

Technical Note

Project: Forge Farm Barn Conversions
Subject: Structural Assessment
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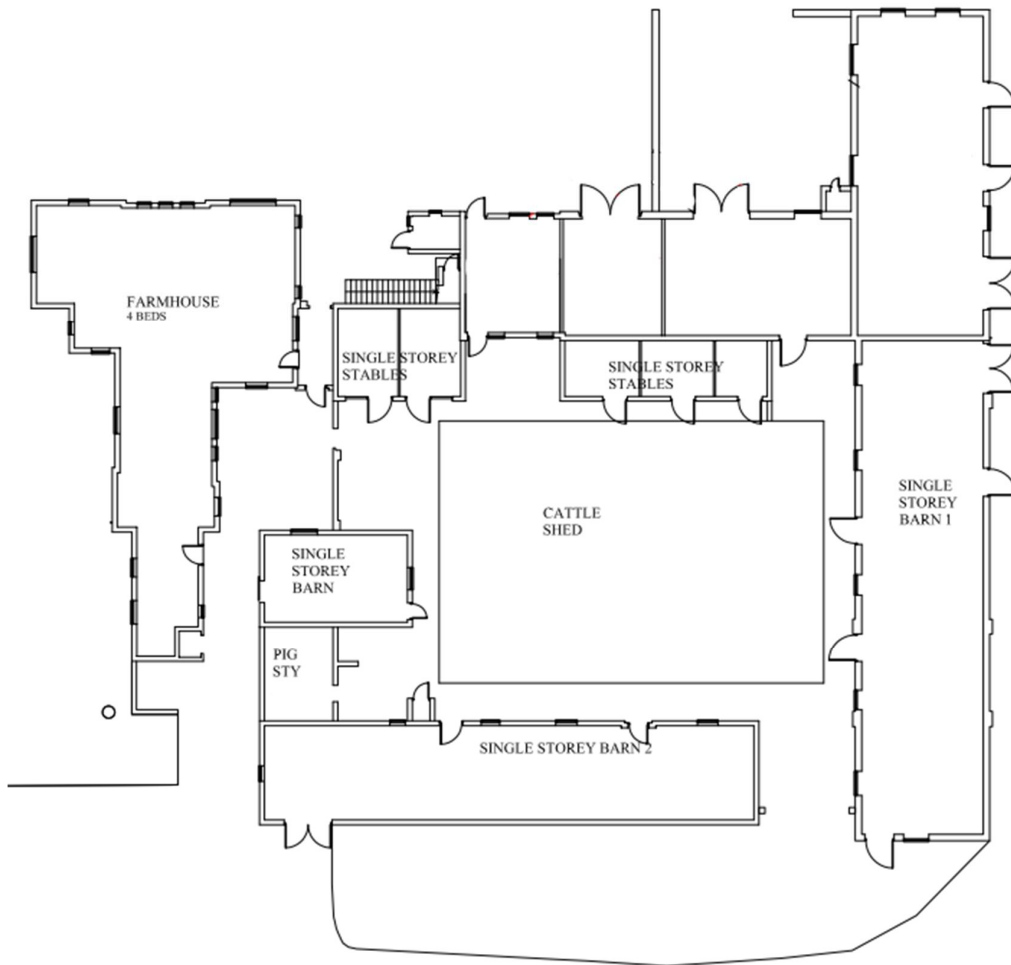
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Introduction

ECSL have been appointed to carry out a visual inspection of four existing barns that the client wishes to convert to dwellings. These four structures have recently been classified as having local heritage asset status. ECSL are therefore required to assess the present structural condition and propose suitable repairs or strengthening where appropriate, to suit the historic nature of the structures.

Based on mapping information, the structures are assumed to have been built between 1835 and 1880.

Currently the property has a 4-bedroom Farmhouse, several single storey stables and cattle shed all in present usage. The 3 storey Barn to the north side of the site, is in use at Ground floor level only, but upper levels are empty. The remaining barns to the east side of the site and the south are currently not in use.



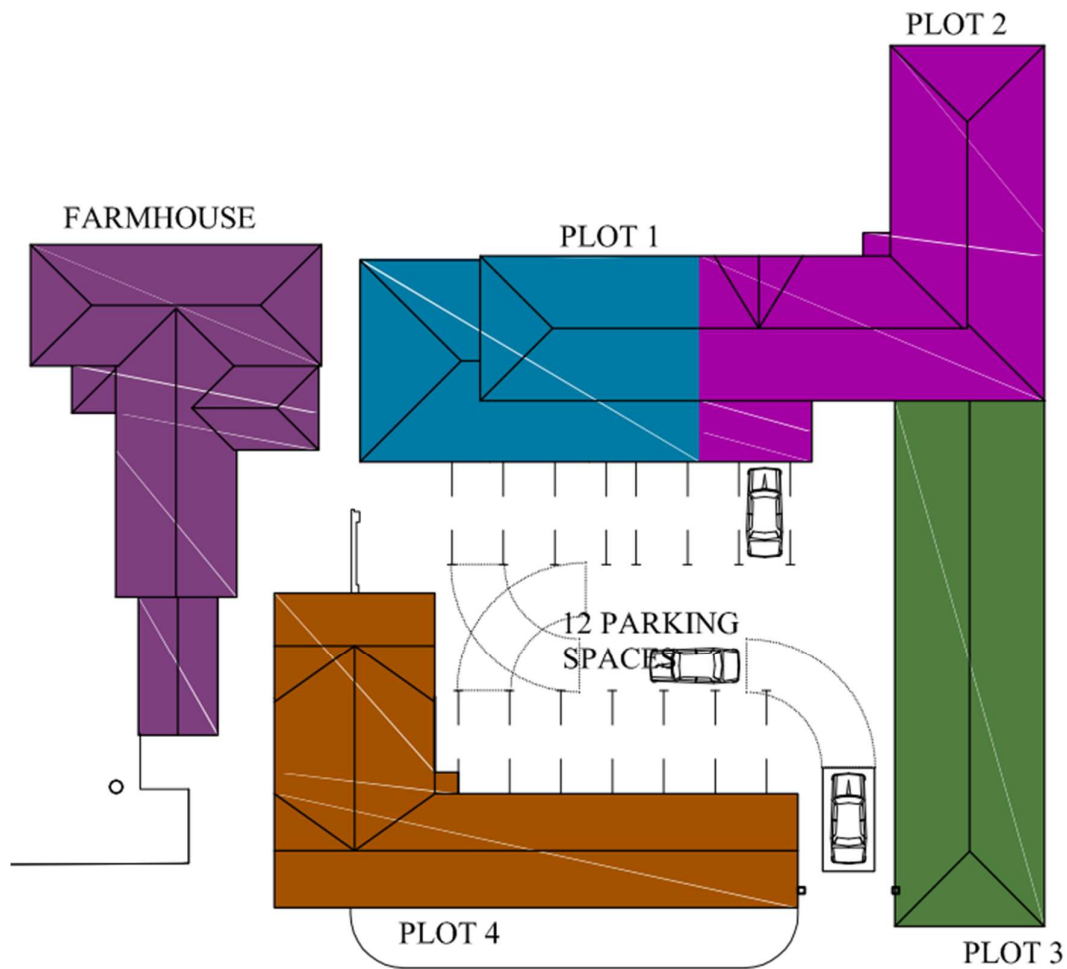
Existing Site Layout

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The Proposed plans are to convert the Existing barns into living dwellings, these barns will be split into four plots. The cattle shed will be demolished to make way for car parking for residents of the proposed plots and existing farmhouse.

Extensions to join existing parts of structure are currently proposed for Plot 1 and Plot 4. Plot 1 proposals show the single storey stables to be joined at ground floor level, with the rear of the stable to the left on plan being extended also. Plot 4 proposals show the adaption of the small barn and pig sty, with the pig sty being extended at ground floor level to create a link between the two areas.

Whilst the Farmhouse is currently being lived in, the rear of the property is empty and unoccupied. The current plans are to refurbish this area, to allow it to be used as part of the Farm House



Proposed Site Plan

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Survey

Single Storey Barns to form part of Plot 1:





The roof structure has a substantial number of missing tiles throughout, which has resulted in the structural timber being exposed to external weathering for some time. Whilst the timber trusses and purlin elements appear to be supporting what is left of the roof, without too much distortion, there are several members that have appeared to suffer from rot due to being

exposed for so long. There will undoubtedly also be wet rot issues that are uncovered once the existing tiles are lifted to repair the roof covering.

The plans for this area suggest that the internal walls are to be removed, to allow better flow to the dwelling. However, currently the internal masonry walls appear to be supporting the timber frames above. In their current condition, even if the bottom cords are supported off the external walls, it would be unlikely that these frames would be suitable to support the existing roof structure once repaired.

The roof Structure in this area will need to be replaced with a suitable timber frame arrangement, with supporting purlin over, to replicate the existing arrangement.

Once the roof tiles have been removed the condition of the existing timber from above can be assessed in more detail. There may be rafters, etc that can be reused for the roof repair, which would be beneficial to the historic repair required.



The brickwork looked to be in reasonable condition, there are brickwork faces that have blown away, and some loose mortar in places. We would suggest all loose mortar be removed from the walls and repointed. Where excessive brickwork damage to faces has occurred, these bricks should be replaced with suitable replacement bricks to suit the existing brickwork era. Although no cracks were noted, it would typically be advised that any cracks be assessed individually for issues. In some cases there may be a requirement to add brickwork reinforcement into the mortar repair to restrain the wall from further cracking, or to add additional strength back to the existing cracked wall. Typically, this would be done using a helifix crack stitching HeliBar installed to manufacturer's guidance to suit the wall construction and character of the structure.

Parts of the stables have been adapted over the years, with the addition of Blockwork infill panels between larger openings. It is unlikely that these would have any historic structural

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requirements, however, the existing timber lintels will need to be assess once properly uncovered. It is likely that these will need replacing to suit the proposed plans to have these openings restored, to house glazed windows/screens. In the event these lintels need replacing, they will need to be replaced for a like for like timber lintel, designed to current standards and loadings for the proposals.



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Main 3 Storey Barn to form plot 1





First Floor Timber floor structure over proposed dining area has been subject to moisture and condensation, there are signs of rot in places, but overall condition is difficult to determine with painted finish over.

Client is currently assessing floor levels in this structure to provide a more even distribution across the 3 storeys for the final design, therefore this floor structure may need to be lowered to achieve this.

It would be advised that the main floor beam and joist are stripped back to good material and reused if possible. The beam and floor joist appear to be oversized for the loading that will be applied in the domestic usage proposed. So, there will be some tolerance to remove material. This should be reassessed by the structural engineer appointed to carry out any structural designs required. A minimum joist size should be calculated.

As the existing joist is quite deep in this area, the designers should note that existing window levels in areas are already close to the underside of the joist, so careful planning in this area may be required, along with possibly assess window requirements.

The main floor beam across the middle of the floor joist spans is also bearing onto a masonry thickening in the wall. If this element were to be lowered to allow the floor levels to be reduced, the bearing of the beam would need to be reviewed by the structural engineer.



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Lintels over existing windows have been formed using both Brickwork and timber in places. Where brickwork has been used, there does not seem to be any structural issues, or cracking that would look to be a potential future issue.

Timber lintels in places look to be structurally sound, whereas in other areas rot has taken affect and these would need to be replaced with a like for like replacement. Some internal lintels were not accessible at the time of visit, it is suggested each lintel is assessed individually once the works begin onsite.





Large arched opening to the rear of plot 1, is generally in good condition, with no signs of cracking to suggest movement or future issues. However, there is a single brick at the head of the arch that is missing a large section of material. It is advisable that this is repaired at the time of the conversion to ensure no future issues arise. It is likely that this brick will continue to

decay and collapse of the first string of bricks in the arch may occur. This would need to be done by an experienced masonry craftsman with experience of working with arched brickwork. Temporary propping will be required to provide support once the damaged brick is removed.

There are a few areas of brickwork above the arch with blown faces and missing mortar. Where excessive amounts of material are missing, or several bricks in close proximity are damaged, these bricks should be replaced with bricks to suit the age of the structure. It would also be advised to clean out the joints of any loose mortar between brickwork where loose and damaged and repoint to suit the rest of the structure.



The first-floor joist over the proposed lounge area appears to be in very good condition throughout, with no visible issues noted from the underside. As noted previously, this floor may need to be lowered to accommodate floor level adjustments to suit the proposed usage. In this case these joists should be able to be reused.





At first floor level the floorboards below generally look to be in good condition. However, there are some areas of damaged boards that will need to be lifted and replaced with new items. On removing damaged boards, the top of the joist below should be further assessed

to check for further damage and rot. If rot is found in these locations, it may be a good option to lift further boards to inspect the joist below beyond the damaged areas. From the views below, the area above the proposed dining area may be the worst affected, with the joist above the proposed lounge looking to be in much better condition, and most likely replaced at some point not too long ago.

Floor joist and beams over the first-floor level forming the second floor, look to be in good condition, with no visible signs of rot or damage from the underside.

Timber lintels also seem to be in good overall condition, however, once works begin and the areas cleaned, these elements should be inspected further to ensure their condition is as appears.

Brickwork internal also seems to be in good condition, with only minor areas showing damage/blown brickwork faces. However, once works begins and the walls are cleaned up, if any issues are uncovered these areas will require further assessment.



At second floor level, there are visible loose/cracked brickwork around timber roof rafters, these should be replaced with suitable bricks, noting that brickwork sizing is typically larger than current standard brickwork sizing in the UK, therefore traditional brickwork units will need to be sources where spare bricks from the property cannot be found or reused for the repair.



Typically, the Roof trusses seem to be in good condition, once works on site begin, these should be cleaned down and double checked for damp, rot and any damage not visible from below. If damaged areas are found in isolation, these may still be able to be used in the final build, however they will need to be checked individually with structural calculations to assess minimum structural capacity is still achieved for the applied roof loadings.



There appears to be concrete lintels over some windows and no lintels over others. The concrete lintels are not from the original build, so will have been added, most likely due to masonry movement over the window openings. Whilst no cracking or movement was noticed in these areas, it may occur later in the building life and if lintels can not be added for historic heritage reasons, then alternative measure may be worth investigating to ensure

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later issues do not occur. Helifix HeliBar or similar masonry bed joint reinforcement can be utilised here. This works well with the additional strengthening being hidden from view and keeping appearances as close to existing as possible.

The timber window frames will be providing support in the current form. However, with more frequent opening of windows, once the dwelling is in use, the strengthening over the window should be reviewed to ensure future issues do not arise where lintels are not present.



Roof covering missing throughout the roof structure, these would need to be replaced. With the extent of missing tiles and movement of tiles, along with rot and damage to binder timbers. It would be best to completely relay the roof coverings. This would also allow further inspection of the roof timber rafters, purlins and trusses from the top, where water damage/rot is most likely to occur.

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Main 3 Storey Barn to form Plot 2



Generally, the Roof structure in this area is as noted for Plots 1, as currently it is the same building with no separation, therefore all points noted for that area are also relevant for plot 2. However, where the existing Dormer/hipped roof extension is present, there is Rot present

to all timber members forming the valleys on both sides of the dormer. These elements would need to be replaced in full with like for like timber elements. Whilst the area is uncovered, it would also be advisable to assess all other timber elements uncovered to better assess for rot, damp, or any other invisible damage from below.



Areas of damage to Floorboards. These will need to be replaced with like for like boards. Whilst removing boards, joist under to be further assessed for damage.

Where holes in the roof structure have formed it is typical for the floors directly below to be the worst affected. This can transfer all the way down to the ground floor level. Therefore once works begin and the structure is cleaned up and starting to be stripped. It is advisable to review holes and the areas directly below them for further damage from water and weather.





Existing farming structure and trap door within floor at second floor level is to be removed and infilled with new floor joist and boarding to structural engineer's design, and to suit existing floor structure around. Existing timber floor trimmers forming the holes, should be checked for the new loading to ensure structurally sound. All joints and connections should be reviewed on site also to ensure these are adequate and meet required standards.

Masonry condition in these areas is consistent with that noted for plot 1 assessments. Therefore, recommended further works and assessment are expected to be as required for plot 1 throughout Plot 2 also.





Masonry condition within the barn to the north east of the site, forming plot 2 is generally in good condition structurally. However, there are a few areas that will require repair. Firstly, the area above the door pictured above to the east elevation has substantial cracking, over it and up to roof level around the masonry pier. Has there does not seem to be any movement around the door or arched frame around the door, this is likely to have been caused by water ingress and frost. The timber wall plate has also shown signs of movement. There does not appear to be any visible cracking from the outside elevation, so appears to be internally only. The repair for this area would require all loose material to be removed. Helifix HeliBar or similar bed joint reinforcement would be recommended to ensure additional strengthening within the joints and ensure good key to the existing brickwork. This would need to be undertaken with care over the arched brickwork opening to ensure it does not collapse. Further temporary propping may be required if brickwork needs to be removed and rebuilt on closer inspection.

Similarly, the masonry on the west elevation where the roof valley meets the wall plate, there are several loose bricks that would need to be cleaned up and re-laid. A section of wall plate in this area is rotten, therefore this should also be replaced for a like for like timber section. Careful consideration between engineer and builder should be undertaken to ensure the correct length of wall plate be replaced, to ensure further parts of the roof are not affected.

Cracking to the window directly below this area is likely due to trapped water and frost. Cracking is generally small. As noted previously the repair here would be Helifix Helibar crack stitching and repointing.



Roof structure substantially damaged in this area. All roof rafters, binders, purlins, coverings etc will need to be replaced with like for like timbers, designed and specified by appointed structural engineer.

The King Post truss looks to have minimal damage but is likely to be damp due to the exposure, therefore further assessments will need to be done to check the condition once access is available. Visually, there is a missing member to the truss internally and as shown in the picture there are signs of damp on the surface. It is likely that some of this truss may need to be replaced to unsure it can support the new roof over. But many of the existing timbers in the truss look to be solid from this view.

All timbers forming the valley in the roof will need to be replaced, this includes binders, joist and purlins. It is unclear if the remaining timbers on either side of the hole can be reused, as the collapse of this section of roof will have likely caused damage to any timbers not already rotten.



Timber Floor is generally structurally sound, however, directly below the hole in the roof, the floor structure is severely rot damaged, and will need to be stripped to assess the extent and replaced like for like.



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Adjacent to the large area of rotten floor timber is an existing opening within the floor with timber structures used as part of the old farm. This will need to be completely removed and replaced with new flooring to match the existing. Note that the column and beam structure currently supporting the first-floor structure stops at this point. The support of the new proposed floor joist in this area will need to be assessed by the Structural engineer for the new layout and loadings. With potentially new beams/support required.



Typically, Lintels in this section of the property seem to be structurally sound. However, the timber lintel over the window above is rotten and will need to be replaced. It is possible that this lintel may have caused some of the cracking through movement to the wall above, but is unlikely to be the main cause.

The lintel will need to be replaced with a suitable lintel designed by the structural engineer to support the floor joist loadings over. This should ideally be a like for like timber lintel to match the existing structure.

Single Storey Barn to form Plot 3



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Roof severely damaged and rotten where adjoined to plot 2 elevation. Roof structure to be completely replaced in this area to replicate the existing roof throughout plot 3. Structural support to purlins from plot 2 party/external wall.

Masonry adjoining plot 2 wall also damaged and not fully connected to wall to provide adequate restraint. Most of the issues seem to be internally, as from the outside view of this area the masonry does not seem to be damaged or cracking. Therefore, removing loose bricks and mortar and rebuilding should be adequate. In the event more than 20% of the height of the wall needs to be removed, it would be advised to also install some form of masonry tie within the mortar joint to provide additional fixity between the two walls.



Existing Timber lintel showing signs of rot. This will need to be replaced with a suitably sized timber lintel to support the roof structure over. Also note missing mortar joints and potentially loose brickwork to either side at the top of the opening. All loose material to be removed and rebuilt and pointed.



Roof within main area of plot 3 has substantial number of holes within the roof covering, causing issues with purlins, joist, and trusses where directly exposed and beyond in some cases. Most noticeable area is pictures above where the bottom chord of the king post truss has rotted all the way through and broke into two sections. This has most likely also caused the internal member to become disjointed. This truss will need to be replaced with a like for like replacement, designed for the proposed loadings by the structural engineer. Roof purlin and rafters in this area will also need to be completely replaced were rotten.

From a visual inspection from Ground level the remaining king trusses seem fine, with only minor defects, however, these would need to be reassessed once the roof covering is removed to ensure there is not any damp, rot or hidden damage from above.

Some minor removal of rotten material may be acceptable in the final build, but further assessment will need to be carried out by the structural engineer, to ensure a minimum cross-sectional area of each member of the truss is calculated for the proposed loading.

Due to the failure of the bottom chord member of the above truss. The external wall to the west elevation has been pushed out substantially. Due to the level of movement and cracking along the middle of the wall in this area, we would suggest carefully removing the brickwork along the affected area, to allow it to be rebuilt using the existing masonry as much as possible. This will ensure no future issue with movement once the roof structure is repaired.



Elsewhere there are several areas of loose brickwork and missing mortar, mostly at the head of the wall in areas supporting the roof trusses. These areas should have any loose elements removed and cleaned up to allow them to be reused in the reconstruction of the wall and pointed afterwards.

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Single Storey Barn to form Plot 4







The roof in plot 4 is in the worst condition overall, with much of the roof missing coverings. Several of the king post trusses have severe rot and will need to be replaced. Purlins member between trusses in several areas are also rotten, along with roof rafters and binders. Once the roof covering is fully removed the king post trusses that appear ok from ground level can be properly checked for rot, damp, and damage. Where the damaged timber trusses are found, king post trusses replicating the existing trusses would be ideally used, potentially where possible reusing existing timber that remain in usable condition.

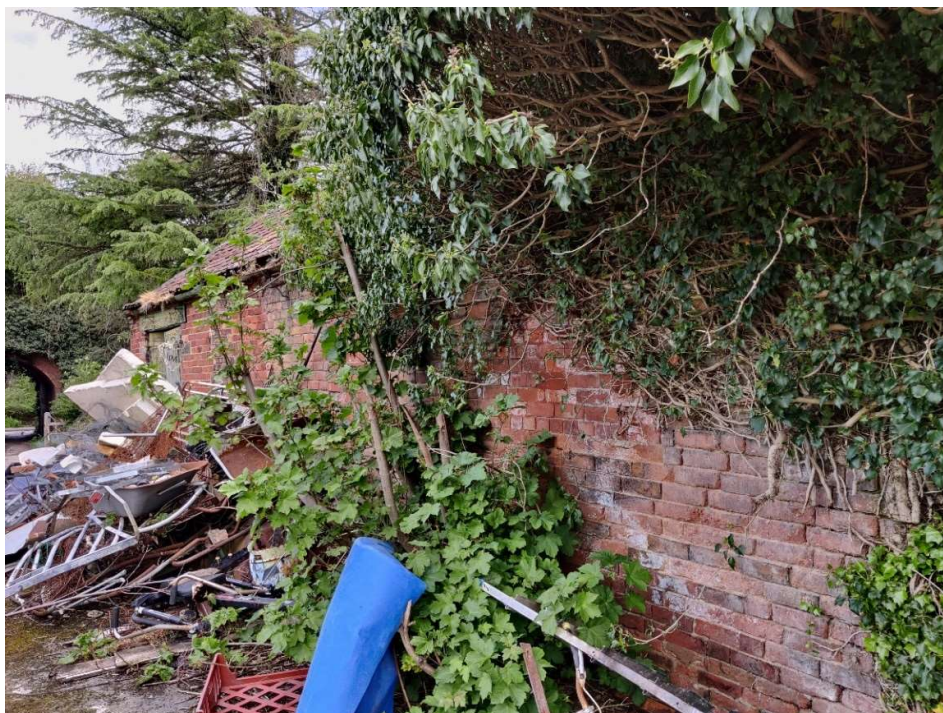
Due to the damage to the roof structure, movement has occurred at the head of some of the walls causing brickwork to become loose and leaning. Where this is the case, all leaning and damaged brickwork is to be carefully removed and rebuilt using the existing brickwork wherever possible. It is also likely that the timber wall plates will also need to be replaced due to rot throughout.

Masonry internally below the top section of walls, does not look substantially damaged. However, there are lot of obstructions, including tree roots growing around the wall that have likely caused damaged. All growth will need to be fully removed from the wall to allow proper inspection. It is highly likely that some rebuilding will need to be undertaken, and at a minimum repair of loose bricks and pointing. In this case the existing brickwork should be reused wherever possible.

Timber lintels to several windows are also rotten and will need to be replaced with similar timber lintel ideally, to structural engineer's design to suit new loading requirements.



External Brickwork visible beyond the tree growth will require repair in places. Most noticeably the southeast corner of the structure where there are several missing bricks that would need to be rebuilt. Brickwork with Blown faces generally will need to be replaced where excessive, as shown in the picture above. Several areas of the wall require repointing, loose material should be removed where found.



Vegetation to south face of plot 4 is extensive, as noted for the internal assessment, damage is difficult to determine without the removal of vegetation. But it is very likely that at least loose bricks, minor cracking, and missing mortar will be present. This should be repaired where possible using the existing brickwork, and repointed. Any excessive cracks should be repaired using Helifix HeliBar as noted previously. If walls have been caused to lean up to approx. 100mm (assuming wall thickness of 225mm), then it is also likely that the wall will need to be rebuilt in these places to ensure future structural stability is maintained.



Existing wall to rear of Pig Sty is leaning. If this is less than 100mm, assuming a 225mm thick wall. Then it may be possible to strengthen the wall using Helifix HeliBar or similar bed joint reinforcement within the mortar and then repointed. However, as this wall is to form part of the plot 4 structure, and supporting of the new roof over. It would be a better option to rebuild using the existing brickwork. All vegetation will need to be removed.

It would also be advisable that the foundations of this wall be assessed before applying vertical loadings, as part of the proposed plans for this area.



Cracking to external side of barn north of pig sty. Internal face not visible due to plaster or similar finish. However, if cracking was present internally it would likely have also cracked this finish. Therefore, suggest crack repair using Helifix HeliBar as previously and repointing to external side only. All vegetation to be removed and wall to be rechecked for further hidden damage.



Roof within barn has been covered with timber throughout. However, daylight is present through the joint that suggest the roof construction over is in similar condition to the other barns. Where there is an access hole it is visible that there are holes within the roof covering and will therefore require further work. Once the timber finish is removed, measures similar to

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that pointed out elsewhere on the site should be adopted. If in doubt, then a structural engineer should be appointed to review further and advise.

General considerations

Brickwork:

- Loose brickwork should be removed and rebuilt to ensure structural stability throughout.
- Loose mortar to be removed and repointed, ensuring brickwork surround is not loose before repair.
- Where brickwork is cracking it is advised to install some form of reinforcement or crack stitching. Typically, this would be Helifix HeliBar installed to manufacturers guidance and specification. This can also be used over openings to create lintels or further strength to stop cracking or movement where required.
- Blown faces of brickwork is typically a sign of frost damage, where this has caused several bricks to be damaged in one area, the bricks should be replaced.
- Stainless steel masonry ties should be provided where masonry is butted up to masonry to provide key and structural restraint.
- Leaning walls of up to 50% of their thickness, can sometimes be maintained, but where vertical roof loadings are to be applied over, it is advised that this percentage be reduced to 25%. In the case of plot 3 where cracking has occurred, this would almost always require a rebuild of this section of wall.
- Lime mortar is typical of this age of structure, along with historic bricks which differ in dimensions and construction. The use of non-historic bricks and cement mortar will cause issues to existing walls, and most likely is the cause of blown brickwork faces in some areas if they have been repointed using cement previously. The use of cement mortar also causes issue with the breathability of the wall, therefore if any sections of the wall look to have cement mortar in place this should be removed and replaced with cement mortar.

Lintels:

- Timber lintels should typically be replaced where existing lintels are showing signs of rot and deflection. Usually, a lintel the same size as the existing is adequate, however, this should be checked/checked by the structural engineer to ensure loadings do not exceed the capacity of the replacement lintel.
- Where cracking over arched brickwork openings or no lintels are present and there are signs of movement, it is advised that additional structural support is provided. Helifix provide a masonry strengthening system that allows HeliBar's to be inserted into the existing wall to provide additional structural support and provide repair.

Floors:

- Timber Floor joist typically look to be in good condition throughout, however where floorboards are damaged it is highly advised that the timbers are assessed from the top to ensure hidden issues are not present.
- Where areas have been susceptible to water ingress, through damage to roof coverings, the areas below should be inspected to ensure no hidden rot below floorboards.
- Where infilling of floor structure is required, the existing trimming joist should be checked by a structural engineer to ensure they have structural capacity for the new loadings applied.

- Closer inspection of joist ends at bearing points should be carried out once work begins and visibility is better to assess joist for damp, rot, or damage. Where water ingress as occurred from damaged openings above, or water have entered through cracks in the masonry, rot is commonly an issue, and joist should be replaced.

Roof Structure:

- Roof covering to be repaired with suitable replacements to match existing tiles.
- Where there are extensive holes in the roof coverings, it is advised that large sections of the tiles be removed, so that the condition of the timbers under can be properly assessed, and roof coverings can be reapplied to properly integrate with existing tiles.
- Timber Purlins, joist and binders should be replaced with like for like timbers to suit existing when found to be excessively damp, rotten, or damaged. However, to ensure no future issues, it is also advised that a structural engineer checks the existing size is adequate for current standards where appropriate.
- King post trusses are noted as being an import feature of the structure, therefore it is important that these elements of the structure can remain wherever possible. Where damage is severe, it is usually best to install new trusses to replicate the existing. Hopefully, in most causes only individual elements will need replacement. Assessment should however be carried out to determine the minimum cross section sizes of each type of king post truss, this will help determine whether loss of bad material can be accommodated, or whether whole sections need to be replaced.