T5859/JCT/krrt

Structural assessment

of

Pentre Barn

at

Llangattock Lingoed

Monmouthshire

NP7 8NS

as instructed via

Powells Rural Property Professionals ltd

Report Issue:	Issue 1
Author:	John Topp
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North Elevation

Contents:

1.0 Brief.

As instructed via Powells Rural Property Professionals ltd, on behalf of the applicant, to inspect and report upon suitability an existing barn for change of use to residential.

The report is intended for use in planning matters and not to provide detailed information pertaining to Building Regulation approval.

My inspection took place on 5th July 2022. The survey did not include intrusive investigations or specialist testing.

The inspection was carried out, and report prepared, by John Topp IEng AMIStructE AssocRICS.

2.0 Location and setting

The subject building is at OS map reference SO 36107 20386, being situated approximately 310m north of St Cadocs Church, Llangattock Lingoed.

The barn occupies a sloping site at an approximate elevation of 175m AOD.

The subject building comprises a rectilinear barn with a ridge aligned east-west. The interior dimensions of the barn are approximately 6.8m x 15.6m. The building height varies as a consequence of the sloping ground floor, but the height to the truss chord on the north side door reveal is approximately 4.15m. There is a small projecting store to the SW corner which has been largely reconstructed, and was difficult to access for inspection. The eastern end of the building is contained within a ‘wraparound’ modern steel structure.

BGS mapping data indicates no superficial deposits, and to be underlain by bedrock comprising interbedded sandstone of the St Maughans Formation. No site specific geotechnical investigations have yet been undertaken, but near-surface, weathered sandstone often presents as sandy clay.

3.0 Observations

3.1 **Roof**

- The roof structure is in five bays comprising three inclined purlins per slope spanning between six trusses, including those adjacent to gables. Currently, the roof is covered with galvanised steel sinusoidal profiled sheeting, and none of the original common rafters is present.
- Trusses are numbered east – west (E-W).
- Trusses 1 and 6 (adjacent to gable walls) are simple triangular frames comprising principal rafters and bottom chord.
- Trusses 2 – 5 are similar except with diagonal chords propping the principal rafters just above the central purlin bearing. Note that the principal rafters are connected onto the top of the bottom chord.
- The bottom chords of trusses 2 and 3 both display significant surface damage from wood boring insect attack, and truss 3 appears to have internal voiding at mid-span and at the south bearing.
- Although the (lime-washed) surface of the bottom chord of truss 4 has a more consistent appearance, there is again the suggestion of interior voiding as a result of insect attack.
- A longitudinal fissure (shake) is present along the bottom chord of truss 5 but this appears to be of structural significance only towards the southern bearing.
- Decay was noted at a number of principal rafter ends.
- The original purlins have been adapted on the southern slope between trusses 3 and 4, and the lower southern purlin between trusses 1 and 2 is in poor order. Lower purlin on northern slope between trusses 4 and 5 has been affected by water ingress. The upper surface of the purlins and principal rafters cannot be examined until the roof coverings are removed, and there remains a possibility of structurally significant decay being present.

- Overall rotation (racking) of the trusses was noted (see later comments regarding the gable apex panels) but there is also localised rotation of the bottom chord, which has consequently weakened the tenoned connection to the principal rafters on some trusses. These connections will require steel plating repairs.
- On the basis of what is visually accessible at present, the size and condition of structural elements is suitable for ongoing use, subject to repairs of defects noted above. These repairs may be undertaken with the roof in-situ, and will involve the addition of steel plating in some locations.

3.2 Walls

As a result of the significant door openings on the north and south, the walls may be described in six distinct panels. Firstly however, the form of construction must be described, as it has a significant impact upon method of repair.

3.2.1 Construction

The walls are very thick, being nominally 900mm wide at the base, with gradually tapered outer faces. These are constructed from thin-format stones. Measured at several locations, 10 (ten) stone courses averaged only 390mm – 490mm. Stone lengths vary up to approx 450mm. The stones are laid largely in dry-stone form. There is a general lack of mortar used to bond the masonry, and where present, is typically of very thin beds (3mm – 6mm). Refer to appended sketch **T5859-SK01** for diagrammatic sketch of the wall form, compared with the more common 'solid' traditional wall construction.

Barn interior looking east

Barn interior looking west

3.2.2 East gable

- The wall incorporates the characteristic triangular upper, and rectangular lower, ventilation openings. In this instance, the upper openings being covered internally with corrugated steel sheeting. The lower openings are tapered on plan and incorporate substantial timber lintels, combined as a bonding timber on the southern half of the wall.

- Junctions with the north and south walls display failure of the dry-stone 'bonding' with significant outward movement of the north wall (see later notes). The gable has also rotated eastwards
- The apex of the east gable has been reconstructed in single-leaf modern blockwork, incorporating a central pier on the line of the ridge. Externally, the purlins have been seen to retreat from the wall face due to outward wall rotation.

3.2.3 South-east panel

- Significant structural distress is evident in the section of wall, which appears to have resulted from a combination of impact damage and under-mining of founding sub-soil along the external face of the wall, within the modern steel barn.

- In-situ concrete is apparent along the base of the exterior of the wall where levels appear to have been reduced, resulting in loss of support to the foundation of the original wall.
- Wall distortion is so significant that a substantial area of reconstruction will be required.

3.2.4 South-west panel

- Significant misalignment of masonry bed joints is evident towards the SW corner, where an area of pointed, possibly rebuilt, stonework can be seen. Foundation related movement appears to have taken place.
- Loss of masonry is apparent around the upper triangular apertures.
- Lintel to the main door opening is deflected and requires is deflected, resulting in a partially reconstructed area of masonry to the eastern bearing, and a vertical crack beyond the western bearing. Replacement or strengthening will be required.

3.2.5 West gable

- The main portion of the gable wall appears relatively perpendicular, but the apex displays an outward lean.
- The exterior face of masonry is in very poor condition as a result of weathering
- Some voiding is present

3.2.6 North-west panel

- This wall displays a significant outward lean, which is evident at the high level junction at the NW corner, and worsens towards the east.

- The extent of outward lean was measured at the door reveal, where the base of the vertical laser line shown in the photograph is touching the inner face of the wall. The outward lean is 300mm in a height of 3150mm.

- Delamination (vertical fracturing within the thickness of the wall) is clearly evident at the door reveal and within the ventilation apertures.

- As a consequence of the outward lean, combined with the delamination, a substantial portion of this wall requires reconstruction. The approximate elevational area of reconstruction will be a minimum of 14m2.

3.2.7 North-east panel

- This wall displays a significant and consistent outward lean, which is evident at the door reveal and the fractured junction at the NE corner.

- The extent of outward lean was measured at the NE corner, where the base of the vertical laser line shown in the photograph is touching the inner face of the wall. The outward lean is 200mm in a height of 3600mm.

- Delamination (vertical fracturing within the thickness of the wall) is clearly evident at the door reveal and within the ventilation apertures.

- As a consequence of the outward lean, combined with the delamination, a substantial portion of this wall requires reconstruction. The approximate elevational area of reconstruction will be a minimum of 18m2.

4.0 Discussion

The main walls are in poor order and require substantial repair. Apart from the obvious impact and undermining damage to the SE panel, there is evidence of foundation related movement and consequential superstructure damage. Unfortunately the form of construction, which is relatively unusual, limits the available methods of in-situ repair. With most traditional solid masonry wall construction, it is possible to improve overall stability conditions by upgrading roof connectivity and fixing an inserted upper floor which acts as a restraining diaphragm. In addition to this, through-wall instability can be resolved using specialist stitching anchors. In effectively dry-stone walls with such 'thin' masonry units, this relatively common approach to repair is not feasible.

As a consequence of the above, reconstruction will be necessary in a number of locations. The approximate extent is depicted on appended drawing **T5859-SK02**. In some cases, such as where the facing stonework is badly eroded on the western gable, this could comprise dismantling and reconstruction of partial-thickness rather than the entire wall. The walls are extremely thick (refer to sketch T5859-SK01) which makes this partial replacement viable. This partial-thickness repair also applies to a number of localised problems surrounding ventilation apertures and along verges etc.

Where the outward movement is more significant and is combined with delamination, such as along the north wall, reconstruction of the full thickness of the wall will be required.

The response of these walls to underpinning will be unpredictable. Unlike most traditionally constructed solid walls, the capacity for this particular construction form to temporarily 'span' across underpinning excavations will be limited. Avoiding underpinning will dictate the proposed ground floor level.

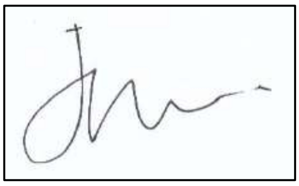
5.0 Conclusion

Significant structural interventions are required in order to execute a change of use to residential class but it must be borne in mind that these repairs will be required regardless of the development proposals if the building is to survive. The approximate extent of wall reconstruction is depicted on appended drawing T5859-SK02. The response to wall defects is driven by the specific form of construction which is relatively unusual and is depicted on appended sketch T5859-SK01.

The design proposals set out in the application have already taken into account the recommended avoidance of underpinning the remaining walls, which has resulted in a suspended ground floor construction coincident with the higher ground level on the north side of the building.

I trust that the above report is of assistance.

O'Brien & Price Stroud ltd



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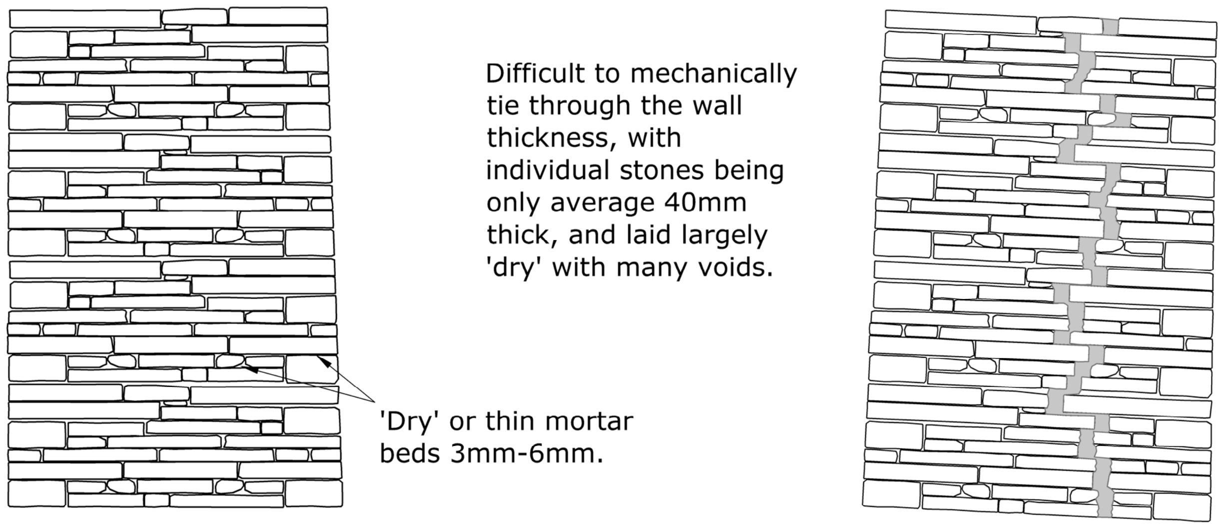
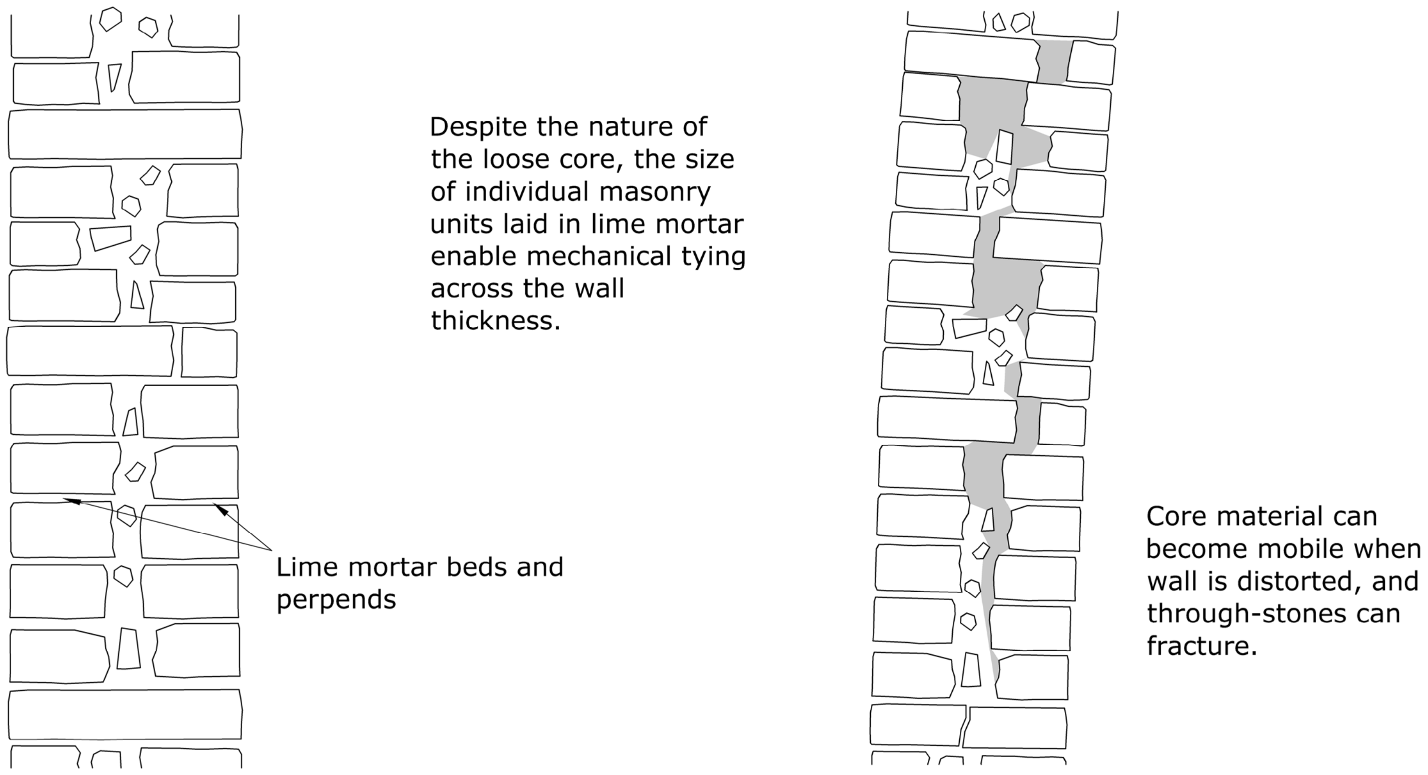
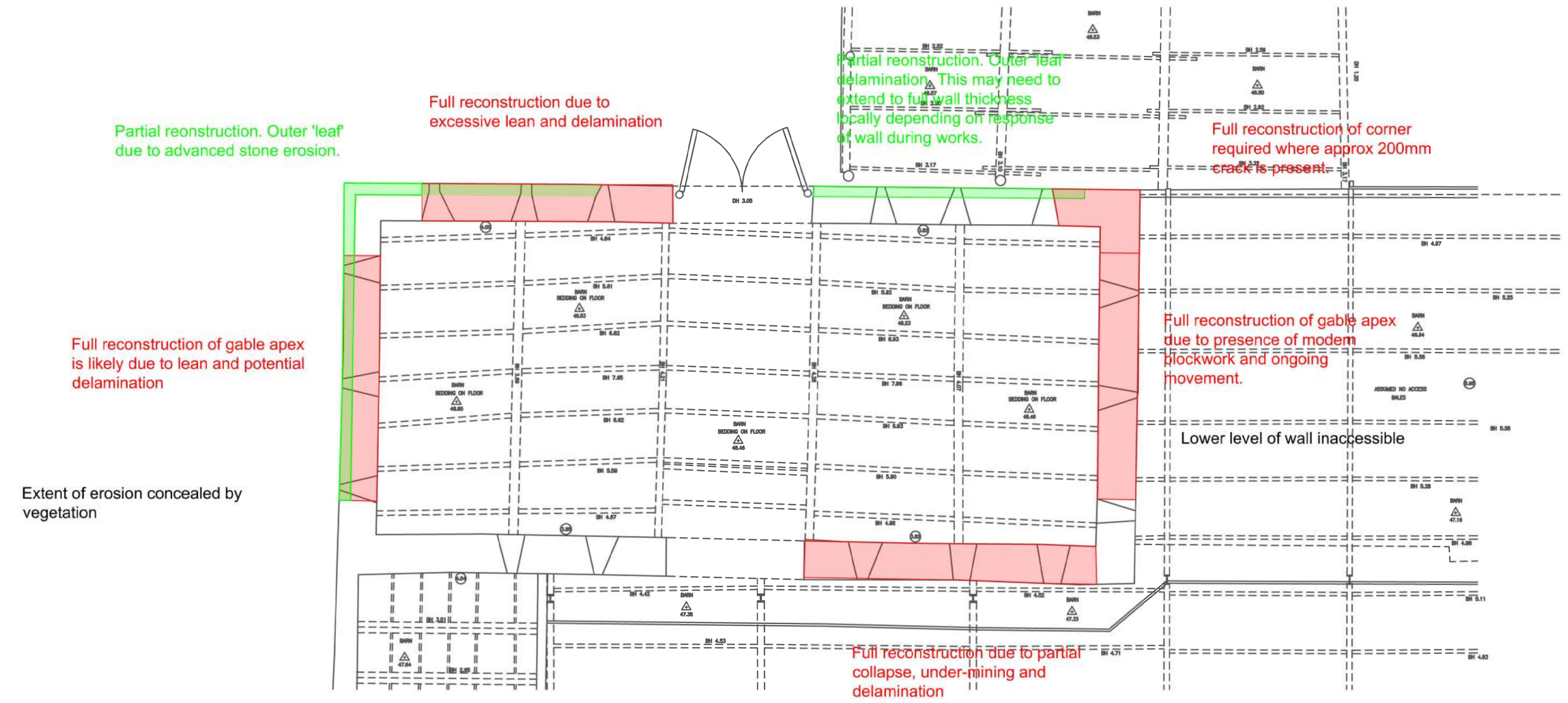


Solid wall - Pentre barn
Up to 900mm thick
This demonstrates the nature of this largely dry-laid wall of solid construction, but adopting thin format stone. This depicts the idealised multipe over-lap bonding through the thickness of the wall.
The structural qualities of the wall are dependent upon the friction between over-lapped stones. The thin nature of the tying stones makes these susceptible to fracture and consequential delamination.

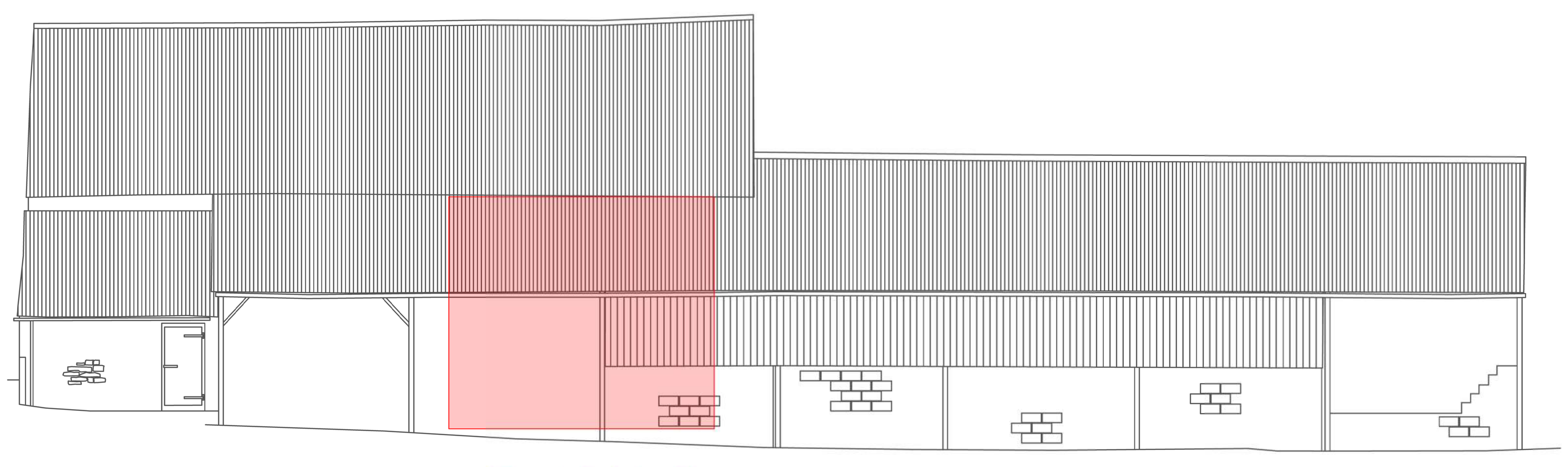


Solid wall - Common form
Typically 550mm - 600mm thick
This demonstrates the nature of a typical 'solid' rubble masonry wall. This depicts the two leaves of masonry with core infill. The stone format, coursing and bonding can vary greatly, as does the nature of the core fill material.
The structural qualities of the wall are dependent upon the frequency of 'through' stones, tying the outer masonry leaves together, and the cohesion of the core infill. The infill can range from 'loose' non-cohesive granular material to a 'solid' mixture of small stones in lime mortar binder.

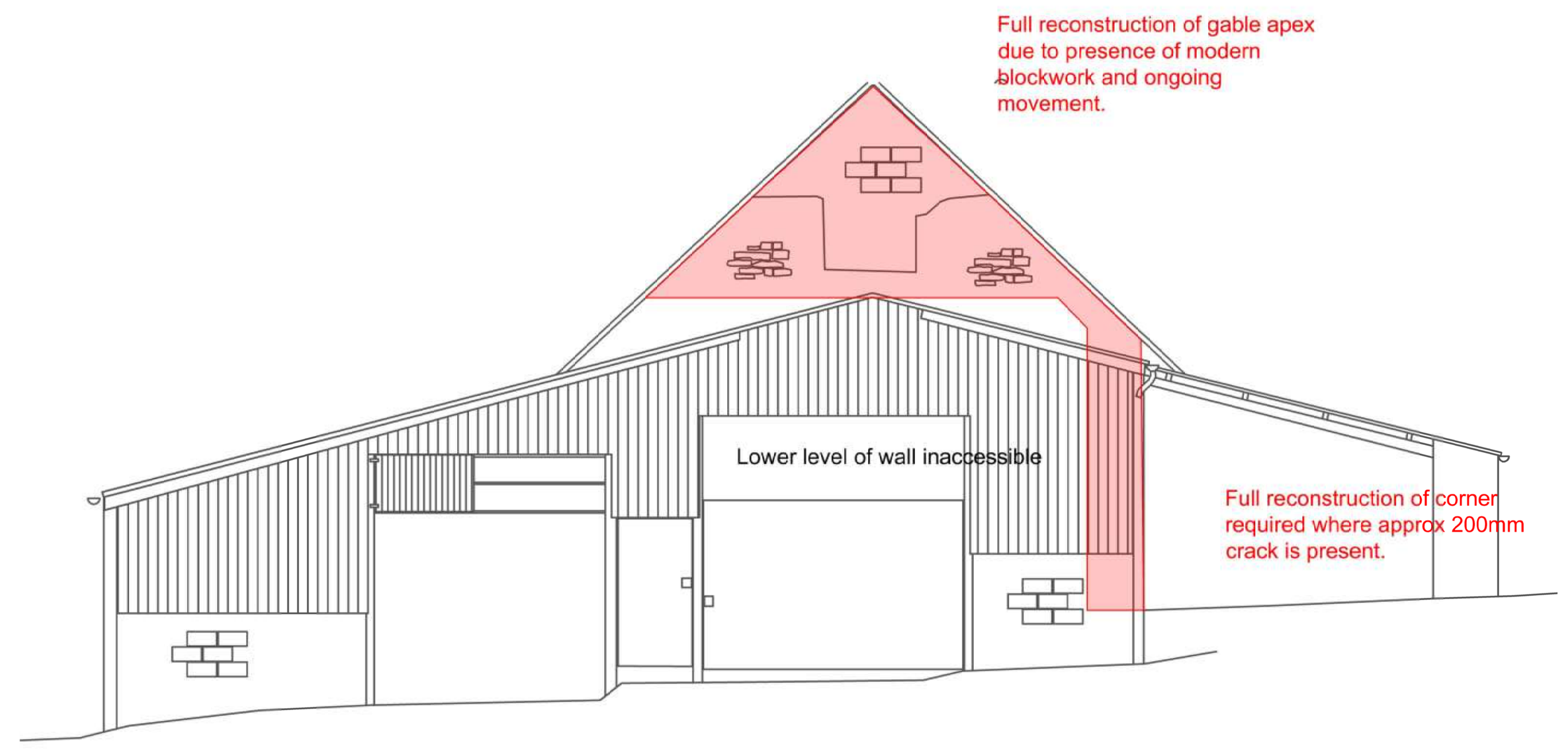
Comparison of walls at Pentre Barn with common traditional solid walls. Explanatory sketch T5859-SK01 *to be read with accompanying report*	O'BRIEN & PRICE STROUD CONSULTING STRUCTURAL ENGINEERS The Old Bakehouse, Monmouth Road, Tintern, Monmouthshire NP16 6SE TELEPHONE: (01291) 689343 E-MAIL: john@obp.co.uk WEBSITE: www.obp.co.uk



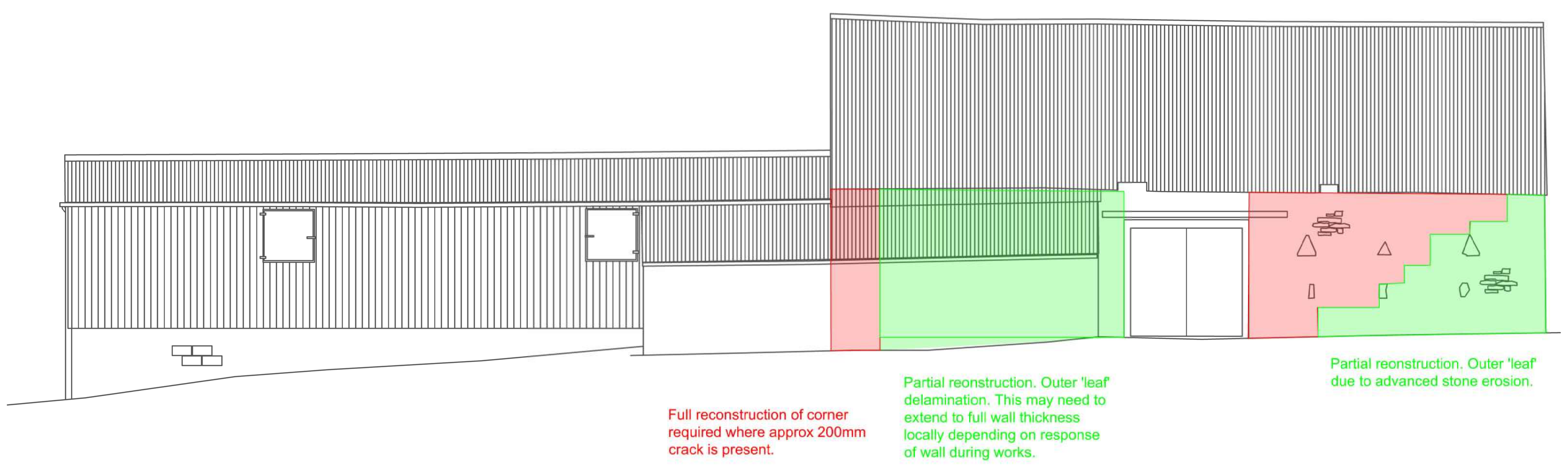
Plan



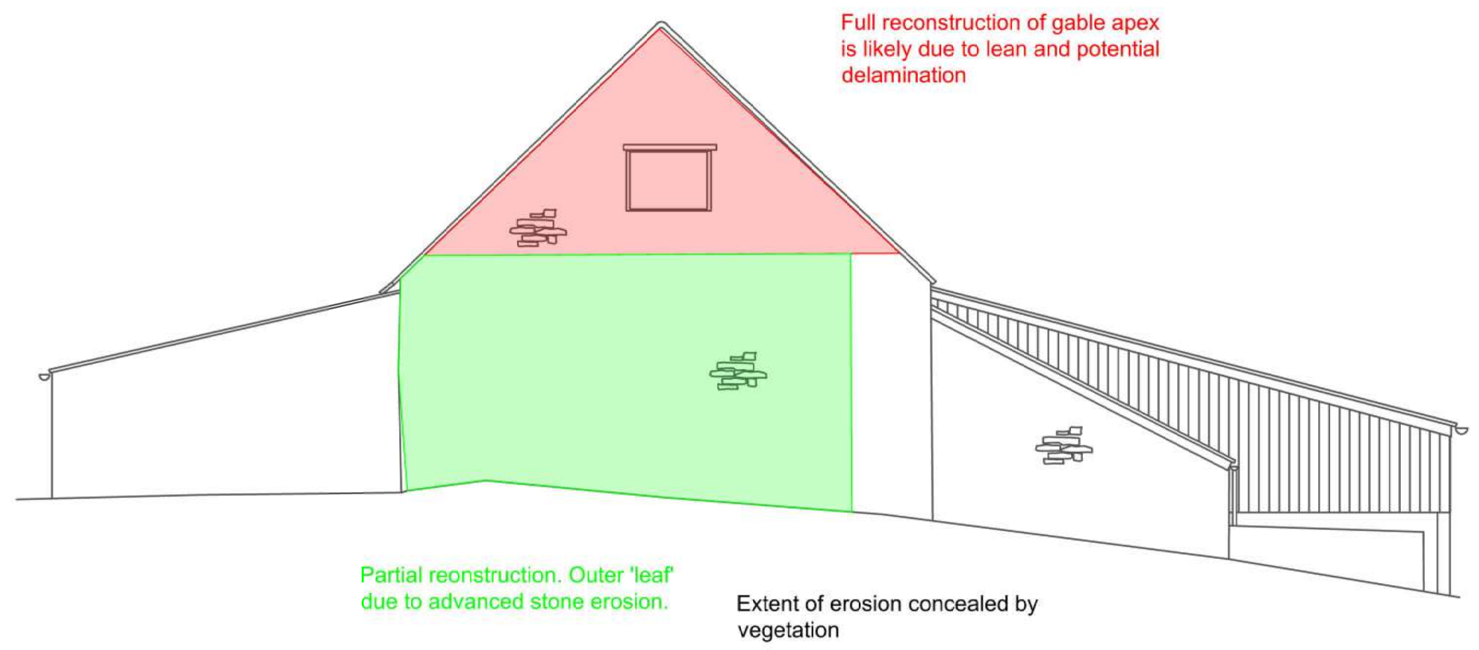
South elevation



East elevation



North elevation



West elevation

Pentre Barn Guidance on extent of full/partial reconstruction of main walls. Explanatory sketch T5859-SK02 *to be read with accompanying report*	O'BRIEN & PRICE STROUD CONSULTING STRUCTURAL ENGINEERS