

ANTHONY-JOHNSON

Consulting Engineer Ltd

Site Address:

Wingland Farm,
Walpole Marsh,
PE14 7JH

Overview:

The purpose of this report is to document the findings of a survey carried out on the existing barn structure at Wingland Farm, which it is proposed is to be converted from agricultural to residential use. This report considers the retention and reinstatement of the building, identifying the areas of masonry and roof that require repair or rebuilding to enable its conversion.

The barn structure was previously employed as stables and consists of masonry elevations with a hand-cut timber roof. The duo pitch timber roof is formed of rafters laid to falls, running from the ridgeline to eaves, with a single purlin on each pitch set to the head of internal masonry partitions and timber trusses. The original roof is formed with sarking boards providing support to plain tiles running from ridgeline to eaves.



Image 1.0: Exterior view of barn complex showing open bay section with plain tile roof

Address:
3 Westgate Street,
Southery
Downham Market
PE38 0PA

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Review of the Structure:

The barn is described in sequence commencing at the section closest to the main residential property and progressing toward the car park/ drive entrance area.

Commencing close to the main residential property, the roof structure to this section has fully collapsed, leaving the masonry end and side elevations standing. The end was clearly formed with a hip roof with the wall plate still present. The wall panel remains intact and functioning as originally intended. The external wall to the front elevation has rotated outward toward the head, with some loss of masonry to the upper courses. The wall to the rear is fully concealed by ivy and could not be visually examined. The finished floor to this section is covered in broken roof tiles and was considered too dangerous to access.

A crack has developed at the front elevation along the juncture with the internal wall, indicating a rotation of the front wall panel in the outward direction. The panel would require reinstatement, tying brickwork back in to the buttressing internal partition.



Image 3.0: Collapsed section adjacent to main residential property, gable and side walls standing

Heading toward the car park area, a stable door is hung off masonry that appears to have bellied in an outward direction with rotation at the head. Reinstatement of the masonry to this section would be required internally, tying the wall back. Horse muck was found to be present to a depth of approximately 1 metre up against the rear elevation, preventing inspection of the finished floor.



Image 4.0: Horse muck, rising to approximately 1 meter above finished floor level.
Collapsed roof with remaining truss

The roof to this section has fully collapsed with a truss remaining but bowing horizontally. The remaining section of roof has dropped, indicating that the truss has dropped at the far end. The ridgeline has been lost and excessive decay was evident within the remaining timbers.

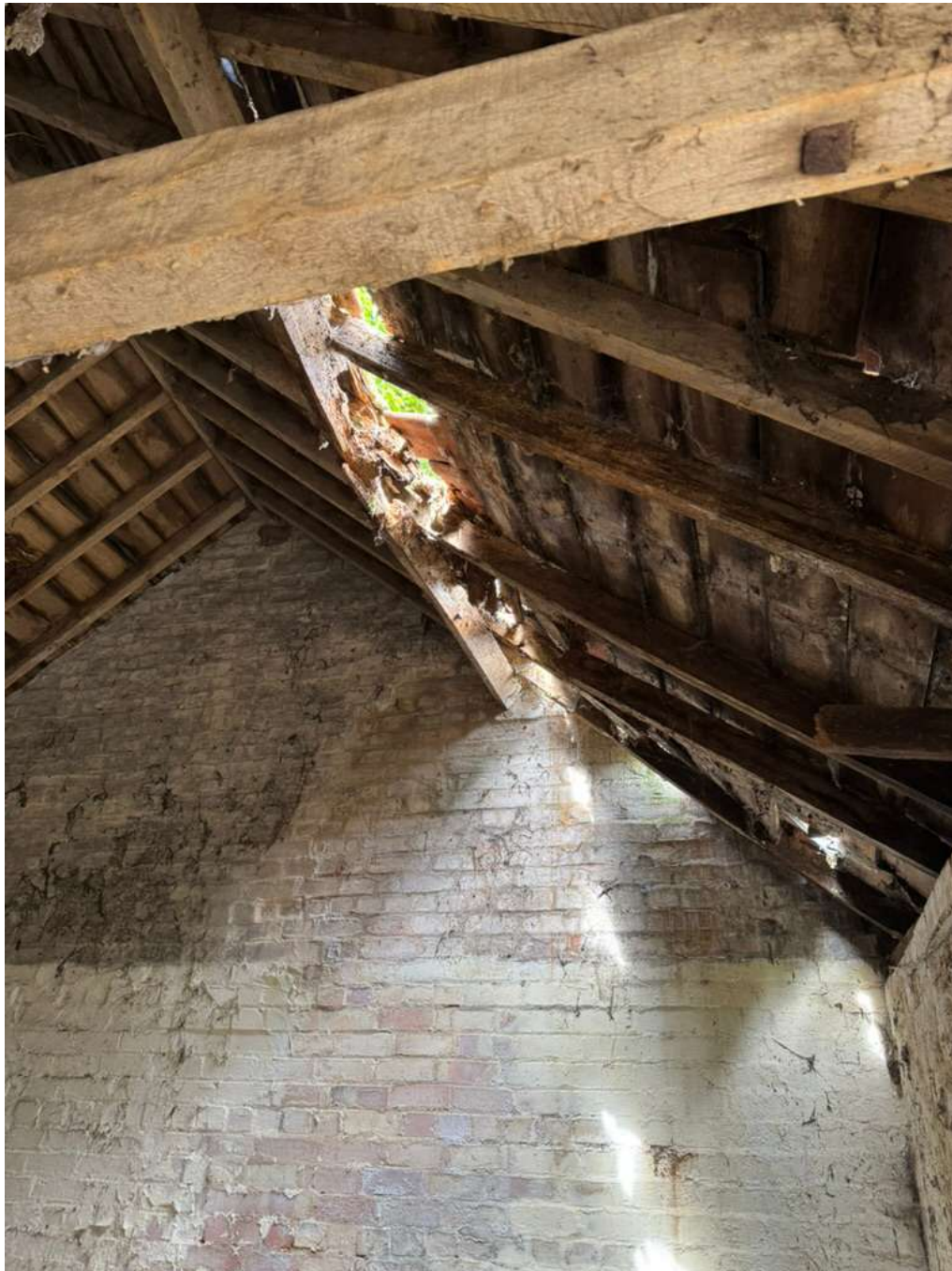


Image 6.0: Failed purlin, with rafters exposed and sarking lost

The next bay is partially intact. A purlin has failed on the front elevation along with the associated rafters and tiles have been lost from the affected area. The sarking board has partially failed. The roof has partially collapsed, although the single truss within this bay remains intact and has partially rotated about its head.

Masonry to this section of the barn is restrained by closely spaced internal wall panels and this has ensured that rotation and bellying of the walls has been limited. The single truss remains fixed to the wall plate, allowing retention of the head of the masonry to this section.

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The final section of barn is formed of three open bays. The first bay comprises a roof that has failed with the purlin having snapped and rafters having collapsed. This has resulted in a valley joining an adjacent garage to have also collapsed, and the head of the brick wall to this bay has belled inwards. Masonry separating this bay from the adjacent bay was noted as being intact.



Image 7.0: Failed purlin, rafters, valley to adjacent roof, failed sarking boards and deflecting ridge board.

The second bay incorporates a roof that spans a considerable distance between adjacent trusses. The purlin has sagged excessively, indicating that it is overstressed, and this has resulted in the roof sagging with the ridgeline dropping excessively. The span between the existing trusses is excessive for a single purlin; an additional truss should be introduced at mid-bay to reduce the purlin span, support the roof and remove the sag.



Image 8.0: Interior of long span bay showing steel beam to rear elevation and internal stable partitions. Purlin to mid-span of rafters is overstressed and has sagged excessively.

The head of the side elevations has spread as a direct result of the sagging roof, the rafters thrusting the heads of the wall panels outward as the ridge has dropped. The rear elevation to this bay incorporates a steel beam, and the masonry either end of the steel beam has rotated, with a crack developing three courses below wall plate level, indicating that the wall panel has rotated in an outward direction, being pushed by the roof as it drops and attempts to spread.



Image 9.0: Masonry and beam rotating outward due to thrust imparted to head of wall panel by rafters.

The truss set between the collapsed valley and the long span section has split and is now supported off a timber post set in-board of the masonry. The masonry has moved outward relative to the bearing location of the truss, increasing the bending moment in the bottom chord and this, coinciding with maximum shear forces in the timber has caused the outermost fibres to fail.



Image 10.0: Collapsed valley junction and split truss, now supported on timber post

The final bay runs out over a partial height masonry elevation and incorporates a roof structure with hips. The roof structure to this bay has fully collapsed and was being cleared of debris at the time of the survey.



Image 11.0: Collapsed end of barn structure

Overall Observations:

The roof structure has failed in a number of locations. The ridgeline was noted as wandering where the roof structure remained intact. Purlins have been lost or are overstressed throughout much of the remaining roof structure and tiles have been lost in a number of locations, allowing for rapid decay of the underlying timber members.



Image 12.0: Deteriorating roof structure, with tiles lost or dislodged, roofline wandering at ridge due to spread at eaves.

Masonry elevations have rotated in a number of locations, exhibiting excessive deviation particularly toward the head of the wall-panels, where spread of the roof structure has translated into outward rotation of brickwork.

The subdividing internal partitions appear relatively intact and do not exhibit excessive movement.

The finished floor to the barns incorporates concrete or cobblestones and these may be retained where suitable.

Notably, whilst the wall panels have rotated and spread at their heads, the walls have not moved vertically. No vertical or differential settlement was evident to the elevations. This indicates that the supporting ground is of low volume-change potential and that the foundations remain sound; the movement observed is attributable to the spread of the failed roof structure, not to any ground or foundation movement.

The mature trees surrounding the barn do not therefore appear to have caused or contributed to structural movement, which is consistent with the low volume-change potential of the underlying ground. The trees are therefore not considered to present a foundation risk to the proposed conversion.

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Conclusion:

The barn structure is considered capable of being retained, reinstated and converted to residential use. Although the roof structure has substantially failed, and a number of masonry panels have rotated, bellied or decoupled, the primary structure — the masonry elevations and the internal partitions — is in the main sound and may be retained. Importantly, the walls have not moved vertically; there is no evidence of vertical or differential settlement. This indicates that the underlying ground is of low volume-change potential, that the foundations remain sound, and that the defects observed are a consequence of the spread of the failed roof rather than of any ground or foundation movement. The mature trees surrounding the barn do not appear to have caused or contributed to the movement.

The masonry elevations may all be re-used. Localised rebuilding and reinstatement is required to: the bellied wall panels (notably the stable-door section, which has bellied outward, and the head of the first open bay, which has bellied inward); the wall panels that have rotated outward and decoupled from their buttressing internal partitions; and the upper courses where masonry has been lost. Rotated panels that remain sound need not be taken down — they may be restrained and stitched back into the buttressing internal partitions; only those panels too distorted to retain need be rebuilt, re-using the existing brick and a suitable mortar, sympathetic with the age and mode of construction.

The roof may be partly repaired and partly rebuilt. The bays in which a truss remains intact and fixed to the wall plate — where bellying of the masonry has been limited by the closely spaced internal partitions — may be retained and locally repaired, replacing failed purlins, rafters, sarking and tiles as required. The collapsed sections, the failed and snapped purlins, the split truss, and the collapsed valley junction with the adjacent garage require rebuilding.

To the long-span bay, the single purlin spans an excessive distance and is overstressed. An additional truss should be introduced at mid-bay to reduce the purlin span and support the roof; the sagged roof can then be re-levelled, arresting the spread that has been imparted to the side elevations. The steel beam to the rear elevation of this bay should be re-bedded so that the outward rotation of the masonry either side of it is removed.

The internal partitions, in their relatively intact condition, are suitable for retention and provide structural benefit in terms of restraint to the external wall panels. The existing finished floor is considered suitable for retention subject to further inspection once the broken tile debris and extensive detritus has been cleared.

Given the absence of vertical or differential settlement, and that the surrounding trees do not appear to have caused movement, the foundations are considered suitable to support the retained and reinstated structure, subject to confirmation by trial holes and a review where any significantly increased loads are to be introduced.

It is recommended that the reinstatement works are carried out so that it may be demonstrated to the Local Planning Authority that the structure is capable of retention and conversion to residential use.