

# MASS TIMBER DESIGN GUIDE.

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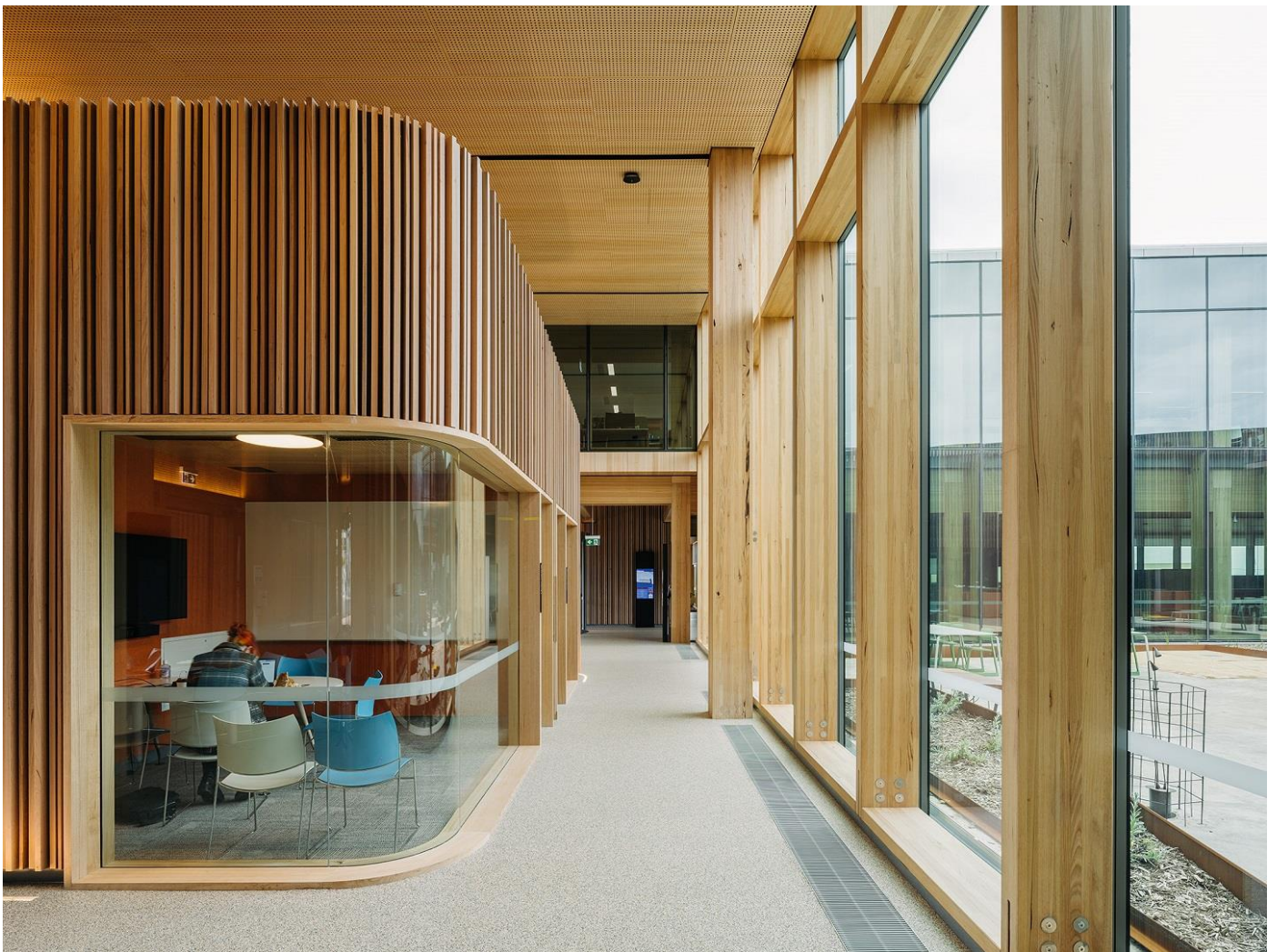
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## WHAT IS MASSLAM?

MASSLAM is Australian Sustainable Hardwoods Pty Ltd (ASH) range of massive timber solutions - also sold as Glue Laminated Timber, GLT, Glulam, ATC, TCC and floor cassettes.

MASSLAM is a high strength, visually appealing, affordable, 'ready to construct' column, beam and flooring system for commercial and large domestic buildings.

Manufactured in Heyfield, using Australian grown, superior strength timber, the MASSLAM range of products offer significant benefits when compared against other mass timber options worldwide.



MASSLAM 45 columns at the University of Tasmania, Burnie, Australia.

## SPECIFICATIONS & CHARACTERISTICS

LABEL	MASSLAM 33	MASSLAM SL35	MASSLAM 38	MASSLAM 45
Species	Radiata Pine	Victorian Ash / Tasmanian Oak	Plantation Oak	Victorian Ash / Tasmanian Oak
Bending Strength	Contact the MASSLAM Design Team	F'b = 35MPa	F'b = 38MPa	F'b = 45MPa
Tension Strength	Contact the MASSLAM Design Team	F't = 25MPa (parallel) F'tp = 0.6MPa (perpendicular)	***F't = 16MPa (parallel) ***F'tp = F'tp = 0.5MPa (parallel)	F't = 25MPa (parallel) F'tp = 0.6MPa (perpendicular)
Shear Strength	Contact the MASSLAM Design Team	F's = 5.0MPa	***F's = 5.0MPa	F's = 5.0MPa
Compression Strength	Contact the MASSLAM Design Team	F'c = 45MPa (parallel) F'cp = 19MPa (perpendicular)	***F'c = 26MPa (parallel) ***F'cp = 8.6MPa (perpendicular)	F'c = 45MPa (parallel) F'cp = 19MPa (perpendicular)
Bearing Strength	Contact the MASSLAM Design Team	F'l – 59MPa (parallel) F'p = 19MPa (perpendicular)	***F'l = 30MPa (parallel) ***F'p = 10MPa (perpendicular)	F'l – 59MPa (parallel) F'p = 19MPa (perpendicular)
Modulus of Elasticity	Contact the MASSLAM Design Team	E = 15,000MPa E0.05 = 11,250MPa **E90,mean = 1,000MPa	***E = 13,300MPa	E = 16,700MPa E0.05 = 12,525MPa **E90,mean = 1,110MPa
Modulus of Rigidity	Contact the MASSLAM Design Team	G = 1,000MPa	***G = 900MPa	G = 1,110MPa
Strength Group	Contact the MASSLAM Design Team	SD3	***SD6	SD3
Joint Group	Contact the MASSLAM Design Team	JD3	***JD4	JD3
Design Density	Contact the MASSLAM Design Team	Mean = 650kg/m3 Pk = 620kg/m3	Mean = 550kg/m3 Pk = 460kg/m3	Mean = 650kg/m3 Pk = 620kg/m3
Service Class	Contact the MASSLAM Design Team	1 & 2 only if untreated (3 in IRON ASH treatment with limitations)	1 & 2 only if untreated (3 in IRON ASH treatment with limitations)	1 & 2 only if untreated (3 in IRON ASH treatment with limitations)
Adhesive	Contact the MASSLAM Design Team	Externally rated, high temperature PUR	Externally rated, high temperature PUR	Externally rated, high temperature PUR
Formaldehyde Emissions	Contact the MASSLAM Design Team	None (E-0)	None (E-0)	None (E-0)
Certification	Contact the MASSLAM Design Team	PEFC	PEFC	PEFC
Char rate	Contact the MASSLAM Design Team	*0.4765mm per min	TBC	*0.4765mm per min
Movement in Service - Axial	Contact the MASSLAM Design Team	0.02% Per 1% change in MC	0.02% Per 1% change in MC	0.02% Per 1% change in MC
Movement in Service - Radial	Contact the MASSLAM Design Team	0.20% per 1% change in MC	0.20% Per 1% change in MC	0.20% per 1% change in MC
Movement in Service - Tangent	Contact the MASSLAM Design Team	0.31% per 1% change in MC	0.31% per 1% change in MC	0.31% per 1% change in MC

\*Warrington Fire NATA lab according to AS1530:4

\*\*Calculated according to EN384:2004

\*\*\* Product in development, product values to improve

## SIZES

MASSLAM 33					
WIDTH (mm)		DEPTH (mm)			
85	X	160	220	260	360
130		240	330	390	540
175		330	450	530	730
220		410	560	660	910
255		500	680	800	1100
265		580	790	930	1280
310		670	910	1170	
355		750	1020	1200	
400		840	1140		
450		920	1250		
		1010			
		1090			
		1180			
		1260			

Note: all depth options can be used with any width on this table

MASSLAM SL35		
WIDTH (mm)		DEPTH (mm)
65	X	120
90		165
112		205
140		250
		290
		340
		375
		420
		450
		510
		550
		595
		635
		680
		720
		765
		805
		850
		890
		935
		975
		1020
		1060
		1100
		1150
		1190
		1230

Note: all depth options can be used with any width on this table

MASSLAM 38 & MASSLAM 45					
WIDTH (mm)		DEPTH (mm)			
120		200	270	350	420
165		270	370	470	570
205		335	460	590	710
250		410	560	710	860
290		480	660	830	1000
335		550	750	950	1150
380		620	840	1070	
420		690	940	1190	
450		760	1030	1250	
		830	1220		
		900	1250		
		970			
		1040			
		1110			
		1180			
		1250			

Note: all depth options can be used with any width on this table



## COATINGS & APPEARANCE

ASH operates a four-sided planer that enables members up to 1300mm x 450mm x 12,000mm to be dressed square and with an arris prior to the CNC process. Pencil round corners or square edges can be produced on request. This ensures an exceptionally accurate building product. MASSLAM is intended for use in stained or coated applications where the member is part of the aesthetics. Occasional skips in the surface are permissible and minor blemishes, checking and voids in timber shall be acceptable as standard.

MASSLAM is available and recommended to be supplied with a protective primer or vapour permeable wrap before leaving the processing plant. It will require sanding and polishing to achieve a furniture finish. Talk to your MASSLAM specialist about coating options.

LABEL	MASSLAM 33	MASSLAM SL35	MASSLAM 38	MASSLAM 45
Machine finish	≡ 60 grit	≡ 60 grit	≡ 60 grit	≡ 60 grit
Grain structure of feedstock	Back sawn	Quarter sawn for stability	Back sawn	Quarter sawn for stability
Gum Vein – Tight	No limit	No limit	No limit	No limit
Gum Vein – Loose	No limit	No limit	No limit	No limit
Gum Pockets	No greater than 7mm wide and 4mm deep	No greater than 7mm wide and 4mm deep	No greater than 7mm wide and 4mm deep	No greater than 7mm wide and 4mm deep
Sound Knots/Burls	No limit	No limit	No limit	No limit
Loose Knots	Filled	Nil	Filled	Nil
Pinhole	No limit	No limit	No limit	No limit
Hobnail	No limit	No limit	No limit	No limit
Black Speck	No limit	No limit	No limit	No limit
Rot/Decay	Nil	Nil	Nil	Nil
Heartwood	Nil	Nil	Nil	Nil
Checking	No limit	No limit	No limit	No limit
Lamination size	Varied	Varied	Varied	Varied

Note: Appearance qualities relate to visual surface only. Surfaces marked 'non-visual' in shop drawings shall accept non-visual grade – which allows any visual characteristic.



## ACCEPTABLE TOLERANCES

MASSLAM	
Width	± 2mm
Depth	± 2mm
Squareness	± 2mm per 300mm depth
Length ≤ 6m	± 2mm
Length > 6m	± 0.05%
Spring/Straightness ≤ 6m	± 6mm
Spring/Straightness > 6m	± 0.1%
Machining (holes, millings, slots etc.) location relative to member	± 3mm in both plan axis
Machining (holes, millings, slots etc.) location relative to other local machining	± 2mm in both plan axis
Machining of holes - diameter	± 1mm
Machining of holes - wandering to mid- width/depth of member	± 1.0% of width/depth
Machining of millings and slots - size (width and depth)	+ 2mm, -1mm
Machining of millings and slots - size (length)	± 2mm

CUSTOM FABRICATED BRACKETRY	
Thickness of plates	± 0.5mm
Width (individual plates)	± 2mm
Squareness (individual plates)	± 1%
Length ≤ 500mm	± 2mm
Length > 500mm	± 4mm
Straightness	± 2mm
Machining (holes, millings/cuts etc.) location relative to plate/member	± 1mm in both plan axis
Machining (holes, millings/cuts etc.) location relative to other local machining	± 1mm in both plan axis
Machining of holes - diameter	+ 0.5mm, -0.2mm
Machining of millings/cuts - size (width, length, depth)	+ 0.5mm
Weld sizes	+ 2mm
Assembly of parts - location relative to other parts	± 1mm in both plan axis
Assembly of parts - angle relative to other parts for parts ≤ 500mm long	± 1.0 degree in all three primary planes
Assembly of parts - angle relative to other parts for parts > 500mm long	± 0.5 degree in all three primary planes

## SPAN CAPACITY

MASSLAM is produced in lengths up to 12m in the factory. Beam connections are utilised for longer lengths.

## STRUCTURAL DESIGN

Please reach out to the MASSLAM Design Team for member sizing and design assistance.

Revit files can be downloaded here: [https://ash.com.au/wp-content/uploads/2021/09/ASH\\_MASSLAM\\_Revit\\_Files.zip](https://ash.com.au/wp-content/uploads/2021/09/ASH_MASSLAM_Revit_Files.zip)

## DURABILITY, WEATHER EXPOSURE AND SUITABILITY

### Service Class 1

Characterised by moisture content in the material corresponding to a temperature of 20 °C and relative humidity of the surrounding air only exceeding 65% for a few weeks per year – i.e. Indoor, controlled environment.

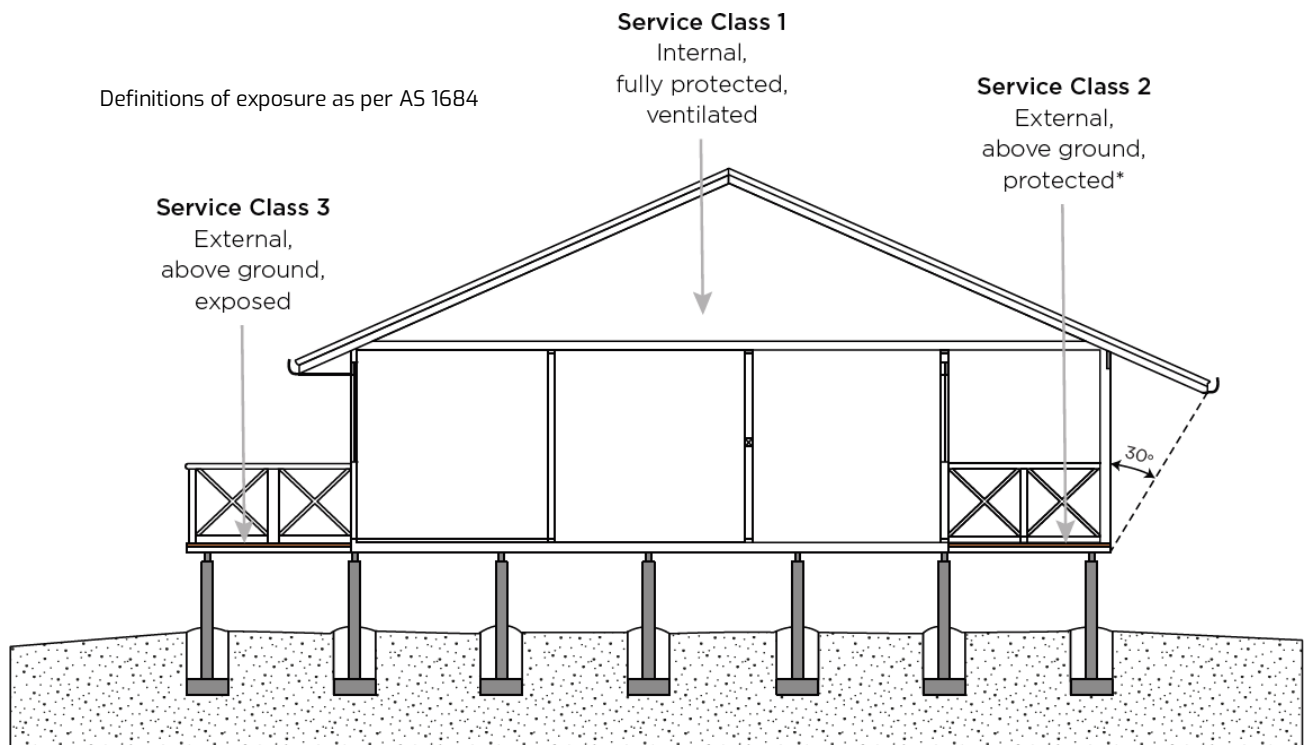
### Service Class 2

Characterised by moisture content in the material corresponding to a temperature of 20 °C and relative humidity of the surrounding air only exceeding 85% for a weeks peryear – i.e. protected from weather but exposed to environment.

### Service Class 3

Characterised by climatic conditions leading to higher moisture contents than Service Class 2, or where timber is directly exposed to sun and/or rain– i.e. fully exposed.

Diagram No. 1



\* External timbers are regarded as protected in AS 1684 if they are covered by a roof projection (or similar) at 30° to the vertical and they are well detailed and maintained (coated and kept well ventilated).

MASSLAM is manufactured from kiln dried timber with a target moisture content of 10% and therefore requires protection from moisture that can occur from:

- Exposure to direct sun and rain (including during construction)
- Contact or close exposure with moisture laden, porous material (e.g. Concrete blocks)
- Exposure to extreme environments such as dry heating systems (e.g. slow combustion wood heaters), air conditioning, large north or west facing windows or moisture laden environments such as pool enclosures

## MASSLAM PROTECTION METHODS

### *During Construction*

All MASSLAM is 'end sealed' prior to leaving the Processing Plant. It is mandatory that all end grain be sealed permanently. ASH recommends MASSLAM products be sealed on all surfaces to protect them from the environment during construction prior to leaving the ASH Processing Plant. If MASSLAM is not supplied coated and is expected to be exposed for a period or become wet, it is recommended that the member be sealed with a construction sealer or moisture permeable wrap that is compatible with the final paint or varnish finish, or wrapped in plastic to provide protection (note: plastic is a temporary protection measure only and must allow for drainage and for the timber to breathe). Speak to your MASSLAM specialist about breathable plastic membranes.

For example:

- If the member is installed inside a building without direct exposure to air conditioning such as in a wall cavity; protection to the beam is not necessary.
- If the member is installed inside a building with direct exposure to air conditioning or dry heat; then a permeable moisture limiting sealer is required.
- If the member is under the eaves and protected from direct rain and sun, it is recommended that an adequate premium quality sealer be applied and maintained (in accordance with the MASSLAM Coatings Guide).
- If the member is exposed to the sun or weather, refer to "Exterior Applications" below.

### *Exterior Applications*

MASSLAM is not to be used for in-ground applications.

MASSLAM is not recommended to be used in fully weather exposed, exterior applications (Service Class 3).

MASSLAM is only recommended to be used in external, above-ground, protected applications (Service Class 2) when special consideration is given to level of weather and UV exposure; coating, maintenance of coating and joint detailing is adequate; durable species is selected.

MASSLAM members used in Service Class 2 applications must be correctly detailed and protected by fully protecting the member with a physical barrier and capping (see diagram no.2):

- correctly coated with a premium quality protective finish (e.g. light coloured pigmented external paint system or penetrating oil) to prevent moisture infiltration. It is important that an inspection and maintenance programme, based on exposure level and the paint manufacturer's recommendations, be prepared, implemented and maintained accordingly (refer to MASSLAM Coating Guide for advice).

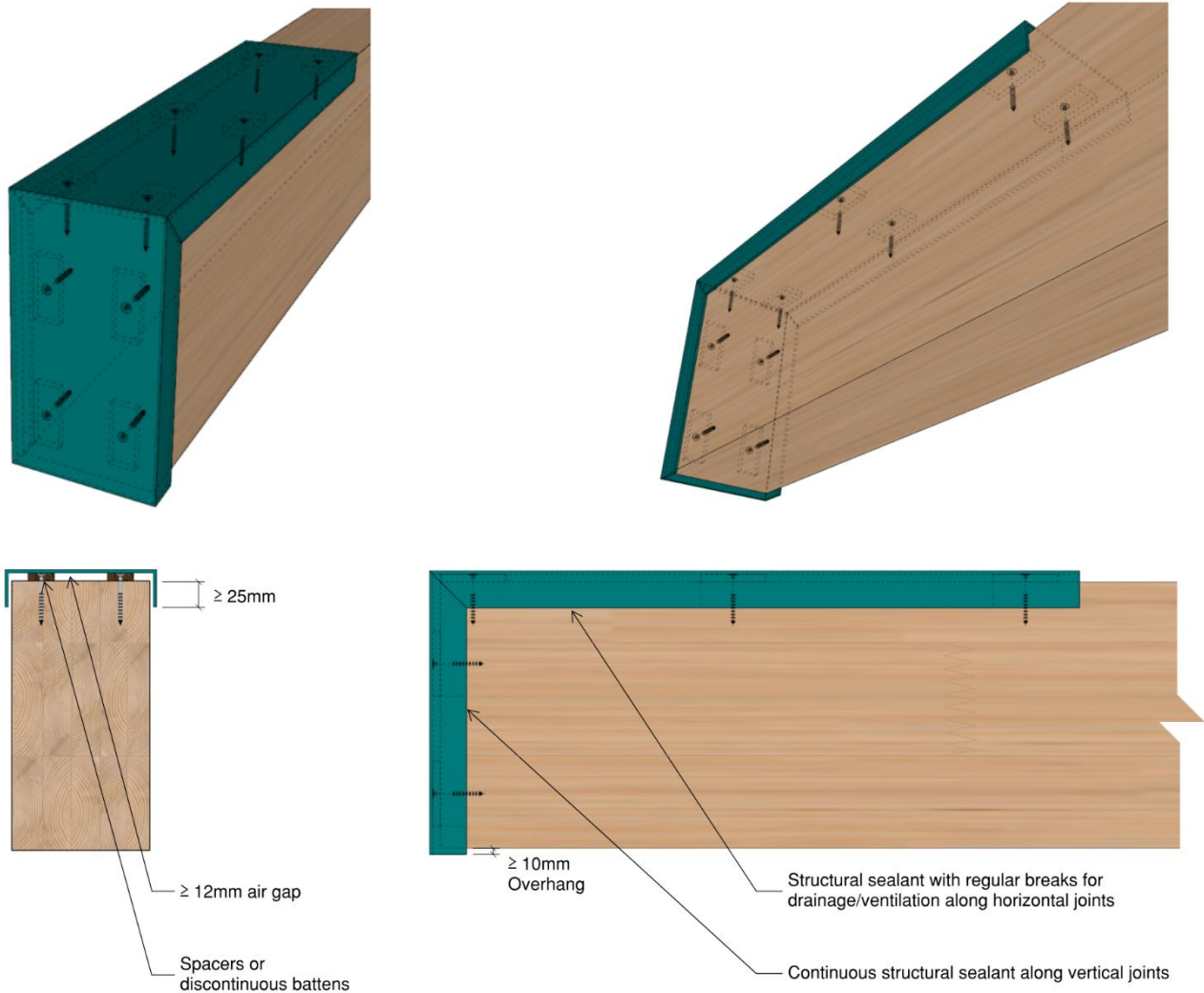
- such as fibre-cement sheet if it is likely to get wet or experience direct sun and not intended to be a visual beam.

### *Design & Construction*

Detailing tips for Service Class 2 applications:

- Use building overhangs and other structures, which protect the members from excessive moisture and sun exposure
- Directly shield the members from moisture or direct sun. The use of metal, fibro or plastic shields on the exposed faces or ends of beams is required to help maintain the member in an unstressed dry condition.
- All members should be provided with adequate ventilation so that moisture content within timber will not exceed 15% and moisture gradients across the member will not occur.
- Use arrised or pencil round corners on members to reduce the likelihood of coating failures on sharp edges.
- Use drip edges or other devices which provide a path for free moisture to flow away from the timber beam. Refer to the 'capping details' or 'end protection' diagram below.
- Columns should be elevated greater than or equal to >300mm above ground level and with adequate drainage. Refer to the 'base details' diagram below.
- Joint detailing should, wherever possible, comply with the following:
  - Consider movement in service of members and attach connectors in a way that prevents splitting of wood fibre caused by rigid mechanical fixings.
  - Keep horizontal contact areas to a minimum, in favour of self-draining vertical surfaces.
  - Ventilate joint surfaces by using spacers, wherever possible.
  - Always use compatible fasteners which have adequate corrosion protection and do not cause splitting during installation e.g. galvanised coatings or stainless steel.
  - Ensure any moisture entering a joint is not trapped and can adequately drain away from the joint.
  - Preference concealed bolted connections over plugged dowels to accommodate movement in service

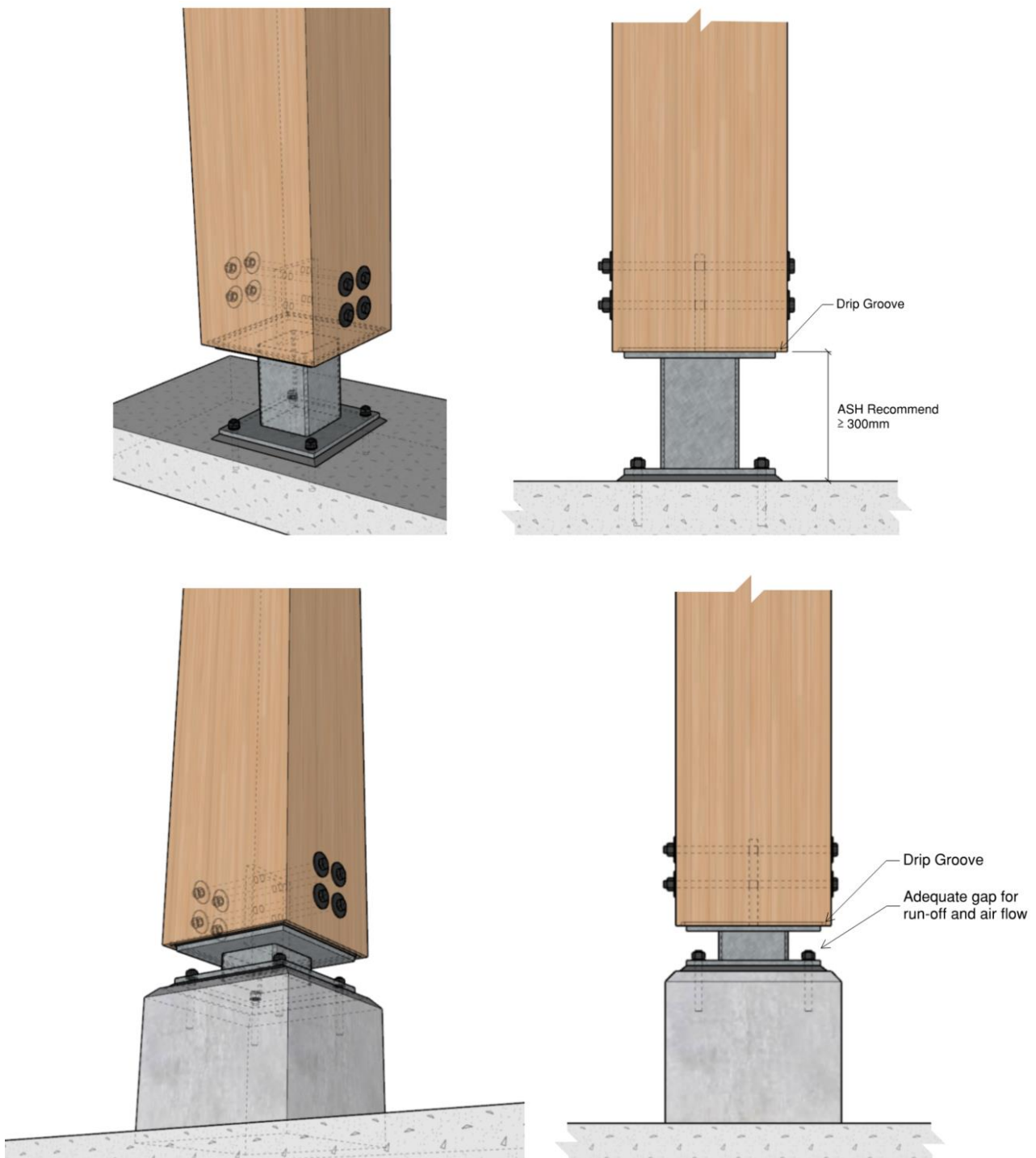
Diagram No. 2



Note: This capping detail is **NOT** a method of protection to allow members to be deemed Service Class 2 elements, but rather recommended practice for members that already comply with Service Class 2 requirements.



Diagram No. 3



Note: 75mm clearance is acceptable between podium and base of column.

## VIBRATION

The human body is very sensitive to low frequency vibration within a building. Due to the lightweight nature of timber, careful consideration is required during design and construction. However, with the help of an accredited engineer and in combination with other materials, this issue is easily resolved. High density timbers used in MASSLAM can offer an acoustic advantage compared to low density timber species.

## SEISMIC PERFORMANCE

MASSLAM posts and beams exhibit a high strength to weight ratio which will enhance the seismic performance. Their elasticity and weight compared to steel or concrete help withstand greater deformations without damage.

This means MASSLAM posts and beams can be economically restored again after an earthquake whereas a concrete structure would likely be demolished.

## DEFLECTION AND CREEP

When designing a timber beam, deflection is the governing factor in most cases. This is especially true in a Mid-Rise building where high standards need to be met or long spans between columns are required. MASSLAM offers the perfect solution considering the unique stiffness.

There are many reasons that influence creep. Creep is mostly caused through a long-term and constant application of load. Further, this complex phenomenon is influenced by the moisture content, ambient condition, size and load history. As part of the serviceability deflection calculations, the load factor for creep deformation ( $j^2 = 2$ ) has been included into the equation to consider the effect of creeping. The stiffness of MASSLAM and the consideration above ensure that the requirement on deflection are always secured and will never fall below the deflection requirement.

## CONNECTIONS

The range of connectors available is wide and varied. The designer has an opportunity to be creative in their joint design. The nature of one particular connector is not only dependent on load capacity but will also require consideration for fire resistance, aesthetics, cost effectiveness and fabrication/installation process. With the benefit of CNC machining there are no boundaries limiting the innovation of an engineer or architect. Possibilities include concealed connectors, dovetail timber joints, mortice and tenon joints, bolts, plugged screws, and more. Speak to your MASSLAM specialist about options and designing for cost efficiency or DfMA.

## FIRE RESISTANCE

When timber burns, a char will develop around the exposed surface. Unlike steel, timber will maintain strength directly proportionate to the uncharred timber below for a determined amount of time due to the charring that insulates and protects the inner fibres. The charring rate, which determines the speed for which timber combusts, is low in higher density timbers such as MASSLAM 45 compared to common softwood species. The charring rate for MASSLAM is based on third party tests using ASH's specific construction methods.

## COMPLIANCE

MASSLAM is manufactured in accordance with AS 1328 – 'Glued-laminated structural timber'

MASSLAM's char rate, fire performance under load and glue lamination formula is third party tested at Warrington Fire (Australia) in accordance with AS 1530.4

H1, H2, H3 and IRON ASH® treatments are treated to the requirements of AS1604.1:2012 and is tested for penetration and retention by NATA accredited laboratory, AgriSolutions, to comply with AS/NZS 1605.3:2006 Section 15 – 'Determination of Tebuconazole and Propiconazole in Preservative-Treated Timber' and AS/NZS 1605.3:2006 – Section 16 'Determination of Permethrin in Timber Extracts'

## STORAGE, HANDLING & MOISTURE CONTROL

Follow the guidelines outlined below to ensure your MASSLAM members are protected prior to, and during installation.

### *Delivery and Protection*

ASH can deliver members to site wrapped in plastic or by other arrangement. Members will require a forklift, crane or hand unload on site. It is essential that members be protected from weathering - which can occur quickly. Carefully store members once delivered to prevent damage or surface marks. Minor damage or marking cannot always be prevented during delivery and assembly. Planing, sanding or re-working any marks should be taken into consideration when calculating costs and are not considered grounds for a complaint.

### *Storage*

MASSLAM members need to be stored in a dry area, protected from all direct weather. If members are not used immediately, dunnage should be used to support them. Dunnage needs to be evenly spaced to supply adequate support and airflow. If a dry place is not available, dunnage should allow for drainage.

MASSLAM is delivered with a temporary wrapping which, if stored, should be placed with the material 'edge face' down. At all times the members need good air circulation whilst protected from moisture. Protect MASSLAM from dirt, abrasions, footprints or damage to corners. See Diagrams 4 & 5 for detail.

## Handling

MASSLAM should be lifted and secured by strategically placed lifting points; or with fabric or plastic slings and edge protectors to avoid slipping and marking of members. To guarantee the members are not overstressed, spreader bars should be used on members longer than 5.4m. Do not drop or drag MASSLAM as this will damage the surface and possibly effect the structural integrity of the product.

Diagram No. 4

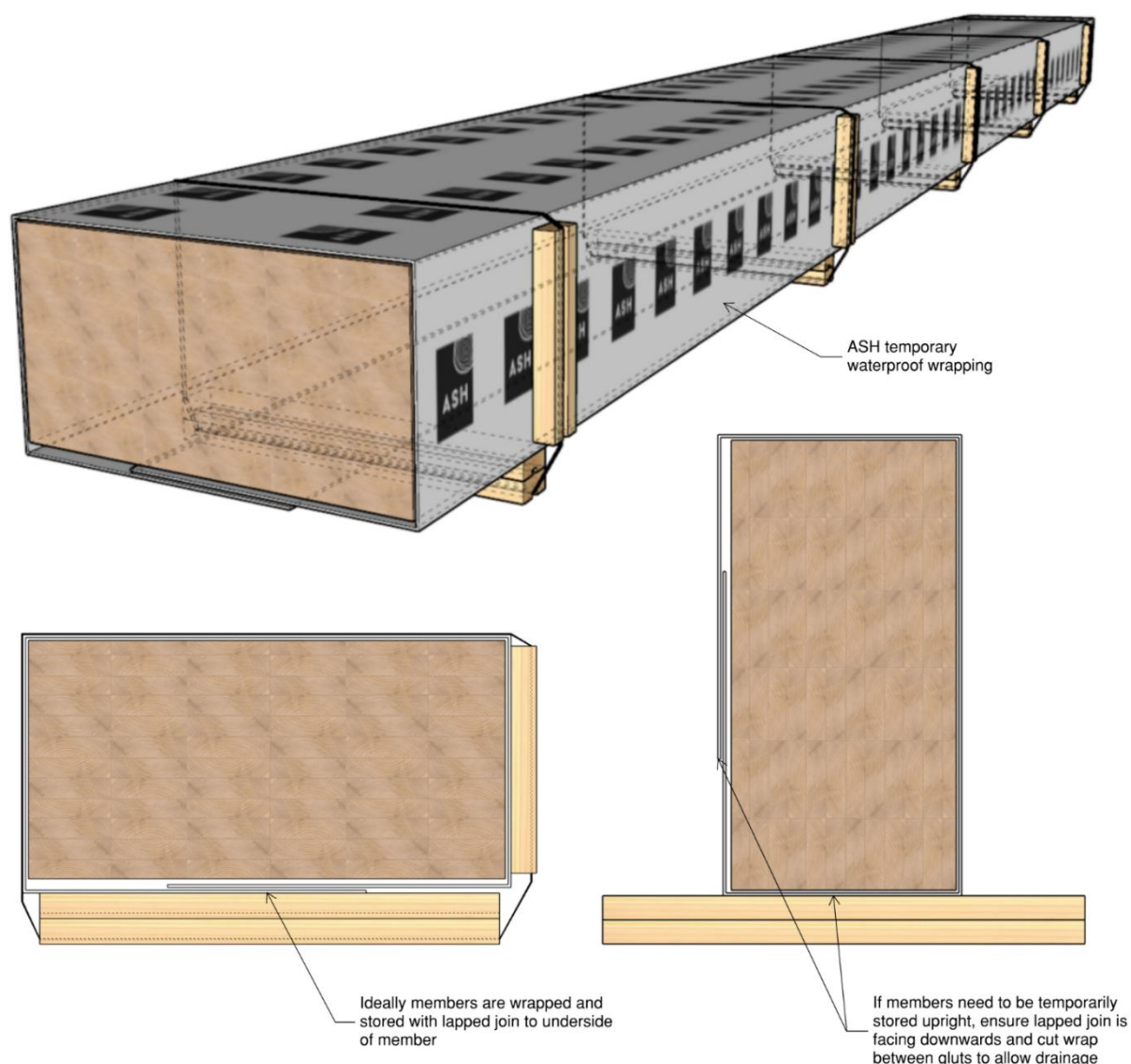
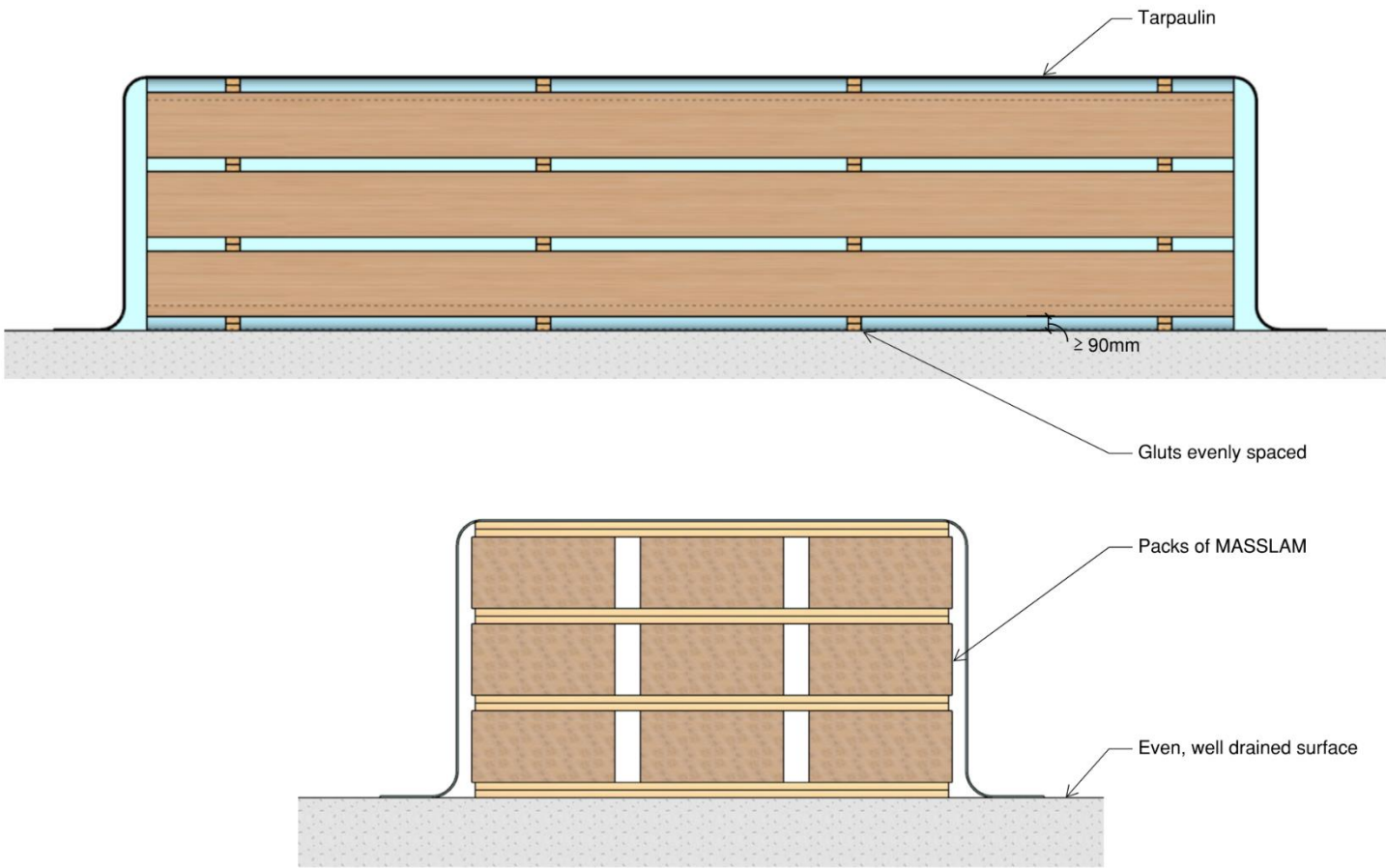


Diagram No. 5



### *Moisture control & management during construction*

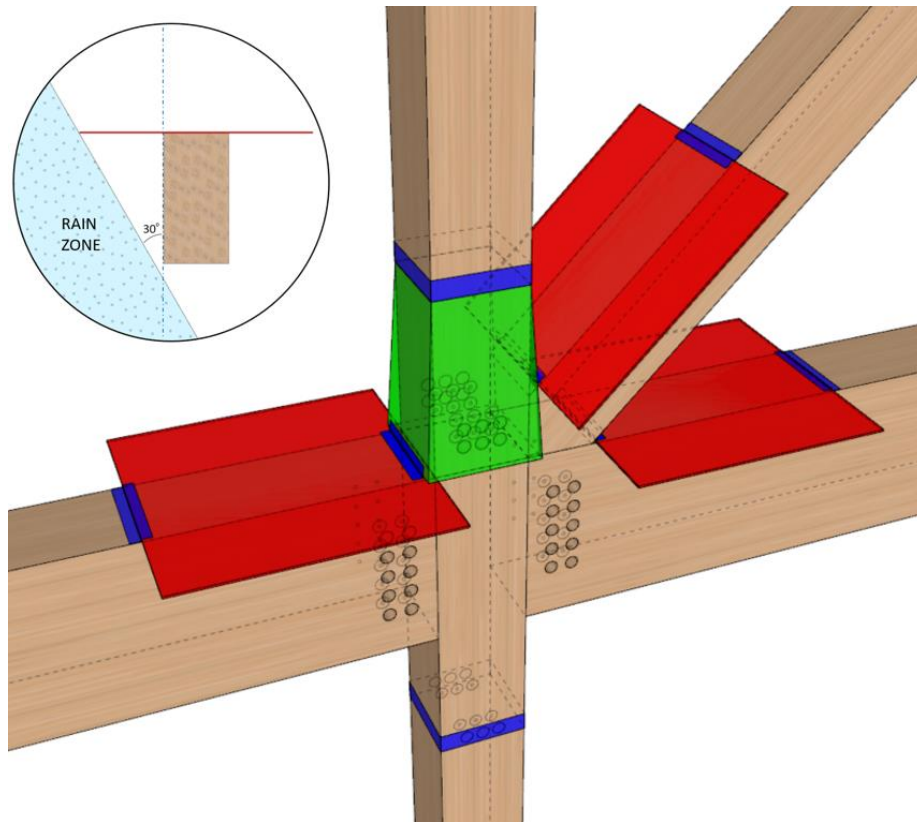
In line with all other advice within this Design Guide and other MASSLAM guides, protection measures employed during construction should aim to limit members from variation of temperature, humidity and/or UV as much as possible until the timber elements are protected in their permanent and intended application. This will help limit impacts and associated reworks resulting from UV degradation, expansion, contraction and/or water damage.

Temporary protection measures recommended will vary with each project and connection detail however principles will include at least all of the following:

- Protecting horizontal elements, floor joints and/or gaps from weather with self-adhesive, vapour permeable wrap (ie – Wraptite SA) or use of construction tents
- protecting exposed elements with an adequate volume of coating designed for the exposure time or use of temporary high performing vapour permeable & UV limiting wraps (ie – Traspir 110)
- shielding connections, millings and other pockets that can house/trap rainwater with temporary shields. See Diagram 6 & 7 as an example
- encapsulate as soon as feasible through installation of facades and levels/roof above
- avoid installation of cover plates, plugs, capping or other preventors of moisture run-off until building envelope is installed and members are at the permanent equilibrium moisture content
- plan for and programme in an allowance for finishing sanding and coat/s once building is enclosed

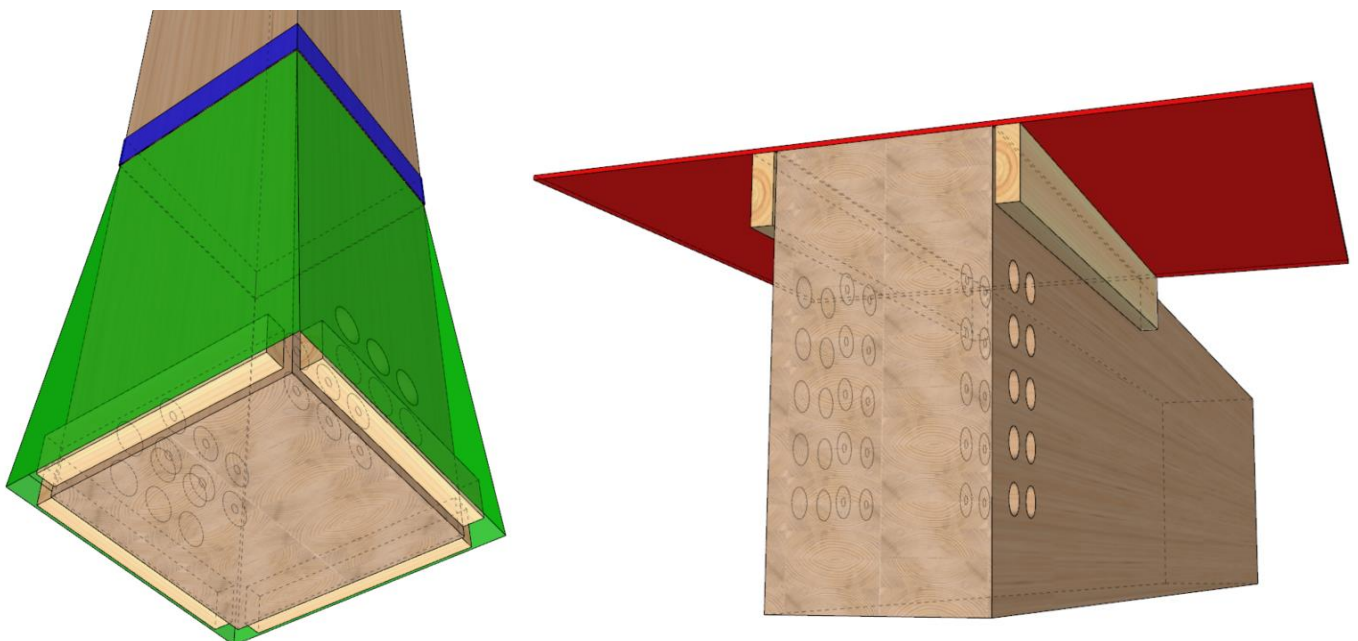


Diagram No. 6



Note: ASH recommend that temporary breathable membranes be stapled to structural flooring or weighted down by being fixed to timber blocks with joint tape used to effectively seal the membrane to the intersecting board, floor or member

Diagram No. 7



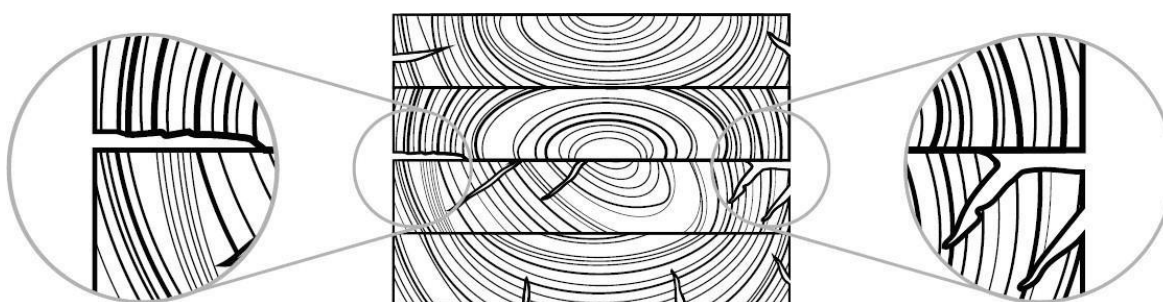


## CHECKING IN MASSLAM

MASSLAM is dried to a target of 10% Moisture Content (MC) as the Equilibrium Moisture Content (EMC) of an indoor environment is typically 10-12% MC. When a MC within timber matches the EMC of an environment, timber is in its most stable form.

In drier conditions, timber loses moisture to the surrounding atmosphere and the outer fibres of the member shrink at a more rapid rate than do the inner fibres. As outer fibres contract, they are restrained by the inner portion of the member that has a higher moisture content. The more rapid the rate of drying, the greater differential in shrinkage between the outer and inner fibres - resulting in fibre stress. These resultant stresses to the grain can cause characteristic wood seasoning 'checks'. The influence of checks on the structural performance of glued laminated timber members is generally minor. See Diagram 8 below. Checking can be minimized by adding a protective coating and with careful installation practices that avoid prolonged exposure of the members during construction.

Diagram No. 8



Checking often occurs along the first glue line adjacent to the outer lamination that may dry more rapidly because a larger surface area of that lamination is exposed to the elements. In general, checks have little to no effect on the strength of glued laminated members. Seasoning checks in bending members affect only the horizontal shear capacity. In establishing allowable horizontal shear values, normal checking due to seasoning has been considered.

Checks are usually not of structural importance unless:

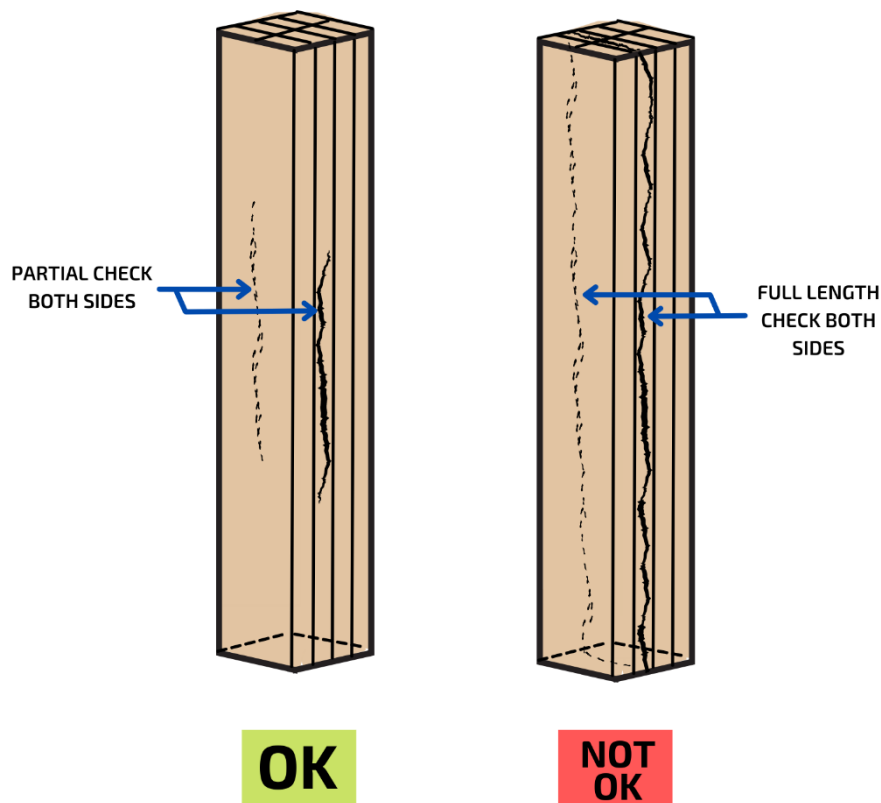
- The design of the member is governed by shear, and
- checks are significant in depth, and
- they occur in the mid-height of the member near the supports.

If these conditions exist, the reduction in shear strength is directly proportional to the ratio of the depth of checks to the width of the bending member. Checks in columns are not of structural importance unless they occur at connection locations or develop into splits, thereby increasing the slenderness ( $L/d$ ) ratio of the column.

While checking is not considered to be of structural significance, the reason for the checking and the means by which further checking may be minimized should be determined. If there is concern regarding structural adequacy, advice can be obtained from a structural engineer experienced and qualified in glued laminated timber. They should evaluate the significance of the checking.

The drawing below shows the structural effect of checking on a glulam column, showing that partial-length checks are not considered to be serious structural problems:

Diagram No. 9



# IS MY CHECKING OK?

**Is the span of the glulam beam greater than 10 times the depth?**

Example: Depth is 300mm, span is greater than 3m

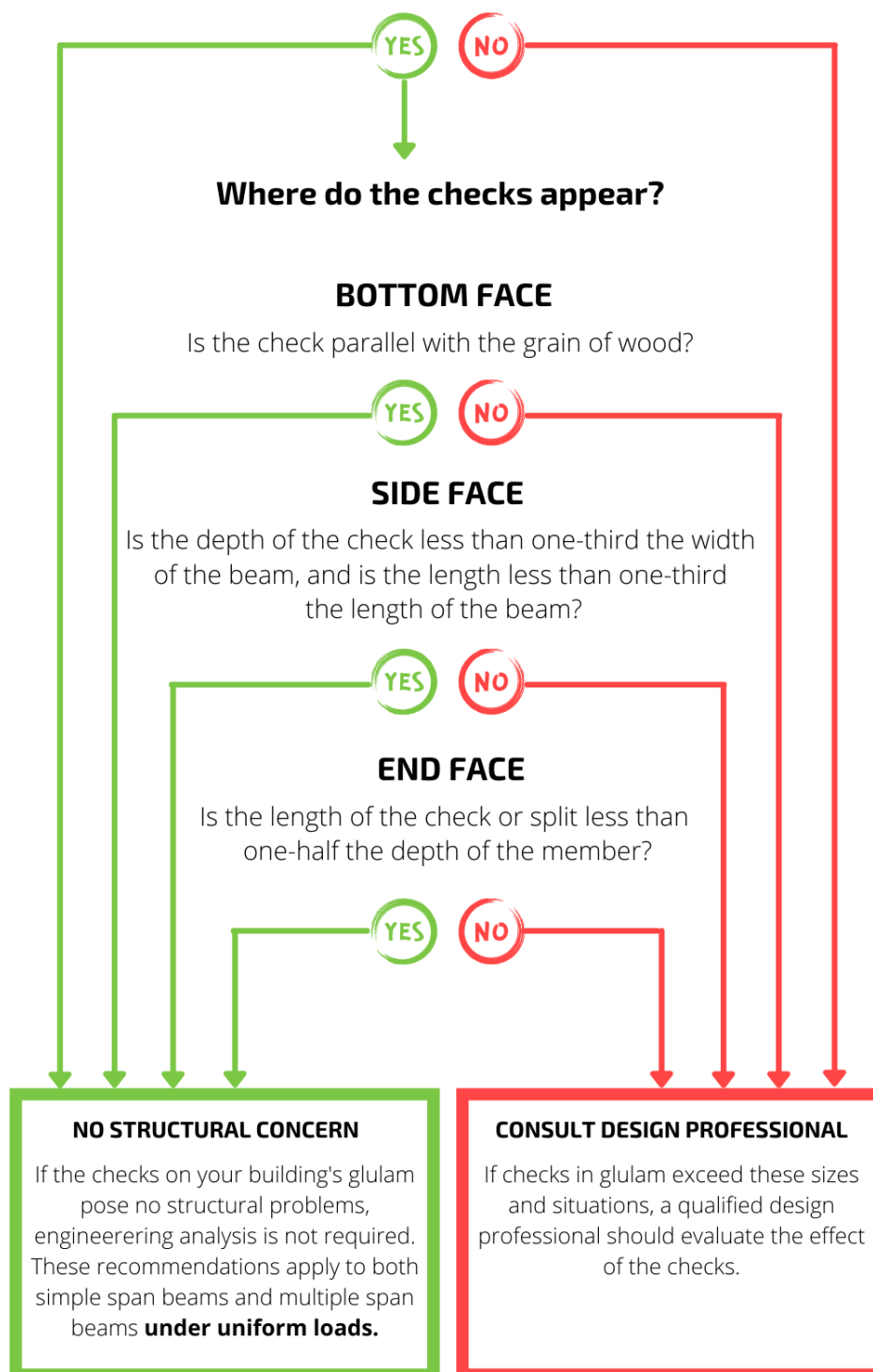


Diagram derived from the 'Evaluation of Check Size' document. Number EWS R475E by The Engineered Wood Association. USA

I, \_\_\_\_\_ of \_\_\_\_\_  
understand and accept the advice given in this MASSLAM Design Guide from  
Australian Sustainable Hardwoods and understand the level of manufacturing,  
coating technology, design advice, storage and handling options that ASH have  
made available to me. Failing to adhere to these recommendations may result in  
reduced performance of members.

Dated \_\_\_\_\_

## DISCLAIMER

The MASSLAM Design Guide provides general advice based on current information and industry practices. ASH acknowledges that these recommendations will not suit every possible project. If in doubt, ASH recommends that independent expert advice is obtained. ASH accepts no responsibility for the performance of members in every possible application in accordance with these recommendations or otherwise. If you have any questions about these guidelines, contact a MASSLAM specialist on 03 5139 7001.