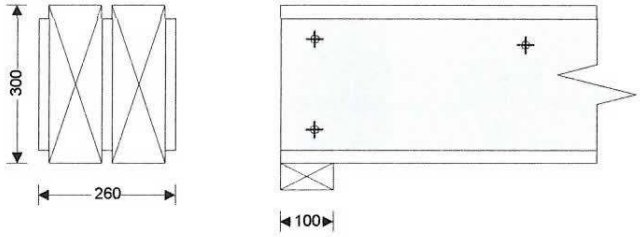
Total load on beam W_{tot} = **72.688** kN

Reactions at support A R_{A_max} = **36.344** kN R_{A_min} = **36.344** kN

Unfactored di load reaction at support A R_{A_DI} = **36.344** kN

Reactions at support B R_{B_max} = **36.344** kN R_{B_min} = **36.344** kN

Unfactored di load reaction at support B R_{B_DI} = **36.344** kN



Timber section details

Breadth of section b = **100** mm Depth of section h = **300** mm

Number of sections N = **2**

Timber strength class **D40**

Steel section details

Breadth of steel plate b_s = **20** mm Depth of steel plate h_s = **250** mm

Number of steel plates in beam N_s = **3** Steel stress p_y = **230** N/mm²

Bolt diameter ϕ_b = **16** mm Maximum bolt spacing S_{max} = **400** mm

Member details

Service class of timber **1** Load duration **Medium term**

Length of bearing L_b = **100** mm

Lateral support - cl.2.10.8

Permiss.depth-to-breadth ratio **3.00** Actual depth-to-breadth ratio **1.15**

PASS - Lateral support is adequate

Check bearing stress

Permissible bearing stress σ_{c_adm} = **4.875** N/mm² Applied bearing stress σ_{c_a} = **1.817** N/mm²

PASS - Applied compressive stress is less than permissible compressive stress at bearing

Bending parallel to grain

Permiss. timber bending stress σ_{m_adm} = **15.625** N/mm² Applied timber bending stress σ_{m_a} = **5.429** N/mm²

PASS - Timber bending stress is less than permissible timber bending stress

Permiss. steel bending stress p_y = **230.000** N/mm² Applied steel bending stress $\sigma_{m\_a\_s}$ = **104.476** N/mm²

PASS - Steel bending stress is less than permissible steel bending stress

Shear parallel to grain

Permissible shear stress τ_{adm} = **2.500** N/mm² Applied shear stress τ_a = **0.212** N/mm²

PASS - Applied shear stress is less than permissible shear stress

Deflection

Permissible deflection δ_{adm} = **23.100** mm Total deflection δ_a = **22.771** mm

PASS - Total deflection is less than permissible deflection

Flitch plate bolting requirements

Bolts required at beam end N_{be} = **2.000** Bolts required to beam length N_{bl} = **2.485**

- Provide a minimum of 2 No.16 mm diameter bolts at each support
- Provide 16 mm diameter bolts at a maximum of 400 mm centres along the length of the beam

Minimum bolt spacings

Minimum end spacing S_{end} = **64** mm Minimum edge spacing S_{edge} = **64** mm

Minimum bolt spacing S_{bolt} = **64** mm

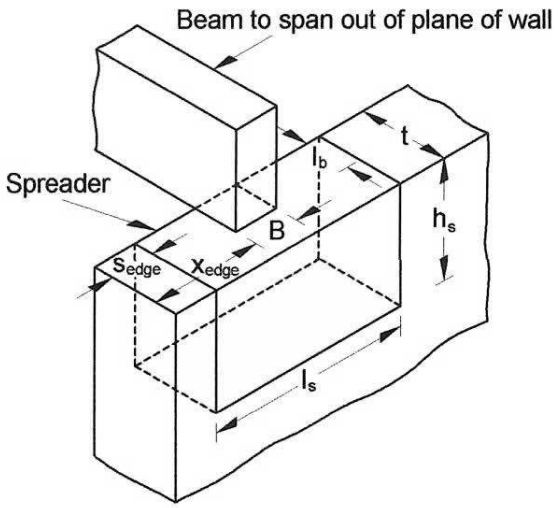
Minimum washer diameter ϕ_w = **48** mm Minimum washer thickness t_w = **4.0** mm

MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.03

Masonry details

Masonry type	**Clay or calcium silicate bricks**		
Compressive strength	p_{unit} = **20.0** N/mm²	Mortar designation	**iii**
Masonry units	**Category I**	Construction control	**Normal**
Partial safety factor	γ_m = **3.1**	Characteristic strength	f_k = **5.0** N/mm²
Leaf thickness	t = **150** mm	Effective wall thickness	t_{ef} = **290** mm
Wall height	h = **2400** mm	Effective height of wall	h_{ef} = **2400** mm



Bearing details

Beam spanning out of plane of wall

Width of bearing	B = **203** mm	Length of bearing	l_b = **150** mm
Edge distance	x_{edge} = **0** mm		

Loading details

Dead load	G_k = **30** kN	Imposed load	Q_k = **25** kN
Design load	F = **81.5** kN		

Masonry bearing type

Bearing type	**Type 1**	Bearing safety factor	γ_{bear} = **1.25**

Check design bearing without a spreader

Design bearing stress	f_{ca} = **2.677** N/mm²	Allowable bearing stress	f_{cp} = **2.016** N/mm²

FAIL - Design bearing stress exceeds allowable bearing stress, use a spreader

Spreader details

Length of spreader	l_s = **300** mm	Depth of spreader	h_s = **225** mm
Edge distance	s_{edge} = **0** mm		

Spreader bearing type

Bearing type **Type 3** Bearing safety factor γ_{bear} = **2.00**

Check design bearing with a spreader

Loading acts eccentrically - stress distribution similar to semi-infinite beam on elastic foundation

Design bearing stress f_{ca} = **2.056** N/mm^2 Allowable bearing stress f_{cp} = **3.226** N/mm^2

PASS - Allowable bearing stress exceeds design bearing stress

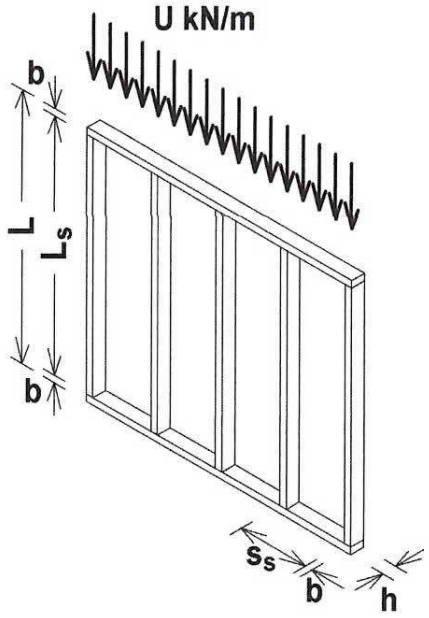
Check design bearing at 0.4 × h below the bearing level

Design bearing stress f_{ca} = **0.467** N/mm^2 Allowable bearing stress f_{cp} = **1.597** N/mm^2

PASS - Allowable bearing stress at 0.4 × h below bearing level exceeds design bearing stress

TIMBER STUD DESIGN (BS5268-2:2002)

TEDDS calculation version 1.0.03



Stud details

Stud breadth	b = **50** mm
Stud depth	h = **100** mm
Number of studs	N_s = **1**

Strength class C16 timber (Table 8 BS5268:Pt 2:2002)

Section properties

Cross sectional area	$A = N_s \times b \times h$ = **5000** mm^2
Section modulus	$Z = N_s \times b \times h^2 / 6$ = **83333** mm^3
Moment of inertia in the major axis	$I_x = N_s \times b \times h^3 / 12$ = **4166667** mm^4
Moment of inertia in the minor axis	$I_y = N_s \times h \times b^3 / 12$ = **1041667** mm^4
Radius of gyration in the major axis	$r_x = \sqrt{(I_x / A)}$ = **28.9** mm
Radius of gyration in the minor axis	$r_y = \sqrt{(I_y / A)}$ = **14.4** mm

Panel details - Studs restrained by sheathing in the plane of the panel

Panel height	L = **1500** mm
Stud length	$L_s = L - (2 \times b)$ = **1400** mm
Standard stud spacing	s_s = **400** mm
Panel opening	O = **0** mm
Loaded panel length	$s = \max(s_s, (O + s_s) / 2)$ = **400** mm
Effective length in the major axis	$L_{ex} = 1.00 \times L_s$ = **1400** mm
Slenderness ratio	$\lambda = L_{ex} / r_x$ = **48.50**

Vertical loading details	**Dead loads**	**Imposed loads**
Roof UDL	U_{r_d} = **2.24** kN/m	U_{r_i} = **1.60** kN/m

Modification factors

Section depth factor — $K_7 = (300\ mm / h)^{0.11} = \mathbf{1.13}$

Load sharing factor — $K_8 = \mathbf{1.10}$

Consider axial compression without bending under medium term loads

Load duration factor — $K_3 = \mathbf{1.25}$

Vertical loading — $F = (U_{r\_d} + U_{r\_i}) \times s = \mathbf{1.54}$ kN

Check compressive stress on stud

Compression member factor — $K_{12} = \mathbf{0.72}$

Compression parallel to grain — $\sigma_c = \mathbf{6.800}$ N/mm²

Permissible compressive stress — $\sigma_{c\_adm} = \sigma_c \times K_3 \times K_8 \times K_{12} = \mathbf{6.730}$ N/mm²

Applied compressive stress — $\sigma_{c\_max} = F / (N_s \times b \times h) = \mathbf{0.307}$ N/mm²

PASS - Applied compressive stress under medium term loads is within permissible limits

Check compressive stress on rail

Bearing stress modification factor — $K_4 = \mathbf{1.20}$

Compression perpendicular to grain (no wane) — $\sigma_{cp1} = \mathbf{2.200}$ N/mm²

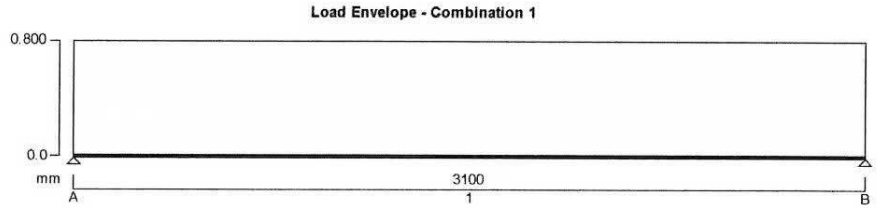
Permissible compressive stress — $\sigma_{cp1\_adm} = \sigma_{cp1} \times K_3 \times K_4 = \mathbf{3.300}$ N/mm²

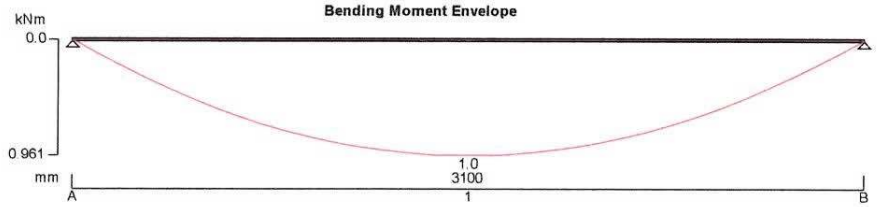
Applied compressive stress — $\sigma_{cp1\_max} = F / (N_s \times b \times h) = \mathbf{0.307}$ N/mm²

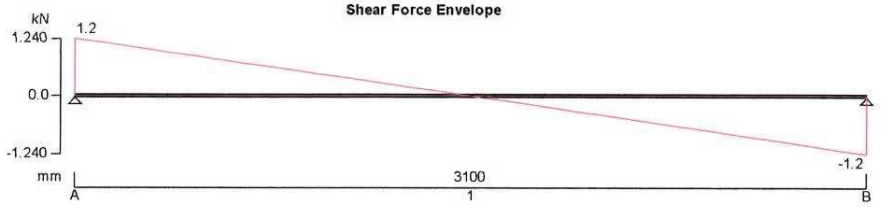
PASS - Applied compressive stress under medium term loads is within permissible limits

TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002

TEDDS calculation version 1.5.04







Applied loading

Beam loads

DI full UDL 0.800 kN/m

Load combinations

Load combination 1	Support A	Dead × 1.00
		Imposed × 1.00
		DI × 1.00
	Span 1	Dead × 1.00
		Imposed × 1.00
		DI × 1.00
	Support B	Dead × 1.00
		Imposed × 1.00
		DI × 1.00

Analysis results

Design moment	M = **0.961** kNm	Design shear	F = **1.240** kN

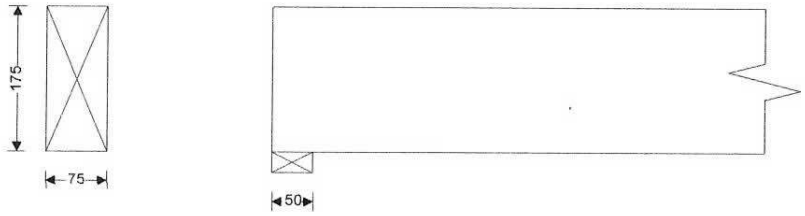
Total load on beam W_{tot} = **2.480** kN

Reactions at support A R_{A_max} = **1.240** kN R_{A_min} = **1.240** kN

Unfactored di load reaction at support A R_{A_DI} = **1.240** kN

Reactions at support B R_{B_max} = **1.240** kN R_{B_min} = **1.240** kN

Unfactored di load reaction at support B R_{B_DI} = **1.240** kN



Timber section details

Breadth of section	b = **75** mm	Depth of section	h = **175** mm
Number of sections	N = **1**	Breadth of beam	b_b = **75** mm
Timber strength class	**C16**		

Member details

Service class of timber	**1**	Load duration	**Medium term**
Length of bearing	L_b = **50** mm		

The beam is part of a load-sharing system consisting of four or more members

Lateral support - cl.2.10.8

Permiss.depth-to-breadth ratio **3.00** Actual depth-to-breadth ratio **2.33**

PASS - Lateral support is adequate

Check bearing stress

Permissible bearing stress σ_{c_adm} = **3.025** N/mm² Applied bearing stress σ_{c_a} = **0.331** N/mm²

PASS - Applied compressive stress is less than permissible compressive stress at bearing

Bending parallel to grain

Permissible bending stress σ_{m_adm} = **7.733** N/mm² Applied bending stress σ_{m_a} = **2.510** N/mm²

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress τ_{adm} = **0.921** N/mm² Applied shear stress τ_a = **0.142** N/mm²

PASS - Applied shear stress is less than permissible shear stress

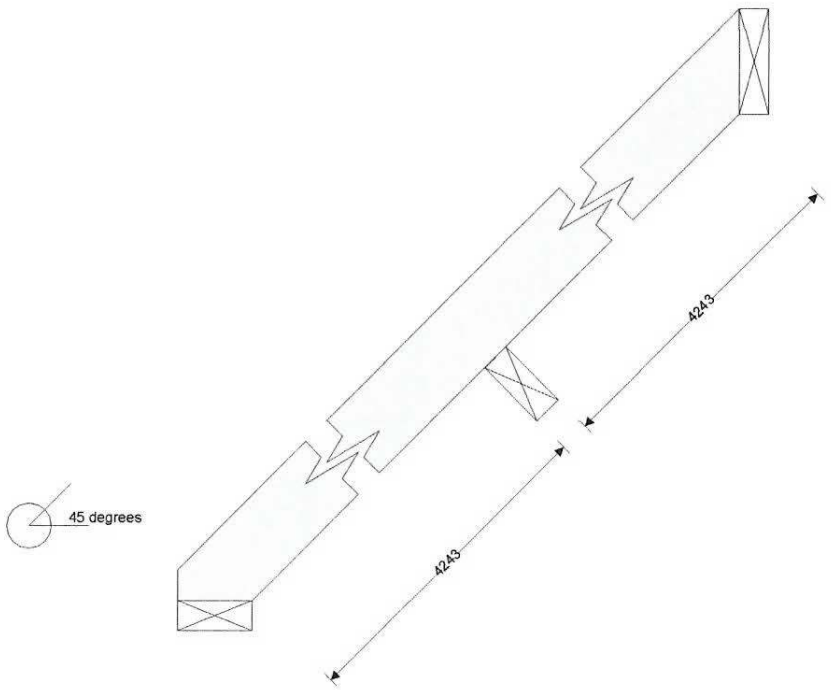
Deflection

Permissible deflection δ_{adm} = **9.300** mm Total deflection δ_a = **5.194** mm

PASS - Total deflection is less than permissible deflection

TIMBER RAFTER DESIGN (BS5268-2:2002)

TEDDS calculation version 1.0.03



Rafter details

Breadth of timber sections	b = **50** mm	Depth of timber sections	h = **125** mm
Rafter spacing	s = **175** mm	Rafter span	**Continuous**
Clear length of span on slope	L_{cl} = **4243** mm	Rafter slope	α = **45.0** deg
Timber strength class	**C16**		

Section properties

Cross sectional area of rafter	A = **6250** mm^2	Section modulus	Z = **130208** mm^3
Radius of gyration	r = **36** mm	Second moment of area	I = **8138021** mm^4

Loading details

Rafter self weight	F_j = **0.02** kN/m	Dead load on slope	F_d = **1.00** kN/m^2
Imposed snow load on plan	F_u = **0.75** kN/m^2	Imposed point load	F_p = **0.90** kN

Modification factors

Section depth factor	K_7 = **1.10**	Load sharing factor	K_8 = **1.10**

Consider long term load condition

Load duration factor	K_3 = **1.00**	Total UDL perp. to rafter	F = **0.137** kN/m
Notional bearing length	L_b = **2** mm	Effective span	L_{eff} = **4245** mm

Check bending stress at purlin

Permissible bending stress	σ_{m_adm} = **6.419** N/mm^2	Applied bending stress	σ_{m_max} = **2.373** N/mm^2

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain at purlin

Permissible comp. stress	σ_{c_adm} = **2.261** N/mm^2	Applied compressive stress	σ_{c_max} = **0.128** N/mm^2

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain at purlin

Combined loading check **0.432 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check bending stress in lower portion of rafter

Permissible bending stress σ_{m_adm} = **6.419** N/mm^2 Applied bending stress σ_{m_max} = **1.335** N/mm^2

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain in lower portion of rafter

Permissible comp. stress σ_{c_adm} = **2.261** N/mm^2 Applied compressive stress σ_{c_max} = **0.186** N/mm^2

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain in lower portion of rafter

Combined loading check **0.295 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **0.737** N/mm^2 Applied shear stress τ_{max} = **0.087** N/mm^2

PASS - Applied shear stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **12.735** mm Total deflection δ_{max} = **3.470** mm

PASS - Total deflection within permissible limits

Consider medium term load condition

Load duration factor K_3 = **1.25** Total UDL perp. to rafter F = **0.203** kN/m

Notional bearing length L_b = **4** mm Effective span L_{eff} = **4246** mm

Check bending stress at purlin

Permissible bending stress σ_{m_adm} = **8.024** N/mm^2 Applied bending stress σ_{m_max} = **3.510** N/mm^2

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain at purlin

Permissible comp. stress σ_{c_adm} = **2.412** N/mm^2 Applied compressive stress σ_{c_max} = **0.189** N/mm^2

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain at purlin

Combined loading check **0.524 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check bending stress in lower portion of rafter

Permissible bending stress σ_{m_adm} = **8.024** N/mm^2 Applied bending stress σ_{m_max} = **1.975** N/mm^2

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain in lower portion of rafter

Permissible comp. stress σ_{c_adm} = **2.412** N/mm^2 Applied compressive stress σ_{c_max} = **0.276** N/mm^2

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain in lower portion of rafter

Combined loading check **0.367 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **0.921** N/mm^2 Applied shear stress τ_{max} = **0.129** N/mm^2

PASS - Applied shear stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **12.739** mm Total deflection δ_{max} = **5.136** mm

PASS - Total deflection within permissible limits

Consider short term load condition

Load duration factor K_3 = **1.50** Total UDL perp. to rafter F = **0.137** kN/m

Notional bearing length L_b = **5** mm Effective span L_{eff} = **4248** mm

Check bending stress at purlin

Permissible bending stress σ_{m_adm} = **9.629** N/mm^2 Applied bending stress σ_{m_max} = **4.322** N/mm^2

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain at purlin

Permissible comp. stress σ_{c_adm} = **2.514** N/mm^2 Applied compressive stress σ_{c_max} = **0.230** N/mm^2

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain at purlin

Combined loading check **0.549 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check bending stress in lower portion of rafter

Permissible bending stress σ_{m_adm} = **9.629** N/mm^2 Applied bending stress σ_{m_max} = **5.405** N/mm^2

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain in lower portion of rafter

Permissible comp. stress σ_{c_adm} = **2.514** N/mm^2 Applied compressive stress σ_{c_max} = **0.277** N/mm^2

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain in lower portion of rafter

Combined loading check **0.684 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **1.106** N/mm^2 Applied shear stress τ_{max} = **0.240** N/mm^2

PASS - Applied shear stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **12.743** mm Total deflection δ_{max} = **13.930** mm

FAIL - Total deflection exceeds permissible limits

Vara Consulting Engineers Ltd		Pages	25
CALCULATION PAD		Date	July' 2011
Job Title	7c GAINSBOROUGH GARDENS	Client Job Ref	11/026.
		VCE Job Ref	10124a
		Calculations by	MV

13.0 FLOOR TRIMMERS:

C 2nd floor level loft Conversion.

L r.s Beam = 2.20m. Consider Dwarf Cant loading

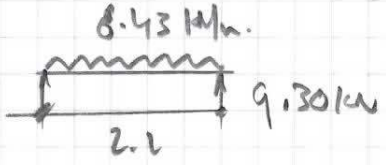
L cant Beam = 1.50m Conditions only.

$\therefore W_{UDL\ FLOOR\ r.s\ BEAM} = 1.5 \times (2.0\ kN/m^2 \times 0.5 \times 2.32 + 1.5\ kN/m^2 \times 2.2)$

$= 8.43\ kN/m.$

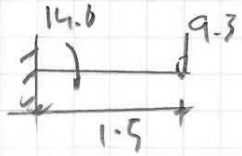
$\therefore M_{>\ r.s\ Beam} = \frac{8.43 \times 2.2^2}{8}$

$= 5.10\ kNm.$



$M_{CANT} = 9.3 \times 1.5$

$= 14.01 kNm.$

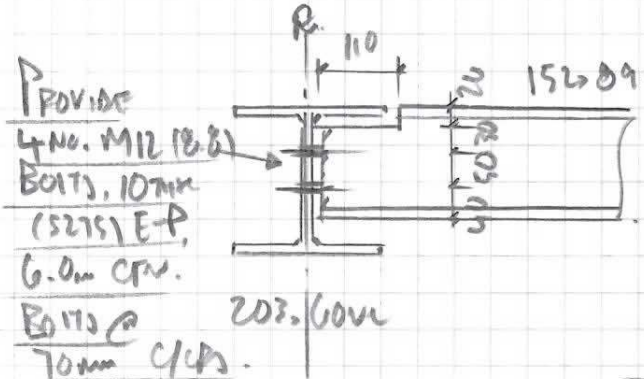


BY INSPECTION PROVIDE NOM. BEAM 152.89.16UB (S275) WITH NOM. CONN^T.

14.0 CONN^{T}S:

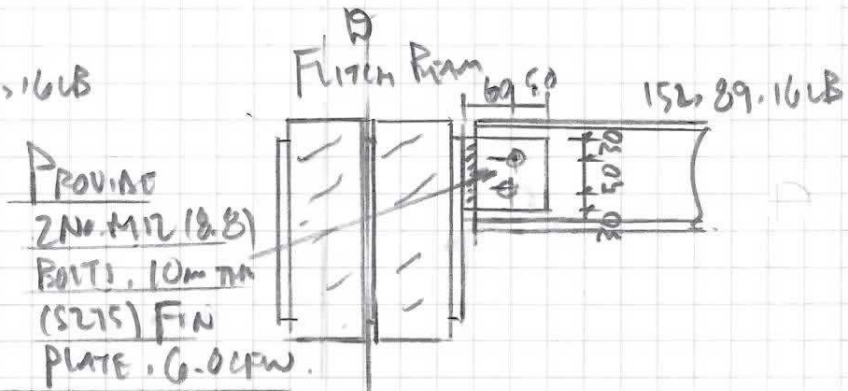
(1) CONN^T TYPE (C1)

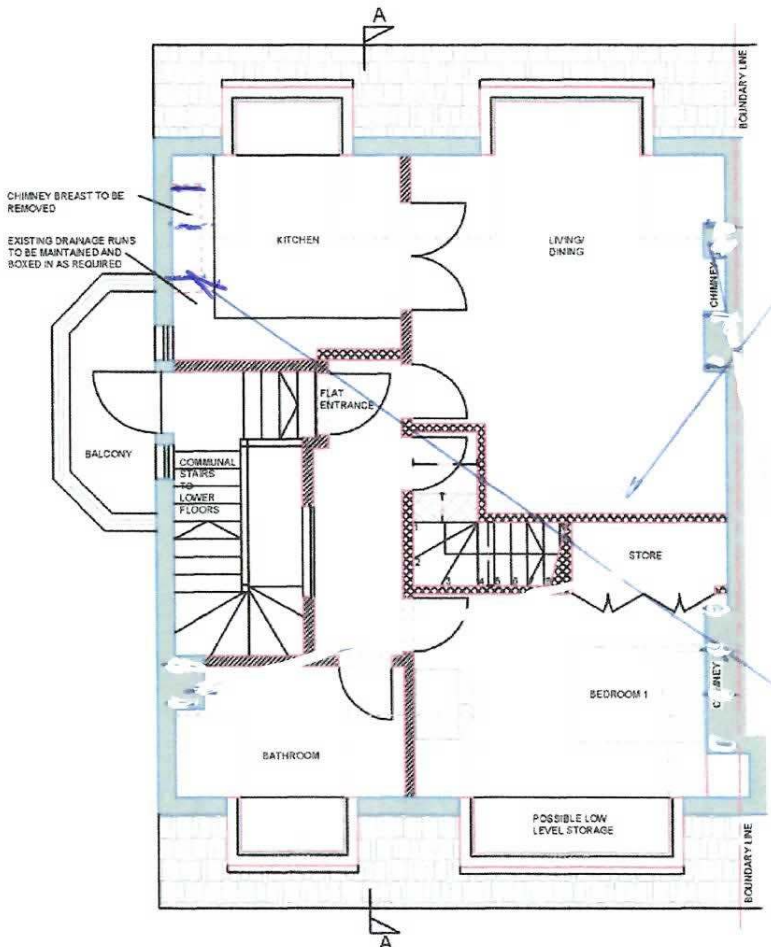
BEAM TO BEAM



OR

BEAM TO FLITCH BEAM





PROPOSED

SECOND FLOOR PLAN

0m 1m 2m 3m 4m 5m N

SCALE @ 1:100

ALL NEW WALLS TO BE CONSTRUCTED USING TIMBER STUDWORK IN ACCORDANCE WITH APPNT SPEC.

CHIMNEY STACK TO BE REMOVED AND SUPPORTED WITHIN LOFT SPACE USING GALVN BRACKETS AS DETAILED @ MAXM 500mm CENTRES (USE GNC M12 FISCHER FIS V RETAIN BOLTS)

SKETCH SHEET NO.

VCE/10124a/SK01/REV A.

NOTE:

1. PADSTONE (P1) - PROVIDE MIN 300 Lg × 150 WD × 45 DP GRADE C20 CONC.

2. FLOOR JOISTS
- PROVIDE 175 × 75 GRADE C16 JOISTS @ 400 mm CENTRES (@ 350 CRS)

3. EXISTING C 125 × 50 GR C16 RAFTERS ARE TO BE RETAINED WITH PROVISION OF ADDITIONAL INTERMEDIATE RAFTERS @ 175 mm CENTRES, ELSE PROVIDE 150 × 75 GR C16 RAFTERS @ 300 mm CENTRES.

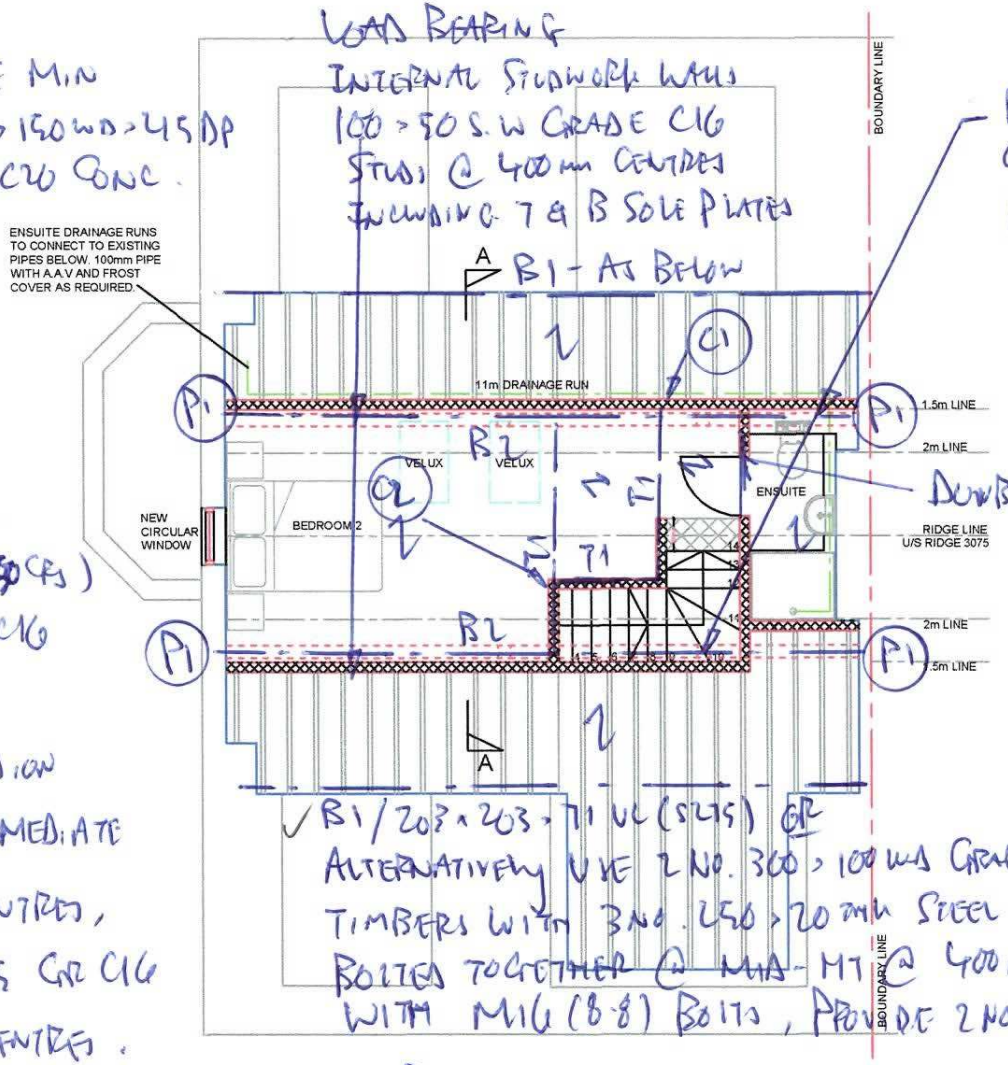
4. CONST DETAILS (C1) & (C2) REFER TO ATTACHED SHEETS.

5. ALL TRIMMERS T1 - 152 × 89 × 16 CB (S275)

LOAD BEARING INTERNAL STUDWORK WALLS 100 × 50 S.W GRADE C16 STUDS @ 400 mm CENTRES INCLUDING T & B SOLE PLATES

B2/203 × 203 × 60 UC (S275) OR ALTERNATIVELY PROVIDE FLITCH BEAMS AS SPECIFIED FOR BEAM B1.

DOUBLE JOISTS UNDER PARTITIONS.



B1/203 × 203 × 71 UC (S275) OR ALTERNATIVELY USE 2 NO. 300 × 100 mm GRADE D40 TIMBERS WITH 3 NO. 450 × 20 mm STEEL PLATES (S275) BOLTED TOGETHER @ MID-HT @ 400 mm HORZ CENTRES WITH M16 (8.8) BOLTS, PROVIDE 2 NO BOLTS @ SUPPORTS.

PROPOSED

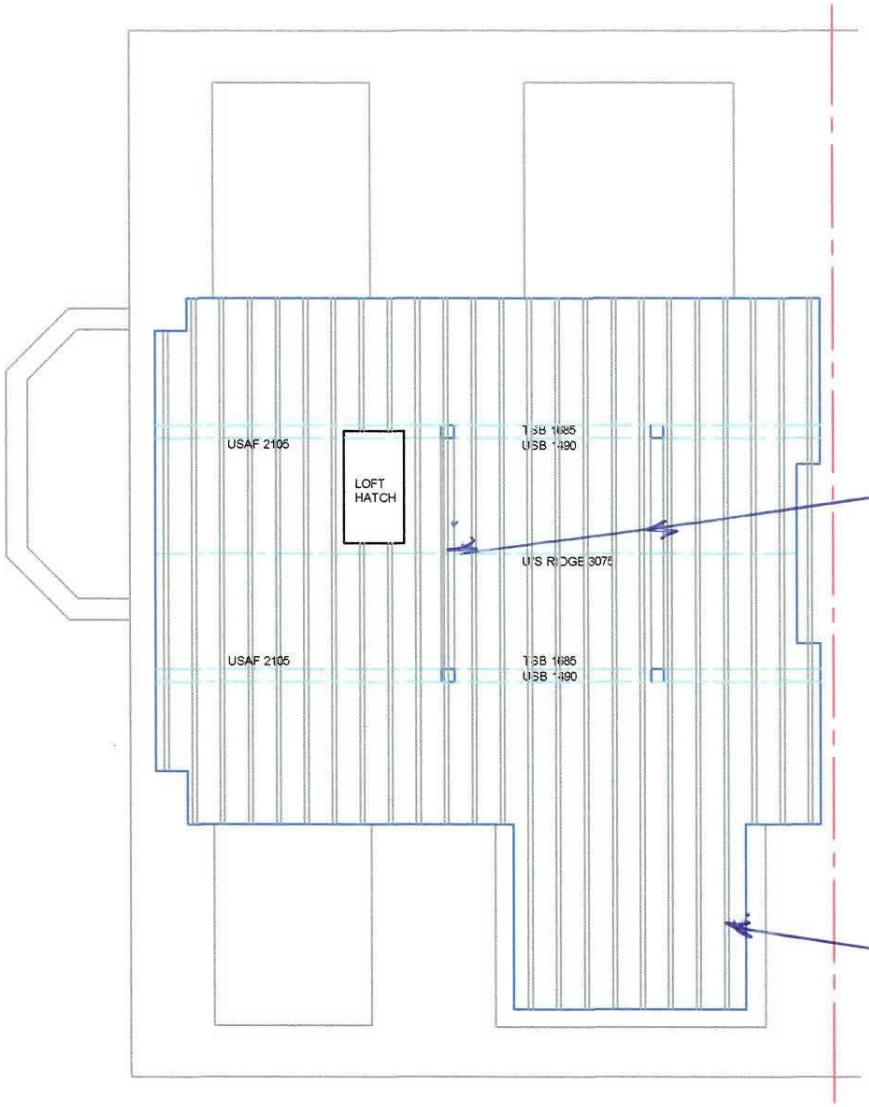
LOFT FLOOR PLAN

0m 1m 2m 3m 4m 5m N

SCALE @ 1:100

SKETCH SHEET NO.

VCE/10124a/SK01



EXISTING

LOFT FLOOR PLAN

0m 1m 2m 3m 4m 5m

SCALE @ 1:100

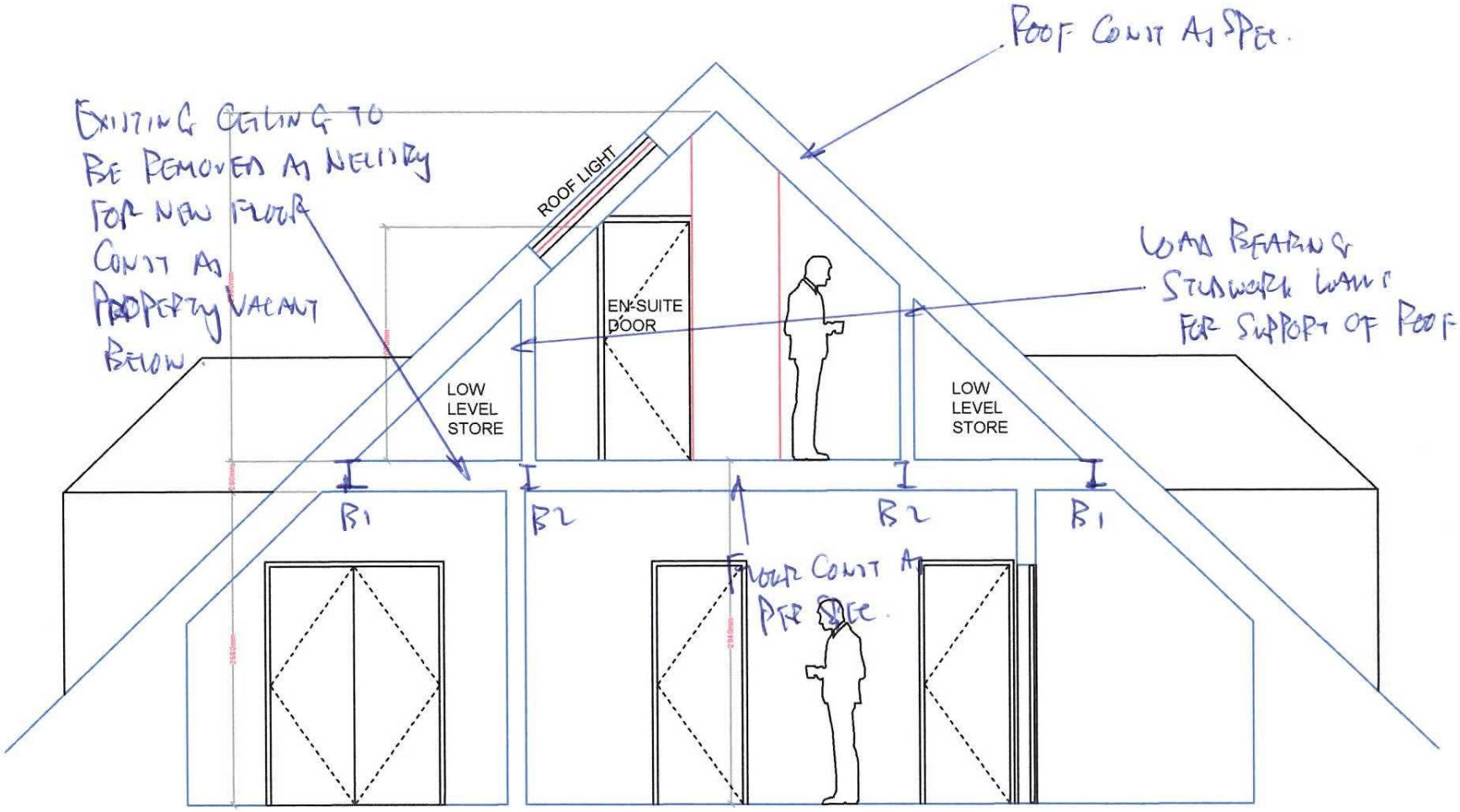
N

✓ EXISTING CHORD OF "HOWE'S" ROOF TRUSS STRUCTURE TO BE REMOVED.

✓ EXTENT OF FLOOR CANNOT EXTEND AS PROPOSED INTO EXTG DORMER LOFT SPACE DUE TO INADEQUACY OF GLAZED WALLS FRAME CONST.

SKETCH SHEET NO.

UCE/10124a/SK04



Typical

SECTION A-A

0m 1m 2m 3m 4m 5m

SCALE @ 1:100

SKETCH SHEET NO.

VCE/10124a/SK03