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Prolam®

Specific engineering design guide

prolamnz.com

Prolam®
Engineered Laminated Timber

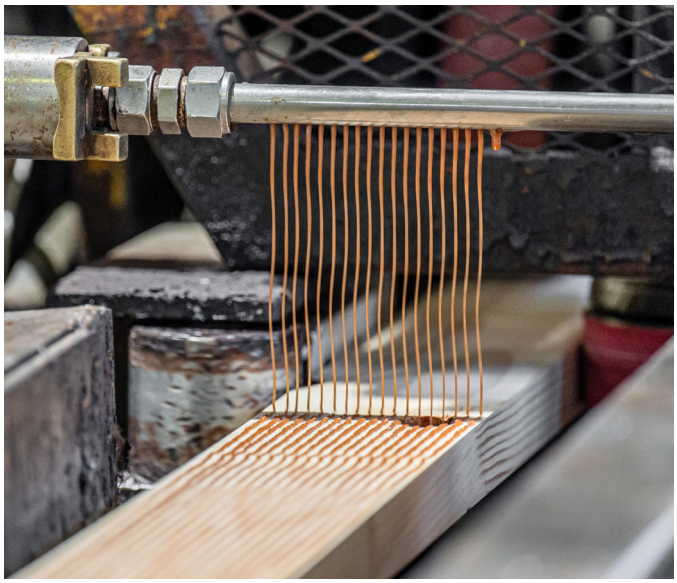
Prolam®
Specific Engineering Design Guide

This document provides the design properties and product information required for the specific engineering design of Prolam products outside the scope of Prolam Specifier and span tables.

Introduction

Prolam supports architects and construction professionals to design and build with strength, confidence and ease with premium engineered timber solutions. With experience spanning more than 20 years, we design, manufacture and supply glue laminated timber solutions for the residential and commercial building industry across New Zealand.

Prolam has two manufacturing sites near Motueka in the Tasman district. Prolam is manufactured to comply with the glue laminated standard AS/NZS 1328.1:1998 and the production process is certified by Bureau Veritas.



Manufacturing Process

Prolam Glulam is manufactured from strength-graded, kiln-dried timber. This process involves bonding smaller pieces of timber together to create larger, more robust structural elements which would be challenging to obtain from solid sawn timber.

Removing natural defects such as knots and unsuitable grain orientations during manufacturing provides a final product which has uniform and reliable properties with higher strength and stiffness. Prolam Glulam is also more stable than a sawn timber beam of the same size and the tendency of large sections of sawn timber to twist, split and shrink is greatly minimised in Prolam. Depending on the service condition in which the products will be used, resorcinol- and melamine-based structural adhesives are used for finger-jointing and resorcinol-based structural adhesives are used for laminating the products (AS/NZS 1328 Parts 1 and 2, AS/NZS 1491).

Product Specification

Wood species	New Zealand Radiata Pine
Lamination thickness	28.5~50mm
Moisture content (leaving the factory)	12~18 %
Default Precamber	Non-visual Beams – 600m radius
	Visual Beams – No Precamber
	Custom precamber available on request

Timber Treatment and Durability

Prolam products are manufactured to the requirements of AS/NZS 1328.1:1998, NZS 3640:2003, AS 1604.1:2012 and AS/NZS 1604.5:2012, under an approved quality system based on the IS0 9000 series of standards.

When the product is used in accordance with Prolam product literature and NZS3602, it will meet the requirements of clause B2 of the New Zealand Building Code for 50-year durability.

Prolam PL8 and PL12 beams are H1.2 treated for interior use or H3.2 treated (CCA or MCA) for exterior and weather-exposed applications, such as veranda beams, deck bearers, and subfloors.

Prolam Posts are CCA or MCA H5 treated for in-ground and weather-exposed applications, such as deck piles, and veranda posts.

PLX20 beams are only supplied as H1.2 treated for interior use.

H3.2 and H5 treatments are applied prior to manufacturing into the final product. As a result, the treatment levels are consistent through the whole member, unlike larger sawn timber members and poles where treatment may not penetrate into the core.

Design Properties

Prolam structural elements may be designed in accordance with NZS AS 1720.1:2022 Timber Structures Part 1: Design methods. This is currently an alternative solution for compliance with clause B1 of the NZ building code.

Design actions are as specified in AS/NZS 1170 Parts 0, 1, 2, and 3 and NZS 1170.5. The design properties presented are for use with Prolam products only.

Grade PL8 and PL12 products

The structural design properties for Prolam PL8 and PL12 products are shown in Table 1 below.

Table 1 – Characteristic strengths for Prolam PL8 and PL12 products with moisture content of 15% or less

Property		PL8 (MPa)	PL12 (MPa)
Modulus of Elasticity	MoE	8000	11500
Modulus of Rigidity	G	530	770
Bending	f'_b	19	25
Shear in beams	f'_s	3.7	4.2
Tension parallel to grain	f'_t	9.0	11.3
Compression parallel to grain	f'_c	21.6	26.1
Bearing perpendicular to grain	f'_p	6.9	6.9

The MoE is the average value and may be used in all deflection calculations. A lower bound value is not needed for the design of Prolam products. The MoE includes an allowance for shear deformation.

The characteristic strengths presented in table 1 can be applied to all Prolam PL8 and PL12 products including posts. These also apply for members with bending about the weak axis.

For dry Prolam PL8 and PL12 members, the densities for SG8 and SG12 timber have been adopted as in Table 2 below.

Table 2 – Densities for dry Prolam PL8 and PL12 members

	Design Density (kg/m^3)	Characteristic Density (kg/m^3)
Prolam PL8	450	375
Prolam PL12	540	450

The design density is used for calculating the self-weight of the member. The characteristic density is used for connection design using the detailed method.

PLX20 Beams

The PLX20 beams are a composite section of timber and steel. The strength values for MoE and f'_b have been determined from testing in accordance with AS/NZS 4063.1:2010. The other values are for SG6 timber as the base material for the glulam timber component.

Due to the make-up of the member, it is intended to be used only in bending and not as a tension or compression member.

For bending about the weak axis, the characteristic properties for SG6 timber should be used. PLX20 beams are only for interior/dry use.

The characteristic strength properties of PLX20 beams for bending about the major axis are presented in table 3.

Table 3 – Characteristic strengths for Prolam PLX20 beams

Property		PLX20 240x90 (MPa)	PLX20 290x90 (MPa)
Modulus of Elasticity	MoE	20000	21000
Modulus of Rigidity	G	480	480
Bending	f'_b	40	45
Shear in beams	f'_s	3.7	3.7
Tension parallel to grain	f'_t	4.0	4.0
Compression parallel to grain	f'_c	15	15
Bearing perpendicular to grain*	f'_p	6.9	6.9

Table 4 – Densities for dry Prolam PLX20 beams

	Design Density (kg/m^3)	Characteristic Density (kg/m^3)
Prolam PLX20	700	330

The design density for PLX20 beams allows for the steel plate inserts and is used when calculating the self-weight of the beam. The characteristic density for SG6 as base timber is to be used for connection design using the detailed method.

The design method for the PLX20 products is the same as for the other Prolam glulam using the section properties presented in Table 5. These have been calculated for the composite section.

Table 5 – Section Properties for PLX20 beams

	Moment of Inertia I (m^4)	Section modulus Z (m^3)
PLX20 240x90	1.01×10^{-4}	8.45×10^{-4}
PLX20 290x90	1.79×10^{-4}	1.23×10^{-3}

Structural Design Information

The following gives guidance for the design of Prolam beams using NZS AS 1720.1:2022. The values given for the various factors must be verified from the standard.

1. Capacity Factor (Ø)

A capacity factor (Ø) of 0.8 is applied when calculating the design capacities. Refer to cl ZZ2.3.

2. Duration of Load Factor for Strength (k_1)

Refer to table 2.3 for the duration of load factors for strength (k_1) which are based on the duration of the peak action. Typical values for various load combinations are given in table G1 appendix G. Table 6 below gives a summary of these. The k_1 factors for connection design are different and may be lower than those shown in table 6.

3. Duration of Load Factor for Creep Deformation (j_2)

For Prolam beams with a moisture content of less than 15%, a j_2 factor of 1.5 may be used for members with a width of 90mm or more, otherwise, a j_2 factor of 2 should be used. Refer to clause 2.4.1.2 and table 2.4.

4. Moisture Content Factor (k_4)

The factor k_4 for moisture is calculated using the annual average moisture content of the member. The factor $k_4 = 1.0$ for members with a moisture content less than 15% (dry use). Refer to clause 2.4.2.3.

5. Temperature Effects (k_6)

No modification for temperature effects is needed for design when Prolam members are used under ambient temperatures within New Zealand.

6. Bearing Factor (k_7)

Bearing factor k_7 may be used in accordance with Clause 2.2.4.

7. Strength Sharing Between Parallel members (k_9)

The modification factor for strength sharing $k_9 = 1.0$ for the design of Prolam beams.

8. Stability Factors

Stability factors for beams are calculated in accordance with sections 3.2.3 and 3.2.4. For beam design, the material constants ρ_b are shown in table 7. These have been calculated for r=0.25.

Table 7 –Material Constant ρ_b for Prolam Beams

Product	ρ_b
PL8	0.88
PL12	0.84
PLX20 240x90	0.81
PLX20 290x90	0.84

Table 6 – Load duration factors for design of Prolam beams.

Load Action	Typical load combination	k_1 for Prolam beams
Permanent actions	1.35G 1.2 G + 1.5 Ψ_l Q	0.57
Roof live load (UDL)	1.2G + 1.5 Q	0.94
Roof live load (concentrated)	1.2 G + 1.5 Q_p	0.97
Floor live load (UDL)	1.2 G + 1.5 Q	0.80
Floor live load (concentrated)	1.2 G + 1.5 Q_p	0.94
Wind load combinations	1.2 G + W_u + Ψ_c Q 0.9 G + W_u	1.0
Snow load combinations (sub-alpine)	1.2 G + S_u + Ψ_c Q	0.94
Seismic combinations	G + E_u + Ψ_c Q	1.0
Fire combinations	G + Ψ_l Q	0.94

9. Size Factor

A size factor of 1 is applied for Prolam products except for tension members. For tension members with a larger cross-section dimension of more than 150mm the characteristic tension strength is to be multiplied by $(150/d)^{0.167}$ - refer to table ZZ7.1.

10. Joint Group for Design of Connections

These apply for the simplified method as applicable for seasoned timber.

PL8	Joint Group JD5
PL12	Joint Group JD4
PLX20	Joint Group JD5

Prolam PLX Portals

The Prolam PLX Portal system has been specifically designed and independently tested to provide a structural bracing solution for buildings designed using NZS3604:2011. The portal design guide contains product information along with span tables, bracing unit capacities and construction details. PLX portals can also be designed using Prolam Specifier.

While the PLX Portal has been tested in accordance with the BRANZ P21 (2010) bracing test and evaluation procedure, the structural properties required for specific design are not available at this stage.

Precamber

The precamber in Prolam beams can be calculated using this equation where '*c*' is the precamber at the centre of the beam in mm, '*l*' is the length of the beam in m, and '*r*' is the precamber radius in m.

$$c = \frac{125 \times l^2}{r}$$

Non-visual beams are supplied with a default precamber radius of 600m while visual beams do not have a precamber by default. Table 8 shows the midspan precamber of beams up to 7.2m long with a precamber radius of 600m.

Table 8 – Precamber for Prolam Beams with 600m precamber radius

Length (m)	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6	7.2
Precamber (mm)	1.2	1.9	2.7	3.7	4.8	6.1	7.5	9.1	10.8

A custom precamber can be supplied on any product if required.

Fire Resistance

Prolam PL8 and PL12 members may be designed for fire resistance as any other solid or glulam timber member. The charring rates assigned on the basis of density by BRANZ appraisal are shown in the following table:

Density (kg/m^3)	Charring Rate (kg/m^3)
400	0.75
500	0.70
600	0.65

It is recommended that this simplified table of data derived from White's model should be adopted for the design of fire-resistant timber structures in New Zealand.

Standard sizes and lengths

Non-standard sizes are available on request however it is recommended that the availability of any non-standard product is confirmed with Prolam prior to final specification.

For bandsawn products allow for a reduced size of 6mm from the overall dimensions (3mm from each face).

Beams (PL8 and PL12)

The following tables present the standard sizes of Prolam beams produced.

Visual Beams (PL8 and PL12)

	88	140	190	225	240	270	290	315	360	405	450	495	540	595
42	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
63	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
88		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
112		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
135		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
180				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
220					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
260								✓	✓	✓	✓	✓	✓	✓
300									✓	✓	✓	✓	✓	✓

Non-Visual Beams (PL8 and PL12)

	88	140	190	225	240	270	290	315	360	405	450	495	540	595
42	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
63	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
88		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
112		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
135		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
180				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
220					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
260								✓	✓	✓	✓	✓	✓	✓
300									✓	✓	✓	✓	✓	✓

Standard lengths

For PL8 and PL12 the standard lengths for beams are:

- **H1.2 Standard lengths:** 3.6m, 4.2m, 4.8m, 5.4m, 6.0m, 6.6m and 7.2m
- **H3.2 and H5 Standard lengths:** 3.6m, 4.2m, 4.8m and up to 18m with 600mm increments

*The minimum beam length produced is 3.6m.

Posts (PL8 and PL12)

Prolam posts are available in the following sizes.

88 x 88	112 x 112	135 x 135	180 x 180	220 x 220	260 x 260	300 x 300

Standard lengths

For PL8 and PL12 the standard lengths for posts are:

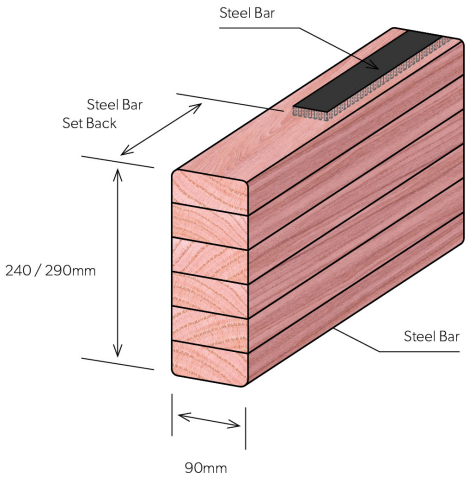
• 2.4m, 2.7m, 3.0m, 3.6m, 4.2m, 4.8m, 5.4m, 6.0m, 6.6m, 7.2m, 7.8m, 8.4m, 9.0m, 9.6m, 10.2m, 10.8m, 11.4m and 12.0m

*The minimum post length produced is 2.4m.

PLX20 Beams- Non-visual- H1.2

PLX20 beams are available in 240x90 mm and 290x90 mm sizes and are supplied in 3.6m to 6.6m lengths. PLX20 beams have steel bars laminated into the top and bottom faces for extra strength and stiffness. The steel bar set back at each end of the beam allows for onsite length adjustments (steel bars must not be cut or drilled through).

Beam Length (m)	Steel Length (m)	Steel Set Back (mm)
3.6	3.2	200
4.2	3.6	300
4.8	4.2	300
5.4	4.7	350
6.0	5.3	350
6.6	6.0	300



Prolam Specifier

Fast, easy and compliant online specification.

The Prolam Specifier is an online design tool for designing structural timber elements outside the scope of NZS3604. It can be used for designing common structural members in various loading configurations. For more complex design problems, it can be used as a time-saving tool for an approximate design at the initial stages of the design process.

Manufacturing Tolerances

The following tolerances are applicable at the time of manufacture without any dead or live loads applied:

- Cross sectional dimensions: + / - 2mm
- Crook/camber/straightness: 1mm per 1.0m to a maximum of 6 mm over 6.0m. Over 6.0m the tolerance increases by 3mm per each additional 6.0m or fraction thereof, but not to exceed 19mm
- Bow: Less than 15mm over a 2.4m length (<30mm for a 4.8m length, etc.). This applies to 42mm and 63mm products only.
- Squareness: + / - 2mm per 315mm of specified depth

Prolam Appearance and Finishing options

Prolam products are available in the following finishes:

Visual Machine Finish - Appearance A

This grade is intended for use in applications where appearance of the member is important and clear or painted finishes are used. All surface voids are filled, small tight knots are permitted. The surfaces are planer machined to a high quality finish.

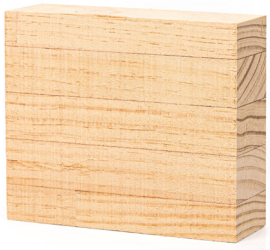
Non-Visual H3.2 - Appearance C

This grade is intended for use in applications where appearance is unimportant. All appearance blemishes are permitted in this grade. The surfaces are machined, but machine skip is permissible and blemishes, voids and manufacturing will remain unrepaired. Loose, knots, wane, pith and open knot holes may be present.

*Image shows more defects to show the appearance difference, structural integrity is not effected.

Non-Visual 1.2 - Appearance C

This grade is intended for use in applications where appearance is unimportant. H1.2 treatment is colour coded pink. All blemishes are permitted in this grade. The surfaces are machined, but skip is permissible, and blemishes, voids and manufacturing will remain unrepaired. Loose knots, wane, pith and open knot holes may be present.



Bandsawn Machine Finish

This is only supplied in the visual grade, as it is used for rustic visual appearance, the "roughness" of the bandsawn finish may vary slightly between batches. This product must be sealed as per our sealing specifications.

Sanded and Sealed Machine Finish

This is a premium finish added to a visual product, where all blemishes are filled, the whole product is sanded and then coated with a sealer that will protect the product from ingress of moisture for 6-8 weeks. This sealer is not a long term sealer. The product must be sealed for the long term as per our sealing specifications.

Preprimed Machine Finish

This is a primary coat that is applied in our factory as a protective coat to stop ingress of moisture until the undercoat and top coats are applied. This primer coat is not to be used as the final finish and the product must be sealed for the long term as per our sealing specifications.

Prolam used in exterior situations

Prolam posts and beams treated to H3 or H5 may be used in exterior situations provided that they are finished with a paint or stain coating within 14 days of installation (refer to the care guide). Particular attention must be paid to ensuring that exposed end grains and cut ends are sealed with a good quality stain or alkyd primer. Where a cut end is sealed with a proprietary capping, it is important to ensure that the capping is tightly sealed. Prolam beams should always be painted with light colours or dark colours with a light reflectance value (LRV) of greater than 45%. Colours with an LRV of 45% or less are not recommended, as they can absorb heat which may result in timber distortion and cracking. The recoating of Prolam beams and exposed sections of Prolam posts should be carried out in accordance with the coating suppliers' instructions.

Storage and handling

To ensure Prolam remains straight and true at the time of installation, follow the below recommendations:

- Store under cover so that it remains dry until installation.
- Stack on closely and evenly spaced bearers to keep flat and straight.
- Keep the stack elevated off the ground to allow for proper ventilation.
- Provide midspan support for longer span beams to prevent creep deflection during construction until fully enclosed.

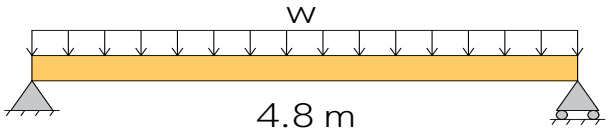
Prolam Branding

Prolam is branded for your protection. We recommend verifying that the right product has been supplied and installed. Lookalike materials may not perform to the same standard. For your protection, do not accept unauthorized substitution.

APPENDIX - PLX20 Design Example

Design Assumptions

- Lintel supporting roof and ceiling
- Lintel Span = 4.8m simply supported
- Lintel Loaded dimension = 4.0m
- G = (Roof weight + Ceiling weight) / cos α = 0.45 kPa
- Where α = roof pitch
- $G_{\text{self weight}}$ = 0.29*0.09*700*9.81= 0.179 kN/m
- Q= 0.25 kPa
- W_{up} = -1.35 kPa ULS
- W_{up} = -0.913 kPa SLS



PLX20-290x90mm

Design for strength (Ultimate Limit State – ULS)

Bending under gravity loads (Positive bending):

1.2G+1.5Q = 0.915 kPa M* = 11.1 kN/m (including self-weight)

$M_d = \varphi\, k_1\, k_4\, k_6\, k_9\, k_{12}\, f_b'Z$

Φ = 0.8 k_1 = 0.94 k_4 = 1.0 k_6 = 1.0 k_9 = 1.0

Assuming trusses/rafters restraining the top edge at L_{ay} = 1.2m

$S_1 = 1.25*(d/b)*(L_{ay}/d)^{0.5} = 8.19$

$\rho_b = 0.84$

$\rho_b S_1 = 6.88 < 10 \rightarrow k_{12} = 1.0$

$f_b' = 45MPa$

$Z = 1.23 \times 10^{-3}\, m^3$

Md = 41.6 kNm > M* = 11.1 kNm OK

Bending under uplift loads (Negative bending):

0.9G+Wup = -1.76 kPa M* = -10.4 kN/m (including self-weight)

$M_d = \varphi\, k_1\, k_4\, k_6\, k_9\, k_{12}\, f_b'Z$

Φ= 0.8 k_1= 1 k_4= 1.0 k_6= 1.0 k_9 = 1.0

Assuming trusses/rafters restraining the top edge at L_{ay} = 1.2m

$S_1 = (d/b)1.35(L_{ay}/d)^{0.25} = 6.92$

$\rho_b = 0.84$

$\rho_b S_1 = 5.81 < 10 \rightarrow k_{12} = 1.0$

$f_b' = 45MPa$

$Z = 1.23 \times 10^{-3}\, m^3$

Md = 44.3 kNm > M*= -10.4 kNm OK

Design for serviceability (Serviceability Limit State – SLS)

E = 21000MPa $I = 1.79 \times 10^{-4}\, m^4$

G + Ψ_l Q:	Ψ_l = 0	J_2= 1.5	Deflection = 5.45mm = Length/880	OK
G + Ψ_s Q:	Ψ_s = 0.7	J_2= 1.5	Deflection = 6.74mm = Length/712	OK
Ws:		J_2= 1.0	Deflection = 6.72mm = Length/714	OK

Building better together

At Prolam, we support engineers, architects and building professionals to design and build with strength, confidence and ease using premium engineered timber solutions.

Have technical questions?

Our sales team and structural engineers are on-hand to support you to find the right solution for your project.

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NZ made quality

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Made from New Zealand plantation timber, with research-backed resistance to harsh environmental conditions, FSC certified timber options available.

Confident compliance

Prolam sets the benchmark in building code compliance and certification for glulam timber products – for smooth engineering and building consent approvals.

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Control at every step, with expert technical advice on tap – from knowledge of local industry codes, precise product specification to installation and after sales support.

Fast and efficient

Industry-best lead times via a secure supply chain, proactive management of stock holdings and next level production efficiencies.

Strong and safe

Precision engineered for a superior fit, optimal structural integrity, dimensional stability, and easy and safe installation.

Cutting edge technology

Advanced manufacturing processes and smart tools that streamline product specification, supply, installation and certification.

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Our team of experts are ready to assist.

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