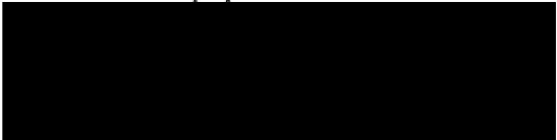


Job No 23/048	Date May '23	For Fevearyear	WEYBREADS LTD Consulting Structural Engineers	
Subject Meadow View, Wingfield			Tel : 01379 608496	
			DD : 07955 897838	
			Email: jason@weybreads.com	
Basis of Design			Sheet No <u>1</u>	Rev <u>0</u>
Scope of Works Proposed outbuilding conversion		Specific Exclusions None		
Design Codes & Standards *		* Delete as applicable		
Imposed, Snow & Wind loads	BS 6399: Parts 1,2 & 3	/	BS EN 1991-1-1 (Eurocode 1)	
Steel	BS 5950-1	/	BS EN 1993-1-1 (Eurocode 3)	
Concrete	BS 8110: Part 1	/	BS EN 1992-1-1 (Eurocode 2)	
Timber	BS 5268-2	/	BS EN 1995-1-1 (Eurocode 5)	
Masonry	BS 5628-1	/	BS EN 1996-1-1 (Eurocode 6)	
Lateral Stability	No special requirements			
Disproportionate collapse building class	1	Special requirements	YES	NO
Temporary Works				
Does project involve removal of a loadbearing wall requiring propping the structure above ?			YES	NO
Does project involve removal of walls currently providing lateral stability?			YES	NO
Will excavations potentially undermine adjacent foundations?			YES	NO
Fire Resistance	N/A			
Soil Conditions & Foundation Type	BGS Geological maps indicate Lowestoft Formation Diamicton clay subsoil.			
400 deep stright brick footings exposed, bearing on clay subsoil		Allowable bearing pressure presumed:	140 kN/m ²	
Party Wall Act	N/A			
Construction (Design & Management) Regulations 2015		Project is: notifiable / non-notifiable		
Principal Designer: R. Adcock		Principal Contractor: TBC		
The project does does not* involve specialist methods or sequence of operations			* Delete as applicable	
Specific requirements are given on the design drawings*				
<i>The design has been carried out with due consideration for safety during construction and occupation and maintenance of the finished structure. Extraordinary hazards and risks that are not present during routine construction operations or would not readily be apparent to a competent contractor are detailed below:</i>				
Element	Hazard	Risk	Action	
	None			
Designed Prepared By: 				
J Albanie BSc (Hons) I.Eng MICE				

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Contents

1. Loading
2. Structure to Outbuilding Conversion

1. Loading

Main Roof

Pitch	40 °		
Dead:		Live: S _b	0.60 kN/m ²
Tiles	45.00 kg/m ²	S _d	0.40 kN/m ²
Felt/battens	5.00 kg/m ²		
Rafters	12.00 kg/m ²		
Ceiling	18.00 kg/m ²		
Total (on slope)	62.00 kg/m ²		excluding ceiling
Total (on slope)	80.00 kg/m ²		including ceiling
Load (on plan)	0.79 kN/m ²		excluding ceiling
Load (on plan)	1.02 kN/m ²		including ceiling

Roof to North bay West elevation

Pitch	30 °		say (final levels TBC)
Dead:		Live: S _b	0.60 kN/m ²
Tiles	45.00 kg/m ²	S _d	0.60 kN/m ²
Felt/battens	5.00 kg/m ²		
Rafters	12.00 kg/m ²		
Ceiling	18.00 kg/m ²		
Total (on slope)	62.00 kg/m ²		excluding ceiling
Total (on slope)	80.00 kg/m ²		including ceiling
Load (on plan)	0.70 kN/m ²		excluding ceiling
Load (on plan)	0.91 kN/m ²		including ceiling

Ceiling

Dead:		Live:	0.25 KN/m ²
Boards	0.00 kg/m ²		
Joists	7.00 kg/m ²		
Plasterbd	18.00 kg/m ²		
Total	0.25 KN/m ²		

External Walls

9" brick/plaster both sides	5.42 KN/m ²
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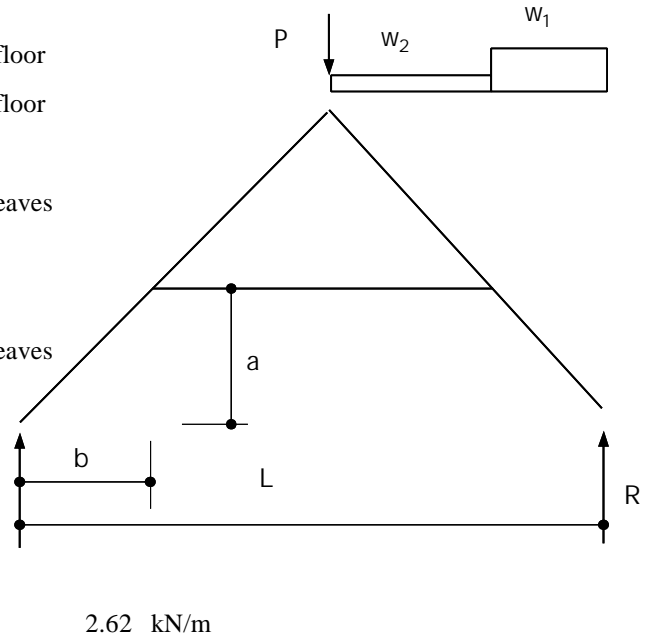
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2. Structure to Outbuilding Conversion

a) Check existing roof trusses to South wing

TR1

Roof load (with ceiling)		1.42	kN/m ²
Roof load (without ceiling)		1.19	kN/m ²
Ceiling load		0.50	kN/m ²
Rafter spacing		400	mm
Rafter	Try	150	x 50 C16
Tie	Try	150	x 50 C16
Roof span	L	3.35	m
Eaves height	H	2.43	m above floor
Height to underside of tie		3.02	m above floor
Roof pitch	a	40	°
Tie height (to centre)	a	0.66	m above eaves
Tie inset	b	0.79	m
Tie span		1.78	m
Ridge height		1.41	m above eaves
Rafter load	w ₁	0.57	kN/m
	w ₂	0.48	kN/m
Ceiling tie load		0.20	kN/m
Ridge point load	P	0.00	kN
Total load		2.10	kN
Reactions	R	1.05	kN
Max rafter moment	M _r	0.65	kNm
Max tie tension	T	1.12	kN
Max tie moment	M _t	0.08	kNm



Rafter forces

	Axial force	Moment
At eaves	0.67 kN	0.00 kNm
Below tie	0.39 kN	0.65 kNm
At ridge	0.86 kN	0.00 kNm
At tie	1.13 kN	0.65 kNm

Deflection at eaves

Rafter 2nd moment of area	14.06	mm ⁴ x 10 ⁶
Rafter elastic modulus	E _{mean}	8800 N/mm ²
Rotation at tie due to w ₂	0.0002	rad
Deflection at R due to w ₂	0.17	mm
Rotation at tie	0.0020	rad (due to moment at tie)
Deflection at R	2.08	mm (due to moment at tie)
Deflection due to R	2.34	mm (due to reactions)
Deflection due to w ₁	-0.49	mm (due to w ₁)
Rotation due to R	0.0023	rad

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Rotation due to w_1		-0.0005 rad	4	0
Rafter leg length		1027 mm		
Total deflection		4.10 mm (diagonally)		
Vertical deflection		3.13 mm at ridge		
Horizontal deflection		2.65 mm at eaves (each side) < 6mm OK		H / 917
Rafter Design				
Effective length	L_{EX}	1160 mm	(y-y restraint from tile battens)	
Modulus of elasticity	E_{min}	5800 N/mm ²		
Moment	M	0.65 kNm		
Compression	C	1.13 kN		
Grade bending stress	S_m	5.30 N/mm ²		
Load duration factor	K_3	1.25		
Depth factor	K_7	1.08		
Load sharing factor	K_8	1.10		
Allowable bending stress	S_m	7.86 N/mm ²		
Slenderness	l	27		
Grade compressive stress	S_c	6.80 N/mm ²		
	$S_{c }$	8.50 N/mm ²		
	$E/S_{c }$	682.35		
Modification factor	K_{12}	0.87		
Allowable compressive stress	$S_{c,adm, }$	7.36 N/mm ²		
Modulus	Z_{xx}	187.50 cm ³		
Applied bending stress	$S_{m,a, }$	3.46 N/mm ²		
Applied compressive stress	$S_{c,a, }$	0.15 N/mm ²		
Euler critical stress	S_e	79.80 N/mm ²		
Combined ratio		0.46		OK
Ceiling Tie				
Maximum span	L	1.78 m	simply supported	
Load	w	0.20 kN/m		
End reaction	R	0.18 kN		
Man load	P	0.90 kN		
		<u>Medium Term</u>	<u>Short Term</u>	
Moment	M_x	0.08 kNm	0.48 kNm	
Tension	T	1.12 kN	1.12 kN	
Grade bending stress	S_m	5.30 N/mm ²		
Grade tension stress	S_t	3.20 N/mm ²		
Load duration factor	K_3	1.25	1.50	
Depth factor	K_7	1.08		
Load sharing factor	K_8	1.10		
Allowable bending stress	$S_{m,adm}$	7.86 N/mm ²	9.44 N/mm ²	
Allowable tensile stress	$S_{t,adm}$	4.75 N/mm ²	5.70 N/mm ²	
Modulus of elasticity	E	8800 N/mm ²	5800 N/mm ²	

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Deflection must be less than		5.33 mm	0.003L	
Z required	$Z_{x \text{ reqd}}$	9.9 cm ³	50.6 cm ³	
I required	$I_{x \text{ reqd}}$	0.55 mm ⁴ x 10 ⁶	3.95 mm ⁴ x 10 ⁶	
Z provided	$Z_{x \text{ prov}}$	187.5 cm ³	187.5 cm ³	OK 27%
I provided	$I_{x \text{ prov}}$	14.06 mm ⁴ x 10 ⁶	14.06 mm ⁴ x 10 ⁶	OK 28%
Bending stress	S_m	0.42 N/mm ²	2.55 N/mm ²	
Tension stress	S_t	0.15 N/mm ²	0.15 N/mm ²	
Combined stress ratio		0.08	0.30	OK
Deflection	d	0.21 mm	1.50 mm	

b) Lintel

L1

	Propose	2	95	x	45	C16
	Check		95	x	90	
Design span	L		0.90 m		simply supported	
Roof Load			2.62 kN/m			
swt			0.10 kN/m			
Total Load	w		2.72 kN/m			
Moment	M_x		0.28 kNm			
End reaction	R		1.22 kN			
Grade bending stress	S_m		5.30 N/mm ²			
Load duration factor	K_3		1.25			
Depth factor	K_7		1.13			
Load sharing factor	K_8		1.00			
Exposure	K_2		1.00	bending/elasticity		
Allowable bending stress	$S_{m,adm}$		7.52 N/mm ²			
Piece factor	K_9		1.14			
Modulus of elasticity	E_{min}		5800 N/mm ²			
Design modulus	E		6612 N/mm ²			
Deflection must be less than			2.70 mm		0.003	L
Z required	$Z_{x \text{ reqd}}$		36.6 cm ³			
I required	$I_{x \text{ reqd}}$		1.30 mm ⁴ x 10 ⁶			
Z provided	$Z_{x \text{ prov}}$		135.4 cm ³		369% of Z req'd	OK
I provided	$I_{x \text{ prov}}$		6.43 mm ⁴ x 10 ⁶		494% of I req'd	OK
Deflection	d		0.55 mm		L / 1646	

c) Common rafters

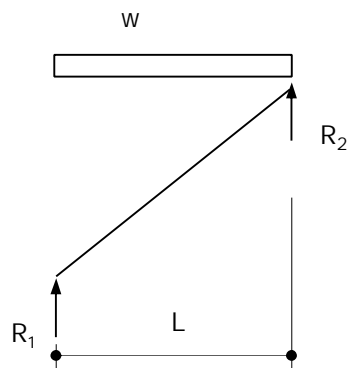
CR1

	Try	120	x	45	C16
Design span	L		2.60 m	on plan	
Pitch	a		30 °		
spacing			0.40 m		
Load	w		0.60 kN/m		
Reaction to ridge	R_2		0.78 kN say	1.96 kN/m	
Slope length	L_{EX}		3002 mm		

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Moment	M	0.51 kNm	
Grade bending stress	S_m	5.30 N/mm ²	
Load duration factor	K_3	1.25	
Depth factor	K_7	1.11	
Load sharing factor	K_8	1.10	
Allowable bending stress	S_m	8.06 N/mm ²	
Z required	$Z_{x\ reqd}$	63.2 cm ³	
Z provided	Z_{xx}	108.00 cm ³	171% of Z req'd OK
Modulus of elasticity	E_{mean}	8800 N/mm ²	
Deflection must be less than		9.01 mm	0.003 x slope length
Slope load	$w \cos^2 a$	0.45 kN/m	
I required	$I_{x\ reqd}$	6.03 mm ⁴ x 10 ⁶	
I provided	$I_{x\ prov}$	6.48 mm ⁴ x 10 ⁶	107% of I req'd OK
Deflection	d	8.38 mm	
Eaves overhang	a	0.15 m	
Reaction to wall plate	R_1	0.88 kN	2.19 kN/m



d) Ridge beam
i) Try softwood

RB1

	Propose	2	195	x	45	C24
	Check		195	x	90	
Design span	L		3.14 m			simply supported
Load	w		2.56 kN/m			
Moment	M_x		3.16 kNm			
End reaction	R		4.03 kN			
Grade bending stress	S_m		7.50 N/mm ²			
Load duration factor	K_3		1.25			
Depth factor	K_7		1.05			
Load sharing factor	K_8		1.10			
Allowable bending stress	$S_{m,adm}$		10.81 N/mm ²			
Piece factor	K_9		1.14			
Modulus of elasticity	E_{min}		7200 N/mm ²			
Design modulus	E		8208 N/mm ²			
Deflection must be less than			9.42 mm		0.003	L
Z required	$Z_{x\ reqd}$		292.3 cm ³			
I required	$I_{x\ reqd}$		41.98 mm ⁴ x 10 ⁶			
Z provided	$Z_{x\ prov}$		570.4 cm ³		195%	of Z req'd OK
I provided	$I_{x\ prov}$		55.61 mm ⁴ x 10 ⁶		132%	of I req'd OK
Deflection	d		7.11 mm		L / 442	

Check Resultant Eaves Spread Due To Vertical Deflection

Roof pitch	40.00 Degs	
Vertical deflection must be less than	7.15 mm	to limit eaves spread to 6mm OK

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Subject Meadow View, Wingfield			

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ii) Fitch alternative

	Consider	2.00	No. pieces	C24	
		145.00	x	45.00	mm
	with	125.00	x	8.00	mm steel fitch
	timber equivalent	145.00	x	128.01	mm
	composi	145.00	x	218.01	mm
Max Span	3.14	m		simply supported	
Load	2.56	KN/m		medium	term loading
Moment	3.16	KNm		K3	1.25
0m allow	7.50	N/mm ²	for C24	K7	1.08
0m allow	11.17	N/mm ²		K8	1.10
Modulus E	8208	N/mm ²		K9	1.14
Z req'd	283	cm ³			
Z prov'd	764	cm ³		270% of Z req'd	OK
Ixx	55	mm ⁴ x10 ⁶			
Roof pitch	40	deg			
Deflection limit 1	7.15	mm		to limit eaves spread to 6mm	
Deflection limit 2	9.42	mm		0.003 L	
deflection	7.14	mm		OK	
timber I	2286	cm ⁴			
steel I	130	cm ⁴			
timber E	8208	N/mm ²			
steel E	205000	N/mm ²			

proportion of load
 on steel 0.59
 on timber 0.41

Check proportion of load on steel

Moment	1.86	KNm
Load Factor	1.50	
Ult moment	2.78	KNm
Z	20.83	cm ³

Bending stress Ult 133.60 N/mm²
 allowable stress py 275.00 N/mm² **OK**

Check shear at end of beam (transfer from steel to timber)

Shear in steel	P	4.03	kN		medium	term
Propose	2	12	mm dia.	bolts	Service class	2
Number of members		3				
Spacing		48	mm		4	d
		<u>Outer members</u>			<u>Inner member</u>	
Material		C24			Steel	
Thickness	t _o	45	mm	t _i	8	mm

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Angle to grain	a_o	90 °	
Permissible load per fixing		2.38 kN	<i>from TRADA Connection Designer</i>
No. of bolts in line		2	
	K_{57}	0.97	
Joint capacity	F_{adm}	4.62 kN	OK

e) Ridge beam

RB2

Propose	2	145	x	45	C24
Check		145	x	90	
Design span	L	2.10 m		simply supported	
Load	w	3.26 kN/m			
Moment	M_x	1.80 kNm			
End reaction	R	3.43 kN			
Grade bending stress	S_m	7.50 N/mm ²			
Load duration factor	K_3	1.25			
Depth factor	K_7	1.08			
Load sharing factor	K_8	1.10			
Allowable bending stress	$S_{m,adm}$	11.17 N/mm ²			
Piece factor	K_9	1.14			
Modulus of elasticity	E_{min}	7200 N/mm ²			
Design modulus	E	8208 N/mm ²			
Deflection must be less than		6.30 mm		0.003 L	
Z required	$Z_{x reqd}$	161.0 cm ³			
I required	$I_{x reqd}$	15.98 mm ⁴ x 10 ⁶			
Z provided	$Z_{x prov}$	315.4 cm ³		196% of Z req'd	OK
I provided	$I_{x prov}$	22.86 mm ⁴ x 10 ⁶		143% of I req'd	OK
Deflection	d	4.40 mm		L / 477	

Check Resultant Eaves Spread Due To Vertical Deflection

Roof pitch	40.00 Degs	
Vertical deflection must be less than	7.15 mm	to limit eaves spread to 6mm OK

f) Lintel

L2

Load shared on 2 no. box lintels

Opening width	1.24 m	
Max Span eff	1.39 m	simply supported
swt wall	2.71 KN/m	
RB1/RB2 spread	1.24 KN/m	
swt lintel	0.10 KN/m	
Total udl	4.05 KN/m	
Total UDL	5.01 KN	
Moment Ms	0.97 KNm	

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Consider	IG Box 100	
Allow UDL	15.00 KN	>W,O.K
Allow shear	7.50 KN	O.K.

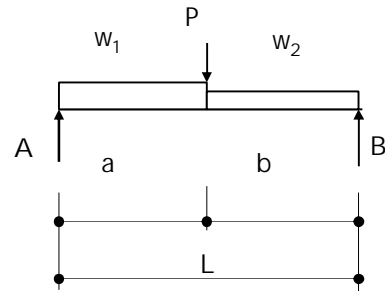
Bearing on wall

Reaction Ru	4.67 KN	
bearing length	150.00 mm	
width	100.00 mm	
compression	0.31 N/mm ²	
fk reqd	0.73 N/mm ²	OK for existing brickwork

g) Lintel

L4

Propose	2	95	x	45	C24
Check		95	x	90	
Design span	L	1.20 m		simply supported	
UDL	w ₁	2.19 kN/m			
	w ₂	2.19 kN/m			
Point Load	P	3.43 kN			
Offsets	a	0.50 m			
	b	0.70 m			
Total Load		6.05 kN			
Reactions	R _A	3.31 kN			
	R _B	2.74 kN			
Zero shear		0.70 m from end B			
Maximum moment	M	1.38 kNm			
Deflection factor		0.06	Average w ₁ + w ₂		
Deflection factor		0.12	P		
Total		0.18			
Grade bending stress	S _m	7.50 N/mm ²			
Load duration factor	K ₃	1.25			
Depth factor	K ₇	1.13			
Load sharing factor	K ₈	1.10			
Exposure	K ₂	1.00	bending/elasticity		
Allowable bending stress	S _{m,adm}	10.31 N/mm ²			
Piece factor	K ₉	1.14			
Basic modulus	E	7200 N/mm ²			
Design modulus	E	8208 N/mm ²			
Deflection must be less than		3.60 mm		0.003	L
Z required	Z _{x reqd}	134.06 cm ³			
I required	I _{x reqd}	5.99 mm ⁴ x 10 ⁶			
Z provided	Z _{x prov}	135.38 cm ³		101% of Z req'd	OK
I provided	I _{x prov}	6.43 mm ⁴ x 10 ⁶		107% of I req'd	OK
Deflection	d	3.35 mm		L/ 358	



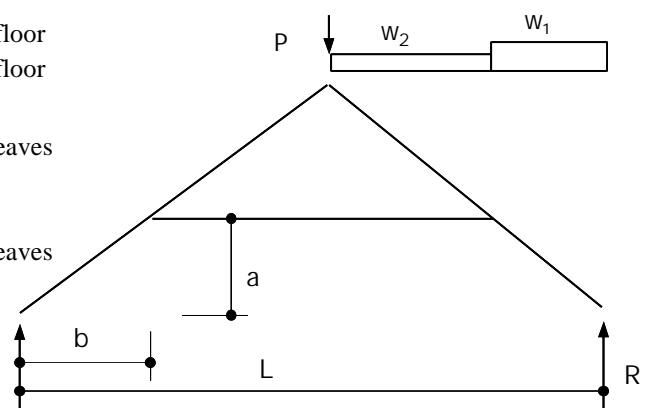
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h) Eaves beam	EB1				
	Propose	2	145	x	45 C24
	Check		145	x	90
Design span	L		2.55 m		simply supported
Roof Load			1.51 kN/m		
swt			0.10 kN/m		
Total Load	w		1.61 kN/m		
Moment	M_x		1.31 kNm		
End reaction	R		2.05 kN		
Grade bending stress	S_m		7.50 N/mm ²		
Load duration factor	K_3		1.25		
Depth factor	K_7		1.08		
Load sharing factor	K_8		1.00		
Exposure	K_2		0.80	bending/elasticity	
Allowable bending stress	$S_{m,adm}$		8.12 N/mm ²		
Piece factor	K_9		1.14		
Modulus of elasticity	E_{min}		7200 N/mm ²		
Design modulus	E		6566 N/mm ²		
Deflection must be less than			7.65 mm		0.003 L
Z required	$Z_{x reqd}$		161.1 cm ³		
I required	$I_{x reqd}$		17.65 mm ⁴ x 10 ⁶		
Z provided	$Z_{x prov}$		315.4 cm ³		196% of Z req'd OK
I provided	$I_{x prov}$		22.86 mm ⁴ x 10 ⁶		130% of I req'd OK
Deflection	d		5.90 mm		L / 432

j) Principal truss	TR3				
Analysis					
Rafter	Try	2	120	x	45
			120	x	90 C24
Tie	Try	1	12	dia. tie bar	

Roof span	L	4.62 m
Eaves height	H	2.10 m above floor
Height to underside of tie		2.40 m above floor
Roof pitch	a	30 °
Tie height (to centre)	a	0.31 m above eaves
Tie inset	b	0.53 m
Tie span		3.56 m
Ridge height		1.33 m above eaves
Rafter load	w_1	0.08 kN/m
	w_2	0.08 kN/m
Ceiling tie load		0.00 kN/m
Ridge point load	P	6.85 kN
Total load		7.20 kN



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Reactions	R	3.60 kN
Max rafter moment	M_r	1.90 kNm
Max tie tension	T	7.90 kN
Max tie moment	M_t	0.00 kNm

Rafter forces	Axial force	Moment
At eaves	1.80 kN	0.00 kNm
Below tie	1.78 kN	1.90 kNm
At ridge	8.55 kN	0.00 kNm
At tie	8.62 kN	1.90 kNm

Deflection at eaves

Rafter 2nd moment of area		12.96 mm ⁴ x 10 ⁶	
Rafter elastic modulus	E_{min}	7200 N/mm ²	
Rotation at tie due to w_2		0.0001 rad	
Deflection at R due to w_2		0.08 mm	
Rotation at tie		0.0139 rad	(due to moment at tie)
Deflection at R		8.53 mm	(due to moment at tie)
Deflection due to R		2.55 mm	(due to reactions)
Deflection due to w_1		-0.01 mm	(due to w_1)
Rotation due to R		0.0042 rad	
Rotation due to w_1		0.0000 rad	
Rafter leg length		612 mm	
Total deflection		11.14 mm (diagonally)	
Vertical deflection		9.55 mm at ridge	
Horizontal deflection		5.75 mm at eaves (each side)	H / 365 < 6mm OK

Rafter Design

Effective length	L_{EX}	2055 mm	(y-y restraint from tile battens)
Modulus of elasticity	E_{min}	7200 N/mm ²	
Moment	M	1.90 kNm	
Compression	C	8.62 kN	
Grade bending stress	S_m	7.50 N/mm ²	
Exposure factor	K_2	1.00	
Load duration factor	K_3	1.25	
Depth factor	K_7	1.11	
Piece Factor	K_9	1.14	
Load sharing factor	K_8	1.00	
Allowable bending stress	S_m	11.82 N/mm ²	
Slenderness	l	59	
Grade compressive stress	S_c	7.90 N/mm ²	
	$S_{c }$	9.88 N/mm ²	
	$E/S_{c }$	729.11	
Modification factor	K_{12}	0.64	
Allowable compressive stress	$S_{c,adm, }$	6.33 N/mm ²	

Job No 23/048	Date May '23	For Fevearyear	WEYBREADS LTD Consulting Structural Engineers
Subject Meadow View, Wingfield			

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Modulus	Z_{xx}	216.00	cm ³
Applied bending stress	$S_{m,a, }$	8.79	N/mm ²
Applied compressive stress	$S_{c,a, }$	0.80	N/mm ²
Euler critical stress	S_e	20.19	N/mm ²
Combined ratio		0.90	OK

Tie Bar

Bar size	12.00	mm
Area	113.10	mm ²
Tension	7.90	KN
f/a	69.82	N/mm ² < 275 O.K.

Tie fixing to rafter

Applied load	P	7.90	kN	Medium	term
Propose	2	12	mm dia.	bolts	Service class 2
Number of members		2			
Spacing		48	mm	4	d
		<u>Member 1</u>		<u>Member 2</u>	
Material		45		steel	
Thickness	t_1	45	mm	t_2	5
Angle to grain	a_1	30	°	a_2	0
Permissible load per fixing		7.92	kN	<i>from TRADA Connection Designer</i>	
No. of bolts in line		1			
	K_{57}	1.00			
Joint capacity	F_{adm}	15.84	kN	OK	

Ridge beam bracket fixing to principal rafter

Shear	6.85	KN	in	C16	timber.
screw dia	5.00	mm		K46	1.00
basic shear load	0.55	KN		K52	1.12
				K54	1.00
Min No reqd	12.00				
spacing along grain	50.00	mm			
spacing across grain	15.00	mm			
edge dist	25.00	mm			