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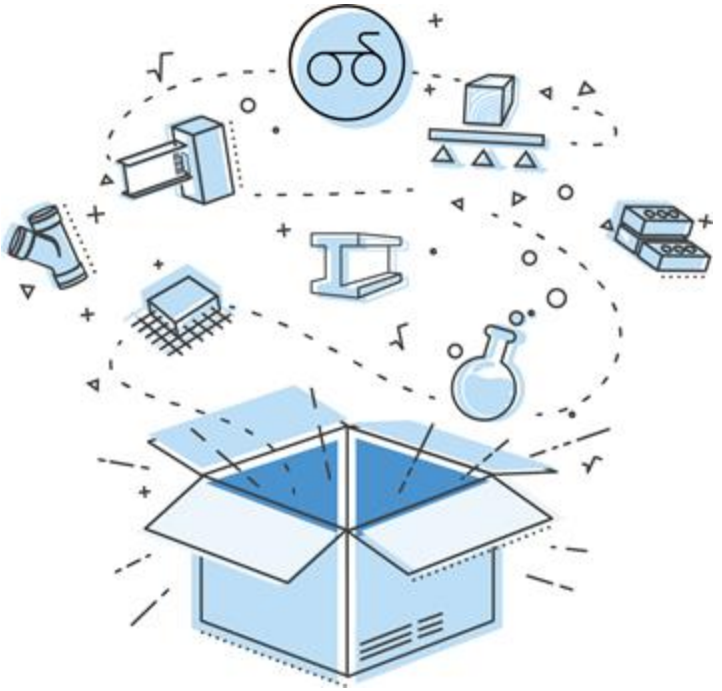
Engineered Wood Products

Specifications and Applications



Tom Rickerby
Tom.rickerby@wesbeam.com

Agenda – Today's Goals

Engineered Wood Products (EWP)

- Types of EWP's in the Australian Market
- Why EWP's differ to traditional sawn timber

The Importance of Correct Specification

- Responsibility of the Structural Engineer
- Where different EWP's may be specified
- CORRECT specification of Laminated Veneer Lumber (LVL)

ClearCalc Example

- Where to find timber design/products

Meet the Presenter

- **Tom Rickerby - Technical Manager at Wesbeam**

  - Chartered Professional Engineer (Structural)
  - Bachelor of Engineering (Civil & Construction) - Hons
  - Graduate Certificate (Timber)
  - Graduate Certificate (Management)

  - 8 years in structural engineering consulting (residential)
  - 8 years in manufacturing and design of LVL
  - Director on the Board of the EWPAA
  - Various timber industry committees and panels

Meet the Presenter

- About wesbeam
  - Australia's only large manufacturer of Laminated Veneer Lumber (LVL) and LVL I-joists
  - 24/7 operation north of Perth WA, producing LVL since 2004
  - 250+ staff including Structural Design and Engineering team of 25 across Australia
  - Full control of wood sourcing, to manufacturing, design, and supply

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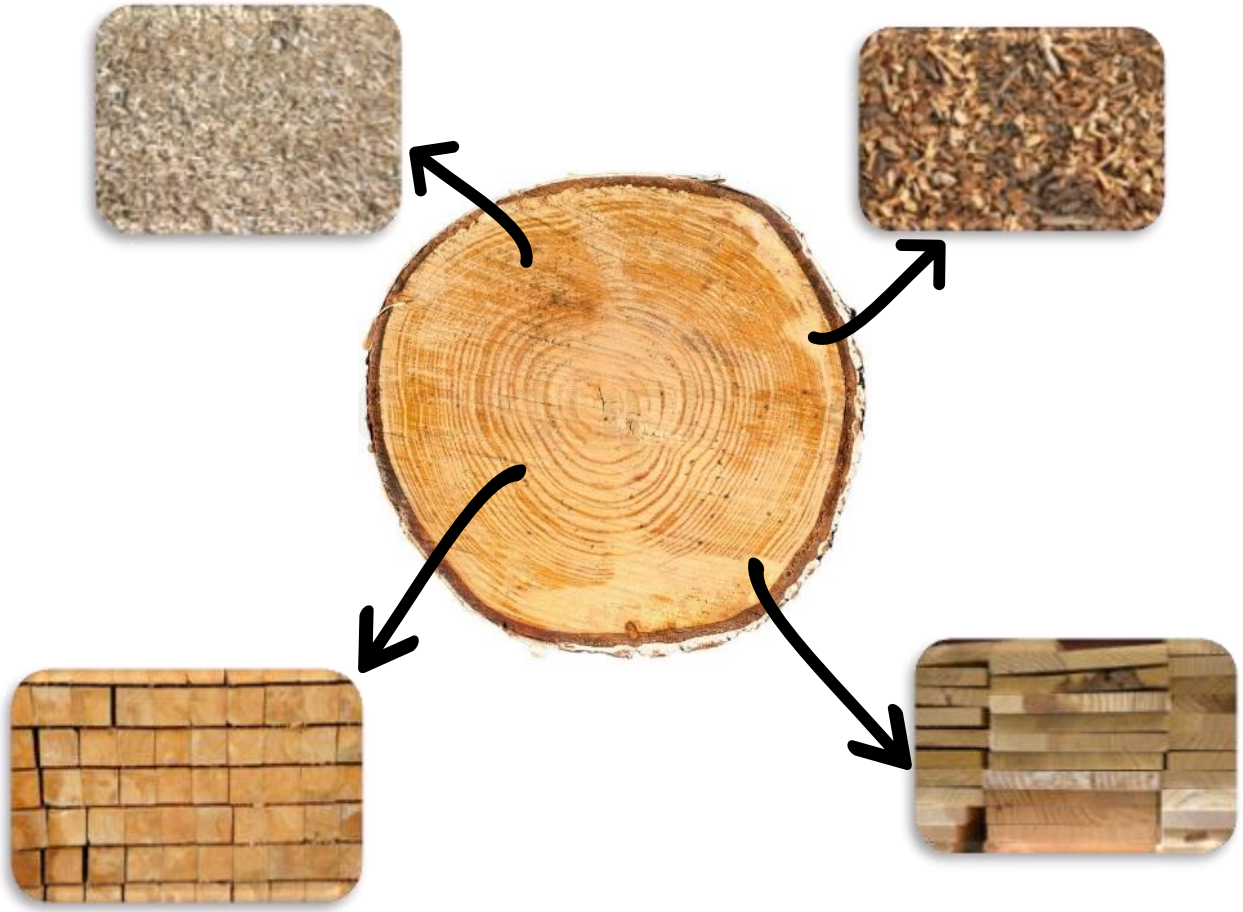
Engineered Wood Products

An overview for the Australian Market

Australia’s focus on Timber



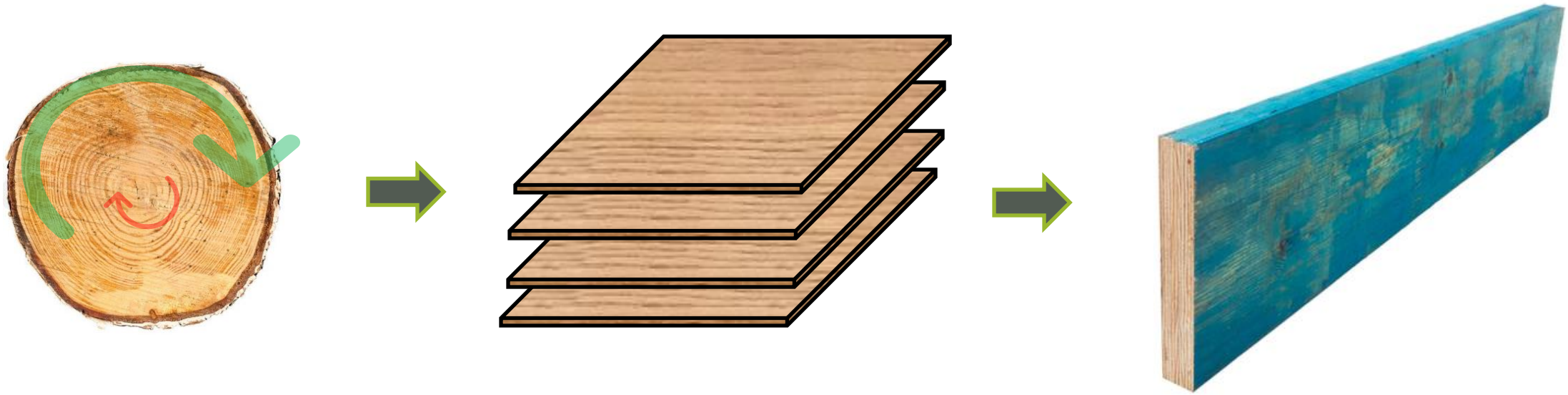
What are EWP's

LAMINATED VENEER LUMBER (LVL)

Did you know?

LVL uses the veneers peeled from the outside of the tree, which are typically denser and stronger than the inner core material.

Common sizes: Width: 35mm – 75mm Depth: 70mm – 450mm (600mm - 1200mm as special order)

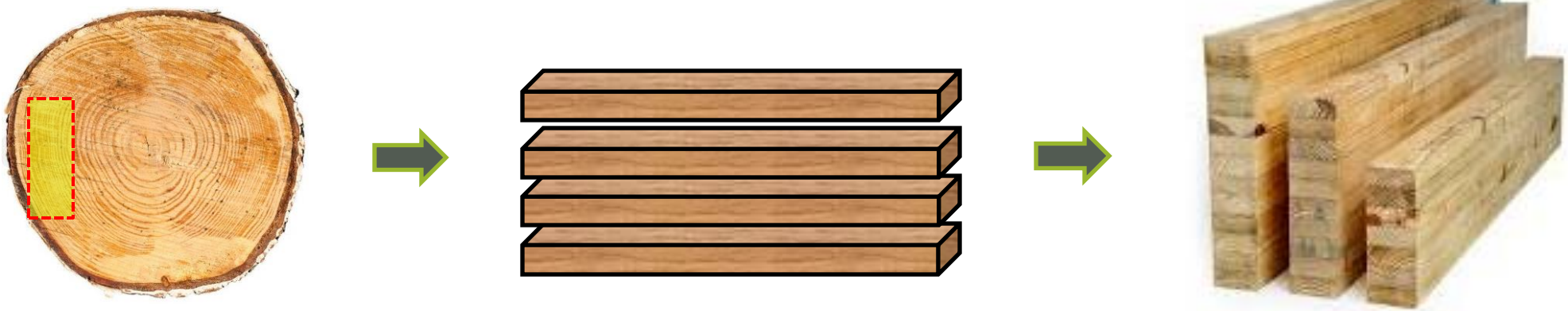


GLUED LAMINATED TIMBER (GLT)

Did you know?

Glulam beams are typically manufactured with a camber (GLC) or can be requested as a straight (GLS)

Common sizes: Width: 65mm – 85mm Depth: 120mm – 625mm (larger/curved as special order)



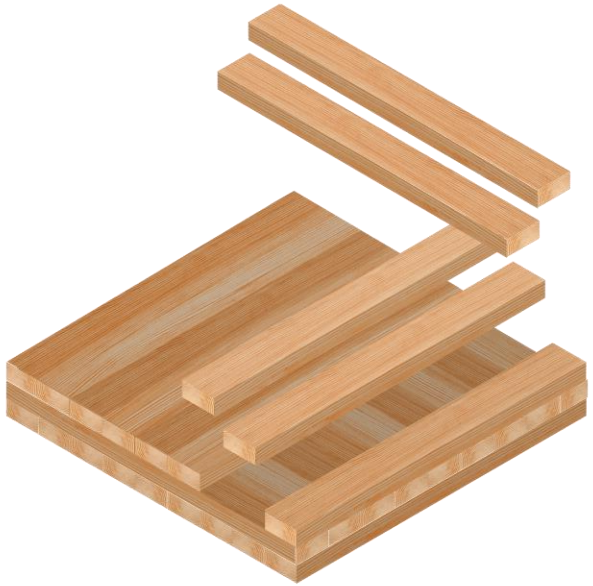
Source: Hyne

CROSS LAMINATED TIMBER (CLT)

Did you know?

CLT buildings offer a sustainable, visually appealing alternative to traditional concrete, pre-cast panel construction.
CLT buildings can be designed to resist fire for 120 minutes

Common sizes: Thickness: 60mm – 200mm Panel sizes: 3m x 16m



Source: Think Wood

Source: Green Building Advisor

I-JOISTS

Did you know?

I-joists have a similar span range to solid LVL joists, but with significantly less weight.
I-joists can have large penetrations cut in the web to run plumbing and other services, without compromising the structural integrity

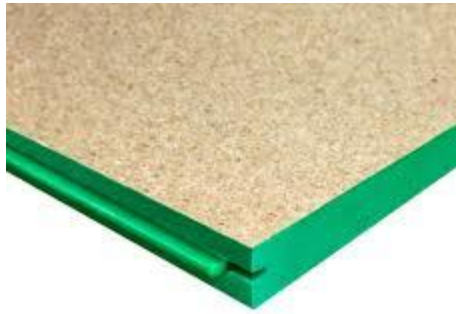
Common sizes: Depth: 200mm – 400mm Width: 40mm x 90mm

Source: Wesbeam

PANEL PRODUCTS

Did you know?

Plywood, OSB, and particleboard can all be used for floor sheeting, wall bracing, and cladding in residential and commercial applications. In Australia, particleboard is most commonly used for floor sheeting, while OSB and plywood are typically used for bracing panels and cladding.

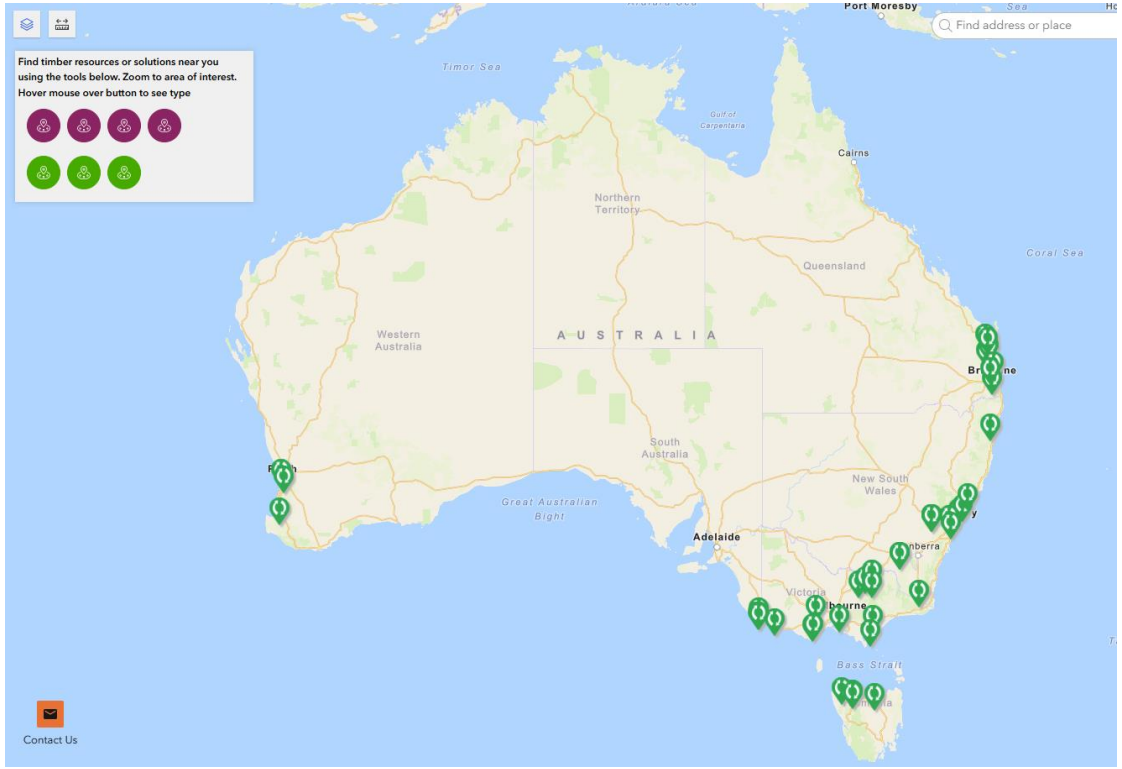


Particleboard

Oriented strandboard

Plywood

MANUFACTURING IN AUSTRALIA



Source: National Centre for Timber Durability and Design Life

- LVL
- I-Joists
- Glulam
- CLT
- Plywood
- Particleboard

Specification of EWP’s

Focus on the the importance of LVL specification

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Where to use what?!

	Floor/wall Slabs	Floor Joists	Floor/Roof Beams	Wall studs	Rafters	Lintels
Sawn Pine (MGP)		✓	✓	✓	✓	✓
CLT	✓					
GLT			✓	✓*		
LVL		✓	✓	✓	✓	✓
I-joists		✓			✓	

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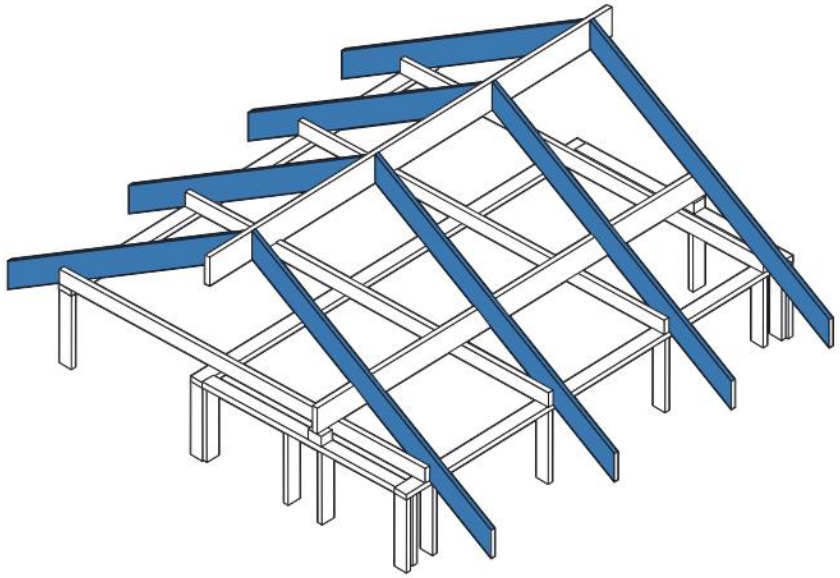
What Information Engineers Give?



190 x 35 MGP10 @ 600c/c
190 x 35 MGP10 H2F @ 600c/c

Timber Depth

Timber Width

Timber Grade

Rafter Spacing

Timber Treatment Level?
Maybe…

Standard Grades to AS 1720.1

TABLE H3.1

CHARACTERISTIC VALUES FOR DESIGN—MGP10, MGP12, MGP15 & A17 STRESS GRADES

Stress grade	Section size		Characteristic values, MPa										Design density	Joint group
			Bending	Tension parallel to grain	Compression parallel to grain	Shear in beams	Average modulus of elasticity (see Note1) parallel to grain	Average modulus of rigidity	Bearing		Shear at joint details	Tension perpendicular to grain		
	Depth mm	Breadth mm	(f'_b)	(f'_t)	(f'_c)	(f'_s)	(E)	(G)	Perpendicular to grain (f'_p)	Parallel to grain (f'_ℓ)	(f'_{sj})	(f'_{tp})	(kg/m^3)	
MGP 10	70 to 140	35 and 45	17	7.7	18	2.6	10 000	670	10	30	4.2	0.5	500	JD5 (see Note 2)
	190		16	7.1	18	2.5								
	240		15	6.6	17	2.4								
	290		14	6.1	16	2.3								
MGP 12	70 to 140	35 and 45	28	12	24	3.5	12 700	850	10	30	4.2	0.5	540	JD4
	190		25	12	23	3.3								
	240		24	11	22	3.2								
	290		22	9.9	22	3.1								
MGP 15	70 to 140	35 and 45	39	18	30	4.3	15 200	1 010	10	30	4.2	0.5	570	JD4
	190		36	17	29	4.1								
	240		33	16	28	4.0								
	290		31	14	27	3.8								
A17	70 to 120	35	45	26	40	5.1	16 000	930	17	50	6.0	0.6	650	JD3
		45	40	24	35	4.5								
	140, 190	35	45	24	35	4.5								
		45	40	21	32	4.0								
	240, 290	35	40	18	27	3.6								
		45	40	17	25	3.3								

NOTES:

1 The average modulus of elasticity includes an allowance for shear deformation and is for short duration loading.

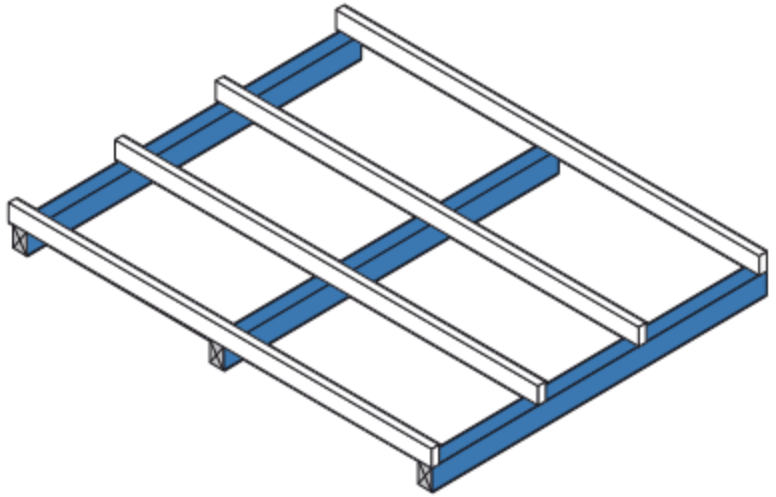
2 For MGP 10 grade, JD4 may be used where heart-in material is excluded.

3 The modulus of rigidity (estimated as one-fifteenth of the average modulus of elasticity) is included for the estimation of torsional rigidity.

4 Interpolation may be used to obtain properties for depths not listed.

What is available?

The same level of info for EWP?



EWP Section Size

EWP Grade

Timber Treatment Level?
Maybe…

210 x 65 GL13C

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Standard Grades to AS 1720.1

TABLE 7.1

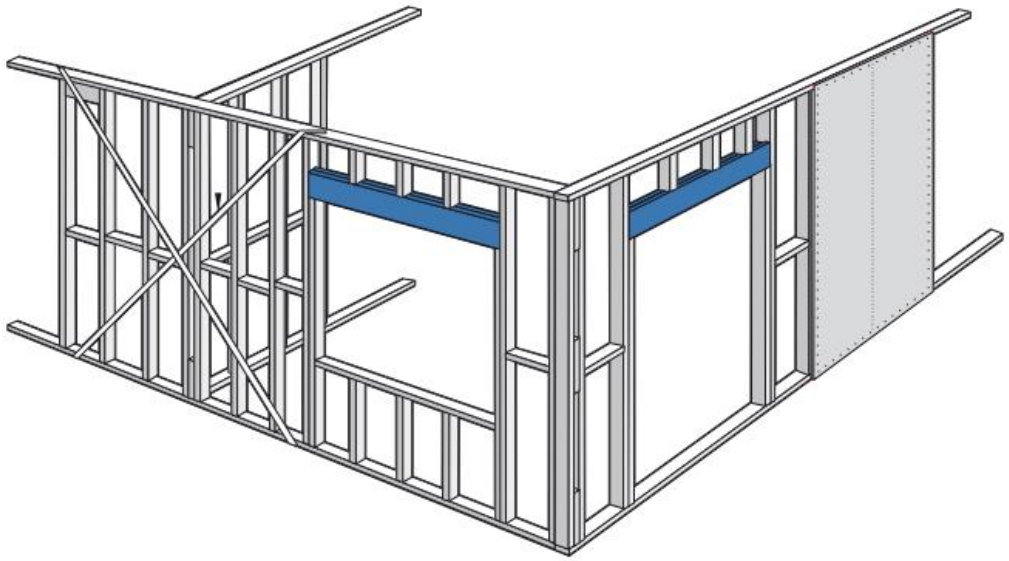
CHARACTERISTIC VALUES FOR STRUCTURAL DESIGN—GL-GRADES

Stress grade	Characteristic values, MPa					
	Bending (f'_b)	Tension parallel to grain (f'_t)	Shear in beam (f'_s)	Compression parallel to grain (f'_c)	Short duration average modulus of elasticity parallel to the grain (E)	Short duration average modulus of rigidity for beams (G)
GL18	45	25	5.0	45	18500	1230
GL17	40	20	4.2	33	16700	1110
GL13	33	16	4.2	26	13300	900
GL12	25	11	4.2	22	11500	770
GL10	22	8	3.7	18	10000	670
GL8	19	6	3.7	14	8000	530

NOTE: The characteristic values for tension for GL grades apply for tension members with the larger cross-sectional dimension not greater than 150 mm. For tension members with a cross-sectional dimension greater than 150 mm, the characteristic values are determined by multiplying the value in the table by $(150/d)^{0.167}$, where d is the larger cross-sectional dimension of the section.

What is available?

What about LVL?



EWP Section Size

EWP Grade

Timber Treatment Level?
Maybe…

300 x 63 LVL 13 ***UNLESS YOU <u>DEFINE</u> WHAT AN LVL13 IS!***

Standard Grades to AS 1720.1

8.3 DESIGN PROPERTIES

8.3.1 Characteristic values for strength properties and elastic moduli

Characteristic values for structural LVL shall be obtained from the manufacturer. Characteristic values for LVL shall include consideration of the section sizes to which they are intended to apply.

Standard Grades to AS 1720.1

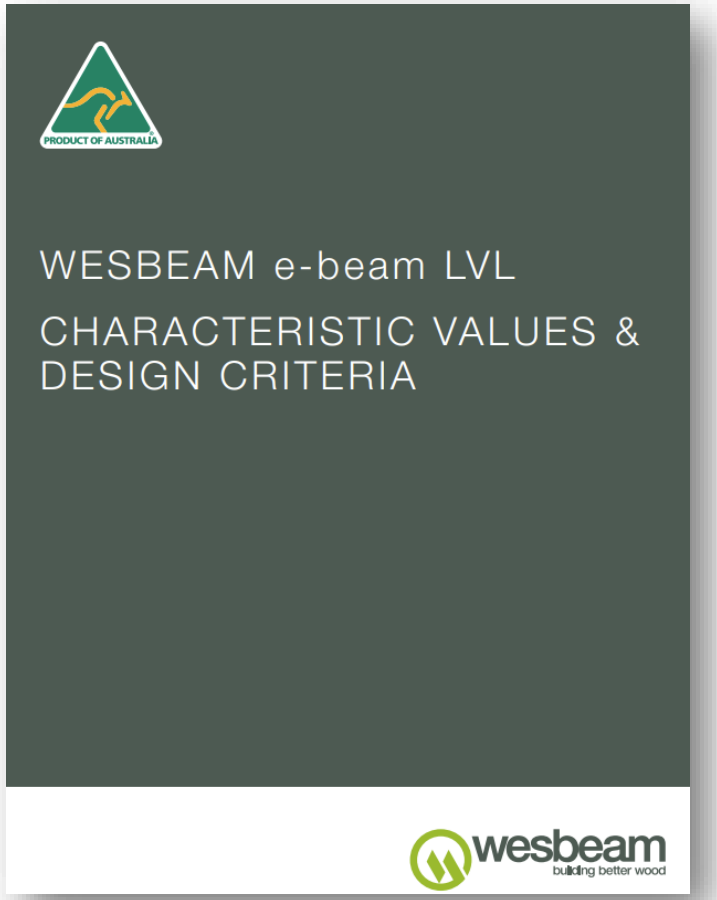
"LVL13" or "LVL13.2" available in the market includes:

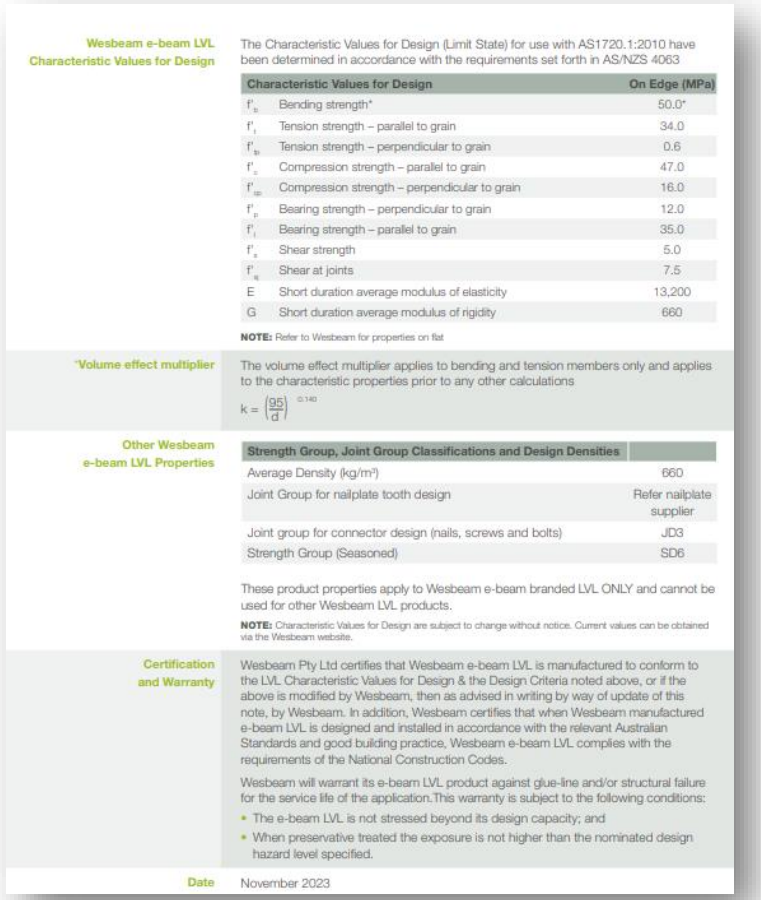
- **Wesbeam e-beam** (flagship product for Wesbeam with an "E13.2")
- Meyer, ITI, Tillings, Dindas, etc…
- Each manufacturer/importer have different product ranges
- Each of these products have different values for:
  - Modulus of Elasticity ("E value")
  - bending strength
  - shear strength
  - compression/tension strength etc.

If you specify LVL13, what properties are you using to check you bending and shear strength?

- In design, you much check all structural properties, not just the E value.

Standard Grades to AS 1720.1





Wesbeam e-beam LVL Characteristic Values for Design

The Characteristic Values for Design (Limit State) for use with AS1720.1:2010 have been determined in accordance with the requirements set forth in AS/NZS 4063

Characteristic Values for Design		On Edge (MPa)
f'_b	Bending strength*	50.0*
f'_t	Tension strength – parallel to grain	34.0
f'_{tp}	Tension strength – perpendicular to grain	0.6
f'_c	Compression strength – parallel to grain	47.0
f'_{cp}	Compression strength – perpendicular to grain	16.0
f'_p	Bearing strength – perpendicular to grain	12.0
f'_l	Bearing strength – parallel to grain	35.0
f'_s	Shear strength	5.0
f'_{sj}	Shear at joints	7.5
E	Short duration average modulus of elasticity	13,200
G	Short duration average modulus of rigidity	660

NOTE: Refer to Wesbeam for properties on flat

***Volume effect multiplier**

The volume effect multiplier applies to bending and tension members only and applies to the characteristic properties prior to any other calculations

$$k = \left(\frac{95}{d}\right)^{0.140}$$

Other Wesbeam e-beam LVL Properties

Strength Group, Joint Group Classifications and Design Densities	
Average Density (kg/m³)	660
Joint Group for nailplate tooth design	Refer nailplate supplier
Joint group for connector design (nails, screws and bolts)	JD3
Strength Group (Seasoned)	SD6

These product properties apply to Wesbeam e-beam branded LVL ONLY and cannot be used for other Wesbeam LVL products.

NOTE: Characteristic Values for Design are subject to change without notice. Current values can be obtained via the Wesbeam website.

Certification and Warranty

Wesbeam Pty Ltd certifies that Wesbeam e-beam LVL is manufactured to conform to the LVL Characteristic Values for Design & the Design Criteria noted above, or if the above is modified by Wesbeam, then as advised in writing by way of update of this note, by Wesbeam. In addition, Wesbeam certifies that when Wesbeam manufactured e-beam LVL is designed and installed in accordance with the relevant Australian Standards and good building practice, Wesbeam e-beam LVL complies with the requirements of the National Construction Codes.

Wesbeam will warrant its e-beam LVL product against glue-line and/or structural failure for the service life of the application.This warranty is subject to the following conditions:

- The e-beam LVL is not stressed beyond its design capacity; and
- When preservative treated the exposure is not higher than the nominated design hazard level specified.

Date November 2023

How to specify generic LVL

1. You could specify a brand and product

e.g. 240 x 63 Wesbeam e-beam LVL

2. You could specify options

e.g. 240 x 63 LVL. Refer to table for options

	Stiffness Properties	Characteristic Strength Properties				
	Average Modulus of Elasticity, E (MPa)	Bending strength, f'_b (MPa)*	Shear Strength, f'_v (MPa)	Bearing perp. to grain, f'_p (MPa)	Compression Strength, f'_c (MPa)	Joint Group
Wesbeam e-beam	**13,200**	**50.0**	**5.0**	**12.0**	**47.0**	**JD3**
	13,200	50.0	5.0	10.0	43.0	JD4
	13,200	48.0	4.5	10.0	30.0	JD4
	13,200	50.0	4.6	12.0	38.0	JD4
	13,200	44.0	4.1	6.0	35.0	JD4

3. You could specify minimum properties

e.g. 240 x 63 LVL. Refer to table for minimum structural properties

LVL Specifiation - Minimum Structural Properties	
Average Modulus of Elasticity, E (MPa)	13,200
Bending strength, f'_b (MPa)*	48.0
Shear Strength, f'_v (MPa)	4.5
Bearing perp. to grain, f'_p (MPa)	10.0
Compression Strength, f'_c (MPa)	30.0
Joint Group	JD4

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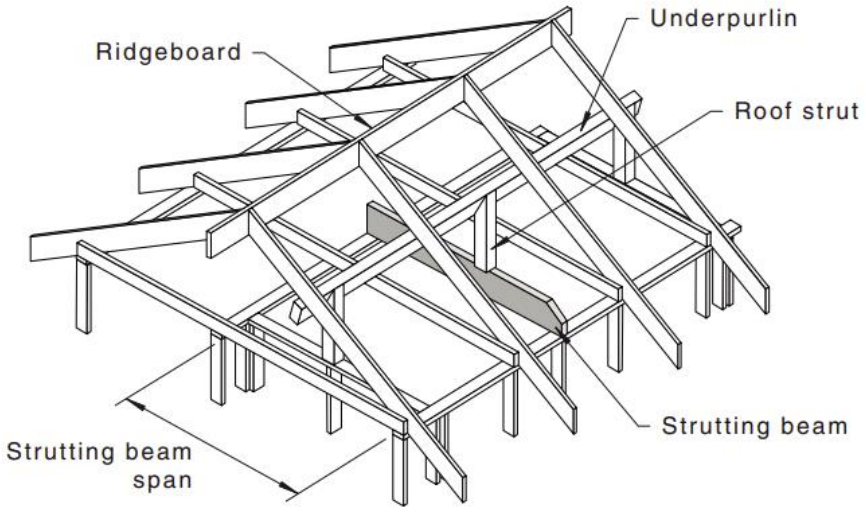
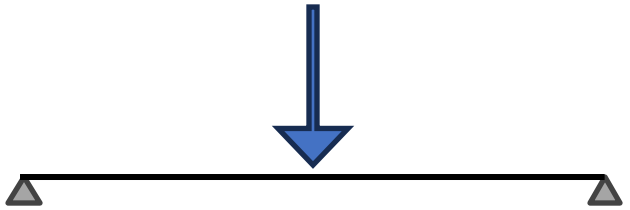
What are the risks if specific incorrectly?





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What are the risks if specific incorrectly?

Engineering Specification – Option 1

240 x 45 LVL (refer to LVL table)

LVL Specifiation - Minimum Structural Properties	
Average Modulus of Elasticity, E (MPa)	13,200
Bending strength, f'_b (MPa)*	48.0
Shear Strength, f'_v (MPa)	4.5
Bearing perp. to grain, f'_p (MPa)	10.0
Compression Strength, f'_c (MPa)	30.0
Joint Group	JD4

Engineering Specification – Option 2

240 x 45 E13 LVL

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What are the risks if specific incorrectly?

LVL Specifiation - Minimum Structural Properties	
Average Modulus of Elasticity, E (MPa)	13,200
Bending strength, f'_b (MPa)*	48.0
Shear Strength, f'_v (MPa)	4.5
Bearing perp. to grain, f'_p (MPa)	10.0
Compression Strength, f'_c (MPa)	30.0
Joint Group	JD4

	Calculation	Member	Quantity
99%	**B2**	240 × 45 - e-beam (Wesbeam®)	2500 mm

Summary

99%	Moment Capacity	$M_d = 12.2\ \text{kN} \cdot \text{m}$
28%	Shear Capacity	$V_d = 34.3\ \text{kN}$
	Bearing Capacity	$N_{d,gov} = 43.7\ \text{kN}$
43%	Governing Short-Term Deflection	$\delta_s = -4.31\ \text{mm}$
31%	Governing Long-Term Deflection	$\delta_l = -3.15\ \text{mm}$
0%	Governing Imposed Load Deflection	$\delta_Q = 0\ \text{mm}$

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What are the risks if specific incorrectly?

Engineering Specification – Option 1

240 x 45 E13 LVL

	Calculation	Member	Quantity
107%	**B2**	240 × 45 - E13 LVL [redacted]	2500 mm

Summary

107%	Moment Capacity	$M_d = 11.3\ \text{kN} \cdot \text{m}$
33%	Shear Capacity	$V_d = 29.8\ \text{kN}$
	Bearing Capacity	$N_{d,gov} = 43.7\ \text{kN}$
43%	Governing Short-Term Deflection	$\delta_s = -4.31\ \text{mm}$
31%	Governing Long-Term Deflection	$\delta_l = -3.15\ \text{mm}$
0%	Governing Imposed Load Deflection	$\delta_Q = 0\ \text{mm}$

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Key Reminder for Engineers

you can be **flexible**, but you can't be **vague**

specifying **products** that are widely **available** will assist the project

if you are **unsure**, **ask**!

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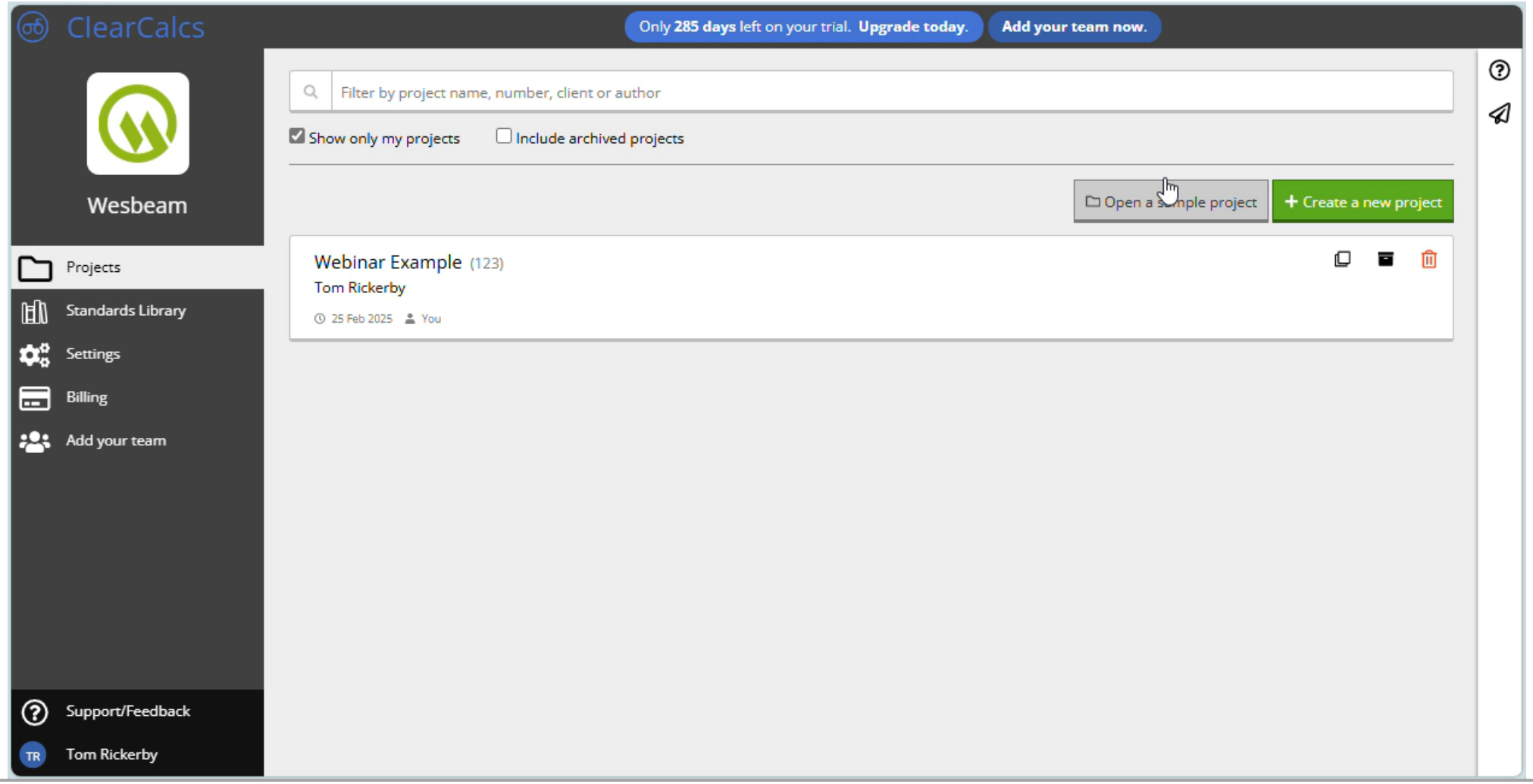
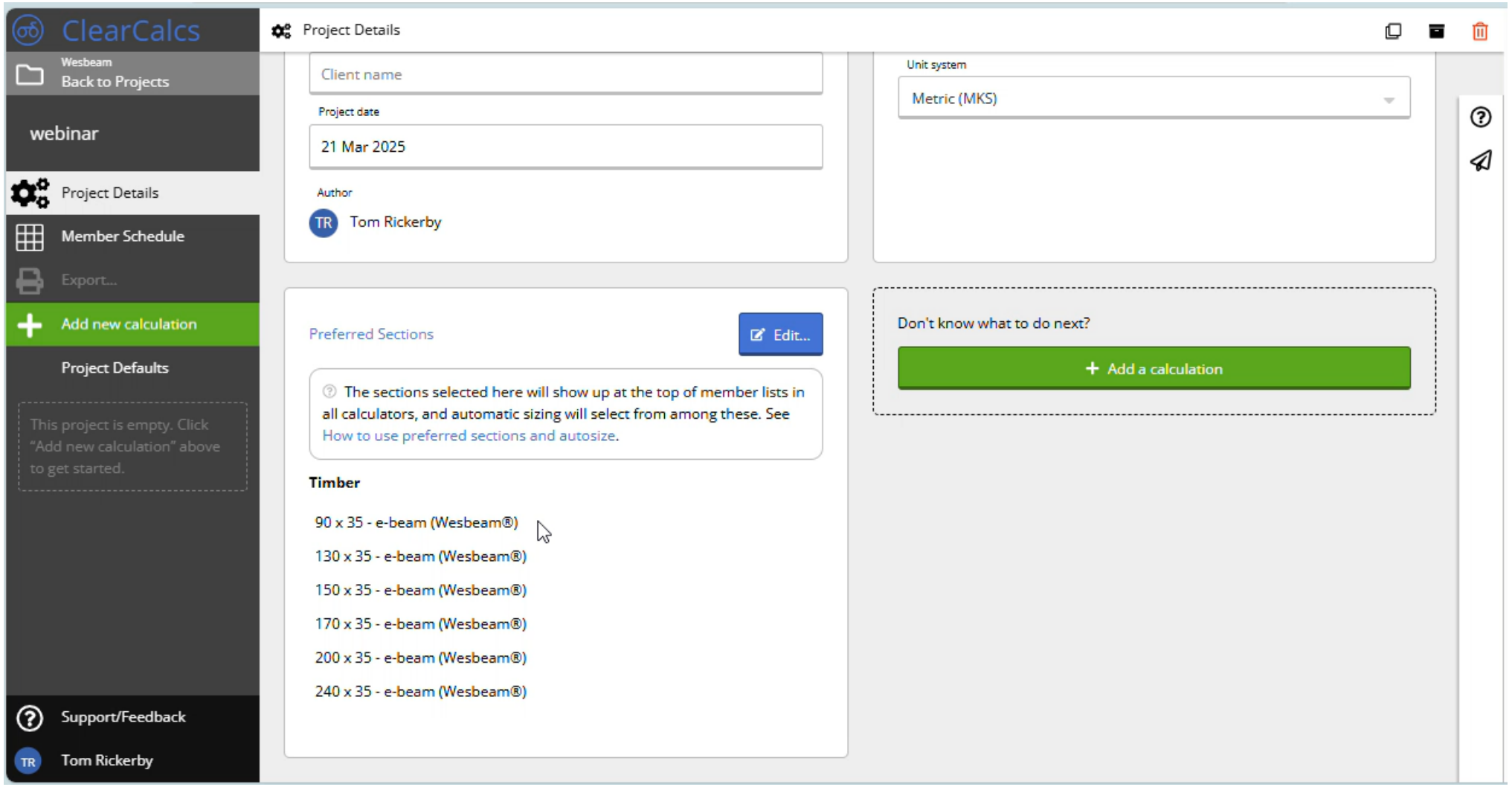
Timber Design

Specification in Clear Calc



Timber Design to AS 1720.3



Questions?

FAQ's f

1. Is th … ey like to u…
2. Why…
3. How…
4. How…
5. Why… diffe…
6. LVL…
7. Can…
8. How…

e-beam Optio…

TABLE 1: WESBEAM LVL – CONSTRUCTION REQUIREMENTS FOR BUSHFIRE

APPENDIX E

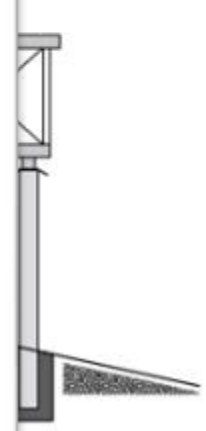
FURTHER DESIGN METHODS FOR MEMBERS

(Normative)

E1 SCOPE

This Appendix extends the design methods given in Section 3, and covers the following topics:

(a) The material constant (ρ) (see Paragraph E2).
(b) Slenderness coefficients for columns (see Paragraph E3).
(c) Spaced columns (see Paragraph E4).
(d) Beam-column bent about both axes (see Paragraph E5).
(e) Slenderness coefficients for beams (see Paragraph E6).
(f) Buckling restraints (see Paragraph E7).
(g) Concentrated loads and partial area loads on grid systems (see Paragraph E8).
(h) Notched beams (see Paragraph E9).
(i) Notched columns (see Paragraph E10).
(j) Notched tension members (see Paragraph E11).
(k) Single-tapered straight beams (see Paragraph E12).
(l) Double-tapered, curved and pitched-cambered beams (see Paragraph E13).



Questions?

Tom.Rickerby@wesbeam.com

THANK YOU!

- We will send you a recording of the webinar by email.
- There will be a survey at the end of this webinar, we would appreciate your feedback on how we can improve.
- If you have further questions, send an email to help@clearcalcs.com or use the Help button in ClearCalcs
- Stay tuned for another webinar next month!