

# Laneside Barn, Grindleton – Structural Inspection for Planning

**Version:** 1.0

**Description:** For client and planning approval

## Summary

An inspection of the traditional masonry field barn located close to the intersection of the Grindleton Road and Green Lane, Grindleton was performed by Richard Lines C.Eng, MIStructE on the 23<sup>rd</sup> of August 2024.



*Figure 1: Laneside barn, Grindleton.*

The barn is suited to conversion, subject to the following recommendations:

- Timely backfilling of the slurry lagoon with free draining granular material, well compacted in layers. Consideration should be given to whether to provide drainage to the lagoon to prevent a buildup of water here.
- Formal drainage should be provided around the shallow original barn foundations and guttering at roof level.
- Installation of a modern concrete ground floor structure.
- Demolition and rebuilding of Extension 1 and WP7 from suitable foundations.
- Any small areas of damaged or excessively deformed masonry should be rebuilt during works.
- Formal tying of any unsupported masonry panels at their abutment to adjacent masonry panels.
- Cosmetic 'repair' of cracks in masonry and a full repointing with a suitable lime mortar to maintain the weatherproof envelope.

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- Replacement of the missing quoin stone at the northwestern corner.
- All timber lintels should be replaced with durable modern steel or concrete units. All stone heads to be retained should be inspected and replaced where necessary. Long span stone heads should be supported by other means.
- Installation of a suitably detailed first floor plate, capable of tying and restraining all connected masonry panels in both principal directions.
- Checks on all roof timbers which are to be re-used (if any) to include a thorough inspection for infestation and decay and verification by calculation for their capacity to bear the proposed new loads.
- The first-floor level doorway adjacent to the masonry arch in WP3 (southern elevation) should be blocked up with tooth bonded masonry, and the lintel below replaced. Temporary stability should be maintained with horizontal and vertical propping at the doorway during any masonry works locally to resist the horizontal arch thrust during works.

This inspection was concerned only with the structural aspects that were visible at the time. The structure was not dismantled, and it is assumed that the aspects visible were representative of the rest of the structure.

Any recommendations that are made are from the point of view of the author on the potential for conversion from a structural perspective and does not make any conclusion on the economics of conversion or the likelihood of the proposals achieving planning permission or meeting current building regulations.

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## 1.0 Site Observations and Layout

The inspection described in this report was carried out on a blustery day with variable sunshine, cloud and rain showers by Richard Lines C.Eng, MIStructE on the 23<sup>rd</sup> of August 2024.

The barn is situated directly to the side of the Grindleton Road at the junction with Green Lane. The barn is situated on a generally flat site with the footprint of the barn broadly on the same level throughout.

No large-scale drainage or geotechnical issues were apparent during the inspection. Localised drainage issues were noted, generally relating to the significant discharge of rainwater from the large roof slopes onto the soils at the shallow foundations, notable at the eastern end of WP7.

According to the British Geological Survey, the local bedrock geology is that of the 'CLITHEROE LIMESTONE FORMATION AND HODDER MUDSTONE FORMATION (UNDIFFERENTIATED) – MUDSTONE' formation which is consistent with our observations of the materials used to construct the masonry walls. The BGS geology viewer indicates 'RIVER TERRACE DEPOSITS, 1 - SAND AND GRAVEL' as the superficial deposits.

Reference to the main barn and additional extensions are made in this report according to the definitions made in Figure 2.

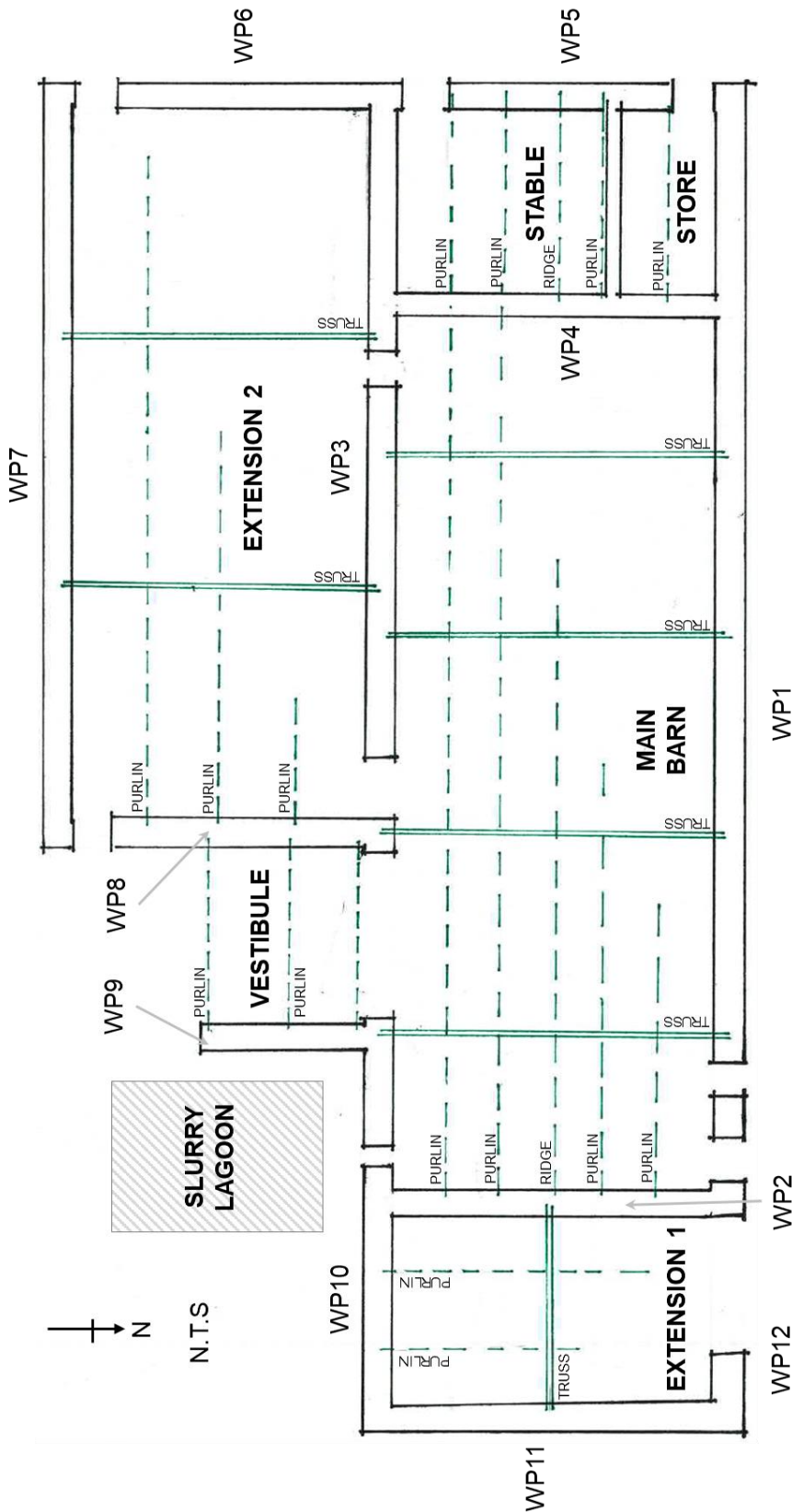


Figure 2: Site layout and nomenclature of the main barn and additional structures.

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## **2.0 Roof**

### **2.1 Main Barn**

The roof to the Main Barn is a typical provision of heavy stone flags (south slope) and concrete tiles (north slope) on timber battens, supported by timber common rafters, two timber purlins per slope, and four timber queen-post type trusses.

The trusses are typically constructed from hewn tree limbs, rather than (relatively) modern sawn timbers. The truss closest to the eastern gable has been repaired with additional steel straps and timbers.

The purlins are a similar assortment of (assumed) original hewn tree limbs, some of which have been repaired with (relatively) modern sawn timbers.

The roof has a visibly undulating profile when viewed from the outside and several flags are missing. Internally the missing flags have allowed water to penetrate the building envelope, causing isolated areas of decay to the exposed structure below.

It is understood that the roof is to be replaced as part of the proposed works and we feel that this is a necessary intervention as the existing roof is unlikely to have sufficient capacity to support a modern roof buildup and maintain stiffness to protect the various brittle finishes under future deflections. That said, some elements of the roof structure are functioning adequately, and may be retained subject to a thorough inspection for infestation and decay and verification by calculation for their capacity to bear the proposed new loads.

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*Figure 3: The roof from inside the Main Barn, viewed from the west (image left) and viewed from the east (image right).*

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*Figure 4: The roof over the Main Barn viewed from the south – covered with stone flags.*



*Figure 5: The roof over the Main Barn viewed from the north – covered with concrete tiles.*

## 2.2 Extension 1

The roof to Extension 1 is a concrete tile covering supported on timber common rafters and two purlins on the mono-pitch roof.

The purlins are supported by a single 'half-truss' at the roof's mid-span. The half truss has had some later strengthening works and is currently propped at the western end. Closer inspection suggests that this propping is due to concern over the supporting masonry and timber lintel rather than the strength of the truss.

The rafters are modern sawn timber, and a membrane has also been provided under the concrete tiles.

Overall, the roof structure for Extension 1 appears to be functioning adequately and exhibits no signs of distress under current loading conditions.



*Figure 6: The roof from inside Extension 1, noting the prop to the truss at WP 11.*



*Figure 7: The roof on Extension 1, external view.*

### **2.3 Stable and Store**

The roof over the Stable and Store is a continuation of the concrete tile / heavy stone flags (depending on the slope aspect) on timber rafters observed on the main barn.

The timber common rafters have been supported internally on two substantial hewn / reclaimed timber purlins on each slope, and another similar at the ridge. The ridge beam and purlins span between the western gable and the internal partition wall.

In addition to the ridge beam, an additional, newer sawn timber ridge has been provided, with timber packing to each rafter above. External inspection indicates that the original ridge may not have been set at a high enough level to maintain continuity of the ridge line following a potential re-roofing, or not necessarily on the same line as the ridge to the main barn.

This newer ridge does not benefit from a bearing at the masonry gable and partition walls, but instead has been supported by a collection of timbers which themselves are supported by the two purlins (one on each slope). The common rafters on the southern slope are supported at the ridge by this beam via a prop at each rafter.

The current arrangement is not a satisfactory means of supporting the roof for a domestic structure and the roof should be replaced accordingly. In addition, the roof timbers have sustained some water damage / decay and therefore we recommend that the roof in this area is replaced during works.



*Figure 8: The new ridge, supported by various props and two boards spanning between the two upper purlins.*



*Figure 9: Separation of the ridge and the rafters below over the Stable / Store areas. note the large fillet of mortar which has become detached and was presumably used to fill the gap.*

## **2.4 Extension 2**

The roof over Extension 2 is a continuation of the southern slope of the main barn and the same heavy flags on timber battens, common rafters and three sawn timber purlins per slope are present.

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The timber purlins are supported by two substantial 'half trusses' which have been constructed from a combination of sawn and hewn timbers.

Some smaller beams are also present between the trusses, and these form part of the former first floor structure and also provide top support to the boskin construction which are not related to the roof structure.

The structural timbers have been exposed to rain coming through the various holes in the roof and have become decayed. The extent of this decay is generally superficial, but more serious in isolated locations such as the eastern 'gable', lower purlin where a pen was able to penetrate easily into the wet, rotten timber.

The trusses are substantial and may justify being retained if there is motivation. We recommend that any timber to be retained is inspected during works and also verified by calculation for their capacity to bear loads associated with a modern roof buildup.



Figure 10: Typical internal view of the roof structure in Extension 2.



*Figure 11: High quality structural joinery using tusk tenons to connect the purlins at the trusses.*



*Figure 12: Example of superficial decay under holes in the roof.*



*Figure 13: Example of heavy decay of a purlin at the eastern gable, note the embedded pen.*

## **2.5 Vestibule**

The vestibule roof was supported from three sawn timber purlins. No signs of distress were present at the time of the inspection.

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## **3.0 Walls**

### **3.1 General comments**

The walls to the Main Barn and the extensions are typically approx. 500mm thick, constructed from a coursed mix of limestone / sandstone / mudstone / slate rubble (assumed to be) in two solid leaves with a loose rubble core. The stones are bedded in lime mortar and substantial dressed gritstone quoins have been installed at the external corners. Through stones are visible in limited locations, although it is likely that the ends of the through stones were dressed in the other locations, concealing their presence.

The masonry is generally plumb and straight for a structure of this age and nature. Some exceptions were noted which are described in the following sub-sections.

Generally, the stone lintels present were in sound condition and adequately supporting their current loads. The timber lintels where present were in a mixed condition and should all be replaced with durable steel or concrete units during conversion.

### **3.2 Structural intervention**

Two steel tie rods bearing against steel pattress plates have been installed at the western end of the structure, restraining WP 1 and WP 3 against outward progression.

A render / plaster finish has been placed in the storeroom, likely at a similar time as the tie rods and plates. In addition, the western gable has been liberally repointed with a strong cement mortar. Neither of these brittle finishes have suffered excessive cracking, indicating that the tie rods have largely halted the outward movement of the front elevation (WP1) at this corner location.

We recommend that a suitably detailed timber floor structure is installed which can provide restraint to these masonry panels in both orthogonal directions during works to assist these interventions into the future.

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*Figure 14: Steel parrass plates in WP 3 (image left) and WP1 (image right)*



*Figure 15: Steel tie rods connecting the two steel patten plates. Western gable beyond.*

### **3.3 Main Barn**

#### WP1

WP1 is the northern elevation of the Main Barn, adjacent to the road. The panel has a widened base and wider flag stones are visible at the existing ground level which are believed to be the foundations of the panel.

Externally, the panel is broadly plumb at its eastern end, and is more deformed at its western end. Internally, the wall is deformed inwards at the bearings of trusses three and four. This apparent inward lean is confirmed as an outward bellying at mid height by the separation at the partition and comparisons to a plumb laser externally.

Several areas of masonry have become damaged as a result of water leaking from the plastic guttering. These areas of masonry have become deformed and should be rebuilt locally during works.

The western corner features a door opening into the storeroom which has no buttressing return. The masonry above is cracked and therefore cannot resist any tensile forces, effectively rendering WP1 free and unsupported at this end.

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Subsequent interventions at the western end (see separate sub-section) have served to restrain the wall from further movement.

The maximum excursion from plumb was estimated as 80mm at the internal partition and 100mm at Truss 4. Considering the restraint provided by the roof and the proposal for a new first floor structure, we believe this is within stable limits if the first-floor structure is properly detailed to tie the masonry panels together.

WP1 has three openings, a window, a personnel door and the main arched 'cart door'. The two smaller openings have stone lintels which appear to be functioning adequately under current loading and may be retained in future plans. The inner lintels are all timber which should be replaced with a durable steel or concrete unit during works.

The arch is in good condition, with a stone masonry arch supporting the outer leaf, which has shown no signs of movement or distress. The vertical joints either side of the keystone are partially dry and should be repointed during works. The inner lintel is an oak bough, selected to follow the arch shape and appears to be functioning adequately under existing loading conditions and may be retained subject to a close inspection during works.

A smaller crack has developed at the window opening close to the arch and the personnel door. The cause is not clear, but it is likely to be related to softening of the soils at the foundation associated with water draining from the roof slope onto the foundations below. Drainage and guttering should be instated in all locations.



*Figure 16: LEFT: Plumb laser highlighting the deviation from vertical at the abutment to the internal partition (WP4).  
RIGHT: Measurement of the maximum excursion from vertical.*



*Figure 17: LEFT: Plumb laser trained on the bearing of Truss 4. RIGHT: Measurement of the maximum excursion from vertical at mid-height of the wall.*

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*Figure 18: External view of WP1.*



*Figure 19: Internal view of WP1.*

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*Figure 20: LEFT: Water damage under the leaking gutter. RIGHT: Stepped lower course construction.*



*Figure 21: Masonry arch lintel.*

#### WP2

WP 2 is the original eastern gable and the partition between Extension 1 and the main barn. Viewed from the main barn, there is a single tapering crack close to the northern corner. These are believed to be related to the outward progression noted in WP1 and are likely to be well restrained by the installation of a suitably detailed first floor structure during works.

One small alcove is present with a stone lintel, which appears to be functioning adequately under the existing loading. Otherwise, the gable is generally plumb and straight and suited to conversion.



Figure 22: WP2 viewed from the main barn.

### WP3

WP 3 is the original rear elevation to the barn, and now forms the partition between the main barn and Extension 2 to the southern elevation.

Viewed from the main barn, the wall panel is generally plumb and straight for a structure of this age and nature, referenced from a plumb laser. The panel appears to have moved outwards at the eaves close to the eastern end (where it should be rebuilt locally during works) but appears to be generally straight at the western end (where the steel ties and pattress plates are located). A tapering crack is present close to the pattress plate which is also present at the other side of this panel, viewed from the stable. The crack is consistent with an outward progression of WP5 (see later sub-section). Several through stones are visible in this panel.

Three major openings are present, a cart door leading to the entrance vestibule, and two personnel doors leading to Extension 2, which are stacked above and below in the same location on plan. The cart door has been furnished with a stone masonry arch to support the outer leaf, and a curved timber tree bough to the inner, similar to the equivalent arch in WP1.

The external masonry arch appears to have flattened slightly, and the mortar joints around the keystone have opened accordingly. This is believed to be related to the lack of buttressing masonry at the arch's western end due to the doorway at first floor level.

The wall at the arch's western support has deformed here and close inspection of the timber door in the first floor level opening indicates that the door is jammed in place and trapped by the moving masonry and is now under compression and may be working to resist further movement of the wall under the arch's horizontal thrust. The door appears to have a curved profile, consistent with the idea that it is in compression and providing buttressing resistance to the arch's outward thrust.

We recommend that this doorway is either blocked with toothed in masonry, or a steel frame provided at this location to transfer the arch's thrust to the remaining length of buttressing masonry.

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The lintels to the personnel door are timber on both sides and should be replaced during works. The replacement of these lintels presents a possible health and safety risk as it is unlikely that the slender strip of masonry above the ground floor lintel will remain in place if the lintel is removed.

If the masonry is removed, then the buttressing restraint to the arch's thrust is significantly reduced and instability may follow. We recommend careful horizontal propping of these doorways prior to any works.

Several ventilation holes and other pockets to support the various structural timbers have been formed in this panel. Most have stone lintels which are functioning adequately, although one of these small lintels has fractured and should be replaced.



*Figure 23: Internal view of WP3 at the eastern end.*

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*Figure 24: Internal view of WP3 at the central area and western at the abutment to WP4.*



*Figure 25: Image LEFT: WP3 relative to a plumb laser at the abutment with WP4. Image RIGHT: WP3 at its western end compared to a plumb laser viewed from Extension 2.*



*Figure 26: Fractured mudstone / slate lintel.*



*Figure 27: Opening of vertical joints of the masonry arch in WP3, consistent with outward movement under the outward thrust at one or both bearings.*



*Figure 28: Image LEFT: A plumb laser trained on the edge of the bottom stone at the arched opening. Note the lack of buttressing masonry at the arch's bearing. Image RIGHT: apparent outward movement, likely due to the arch thrust.*

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*Figure 29: Potential buckling under compression of the door at first floor having been trapped under the outward thrust movement of the arch.*

#### WP4

WP 4 is the partition between the stable/store and the main barn. It has separated from the front and rear elevations (WP 1 and WP 3) and is effectively a free-standing wall, with the exception of a single stone bonding to WP1. Some small settlement related cracks are present under the first-floor level doorway, but otherwise the wall is sound.

The doorway is supported by timber lintel, which also support the roof above and should be replaced with modern, durable steel or concrete units during conversion.

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*Figure 30: WP4 viewed from the Main Barn.*



*Figure 31: The top of WP4 viewed from the Stable.*

### **3.4 Stable and Store**

#### WP5

WP5 is the western gable of the barn and continues to join WP6 which is the 'gable' to Extension 2.

WP5 has undergone an outward progression, indicated by a plumb laser and separation from the internal wall dividing the stable and the storeroom.

Viewed externally, the wall bulges and is generally distorted close to the northern corner. Internally, there is a large tapering and shearing crack, indicating that the crack has opened up in both longitudinal and lateral directions as both WP1 and WP5 move outward. This is likely to be related to the previous movement sustained which was most likely the impetus for the structural intervention described elsewhere.

A second tapering crack is visible internally starting at the upper purlin and progressing down towards the door opening before reducing to nothing and at this point a further crack opens up below the window to continue the progression. The same crack is not visible externally and has likely been concealed by a liberal application of cement mortar repointing 'repairs'. The repointing appears to be relatively old at the time of inspection (estimated in the order of tens of years) and shows only minor signs of separation from the wall panel. We therefore consider the movement that caused the internal cracks non-progressive.

Outward movement was observed, which is likely due to the lack of restraint to this panel once the connection to its restraining elevations has been broken under the outward progression of WP1. The outward movement close to the centre of the panel was estimated with the aid of a plumb laser at around 50mm which is within stable limits.

The two doorways in WP5 are supported by stone lintels externally which appear to be functioning adequately under current loading conditions. Internally the lintels are timber and should be replaced with durable steel or concrete units during conversion.

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A large quoin stone is missing from WP5, the cause of which is unknown. This should be replaced during works.



Figure 32: External view of WP5.



Figure 33: Undulating and bulged surface of WP5.

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*Figure 34: Internal view of WP5.*

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*Figure 35: Separation of WP5 from the internal masonry partition between the stable and storeroom.*



*Figure 36: The missing quoin stone in WP5.*

### **3.5 Extension 1**

#### General comments

Generally speaking, the walls of Extension 1 are in poor condition. Of the three elevations, WP 10 may be retained for future use if desired, but we recommend that the other two elevations are demolished.

Given the relatively poor condition of WP10 when considered in isolation, the practical issues of preserving a fragile, poorly constructed and effectively unsupported masonry panel during larger scale demolition works, we recommend a full demolition and rebuilding of this particular portion of the barn.

#### WP10

WP10 is in the best condition of all three of the walls which form Extension 1 and is likely to be suited to further use if practical, considering the demolition work necessary for the remaining elevations.

WP10 has settled / been pulled away from the main barn gable by the outward progress of WP11.



*Figure 37: WP 10 - the southern elevation of Extension 1.*

#### WP11

WP 11 is in a poor state of repair and features some former window openings which have since been blocked up. The opening closest to the centre has been infilled with a very slender leaf of rubble masonry and props a decayed timber lintel in this location. The decayed timber lintel supports the single roof truss described previously, which has been propped at its intersection to this wall.

Inspection implies that the prop to the roof truss is more likely due to the decaying timber lintel supporting it and the very thin leaf of stone masonry below than any concerns about the strength of the truss.

This panel is leaning outwards by a significant amount, likely due to the discharging of the roof water run-off at the foundations to this elevation and the likely shallow foundations. A significant masonry return has been constructed (WP12), but the effectiveness of this panel in its ability to restrain the noted outward movements is negated when the full height running joint in WP 12 is considered. WP11 is restrained by a formal bond to the abutting WP10, and therefore a large shearing type crack has developed close to the central window as a result of the resultant twisting type movement.

We recommend that this wall should be demolished and rebuilt from a suitable foundation during works.

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*Figure 38: WP11 - the eastern elevation of Extension 1.*



*Figure 39: The eastern elevation of Extension 1. LEFT: Poor quality masonry blocking the opening. RIGHT: The stepped-out nature of the shearing crack visible over the blocked-up opening, just below the gutter.*

#### WP12

The front elevation appears to have been partially blocked up to form a masonry return to WP11 and reduce the overall width of the opening.

As noted previously, the return has not been formally bonded with the original masonry and has become detached from WP11. As a result, a crack has opened up at the full height running joint, permitting free movement of WP11.

The masonry over the timber lintel at the abutment with the main barn has dropped vertically a small amount due to the compression of the timber lintel as it decays over time. We recommend this wall is demolished and rebuilt.

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*Figure 40: WP12 - the northern elevation of Extension 1.*



*Figure 41: LEFT: Separation of the eastern elevation from the northern elevation. RIGHT: settlement of the masonry at the abutment with WP12, WP1 and WP2, believed to be related to the compression of the decaying timber lintel over time.*

### **3.6 Extension 2**

#### WP6

WP6 forms the western gable to Extension 2. Although access to obtain accurate measurements was not possible internally due to a timber first floor beam abutting the wall, the wall is believed to be leaning inward by around 60mm at the centre of the panel.

The causes of this movement are not entirely clear but are likely to be related to the positioning of the doorway without a return at the southern corner and the eventual loss of connection with WP 7. Three openings are present, two doors at ground floor level and one at first floor level. The first-floor level door has been blocked with a thin leaf of masonry, and the two on the ground floor level are furnished with stone lintels to the outer and timber lintels to the inner.

Some shearing type movement has occurred at the southern-most of the two doorways, in sympathy with the inward lean of the gable. These should be rebuilt before new concrete or steel lintels are installed.



*Figure 42: External view of WP6.*



*Figure 43: Internal view of WP6, noting in-situ beams believed to have previously supported a first-floor structure.*



*Figure 44: Movement evident in WP6, related to the outward progression of WP7.*

### WP7

WP7 is the southern elevation of Extension 2 and has several cracks and is leaning outward by around 75mm at the top.

This outward rotation to catslide type extensions is common in such structures, since the roofs catch a significant volume of water over the large slope, all of which is discharged at the shallow foundation of the rear elevation.

The theory for such rotation is that the soil under the foundations is softened by the additional water, with the greatest softening occurring at the outside edge. The relative softening of the outer edge soils sets up a rotational movement where the outside settles more than the inside.

At the base of the external elevation, a line of small stones are exposed at ground level and may be a drain which has been installed in an attempt to remedy this movement. It is possible that this drain may exacerbate the problem of movement if the backfilled granular material is not well compacted below the shallow foundation level.

The soil and drain fall to the east and there is no obvious place for the water to go. A small pool of water was present near the eastern end of WP7 indicating that rainwater collects here. The eastern

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end of WP7 leans more than the western end, and we believe that this pooling of water and the knock-on softening of the soils bearing the foundation is the reason for this greater movement at this location. WP7 should be rebuilt during works from a new foundation.



*Figure 45: WP7, viewed from the south.*



*Figure 46: Profile views of WP7 indicating the greater amount of outward movement at the eastern end (LEFT) and the lesser amount at the western end (RIGHT).*

### WP8

WP8 is the second gable to Extension 2 and shows signs of differential settlement, with the greatest settlement at the southern end in sympathy with the movement and pooling of surface water noted previously for WP6.

The timber inner lintel has decayed and collapsed, and the panel is leaning outward around 60mm in its central location, likely for similar reasons as WP6, considering that the surface water appears to pool at the base of this wall.



*Figure 47: WP8, internally with a just visible tapering crack running down internally from eaves level (LEFT), which was not visible externally.*



Figure 48: External view of WP8.



Figure 49: Failed timber lintel remains visible at the 'right hand' bearing just below the timber first floor beam.

### 3.7 Vestibule

#### WP9

WP9 is the original vestibule wall, and is straight and plumb, but not well bonded to WP3. Formal connection should be reinstated during works.

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*Figure 50: WP 9, straight and plumb.*

#### 4.0 First floor

Timber beams remain in-situ in Extension 2 from what is believed to have been a first-floor structure (see Figure 43). These beams are not suited to further service. Similar timber beams are also present at first floor level in the Stable and are unsuited to reuse.

A hay loft is present at the eastern end of the main barn, over the boskins in traditional style. This is not suited to service as a domestic first floor.

The new first floor structures installed should be suitably detailed such that they can function to provide restraint in the two orthogonal directions to the masonry panels, to tie them together and restrain further movement.



*Figure 51: Remains of the first-floor structure over the Stable.*

**Project:** Laneside Barn  
**Client:** Mr. Keith Lee  
**Description:** Structural Inspection  
**Date:** 26<sup>th</sup> August 2024



*Figure 52: Hayloft over the traditional timber boskins in the Main Barn.*

**Project:** Laneside Barn  
**Client:** Mr. Keith Lee  
**Description:** Structural Inspection  
**Date:** 26<sup>th</sup> August 2024

## **5.0 Substructure and ground floor**

### **5.1 Substructure**

WP 1 and 3 have a step thickening of the wall at low level, and the footing stones are visible at ground level to WP1 indicating that the main barn at least has been provided with a formal, if shallow foundation. The two gables to the main barn share this detail, but none of the extension walls do.

The floors to the main barn are a combination of a cast in-situ concrete provision at the boskins, with a drainage channel. The floor between the two large openings is a stone flag provision, whereas the rest of the barn is compacted earth.

The floor in Extension 1 appears to be compacted earth and the floor in Extension 2 is a cast in-situ concrete floor with drainage channels.

The existing floors are likely to be strong enough to resist the loading associated with domestic use but are unlikely to be suited considering other non-structural technical aspects such as damp proofing, insulation, radon gas etcetera. We therefore recommend that the floors are upgraded to a concrete slab type provision.

### **5.2 Slurry lagoon**

A slurry lagoon is present at the southeastern corner of the main barn / Extension 1 which does not appear to be causing significant issues to the barn structure at the time of inspection.

We recommend that it is drained and filled in with carefully compacted layers of granular material and it is understood that the lagoon has already been drained with the intention of backfilling.

We recommend that the backfilling is undertaken as soon as practically possible to avoid any potential for the unbalancing of loads on the lagoon's retaining walls and hence, risking settlement of the foundations above if the retaining walls were to move. Consideration should be given to whether to provide drainage to the lagoon to prevent a buildup of water here.

### **5.3 Drainage**

The drainage to the whole building should be addressed, especially considering the shallow foundations.

## 6.0 Conclusions

The barn is suited to conversion, subject to the following recommendations:

- Timely backfilling of the slurry lagoon with free draining granular material, well compacted in layers. Consideration should be given to whether to provide drainage to the lagoon to prevent a buildup of water here.
- Formal drainage should be provided around the shallow original barn foundations and guttering at roof level.
- Installation of a modern concrete ground floor structure.
- Demolition and rebuilding of Extension 1 and WP7 from suitable foundations.
- Any small areas of damaged or excessively deformed masonry should be rebuilt during works.
- Formal tying of any unsupported masonry panels at their abutment to adjacent masonry panels.
- Cosmetic 'repair' of cracks in masonry and a full repointing with a suitable lime mortar to maintain the weatherproof envelope.
- Replacement of the missing quoin stone at the northwestern corner.
- All timber lintels should be replaced with durable modern steel or concrete units. All stone heads to be retained should be inspected and replaced where necessary. Long span stone heads should be supported by other means.
- Installation of a suitably detailed first floor plate, capable of tying and restraining all connected masonry panels in both principal directions.
- Checks on all roof timbers which are to be re-used (if any) to include a thorough inspection for infestation and decay and verification by calculation for their capacity to bear the proposed new loads.
- The first-floor level doorway adjacent to the masonry arch in WP3 (southern elevation) should be blocked up with tooth bonded masonry, and the lintel below replaced. Temporary stability should be maintained with horizontal and vertical propping at the doorway during any masonry works locally to resist the horizontal arch thrust during works.