

# INTRODUCTION

Glued laminated timber (Glulam) is a strong, engineered, structural product, well proven in New Zealand building and construction for over 40 years and internationally for much longer. It was first used in 1893 to construct an auditorium in Basel, Switzerland. Now Glulam is gaining renewed popularity because of its many benefits to the designer, builder and end user.

Ongoing research ensures that Glulam is designed to work better than ever in a host of construction applications.

Increased design values have expanded design capabilities and improved performance. The new Bureau Veritas administered quality standards are internationally recognised and more performance based. This gives even greater assurance of long-term serviceability and performance meeting design.

There are many reasons for using Glulam for your project from versatility to environmental reasons, to cost effectiveness.

Unmatched versatility. Glulam has greater strength, stability and stiffness than dimensional timber and can be produced in uniform or varying depths to give strength where it is required. Lengths, dimensions and shapes can be produced almost without limit, making Glulam unsurpassed in its versatility.

Appearance, aesthetics. Glue-laminated structural timber products are usually specified for the beauty as well as for strength. The natural aesthetic qualities of Glulam allow the structural elements of a building to be exposed for architectural effect. This combined with the natural warmth and timeless appeal of exposed timber make Glulam ideal for any application requiring an appealing and architecturally interesting structure.

Lightweight. Weight for strength, a Glulam beam is stronger than both steel and concrete. This means that

Glulam beams can span very long distances with minimal intermediate support required. Dependent upon specific loading conditions a steel beam may be 20% heavier and a reinforced concrete beam 600% heavier than an equivalent Glulam beam for carrying the same load. The resulting lighter structure can lead to significant economies in foundation construction.



*The solution for large open spaces is found in the strength and simplicity of Glulam roof frames.*



*Three-story post and beam structure creates a unique feature demonstrating timber's natural strength and design possibilities.*

Consistency of Performance. The process of glue laminating timber eliminates the natural performance variations that characterise solid sawn timber. As Glulam beams are engineered wood products that are manufactured to meet specific performance criteria, the specifier and user can be assured that Glulam products will consistently perform as expected.

Ease of installation. When it comes to installation existing, traditional skills can be used and builders who are confident in working with timber easily handle Glulam products. Other sub trades find timber easier and quicker to connect to. As a consequence, erection times are significantly reduced in Glulam structures.

Environment. Glulam uses the World's most prolific renewable construction material. In Canada and New Zealand (where Pinus Radiata grows fastest), trees are growing faster than they are being consumed to build

houses and the available plantation pine is increasing dramatically. For their load carrying capability, Glulam beams are very efficient to produce. The energy required to produce a glue-laminated beam from the log is only a fraction of the energy required to produce steel from ore or concrete from limestone.

Using Glulam in fact contributes to a positive storage of carbon compared to the large amount of carbon emission resulting from the production of steel. All round, the production of Glulam has the least effect on the environment by far.



## INTRODUCTION

Fire resistance. When exposed to the heat of a fire, timber undergoes a thermal breakdown (pyrolysis) into combustible gases, and a layer of charcoal forms on the burning surface. Glue laminated timber burns slowly and at a predictable rate, and as such fire design techniques can be relatively easily applied. When large cross-sections are subjected to a fire a char forms around the outside of the beam that protects the core by restricting the oxygen supply. There have been examples of portal frame buildings that have effectively burnt down leaving only the charred portal frame. The portal frames were then cleaned and, after engineers' inspection, the structure rebuilt on the existing Glulam.

Harsh environments. Timber is naturally resilient to attack by corrosive atmospheres that would normally cause rust. With appropriate treatment Glulam members will completely avoid deterioration and require minimal long-term maintenance. This makes Glulam structural members suited to environments exposed to corrosive or high-humidity atmospheres.

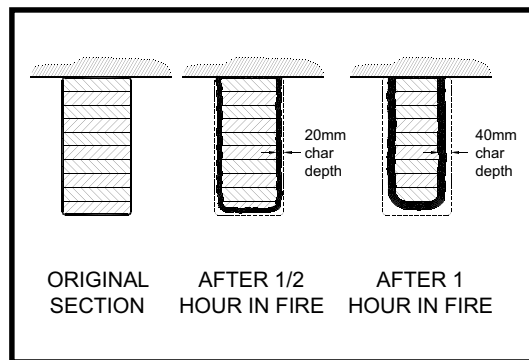
Pre-cambering. Often deflection is a controlling restraint in structural beam design, especially in longer spans. Whilst any structural member can be designed to minimise deflection, Glulam is the only engineered wood product that can easily be precambered to eliminate the aesthetic effect of in-service deflections.

Shock Resistance. Wood, steel, and concrete are the three principal materials utilised by civil engineers when designing structures. Unlike steel and concrete, which

are cast and formed, wood is anisotropic by nature meaning it performs differently in different directions. Wood also has excellent thermal, acoustic and electrical insulating properties. These factors make it very resilient, naturally. This resilience is a great advantage and permits it to absorb seismic and wind shocks that would actually cause failure in other materials.

Selected Timber Species: Glulam beams are commonly produced in New Zealand from the species *Pinus Radiata* and *Douglas Fir*. Occasionally species such as *Macrocarpa* and *Lawson's Cyprus* are also used. All of these species are suitable for structural glue laminated timber products.

More exotic species can also be used with success. Species such as *Jarrah*, *Cedar* or *Eucalyptus Saligna*. Almost any timber species that can be kiln dried can be used in Glulam. However, be aware that different timber species will have varying characteristic strengths and the resulting Elastic Moduli of the Glulam will vary accordingly. Speak to a licensed Glulam manufacturer for more assistance on this subject.



*Curved Glulam portals highlight the design flexibility and natural beauty timber can bring in an indoor – outdoor situation.*



*The clean lines and cranked shape of these pitched Glulam rafters illustrate the versatile roof forms possible using laminated timber.*



# SPECIFICATION DETAILS

## STRUCTURAL GRADES

There are a range of structural grades of glue laminated timber beams produced in New Zealand in accordance with Standard AS/NZS 1328.1 – 1998. These grades were developed by the Australian and New Zealand industries to assist designers and specifiers in the selection of Glulam members and their associated design properties. The following table of structural grade characteristics is referenced from AS/NZS 1328 part 2.

### Characteristic Strengths and Elastic Moduli for Glulam Grades

| GL Grade | Characteristic Strengths (MPa) |                           |               | Elastic Moduli (MPa)          |                                                       |                                              |
|----------|--------------------------------|---------------------------|---------------|-------------------------------|-------------------------------------------------------|----------------------------------------------|
|          | Bending                        | Tension parallel to grain | Shear in Beam | Compression parallel to grain | Short modulus of elasticity parallel to the end grain | Short duration modulus of rigidity for beams |
| GL 12    | 25                             | 12.5                      | 3.7           | 29                            | 11500                                                 | 770                                          |
| GL 10    | 22                             | 11                        | 3.7           | 26                            | 10000                                                 | 670                                          |
| GL 8     | 19                             | 10                        | 3.7           | 24                            | 8000                                                  | 530                                          |

**Note:** All tables in this reference guide are based upon characteristics of Glulam meeting GL8 grade. For references for higher grades than GL8 please refer to a qualified producer. There is a list of qualified producers on page 41 of this publication.

**Higher grades** (i.e. GL10, GL12, etc) will give **greater span and load** carrying capability than GL8 for the same section size.

## APPEARANCE GRADES

There are three standard finishing grades that may be specified, as defined in AS/NZS 1328 part 1. The appearance grades relate to the aesthetic appearance of the visible surfaces of the glued laminated members. This classification bears no relationship to the structural performance of the timber.

### Definition of Appearance Grades

| Appearance Grade | Description                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A                | This grade is intended for use in applications where appearance of the member is important and clear or painted finishes are used. All surface voids are filled or repaired. Unless it is specified otherwise, the surfaces shall be sanded to a minimum of 60-grit finish.                                                                                                                     |
| B                | The grade is intended for use in painted applications where appearance is important but a planed finish is acceptable. The machining shall conform to No. 2 dressed surfaces grade as defined in AS 2796. Occasional skips in the surface are permissible and minor blemishes, voids and machining want shall be acceptable. The outer-most laminations shall be free of loose knots and voids. |
| C                | This grade is intended for use in applications where appearance is not important. All blemishes and voids are acceptable.                                                                                                                                                                                                                                                                       |

**Note:** The Appearance Grades most commonly produced in New Zealand are Grades A and B.



## SPECIFICATION DETAILS

### SERVICE CLASSES

The Service Class defines the environmental conditions in which glue laminated beams may be used. There are three service classes defined as shown in the following table.

#### Definition of Environmental Conditions for Glulam Service Classes

| Service Class | Description             | Environmental Conditions                                                                                                                                                                                                                                                                             |
|---------------|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1             | Interior                | Service Class characterised by moisture content in the materials corresponding to a temperature of 30°C and relative humidity of the surrounding air only exceeding 65% for a few weeks per year.<br>For example: Domestic Houses, Commercial Offices.                                               |
| 2             | Exterior, under cover   | Service Class characterised by moisture content in the materials corresponding to a temperature of 20°C and relative humidity of the surrounding air only exceeding 85% for a few weeks per year.<br>For example: Open sheds, exposed beams under soffits, porches, wool scouring plants, laundries. |
| 3             | Exterior, fully exposed | Service Class characterised by climatic conditions leading to higher moisture content than Service Class 2, or where timber is directly exposed to sun and/or rain.<br>For example: Marine structures, bridges.                                                                                      |

### TIMBER TREATMENT SPECIFICATION OPTIONS

In order to meet the Services Classes outlined above, depending on where the Glulam structure is to be used, specifiers will need to select timber treatment levels based on one of the following:

| Hazard Class | End Use                                         |
|--------------|-------------------------------------------------|
| H1           | Low decay hazard                                |
| H2           | Slight risk of decay and risk of termite attack |
| H3           | Moderate decay hazard                           |
| H4           | High decay hazard                               |
| H5           | Severe decay hazard                             |
| H6           | Marine hazard                                   |

Timber treatment options can be either CCA treatment (the requirement for H5 or H6 is rare and specific situations should be discussed with the manufacturer) or LOSP (up to H3). LOSP is an envelope treatment, and because of this, care must be taken when cutting or drilling post-treatment that the affected area is recoated with a suitable protective coating.

### PAINTING PROCEDURE

If Glulam has been pre-primed, the protective coating primer may tend to deteriorate over a period of time and become slightly chalky – unable to bond adequately to any additional coating systems without some preparation work. A simple way of testing whether there has been any deterioration is to cut a small “x” through the existing coating system with a sharp blade. Press some cellulose sticky tape firmly across the cut and then rip off the tape. If any of the coating comes off with the tape then the primer is not adequately sound and must be removed by sanding. Sand back until the surface is completely free from all dirt and degraded material and dust off.

Prime all surfaces, paying particular attention to cut ends and joints, with a good quality solvent-based alkyd primer. Water based primers are less effective in this application.

Allow to dry as per the manufacturers instructions and lightly sand to an even finish.

Apply two coats of premium brand acrylic exterior grade top coat to the manufacturers recommendations.



**Q** *Why should I use Glulam instead of steel?*

**A** Here are just a few reasons –

- Easier and lighter to handle and fix
- Friendlier on the environment – stores carbon rather than emitting it
- Uses NZ's only renewable construction material – plantation timber
- Uses 14 times less energy to produce than equivalent steel beam
- Superior Fire Resistance compared to steel
- Lower maintenance – Glulam does not rust or corrode
- Cost effective – no boxing in or covering steel beams
- Appearance – natural warmth and beauty of timber cannot be reproduced in steel
- Will not buckle or distort in response to temperature changes
- Direct fixing of plates, joists and other connections is much easier

**Q** *Why should I use Glulam instead of solid timber?*

**A** Because Glulam is manufactured from selected grade, kiln dried material it is stronger and more stable than a solid timber beam of the same section. The tendency of large section solid timber to twist, split and shrink is greatly minimised in Glulam. A Glulam beam can reduce the overall section of members up to 40% compared to unseasoned timber.

**Q** *What Type of Quality assurance comes with Glulam Beams?*

**A** All Glulam must be manufactured to comply with the joint Australia and New Zealand Standard. Licensed manufacturers are regularly inspected by the NZ Timber Certification Board and issued with an individual License number. This certifies that the manufacturer's production system complies with the detailed requirements of AS/NZS 1328 – Glue Laminated Structural Timber. Audits are also carried out by Bureau Veritas to ensure compliance and quality control procedures and records are in place. To ensure you have a quality product check that your supplier has a current license number.

**Q** *Can Glulam beams be used in exterior situations?*

**A** Yes. Treatment to hazard class 3 (H3) is recommended for all Glulam beams exposed to the weather. Along with this treatment an exterior adhesive such as resorcinol adhesive should be used. The finished beams must be suitably coated with either a penetrating sealer or film forming coating. When painting or staining external Glulam beams it is preferable to use lighter colours. Dark colours attract heat and may cause surface shrinkage. Because Glulam is chemically inert it is ideal for corrosive atmospheres such as marine structures, fertilisers and scouring plants where steel is subject to rust and corrosion.

**Q** *What finish should I ask for on my beams?*

**A** If your beam is going to be used in a situation where appearance is important such as house interiors, halls etc – appearance Grade A should be specified. This calls for a flush, filled and sanded surface. Appearance Grade B is intended for applications where surface appearance is not so critical and a machine planed finish that may have occasional skips and other minor voids is acceptable.

**Q** *What strength grades should Glulam be designed to?*

**A** The new Glulam Code AS/NZS 1328 allocated Glulam beams manufacturers in NZ Radiata Pine to three grades – GL8, GL10, & GL12. These figures refer to the stiffness (E) of the beam. The most common is GL8; some manufacturers are certified to produce GL10 or GL12. Check with your supplier.

**Q** *Are there any recommendations for storage of Glulam?*

**A** In order to maintain the best condition of manufactured Glulam proper storage and handling is important. They should be stacked well clear of the ground and protected from the elements. Stacks of beams should be covered with a weatherproof material ensuring adequate ventilation to prevent condensation building up. Avoid black polythene, as this will make the beams sweat. If possible fillet stack beams to allow air circulation.



Avoid the use of chains or hard ropes that might damage the edges of beams. When lifting ensure the beams evenly supported and use fabric slings properly secured to prevent any slipping. Avoid any sudden movements when lifting.

Be careful not to handle and lift long beams on their weak axis – flat – as they are designed to act as a beam not a plank.

Remember these are pre-finished members and a lack of care during storage and installation will affect the finished appearance.

**Q** *How long should I keep wrapping on?*

**A** Wrapping of Glulam beams is primarily to protect them from marking during handling and transport. This is not designed to be a waterproof protection. Once on-site water can often get in under the wrapping and cannot get out. Wrapping should be slit to provide drainage.

Wrapping can be left on Glulam beams for as long as possible (even during construction) to protect against accidental marking.

Also be aware that partial removal of wrapping to access connections may cause patches of discolouration by exposure to weather.

**Q** *Do I need special connections for my beams?*

**A** Glulam can be treated as natural solid timber when it comes to fixings. The use of standard nailing systems and bolts is normal. In exposed situations dark stains can appear from the use of unprotected steel brackets and bolts. Use galvanised metalwork where there is any possibility of moisture.

**Q** *Can finished Glulam beams be re-cut and drilled?*

**A** Any cutting, drilling or slotting that exposes unsealed timber must be protected with an application of appropriate weather or treatment sealer. Avoid cut-outs, rebating or drilling in the top and bottom edges of Glulam beams. These could cause serious weakness in tension and compression areas. Consult the manufacturer or designer first.

**Q** *Will CCA treated Glulam cause corrosion on galvanised fixings?*

**A** While this may be a problem with solid unseasoned timber, Glulam does not act in the same way. Because all Glulam is manufactured from material that is kiln dried after treatment, the treatments salts are thoroughly fixed into the timber. They will therefore not subsequently leach out or affect galvanised fixings. For additional protection bolts may be greased before inserting into CCA treated Glulam beams that are exposed to weathering.

**Q** *Do splits along glue lines mean delamination has occurred?*

**A** Actual delamination is a failure in the laminating process. While an opening along a glue line may be indicative of delamination there are other more common causes. Typical checking that occurs in large section timber in response to moisture variation will most naturally occur in Glulam along a glue line where the natural continuation of the timber fibres is interrupted. This is often mistaken for delamination.

**Q** *How serious are checks and why do they appear?*

**A** Surface checking and splits occur as timber is allowed to absorb moisture then dries out in response to environmental changes. Surface fibres are more severely exposed to these changes than the inner core and as a result of the movement in these fibres as they dry and shrink, surface splits may occur. Changes in atmospheric conditions will affect the appearance and disappearance of these checks. The effect of surface checks are superficial only and do not usually have any effect on the structural performance of the Glulam.

**Q** *How can these checks be minimised?*

**A** Glulam beams should be provided with a coating capable of controlling the ingress of moisture into the timber, which is done before the beams leave the factory. If the beams are exposed to the weather for a greater period than 8-10 weeks a further coating should be applied. For coatings to protect beams that are permanently exposed to the elements consult a coatings specialist.



