XLAM

Cross Laminated Timber

DESIGN GUIDE V2.0

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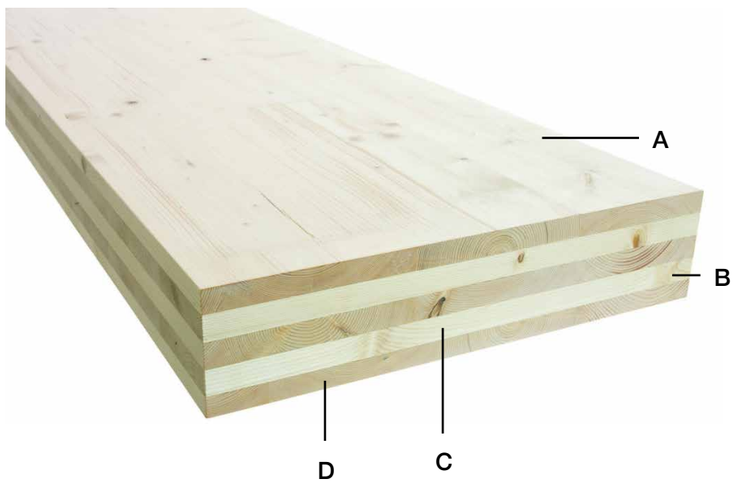
XLAM

CROSS-LAMINATED TIMBER OFFERS A FAST, SAFE AND SUSTAINABLE ALTERNATIVE TO TRADITIONAL CONCRETE, STEEL OR BRICK STRUCTURAL CONSTRUCTION SYSTEMS.

Cross-Laminated Timber (CLT or X-LAM) is a wood panel typically consisting of three, five, or seven layers of dimensional timber oriented at right angles to one another and then glued to form structural panels with exceptional strength, dimensional stability, and rigidity. It is lightweight yet very strong and has superior acoustic, fire, seismic, and thermal properties.

CLT is also fast and easy to install, generating almost no waste onsite. It offers design flexibility and low environmental impacts. For these reasons, cross-laminated timber is proving to be a highly advantageous alternative to conventional materials like concrete, masonry, or steel, and is especially well suited to multi-storey construction.



A - Type and grade of timber

B - Number and thickness of cross-laminated layers

C - Transverse layer

D - Ionitudinal layer

FAST, SAFE AND SUSTAINABLE

Internal or External structural and non-structural applications.

Sustainable building practice with net 0 carbon possibloe.

Factory precision with openings and sevices cut before delivery

Reduced construction period

Excellent fire safety charicteristics

Great thermal and acoustic properties

FROM BOARD TO BUILDING

A.

B.

C.

A. CLT panels are available in 3, 5 and 7 layers to suit diffrent applications such as shear walls, floor slab and roofs.

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.

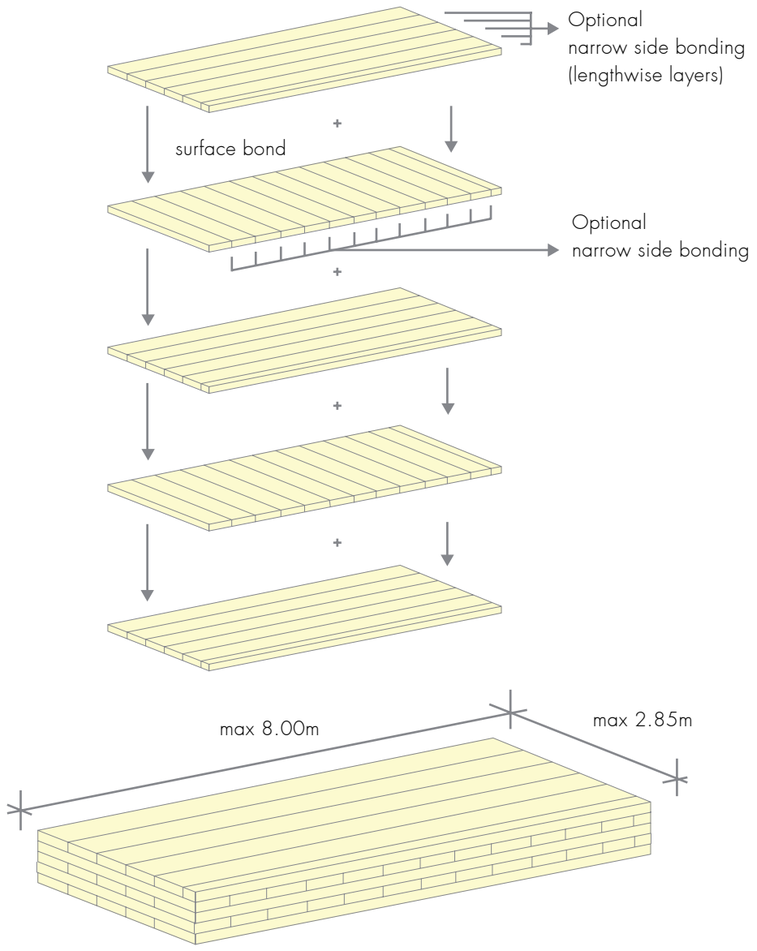
INCREDIBLE POSSIBILITIES

Proposal for a Cross Laminated Timber bridge designed by Paul Cocksedge studios. The bridge will be built from Euculyptus CLT panels over a river in Newlands, Cape Town.

SPECIFICATIONS

XLAM Cross Laminated Timber is manufatured at our Cape Town factory and is made from locally sourced plantations timber. We are an FSC (Forest Stewardship Council) certified manufacturer, and are proud to be offering a sustainable alternative to traditional structural materials. We manufacture in accordance with the South African national standard SANS8829, ensuring our CLT panels are suitable for use under the SANS 10400 national building code. The information in this guide should aid your designing and engineering future projects in CLT. We are also avaliable to help out with any question you may have.

Example:
Design of a 5 layer CLT solid wood panel



Product
is a large-format, solid timber panel (cross-laminated timber panel) with multi-layered, crosswise cross-section lay-up.

Lay-up and production
Finger-jointed and planed lamellas are loosely laid next to each other and the flat surfaces of layers glued at right angles to one another. To avoid uncontrolled stress cracks, the narrow sides are typically not glued. The layers are pushed laterally to dimension before applying pressure in order to obtain a gap-free surface.

Dimensions
Lengths to 8.25 m
Widths to 2.85 m
Thicknesses 45 to 230 mm
Standard widths 2.10 m/2.50 m/2.80 m

Technical approvals
SANS 8892
*SANS Technical Approval Pending
(currently in process)

Types of wood
Monterey Pine (Pinus radiata)
Saligna (Eucalyptus Grandis x Saligna)
Optional hardwood veneered faces

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: 0.64 mm/min
for ceilings: 0.71 mm/min

PRODUCTION SIZES

XLAM Cross Laminated Timber is avaliabl in two formats:

Transverse Panels which are well suited for vertical shear elements such as walls.These panels have the outer layer (the strength direction of the panel) in the short direction.

Longitudinal Panels which are typically used as horizontal shear elements such as floor slabs or roof structures.These panels have the outer layer (the strength direction of the panel) in the long direction. The thickness of these panels is normally determined by the span that needs to be achieved.

COVERING LAYER IN THE TRANSVERSE PANEL DIRECTION TT (WALL)

Nominal Thickness (mm)	Item	Layers	Lamella Structure (mm)							Standard Panel Widths (m)	Maximum Panel Length (m)
			T	L	T	L	T	L	T		
66	XT3/66	3	22	22	22					2.10 / 2.50 / 2.80	8.25
77	XT3/77	3	22	33	22					2.10 / 2.50 / 2.80	8.25
88	XT3/88	3	33	22	33					2.10 / 2.50 / 2.80	8.25
99	XT3/99	3	33	33	33					2.10 / 2.50 / 2.80	8.25
110	XT5/110	5	22	22	22	22	22			2.10 / 2.50 / 2.80	8.25
121	XT5/121	5	22	22	33	22	22			2.10 / 2.50 / 2.80	8.25
132	XT5/132	5	33	22	22	22	33			2.10 / 2.50 / 2.80	8.25
143	XT5/143	5	33	22	33	22	33			2.10 / 2.50 / 2.80	8.25
154	XT5/154	5	33	33	22	33	33			2.10 / 2.50 / 2.80	8.25
165	XT5/165	5	33	33	33	33	33			2.10 / 2.50 / 2.80	8.25

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

Nominal Thickness (mm)	Item	Layers	Lamella Structure (mm)							Standard Panel Widths (m)	Maximum Panel Length (m)
			L	T	L	T	L	T	L		
66	XL3/66	3	22	22	22					2.10 / 2.50 / 2.80	8.25
77	XL3/77	3	22	33	22					2.10 / 2.50 / 2.80	8.25
88	XL3/88	3	33	22	33					2.10 / 2.50 / 2.80	8.25
99	XL3/99	3	33	33	33					2.10 / 2.50 / 2.80	8.25
110	XL5/110	5	22	22	22	22	22			2.10 / 2.50 / 2.80	8.25
121	XL5/121	5	22	22	33	22	22			2.10 / 2.50 / 2.80	8.25
132	XL5/132	5	33	22	22	22	33			2.10 / 2.50 / 2.80	8.25
143	XL5/143	5	33	22	33	22	33			2.10 / 2.50 / 2.80	8.25
154	XL5/154	5	33	33	22	33	33			2.10 / 2.50 / 2.80	8.25
165	XL5/165	5	33	33	33	33	33			2.10 / 2.50 / 2.80	8.25
198	XL7/176	7	33	22	33	22	33	22	33	2.10 / 2.50 / 2.80	8.25
187	XL7/187	7	33	22	22	33	22	22	33	2.10 / 2.50 / 2.80	8.25
198	XL7/198	7	33	22	33	22	33	22	33	2.10 / 2.50 / 2.80	8.25
209	XL7/209	7	33	22	33	33	33	22	33	2.10 / 2.50 / 2.80	8.25
220	XL7/220	7	33	33	33	22	33	33	33	2.10 / 2.50 / 2.80	8.25
231	XL7/231	7	33	33	33	33	33	33	33	2.10 / 2.50 / 2.80	8.25

Max dimensions of master elements 8250x2800x231mm
Min dimensions of master elements 2100x2100x66mm
Special CLT 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 2.1m up to max 8.25m, in 10cm increments
Charded width: 2.10 / 2.50 / 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.

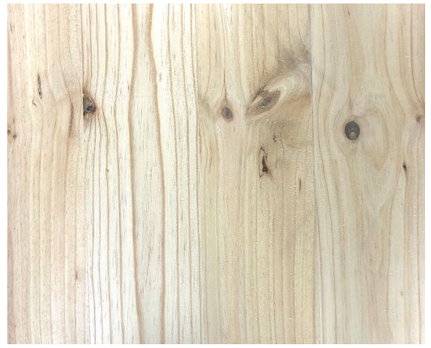
SURFACE QUALITY

XLAM Cross Laminated Timber is available in three different surface qualities. The choice of surface quality does not affect the strength of the panels and is normally defined by if the timber will be visible or not.

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 lamellas have a maximum thickness of 22mm and are processed in a pre-glued and pre-dried state, which guarantees minimum joint opening.
- The surface is planed and sanded.



Industrial Visual Quality

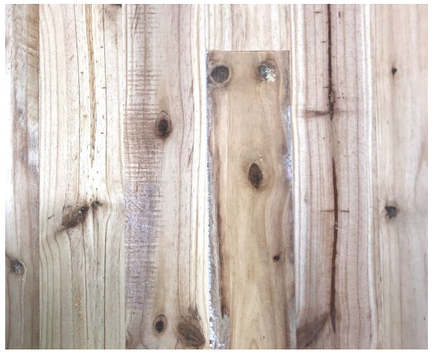
With additional requirements for visual applications.

- 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.

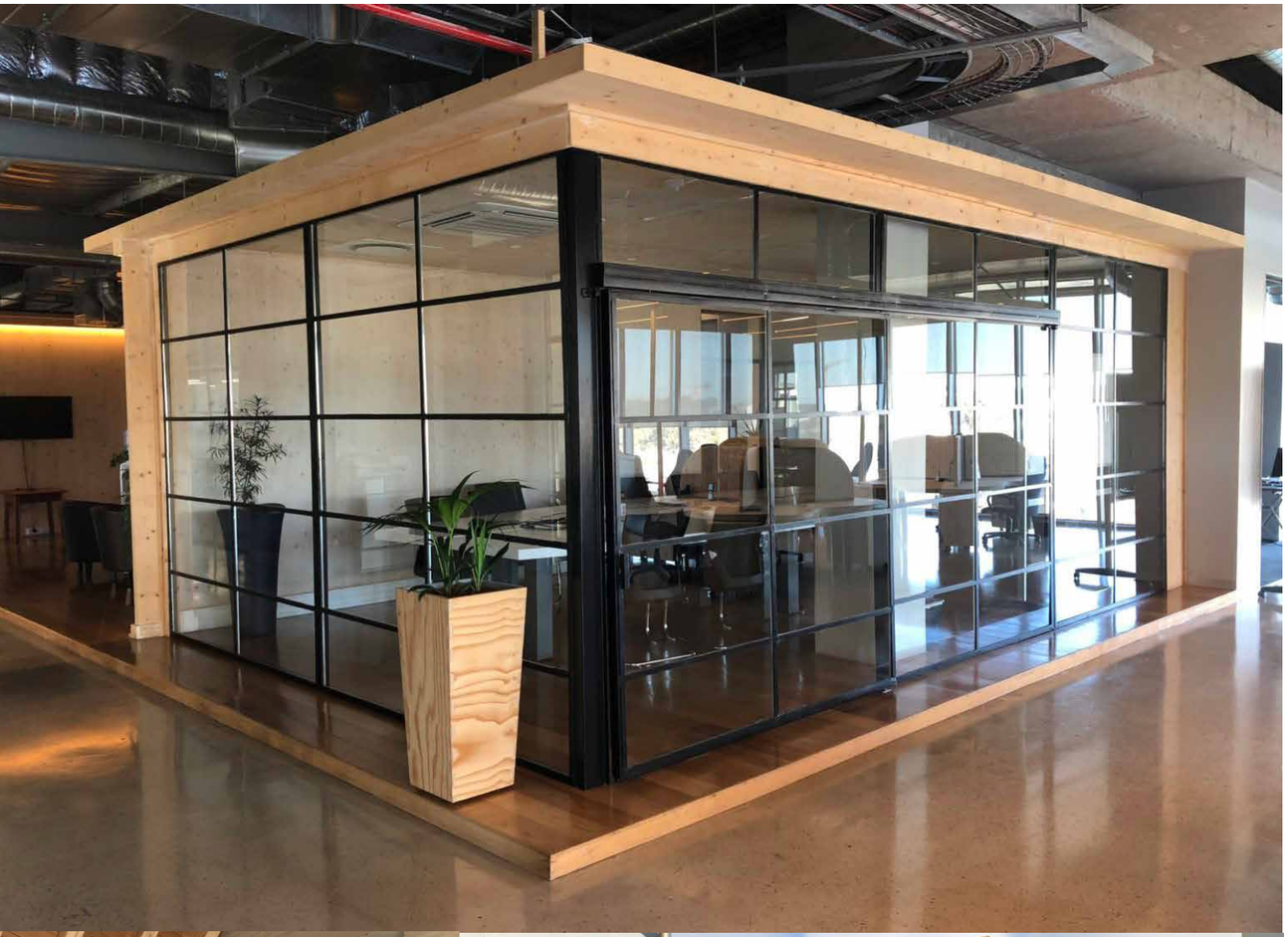
- The top lamellas are exclusively sorted according to the sorting criteria of the load-bearing strength.
- Colour variations of individual lamella (e.g. blue stain) as well as loose knots, bark ingrowths and resin pockets are possible.
- Isolated gaps in the outer layers, glue stains as well as isolated 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	Some 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 ‘The structural use of timber.’

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. Point loads and penetrations will reduce the allowable spans specified in the tables.

CLT WALLPANELS - PINE

- Fixing details of the walls require structural engineering design
- Fixing strength depends upon fixing type and foundation medium
- All load demands (wind & seismic) require engineering design

Panel Thickness (mm)	**Wall Height** (m)	**Axial Capacity** P_r (kN/m)	**Tensile Capacity** P_t (kN/m)	**Shear Capacity** V_r (kN/m)	**Bracing Capacity** (BU/m)
XL3/66	2.0	374	282	24	480
	3.0	220	282	7	144
	5.0	81	282	3	60
XL3/77	2.0	477	282	31	617
	3.0	335	282	11	218
	5.0	145	282	3	60
XL3/88	2.0	856	493	68	1358
	3.0	613	493	29	571
	5.0	277	493	6	124
XL3/99	2.0	966	493	76	1514
	3.0	750	493	35	690
	5.0	417	493	8	169
XL5/110	2.0	1056	493	84	1754
	3.0	824	493	41	789
	5.0	512	493	11	224
XL5/121	2.0	1163	532	92	1965
	3.0	941	532	49	934
	5.0	611	532	14	287
XL5/132	2.0	1273	634	109	2188
	3.0	1085	634	54	1082
	5.0	678	634	16	320
XL5/143	2.0	1458	739	134	2674
	3.0	1320	739	68	1367
	5.0	859	739	22	440
XL5/154	2.0	1469	739	156	2774
	3.0	1419	739	82	1432
	5.0	926	739	35	512
XL5/165	2.0	1485	872	187	2808
	3.0	1485	872	110	1521
	5.0	1085	872	43	546

DISCLAIMER: Nothing contained in this material shall be construed as a warranty or otherwise as to the accuracy of the information provided. Specific design work shall be carried out by a qualified structural engineer.

CLT FLOOR PANELS - PINE

- All loads are uniformly distributed over the element
- The spans correspond to a deflection limit of SPAN/400
- The cantilever back-span is assumed to be 1.25 x cantilever span with the back span unloaded

Panel Thickness (mm)	Live Load (kN/m2)	Single Span (m)	Continuous Span (m)	Cantilever (m)
XL3/66	2.0	2.10	2.10	0.67
	3.0	2.00	2.10	0.62
	5.0	1.75	2.10	0.55
XL3/77	2.0	2.51	2.51	0.79
	3.0	2.42	2.51	0.71
	5.0	2.10	2.51	0.62
XL3/88	2.0	2.73	2.73	0.86
	3.0	2.66	2.73	0.77
	5.0	2.30	2.73	0.65
XL3/99	2.0	3.40	3.40	1.13
	3.0	3.40	3.40	1.02
	5.0	2.95	3.40	0.87
XL5/110	2.0	3.60	3.60	1.19
	3.0	3.60	3.60	1.08
	5.0	3.15	3.60	0.92
XL5/121	2.0	3.75	3.75	1.34
	3.0	3.75	3.75	1.22
	5.0	3.35	3.75	1.05
XL5/132	2.0	3.90	3.90	1.41
	3.0	3.90	3.90	1.28
	5.0	3.55	3.90	1.10
XL5/143	2.0	4.20	4.20	1.50
	3.0	4.20	4.20	1.38
	5.0	3.87	4.20	1.20
XL5/154	2.0	4.43	4.43	1.57
	3.0	4.43	4.43	1.44
	5.0	4.08	4.43	1.25
XL5/165	2.0	4.73	4.73	1.72
	3.0	4.73	4.73	1.58
	5.0	4.42	4.73	1.38
XL7/176	2.0	4.92	4.92	1.81
	3.0	4.92	4.92	1.67
	5.0	4.64	4.92	1.46
XL7/187	2.0	5.05	5.05	1.83
	3.0	5.05	5.05	1.70
	5.0	4.83	5.05	1.50
XL7/198	2.0	5.21	5.21	1.87
	3.0	5.21	5.21	1.72
	5.0	4.97	5.21	1.50
XL7/209	2.0	5.38	5.38	1.95
	3.0	5.38	5.38	1.72
	5.0	5.17	5.38	1.57
XL7/220	2.0	5.67	5.67	2.05
	3.0	5.67	5.67	1.89
	5.0	5.50	5.67	1.65
XL7/231	2.0	5.90	5.90	2.15
	3.0	5.90	5.90	2.00
	5.0	5.32	5.90	1.75

CLT ROOF PANELS - PINE

- All loads are uniformly distributed over the element
- The spans correspond to a deflection limit of SPAN/400
- The cantilever back-span is assumed to be 1.25 x cantilever span with the back span unloaded

Panel Thickness (mm)	Live Load (kN/m2)	Single Span (m)	Continuous Span (m)	Cantilever (m)
XL3/66	0.0	2.94	2.94	0.94
	1.0	2.80	2.94	0.87
	3.0	2.45	2.94	0.77
XL3/77	0.0	3.51	3.51	1.11
	1.0	3.39	3.51	0.99
	3.0	2.94	3.51	0.87
XL3/88	0.0	3.82	3.82	1.20
	1.0	3.72	3.82	1.08
	3.0	3.22	3.82	0.91
XL3/99	0.0	4.76	4.76	1.58
	1.0	4.76	4.76	1.43
	3.0	4.13	4.76	1.22
XL5/110	0.0	5.04	5.04	1.67
	1.0	5.04	5.04	1.51
	3.0	4.41	5.04	1.29
XL5/121	0.0	5.25	5.25	1.88
	1.0	5.25	5.25	1.71
	3.0	4.69	5.25	1.47
XL5/132	0.0	5.46	5.46	1.97
	1.0	5.46	5.46	1.79
	3.0	4.97	5.46	1.54
XL5/143	0.0	5.88	5.88	2.10
	1.0	5.88	5.88	1.93
	3.0	5.42	5.88	1.68
XL5/154	0.0	6.20	6.20	2.20
	1.0	6.20	6.20	2.02
	3.0	5.71	6.20	1.75
XL5/165	0.0	6.62	6.62	2.41
	1.0	6.62	6.62	2.21
	3.0	6.19	6.62	1.93
XL7/176	0.0	6.89	6.89	2.53
	1.0	6.89	6.89	2.34
	3.0	6.50	6.89	2.04
XL7/187	0.0	7.07	7.07	2.56
	1.0	7.07	7.07	2.38
	3.0	6.76	7.07	2.10
XL7/198	0.0	7.29	7.29	2.62
	1.0	7.29	7.29	2.41
	3.0	6.96	7.29	2.10
XL7/209	0.0	7.53	7.53	2.73
	1.0	7.53	7.53	2.41
	3.0	7.24	7.53	2.20
XL7/220	0.0	7.94	7.94	2.87
	1.0	7.94	7.94	2.65
	3.0	7.70	7.94	2.31
XL7/231	0.0	8.26	8.26	3.01
	1.0	8.26	8.26	2.80
	3.0	7.45	8.26	2.45

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XLAM

Corner White & Tokai Road
Retreat
Western Cape
South Africa
7925

info@xlam.co.za
Cel +27 84 661 1095

www.xlam.co.za