

Date: 11/30/2023

Council: District Council

***BWhite
Consulting Ltd***

Subject: B2 compliance in respect of Proposed shed at 343 Brophys Road, Cheviot, New Zealand

District Council typically requests a Producer Statement/Other means of compliance for Design for Clause B2 of the Building Code-Durability

We are not able to provide a Producer Statement for durability because compliance needs to be shown on material-by-material basis using a variety of compliance methods, and not all materials used have a clear compliance path.

We can confirm that for the structural elements shown in our documentation under Clause B1:

Timber

Timber treatment has been selected to meet or exceed the requirements of table 1A of B2/AS1 and NZS3602

Steel fixing

Steel fixings are protected against weather as per table 4.1 and 4.2 of NZS3604-2011

Yours Faithfully

BWhite CONSULTING LTD

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Pole Shed App Ver 01 2022

Job No.: 2310047

Address: 343 Brophys Road, Cheviot, New Zealand

Date: 11/30/2023

Latitude: -42.822392

Longitude: 173.194493

Elevation: 136 m

General Input

Roof Live Load	0.25 KPa	Roof Dead Load	0.25 KPa	Roof Live Point Load	1.1 Kn
Snow Zone	N4	Ground Snow Load	0.9 KPa	Roof Snow Load	0.63 KPa
Earthquake Zone	3	Subsoil Category	D	Exposure Zone	B
Importance Level	1	Ultimate wind & Earthquake ARI	100 Years	Max Height	4.5 m
Wind Region	NZ2	Terrain Category	2.3	Design Wind Speed	37.66 m/s
Wind Pressure	0.85 KPa	Lee Zone	NO	Ultimate Snow ARI	50 Years
Wind Category	High	Earthquake ARI	100		

Note: Wind lateral loads are governing over Earthquake loads, So only wind loads are considered in calculations

Pressure Coefficients and Pressures

Shed Type = Mono Enclosed

For roof $C_{p,i} = 0.6469$

For roof $C_{p,e}$ from 0 m To 4.05 m $C_{p,e} = -0.9$ $p_e = -0.60$ KPa $p_{net} = -1.12$ KPa

For roof $C_{p,e}$ from 4.05 m To 8.10 m $C_{p,e} = -0.5$ $p_e = -0.34$ KPa $p_{net} = -0.86$ KPa

For wall Windward $C_{p,i} = 0.6469$ side Wall $C_{p,i} = -0.5513$

For wall Windward and Leeward $C_{p,e}$ from 0 m To 18.40 m $C_{p,e} = 0.7$ $p_e = 0.51$ KPa $p_{net} = 1.0$ KPa

For side wall $C_{p,e}$ from 0 m To 4.05 m $C_{p,e} =$ $p_e = -0.47$ KPa $p_{net} = 0.02$ KPa

Maximum Upward pressure used in roof member Design = 1.12 KPa

Maximum Downward pressure used in roof member Design = 0.64 KPa

Maximum Wall pressure used in Design = 1.0 KPa

Maximum Racking pressure used in Design = 0.92 KPa

Design Summary

Purlin Design

Purlin Spacing = 750 mm

Purlin Span = 4450 mm

Try Purlin 200x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

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K1 Short term = 1 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 1.00

K8 Upward = 0.46 S1 Downward = 11.27 S1 Upward = 24.92

Shear Capacity of timber = 3 MPa Bending Capacity of timber = 14 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{1.35D}	0.63 Kn-m	Capacity	2.23 Kn-m	Passing Percentage	353.97 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.78 Kn-m	Capacity	2.97 Kn-m	Passing Percentage	166.85 %
M _{0.9D-WnUp}	-1.66 Kn-m	Capacity	-1.73 Kn-m	Passing Percentage	104.22 %
V _{1.35D}	0.56 Kn	Capacity	9.65 Kn	Passing Percentage	1723.21 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	1.57 Kn	Capacity	12.86 Kn	Passing Percentage	819.11 %
V _{0.9D-WnUp}	-1.49 Kn	Capacity	-16.08 Kn	Passing Percentage	1079.19 %

Deflections

Modulus of Elasticity = 6700 MPa NZS3603 Amt 4, Table 2.3 considering at least 4 members acting together

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 9.83 mm Limit by Woolcock et al, 1999 Span/240 = 18.33 mm

Deflection under Dead and Service Wind = 13.44 mm Limit by Woolcock et al, 1999 Span/100 = 44.00 mm

Reactions

Maximum downward = 1.57 kn Maximum upward = -1.49 kn

Number of Blocking = 0 if 0 then no blocking required, if 1 then one midspan blocking required

Rafter Design Internal

Internal Rafter Load Width = 4600 mm Internal Rafter Span = 4350 mm Try Rafter 2x300x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1 K1 Medium term = 0.8 K1 Long term = 0.6 K4 = 1 K5 = 1 K8 Downward = 1.00

K8 Upward = 1.00 S1 Downward = 6.81 S1 Upward = 6.81

Shear Capacity of timber = 3 MPa Bending Capacity of timber = 14 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{1.35D}	3.67 Kn-m	Capacity	10.08 Kn-m	Passing Percentage	274.66 %
M _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	10.23 Kn-m	Capacity	13.44 Kn-m	Passing Percentage	131.38 %

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M _{0.9D-WnUp}	-9.74 Kn-m	Capacity	-16.8 Kn-m	Passing Percentage	172.48 %
V _{1.35D}	3.38 Kn	Capacity	28.94 Kn	Passing Percentage	856.21 %
V _{1.2D+1.5L 1.2D+Sn 1.2D+WnDn}	9.40 Kn	Capacity	38.6 Kn	Passing Percentage	410.64 %
V _{0.9D-WnUp}	-8.95 Kn	Capacity	-48.24 Kn	Passing Percentage	538.99 %

Deflections

Modulus of Elasticity = 5400 MPa NZS3603 Amt 4, Table 2.3

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 5.46 mm Limit by Woolcock et al, 1999 Span/240 = 18.75 mm

Deflection under Dead and Service Wind = 8.29 mm Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Reactions

Maximum downward = 9.40 kn Maximum upward = -8.95 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 2

Calculations as per NZS 3603:1993 Amend 2005 clause 4.4

Joint Group for Rafters = J5 Joint Group for Pole = J5

Minimum Bolt edge, end and spacing for Load perpendicular to grains = 60 mm

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 100 mm

For Parallel to grain loading

K₁₁ = 2.0 f_{cj} = 36.1 Mpa for Pole with effective thickness = 100 mm

Capacity under short term loads = 21.67 Kn > -8.95 Kn

Rafter Design External

External Rafter Load Width = 2300 mm External Rafter Span = 4323 mm Try Rafter 300x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K₁ Short term = 1 K₁ Medium term = 0.8 K₁ Long term = 0.6 K₄ = 1 K₅ = 1 K₈ Downward = 0.94

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K8 Upward =0.94 S1 Downward =13.93 S1 Upward =13.93

Shear Capacity of timber =3 MPa Bending Capacity of timber =14 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

M _{1.35D}	1.81 Kn-m	Capacity	4.72 Kn-m	Passing Percentage	260.77 %
M _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	5.05 Kn-m	Capacity	6.30 Kn-m	Passing Percentage	124.75 %
M _{0.9D-W_nUp}	-4.81 Kn-m	Capacity	-7.87 Kn-m	Passing Percentage	163.62 %
V _{1.35D}	1.68 Kn	Capacity	14.47 Kn	Passing Percentage	861.31 %
V _{1.2D+1.5L 1.2D+S_n 1.2D+W_nD_n}	4.67 Kn	Capacity	19.30 Kn	Passing Percentage	413.28 %
V _{0.9D-W_nUp}	-4.45 Kn	Capacity	-24.12 Kn	Passing Percentage	542.02 %

Deflections

Modulus of Elasticity = 5400 MPa NZS3603 Amt 4, Table 2.3

k₂ for Long Term Loads = 2

Deflection under Dead and Live Load = 6.06 mm Limit by Woolcock et al, 1999 Span/240= 18.75 mm

Deflection under Dead and Service Wind = 8.29 mm Limit by Woolcock et al, 1999 Span/100 = 45.00 mm

Reactions

Maximum downward =4.67 kn Maximum upward = -4.45 kn

Rafter to Pole Connection check

Bolt Size = M12 Number of Bolts = 2

Calculations as per NZS 3603:1993 Amend 2005 clause 4.4

Joint Group for Rafters =J5 Joint Group for Pole = J5

Factor of Safety = 0.7

For Perpendicular to grain loading

K₁₁ = 14.9 f_{pj} = 12.9 Mpa for Rafter with effective thickness = 50 mm

For Parallel to grain loading

K₁₁ = 2.0 f_{cj} = 36.1 Mpa for Pole with effective thickness = 100 mm

Eccentric Load check

V = phi x k₁ x k₄ x k₅ x f_s x b x d_s (Eq 4.12) = -25.20 kn > -4.45 Kn

Single Shear Capacity under short term loads = -10.84 Kn > -4.45 Kn

Girt Design Front and Back

Girt's Spacing = 900 mm

Girt's Span = 4600 mm

Try Girt 200x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =0.77 S1 Downward =11.27 S1 Upward =18.02

Shear Capacity of timber =3 MPa Bending Capacity of timber =14 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

$M_{Wind+Snow}$	2.38 Kn-m	Capacity	2.86 Kn-m	Passing Percentage	120.17 %
$V_{0.9D-WnUp}$	2.07 Kn-m	Capacity	16.08 Kn-m	Passing Percentage	776.81 %

Deflections

Modulus of Elasticity = 6700 MPa NZS3603 Amt 4, Table 2.3

Deflection under Snow and Service Wind = 38.30 mm Limit by Woolcock et al, 1999 Span/100 = 46.00 mm

Sag during installation = 27.15 mm

Reactions

Maximum = 2.07 kn

Girt Design Sides

Girt's Spacing = 900 mm

Girt's Span = 4500 mm

Try Girt 200x50 SG8 Dry

Moisture Condition = Dry (Moisture in timber is less than 16% and timber does not remain in continuous wet condition after installation)

K1 Short term = 1 K4 =1 K5 =1 K8 Downward =1.00

K8 Upward =0.78 S1 Downward =11.27 S1 Upward =17.82

Shear Capacity of timber =3 MPa Bending Capacity of timber =14 MPa NZS3603 Amt 4, table 2.3

Capacity Checks

$M_{Wind+Snow}$	2.28 Kn-m	Capacity	2.90 Kn-m	Passing Percentage	127.19 %
$V_{0.9D-WnUp}$	2.02 Kn-m	Capacity	16.08 Kn-m	Passing Percentage	796.04 %

Deflections

Modulus of Elasticity = 6700 MPa NZS3603 Amt 4, Table 2.3

Deflection under Snow and Service Wind = 35.07 mm Limit by Woolcock et al. 1999 Span/100 = 45.00 mm

Sag during installation = 24.86 mm

Reactions

Maximum = 2.02 kn

Middle Pole Design

Geometry

225 SED H5 (Minimum 250 dia. at Floor Level)	Dry Use	Height	4200 mm
Area	44279 mm ²	As	33209.1796875 mm ²
Ix	156100441 mm ⁴	Zx	1314530 mm ³
Iy	156100441 mm ⁴	Zy	1314530 mm ³
Lateral Restraint	1300 mm c/c		

Loads

Total Area over Pole = 20.7 m²

Dead	5.17 Kn	Live	5.17 Kn
Wind Down	13.25 Kn	Snow	13.04 Kn
Moment wind	10.69 Kn-m	Moment snow	3.10 Kn-m
Phi	0.8	K8	1.00
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Peeling	Steaming	Normal	Dry Use
fb =	36.3 MPa	fs =	2.96 MPa
fc =	18 MPa	fp =	7.2 MPa
ft =	22 MPa	E =	9257 MPa

Capacities

PhiNcx Wind	637.62 Kn	PhiMnx Wind	38.17 Kn-m	PhiVnx Wind	78.64 Kn
PhiNcx Dead	382.57 Kn	PhiMnx Dead	22.90 Kn-m	PhiVnx Dead	47.18 Kn
PhiNcx Snow	510.09 Kn	PhiMnx Snow	30.54 Kn-m	PhiVnx Snow	62.91 Kn

Checks

$$(M_x/\phi M_{nx}) + (N/\phi N_{cx}) = 0.32 < 1 \text{ OK}$$

$$(M_x/\phi M_{nx})^2 + (N/\phi N_{cx}) = 0.12 < 1 \text{ OK}$$

$$\text{Deflection at top under service lateral loads} = 19.64 \text{ mm} < 42.00 \text{ mm}$$

Drained Lateral Strength of Middle pile in cohesionless soils Free Head short pile

Assumed Soil Properties

Gamma 18 Kn/m³ Friction angle 30 deg Cohesion 0 Kn/m³

$$K_0 = (1 - \sin(30)) / (1 + \sin(30))$$

$$K_p = (1 + \sin(30)) / (1 - \sin(30))$$

Geometry For Middle Bay Pole

Ds = 0.6 mm Pile Diameter
L = 1450 mm Pile embedment length
f1 = 3375 mm Distance at which the shear force is applied
f2 = 0 mm Distance of top soil at rest pressure

Loads

Moment Wind = 10.69 Kn-m Moment Snow = Kn-m
Shear Wind = 3.17 Kn Shear Snow = 3.10 Kn

Pile Properties

Safety Factory 0.55
Hu = 5.63 Kn Ultimate Lateral Strength of the Pile, Short pile
Mu = 11.16 Kn-m Ultimate Moment Capacity of Pile

Checks

$$\text{Applied Forces/Capacities} = 0.96 < 1 \text{ OK}$$

End Pole Design

Geometry For End Bay Pole

Geometry

225 SED H5 (Minimum 250 dia. at Floor Level) Dry Use Height 4200 mm

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Area	44279 mm ²	As	33209.1796875 mm ²
Ix	156100441 mm ⁴	Zx	1314530 mm ³
Iy	156100441 mm ⁴	Zy	1314530 mm ³
Lateral Restraint	mm c/c		

Loads

Total Area over Pole = 10.35 m²

Dead	2.59 Kn	Live	2.59 Kn
Wind Down	6.62 Kn	Snow	6.52 Kn
Moment Wind	5.34 Kn-m	Moment snow	1.55 Kn-m
Phi	0.8	K8	0.78
K1 snow	0.8	K1 Dead	0.6
K1 wind	1		

Material

Peeling	Steaming	Normal	Dry Use
fb =	36.3 MPa	fs =	2.96 MPa
fc =	18 MPa	fp =	7.2 MPa
ft =	22 MPa	E =	9257 MPa

Capacities

PhiNcx Wind	499.48 Kn	PhiMnx Wind	29.90 Kn-m	PhiVnx Wind	78.64 Kn
PhiNcx Dead	299.69 Kn	PhiMnx Dead	17.94 Kn-m	PhiVnx Dead	47.18 Kn
PhiNcx Snow	399.59 Kn	PhiMnx Snow	23.92 Kn-m	PhiVnx Snow	62.91 Kn

Checks

$$(M_x/\Phi M_{nx}) + (N/\Phi N_{cx}) = 0.21 < 1 \text{ OK}$$

$$(M_x/\Phi M_{nx})^2 + (N/\Phi N_{cx}) = 0.06 < 1 \text{ OK}$$

Deflection at top under service lateral loads = 10.49 mm < 44.89 mm

Ds =	0.6 mm	Pile Diameter
L =	1450 mm	Pile embedment length
f1 =	3375 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

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Total Area over Pole = 10.35 m²

Moment Wind =	5.34 Kn-m	Moment Snow =	1.55 Kn-m
Shear Wind =	1.58 Kn	Shear Snow =	1.55 Kn

Pile Properties

Safety Factory	0.55	
Hu =	5.63 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	11.16 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.48 < 1 OK

Drained Lateral Strength of End pile in cohesionless soils Free Head short pile

Assumed Soil Properties

Gamma	18 Kn/m ³	Friction angle	30 deg	Cohesion	0 Kn/m ³
K0 =	$(1 - \sin(30)) / (1 + \sin(30))$				
Kp =	$(1 + \sin(30)) / (1 - \sin(30))$				

Geometry For End Bay Pole

Ds =	0.6 mm	Pile Diameter
L =	1450 mm	Pile embedment length
f1 =	3375 mm	Distance at which the shear force is applied
f2 =	0 mm	Distance of top soil at rest pressure

Loads

Moment Wind =	5.34 Kn-m	Moment Snow =	1.55 Kn-m
Shear Wind =	1.58 Kn	Shear Snow =	1.55 Kn

Pile Properties

Safety Factory	0.55	
Hu =	5.63 Kn	Ultimate Lateral Strength of the Pile, Short pile
Mu =	11.16 Kn-m	Ultimate Moment Capacity of Pile

Checks

Applied Forces/Capacities = 0.48 < 1 OK

Uplift Check

Density of Concrete = 24 Kn/m³

Density of Timber Pole = 5 Kn/m³

Due to cast in place pile, the surface interaction between soil and pile will be rough thus angle of friction between both is taken equal to soil angle of internal friction

Ks (Lateral Earth Pressure Coefficient) for cast into place concrete piles = 1.5

Formula to calculate Skin Friction = Safety factor (0.55) x Density of Soil(18) x Height of Pile(1450) x Ks(1.5) x $0.5 \times \tan(30)$ x π x Dia of Pile(0.6) x Height of Pile(1450)

Skin Friction = 16.98 Kn

Weight of Pile + Pile Skin Friction = 20.30 Kn

Uplift on one Pile = 18.53 Kn

Uplift is ok