Ref 3.448

April 2018

OUTBUILDINGS

AT

RUDDA FARM

STAINTONDALE, NORTH YORKSHIRE

FOR

MR M ELSE

STRUCTURAL APPRAISAL

Prepared by

Richard Agar
Associates Limited
Consulting Civil & Structural Engineers
Established 1988

Ivy House Farm, 8 Main Road, Aislaby, WHITBY, North Yorkshire, YO21 1SW

The Institution of Structural Engineers

Chartered Institute of Arbitrators

Institution of Civil Engineers

STRUCTURAL APPRAISAL
OF
OUTBUILDING
AT
RUDDA FARM, STAINTONDALE
NORTH YORKSHIRE
FOR
MR M ELSE

1.0 BRIEF:-

This report has been prepared on the instruction of Mr Else. The report is required to provide supporting information regarding a planning application to convert redundant outbuildings into a dwelling.

We have previously visited these buildings in August 1996 and also July 2011. While this report is required to update earlier reports, it is also extended to include additional outbuildings that form part of the current planning application.

The objective of this report is:-

- to provide a general appraisal of the current structural status of the outbuilding.
- to comment on the structural implications, if any, of the proposed change of use.

This report is NOT a full structural specification for carrying out the works.

We have not inspected the woodwork or other parts of the structure which are covered, unexposed or inaccessible and we are, therefore, unable to report that any such part of the property is free from defect.

Dimensions noted in this report are rough visual estimates for identification purposes only. No actual measurements have been taken at the site.

2.0 INTRODUCTION:-

The outbuildings which are the subject of this report are located immediately to the North of the main farm house at Rudda Farm (indicated Cottage 'A'; 'B'; 'C' & 'D' on attached sketch).

The eastern leg (as previous report) of the building is approximately 17 metres long x 5.5 metres wide (indicated as cottage 'A' & 'B' on sketch plan). The northern leg (new addition to planning application-marked cottage 'C' & 'D' on sketch plan) is approx 30 metres long x 5-6 metres wide.

2.1 Grid Reference:-

The Ordnance Survey grid reference is SE 981/996

2.2 Date of Visit:-

The site was visited for the purpose of this report on the 5th April 2018. Previous inspections were made on 22nd August 1996 and 20th July 2011.

2.3 Weather:-

The weather was mild and dry. Recent months have been particularly wet and windy.

2.4 Topography:-

The site is situated in an elevated location near the coast on the North York Moors. The building is approximately 1 km from the cliffs and 180 metres above sea level. There is a modest slope down towards the South East across the site.

Vegetation immediately adjacent to the building is minimal comprising surfaced yard or unsurfaced tracks.

2.5 Geology:-

The British Geological Survey sheet 44 (one inch series) indicates that the subsoil should comprise Boulder clay over shale and sandstone beds of the Lower Oolite Series. The map indicates a geological fault close to the site.

The Ordnance Survey map indicates that there are springs in the area.

At this stage no subsoil investigations have been carried out.

3.0 GENERAL:-

3.1 Type of Building:-

The buildings are redundant farm outbuildings. They have generally been used as loose boxes for stock or stables in the past (more modern outbuildings have been added some time ago to the northern elevation). The age of the outbuildings is not known, but we anticipate that it is over 100 years old. Some first floor timbers appear to be more recent.

The buildings are essentially single storey stone construction with steeply pitched roof. Height to eaves is approximately 3.5 metres and this has provided sufficient room for a first floor within the roof space on the eastern leg. The wall of the West elevation comprises clay brick rather than stone.

3.2 Overall Stability:-

Overall stability is provided by the stocky proportions of the walls, which contain few and modest openings.

On the eastern leg, there are at least two main internal cross-walls to assist with general lateral stability of the external walls. On the northern leg there are 3 main cross-walls.

The roof is a traditional timber purlin and rafter construction. This type of construction did not traditionally include any bracing and is prone to lateral spread at the eaves.

3.3 Past Alterations:-

Past alterations to the eastern leg appear to have been minimal and limited to one or two small openings that have been altered or blocked up. On the northern leg some openings are quite large for machine/stock circulation and some walls have been replaced with concrete blockwork. All alterations appear quite old.

4.0 OBSERVATIONS:-

Where appropriate we have classified the visible signs of damage/movement to the building in accordance with Building Research Establishment digest no. 251 (BRE 251) "Assessment of damage to low-rise buildings". The digest has six categories '0' (negligible) to '5' (very severe).

All dimensions quoted in this report are approximate for identification purposes only.

4.1 EASTERN LEG

(denoted cottage 'A' & 'B' on sketch plan)
This leg was included in previous reports/applications and thus notes have been edited/updated from previous reports.

West Elevation (Eastern leg):-

This elevation faces the yard to the rear of the main farm house. The wall is approximately 17 metres long x 3.5 metres to eaves. Adjacent buildings provide a modest amount of shelter from the weather.

The wall generally comprises clay brickwork of solid 225mm thick construction. There are small piers adjacent to main openings. There are sandstone quoins at the Southern gable.

The stone ridge undulates modestly indicating some deterioration of the roof structure. The deflections are less than many other similar buildings that we have inspected.

A significant number of clay pantiles to the roof have been pointed with cement indicating problems with water ingress and general deterioration of the tile fixings. An approx 4m length to the south end has been recovered with tiles.

The eaves masonry is local sandstone on top of the clay brickwork.

Rainwater goods comprise plastic guttering and down pipes which are in need of an overhaul.

Timberwork built into the masonry, such as window frames etc., has been affected by damp and old age and is in need of replacing.

Lintels over the openings vary from timber to stone to concrete and possibly steel. Timber lintels have rotted with damp and age and should be replaced with stone or concrete depending on the actual location.

A lean-to over the yard has steel angles built into the masonry. Corrosion of the steelwork could lead to cracking of the masonry in the future. We assume that this lean-to roof will probably be removed as part of the conversion works. There is some green mould staining locally.

There are visually some minor undulations in the line and level of the wall. Some minor bulging was noted to the walls. The amount of past movement appears to be reasonably minor and probably quite old. The masonry would benefit from some general re-pointing.

Generally observations and degree of damage/movement are very much as previous inspections carried out in 1996 and 2011.

South Gable (Eastern leg):-

(cottage 'A' on sketch plan)
This wall faces the garden of the main farmhouse and is reasonably exposed to the weather.

The wall is approximately 5.5 metres long x 3.5 metres to eaves. Height to apex of the spandrel panel is approximately 2.0 metres above the eaves. The wall comprises solid sandstone blocks and is probably approximately 400mm thick. There is one small window opening at ground floor level.

Re-pointing in the past appears to have been with an excessively strong mortar. It is important that pointing is with a weak mix in order to avoid damage to the relatively weak sandstone masonry.

Past pointing may have covered old cracking. There appeared to be one vertical crack above the small window. The cracking was generally contained within the jointing and limited to approximately 1mm width. There is also similar evidence of cracking towards the western end (over the oil tank).

The vertical nature of the cracking suggested to us there could have been some slight horizontal movement of the roof at the eaves. A modest rotation of the timber purlin combined with some water ingress is the most likely cause of this damage.

Observations and degree of damage appeared very much as our notes taken in 1996 and 2011.

In accordance with BRE digest 251 we would classify the damage on this elevation as category 2 (Slight) for which the digest states "some external re-pointing required to ensure weather tightness"..

We will be recommending re-pointing to the masonry and replacement of the roof timber work.

East Elevation (Eastern leg):-

This elevation faces East and is quite exposed to weather from the North Sea.

Generally proportions are similar to the West elevation.

The wall appears to be of solid sandstone construction. Openings are of generally modest proportions and evenly spread along the length of the wall.

The stone ridge dips occasionally as noted for the West elevation. Small areas of tiles are missing or loose. A small section of roof at the southern end has been recovered.

There are a number of vertical cracks of minor width along the length of the wall. There is also evidence that tie rods have been installed in the past. There were also modest undulations in the line and level of the wall generally.

Noting the age and construction of the building, we felt that the general cracking was probably a result of a deteriorating roof structure combined with water ingress and weathering. The damage did not give us cause for very serious concern, but remedial works as noted later will be required to reduce the likelihood of further damage.

There is only one rainwater down pipe for the reasonably long length of the wall. In view of the exposed location, two would be a more appropriate minimum.

At the Northern end, an old timber lintel was rotting seriously due to damp and age. There was some localised cracking and displacement to the masonry over this lintel.

In accordance with BRE 251, we would classify the visible damage on this elevation as category 2 to 3 (slight to moderate) for which the digest states

"...cracks require some opening up and can be patched by a mason. Re- pointing of external masonry and a small amount of masonry to be replaced".

Notes and observations as previous report dated 1996 and 2011.

North Gable (Eastern leg):-

This elevation is predominantly open for access to adjacent sheds. Masonry piers to the sides of the opening are relatively modern concrete blockwork.

Internal (Eastern leg):-

Internal walls appear to be of clay brickwork. Minor hairline cracks at junctions indicate that lateral movement of external walls has been minimal.

Ground floors generally comprise rough concrete slabs which did not indicate to us that there had been any recent significant movement.

Timber joists to the first floor were typically 75 or 100mm depth x 50mm at 400mm spacings. Ends were built into the solid masonry walls. Although the timbers appeared newer than much of the construction, they are flimsy and have been affected by damp at ends and also in other locations where the roof leaks.

Two timber beams (approximately 225 x 75mm) support the floor over the central loose box. In our view the first floor construction should be replaced and improved.

The roof construction generally comprised clay pantiles on timber lathes on common rafters (75 x 75 @ 400mm c/crs) supported by purlins (vary typ 150 x 75) supported by tied principal rafters at 3.0m c/crs.

The ties to the principal rafters were slightly raised above the eaves. There is a modest tendency for this construction to spread horizontally at the eaves.

In locations inspected, the ends of the rafters were built directly into the masonry.

Replacing the roof timbers with a slightly deeper section rafters is recommended.

The small loose box adjacent to the southern gable has been converted into a shower room and includes a small 1st floor mezzanine floor.

Generally notes/evidence of movement etc were all as previous report.

4.2 NORTHERN LEG

(denoted cottage 'C' & 'D' on sketch plan)

Wall construction varies significantly. Main original external walls are coursed sandstone approximately 450mm thick solid construction. Some walls on the Northern elevation are more modern concrete blockwork.

The roof line undulates quite significantly, particularly at the Eastern end. This usually indicates lateral spread of the roof due to flimsy construction or deterioration of roof timbers with age etc.

Near the centre of this northern leg there is a step in the roof line *(partition between cottage 'C' & 'D')*. At this roof-step there is vertical cracking visible internally in the wall adjacent to the Southern elevation. Externally small vertical cracks are visible. This type of damage appears to be the result of modest lateral spread of the roof. Currently the internal partition is buttressed by a modern concrete block wall (on the Southern side).

On the Eastern half of this leg the roof is supported by 2 no. old King Post trusses. In our view the existing timbers are flimsy and have deteriorated with age. On the Western half of this leg the timber roof trusses are 'ad-hoc' timbers that are old and excessively flimsy.

Generally, there were minor vertical cracks at the junctions of the internal cross walls with the external elevations.

At the Western end there is a short return to the building line. Currently used as a loose box. The Southern gable has been heavily re-pointed and relatively modern doors installed.

Adjacent to the Southern gable there is a significant vertical crack which also shows evidence of horizontal displacement (approximately 60mm) to the flank walls.

Concrete floors are quite rough, but did not indicate evidence of recent movement.

5.0 CONCLUSIONS:-

The building is effectively complete. Taking into account the age and past use of the building, we would describe the essential structure as being in good condition.

Signs of significant structural movement or distress appear to be quite minor.

The building has stocky proportions with few openings and, therefore, overall stability characteristics may be described as inherently good.

The proposed domestic use of the building is unlikely to produce loadings in excess of those that the building has already been subjected to.

While the walls show little signs of lateral movement due to the deteriorating roof, we would advise that measures to improve the stability of the roof and walls should be incorporated into the new works. For the proposed 2-storey sections, steel ridge beams will be required, while for single storey sections prefabricated roof trusses with horizontal ties at eaves level could be used.

This type of existing construction usually is based on shallow foundations. The stone units in a weak mortar provide a wall that is able to accommodate movements due to seasonal variations without resulting in serious structural distress. New works should allow for continued seasonal movements of the foundations.

6.0 RECOMMENDATIONS:-

Generally all our observations were very similar to our 1996 (& 2011) notes. There does not appear to have been any significant deterioration/movement of this outbuilding since our previous inspection in 1996. Recommendations remain very much as our previous reports.

6.1 Roof:-

- Generally replace roof structure with new timbers of deeper section to accommodate insulation, ventilation etc. Include steel ridge beams to design by Chartered Structural Engineer
- Replace tiles on new tanalised battens and roofing felt.
- Lead flashings to verge etc.
- Ends of all timbers to be protected from damp.
- Generally replace and improve rainwater goods.

6.2 Walls:-

- Externally rake out all joints to a depth of at least 15mm and re-point with a mortar no stronger than 1:2:9 cement:lime:sand.
- Install suitable dpc course e.g. chemical injection system by specialist contractor.
- New internal cross-walls to be masonry and to be fixed/bonded to existing walls using stainless steel 'crocodile' strip or other suitable fixings. New cross-walls to extend into roof space to support purlins
- Replace timber lintels with more appropriate stone or concrete type.
- Small localised areas of masonry to be carefully dismantled and re-built:
  - East leg, east elevation near North gable – approximately 3 sq.m.
  - East leg, West elevation – allow 2 sq.m. to replace excessively weathered brickwork.

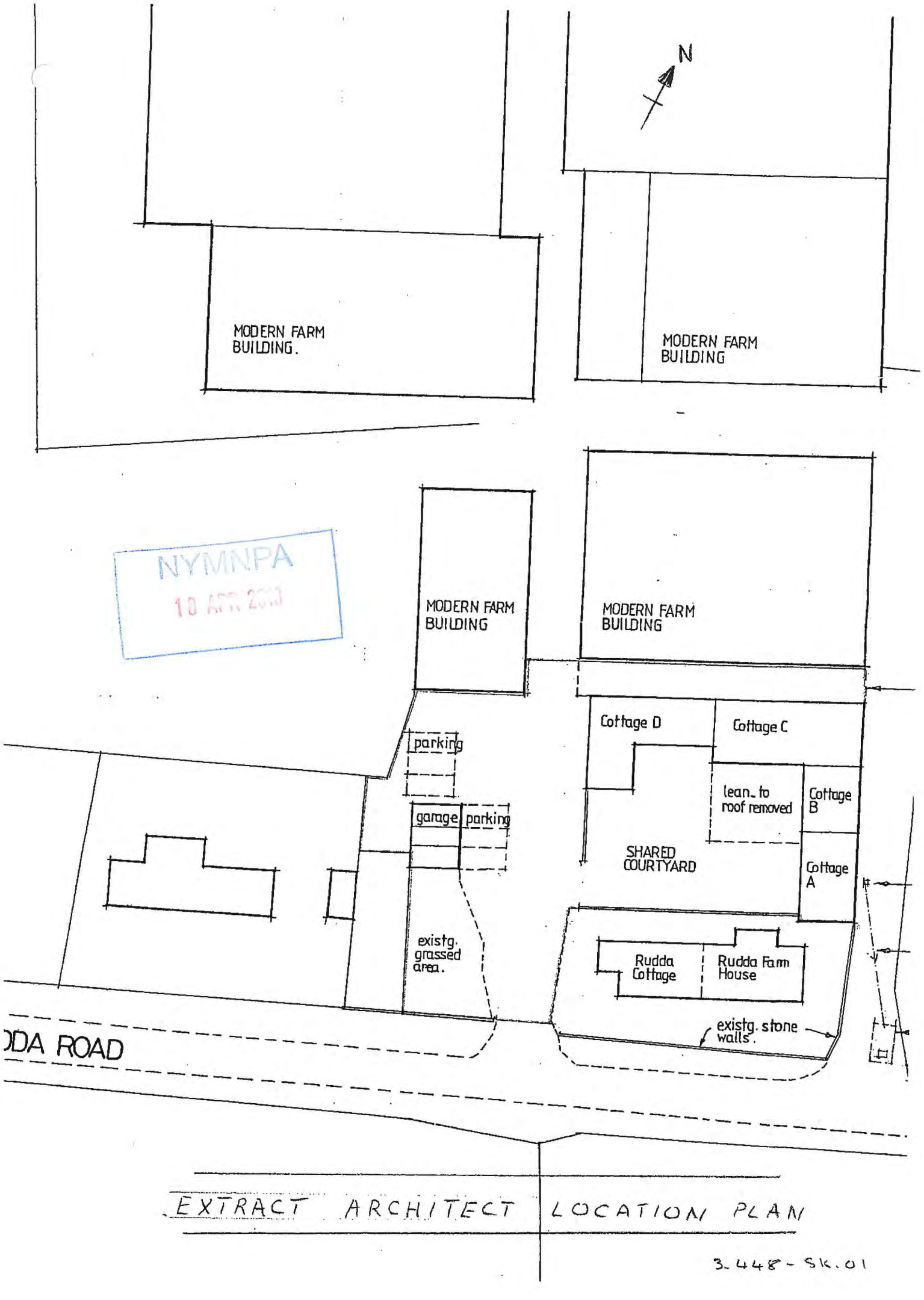
- North leg – step in roof line, 3 sq. metres (gable panel).
- Provide new steel tie rods on eastern leg at first floor level and adjacent to each cross-wall and gables (i.e. 6 nr.)
- Allow various crack repairs to include stainless steel helical bar stitching to masonry (final number to be confirmed on site):
  - West leg; south gable 6.no
  - North leg; Step in roof line: 16 no.
  - North leg; west return: 8 no.

6.3 Floors:-

- Replace first floor timber construction with more appropriate deeper sections.
- Protect ends of joists from damp.
- Replace existing rough floor with new concrete slab on dpm on hardcore bed.

Signed for
Richard Agar Associates Limited,

Eur Ing RICHARD AGAR
BSc(Hons) MSc CEng MIStructE MICE MCS MCIArb
Chartered Structural Engineer
Chartered Civil Engineer



EXTRACT ARCHITECT LOCATION PLAN

3.448 - SK.01

Ref 3.448

April 2018

OUTBUILDINGS

AT

RUDDA FARM

STAINTONDALE, NORTH YORKSHIRE

FOR

MR M ELSE

STRUCTURAL CALCULATIONS

Prepared by

Richard Agar
Associates Limited
Consulting Civil & Structural Engineers
Established 1988

Ivy House Farm, 8 Main Road, Aislaby, WHITBY, North Yorkshire, YO21 1SW

The Institution of Structural Engineers

Chartered Institute of Arbitrators

Institution of Civil Engineers

Ref: 3.448
Project: Conversion of Outbuildings at Rudda Farm, Staintondale.
Client: Mr M Else
Architect / Surveyor: T Horton

CALCULATION RESULTS / SIZE SUMMARY

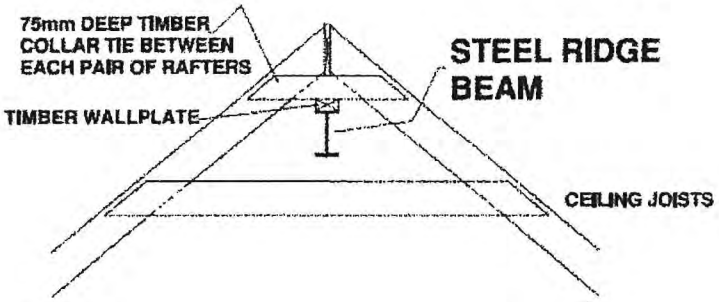
(see sketches on following pages for general locations)

BEAM(S)

Location:	**Size**
B.01-B.03	254 x 146 x 37 kg UB
B.04	254 x 146 x 37 kg UB

(cantilevered ends of ridge beams to be tied together)

B.05 (lintel inner leaf) 152 x 89 x 16 kg UB
(double-up as necessary
or use in conjunction with suitable external leaf lintel)



TYPICAL SECTION (at ridge)

ROOF TIMBERS

Common rafters: 47 x 170 @ 400 mms crs
Grade C.16 timber

GENERAL NOTES:

All steel beams that are to be supported by masonry to have min 100mm bearing each end onto concrete padstones.

Concrete padstones min 440 x 100 (or equivalent area) x 215mm deep. (per leaf – or combine into one larger padstone for pair of beams).
If preferred depth of concrete padstones may be reduced to 150 mm if off-cuts of 150 mm deep pre-cast (reinforced) concrete lintels are used.

DESIGN NOTES

Proposals are for conversion of outbuildings to form accommodation.

Lateral spread of roof to be controlled by providing a steel ridge beams.

1st floor construction to be confirmed by others.

Normal good practice and compliance with Building Regulations assumed
e.g use of mild steel restraint straps at eaves & verge on roof.
adequate propping during installation of new steel beams.
fire protection to steelwork (2 layers plasterboard).

General stability is to be as existing.

Design standards used.

EN 1995-1:2004	Timber
EN 1993-1-1: 2005	Steel
EN 1991-1-1: 2002	Actions on Structures

Where European Standards have been used, reference will also have been made to the relevant UK National Annexe.

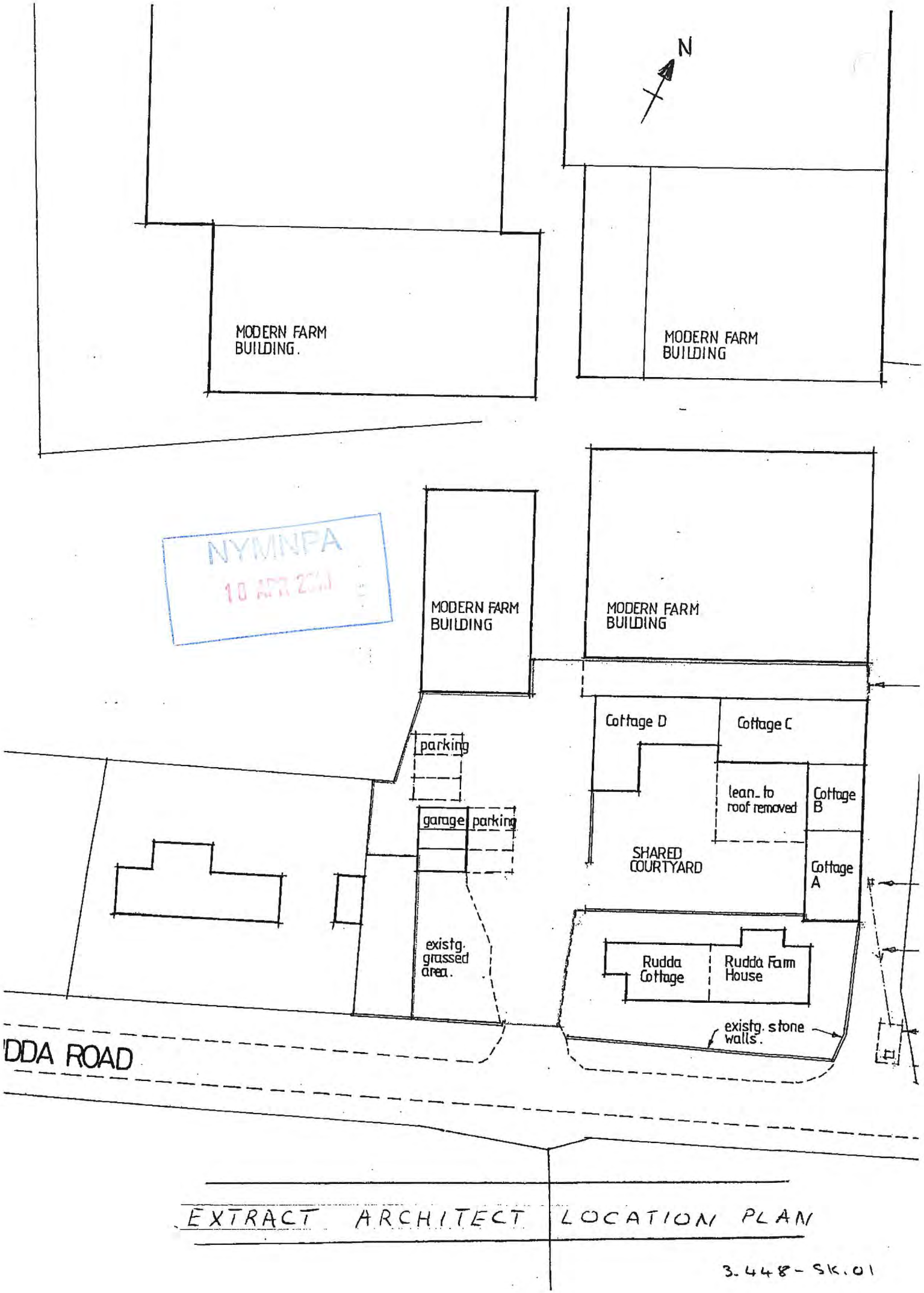
GENERAL

The site has been inspected by the engineer.

Structural design has been based on architectural drawings.

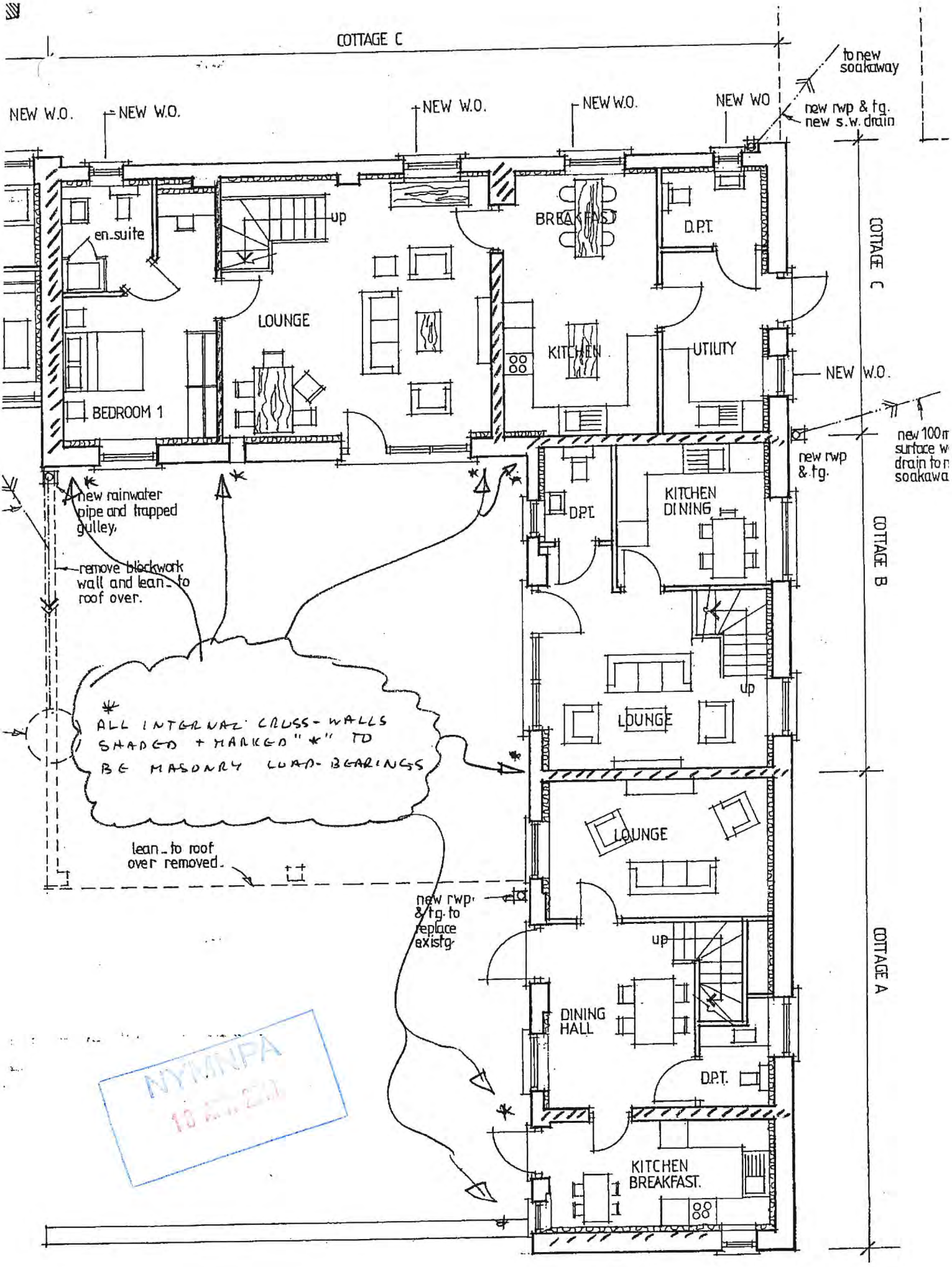
These calculations are subject to approval by the relevant statutory bodies and authorities before construction work begins.

If in doubt, ASK!

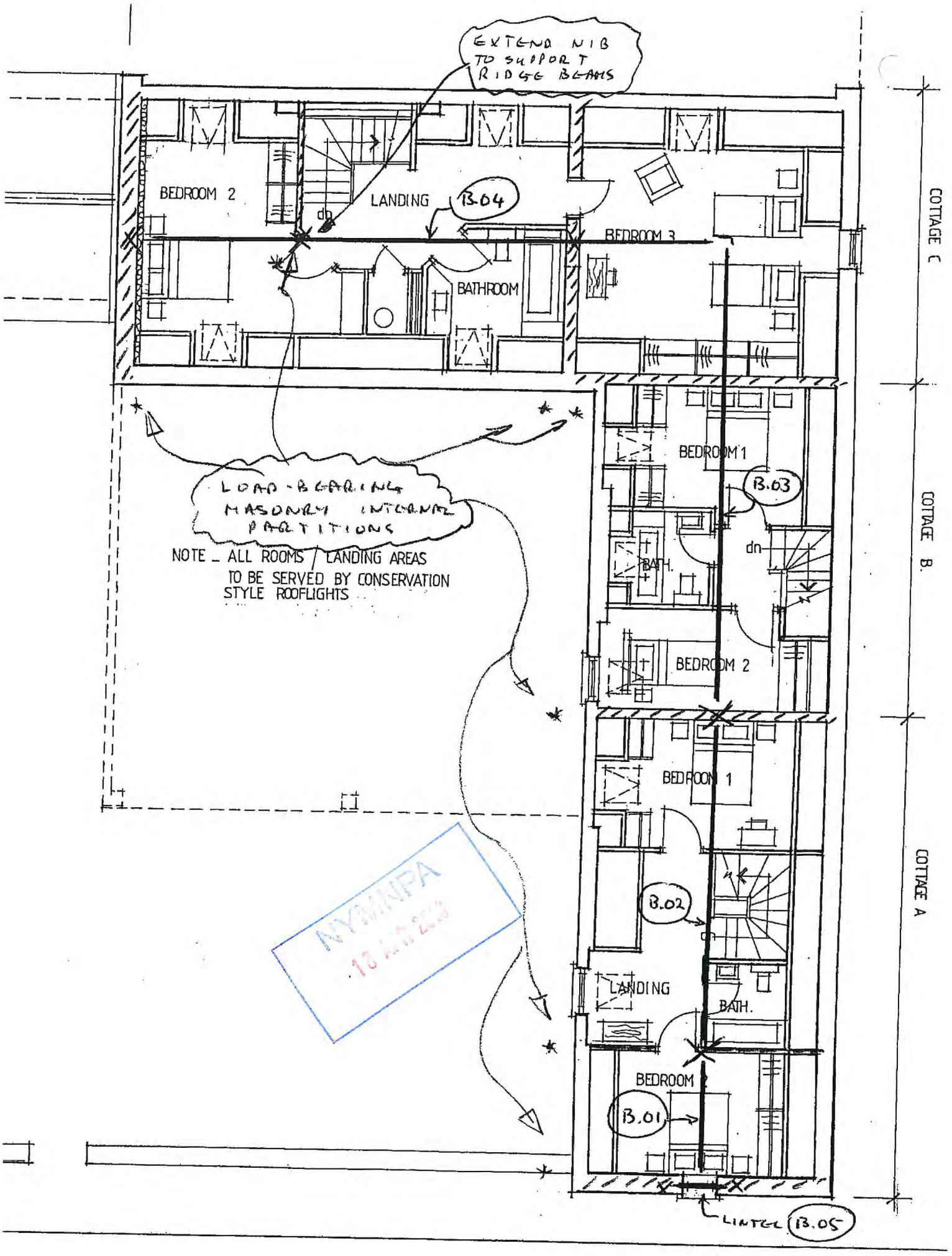


EXTRACT ARCHITECT LOCATION PLAN

3.448 - SK.01


COTTAGE C
NEW W.O.
NEW W.O.
NEW W.O.
NEW W.O.
NEW W.O.
to new soakaway
new rwp & tg.
new s.w. drain
en-suite
up
BREAKFAST
D.P.T.
LOUNGE
KITCHEN
UTILITY
NEW W.O.
BEDROOM 1
new 100m surface w drain to n soakawa
new rwp & tg.
new rainwater pipe and trapped gulley.
D.P.T.
KITCHEN DINING
remove blockwork wall and lean-to roof over.
COTTAGE B
up
LOUNGE
ALL INTERNAL CROSS-WALLS SHADED + MARKED "*" TO BE MASONRY LOAD-BEARINGS
LOUNGE
lean-to roof over removed.
new rwp & tg. to replace existg.
up
DINING HALL
D.P.T.
COTTAGE A
KITCHEN BREAKFAST.
NYMNPA
18 JAN 2021

3.448 - SK.02


EXTEND NIB TO SUPPORT RIDGE BEAMS
BEDROOM 2
LANDING
B.04
dn
BEDROOM 3
BATHROOM
LOAD-BEARING MASONRY INTERNAL PARTITIONS
NOTE - ALL ROOMS / LANDING AREAS TO BE SERVED BY CONSERVATION STYLE ROOFLIGHTS
BEDROOM 1
B.03
dn
BATH.
BEDROOM 2
BEDROOM 1
B.02
LANDING
BATH.
BEDROOM
B.01
LINTEL
B.05
COTTAGE C
COTTAGE B.
COTTAGE A
NYMNPA
18 AUG 2023

3.448 - SK.03

Richard Agar Associates Limited
Consulting Civil & Structural Engineers

Project: RUDDA FARM	Job ref: 3.448
Structure: OUTBUILDINGS	Page: 10.00
Member: RIDGE BEAMS B1 → B3	Date: APR 18

Ref	Calculations	Output

LOADINGS

	G_k	Q_k
Roof		
DL = $\frac{5.60}{2}$ × 1.523 =	4.20	
LL = $\frac{5.60}{2}$ × 0.75 =		2.10
	4.20	2.10

kN/m

Span max span = 7m

Cantilev max 3.00m

} 254 x 146 x 37 UB

SEE RESULTS ON FOLLOWING PAGES

prepared by MR.

checked by

Richard Agar Assc. Ltd Consulting Engineers
ANALYSIS & DESIGN OF SINGLE SPAN STEEL BEAMS TO EN 1993-1-1: 2005

3.448
10.01

Job Reference:- Rudda Farm Job No. : 3.448
Beam Reference:- Ridge beams B.01-B.03
Following dimensions for design calculation purposes only.
Contractor should check all dimensions on site before ordering materials.

SPAN DATA
Span Ls = 7 metres
Effective length Le = 7 metres

LOADING DATA (characteristic loads)

Load Type	Variable	Permanent	Start Dist.	Cover Dist.
Patch load (kN/m)	2.10	4.20	0.00	7.00

Load factors: Variable actions = 1.50 ; Permanent actions = 1.35

TRIAL SECTION SIZE: 254*146*37kg UB
Material grade is S 275 and section classification is: PLASTIC (EN 1993-1-1 table 5.2 & cl. 5.5.2 (6)

SHEAR CAPACITY cl.6.2.6(2)
Ultimate shear capacity of beam Vpl.Rd = 284.82 kN
Applied max shear on beam V.Ed = 30.87 kN
SHEAR CHECK OK

MOMENT CAPACITY cl.6.2.5 & 6.2.8
(includes reduction for high shear if applicable)
Limiting Shear value 0.5*Vpl.Rd = 142.41 kN
Applied shear at max moment Fvbm = 0.62 kN
Moment capacity Mv.Rd = 133.38 kN.m
Applied moment M.Ed = 54.02 kN.m
MOMENT CHECK OK

LATERAL TORSIONAL BUCKLING (LTB) cl.6.3.2.3
Buckling Moment of resistance Mb.Rd = 68.26 kN.m
Applied moment M.Ed = 54.02 kN.m
LTB CHECK OK

WEB BEARING CHECKS
1. Web Crushing
Stiff bearing length ss = 50.00 mm
Web crushing capacity Ry.Rd = 127.28 kN
2. Web Crippling
Web crippling capacity Ra.Rd = 265.73 kN
Max applied end reaction Rmax = 30.87 kN
WEB BEARING CHECKS OK

DEFLECTION CHECK (at mid-span)
NA.2.23 :-floors, roofs -brittle finishes
Deflection due to Variable actions d.i = 5.62 mm
Allowable deflection due to Variable actions d.2 = 19.44 mm
DEFLECTION CHECK OK

3.448
10.02

Richard Agar Assc. Ltd Consulting Engineers
ANALYSIS & DESIGN OF STEEL CANTILEVER BEAMS TO EN 1993-1-1: 2005

Job Reference:- Rudda Farm Job No. : 3.448
Beam Reference:- Ridge B.03

Following dimensions for design purposes only
Contractor should check all dimensions on site before ordering materials
This sheet is brief summary of computed results. Full details are available if required. Program adopts conservative approach for the strength checks

SPAN DATA:
Span Ls = 3 m
Effective length Le = 6 m
Load factors :- Variable Actions (imposed) = 1.5 Permanent Actions (Dead) = 1.35

TRIAL SECTION SIZE :-254*146*37kg UB
Material is grade S275 Section classification is PLASTIC

SHEAR CAPACITY cl. 6.2.6
Ultimate shear capacity of beam Vpl.rd = 271.67 kN
Applied max shear on beam Vsd = 26.46 kN
SHEAR CHECK O.K

MOMENT CAPACITY cl. 6.2.5 & 6.2.8
(includes reduction for high shear if applicable)
Shear value 0.5*Vpl.Rd = 135.84 kN
Applied shear at max moment Fvbm = 26.46 kN

Moment capacity Mv.rd = 133.38 kN.m
Applied moment Mult = 39.69 kN.m
MOMENT CHECK O.K

LATERAL TORSIONAL BUCKLING cl. 6.3.2.3
Simple Conservative approach
Buckling moment of resistance Mb.rd = 71.58 kN.m
Applied ultimate moment Msd = 39.69 kN.m
LATERAL TORSIONAL BUCKLING O.K

WEB BEARING CHECKS
1. Web Crushing
Stiff bearing length ss = 50 mm
Web crushing capacity Ry.Rd = 127.28 kN
2. Web Crippling
Web crippling capacity Ra.Rd = 265.73 kN
Max applied end reaction Rmax= 26.46 kN
WEB CRIPPLING & CRUSHING CHECK O.K

DEFLECTION CHECK (at end of cantilever)
**Unfactored dead load deflection dd = 3.64 mm
Deflection due to imposed loads di = 1.82 mm
Allowable deflection
NA.2.23 :-floors, roofs -brittle finishes
**Allowable Dead & Imposed deflection dmax = 24.00 mm
(**- N.B. EN 1993 Dead load check NOT reqd.)
Allowable Imposed load deflection d2 = 16.67 mm
DEFLECTION CHECK O.K

Richard Agar Associates Limited
Consulting Civil & Structural Engineers

Project: RUDDA FARM	Job ref: 3.448
Structure: OUTBUILDING	Page: 11.00
Member: RIDGE BEAM B.4.	Date: APR 18

Ref	Calculations	Output

LOADINGS

Roof

DL: $\frac{6.4}{2} \times 1.50 =$ 4.80

LL: $\frac{6.4}{2} \times 0.75 =$ 2.40

G_{1k}	Q_{1k}
4.80	2.40

kN/m

Span max 6m

Cantilever max 3m

SEE RESULTS NEXT PAGE →

254 x 146 x 37 UB

Richard Agar Assc. Ltd Consulting Engineers
ANALYSIS & DESIGN OF SINGLE SPAN STEEL BEAMS TO EN 1993-1-1: 2005

3.448
11.01

Job Reference:- Rudda Farm Job No. : 3.448
Beam Reference:- Ridge beams B.04
Following dimensions for design calculation purposes only.
Contractor should check all dimensions on site before ordering materials.

SPAN DATA
Span Ls = 6 metres
Effective length Le = 6 metres

LOADING DATA (characteristic loads)

Load Type	Variable	Permanent	Start Dist.	Cover Dist.
Patch load (kN/m)	2.40	4.80	0.00	6.00

Load factors: Variable actions = 1.50 ; Permanent actions = 1.35

TRIAL SECTION SIZE: 254*146*37kg UB
Material grade is S 275 and section classification is: PLASTIC (EN 1993-1-1 table 5.2 & cl. 5.5.2 (6)

SHEAR CAPACITY cl.6.2.6(2)
Ultimate shear capacity of beam Vpl.Rd = 284.82 kN
Applied max shear on beam V.Ed = 30.24 kN
SHEAR CHECK OK

MOMENT CAPACITY cl.6.2.5 & 6.2.8
(includes reduction for high shear if applicable)
Limiting Shear value 0.5*Vpl.Rd = 142.41 kN
Applied shear at max moment Fvbm = 0.60 kN
Moment capacity Mv.Rd = 133.38 kN.m
Applied moment M.Ed = 45.36 kN.m
MOMENT CHECK OK

LATERAL TORSIONAL BUCKLING (LTB) cl.6.3.2.3
Buckling Moment of resistance Mb.Rd = 77.12 kN.m
Applied moment M.Ed = 45.36 kN.m
LTB CHECK OK

WEB BEARING CHECKS
1. Web Crushing
Stiff bearing length ss = 50.00 mm
Web crushing capacity Ry.Rd = 127.28 kN
2. Web Crippling
Web crippling capacity Ra.Rd = 265.73 kN
Max applied end reaction Rmax = 30.24 kN
WEB BEARING CHECKS OK

DEFLECTION CHECK (at mid-span)
NA.2.23 :-floors, roofs -brittle finishes
Deflection due to Variable actions d.i = 3.47 mm
Allowable deflection due to Variable actions d.2 = 16.67 mm
DEFLECTION CHECK OK

Richard Agar Assc. Ltd Consulting Engineers
ANALYSIS & DESIGN OF STEEL CANTILEVER BEAMS TO EN 1993-1-1: 2005

3448
11.02

Job Reference:- Rudda Farm Job No. : 3.448
Beam Reference:- Ridge B.04

Following dimensions for design purposes only
Contractor should check all dimensions on site before ordering materials
This sheet is brief summary of computed results. Full details are available if required. Program adopts conservative approach for the strength checks

SPAN DATA:
Span Ls = 3 m
Effective length Le = 6 m
Load factors :- Variable Actions (imposed) = 1.5 Permanent Actions (Dead) = 1.35

TRIAL SECTION SIZE :-254*146*37kg UB
Material is grade S275 Section classification is PLASTIC

SHEAR CAPACITY cl. 6.2.6
Ultimate shear capacity of beam Vpl.rd = 271.67 kN
Applied max shear on beam Vsd = 30.24 kN
SHEAR CHECK O.K

MOMENT CAPACITY cl. 6.2.5 & 6.2.8
(includes reduction for high shear if applicable)
Shear value 0.5*Vpl.Rd = 135.84 kN
Applied shear at max moment Fvbm = 30.24 kN

Moment capacity Mv.rd = 133.38 kN.m
Applied moment Mult = 45.36 kN.m
MOMENT CHECK O.K

LATERAL TORSIONAL BUCKLING cl. 6.3.2.3
Simple Conservative approach
Buckling moment of resistance Mb.rd = 71.58 kN.m
Applied ultimate moment Msd = 45.36 kN.m
LATERAL TORSIONAL BUCKLING O.K

WEB BEARING CHECKS
1. Web Crushing
Stiff bearing length ss = 50 mm
Web crushing capacity Ry.Rd = 127.28 kN
2. Web Crippling
Web crippling capacity Ra.Rd = 265.73 kN
Max applied end reaction Rmax= 30.24 kN
WEB CRIPPLING & CRUSHING CHECK O.K

DEFLECTION CHECK (at end of cantilever)
**Unfactored dead load deflection dd = 4.16 mm
Deflection due to imposed loads di = 2.08 mm
Allowable deflection
NA.2.23 :-floors, roofs -brittle finishes
**Allowable Dead & Imposed deflection dmax = 24.00 mm
(**- N.B. EN 1993 Dead load check NOT reqd.)
Allowable Imposed load deflection d2 = 16.67 mm
DEFLECTION CHECK O.K

Richard Agar Associates Limited
Consulting Civil & Structural Engineers

Project	Job ref
RUDDA FM	3 448
Structure	**Page**
	12.00
Member	**Date**
LINTEL B5	APR 18

Ref	Calculations	Output

DESIGN FOR A WORST CASE 1 SPAN OF 1200 TO ALLOW PDSS USE IN VARIETY OF LOCATIONS.

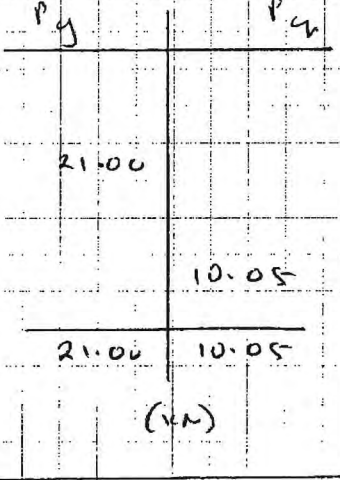
LOADINGS

P.1000

Ridge beam.

DLT $\frac{10}{2} \times 4.20 =$ 21.00

LL $\frac{10}{2} \times 2.10 =$ 10.05



SEE RESULTS NEXT PAGE →

152 x 89 x 16 UB

(IN CONJUNCTION WITH OTHER LINTELS AS NECESSARY)

prepared by

checked by

3.448
12.01

Richard Agar Assc. Ltd Consulting Engineers
ANALYSIS & DESIGN OF SINGLE SPAN STEEL BEAMS TO EN 1993-1-1: 2005

Job Reference:- Rudda farm Job No. : 3.448
Beam Reference:- Lintels B.05
Following dimensions for design calculation purposes only.
Contractor should check all dimensions on site before ordering materials.

SPAN DATA
Span Ls = 1.2 metres
Effective length Le = 1.2 metres

LOADING DATA (characteristic loads)

Load Type	Variable	Permanent	Start Dist.	Cover Dist.
Point load (kN)	10.05	21.00	0.60	
Patch load (kN/m)	0.00	4.00	0.00	1.20

Load factors: Variable actions = 1.50 ; Permanent actions = 1.35

TRIAL SECTION SIZE: 152*89*16kg UB
Material grade is S 275 and section classification is: PLASTIC (EN 1993-1-1 table 5.2 & cl. 5.5.2 (6)

SHEAR CAPACITY cl.6.2.6(2)
Ultimate shear capacity of beam Vpl.Rd = 132.32 kN
Applied max shear on beam V.Ed = 24.95 kN
SHEAR CHECK OK

MOMENT CAPACITY cl.6.2.5 & 6.2.8
(includes reduction for high shear if applicable)
Limiting Shear value 0.5*Vpl.Rd = 66.16 kN
Applied shear at max moment Fvbm = 21.78 kN
Moment capacity Mv.Rd = 34.10 kN.m
Applied moment M.Ed = 14.00 kN.m
MOMENT CHECK OK

LATERAL TORSIONAL BUCKLING (LTB) cl.6.3.2.3
Buckling Moment of resistance Mb.Rd = 33.27 kN.m
Applied moment M.Ed = 14.00 kN.m
LTB CHECK OK

WEB BEARING CHECKS
1. Web Crushing
Stiff bearing length ss = 50.00 mm
Web crushing capacity Ry.Rd = 84.22 kN
2. Web Crippling
Web crippling capacity Ra.Rd = 163.18 kN
Max applied end reaction Rmax = 24.95 kN
WEB BEARING CHECKS OK

DEFLECTION CHECK (at mid-span)
NA.2.23 :-floors, roofs -brittle finishes
Deflection due to Variable actions d.i = 0.02 mm
Allowable deflection due to Variable actions d.2 = 3.33 mm
DEFLECTION CHECK OK

3.448
14.00

Richard Agar Assc. Ltd Consulting Engineers
DESIGN OF TIMBER JOISTS TO EN 1995-1:2004

Job No. 3.448
Member / Element ;- Common Rafters

Joist size 47 x 170 mm @ 400 mm crs
Span 3.3 metres Service class 2

LOADINGS & GEOMETRY
Characteristic Variable Load Qk = 0.75 kN/sq.m
Characteristic permanent Load Gk = 1.5 kN/sq.m

Loadings per joist
Characteristic Variable Load Qk1 = 0.30 kN/m run
Characteristic permanent Load Gk1 = 0.60 kN/m run

Safety Factor for Variable Load Yq = 1.5
Safety Factor for Permanent Load Yg = 1.35
Design bending moment M.ed = 1.72 kN.m
Design shear force V.ed = 2.08 kN

TIMBER GRADE STRESSES (EN338:2003 table 1)
Timber grade C16
Bending fmk = 16.00 N/sq.mm
Shear fvk = 1.80 N/sq.mm

TIMBER MODIFICATION FACTORS
Depth Factor kh = 0.98
Lateral buckling Kcrit = 1.00
table 3.1 Kmod = 0.80
Load Sharing Ksys = 1.10

BENDING CHECK
Design bending stress sigma.m.y.d = 7.58 N/sq.mm
Design bending resistance f.m.y.d = 9.60 N/sq.mm

SHEAR CHECK
Design shear stress Td = 0.58 N/sq.mm
Design shear resistance f.v.d = 1.22 N/sq.mm

DEFLECTION CHECKS
Instantaneous deflections from bending and shear
Imposed load u2 = 3.13 mm
Permanent load u1 = 6.26 mm

Check 1 - Design imposed load deflection
Imposed load u2d = 3.13 mm
Allowable (span/350) = 9.43 mm

Check 2 - Design imposed load deflection plus creep factor
Design deflection u2d + Ucreep = 8.89 mm
Allowable (span/250) = 13.20 mm

Check 3 - Final design deflection
Design deflection u1 + u2d + Ucreep = 15.16 mm
Allowable (span/200) = 16.50 mm