Structural Report

The Dutch Barn
Bluegates Farm
Berkeley
Gloucestershire

LPS

Cobham Lodge
The Street
Uley
GL11 5SL

[redacted]

Introduction

This document accompanies an application for consent to convert an existing agricultural building to residential use, following a visual inspection of the structure to confirm its form and condition. This will then be used within an assessment of its suitability to accommodate the changes required to facilitate such a conversion. The potential changes to the external envelope required to achieve the level of thermal insulation and protection against damp penetration, plus the effects of the installation of mechanical and electrical services will be discussed. This will then form the basis of an evaluation of the viability of a conversion retains all existing structural elements in their current form as the principal loadbearing elements of the converted building.

The Site

Bluegates Farm occupies an area of farmland to the southwest of the town of Berkeley, with a number of buildings occupying the farmyard, including former stables and livestock sheds that have been converted to residential use previously. The Dutch Barn stands to the rear of the farmyard and has recently been used for storage of feedstuffs, materials and for parking of farm machinery.

The site has direct vehicular access to the public highway with areas immediately behind the converted buildings allocated as amenity space and for car parking to these units. The approach to the Dutch Barn passes alongside the converted units onto an external hardstanding to the front and side of the building. Immediately behind the Lean-to that adjoins the Dutch Barn is a further area of open space, currently used for access to the building with open farmland beyond.

The Building

The building is a steel framed Dutch Barn with a barrel vault roof structure consisting of a series of steel angle purlins taken onto steel trusses that span between steel columns arranged along the two side elevations. The columns are tied with substantial steel channel sections at eaves level on all elevations, plus a further channel rail at mid-height and a cold rolled cladding rail on the rear and side elevations, which support timber hit and miss cladding. Each gable is enclosed to eaves level with vertical corrugated steel cladding supported on the roof and eaves level steelwork. The steel columns have been encased up to mid-height with block masonry, which also runs between the steel sections on all four elevations, apart from the two central bays of the front elevation , which have full height openings, to provide vehicular access. .

Adjoining the rear of the Dutch Barn is a steel framed lean-to shed, consisting of steel columns and rafters, supporting a series of cold rolled purlin sections that carry corrugated single skin cladding. The external ground falls away towards the rear of the site, with the internal levels within the lean-to some 300-400mm lower than in the floor slab in the Dutch Barn. The lean-to does not appear to have a floor slab.

The steel frame on the Dutch Barn has tubular bracing which combines with the masonry shear walls to provide longitudinal stability. Lateral stability would appear to be provided by the column bases being cast into concrete pad foundations and the bolted connections to the roof trusses, which would have been further enhanced by the introduction of the bock masonry walls to the side elevations.

There are no internal services within either the Dutch Barn or the lean-to.

Condition

The steel framing appears generally to be in sound condition, with what would appear to be local repair to corroded areas on two of the columns to the front elevation. The columns remain plumb and vertically aligned. The roof trusses are fabricated from relatively slender sections as are the purlins, but they remain intact and largely free from corrosion. The roof covering has been compromised, with openings where the steel has corroded, allowing rainwater penetration. The vertical timber cladding is in good condition, but as with the roof cladding, it is not weathertight, presumably to allow air flow within the building, reflecting its agricultural use. The steel framing to the lean to is in reasonable conditions with some local corrosion to the base of the columns, where they meet the cast insitu pad foundations. Lateral stability is provided by the adjoining Dutch Barn and longitudinal stability is provided by the knee bracing at the column heads and the plan bracing to one end bay of the roof structure.

The masonry walls that enclose the Dutch Barn are substantial and in sound condition. They remain plumb and are free of visual signs of lateral or vertical movement. The floor slab within the Dutch Barn appears level and has does not appear to have been adversely affected by the storage of materials or farm machinery. The lean-to structure has a compacted hardcore base in some areas but no floor slab. There are no rainwater goods on the Dutch Barn. The Lean-to has a gutter running its full length, but the original downpipes are missing.

Structural Assessment

In assessing a structure of this nature to determine its potential for conversion to an alternative use, its' ability to provide the necessary resistance to the dead, imposed and wind loads that it has been subjected to in its former use is likely to be more informative than a simple, direct comparison with the requirements of modern design standards for agricultural/industrial buildings. The key considerations are whether the structure has performed satisfactorily in its current use and how the proposed change of use may either lead to increase in load or a change to how the loads will be applied and distributed around the structure.

From a visual inspection it is apparent that both structures have been capable of resisting the combination of loads to which they have been subjected to date. The buildings would appear to have remained stable and whilst some repairs have been undertaken over the course of their lives, each structure in its current condition remains sound. The masonry walls, which appear to be a later addition to the original structure are substantial and robust, extending below the floor slab onto a form of concrete strip footing. Similarly, the steel columns would have been constructed on mass concrete pad foundations.

Both the masonry and steel framed structures would appear to be adequately supported, such that they can be retained as the principal loadbearing elements of a converted building. Whilst the high-level timber wall cladding is sound, it could not be considered suitable for enclosure of habitable accommodation. However, the provision of existing cladding rails is such that replacement with a modern, insulated cladding system, incorporating openings for external windows, is entirely feasible.

The existing structure has the capacity to accommodate the resulting increase in vertical load. Similarly, the block masonry walls are such that the formation of openings for windows and doors would not compromise their integrity. The installation of fully or partially glazed screens to the open sections of the front elevation would be required, fixed to the steel frame and masonry piers without detriment. The blockwork to the external elevations of the Dutch Barn is suitable for over cladding with a system that incorporates a suitable moisture barrier. The required level of thermal insulation to the blockwork can be provided by an internal lining of insulated plasterboard, with an integral vapour control layer. This would provide a suitable external wall construction that would meet the thermal performance requirements of the current Building Regulations within the load capacity of the existing structure.

The renewal of the roof cladding required to meet current standards of thermal performance and resistance to the passage of moisture, will lead to an increase in dead load to be carried by the steel frame. The live load and wind load applied through the roof cladding will remain as before. The proposed change of use would result therefore in a moderate increase in load on the roof structure, which the new cladding system would need to be capable of transmitting safely to the existing steel frame. The eaves level support channels can accommodate this increase in load and could work with a stiffened, built-up standing seam system that that follows the existing curved profile with integral stiffeners and quilt insulation over an underlining tray. A system such as “Euroseam” would be appropriate. This would encapsulate the existing angle purlins and the trusses would remain to continue to tie the tops of the steel columns for structural integrity. Alternatively, renewal of the single skin cladding spanning onto the purlins and trusses could be considered, with a secondary insulated composite panel system installed at eaves level, spanning between the existing eaves beams.

The existing floor slab in the Dutch Barn is clearly capable of sustaining a relatively high imposed load, such as is associated with agricultural and commercial use, both of which are considerably higher than that required for residential use. The slab is however not likely to incorporate any thermal insulation and may not have a damp proof membrane but would form a suitable substrate to support a new built-up ground floor, comprising a damp proof membrane laid over the slab with rigid board insulation and a sand cement screed above. The floor slab would also be capable of supporting internal lightweight partition walls to sub-divide the accommodation as required. The installation of new mechanical and electrical services would not compromise the existing structure and with existing nearby connections available for surface and foul water systems the provision of suitable sanitary facilities would be relatively straightforward.

For the lean-to, replacement of the roof cladding with a built-up system, spanning onto the existing purlins would be feasible. However, there are no existing external walls that can be upgraded to meet current regulations and therefore new steel framing, or masonry walls built off new footings would be required if this was to be included on the proposed conversion. The Lean-to would also require a new floor slab, incorporating a damp proof membrane and insulation if it were to be converted.

Conclusion

The Dutch Barn structure in its current form would appear to be suitable for conversion to residential use. The existing cladding systems will need to be replaced with suitable modern alternatives, along with new screens inserted into the full height openings to provide the level of thermal performance required by current Building Regulations and to ensure a watertight envelope. The associated changes to the external envelope to provide door and window openings would not compromise the integrity of the structure. Introduction of mechanical and electrical services, foul and surface water drainage systems can also be completed without weaking the structure, which will remain capable of sustaining the dead, imposed and wind loads to which it will be subjected to.

The lean-to structure appears stable and could be converted with the existing steel frame retained. To make a weatherproof enclosure would however require extensive work to supplement this existing structure, with new external walls and floor slabs. Alternatively, the lean-to could be retained in its current form as an open structure, providing covered amenity space at the rear of the converted barn.

The Structure of the Dutch Barn appears suitable for conversion without the need for any structural improvement of the floor slab, foundations, steel framing or the masonry walls and it lends itself readily therefore to conversion for residential use.

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