



Site Address:

279 Broadgate,
Sutton St Edmund,
Cambridgeshire.
PE12 0LT

Purpose of Report:

The purpose of the survey and associated report is to discern the condition of an existing Structure, located to the land at the above address. The survey aims to further ascertain the general level of works required to convert this structure into a residential building.

Summary:

An existing Pole Barn, formed from timber throughout, the structure offers an existing framing system that is sufficiently robust for inclusion within a residential property. Existing structural elements, including columns, pad foundations and infill timber beams may be incorporated into the revised structure, as a means to transfer loads to ground level. The inclusion of new structural infill members would improve the robustness of the building by restraining existing structural members, thereby increasing their structural capacity significantly.

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Site Location:

The site is located in an existing field, set to open rural land, to the rear of existing residential units.



Image 1.0: Aerial View of Site location.

Access to the site is via a made track, formed from Gravel in part and graded Type 1 aggregate, reducing to a grassed track. A series of mature trees form the boundary to the site, to the north of the existing structure.



Image 2.0: View of Access track.



Overview of Structure:

The structure, which is divided into two distinct sections, is agricultural in nature, having been employed in the rearing of livestock and the storage of hay bales. It is noted that finished floor level comprises bare earth.

Front Section of Structure:

The front consists of an enclosed area, with mezzanine floors running either side of a central aisle. Access is via an opening to the front elevation, with timber posts incorporated into the framing of the entrance.



Image 3.0: Entrance to front of structure.

The front and side elevations incorporate horizontal timber side rails, spanning between timber columns. Vertical half rounded timber cladding sections are affixed back to the side rails at suitable centres, forming infill screens.



Image 4.0: View to interior of front half of structure.

Rear section of Structure:

The rear of the structure incorporates a full height store, with side access via a full width, full height opening. The area is enclosed internally on one side by horizontal timber boarding running ground to eaves level, dividing the rear of the structure from the front.



Image 5.0: Side Elevation, with opening to rear section of barn.



The Westerly and Northerly elevations incorporate infill screens matching those to the front of the building.



Image 6.0: View of timber columns to existing Barn.

Structural Framing:

The entire structure incorporates a series of square timber columns, set on a grid at approximately 4 meter centres. Columns span ground to eaves level. At base level, columns were found to be set to concrete pads, formed below ground level.

Columns were found to be approximately 250x250mm on plan, with a length of 4 meters to eaves level. To the roof, Primary timber beams span between columns, with rafters spanning perpendicular at approximately 1 meter centres between. The roof finish comprises steel pressed cladding, set to span between timber rafters.

Timber rafters were noted as being supported off primary beams and columns via zinc plated side fixed joist hangers.



Image 7.0: View of rafters to rear half of structure, supported from columns and Primary beams.

Pad foundations:

Exposure of a Pad foundation to the centroid of the Southerly elevation revealed a rectangular concrete mass, formed to the perimeter of the timber post. The concrete was found to extend out 600mm from the face of the column, with a width of 400mm and depth of 600mm. Pad foundations were found to be set to firm clay.



Image 8.0: View of Pad foundation to existing column.



Function of structural members:

In reviewing the structure, it was considered that it functions via transfer of vertical and limited horizontal loads as follows:

- Rafters, spanning between Primary timber members and columns, carry vertical loads imparted by Snow and self weight. Wind loading, where present, forms uplift. Given that the pitch of the roof is shallow, positive pressure from wind loading cannot develop.
- Rafters further provide restraint to the structure at eaves level, transferring lateral forces applied to external elevation by wind loading, back through the structure to locations where it can be resisted by plate action.
- Primary timber beams provide restraint to the head of columns in the opposite direction to rafters, transferring lateral forces applied to the external elevation by wind loading, back through the structure to locations where it can be resisted by plate action.
- Primary timber members further transfer vertical loads from rafters back into columns in the form of axial loads, applied eccentrically.
- Infill panels to the external perimeter of the structure are formed from equally spaced half round timber sections. The shape of the sections, coupled with gaps between each individual member yields eddy shedding, reducing overall wind loading on the structure, hence limiting sway due to wind loading. However, horizontal forces due to wind, although limited, are carried by infill panels and transferred back via horizontal members to columns at eaves level and mid span. These loads are carried through shear at pad foundation level and axial loading in rafters/ primary timber members at roof level. Infill panels running perpendicular remove lateral wind loading via racking, converting wind loads into axial loads in columns.



Image 9.0: Infill panel to exterior of structure

- Columns carry axial load, bending due to eccentric loading and bending at mid span applied by infill panels. Loads applied to the columns are restrained laterally at the head via rafters and both laterally and vertically at the base via concrete pad foundations.
- Given the aspect ratio of the structure, sway is removed via pad foundations through rotation about an axis running along the line of the main elevations. In the opposite direction, sway due to wind parallel to the main elevations is removed via racking action in the infill panels.



Inspection of Structural members:

In reviewing the structural members, the following was noted:

- Timber columns span from pad foundation to Eaves level. Restraint to the columns is provided predominantly along one axis, with the other axis having an effective length equal to $1.2 \times$ overall length. It is therefore surmised that the full compressive strength of the timber is not being utilized. Timber columns were found to be in good overall condition, with limited deterioration and no signs of stress induced damage. Columns were found to remain straight and true.
- Primary timber beams were found to be restrained at suitable centres by rafters, yielding members that showed limited deflection- hence inferring limited stress. Given the lateral restraint provided by rafters, it is considered that the maximum bending strength of primary timber beams is available in the existing structure. Similarly, in considering axial loads within the members, intermediate restraint to the minor axis yields structural members that are not slender.
- To the rear section of the barn , rafters were found to be overly stressed, with significant deflection at mid span. This was considered a result of the considerable span of the structural members, as opposed to the magnitude of loading.



Image 10.0: Excess deflection to rafters over rear Section of structure.



Review of findings in lieu of Proposal:

In reviewing the existing structure, with a view to conversion to residential, it is considered that:

- The existing structural elements to the flat roof require remedial works so as to facilitate the formation of an insulated, weatherproof finish, capable of supporting additional loads, without detrimental effects to finishes. To this end, further structural elements would be required, along with upgrading to existing end support conditions.
- Existing timber columns are considered sufficient for the given task, wherein loads from the roof would be carried in bearing by the columns.
- Replacement of existing infill wall panels would be required, so as to facilitate sufficient insulation, provide a weatherproof finish and provide a suitable finish internal to the structure. In reviewing the existing structure, it is proposed that a solution, similar to that already employed is utilized, wherein wall panels are set between existing columns. These in turn would provide robust bracing to columns, reducing their effective lengths to an extent that facilitates additional loads associated with a heavier roof finish.
- A new floor, internal to the existing structure would be required. This should be formed from concrete and would provide a surface onto which studwork partitions can bear, carrying loads from a potential first floor over. Formed within the demise of the existing structures footprint, the new floor would permit the distribution of loads into the ground, without imparting additional loads on existing columns.
- Notably, infill racking panels would remove lateral sway from the structure, increasing the axial load capacity of pad foundations, thereby permitting the inclusion of a heavier roof finish.



Conclusion:

It is concluded that the structure is suitable for inclusion in the formation of a new residential property. Existing primary structural members including columns, primary beams and pad foundations offer framing into which new elements can be affixed, improving the robustness of the structure and permitting increased loads applied at roof and internal floor levels to be carried.

It is noted that over-stressed structural elements are limited to secondary members. This in itself allows for the potential to provide additional elements, without changing existing load paths.

The inclusion of racking walls and a concrete floor, all within the demise of the existing structure would introduce local stability to existing structural elements, allowing for the inclusion of additional materials at roof level

In reviewing individual structural elements, they were found to be in good physical condition, with limited signs of deterioration. To this end, remedial works would be limited, reducing the need to overhaul existing structural elements prior to conversion from Agricultural to residential use.