XLAM

Cross Laminated Timber

DESIGN GUIDE V3.0

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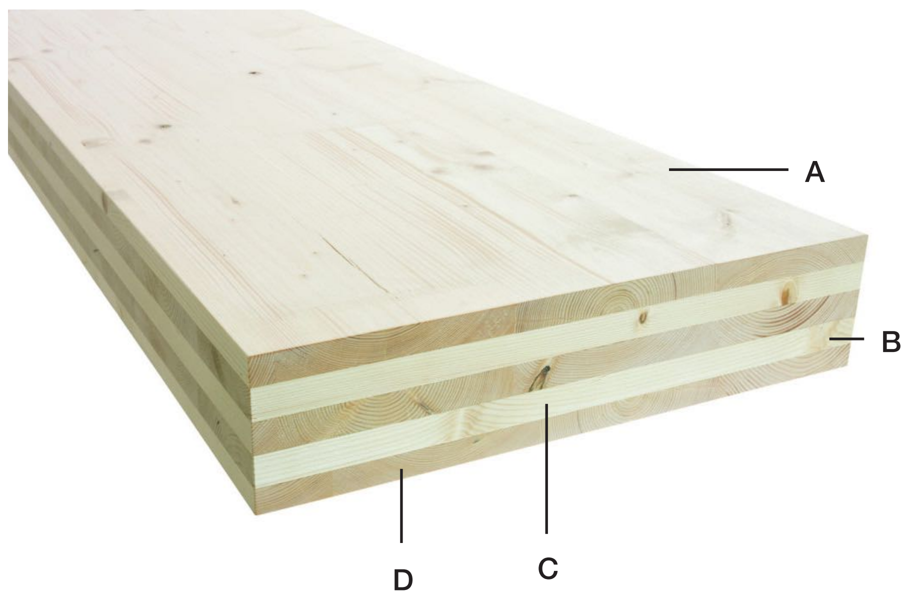
XLAM

CROSS-LAMINATED TIMBER: A FAST, SAFE, AND SUSTAINABLE ALTERNATIVE TO TRADITIONAL CONSTRUCTION MATERIALS.

Cross-Laminated Timber (CLT or X-LAM) is an advanced engineered wood product composed of three, five, or seven layers of dimensional timber, each oriented at right angles and bonded together to create structural panels of exceptional strength, stability, and rigidity. CLT is light weight and delivers outstanding performance in acoustic insulation, fire resistance, seismic resilience, and thermal efficiency.

CLT enables rapid and efficient installation with minimal on-site waste, offering architects and builders significant design flexibility while reducing environmental impact. As a result, it is emerging as a highly advantageous alternative to conventional materials such as concrete, masonry, and steel—particularly in multi-story construction, where speed, sustainability, and performance are paramount.



A - Type and grade of timber

B - Number and thickness of cross-laminated layers

C - Transverse layer

D - lonitudinal layer

FAST, SAFE AND SUSTAINABLE

- CLT is suitable for all projects, from small to large multi story buildings.
- Reduce build program by 30% – 40%
- Manufactured from sustainable, local resources.
- Mass timber construction is a great thermal insulator
- Significant reductions in installation time.
- Factory manufactured to higher tolerances.

A.

FROM BOARD TO BUILDING

B.

C.

A. The Ridge, V&A Waterfront 2020

B. Panels are delivered in finshed form from the factory and are lifted into place with the aid of a crane.

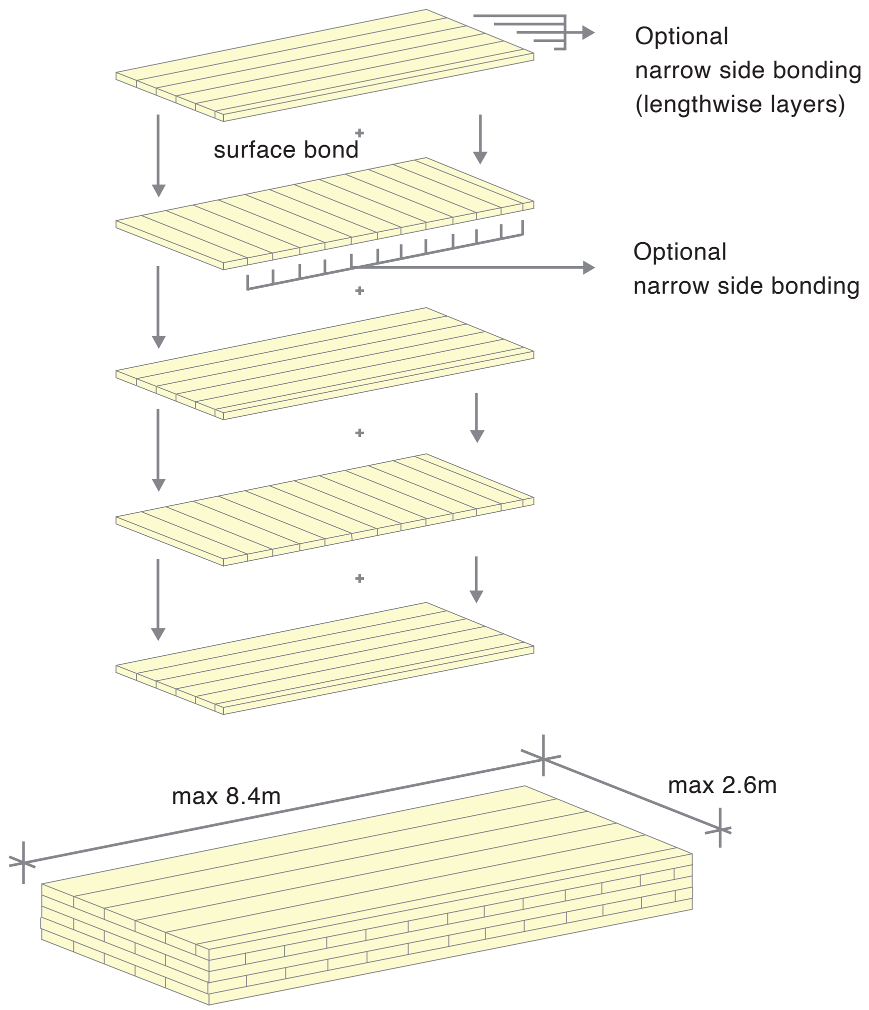
C. CLT timber can used as a finished surface or covered with any number of materials to aesthetic requirements.

Kloof house, Bettys Bay 2021

XLAM Cross-Laminated Timber: Locally Manufactured, Sustainably Sourced
XLAM Cross-Laminated Timber is proudly manufactured at our Cape Town facility using locally sourced plantation timber. As an FSC® (Forest Stewardship Council) certified manufacturer, we are committed to providing a sustainable alternative to traditional structural materials.

Our CLT panels are produced in strict accordance with the South African National Standard (SANS 8829) and fully comply with the SANS 10400 national building code, ensuring their suitability for a wide range of construction applications.

This guide is designed to support architects and engineers in integrating CLT into their projects. Additionally, our team is readily available to provide expert guidance and answer any questions you may have.



Example:
Design of a 5 layer CLT solid wood panel

Product
CLT (cross-laminated timber) is a large-format, multi-ply solid timber panel used for wall, ceiling, roof and special construction elements for load-bearing purposes

Layup
Finger-jointed and planed lamellas are face laminated in layers at right angles to one another. Layup are typically 3, 5 or seven layers.

Dimensions
Lengths to 8.4 m
Widths to 2.6 m
Thicknesses 45 to 230 mm
Standard widths 2.00 m/2.60 m

Technical approvals
SANS 8892 Standard for Performance Rated Cross-Laminated Timber

Types of wood
SA Pine (Pinus radiata, Elliotii, Patula)
Saligna (Eucalyptus Grandis x Saligna)

Lamellas
Kiln-dried, S5, S7 quality graded and finger-jointed Strength classes (lamellas) SANS 10096:2013 finger jointed structural timber (SANS 1783:2013 Structural Timber Grading.)

Gluing
Polyurethane or Melamine resin-based adhesive, Adhesive Class I acc. to SABS 1349 approved for the gluing of load-bearing timber components.

Weight
Approx. 480 kg/m³ for determination of the transport weight
5 kN/m³ for static calculations

Moisture content
15% (± 2%)

Dimensional stability
Parallel to panel plane 0.01% per % change in moisture content
Perpendicluar to panel plane 0.20% per % change in moisture content

Thermal conductivity
λ = 0.10 W/m2K

Heat capacity
c = 1.60 kJ/kgK

Water vapour resistance factor
μ = 60 (at 12% moisture content)

Airtightness
Airtight from a panel thickness of 90 mm

Sound insulation
Dependent on wall or ceiling build-up.

Reaction to fire
According to EN 13501: D, s2, d0

Fire resistance
60min rating for 100mm Pine CLT
90Min rating for 100mm Euclyptus CLT

Charring rate
The average charring rate across several layers is for walls: 0.9 mm/min
for ceilings: 1 mm/min

PRODUCTION SIZES

XLAM CROSS-LAMINATED TIMBER PANEL FORMATS

XLAM Cross-Laminated Timber (CLT) is available in two primary formats, each designed for specific structural applications:

Transverse Panels – Ideal for vertical shear elements such as walls, these panels have their outer layer (the primary strength direction) oriented in the short direction.

Longitudinal Panels – Typically used for horizontal shear elements, including floor slabs and roof structures, these panels have their outer layer (the primary strength direction) aligned in the long direction.

The required panel thickness is determined by the span and structural performance requirements of the project.

COVERING LAYER IN THE TRANSVERSE PANEL DIRECTION TT (WALL)							
Nominal Thickness (mm)	Item	Layers	Lamella Structure (mm)				
			T	L	T	L	T
45	XT3/45	3	**15**	15	**15**		
65	XT3/65	3	**15**	35	**15**		
85	XT3/85	3	**35**	15	**35**		
105	XT3105	3	**35**	35	**35**		
135	XT5/135	5	**35**	15	**35**	15	**35**

COVERING LAYER IN THE LONGITUDINAL PANEL DIRECTION TL (CEILING/ROOF)							
Nominal Thickness (mm)	Item	Layers	Lamella Structure (mm)				
			L	T	L	T	L
85	XL3/85	3	**35**	15	**35**		
105	XL3105	3	**35**	35	**35**		
135	XL5/135	5	**35**	15	**35**	15	**35**
155	XL5/155	5	**35**	35	**15**	35	**35**
175	XL5/175	5	**35**	35	**35**	35	**35**
210	XL5/210	5	**35**	35	**35*2**	35	**35**

Max dimensions of master elements 8250x2700x210mm
Min dimensions of master elements 2200x1800x85mm
Special XLAM element designs are available on request

Charged dimensions: Minimum length x minimum width required for master panel , including any cut-outs which may result
Charged length: from minimum production length of 2.2m up to max 8.25m, in 10cm increments
Charged width: 2.20 / 2.40 / 2.60 / 2.80

We manufacture our cross Laminated Timber is made in accordance with the requirments of SANS 8892. After the panel is machined the dimensions shall be within the following tolerances:

- Thickness; ±1.6mm or 2% of the target thickness (whichever is greater)
- Width; ±3.2mm
- Length; ±6.4mm
- Squareness; the length of the two panel face diagonals (measured from corner to corner) shall not differ by more than 3.2mm.
- Straightness; deviations of straight edges (from corner to corner) shall not exceed 1.6mm.
- Total thickness; the finished thickness of the CLT panel shall not exceed 508mm.

SURFACE QUALITY

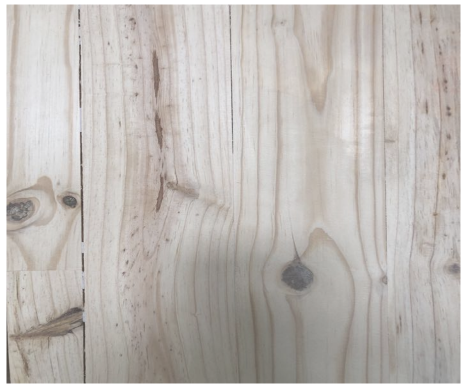
XLAM Cross Laminated Timber is available in three different surface qualities, including non-visual quality, industrial visual quality, and Visual Quality. The surface quality of a CLT panel depends on where it will be used and whether it will be visible.

Visual Quality

For high requirements in the visible component area.
- Here, raw materials of the highest optical sawn-timber grading classes are exclusively used.
- The surface lamellas have a maximum thickness of 22mm and are processed in a pre-glued and pre-dried state, which minimizes joint opening.
- The surface is planed and sanded.

Industrial Visual Quality

With additional requirements for visual applications.
- Visual criteria for outer layers are applied in addition to the sorting criteria for load-bearing strength.
- Selected outer lamellas with healthy intergrown knots. A few isolated loose knots are possible, defects and small resin pockets are permissible.
- Planed and sanded surface.



Non Visual Quality

For non-visual applications.
- The top lamellas are exclusively sorted according to the sorting criteria of the load-bearing strength.
- Colour variations of individual lamella (e.g. blue stain) as well as loose knots, bark ingrowths and resin pockets are possible.
- Isolated gaps in the outer layers, glue stains as well as isolated pressure points and markings can appear.
- Surface planed

FEATURE	GRADE		
	Visual Grade (VI)	Industrial Visual (IV)	Non- Visible (NV)
Bonding	Occasional open up to 1mm width permitted	Occasional open up to 2mm width permitted	Occasional open up to 3mm width permitted
Timber grade	Selected special, Clear or S7 grades	Selected S7, S5 or Industrial grades	S5, S7 or Industrial grades
Appearance	Well balanced colour and texture	Largely balanced colour and texture	No requirement
Knots	Small knots Permitted	Permitted	Permitted
Plugs	Natural knot plugs permitted	Permitted	Permitted
Resin Pockets	Occasional up to 3mm	Occasional up to 5mm	Permitted
Bark pockets	Not Permitted	Occasional permitted	Permitted
Dry cracks	Occasional surface cracks	Permitted	Permitted
Pith	Occasional up to 40cm	Permitted	Permitted
insect damage	Not permitted	Not Permitted	Occasional non active holes
Blue Stain	Not Permitted	Slight discolouration permitted	Permitted
Quality of surface finish	Occasional small faults permitted	Occasional faults permitted	Occasional faults permitted
Sides and face ends	Occasional small faults permitted	Occasional faults permitted	Occasional faults permitted
width of lamellas	Minium 130mm	No specification	No specification
lamella profile	Tongue and groove (T&G)	No specification	No specification
Finish	Planed and Sanded 60 grit	Planed and Sanded 40 grit	Planed only

Note

Timber is a natural product. Variations in the surface quality can occur with even the most careful selection of the raw material.

The appearance of the surface is determined by the board structure of the top layer. Gaps may occur between the individual boards over time due to shrinkage, etc. Superficial drying cracks are also possible.

SPAN TABLES

The following span tables are intended for use in pre-analysis designs, and are a guide for panel thicknesses. The structural design of the mass timber structures must be done on a per project basis and requires the input of a registered structural engineer. The design of these structures must be done in accordance with *SANS 10163-1: The Structural Use of Timber* and international best practice.

CLT floor and slab slabs are often governed by serviceability criteria such as deflection and vibrations induced by foot traffic. Recommended maximum spans for various panel thicknesses and live loads are given for both design criteria. The vibration check can be ignored for inaccessible roof panels where minimal foot traffic is expected.

These span tables are only based on serviceability criteria. No strength checks have been performed.

NOTES:

1. Unless noted, the span tables assume a uniform loading over the panel. No line loads or point loads have been checked, nor has any account been made for penetrations in the panel, all of which can reduce the allowable spans specified in the tables.
2. Density of SA pine used for calculations = 500 kg/m^3
3. Deflection=controlled spans are based on a limit of SPAN/300.
4. The cantilever back-span is 1.5 * cantilever span, with the back-span having no live load.
5. For the continuous beam, only one span has a live load.
6. The continuous span for all panels is limited to 4.1m, which is half of the maximum length of panel currently manufactured by XLAM.
7. Deflections were calculated using guidance from the Canadian CLT Handbook (2019 Edition). This method takes into account the long-term effect of creep, for which a dry service condition was assumed (average moisture content is 15% or less, and never exceeds 19%). No live load duration factor was applied as a 'standard term' duration was assumed. Serviceability load factors were taken from SANS 10160-1.
   The following formula was used to calculate deflection:

$$\Delta_{TOTAL} = \gamma_G * k_{creep} * (\Delta_{OW} + \Delta_{MISC}) + \gamma_Q * \Delta_Q$$

γ_G	Serviceability permanent/dead load factor = 1.1
k_{creep}	Creep adjustment factor = 2.0
Δ_{OW}	Deflection due to own weight of CLT
Δ_{MISC}	Deflection due to miscellaneous permanent/dead load of 50 kg/m^2
γ_Q	Serviceability imposed/live load factor = 1.0
Δ_Q	Deflection due to uniform imposed/live load

8. The Canadian and Swedish CLT Handbooks (2019 Editions) have differing approaches for calculating the vibration-controlled spans. Both are given for comparison.
9. For both methods only the own weight of the CLT was used. Additional mass can influence the vibration performance.
10. The tables assume bending in the longitudinal (major) direction i.e. outer lamella in the direction of the span. Thus, the allowable spans cannot be used for minor axis bending.

CLT STRENGTH

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COVERING LAYER IN THE TRANSVERSE PANEL DIRECTION TT (WALL)

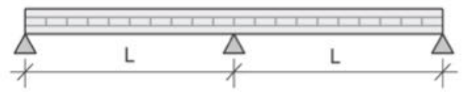
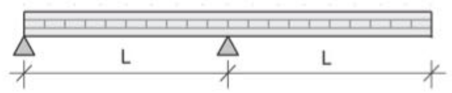
Nominal Thickness (mm)	Item	Layers	Lamella Structure (mm) T	L	T	L	T	Major Strength Direction M_r,0 (kNm/ m of width)	(EI)eff,0 (Nmm^2/m of width)	(GA)eff,0 (N/m of width	Vr,0 (kN/ m of width)
45	XT3/45	3	**15**	15	**15**			3.18	5.71E+10	2.66E+06	12.00
65	XT3/65	3	**15**	35	**15**			5.84	1.52E+11	3.34E+06	17.33
85	XT3/85	3	**35**	15	**35**			11.71	3.97E+11	6.59E+06	22.67
105	XT3/105	3	**35**	35	**35**			17.32	7.26E+11	6.20E+06	28.00
135	XT5/135	5	**35**	15	**35**	15	**35**	27.11	1.46E+12	1.32E+07	36.00

COVERING LAYER IN THE LONGITUDINAL PANEL DIRECTION TL (CEILING/ROOF)

Nominal Thickness (mm)	Item	Layers	Lamella Structure (mm) L	T	L	T	L	Major Strength Direction M_r,0 (kNmm/ m of width)	(EI)eff,0 (Nmm^2/m of width)	(GA)eff,0 (N/m of width)	Vr,0 (kN/ m of width)
45	XL3/45	3	**15**	15	**15**			3.18	5.71E+10	2.66E+06	12.00
65	XL3/65	3	**15**	35	**15**			5.84	1.52E+11	3.34E+06	17.33
85	XL3/85	3	**35**	15	**35**			11.71	3.97E+11	6.59E+06	22.67
105	XL3/105	3	**35**	35	**35**			17.32	7.26E+11	6.20E+06	28.00
135	XL5/135	5	**35**	15	**35**	15	**35**	27.11	1.46E+12	1.32E+07	36.00
155	XL5/155	5	**35**	35	**15**	35	**35**	32.94	2.04E+12	9.36E+06	41.33
175	XL5/175	5	**35**	35	**35**	35	**35**	39.86	2.78E+12	1.24E+07	46.67
210	XL5/210	5	**35**	35	**35*2**	35	**35**	53.84	4.51E+12	1.85E+07	56.00

SPAN TABLE

FLOORS - 1KN Dead Load

Panel Layup	Nominal Thickness (mm)	**SIMPLE SPAN** (m) 				**CONTINUOUS SPAN** (m) 				**CANTILEVER SPAN** (m) 			
		Vibration	**0.5KN**	**1.5KN**	**2.5KN**	**Vibration**	**0.5KN**	**1.5KN**	**2.5KN**	**Vibration**	**0.5KN**	**1.5KN**	**2.5KN**
XL3/45	**45**	1.85	**1.85**	1.75	1.50	2.22	**2.22**	**2.22**	1.95	0.69	**0.69**	**0.69**	0.66
XL3/65	**65**	2.35	**2.35**	**2.35**	2.10	2.82	**2.82**	**2.82**	2.75	0.87	**0.87**	**0.87**	**0.87**
XL3/85	**85**	3.01	**3.01**	**3.01**	**2.95**	3.61	**3.61**	**3.61**	**3.61**	1.11	**1.11**	**1.11**	**1.11**
XL3/105	**105**	3.50	**3.50**	**3.50**	**3.50**	4.20	**4.20**	**4.20**	**4.20**	1.30	**1.30**	**1.30**	**1.30**
XL5/135	**135**	4.16	**4.16**	**4.16**	**4.16**	4.99	**4.99**	**4.99**	**4.99**	1.54	**1.54**	**1.54**	**1.54**
XL5/155	**155**	4.50	**4.50**	**4.50**	**4.50**	5.40	**5.40**	**5.40**	**5.40**	1.67	**1.67**	**1.67**	**1.67**
XL5/175	**175**	4.86	**4.86**	**4.86**	**4.86**	5.83	**5.83**	**5.83**	**5.83**	1.80	**1.80**	**1.80**	**1.80**
XL5/210	**210**	5.47	**5.47**	**5.47**	**5.47**	6.56	**6.56**	**6.56**	**6.56**	2.03	**2.03**	**2.03**	**2.03**

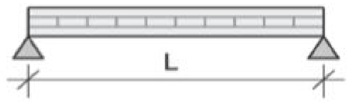
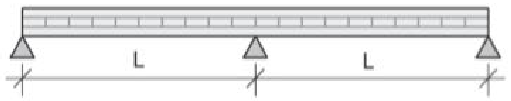
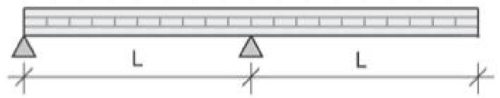
NOTES:

1. Material is S5 Graded SA Pine
2. Laminations are 35mm or 15mm thick
3. Specified modulus of elasticity and strength in major strength direction: E0 = 9500 MPa; fb,0 = 11.8 MPa; fv,0 = 1.5 MPa; fvr,0 = 0.5 MPa; fc,0 = 11.5 MPa; ft,0 = 5.5 MPa
4. Specified modulus of elasticity and strength in minor strength direction: E90 = 9500 MPa; fb,90 = 11.8 MPa; fv,90 = 1.5 MPa; fvr,90 = 0.5 MPa;
5. Dead load includes panel self-weight plus 1.0 kPa flooring load.
6. Bold text indicates span governed by vibration; regular text indicates span governed by dead plus live load deflection limit of L/300.
7. All spans are assumed to be equal for multi-span panels.
8. Spans shown represent distance between the centerlines of supports.
9. Maximum spans shown are only to be used for preliminary design.
10. Engineer to ensure that L/300 deflection limit is appropriate for intended use.
11. The following factors were used for calculations: KD = 1.0; KS = 1.0; KT = 1.0; KH = 1.0.
12. Shear stiffness has been reduced by 50% to account for creep deformation.

SPAN TABLE

ROOFS - 0.5KN Dead Load

XLAM

Panel Layup	Nominal Thickness (mm)	SIMPLE SPAN (m) 			CONTINUOUS SPAN (m) 			CANTILEVER SPAN (m) 		
		0.5KN	1.5KN	2.5KN	0.5KN	1.5KN	2.5KN	0.5KN	1.5KN	2.5KN
XL3/45	**45**	2.40	1.85	1.60	3.00	2.40	2.05	1.05	0.80	0.70
XL3/65	**65**	3.30	2.60	2.25	**4.20**	3.30	2.85	1.45	1.10	0.95
XL3/85	**85**	4.60	3.60	3.15	**5.80**	**4.60**	4.00	2.00	1.55	1.35
XL3/105	**105**	5.60	4.40	3.80	**7.10**	**5.60**	**4.85**	2.45	1.90	1.60
XL5/135	**135**	7.10	5.60	4.90	**9.00**	**7.10**	**6.20**	3.10	2.45	2.10
XL5/155	**155**	7.90	6.25	5.40	**10.00**	**7.95**	**6.85**	3.45	2.70	2.30
XL5/175	**175**	8.80	6.95	6.05	**11.15**	**8.80**	**7.65**	3.85	3.00	2.60
XL5/210	**210**	10.40	8.20	7.10	**13.10**	**10.35**	**9.00**	4.55	3.55	3.10

NOTES:

1. Material is S5 Graded SA Pine
2. Laminations are 35mm or 15mm thick
3. Specified modulus of elasticity and strength in major strength direction: E0 = 7800 MPa; fb,0 = 11.5 MPa; fv,0 = 1.6 MPa; fvr,0 = 0.4 MPa; fc,0 = 18 MPa; ft,0 = 6.7 MPa
4. Specified modulus of elasticity and strength in minor strength direction: E0 = 7800 MPa; fb,0 = 11.5 MPa; fv,0 = 1.6 MPa; fvr,0 = 0.4 MPa; fc,0 = 18 MPa; ft,0 = 6.7 MPa
5. Dead load includes panel self-weight plus 0.5 kPa additional load.
6. Bold text indicates span governed by manufacturing size and are limited to half the length of the maximum panel size (4100mm)
7. All spans are assumed to be equal for multi-span panels.
8. Spans shown represent distance between the centerlines of supports.
9. Maximum spans shown are only to be used for preliminary design.
10. Engineer to ensure that L/300 deflection limit is appropriate for intended use.
11. The following factors were used for calculations: KD = 1.0; KS = 1.0; KT = 1.0; KH = 1.0.
12. Shear stiffness has been reduced by 50% to account for creep deformation.

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