Mrs J Clay
Ramhurst Barns
Powder Hills Lane
Leigh
Kent TN11 9AS

Ref AJL/JC/22227
24 October 2023

Ref: STRUCTURAL APPRAISAL OF AGRICULTURAL BARN AT RAMHURST BARNS POWDER HILL LANE LEIGH KENT

Dear Mrs Clay,
I write to report the findings of my structural assessment of the agricultural barns and their suitability to be converted to domestic type properties. Survey carried out in October 2023. The weather was sunny at the time of the visit.

The three barns in question form the a ñZò shape floor plan configuration, with a domestic attached garage on one of the corners that is not part of this assessment or conversion.

The three barns are open fronted timber framed, clay tiled pitched roof buildings. All off masonry plinth walls with weather boarded finish external with a mix of brick/concrete strip and concrete pad foundations. The ground floors are either concrete slabs or plain soil.

The first barn nearest the main drive is a **Four bay more period type timber frame building**; cut timber rafters over timber purlins clasped into the higher level timber collars with timber main tie beams dovetail jointed into the top of a perimeter timber eaves beam, all supported off timber posts on the front elevation and the nine inch solid masonry brick wall to the rear and sides. The barn has hipped ended roof onto timber load bearing stud wall to the ends/flanks. The building achieves its stability through inclusion of diagonal bracing in the timber walls, the rear masonry wall, coupled with some knee bracing to the front posts. The timber work, though historic, has been looked after and is in good order. The rear right hand corner of the building has sections of black iron strapping on the corner to arrest the historic movement that has taken place.

The roof is already supporting a full clay tile roof without issue and will be adequate to take the additional load of insulation and finishes limited structural improvement, see attached structural check calculations. The building will be subjected to very small increase in load and the existing foundations rear wall and posts are on foundations and are suitable for conversion.

The barn has a soil floor so this will be replaced with a concrete slab.

The second barn, the central section of the ñZò, is a more substantial higher timber barn. It is understood that the original historic barn was once thatched, but this caught fire and burnt to the ground in 1970ĉs and was rebuilt entirely, to a slightly different footprint though many of the charred timbers were reused in the new structure, and can be seen to be older reused timbers. There are charring marks on some of the timber posts and beams, but the structure has been fully rebuilt/replaced.

The timber frame building consists of; cut timber 100x50 rafters at 400mm centres over double 230mmx100mm timber purlins which span onto fabricated timber trusses at 4.5m centres. There are also similar sized timbers as the eaves and the rear catslide roof, where the rafters span down onto the rear timber stud weather boarded wall. the purlins span onto the timber load bearing stud wall to the ends of the barn. The building achieves its stability through inclusion of diagonal bracing in the timber walls coupled with some knee bracing to the front and internal posts. The timber work, though historic and chard in places, has been looked after and is in good order.

The timber frame is supported off masonry plinths under the walls and concrete padstones under the posts, all of which looks to be holding the building straight, in line and level and showing little sign of movement. However, through trial hole investigation, the rear wall of the barn has been found to have limited foundation and a level of underpinning will be required to enable conversion of this section of the property. The superstructure of the barn is considered structurally acceptable, with limited improvements, to be converted to a domestic property.

The final barn is a single storey barn consisting of a series of five bays of cut timber roof of 150x50 C24 rafters, 200x50C24 ceiling joists all at 400mm centres spanning onto a solid 225mm brick rear wall and a series of 150mm deep x 175 mm wide front eaves beams spanning posts to post assisted with knee braces into 150x150mm timber posts off saddle stone supports of assumed pad foundations. looking at the timbers the building roof structure looks to have been rebuilt, again due to the fire damage.
The barn is standing straight and vertical showing no signs of overall settlement/subsidence issue and the superstructure will be more than adequate for the conversion.

This section of the barn has adequate foundation for the conversion. The floor is a soil floor so will need a more formal concrete slab installed in the conversion works.

In conclusion I consider the existing property is suitable to be converted to a domestic property without large scale structural improvement to the existing structural fabric.

See also attached check calculations on the main structural elements of the existing barn.

I have included some of the pictures take during the survey for information.

I trust this covers your requirement but if you have any questions please get in contact.

Yours sincerely

Andrew Locke MIStructE CEng
DIRECTOR

For and on behalf of AJ Locke Consulting Engineers Ltd
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STRUCTURAL CALCULATIONS COVERING DESIGN CHECK OF AN EXISTING AGRICULTURAL BARN FOR CONVERSION TO A DOMESTIC HOUSE AT RAMHURST BARNS POWDER HILLS LANE LEIGH KENT

STRUCTURAL CALCULATIONS COVERING DESIGN CHECK OF AN EXISTING AGRICULTURAL BARN FOR CONVERSION TO DOMESTIC HOUSE AT RAMHURST BARNS POWDER HILLS LANE LEIGH KENT

Client:	Project Site Address:
Mrs Clay	As above

Prepared By:

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CONTENTS

1.0 INTRODUCTION

The following structural calculation covers the outline feasibility structural design check of an agricultural barn for conversion to domestic house. The barn has a tiled roof over timber rafters and timber purlins over timber trusses set at between 3.3m to 4.3m centres spanning the width of the existing timber framed barn. the barn walls are built off a masonry brick plinth of a mix of good to limited foundations.

Sway stiffness is achieved through wall sheathing and knee bracing in the timber frame.

2.0 Typical loads

Pitched Roof
Snow load 0.5kn/m^2 x0.8=0.4kn/m2
Dead load; tiles 0.6kn/m^2
Rafter 0.05kn/m^2
Total 1.1kn/m^2

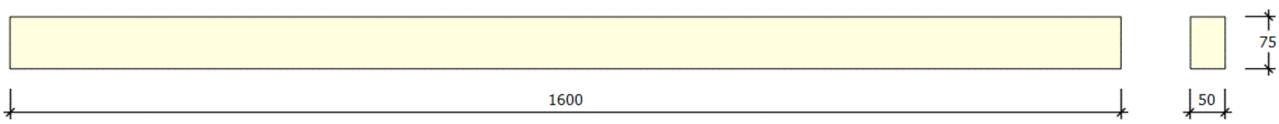
Upper floor
Live load 1.5kn/m^2
Dead load; 0.5kn/m^2
Partitions 0.5kn/m^2
Total 2.5kn/m^2

Stud walls
Plaster board 0.14kn/m^2
Studs 0.1kn/m^2
Total 0.24kn/m^2 x 2.4m = 0.6kn/m run

3.0 Structural design check

MASTERKEY : TIMBER DESIGN

BEAM DESIGN TO BS 5268 : PART 2
Pitched roof rafter check



Summary Design Data

Section Size	b = 50, h = 75, 75x50 in Strength Class C24
Section Properties (cm²,cm⁴,cm³)	Area 37.5, Ix 175.8, Z 46.9
Specification	2 : Covered and generally unheated, Medium Term loading Load sharing
Beam data	Span 1.6 m, Spacing 0.4 m, Bearing length B 50, Distance to Bearing 0 mm
Beam loading	Dead load 1.2 kN/m², Live load 0.6 kN/m²

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{m.adm} = K_2.K_3.K_7.K_8.\sigma_m$	1.00 x 1.25 x 1.16 x 1.10 x 7.50	12.01 N/mm²	
$\sigma_{c}\perp_{.adm} = K_2.K_3.K_4.K_8.\sigma_c\perp$	1.00 x 1.25 x 1.00 x 1.10 x 1.90	2.61 N/mm²	
$\tau_{adm} = K_2.K_{3\_}.K_8.\tau$	1.00 x 1.25 x 1.10 x 0.71	0.98 N/mm²	
$E = K_2.E_{mean}$	1.00 x 10800	10800.0 N/mm²	

Design Loads

Density and Selfweight	Timber Density 420 kg/m³, Fj 0.02 kN/m		
w = (Fd+Fl).s+Fj	(1.20 + 0.60) x 0.4 + 0.02	0.74 kN/m	

Bending Check

M=w.L²/8	0.74 x 1.6 ² / 8	0.237 kN.m	
$\sigma_{m.a}$ = M/Z	0.237 / 46.88 ≤ 12.01	5.05 N/mm²	OK

Shear and Bearing Check

Fv=w.L/2	0.74 x 1.6 / 2	0.592 kN	
τ_a= 1.5 Fv / Area	1.5 x 0.592 / 37.5 ≤ 0.98	0.24 N/mm²	OK
$\sigma_c\perp_a$ = Fv / (b.B)	0.592 / (50 x 50) ≤ 2.61	0.24 N/mm²	OK

Deflection Check

δ_m= 5.w.L⁴/(384.E.Ix)	5 x 0.74 x 1.6⁴ /(384 x 10800 x 175.8)	3.33 mm	
δ_s= 12.w.L² / (5.E.Area)	12 x 0.74 x 1.6² / (5 x 10800 x 37.5)	0.11 mm	

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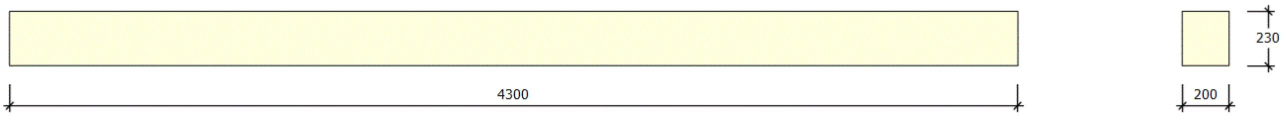
$\delta = \delta_m + \delta_s$	$3.33 + 0.11 \leq L/300$	3.44 mm	OK

MASTERKEY : TIMBER DESIGN

BEAM DESIGN TO BS 5268 : PART 2
Purlin



Summary Design Data

Section Size	b = 200, h = 230, 230x200 in Strength Class C24
Section Properties (cm^2,cm^4,cm^3)	Area 460, Ix 20278.3, Z 1763.3
Specification	2 : Covered and generally unheated, Medium Term loading 2 pieces of softwood, Use minimum modulus
Beam data	Span 4.3 m, Spacing 1.6 m, Bearing length B 50, Distance to Bearing 0 mm
Beam loading	Dead load 1.0 kN/m², Live load 0.6 kN/m²

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{m.adm} = K_2.K_3.K_7.K_8.\sigma_m$	1.00 x 1.25 x 1.03 x 1.00 x 7.50	9.65 N/mm²	
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.25 x 1.00 x 1.00 x 1.90	2.38 N/mm²	
$\tau_{adm} = K_2.K_{3\_}.K_8.\tau$	1.00 x 1.25 x 1.00 x 0.71	0.89 N/mm²	
$E = K_2.K_9.E_{min}$	1.00 x 1.14 x 7200	8208.0 N/mm²	

Design Loads

Density and Selfweight	Timber Density 420 kg/m³, Fj 0.19 kN/m		
w = (Fd+Fl).s+Fj	(1.00 + 0.60) x 1.6 + 0.19	2.75 kN/m	

Bending Check

$M=w.L^2/8$	2.75 x 4.3 ² / 8	6.356 kN.m	
$\sigma_{m.a} = M/Z$	$6.356 / 1763.33 \leq 9.65$	3.60 N/mm²	OK

Shear and Bearing Check

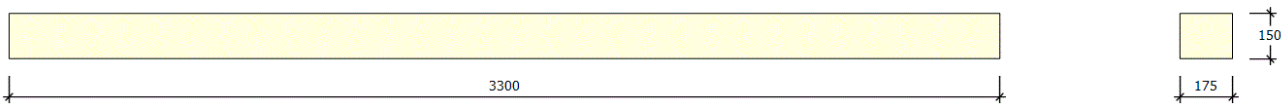
Fv=w.L/2	2.75 x 4.3 / 2	5.913 kN	
τ_a= 1.5 Fv / Area	$1.5 \times 5.913 / 460 \leq 0.89$	0.19 N/mm²	OK
$\sigma_{c\perp a}$ = Fv / (b.B)	$5.913 / (200 \times 50) \leq 2.38$	0.59 N/mm²	OK

Deflection Check

$\delta_m = 5.w.L^4/(384.E.Ix)$	$5 \times 2.75 \times 4.3^4 /(384 \times 8208 \times 20278.3)$	7.35 mm	
$\delta_s = 12.w.L^2 / (5.E.Area)$	$12 \times 2.75 \times 4.3^2 / (5 \times 8208 \times 460)$	0.32 mm	
$\delta = \delta_m + \delta_s$	$7.35 + 0.32 \leq L/300$	7.68 mm	OK

MASTERKEY : TIMBER DESIGN

BEAM DESIGN TO BS 5268 : PART 2
Pitched roof eaves beam



Summary Design Data

Section Size	b = 175, h = 150, 150x175 in Strength Class C24
Section Properties (cm^2,cm^4,cm^3)	Area 262.5, Ix 4921.9, Z 656.3
Specification	2 : Covered and generally unheated, Medium Term loading Use minimum modulus
Beam data	Span 3.3 m, Spacing 1.5 m, Bearing length B 50, Distance to Bearing 0 mm
Beam loading	Dead load 1.3 kN/m², Live load 0.6 kN/m²

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Grade and Admissible Stresses (Strength Class C24)

$\sigma_{m.adm} = K_2.K_3.K_7.K_8.\sigma_m$	1.00 x 1.25 x 1.08 x 1.00 x 7.50	10.12 N/mm²	
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.25 x 1.00 x 1.00 x 1.90	2.38 N/mm²	
$\tau_{adm} = K_2.K_3\_.K_8.\tau$	1.00 x 1.25 x 1.00 x 0.71	0.89 N/mm²	
$E = K_2.K_9.E_{min}$	1.00 x 1.00 x 7200	7200.0 N/mm²	

Design Loads

Density and Selfweight	Timber Density 420 kg/m³, Fj 0.11 kN/m		
w = (Fd+Fl).s+Fj	(1.30 + 0.60) x 1.5 + 0.11	2.96 kN/m	

Bending Check

$M=w.L^2/8$	2.96 x 3.3 ² / 8	4.029 kN.m	
$\sigma_{m.a} = M/Z$	4.029 / 656.25 ≤ 10.12	6.14 N/mm²	OK

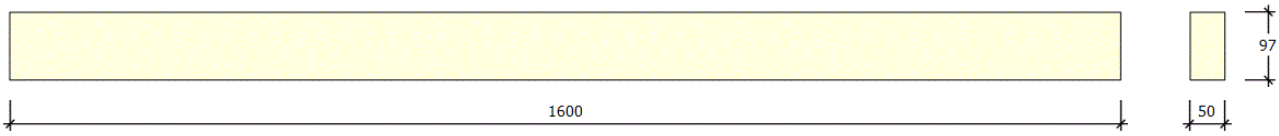
Shear and Bearing Check

$F_v=w.L/2$	2.96 x 3.3 / 2	4.884 kN	
τ_a= 1.5 Fv / Area	1.5 x 4.884 / 262.5 ≤ 0.89	0.28 N/mm²	OK
$\sigma_{c\perp a}$ = Fv / (b.B)	4.884 / (175 x 50) ≤ 2.38	0.56 N/mm²	OK

Deflection Check

$\delta_m= 5.w.L^4/(384.E.Ix)$	5 x 2.96 x 3.3⁴ /(384 x 7200 x 4921.9)	12.90 mm	
$\delta_s= 12.w.L^2 / (5.E.Area)$	12 x 2.96 x 3.3² / (5 x 7200 x 262.5)	0.41 mm	
$\delta = \delta_m+ \delta_s$	12.90 + 0.41 ≤ L/250	13.31 mm	Warning

BEAM DESIGN TO BS 5268 : PART 2
Pitched roof rafter check



Summary Design Data

Section Size	b = 50, h = 97, 97x50 in Strength Class C24
Section Properties (cm²,cm⁴,cm³)	Area 48.5, Ix 380.3, Z 78.4
Specification	2 : Covered and generally unheated, Medium Term loading Load sharing
Beam data	Span 1.6 m, Spacing 0.4 m, Bearing length B 50, Distance to Bearing 0 mm
Beam loading	Dead load 1.2 kN/m², Live load 0.6 kN/m²

Grade and Admissible Stresses (Strength Class C24)

$\sigma_{m.adm} = K_2.K_3.K_7.K_8.\sigma_m$	1.00 x 1.25 x 1.13 x 1.10 x 7.50	11.68 N/mm²	
$\sigma_{c\perp.adm} = K_2.K_3.K_4.K_8.\sigma_{c\perp}$	1.00 x 1.25 x 1.00 x 1.10 x 1.90	2.61 N/mm²	
$\tau_{adm} = K_2.K_3\_.K_8.\tau$	1.00 x 1.25 x 1.10 x 0.71	0.98 N/mm²	
$E = K_2.E_{mean}$	1.00 x 10800	10800.0 N/mm²	

Design Loads

Density and Selfweight	Timber Density 420 kg/m³, Fj 0.02 kN/m		
w = (Fd+Fl).s+Fj	(1.20 + 0.60) x 0.4 + 0.02	0.74 kN/m	

Bending Check

$M=w.L^2/8$	0.74 x 1.6 ² / 8	0.237 kN.m	
$\sigma_{m.a} = M/Z$	0.237 / 78.41 ≤ 11.68	3.02 N/mm²	OK

Shear and Bearing Check

$F_v=w.L/2$	0.74 x 1.6 / 2	0.592 kN	
τ_a= 1.5 Fv / Area	1.5 x 0.592 / 48.5 ≤ 0.98	0.18 N/mm²	OK
$\sigma_{c\perp a}$ = Fv / (b.B)	0.592 / (50 x 50) ≤ 2.61	0.24 N/mm²	OK

Deflection Check

$\delta_m= 5.w.L^4/(384.E.Ix)$	5 x 0.74 x 1.6⁴ /(384 x 10800 x 380.3)	1.54 mm	
$\delta_s= 12.w.L^2 / (5.E.Area)$	12 x 0.74 x 1.6² / (5 x 10800 x 48.5)	0.09 mm	

$\delta = \delta_m + \delta_s$	$1.54 + 0.09 \leq L/300$	1.62 mm	OK

Pad foundation check

Axial load=roof 1.8kn/m2x4.3mx5.8m/2=22.5
Proposed 1st floor 2.6kn/m2x4.3mx5.8m/2=32.4kn
Wall 1kn/mx4.3m=4.3kn
Total=59kn/0.8mx0.8m=92kn/m2, acceptable onto firm clay formation.

Pad foundations acceptable for new floor loads.

Photos taken during survey.

 Barn 1, period timber framed 3 bay barn.

Typical roof arrangement of Barn 1

 Typical roof arrangement of Barn 1


brick work piers in Barn 1


Timber posts with knee bracing, barn 1


Barn 2, mid section.

 Typical timber arrangement in Barn 2

 Barn 2 timber post with knee bracing.

 Typical truss connection detail, with tie beams showing charring from previous fire.

 Truss detail.


Timber post on concrete plinth, and existing concrete slab.


Existing blockwork wall in barn 2.


Barn 3, 5 bay timber framed barn with masonry rear wall.


Roof timbers to barn 3

 Barn 3 post and knee bracing detail.

Masonry rear wall.