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Design Calculations

Rallin Brow, Giggleswick

David Gates

Ref: L39338.DC/001

Refer to RG Parkins & Partners Ltd Drawings: L39338/SK1 and SK2

Version	Date	Prepared By	Checked By	Approved By
Original	03/10/2023	James A Thomas	J Freeman	J Freeman

Registered Office: RG Parkins & Partners Ltd, Meadowside, Shap Road, Kendal, LA9 6NY
Registered in England & Wales - Company number 04107150

R G PARKINS

Project:	RALLIN BROW, GIGGLESWICK	Office:	Kendal	Prepared By:	JAT
Title:		Project Ref:	L39338	Checked By:	
		Revision:		Date:	03.10.23

Information taken from site survey and photographs

Loading

Roof 30° pitch	flags	1.00	
	battens + felt	0.05	
	rafters	0.05	
		1.10	up slope
		1.27	on plan
	snow	0.60	
		1.87 kN/m^2	

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Replacement Rafters - effective span 0.95m

$UDL = (1.27 \times 0.4 \times 1.35) + (0.6 \times 0.4 \times 1.5) = 1.05 kN/m$

$M = 1.05 \times 0.95^2 \times 0.125 = 0.12 kNm$

Try 45X45 C16

Design bending stress $= \frac{0.6 \times 16 \times 0.6}{1.3} = 8.12 N/mm^2$

Actual bending stress $= \frac{0.12 \times 10^6 \times 6}{45 \times 45} = 7.90 N/mm^2$

Deflection SLS

Permanent Load Deflection

Bending deflection $= \frac{5 \times 0.51 \times 950^4 \times 12}{384 \times 8000 \times 45 \times 45^3} = 1.98mm$

Shear deflection $= \frac{1.2 \times 0.51 \times 950^2}{8 \times 500 \times 45 \times 45} = 0.07mm$

2.05mm

Variable Load Deflection

Bending deflection $= \frac{5 \times 0.24 \times 950^4 \times 12}{384 \times 8000 \times 45 \times 45^3} = 0.93mm$

Shear deflection $= \frac{1.2 \times 0.24 \times 950^2}{8 \times 500 \times 45 \times 45} = 0.03mm$

0.96mm

Final deflection $= (2.05 \times 1.6) + (0.96 \times 1.0) = 4.24mm$

Permissible deflection $= \frac{950}{250} = 3.80mm$

By inspection use 70X45 C16 timber rafters at 400mm centres.

R G Parkins & Partners Ltd

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Job Ref :
Sheet : /
Made by :
Date : 03 October 2023 / Ver. 2023.08.17
Checked :
Approved :

MasterKey : Timber Design
Axial Load With Moment Design to BS EN 1995-1-1:2004 + A1:2008
Member TBL1ld 1 @ Level 1

Summary Design Data

Eurocode National Annex	Using UK values
Strength class code	BS EN 338:2009
Design Cases Covered	1.35 D1 + 1.5 L1
Deflection Cases Covered	1.0 D1, 1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 100, h = 195, 195x100 in Strength Class C24
Section Properties (cm^2,cm^3,cm)	Area 195, $W_{el.y}$ 633.8, $W_{el.z}$ 325, i_y 5.63, i_z 2.89
Specification	1 : Internal use in continuously heated building Medium term loading
Integrated Design Critical Case	: Dead plus Live (Ultimate)
Member Details	N_{Ed} = 0.0 kN, L = 3.6 m, L_y = 3.6 m, L_z = 3.6 m, $L_{cr.y}$ = 1.0 L_y, $L_{cr.z}$ = 1.0 L_z Bearing length 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$f_{m.y.d} = K_{mod}.K_{hy}.K_{sys}.f_{m.k}/\gamma_m$	0.80 x 1.00 x 1.00 x 24.00/1.3	14.77 N/mm^2	
$f_{m.z.d} = K_{mod}.K_{hz}.K_{sys}.f_{m.k}/\gamma_m$	0.80 x 1.08 x 1.00 x 24.00/1.3	16.02 N/mm^2	
$f_{c.90.d} = K_{mod}.K_{c.90}.K_{sys}.f_{c.90.k}/\gamma_m$	0.80 x 1.50 x 1.00 x 2.50/1.3	2.31 N/mm^2	
$f_{v.d} = K_{mod}.K_{sys}.f_{v.k}/\gamma_m$	0.80 x 1.00 x 4.00/1.3	2.46 N/mm^2	
E_{mean}	Instantaneous Deflection	11000 N/mm^2	Deflection

Axial Load with Moments Check

Critical Design Location	X = 1.800		
$\sigma_{m.y.d} = M_y/W_{el.y}$	3.628 / 633.75 ≤ 14.77	5.72 N/mm^2	OK
$\sigma_{m.z.d} = M_z/W_{el.z}$	2.094 / 325 ≤ 16.02	6.44 N/mm^2	OK
$U_{m.y} = \sigma_{m.y.d}/f_{m.y.d}$	5.720/14.769	0.387	OK
$U_{m.z} = \sigma_{m.z.d}/f_{m.z.d}$	6.440/16.017	0.402	OK
$U_{m.y}+k_m.U_{m.z}$	0.387+0.7x0.402	0.669	OK
$k_m.U_{m.y}+U_{m.z}$	0.7x0.387+0.402	0.673	OK

Shear and Bearing Check

Critical Design Location	X = 0.000		
$\tau_a = 1.5\sqrt{(V_{y.Ed}{}^2+V_{z.Ed}{}^2)}$ / Area / kcr	1.5 $\sqrt{(4.035^2+2.329^2)}$ / 195 / 0.67 ≤ 2.46	0.53 N/mm^2	OK
$\sigma_{cax} = V_{y.Ed}$ / $(b.l_y)$	4.035 / (100 x 75) ≤ 2.31	0.54 N/mm^2	OK
$\sigma_{cay} = V_{z.Ed}$ / $(h.l_z)$	2.329 / (195 x 75) ≤ 2.31	0.16 N/mm^2	OK

Deflection Check (Shear Deflection NOT Included)

Critical Load Case 004 : Dead plus Live (Serviceability)

$\delta = \delta_m$	In-span 10.50 ≤ L/250	10.50 mm	OK

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Axial Load With Moment Design to BS EN 1995-1-1:2004 + A1:2008
Member TBL1Id 1 @ Level 1

Summary Design Data

Eurocode National Annex	Using UK values
Strength class code	BS EN 338:2009
Design Cases Covered	1.35 D1 + 1.5 L1
Deflection Cases Covered	1.0 D1, 1.0 L1, 1.0 D1 + 1.0 L1
Section Size	b = 100, h = 150, 150x100 in Strength Class C24
Section Properties (cm^2,cm^3,cm)	Area 150, $W_{el.y}$ 375, $W_{el.z}$ 250, i_y 4.33, i_z 2.89
Specification	1 : Internal use in continuously heated building Medium term loading
Integrated Design Critical Case	: Dead plus Live (Ultimate)
Member Details	N_{Ed} = 0.0 kN, L = 3.6 m, L_y = 3.6 m, L_z = 3.6 m, $L_{cr.y}$ = 1.0 L_y, $L_{cr.z}$ = 1.0 L_z Bearing length 75, Distance to Bearing 150 mm

Grade and Admissible Stresses (Strength Class C24)

$f_{m.y.d} = K_{mod}.K_{hy}.K_{sys}.f_{m.k}/\gamma_m$	0.80 x 1.00 x 1.00 x 24.00/1.3	14.77 N/mm^2	
$f_{m.z.d} = K_{mod}.K_{hz}.K_{sys}.f_{m.k}/\gamma_m$	0.80 x 1.08 x 1.00 x 24.00/1.3	16.02 N/mm^2	
$f_{c.90.d} = K_{mod}.K_{c.90}.K_{ys}.f_{c.90.k}/\gamma_m$	0.80 x 1.50 x 1.00 x 2.50/1.3	2.31 N/mm^2	
$f_{v.d} = K_{mod}.K_{sys}.f_{v.k}/\gamma_m$	0.80 x 1.00 x 4.00/1.3	2.46 N/mm^2	
E_{mean}	Instantaneous Deflection	11000 N/mm^2	Deflection

Axial Load with Moments Check

Critical Design Location	X = 1.800		
$\sigma_{m.y.d} = M_y/W_{el.y}$	$4.135 / 375 \leq 14.77$	11.03 N/mm^2	OK
$U_{m.y} = \sigma_{m.y.d}/f_{m.y.d}$	11.030/14.769	0.747	OK
$U_{m.y}$	0.747	0.747	OK
$L_{eff}=L.K_{LTB}$	3.600x1.000	3.600	
$\sigma_{mcrit}=\pi\sqrt{(E_{05}.I_z.G_{05}.J)}/(L_{eff}.W_y)$	$\pi\sqrt{(7.40x1250.00x0.46x2934.57)}/(3.600x375.00)$	82.604	
$\lambda_{r,elm}=\sqrt{(f_{mk}/\sigma_{mcrit})}$	$\sqrt{(24.00/82.60)}$	0.539	
k_{Crit}	$\lambda_{r,elm} < 0.75$	1.000	
$\sigma_{m.y.d}/(k_{Crit} \bullet f_{m.y.d})$	11.030/(1.000x14.769)	0.747	OK

Shear and Bearing Check

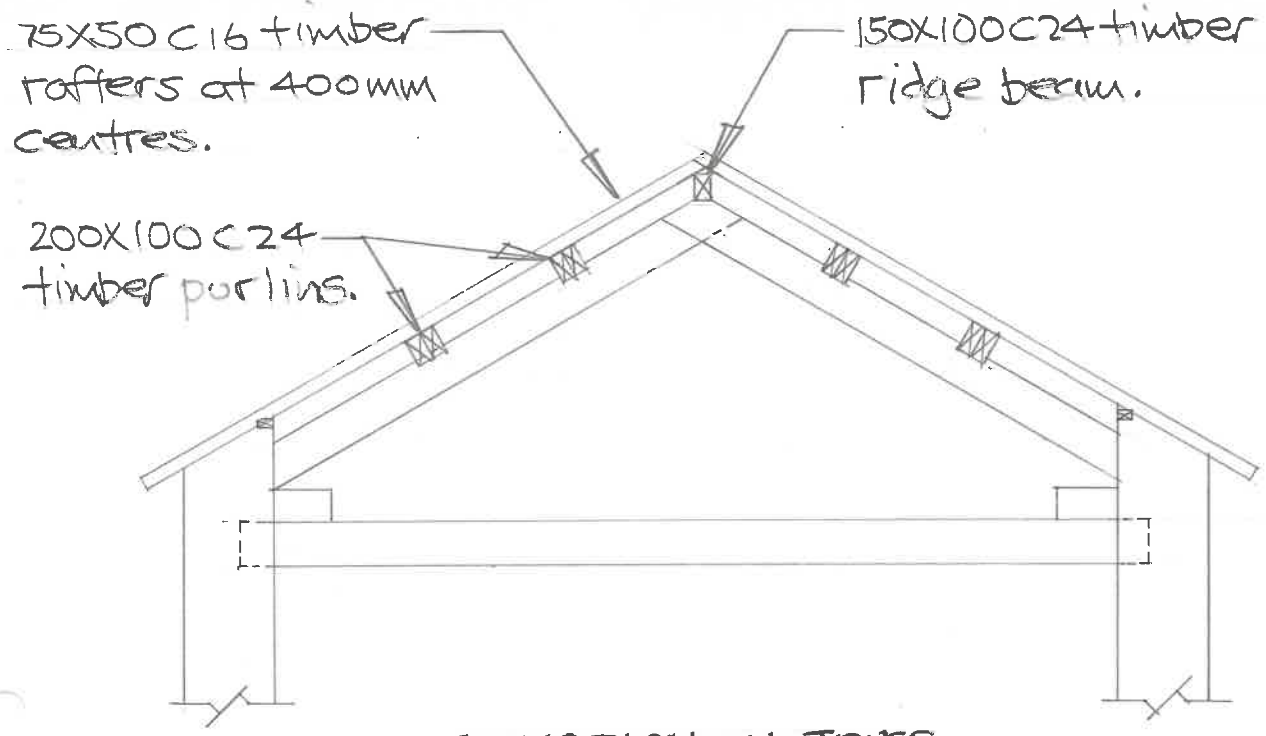
Critical Design Location	X = 0.000		
τ_a= 1.5 $V_{y.Ed}$ / Area / k_{cr}	$1.5 \times 4.598 / 150 / 0.67 \leq 2.46$	0.69 N/mm^2	OK
$\sigma_{cax} = V_{y.Ed}$ / (b.l_y)	$4.598 / (100 \times 75) \leq 2.31$	0.61 N/mm^2	OK

Deflection Check (Shear Deflection NOT Included)

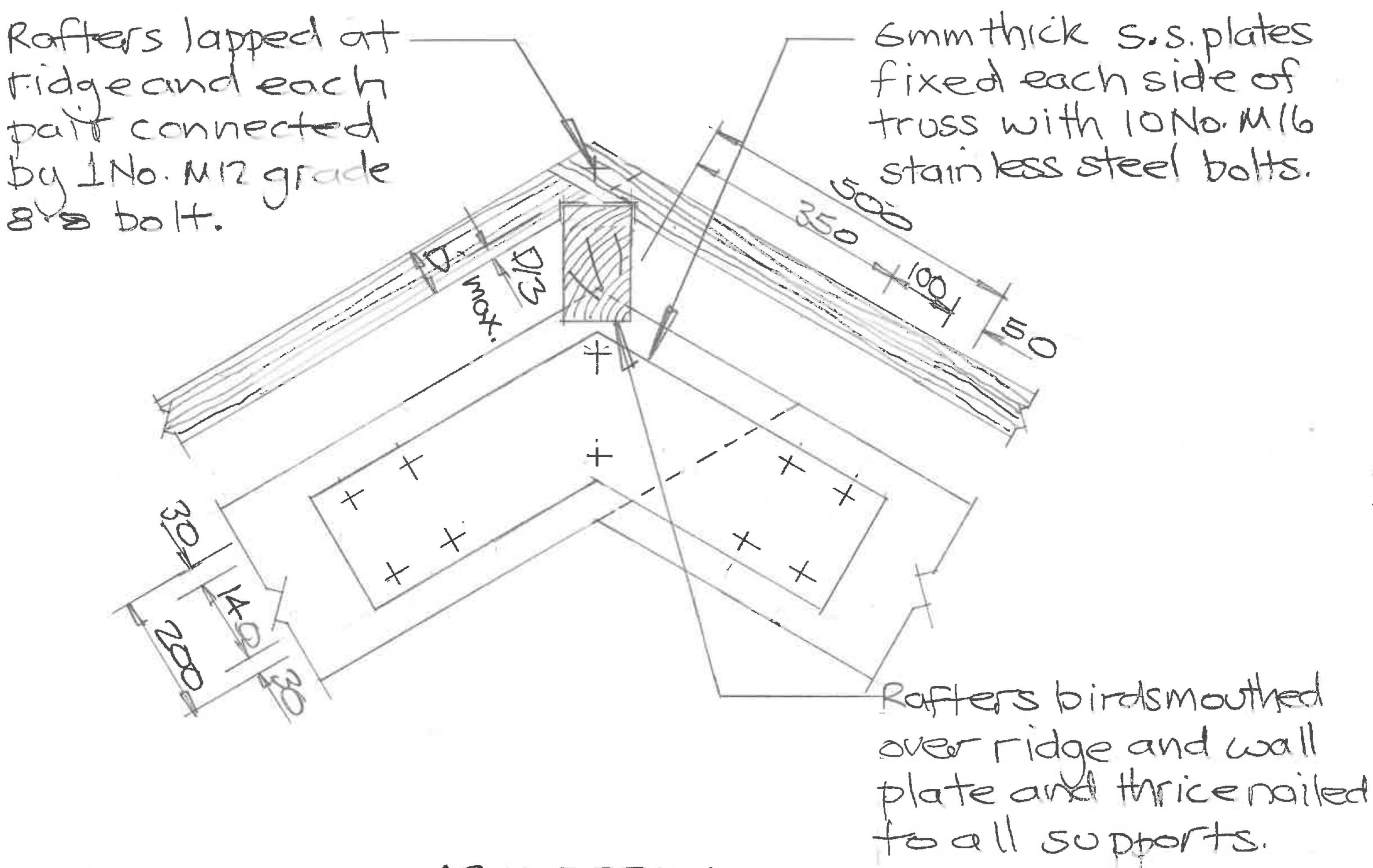
Critical Load Case 004 : Dead plus Live (Serviceability)

$\delta = \delta_m$	In-span $12.93 \leq L/250$	12.93 mm	OK

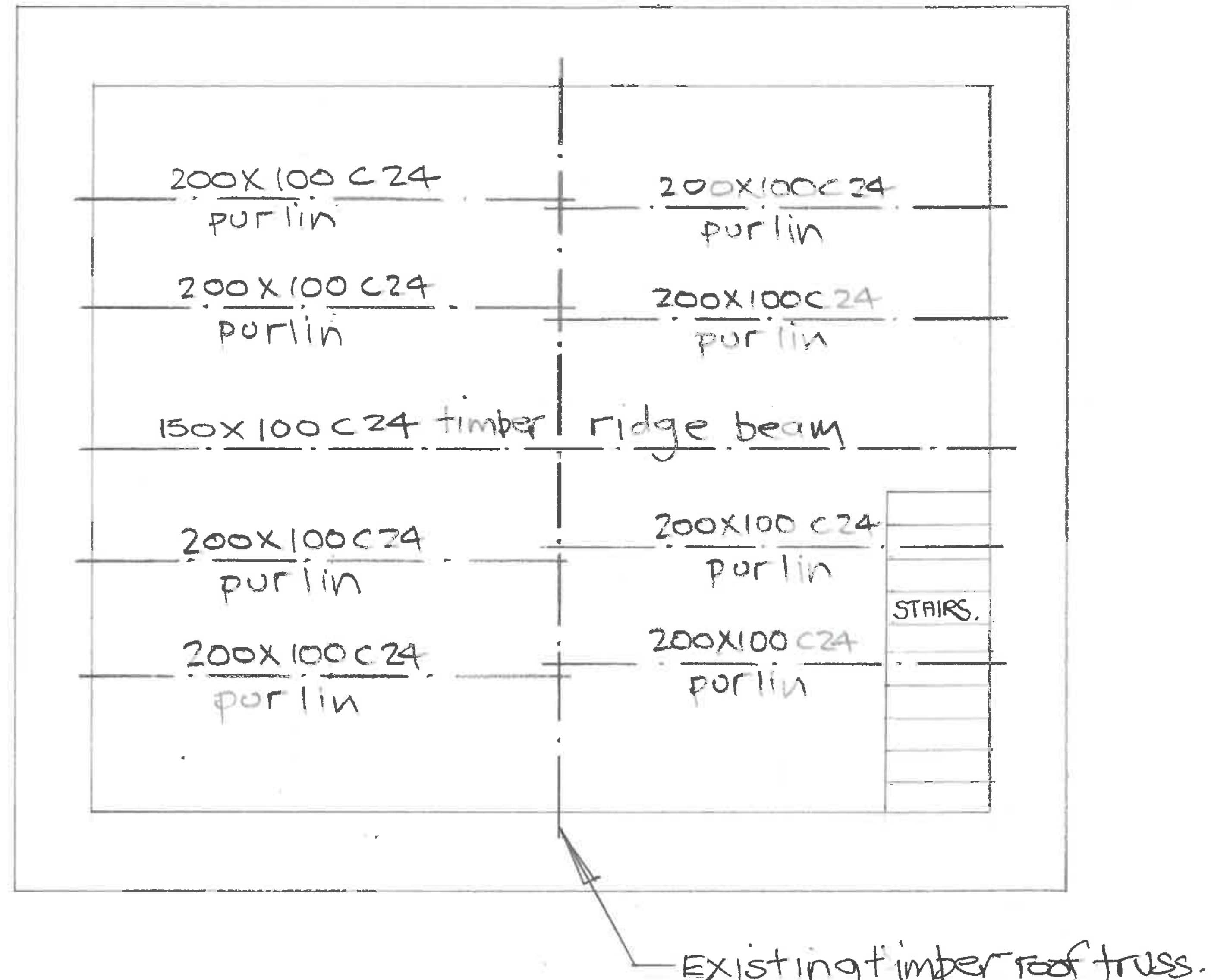
All timber purlins and ridge beams may be alternatively specified in grade D30 oak (structurally graded and seasoned)



ELEVATION ON TRUSS



APEX DETAIL



ROOF PLAN

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Scale @ A3: 1:50, 1:10	First Issue: 03.10.23	Office of Origin: KENDAL	
Drawn by: JAT	Checked by:	Approved:	
Project No: L39338	Drawing No: SK1	Rev:	
BIM No:			

Client: DAVID GATES

Project: RALLIN BROW, GIGGLESWICK

Drawing Title: STRUCTURAL DETAILS TO ROOF

R G PARKINS

Kendal | 01539 729393 Lancaster | 01524 32548

Scale @ A4:	1:10
First Issue:	03.10.23
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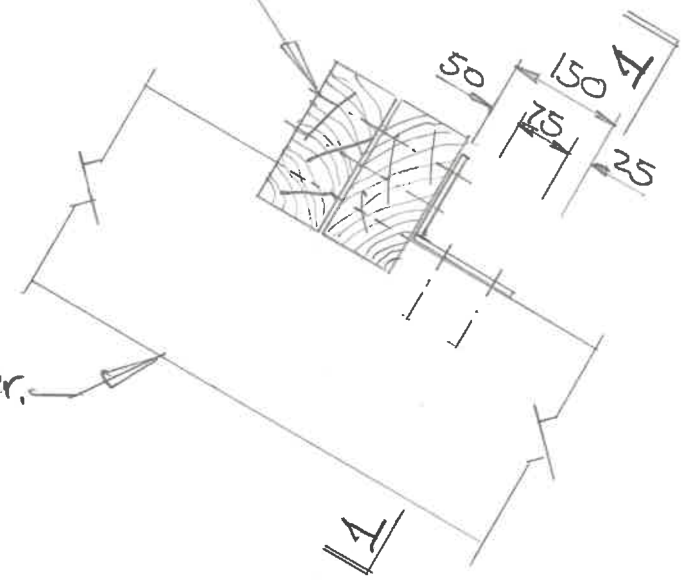
Drawn by:	JAT
Checked by:	
Approved:	
Project No:	L39338
Drawing No:	SK2
Rev:	
BIM No:	

Client: DAVID GATES

Project: RALLIN BROW, GIGGLESWICK

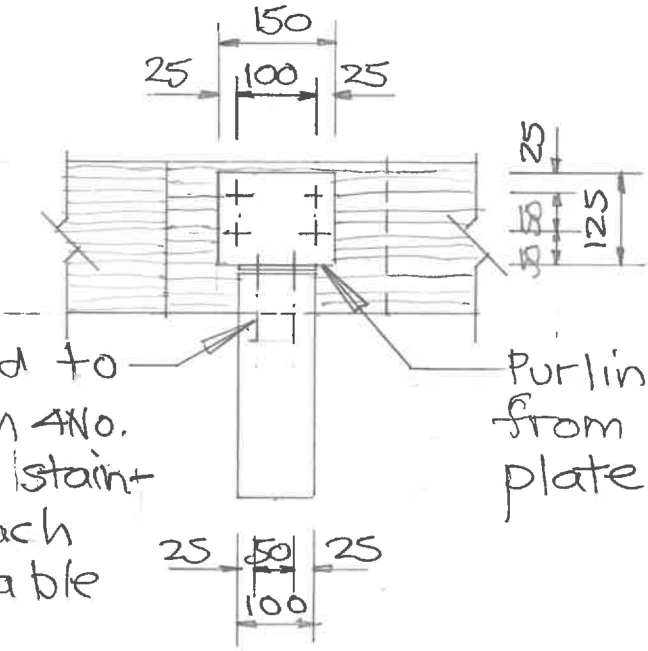
Drawing Title:

Purlin cleat fixed to purlin with 4No. M12 stainless steel bolts.



Existing truss rafter.

SECTION THROUGH PURLIN



Purlin cleat fixed to truss rafter with 4No. 12 dia. x 100 long stainless steel coach screws in suitable pilot holes.

Purlin cleat fabricated from 6mm thick S.S. plate.

SECTION 1-1