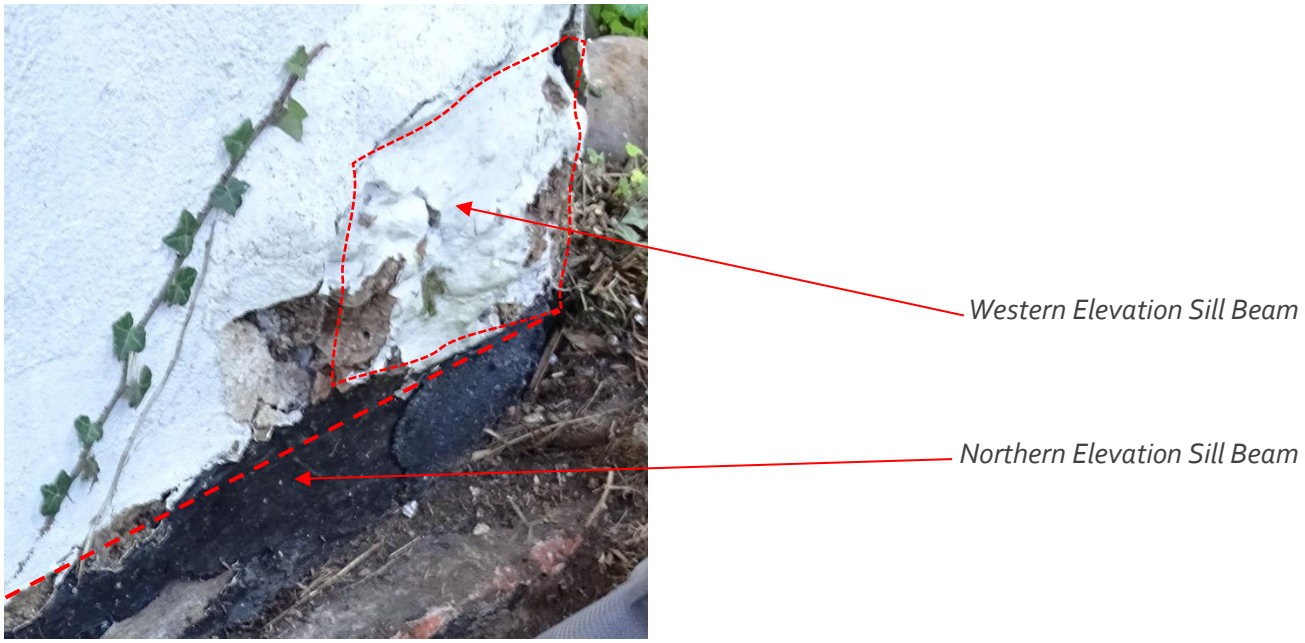


FIGURE 3 - JUNCTION OF WESTERN AND NORTHERN SILL BEAMS

Northern Elevation

The Sill beam along the Northern Elevation was partially exposed being at or below ground level and was observed to be in poor condition displaying surface deterioration and the presence of rot along the full length. An early scarf joint centrally would suggest that there had been previous repairs to this timber element.

Particularly noteworthy was the corner of the North and East elevations where the timber sill beam was observed to be rotted, pieces of which were breaking away. This is a significant location and may demonstrate the rotting out of the sill beam which would cause distress to the structural integrity of the building.







FIGURE 4 - SCARF JOINT - NORTHERN ELEVATION

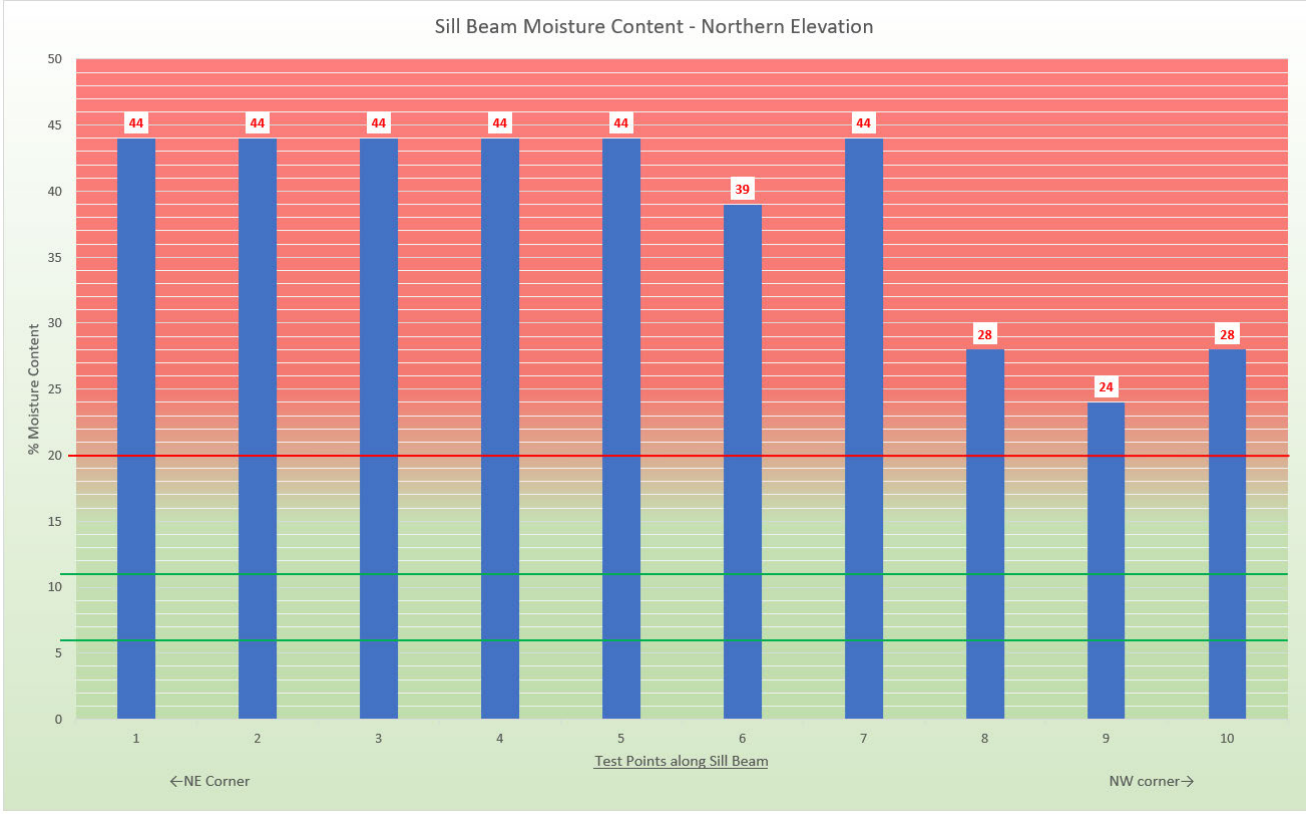
Moisture Readings

Moisture readings were obtained from 10 locations along the sill beam 60% of which were found to be at >44%. This was the highest reading possible of the moisture meter and these values can be accepted as being in excess of this maximum reading. Of the readings obtained all were found to be in excess of 20%. This percentage is deemed to be the acceptable upper limit which if endured for a long period of time will likely result in decay and infestation. Environmental conditions must be of relatively high humidity (70%) and between temperatures of 0°C and 40°C. This is easily achievable where the timber is below ground level, encased in a non-breathable material and continuously damp. It is assessed that the Northern Elevation is at risk from these factors. Shading from vegetation in this case is also likely to be a contributing factor which will prevent the exposed timber from drying out.

The readings show quite clearly that the moisture content of the sill beam from the North East corner for approximately 2/3rds of the sill beam towards the North West corner is showing readings that place the structure at these points in significant risk of structural failure.

Readings obtained at eaves level on the N/W corner and N/E corner were found to be 25% and 23% respectively.





1. Readings showing 44% should be interpretted as being in excess of this reading due to the maximum being reached so the timber can be assumed to be higher than the reading shown.
2. Wood begins to suffer damage if its moisture content remains at over 20% for long periods of time - illustrated by red line.
3. The tensile strength of wood is at its greatest in the 6-12% moisture content range – illustrated by solid green lines.
4. Molding and decaying of wood timber between temperatures of +0 and + 40 C with the air humidity at above 70% being critical.

FIGURE 5 - MOISTURE CONTENT GRAPH - NORTHERN ELEVATION SILL BEAM

The overall visual appearance of the elevation was that the wall appears to flare outwards at the base. This is something that in every likelihood was evident at the time of the encasing in cementitious render[1]. This is a common indicator that the sill beam is in some distress and potentially is rotting out and rolling away from the property which gives rise to the flared appearance. This coupled with the scarf joint and the present condition

[1] Encasing in EML and hard cementitious render was common practice in the 1970's-1980's and has since been established as causing significant harm to the underlying structure. No longer advised or supported, particularly in respect of timber framed buildings.

of the sill beam suggests that this area of the frame has been previously repaired and replaced probably for similar reasons.

Eastern Elevation

The sill beam along the Eastern elevation was not visible externally and can be assumed where it still exists to be fully encased in cementitious render. Internal examination showed cracking along the covering which is likely to be as a result of the movement and rotation of the frame towards the North East corner.



FIGURE 6 - INTERNAL EASTERN ELEVATION - POSSIBLE SILL BEAM

Southern Elevation

The Sill beam on the Southern Elevation was not visible externally and can be assumed where it still exists to be fully encased in cementitious render.

The area was not able to be fully investigated however there is substantial cracking along the length of the property which exposes the foundation/plinth under the area that the sill beam would be expected to be.



FIGURE 7 - SOUTHERN ELEVATION – PLINTH LEVEL

The Primary Timbers

Without the removal of the hard-cementitious render it was not possible to fully examine the condition of the corner posts. The only primary timbers that were able to be meaningfully examined were above the outshot.

Cementitious render

The cementitious render is noteworthy and is a contributory factor in the distress that this property is showing. Batons have been secured to the primary timbers externally to enable a 'straight edge' and fixing point for the EML which is visible at eaves level. This has been applied to all elevations and then covered in coatings of the render. Where the render has cracked and broken away throughout the elevations this has allowed moisture to penetrate the structure that has then been trapped inside the structure. The batons were examined where exposed and found to be in poor condition, wet and spongy to the touch with pieces falling away in several locations. This would indicate that a significant amount of moisture is being retained under the rendered surface which might be transmitted into the primary timbers.

Corner posts of the North and Eastern Elevations

Northern Elevation

Unable to examine due to cementitious render covering and presence of supporting batons to secure EML at corners.

Eastern Elevation

Unable to examine due to cementitious render covering and presence of supporting batons to secure EML at corners.

The support baton was in very poor condition at ground level and had rotted out. Brick had been leant vertically in front of it and then rendered over. This is an unusual construction detail.

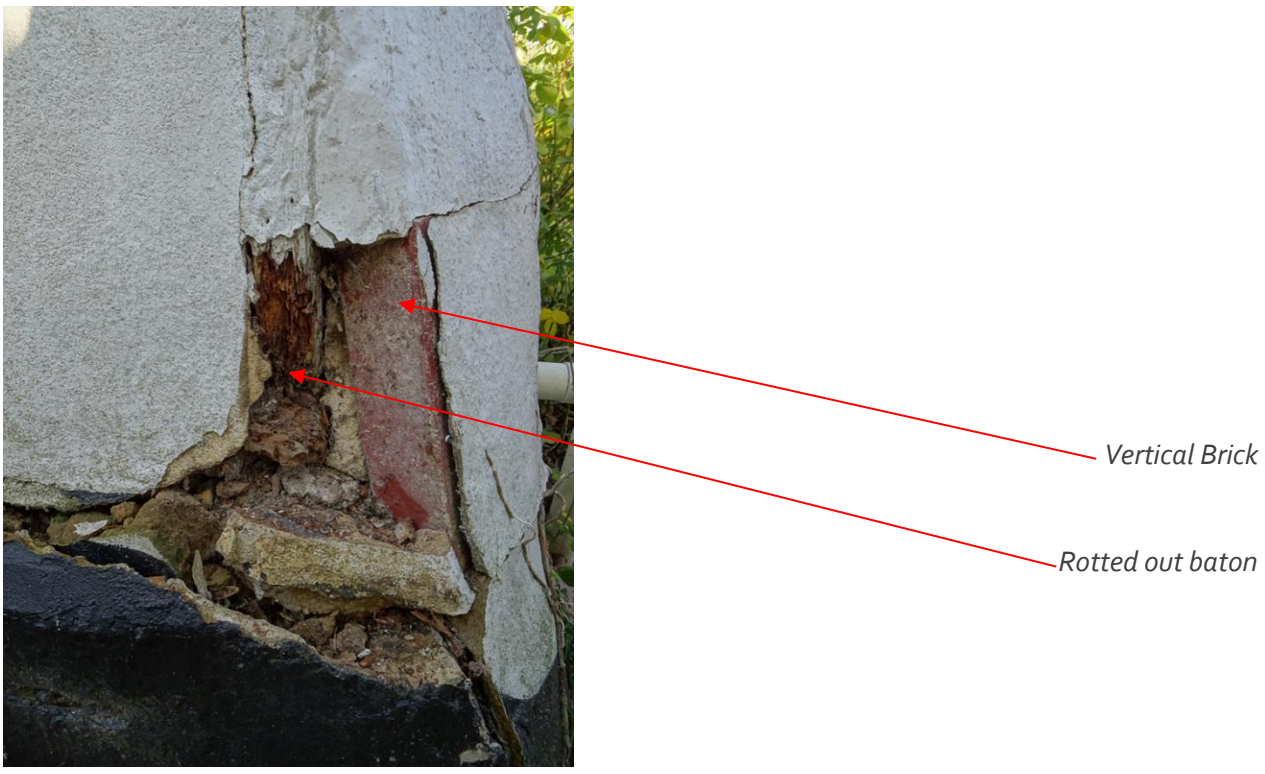


FIGURE 8 - SE CORNER

Outshot timbers either side of the front door

Unable to examine due to cementitious render covering and presence of supporting batons to secure EML at corners.

The exposed areas of support baton were examined and found to be in poor condition. Cracking was noted along the junctions of all the main timbers.

Outshot timbers above the front door

Much of the paint and surface covering was cracked in this area and exposed the large horizontal timber at eaves level. The junction of the outshot and eaves thatch was exposed with paint having blistered away from the structure to expose the timber. This was found to be rotted out from the corner of the outshot porch for a section towards the Southern Elevation for approximately 500mm.

This timber is believed to have been installed at the time of the outshot and is bolted through the wall and can be seen internally at staircase level. This was potentially installed to support the staircase so that it could be secured against the wall internally.



FIGURE 9 - OUTSHOT SUPPORT TIMBER



FIGURE 10 - AREA OF SIGNIFICANT DETERIORATION

The Buttresses

The buttresses were examined to ascertain if they were tied into the main structure.

Observations

Brickwork was found under the wall in the locations that were exposed. It was difficult to ascertain if a sill beam was above this due to the presence of the cementitious render.

Each buttress was found to extend under the property and was tied into brickwork adjacent to it, including that of the chimney.

The depth of the brickwork under the chimney was found to be approximately 150mm below ground level with the large central buttress extending further below ground and corbelled outwards to support its brick mass. The foundation for the chimney buttress continued for a minimum of an additional 300mm below the foundation of the chimney.

Concrete apron Western elevation

The depth of the concrete apron was examined to ascertain if it covered the sole plate.

Observations

The presence of the sole beam in this area was found to be at a higher level than the concrete apron. It was visually examined internally within the under stairs cupboard and found to be in sound condition at this point although water staining to the paint work at the location of the original front door indicates that there is moisture ingress at this point.

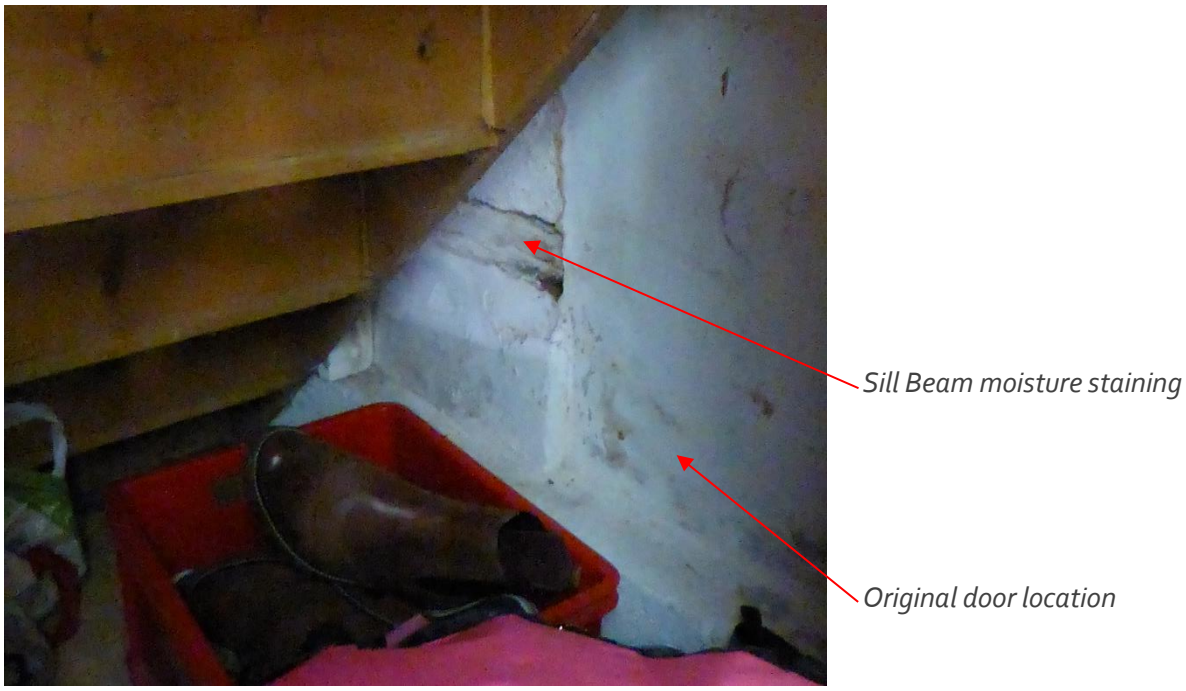


FIGURE 11 - LOCATION OF ORIGINAL FRONT DOOR SHOWING MOISTURE INGRESS

Pebbled area to the left of the front door

The pebbled area to the left of the front door was investigated to see if a French drain had been installed at this point.

Observations

The pebbled area was found to have been set in a cementitious material. A trial pit at the North-Western extremity of the pebbled area only revealed earthen material below. There was no evidence of a French drain being constructed at this location.

Conclusions

Whilst it was not possible to examine the main elements of the timber frame to the extent expected certain conclusions can be drawn from the information and observations.

The sill beam and plinth are in a poor condition both of which will have consequences to the overall structural integrity of the building.

The sill beam is either at ground level or slightly below. Moisture readings show that the timber is predominantly well above the required level for decay and infestation and where this does not have the ability to dry out thoroughly there is a risk of the total loss of elements of the frame if not addressed.

The sill beam of the Northern Elevation is showing significant signs of rot where exposed particularly towards the North-Eastern Corner and as far along to the early scarf joint.

The areas where it is presumed to be above ground level the sill beam was covered with hard cementitious render and could not be examined. This was also the case with the primary timbers. This said it is apparent that the battening used to secure the EML to the primary timbers is exposed and rotting out in a significant number of locations on each of the corners of the property, the outshot and return. As this is the case it can be assumed that a certain amount of moisture ingress has occurred along each of these corners, potentially creating an environment where decay and infestation will thrive.

The timber over the outshot was found to be substantially rotted. This might explain the cracking to the body of the outshot above where the timber is no longer able to assist in the support of the stairs.

The buttress foundations were found to have been installed under the original foundation and to a greater depth. This was particularly noticeable where the large central buttress was installed by the chimney where the foundations were observed as being only 150mm below ground level.

The buttresses at either end of the structure serve no purpose and are giving a false indication of the crack mechanism. These have been built against original wattle and daub walls and do not prevent the structure from moving. These are not tied into the structure by any other means than at the shallow foundation level. It is believed that structure is moving leaving the buttresses as built. This again would indicate that the timber frame hidden below the hard-cementitious render is in distress.

The differing foundation levels of the buttress and that of the chimney may in themselves cause cracking and differential movement in each of these areas. Having now assessed the crack mechanisms in relation to the condition of the visible elements of the timber frame, construction type and materials it is likely that the rotting out of the timber elements is influencing the displayed crack mechanisms. Whilst it is accepted that the Chimney, a large brick mass is possibly subject to clay shrinkage this is not the only factor involved. Although not entirely visible, enough information has been obtained to assess that the elements where rot is evident is potentially causing or exacerbating the cracking throughout the building resulting in the predominant lean towards the Northern elevation and the North East corner. This has been happening for some considerable time. It is probable that the frame has for some time been struggling to maintain equilibrium due to the defects which coupled with a very dry summer have been intensified and worsened by clay shrinkage under the chimney.

This is not a simple case and a holistic approach will be required to address the cracking to the brickwork and rotting of the timber elements.

Recommendations

- As a matter of some urgency it is suggested that all the hard-cementitious render, EML and batons are removed from the exterior and plinth and replaced with a breathable lime/clay-based material.

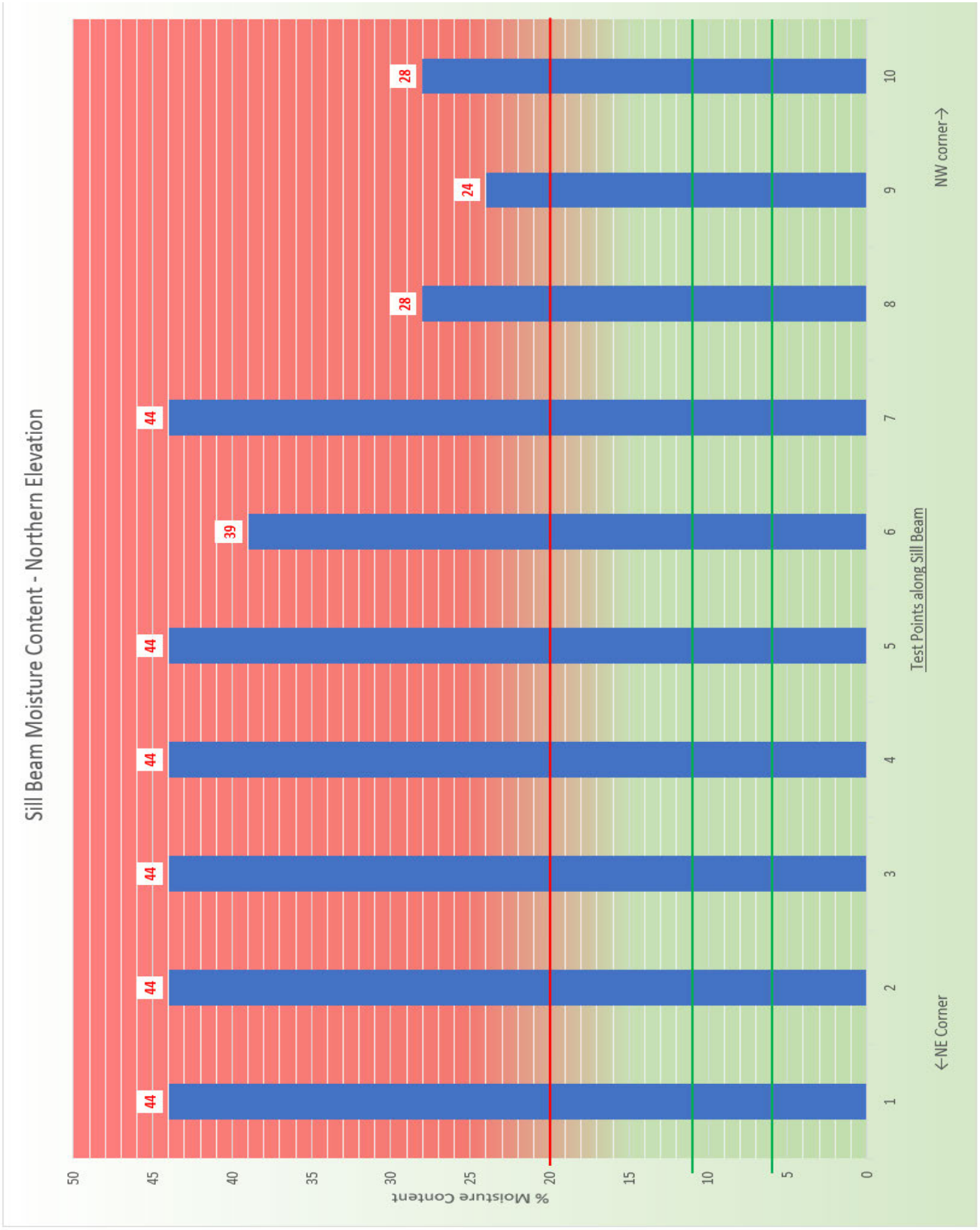
- Once the render has been removed the timber frame in its entirety can be assessed and recorded and repaired appropriately.

- As minimum a recommendation would be to repair or replace the sole beam on the Northern elevation and to repair/replace the timber above the outshot, this should be completed by a timber frame specialist who has experience in buildings of this type and age.

- It is advised that the foundations are examined carefully and repaired or replaced.

- It would be prudent due to the level and type of repairs to engage the local conservation officer at an early point in discussions as **Listed Building Consent will be required** prior to the undertaking of any of the recommendations.

Appendix A - moisture content graph of Northern elevation



Bibliography

Stevens, A. (2019). *SC19-124 - Church Farm Cottage - Site Survey.* Stress Uk Ltd. Retrieved November 17th, 2019