



## Structural Computations

**Project:**

**Project No:**

**Description:**

### Relevant Australian Standards:

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|--|--|--|
| <input type="checkbox"/> AS1170.1 Dead & Live Loading          | <input type="checkbox"/> AS1684.2 Residential Timber Framing | <input type="checkbox"/> AS3700 Masonry Structures         |
| <input type="checkbox"/> AS1170.2 Wind Loading                 | <input type="checkbox"/> AS1720 Timber Engineering           | <input type="checkbox"/> AS4678 Earth Retaining Structures |
| <input type="checkbox"/> AS1170.3 Snow Loading                 | <input type="checkbox"/> AS3600 Concrete Structures          | <input type="checkbox"/> AS2327 Composite Structures       |
| <input type="checkbox"/> AS1170.4 Earthquake Loading           | <input type="checkbox"/> AS4100 Steel Structures             | <input type="checkbox"/> AS4600 Cold Formed Steel          |
| <input type="checkbox"/> AS2870 Residential Slabs and Footings |  |  |

Approved:

Date:

STEEL FLOOR BEAM V5.04

Brogue Consulting Engineers

Member: (FB8 - VERTICAL CHECK) 310UB40.4 (G300)  
 Bending:  $M(\max) = 98.9 \text{ kNm} < \phi M_b(600, \alpha_m = 1.00) = 182.3 \text{ kNm}$  **OK (0.54)**  
 Shear:  $V.\max = 60.8 \text{ kN} < \phi V_w = 320.4 \text{ kN}$  (Web area full depth) **OK (0.19)**  
 Deflection:  $\delta_{dl} = L/616$  (11mm),  $\Psi_s.\delta_{ll} = L/1113$  (6mm),  $\delta_{tot.} = L/396$  (16mm), 1kN midspan  $\delta = 0.3 \text{ mm}$  **OK**  
 Precamber: Not required  
 Reactions: (Each end)  $R_{dl} = 25.5 \text{ kN}$ ,  $R_{ll} = 20.2 \text{ kN}$ ,  $R^* = 60.8 \text{ kN}$

Geometry

Span (L) = 6500 mm Effective length (Le) = 600 mm  
 Centres (cts) = 3100 mm  $\alpha_m = 1.00$

Design at = M mm from LHS, (M)ax, (S)eg

Effective length (Le) = 600 mm  
 $\alpha_m = 1.00$

Loadings

Floor area = 20.2 m<sup>2</sup> Live load type = N (Normal), (S)orage, (M)annual  
 Apply reduction = N (Yes, (N)o AS/NZS 1170.0 - Table 4.1  
 Floor reduction ( $\Psi_a$ ) = 1.00 AS/NZS 1170.1 - Cl 3.4.2

Uniform dead loads

Floor dead load (wdl) = 1.50 kPa *	3100 mm +	kN/m =	4.65 kN/m
Wall dead load (wdl) = 0.50 kPa *	3100 mm +	kN/m =	1.55 kN/m
Roof (wdl) = 0.40 kPa *	3100 mm +	kN/m =	1.24 kN/m
Include S.Wt = Y (Yes, (N)o		S.Wt =	0.41 kN/m
		$\Sigma wdl =$	7.85 kN/m

Uniform live loads

Floor live load (wll) = 2.00 kPa * $\Psi_a$ *	3100 mm +	kN/m =	6.20 kN/m
Other live load (wll) = kPa *	3100 mm +	kN/m =	0.00 kN/m
Alternate point live load = 1.80 kN	Distr. to 1 members	$\Sigma wll =$	6.20 kN/m

Point loads

Dead load (pdl) = kN Position = 3250 mm from LHS  
 Live load (pll) = kN

Short term LL factor ( $\Psi_{su}$ ) = 0.70 ( $\Psi_{sp}$ ) = 1.00

$w^* = 1.2 * wdl + 1.5 * wll =$	18.72 kN/m	$R_{dl} =$	25.5 kN
$p^* = 1.2 * pdl + 1.5 * pll =$	0.00 kN	$R_{ll} =$	20.2 kN
Max $M^*$ at =	3250 mm	$R^* =$	60.8 kN
$M^* =$	98.9 kNm (Maximum)		

Capacity

Description = 310UB40.4 (G300)	Warping constant ( $I_w$ ) =	165 x10 <sup>9</sup> mm <sup>6</sup>
Flange yield ( $f_{yf}$ ) = 320 MPa	Torsional constant (J) =	157 x10 <sup>3</sup> mm <sup>4</sup>
Web yield ( $f_{yw}$ ) = 320 MPa	Effective section mod. ( $Z_{ex}$ ) =	633 x10 <sup>3</sup> mm <sup>3</sup>
Area ( $A_g$ ) = 5210 mm <sup>2</sup>	Effective section mod. ( $Z_{ey}$ ) =	139 x10 <sup>3</sup> mm <sup>3</sup>
Stiffness ( $I_x$ ) = 86.4 x10 <sup>6</sup> mm <sup>4</sup>	Elastic modulus (E) =	200000 MPa - Cl 1.4
Stiffness ( $I_y$ ) = 7.65 x10 <sup>6</sup> mm <sup>4</sup>	Shear modulus (G) =	80000 MPa - Cl 1.4
$\phi = 0.9$ Table 3.4		
$M_{sx} = \min(f_{yf}, f_{yw}) * Z_{ex} =$	$\phi M_{sy} = \phi * \min(f_{yf}, f_{yw}) * Z_{ey} =$	40.0 kNm - Cl 5.2.1
$M_{oa} = 6202.9 \text{ kNm}$ - Cl 5.6.1.1(3)	$\phi M_{sx} =$	182.3 kNm
$\alpha_s = 1.000$ $\alpha_m = 1.00$	$\phi M_{bx} = \alpha_s * \alpha_m * \phi M_{sx} =$	182.3 kNm

Deflections

Ireq'd DL (L/360) = 50.5 x10 <sup>6</sup> mm <sup>4</sup>	$\delta_{DL} =$	10.6 mm	Span / 616
Ireq'd $\Psi_s.LL$ (L/360) = 27.9 x10 <sup>6</sup> mm <sup>4</sup>	$\Psi_s.\delta_{LL} =$	5.8 mm	Span / 1113
Ireq'd DL+ $\Psi_s.LL$ (L/250) = 54.5 x10 <sup>6</sup> mm <sup>4</sup> < Critical	$\delta_{Total} =$	16.4 mm	Span / 396
Max. precamber (0.3%*span) = 20 mm	Min. precamber =	15 mm	
Precamber 80% of $\delta_{DL} =$	Adopted precamber =	0 mm	
	1kN midspan $\delta =$	0.3 mm	



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Page:  
Project No.: 20501  
Designed: SM

FJ2 - ex.house floor joist

TIMBER FLOOR BEAM V5.06

Brogue Consulting Engineers

Beam:	(FJ2 - ex.house floor joist) 300mm x 58mm Smart LVL15 (Oregon) (Single span) (Interior)	
Bending:	M(dll)* = 6.21kNm (+ve) < øM(dll) = 16.04kNm, M* = 10.28kNm (+ve) < øM = 23.60kNm	OK (0.39,0.44)
Shear:	V(dll)* = 4.14kN < øV(dll) = 24.99kN, V* = 6.86kN < øV = 35.08kN	OK (0.17,0.20)
Deflection:	δ(dll+ψll) = L/334 (18mm), ψs.δll = L/799 (8mm), 1kN midspan δ = 2.2mm	Warning
Reactions:	(Each end) Rdl = 2.34kN, Rll = 2.70kN, R* = 6.86kN	

Geometry (For a primary building member)

Category =	2 (1) House, (2) Primary building elements, (3) Important		
House =	Y (Yes),(N)o	Edge restrained =	B (T)ension, (C)ompression, (B)oth
Span (L) =	6000 mm	Lay.t (Top) =	2000 mm
Centres (cts) =	450 mm	Lay.b (Bottom) =	2000 mm
Span type =	S (Single),(D)ouble		

Loadings

Floor area (A) =	2.70 m <sup>2</sup>	Live load type =	N (Normal), (S)torage, (M)annual AS/NZS 1170.0 - Table 4.1
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Uniform dead loads

Floor dead load (wdl) =	1.50 kPa *	450 mm +	kN/m =	0.68 kN/m
Wall dead load (wdl) =	kPa *	450 mm +	kN/m =	0.00 kN/m
Other dead load (wdl) =	kPa *	mm +	kN/m =	0.00 kN/m
Include S.Wt =	Y (Yes),(N)o		S.Wt =	0.10 kN/m
			Σwdl =	0.78 kN/m

Uniform live loads

Floor live load (wll) =	2.00 kPa *	450 mm +	kN/m =	0.90 kN/m	
Partitions (wll) =	kPa *	450 mm +	kN/m =	0.00 kN/m	
Alternate point live load =	1.80 kN	Distr. to	1 members	Σwll =	0.90 kN/m

Point loads

Dead load (pdl) =	kN	Position =	3000 mm from LHS
Live load (pll) =	kN	Shear using PL at support =	N (Yes),(N)o

Short term LL factor (ψsu) =	1.00	(ψsp) =	1.00
Long term LL factor (ψlu) =	0.33 / 0.40 (wdl*)	(ψlp) =	0.33 / 0.40 (pdl*)
wdl* = 1.2*wdl+1.5*ψlu*wll =	1.38 kN/m	M(dll+ψll)* =	6.21 kNm (Max at 3000mm)
w* = 1.2*wdl+1.5*wll =	2.29 kN/m	M* =	10.28 kNm (Max at 3000mm)
pdl* = 1.2*pdl+1.5*ψlp*pll =	0.00 kN	V(dll+ψll)* =	4.14 kN
p* = 1.2*pdl+1.5*pll =	0.00 kN	V* =	6.86 kN

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member =	300mm x 58mm Smart LVL15	Area (A) =	17400 mm <sup>2</sup>
Description =	LVL15 seasoned softwood	Section modulus (Zx) =	870 x10 <sup>3</sup> mm <sup>3</sup>
Design depth (dD) =	300 mm	Stiffness (Ix) =	130.5 x10 <sup>6</sup> mm <sup>4</sup>
Design width (dW) =	58 mm	Modulus of elasticity (E) =	15500 MPa - Cl 8.3

S1 = (dD/dW) <sup>1.35</sup> *(Lay.b/dD) <sup>0.25</sup> =	14.77 For bottom tension edge restrained - Cl 3.2.3.2(b)		
k12d = 1.5-0.05*pbd*S1 =	0.772 for 10 ≤ pbd*S1 ≤ 20 - Cl 3.2.4	f'b =	46.5 MPa
k12 = 1.5-0.05*pb*S1 =	0.809 for 10 ≤ pb*S1 ≤ 20 - Cl 3.2.4	f's =	4.2 MPa
Strength reduction factor (ø) =	0.9 Table 2.1	Material constant (pbd) =	0.99 (rbd=0.25)
øM(dll) = ø*(k1=0.57)*k4*k6*k9*k12d*f'b*Zx =	16.04 kNm	Material constant (pb) =	0.93 (rb=0.59)
øM = ø*k1*k4*k6*k9*k12*f'b*Zx =	23.60 kNm	Duration factor (k1) =	0.80
øV(dll) = ø*(k1=0.57)*k4*k6*f's*(2/3*A) =	24.99 kN	Moisture factor (k4) =	1.00
øV = ø*k1*k4*k6*f's*(2/3*A) =	35.08 kN	Temp. factor (k6) =	1.00
		Sharing factor (k9) =	1.00
		Size modifier (mod.b) =	1.00
		Size modifier (mod.s) =	1.00

Deflections

		Duration factor (j2) =	2.0		
Ireq'd DL+ψll.LL (16mm) =	146.5 x10 <sup>6</sup> mm <sup>4</sup>	< Critical	δDL+ψll.LL =	18.0 mm	Span / 334
Ireq'd ψs.LL (12mm) =	81.7 x10 <sup>6</sup> mm <sup>4</sup>		ψs.δLL =	7.5 mm	Span / 799
			1kN midspan δ =	2.2 mm	



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Page:  
Project No.: 20501  
Designed: SM

RJ1 - ex.house roof rafters

TIMBER ROOF BEAM V5.06

Brogue Consulting Engineers

Beam: (RJ1 - ex.house roof rafters) 240mm x 42mm Smart LVL15 (Oregon) (Single span)  
 Bending:  $M(dl)^* = 1.83kNm (+ve) < \phi M(dl) = 8.54kNm$ ,  $M^* = 4.10kNm (+ve) < \phi M = 14.72kNm$  OK (0.21,0.28)  
 $Mw^* = 1.28kNm (-ve) < \phi Mw = 15.34kNm$  OK (0.08)  
 Shear:  $V(dl)^* = 1.22kN < \phi V(dl) = 15.28kN$ ,  $V^* = 2.73kN < \phi V = 25.20kN$  OK (0.08,0.11)  
 $Vw^* = 0.85kN < \phi Vw = 26.81kN$  OK (0.03)  
 Deflection:  $\delta dl = L/444$  (14mm),  $\delta ll = L/909$  (7mm),  $\delta wl = L/707$  (-8mm) OK  
 Reactions: (Each end)  $Rdl = 0.90kN$ ,  $Rll = 1.10kN$ ,  $Rwl^* = -1.66kN$ ,  $R.dn^* = 2.73kN$ ,  $R.up^* = 0.85kN$

Geometry (For a member in a house or secondary member in a building)

Category = 1 (1) House, (2) Primary building elements, (3) Important  
 Span (L) = 6000 mm Edge restrained (down) = C (T)ension,(C)ompression,(B)oth  
 Centres (cts) = 600 mm Lay.t (Top) = 900 mm  
 Span type = S (S)ingle,(D)ouble

Loadings

Roof area (A) = 3.60 m<sup>2</sup> Apply wind reduction = Y (Y)es,(N)o  
 LL = 1.8/A+0.12 ≥ 0.25 = 0.62 kPa Roof reduction (Ka) = 1.00 AS/NZS 1170.2, Table 5.4  
 Ratio Ws/Wu = 0.68 (Refer wind analysis)

Uniform dead loads

Roof dead load (wdl) = 0.40 kPa \* 600 mm + kN/m = 0.24 kN/m  
 Other dead load (wdl) = kPa \* 600 mm + kN/m = 0.00 kN/m  
 Include S.Wt = Y (Y)es,(N)o S.Wt = 0.06 kN/m  
 $\Sigma wdl = 0.30 kN/m$

Uniform live loads

Roof live load (wll) = 0.25 kPa \* 600 mm + kN/m = 0.15 kN/m  
 Other live load (wll) = kPa \* 600 mm + kN/m = 0.00 kN/m  
 Alternate point live load = 1.10 kN (critical) Distr. to 1 members  $\Sigma wll = 0.37 kN/m$

Uniform wind loads

Ult. wind load (Wu) = 0.84 kPa \* 600 mm  
 Cp,e = 0.9 Cp,i = 0.2  $\Sigma wwl^* = -0.55 kN/m$  (up)

Point loads

Dead load (pdl) = kN Position = 3000 mm from LHS  
 Live load (pll) = kN Shear using PL at support = Y (Y)es,(N)o  
 Wind load (pwl\*) = kN (-ve up)  
 $w(dl)^* = 1.35 * wdl = 0.41 kN/m$   $M(dl)^* = 1.83 kNm$  (Max at 3000mm)  
 $w^* = 1.2 * wdl + 1.5 * wll = 0.91 kN/m$   $M^* = 4.10 kNm$  (Max at 3000mm)  
 $w.up^* = 0.9 * wdl + wwl^* = 0.28 kN/m$  (up)  $Mw.up^* = 1.28 kNm$  (Max at 3000mm)  
 $p(dl)^* = 1.35 * pdl = 0.00 kN$   $V(dl)^* = 1.22 kN$   
 $p^* = 1.2 * pdl + 1.5 * pll = 0.00 kN$   $V^* = 2.73 kN$   
 $p.up^* = 0.9 * pdl + pwl^* = 0.00 kN$   $Vw.up^* = 0.85 kN$

Bending and Shear capacity - Cl 3.2.1 & Cl 3.2.5

Member = 240mm x 42mm Smart LVL15 Area (A) = 10080 mm<sup>2</sup>  
 Description = LVL15 seasoned softwood Section modulus (Zx) = 403 x10<sup>3</sup> mm<sup>3</sup>  
 Design depth (dD) = 240 mm Stiffness (Ix) = 48.4 x10<sup>6</sup> mm<sup>4</sup>  
 Design width (dW) = 42 mm Modulus of elasticity (E) = 15500 MPa - Cl 8.3  
 $S1d = 1.25 * dD / dW * (Lay.t / dD)^{0.5} = 13.83$  For top comp. edge restrained - Cl 3.2.3.2(a)  
 $S1u = (dD / dW)^{1.35} * (Lay.t / dD)^{0.25} = 14.64$  For top tension edge restrained in uplift - Cl 3.2.3.2(b)  
 $k12d = 1.5 - 0.05 * \rho bd * S1d = 0.804$  for 10 ≤ ρb \* S1d ≤ 20 - Cl 3.2.4  
 $k12 = 1.5 - 0.05 * \rho b * S1d = 0.841$  for 10 ≤ ρb \* S1d ≤ 20 - Cl 3.2.4 f'b = 48.6 MPa  
 $k12u = 1.5 - 0.05 * \rho bu * S1u = 0.823$  for 10 ≤ ρbu \* S1u ≤ 20 - Cl 3.2.4 f's = 4.2 MPa  
 Strength reduction factor (ϕ) = 0.95 Table 2.1 Material constant (ρbd) = 1.01 (rbd=0.25)  
 $\phi M(dl) = \phi * (k1=0.57) * k4 * k6 * k9 * k12 * f'b * Zx = 8.54 kNm$  Material constant (ρb) = 0.95 (rb=0.60)  
 $\phi M = \phi * k1 * k4 * k6 * k9 * k12 * f'b * Zx = 14.72 kNm$  Stress reversal (ρbu) = 0.92 (rbu=1.00)  
 $\phi Mw = \phi * (k1=1) * k4 * k6 * k9 * k12 * f'b * Zx = 15.34 kNm$  Duration factor (k1) = 0.94 (Live)  
 $\phi V(dl) = \phi * (k1=0.57) * k4 * k6 * f's * (2/3 * A) = 15.28 kN$  Moisture factor (k4) = 1.00  
 $\phi V = \phi * k1 * k4 * k6 * f's * (2/3 * A) = 25.20 kN$  Temp. factor (k6) = 1.00  
 $\phi Vw = \phi * (k1=1) * k4 * k6 * f's * (2/3 * A) = 26.81 kN$  Sharing factor (k9) = 1.00

Deflections

Duration factor (j2) = 2.0  
 Ireq'd DL (16mm max) = 40.9 x10<sup>6</sup> mm<sup>4</sup> < Critical  $\delta DL = 13.5 mm$  Span / 444  
 Ireq'd LL (L/240) = 12.8 x10<sup>6</sup> mm<sup>4</sup>  $\delta LL = 6.6 mm$  Span / 909  
 Ireq'd WL (L/180) = 12.3 x10<sup>6</sup> mm<sup>4</sup>  $\delta WL = -8.5 mm$  Span / 707