

## This guide was revised in Oct 2016

Please check woodsolutions.com.au/publications to ensure you have the latest edition

# Engineered Woods and Fabrication Specification

Technical Design Guide issued by Forest and Wood Products Australia



#### **WoodSolutions Technical Design Guides**

A growing suite of information, technical and training resources, the Design Guides have been created to support the use of wood in the design and construction of the built environment.

Each title has been written by experts in the field and is the accumulated result of years of experience in working with wood and wood products.

Some of the popular topics covered by the Technical Design Guides include:

- Timber-framed construction
- Building with timber in bushfire-prone areas
- Designing for durability
- Timber finishes
- Stairs, balustrades and handrails
- Timber flooring and decking
- Timber windows and doors
- Fire compliance
- Acoustics
- Thermal performance

#### More WoodSolutions Resources

The WoodSolutions website provides a comprehensive range of resources for architects, building designers, engineers and other design and construction professionals.

#### To discover more, please visit www.woodsolutions.com.au The website for wood.

Downloading of these Technical Design Guides is restricted to an Australian market only. Material is only for use within this market. Documents obtained must not be circulated outside of Australia. The Structural Timber Innovation Company, its shareholders or Forest Wood Products Australia, will not be responsible or liable for any use of this information outside of Australia.



WoodSolutions is an industry initiative designed to provide independent, non-proprietary information about timber and wood products to professionals and companies involved in building design and construction.

WoodSolutions is resourced by Forest and Wood Products Australia (FWPA – www.fwpa.com.au). It is a collaborative effort between FWPA members and levy payers, supported by industry bodies and technical associations.

This work is supported by funding provided to FWPA by the Commonwealth Government.

ISBN 978-1-925213-34-8

#### Acknowledgments

Authors: TDA

The research and development forming the foundation of this Design Guide as well as its preparation and production was proudly made possible by the shareholders and financial partners of the Structural Timber Innovation Company Ltd.



Forest Wood Products Australia

First published: 2015 Revised: October 2016

#### © 2016 Forest and Wood Products Australia Limited. All rights reserved.

These materials are published under the brand WoodSolutions by FWPA. This guide has been reviewed and updated for use in Australia by TDA NSW.

#### **IMPORTANT NOTICE**

While all care has been taken to ensure the accuracy of the information contained in this publication, Forest and Wood Products Australia Limited (FWPA) and WoodSolutions Australia and all persons associated with them as well as any other contributors make no representations or give any warranty regarding the use, suitability, validity, accuracy, completeness, currency or reliability of the information, including any opinion or advice, contained in this publication. To the maximum extent permitted by law, FWPA disclaims all warranties of any kind, whether express or implied, including but not limited to any warranty that the information is up-to-date, complete, true, legally compliant, accurate, non-misleading or suitable.

To the maximum extent permitted by law, FWPA excludes all liability in contract, tort (including negligence), or otherwise for any injury, loss or damage whatsoever (whether direct, indirect, special or consequential) arising out of or in connection with use or reliance on this publication (and any information, opinions or advice therein) and whether caused by any errors, defects, omissions or misrepresentations in this publication. Individual requirements may vary from those discussed in this publication and you are advised to check with State authorities to ensure building compliance as well as make your own professional assessment of the relevant applicable laws and Standards.

The work is copyright and protected under the terms of the Copyright Act 1968 (Cwth). All material may be reproduced in whole or in part, provided that it is not sold or used for commercial benefit and its source (Forest and Wood Products Australia Limited) is acknowledged and the above disclaimer is included. Reproduction or copying for other purposes, which is strictly reserved only for the owner or licensee of copyright under the Copyright Act, is prohibited without the prior written consent of FWPA.

WoodSolutions Australia is a registered business division of Forest and Wood Products Australia Limited.

## **Contents**

1	Introduction	4	
2	Fabrication Specifictions	5	
2.1 2.2 2.3 2.4 2.5 2.5.1 2.5.2 2.6	General Timber Moisture Content Adhesive Used for Manufacturing and Fabrication Appearance of Finished Members 1 Glulam 2 Laminated Veneer Lumber (LVL) Protection of Finished Members	8 8 8 8 8 	
3	Timber Storage, Transportation and Handling	10	
3.1 3.2 3.2.1 3.3 3.4	Loading and Unloading Timber Storage 1 Fire During Construction Transportation and Handling Erection	10 11 12 13 13	
4	Mould Prevention	14	
4.1 4.2 4.3 4.4 4.5	Occurrence Effect of Moulds Termination Action Remediation	14 14 14 14 15	
5	Moisture Protection – Rain During Construction	16	
5.1	Iron Stain	17	
References 21			

## Introduction

### This Guide provides a summary of fabrication and installation specifications of engineered wood products, i.e. laminated veneer lumber (LVL) and glulam.

It provides recommendations for different steps of the timber structure supply chain, including storage, handling and transportation, erection and assembly. It includes insect and mould preventions and moisture design considerations.

This Guide is based on information contained within the Structural Timber Innovation Company, EXPAN guides and timber manufacturing and supply companies. It is considered general information only and should not take precedence over manufacturers' literature and specifications.



## **Fabrication Specifications**

#### 2.1 General

Fabrication should be in accordance with recognised sound practice, using adequate plant and equipment under the supervision of qualified personnel, and must be adequate and uniform with correct damping sequences and contact pressures.

#### 2.2 Timber

Timber should have characteristic strengths and stiffness properties. For glulam members manufactured to AS/NZS 1328, they should have stress grades of GL8, GL10, GL12, GL13, GL17, GL18 or GL21\* as given in AS 1720.1. Alternatively, manufacturers or suppliers of the Glulam may have specific characteristic strengths and stiffness of glulam members.

Characteristic strengths and stiffness for Laminated Veneer Lumber (LVL) should be as per the LVL manufacturers or suppliers.

GL21 should be as per the manufacturer's detail.

#### 2.3 Moisture Content

The moisture content of glulam or LVL members should be between 8% and 15%.

#### 2.4 Adhesive Used for Manufacturing and Fabrication

Adhesive components used in fabrication of timber elements should be stored, mixed, handled, spread and cured in accordance with the adhesive manufacturers' instructions. For service classed 1 and 2, a minimum bond of type II should be used. A minimum bond of type I is required for service class 3 (exposed exterior use). Refer to AS 4364 for further information on bond types.

#### 2.5 Appearance of Finished Members

#### 2.5.1 Glulam

The appearance of glulam should meet the requirements of grade A, B or C from AS/NZS 1328.2, or as required by the specifier. Refer to Table 2.1 for descriptions of each of these grades. Special finishes, such as band-sawn, should be nominated by the specifier and by direct negation with the manufacturer or supplier.

#### Table 2.1: Glulam appearance grades.

Grade	Intended Use	Requirement
A	This grade is intended for use in applications where appearance of the member is important and clear or painted finishes are to be used.	Filled and sanded finish. All surface voids to be plugged or filled.
В	This grade is intended for use in applications where surface appearance is important but a machine-planed finish is acceptable.	Machine-planed finish with occasional skips, blemishes and voids.
С	This grade is intended for use in applications where appearance is unimportant.	All blemishes and voids are acceptable.

#### 2.5.2 Laminated Veneer Lumber (LVL)

Generally LVL has a sanded surface but, because the knot holes are not filled, the appearance of LVL is similar to the requirements of 'DD' plywood. Refer to the plywood standard AS 2269.0 for further information.

Other appearance specifications for LVL elements are possible, but only by direct negation with the manufacturer or supplier.

#### 2.6 Protection of Finished Members

Where timber elements are to be exposed to the weather during their erection and/or are to be the final decorative surface, all members should be weather protected with a minimum of one coat of weather-approved sealer.

End grain should be sealed with a minimum of two coats of sealer or end capped. All surfaces need to be maintained in good order. All surfaces to be coated should be clean, dry and free from mould, fungi, etc.

Where LVL is not exposed to the weather, there is no need to use weather sealer.

## Timber Storage, Transportation and Handling

This Section outlines the specific requirements for the on-site storage, transportation and handling of LVL and glulam. Strict adherence to these requirements will ensure that the finished product performs to specifications.

Engineered wood products must be stored properly and handled with care to assure optimum performance. Care must be taken during loading, unloading and transportation, as well as when they are in storage and on the construction site, to protect them from damages.

Engineered wood products may be supplied with various forms of protection, depending on their final application. This protection should be commensurate with the end use of the products.

#### 3.1 Loading and Unloading

The wood products should be loaded, unloaded and secured during transport by means that will not damage the edges, surfaces or packaging.

Timber beams are commonly loaded and loaded using forklifts. For more stability and safety, it is recommended to place the sides of the beams flat on the forks, rather than the bottoms of the beams, as depicted in Figure 3.1. In the case of extremely long timber beams, two or more forklifts maybe need to lift the beams in unison to avoid flex.

To avoid damage to structural timber members, only fabric webbing slings should be used to lift or secure timber products. Chains and wire slings are not recommended. Where chains and wire ropes are used, adequate corner protection is required. Slings should be located carefully to ensure balanced support or a spreader bar should be used. Guy lines should be used to control the members during lifting. Timber members should be lifted on edge wherever possible and spreader bars of suitable length used on long members to eliminate the possibility of overstressing the member and the risk of damage during lifting.



Figure 3.1: Loading and unloading timber beams using a forklift.

#### 3.2 Timber Storage

Engineered wood products should be kept dry on-site and protected from direct exposure to the weather. The following recommendations for storage are made to ensure that the full benefits of engineered wood products as a dry, straight and true material are available at the time of installation:

- 1. Stack on level bearers to keep flat and straight.
- 2. Stack well clear of the ground using timber blocking, skids or rack systems for good ventilation. as shown in Figure 3.2.
- 3. Store in a level, well-drained covered storage site to keep dry prior to installation during storage and transport. If covered storage is not available, the members should be covered with suitable non- transparent plastic or tarpaulins.
- 4. Forklift damage should be prevented. If the ground is not level in the storage area, reduce forklift speed to avoid bouncing the load.
- 5. The cover should be placed to preclude moisture while maintaining good air circulation in and around the members with fillets placed between each layer.
- 6. Bearers and fillets should be placed vertically in line to support engineered wood products evenly and flat.
- 7. Glulam members that are supplied individually wrapped should be placed on the dunnage with the wrapping material edge or seal face down as shown in Figure 3.3.
- 8. Always store I-joist beams vertically and level never flatwise, as shown in Figure 3.4.



Figure 3.2: Stacking timber clear off the ground by skids.



Figure 3.3: Site storage of glulam.



Figure 3.4 Storage of I-joist beams.

Engineered wood products should be stored on level bearers at maximum 1800 mm centres at least 75 mm clear of the ground, well ventilated and away from any source of ignition.

The bearers, such as skids or blocks, need to be located so that self-weight is uniformly supported to avoid distortion. Strips or blocks as spacers need to be used, in line vertically, between components to avoid dirt or water being trapped between timber faces.

If the elements are wrapped, they need to be kept wrapped. The wrapping protects them from moisture, soiling, sunlight and scratches. For long-term storage, cutting slits in the bottom of the wrapping will allow ventilation and drainage of the entrapped moisture.

Exposure to rain can lead to swelling and staining. Exposure to sunlight can darken timber quite quickly.

#### 3.2.1 Fire During Construction

To minimise construction fire risk, consideration needs to be given to the storage location of timber elements prior to their installation. As far as possible, program the delivery of combustible materials to minimise the time they are stored on-site.

Where significant volumes of combustible building materials are to be kept on-site, they should be stored in a secure area at least 10 metres away from any buildings or partially constructed buildings, and any location where hot works are undertaken.

Where there are no reasonably practicable alternatives and combustible building materials have to be stored within or close to the building under construction, the area used for storage should:

- have controlled access
- not be in an area where hot works are being carried out
- be in either an area covered by the site fire detection system or included on the route of regular fire checks
- · have firefighting equipment close by
- be protected from ignition sources, where reasonably practicable, by fire preventative covers (e.g. fire retardant, fire resistant, or non-combustible sheeting).

For more information refer to WoodSolutions Technical Design Guide #20: *Fire Precautions During Construction of Large Buildings.* 

#### 3.3 Transportation and Handling

Engineered wood products (EWP) should be kept dry during transportation by individual wrapping or as a truck load tarped to protect the products from weather and wheel spray.

Engineered wood products should be stacked or supported so that they are not subject to permanent bending or twisting that will affect the final intended shape.

Care should be taken to prevent damage to the finished surfaces in all handling; such treatment may cause damage to the surfaces and edges and possibly structural damage. Causes of mechanical damage to surfaces of engineered wood products occur from dropping, jarring, crowbarring or dragging the products, or running into them with lifting equipment.

#### 3.4 Erection

The safety of all erection operations should be the responsibility of the specialist contractor. Design of the lifting system should be agreed upon during the design process. A detailed method statement for erection should be developed in agreement with the structural engineer.

The specialist contractor may be required to supply an erection supervisor to oversee the installation of all timber elements. Cranage, scaffolding and erection equipment should be provided by the specialist contractor.

The building contractor must liaise with the structural engineer for the project to determine the propping requirements that may or may not be required. These requirements will be dependent on the design philosophy adopted by the engineer around managing the creep deflections associated with moisture. After installation, exposure to sun and rain for normal periods of construction is not a cause for concern. (Add detail regards to finishes, maintenance, etc)

#### #36 • Engineered Wood and Fabrication Specification



## **Mould Prevention**

#### 4.1 Occurrence

Moulds and algal growths occur on both treated and untreated timber and on timber that is seasoned. Their presence is related to temperature, humidity, wetting and the presence of atmospheric mould spores. Both sapstain and moulds can be black. Some moulds are green, but algae are associated with surface water as compared to high moisture content timber. Mould growth can spread rapidly in favourable circumstances, especially warm humid weather.

#### 4.2 Effect of Moulds

Moulds and algae are a surface effect and do not penetrate the wood structure. Sapstain and decay fungi penetrate the wood and actively grow within the wood section.

The engineered wood product is not weakened by their presence even for lengthy periods. Moulds do not result in damage to the wood structure or loss of strength during normal construction periods. With appropriate treatment, mould and algae are not a decay hazard. In wet situations, e.g. decking, moulds or algae can be slippery, which becomes a safety issue.

Where weather exposure becomes extensive, causing high moisture contents for long periods, fungal decay may become a hazard and may require investigation. Where this happens, it may become associated with fungal attack and some elements close to the ground may require investigation.

#### 4.3 Termination

Below about 18% moisture content, mould development will cease. Enclosing the structure and allowing it to dry out will eliminate the presence of mould, although there may be discolouration. Providing provision for floors to drain in wet weather is strongly recommended, as is early close in for the structure. Any flowering parts of the mould will fall or brush off and will have no effect on dry cavities. Similarly, dry out eliminates surface algae.

#### 4.4 Action

Surface mould on timber elements during normal construction does not require specific action by the builder unless it is to be used in a decorative application. Investigation may be required if building is interrupted and the engineered wood product is exposed for exceptional periods. Where concern is raised, specialist investigation for the presence of significant decay fungi may be required. It is not possible to generalise on how long an exceptional period is, as local conditions and actual exposure will affect this.

#### 4.5 Remediation

Although moulds do not affect the performance of the timber, the application of proprietary products can restore the appearance of the product.

## Moisture Protection – Rain During Construction

Timber products are manufactured under controlled environment to ensure they are dry. The moisture content depends upon humidity, exposure to wetting and drying conditions during construction and service life. Wetting during construction may lead to temporary elevated moisture content and dimensional changes in timber products.

Once covered, LVL and I-joist will ultimately dry and re-equilibrate to the ambient humidity conditions, even if there is a weather sealant applied. However, due to exposure to normal and excessive moisture exposures during distribution, storage and construction, some dimensional changes affecting serviceability may remain after redrying. These dimensional changes include cupping, bowing or expansion to dimensions beyond the specified tolerance of the product.

Where appearance is critical, timber elements and fastenings must be protected from moisture both during construction and in service. Where appropriate, building practices should be followed that minimise moisture exposure and facilitate products to re-equilibrate to dry conditions, and moisture increase taking place under normal construction situations should have no adverse effect on the performance of timber products. For more information on protection from weathering during service life, refer to WoodSolutions Design Guide #5: *Timber Service Life Design – Design Guide for Durability*.

If it is not possible to fully protect the timber element during construction, then some surface remedial work may be required to remove water stains and construction damage.

Where appearance is not critical, untreated timber can withstand some rain wetting during construction or occasional wetting in service without significant structural degradation; however, water staining and mould growth is possible. Timber must return to the dry condition (below 15% moisture content is considered dry for structural purposes) before installation with moisture sensitive materials, such as wall linings, floor coverings coatings or adhesives.

Methods of protection may be a sealant coating or impervious covering/ wrapping to minimise moisture uptake during construction. Protective timber sealant coating can retard moisture ingress during normal construction periods of around six weeks. Should this period be extended, or should there be signs that the sealant is no longer performing, renewal of the protective sealant may be necessary. Should the engineered wood product be cut, checked, bolted or otherwise worked on, renewal of the protective sealer to the exposed or unsealed timber will be required.

Where an impervious wrapper is used, it should be placed with the edge on the underside if possible and should be slit on the underside to allow moisture to escape, as shown in Figure 5.1. Where supports or intersecting members damage the protection, moisture ingress should be prevented.



Figure 5.1: Protection of glulam in final position.

#### 5.1 Iron Stain

Iron stain is an unsightly blue–black or grey discoloration that can occur on LVL in wet conditions on site, as shown in Figure 5.2.



Figure 5.2: Iron stain on LVL members in wet conditions on site. (Image courtesy of Nelson Pine Ltd)

The discoloration is caused by a chemical reaction between extractives in the wood and iron in steel products, such as nails, screws and other fasteners and appendages. This often occurs the first morning after rain or dew, when water enables the extractives and iron to meet and react.

If the timber products are kept dry (indoors), no discoloration will occur. Steel used in contact with timber products must not corrode. This can be accomplished by using stainless steel or by coating the steel. Coatings for fasteners, such as galvanising (zinc) or ceramic coatings, give a wide range of performance; whereas, stainless steel is the best choice for fasteners, particularly screws.

Where traces of iron are left on wood from cutting or slicing, cleaning the surface with steel wool, wire brushes, or iron tools; using finishes stored in rusty containers; and using iron-containing or iron-contaminated finishes may also cause discoloration. Iron dust from metalworking and even plant fertilisers can also be sources of iron.

Iron staining can be removed by diluted oxalic acid as the oxalic acid reacts with iron to form a colourless chemical complex. After treating wood with oxalic acid, thoroughly wash the surface with fresh, warm water to remove excess acid. If all sources of iron are not removed or protected from corrosion, staining will occur again.

## References

#### **Australian Standards**

AS 1328 Glued laminated structural timber. 1998, Standards Australia, Australia.

AS 1720.1 Timber structures, in Part 1: Design methods. 2010, Standards Australia, Australia.

AS 4364 Timber, in Bond performance of structural adhesives. 2010, Standards Australia, Australia.

AS 2269.0 Plywood—Structural, Part 0: Specifications. 2012, Standards Australia, Australia.

#### **WoodSolutions Technical Design Guides**

WoodSolutions Technical Design Guide #20: *Fire Precautions During Construction of Large Buildings*. 2014, WoodSolutions, Melbourne, Australia.

WoodSolutions Technical Design Guide #5: *Timber Service Life Design – Design Guide for Durability*. 2012, WoodSolutions, Melbourne, Australia.



# Discover more ways to build your knowledge of wood

If you need technical information or inspiration on designing and building with wood, you'll find WoodSolutions has the answers. From technical design and engineering advice to inspiring projects and CPD linked activities, WoodSolutions has a wide range of resources and professional seminars.

#### www.woodsolutions.com.au

Your central resource for news about all WoodSolutions activities and access to more than three thousand pages of online information and downloadable publications.

#### **Technical Publications**

A suite of informative, technical and training guides and handbooks that support the use of wood in residential and commercial buildings.

#### **WoodSolutions Tutorials**

A range of practical and inspirational topics to educate and inform design and construction professionals. These free, CPD related, presentations can be delivered at your workplace at a time that suits you.

#### **Seminars and Events**

From one day seminars featuring presentations from leading international and Australian speakers to international tours of landmark wood projects, WoodSolutions offer a range of professional development activities.

#### What is WoodSolutions?

Developed by the Australian forest and wood products industry for design and building professionals, WoodSolutions is a non-proprietary source of information from industry bodies, manufacturers and suppliers.

