

PROPOSED NEW CARPORT BEAM

for

**Dave Davies
40 Wharf Road, Riwaka**

STRUCTURAL CALCULATIONS



Job ref: 13180
July 2013

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Project:

Davies

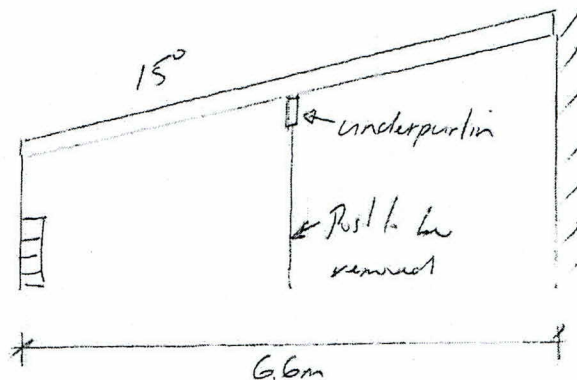
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By: DB

Removal of post to carport



* Underpurlin is primary load: supports $4.6/2 = 2.3$ of roof $6.6/2 = 3.3$ wide. $\therefore$ Trib area = $2.3 \times 3.3 = 7.6 \text{ m}^2$

* Minor loading from eave, 1.2m retained

$\therefore$ Span: $\cos 15^\circ = 6.6/\text{span} \therefore \text{span} = \frac{6.6}{\cos 15^\circ} = 6.8 \text{ m}$

Wind zone: assume high: 44 m/s.

$\therefore$ Cpe for max up/dn ≈ -1.2 .

$\therefore p = 0.5 \times 1.2 \text{ kg/m}^3 \times (44 \text{ m/s})^2 \times -1.2$
 $\approx 1.4 \text{ kPa}$

Loads: CDL: $G = 1.2 \text{ m} \times 0.4 \text{ kPa} = 0.5 \text{ kN/m}$

$Q = 1.2 \text{ m} \times 0.25 \text{ kPa} = 0.3 \text{ kN/m}$

$W_{up} = 1.2 \text{ m} \times 1.4 \text{ kPa} = 1.7 \text{ kN/m}$

Point: $G = 7.6 \text{ m}^2 \times 0.4 \text{ kPa} = 3.0 \text{ kN}$

$Q = 7.6 \text{ m}^2 \times 0.25 \text{ kPa} = 1.9 \text{ kN}$

$W_{up} = 7.6 \text{ m}^2 \times 1.4 \text{ kPa} = 10.6 \text{ kN}$



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DB.

1. 300x90 hyONE LVL ($E=16 \text{ GPa}$).

$$\Rightarrow \delta_{kL}(L+Q) = 21.7 \text{ mm} = L/313 \quad \checkmark \text{ OK.}$$

$$\Rightarrow \delta_{wsp(s)} = -29.7 \text{ mm} = L/229 \text{ i high, but}$$

acceptable given flexible handisisted climbing
and age of house. OK.

$$\Rightarrow \text{Strength all OK.}$$

300x90 hyONE

or

315x88 CL16

2. 315x88 CL16 (Purchased PL16-350).

$$\Rightarrow \delta_{kL}(L+Q) = 15.6 \text{ mm} = L/435 \text{ Good/OK.}$$

$$\Rightarrow \delta_{wsp(s)} = -21.3 \text{ mm} = L/319 \quad \text{OK.}$$

Connection Design

- ① Underpin connection: $G = 3.0 \text{ kN}$
 $Q = 1.9 \text{ kN}$
 $W_{sp} = -10.6 \text{ kN}$

$$\therefore 1.2G + 1.5Q = 6.5 \text{ kN}$$

$$0.9G + W_{sp} = -7.9 \text{ kN}$$

New beam: 4/M12 with steel bracket; $b_e = 90$

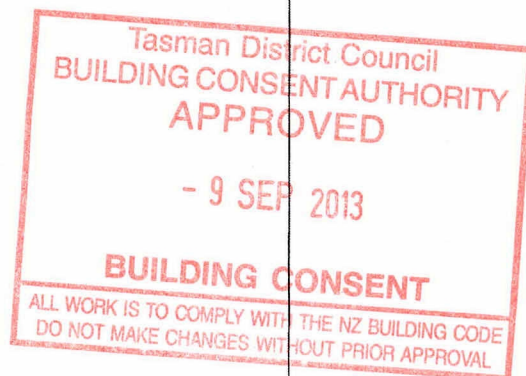
$$\phi Q_n = \phi n k_1 k_{12} k_{13} Q_{kp}$$

$$(k_1 = 0.8) = 0.7 \times 4 \times 0.8 \times 1.0 \times 1.0 \times 6.97 \text{ kN} \times 1.25 (\text{Steel})$$

$$= 19.5 \text{ kN} \geq 6.5 \text{ kN} \quad \checkmark \text{ OK.}$$

$$(k_1 = 1.0) = 0.7 \times 4 \times 1.0 \times 1.0 \times 1.0 \times 6.97 \times 1.25$$

$$= 24.4 \text{ kN} \geq 7.9 \text{ kN} \quad \checkmark \text{ OK.}$$





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Existing beam connection: 2/M12 with steel end side.

(double) (steel.)

$$\phi Q_n = \phi_n k_1 k_2 k_3 Q_{kp} \times 2 \times 1.25$$

$$(k_1 = 0.8) \quad \approx 19.5/2 \times 2 \geq 6.4 \text{ kN} \quad \text{OK.}$$

ϕ_n bolts not 4 or more

$$(k_2 = 1.0) \quad \approx 24.4/2 \times 2 \geq 7.9 \text{ kN} \quad \text{OK.}$$

② Lower end.

$$C_1 \approx 0.5 \text{ kN/m} \times 3.3 \text{ m} + 3.0 \text{ kN/2} \approx 3.4 \text{ kN}$$

$(+ 0.3 \times 0.09 \times 5.5 \times 3.3 \text{ m})$

$$Q \approx 0.3 \text{ kN/m} \times 3.3 \text{ m} + 1.9 \text{ kN/2} \approx 1.9 \text{ kN}$$

$$W_{up} \approx -1.7 \text{ kN/m} \times 3.3 \text{ m} + -10.6 \text{ kN/2} \approx 10.9 \text{ kN}$$

$$1.2 C_1 + 1.5 Q \approx 6.9 \text{ kN}$$

$$1.35 C_1 \approx 4.6 \text{ kN}$$

$$0.9 C_1 + W_{up} \approx -7.8 \text{ kN}$$

} supported by post, not end post.



Uplift fixing: 2/M12 in double shear ~~or 1/M12 in single shear~~

$$\therefore \phi Q = 24.4 \text{ kN} (k_2 = 1.0) \geq 7.8 \text{ kN} \quad \text{OK.}$$

$\Rightarrow$ longitudinally control section is stronger;

$$Q_{hd} > Q_{up} \therefore \text{OK.}$$

③ Upper end. 2/M12 in single shear; steel bracket.

$$k_1 = 0.6: \phi Q_n = 0.7 \times 2 \times 0.6 \times 6.97 \times 1.25$$

$$\approx 7.3 \text{ kN} \geq 4.6 \text{ kN} \quad \text{OK.}$$

$$k_2 = 0.8 \quad \phi Q_n = 7.3/0.6 \times 0.8$$

$$\approx 9.7 \text{ kN} \geq 6.9 \text{ kN} \quad \text{OK.}$$

$$k_3 = 1.0 \quad \phi Q_n = 7.3/0.6 \approx 12.1 \text{ kN} \geq 7.8 \text{ kN} \quad \text{OK.}$$



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Uplift fixing to base of stud:

Assume wall weight contributes; 1m Light weight
& 1m medium weight $\Rightarrow$ 3m each. (conserv.)

$$W = 3m \times 0.4kPa \text{ (light)} + 3m \times 1.0kPa \text{ (medium)} \\ = 4.2kN$$

$\therefore$ Residual hold-down required to base of stud;

$$78kN - 4.2kN = 73.8kN$$

$\Rightarrow$ '6kN' hold-down will be adequate

Glue to
base of stud
OK.

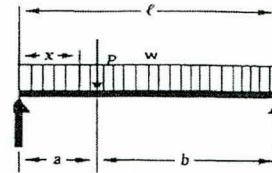


TIMBER BEAM CALCULATOR

For a Simply Supported Beam with UDL Applied

to NZS 3603:1993

Enter Blue cells



Beam Description : Davies Carport Beam (GL16)

Depth D mm =	315	UDL		Point Load	
Width B mm =	88	Dead (G) kN/m =	0.666	Dead (G) kN =	3.000
Supported Length L mm =	6800	Live (Q) kN/m =	0.300	Live (Q) kN =	1.900
Effective Length Lay mm =	900	Wind kN/m Wu ↑ =	-1.700	Wind kN/m Wu ↑ =	-10.600
No of elements - sawn timber only	1	Wu ↓ =	0.000	Wu ↓ =	0.000
K4 or K6 =	1.00	Wind kN/m Ws ↑ =	-1.139	Wind kN/m Ws ↑ =	-7.102
Characteristic Bending Stress =	40	Ws ↓ =	0.000	Ws ↓ =	0.000
Characteristic Shear Stress =	3.7	Snow Su =	0.000	Snow Su =	0.000
		Ss =	0.000	Ss =	0.000
S1 = $1.35 \cdot (Lay/B \cdot ((D/B)^2 - 1)^{0.5})^{1.5}$ =	8.00	short term ψ_s =	0.70	Distance to nearest support (a) mm =	3400.00
K8 =	1.00	long term ψ_l =	0.00	(a ≤ b)	
Size factor K24 =	0.99	combination ψ_c =	0.00	short term ψ_s =	0.70
S1 uplift =	10.74			long term ψ_l =	0.00
K8 uplift =	1.00			combination ψ_c =	0.00
Z mm ³ =	1.46E+06				
I mm ⁴ =	2.29E+08				
phi (0.8 timber, 0.9 LVL) =	0.8				

BENDING STRENGTH

Load Combinations	K1	Design Moment kNm	Strength phi=0.8 kNm	
1.35G	0.6	12.08	27.72	-OK-
1.2G + 1.5Q	0.8	18.19	36.95	-OK-
1.2G + $\psi_c Q$ + Wu (min up)	1.0	10.74	46.19	-OK-
0.9G + Wu (max up)	1.0	-19.79	46.16	-OK-
1.2G + $\psi_c Q$ + Su	0.8	10.74	36.95	-OK-

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BUILDING CONSENT AUTHORITY
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- 9 SEP 2013

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DO NOT MAKE CHANGES WITHOUT PRIOR APPROVAL

SHEAR STRENGTH

Load Combinations	K1	Design Shear force kN	Strength phi=0.8 kN	
1.35G	0.6	5.08	32.82	-OK-
1.2G + 1.5Q	0.8	7.47	43.76	-OK-
1.2G + $\psi_c Q$ + Wu (min up)	1.0	4.52	54.70	-OK-
0.9G + Wu (max up)	1.0	7.69	54.70	-OK-
1.2G + $\psi_c Q$ + Su	0.8	4.52	43.76	-OK-

Deflection for Simply Supported Beam

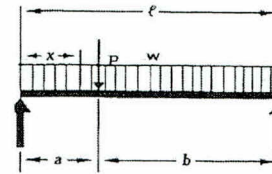
E (GPa) =	16.00	K ₂ =	1.5
Deflection(mm)	Span/	Deflection	
G	10.42	653	
Q	5.67	1199	
k2(G + $\psi_l Q$)	15.63	435	
G + $\psi_s Q$	14.39	473	
Ws ↑	-21.33	-319	

TIMBER BEAM CALCULATOR

For a Simply Supported Beam with UDL Applied

to NZS 3603:1993

Enter Blue cells

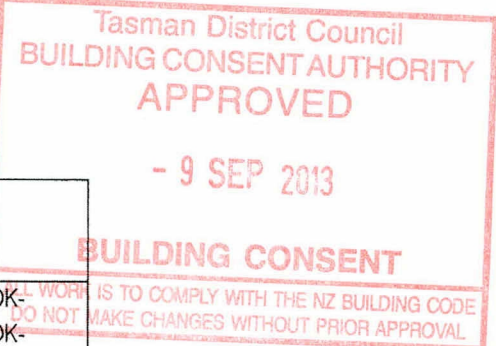


Beam Description : Davies Carport Beam (hyONE)

Depth D mm =	300	UDL		Point Load	
Width B mm =	90	Dead (G) kN/m =	0.662	Dead (G) kN =	3.000
Supported Length L mm =	6800	Live (Q) kN/m =	0.300	Live (Q) kN =	1.900
Effective Length Lay mm =	900	Wind kN/m Wu ↑ =	-1.700	Wind kN/m Wu ↑ =	-10.600
		Wu ↓ =	0.000	Wu ↓ =	0.000
No of elements - sawn timber only	1	Wind kN/m Ws ↑ =	-1.139	Wind kN/m Ws ↑ =	-7.102
K4 or K6 =	1.00	Ws ↓ =	0.000	Ws ↓ =	0.000
Characteristic Bending Stress =	65	Snow Su =	0.000	Snow Su =	0.000
Characteristic Shear Stress =	4.6	Ss =	0.000	Ss =	0.000
S1 = $1.35 \cdot (Lay/B \cdot ((D/B)^2 - 1)^{0.5})$	7.61	short term ψ_s =	0.70	Distance to nearest support (a) mm =	3400.00
K8 =	1.00	long term ψ_l =	0.00	(a ≤ b)	
Size factor K24 =	1.00	combination ψ_c =	0.00	short term ψ_s =	0.70
S1 uplift =	10.00			long term ψ_l =	0.00
K8 uplift =	1.00			combination ψ_c =	0.00
Z mm ³ =	1.35E+06				
I mm ⁴ =	2.03E+08				
phi (0.8 timber, 0.9 LVL) =	0.9				

BENDING STRENGTH

Load Combinations	K1	Design Moment kNm	Strength phi=0.8 kNm	
1.35G	0.6	12.05	47.39	-OK-
1.2G + 1.5Q	0.8	18.16	63.18	-OK-
1.2G + $\psi_c Q$ + Wu (min up)	1.0	10.71	78.98	-OK-
0.9G + Wu (max up)	1.0	-19.81	78.98	-OK-
1.2G + $\psi_c Q$ + Su	0.8	10.71	63.18	-OK-



SHEAR STRENGTH

Load Combinations	K1	Design Shear force kN	Strength phi=0.8 kN	
1.35G	0.6	5.06	44.71	-OK-
1.2G + 1.5Q	0.8	7.46	59.61	-OK-
1.2G + $\psi_c Q$ + Wu (min up)	1.0	4.50	74.51	-OK-
0.9G + Wu (max up)	1.0	7.70	74.51	-OK-
1.2G + $\psi_c Q$ + Su	0.8	4.50	59.61	-OK-

Deflection for Simply Supported Beam

E (GPa) =	13.00	K ₂ =	1.5
Deflection(mm)	Span/	Deflection	
G	14.47	470	
Q	7.90	861	
k2(G + $\psi_l Q$)	21.70	313	
G + $\psi_s Q$	20.00	340	
Ws ↑	-29.72	-229	

3.4 hyONE® LIMIT STATE DESIGN CHARACTERISTIC PROPERTIES

The limit state design characteristic properties for hyONE® are detailed in Table 9.

Standard section sizes, properties and design capacities for hyONE are detailed in Table 10.

TABLE 9: CHARACTERISTIC DESIGN STRESSES AND ELASTIC MODULI FOR hyONE®

Property		Edge MPa	Flat MPa
Modulus Of Elasticity	E	16,000	16,000
Modulus Of Rigidity	G	800	800
Bending	f_b^1	65.0	52.0
Tension Parallel To Grain	f_t^2	26.0	26.0
Compression Parallel To Grain	f_c	48.0	48.0
Shear In Beams	f_s	4.6	3.2
Compression Perpendicular To Grain	f_p	12.0	12.0
Joint Group		See Table 4	

Size Factors:

¹For beams exceeding 95 mm - multiply the published characteristic value for bending by $(95/d)^{0.154}$ where d is the depth of the beam

²For tension members with the largest cross-sectional dimension exceeding 150 mm - multiply the published characteristic value for tension by $(150/d)^{0.147}$, where d is the largest cross sectional dimension of the tension member

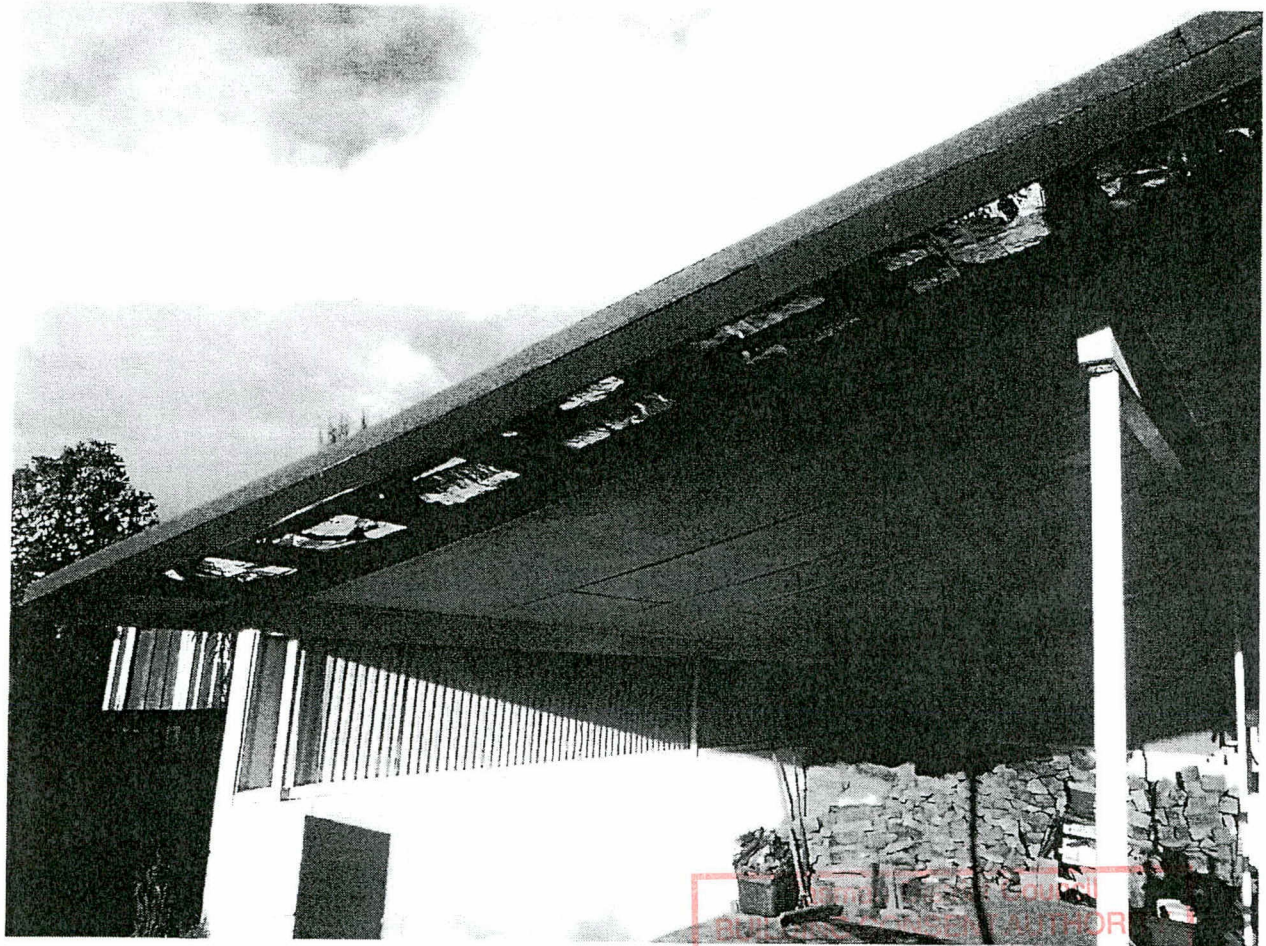
TABLE 10: hyONE® SECTION SIZES AND PROPERTIES

Product Code	Dimensions (mm x mm)	Mass (kg/m)	I_{xx} (10^6 mm^4)	Z_{xx} (10^3 mm^3)	J (10^6 mm^4)	EI_x (10^9 Nmm^2)	$\phi f_t Z_x^*$ (kNm)
240x90	240 x 90	13.4	101	845	41.9	1622	42.9
300x90	300 x 90	16.7	198	1320	55.6	3168	64.7
360x90	360 x 90	20.1	342	1901	69.2	5474	90.6
400x90	400 x 90	22.3	469	2347	78.3	7509	110.0

hyONE is available in lengths up to 7.2 metres. Contact CHH Woodproducts NZ for availability of non-standard sizes and lengths.

* $\phi = 0.9$, for category 2 applications (Refer to Table 2)





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