

# INFORMATION SHEET

## STRUCTURAL MATERIALS



## GLUE-LAMINATED TIMBER PERFORMANCE

The information provided below has been taken from the New Zealand Timber Design Guide 2007, published by the Timber Industry Federation and edited by Professor A H Buchanan. To purchase a copy of the Timber Design Guide, visit [www.nztif.co.nz](http://www.nztif.co.nz)

Designers using the GL grades should use the characteristic stresses from Table 1, taken from AS 1720. Higher grades (i.e. GL10, GL12) will give greater span and load carrying capability than GL8 for the same section size. The GL grades are “strength classes” to be used by designers. The manufacturer must be able to demonstrate that the characteristic values of the specified strength class are achieved.

**Table 1: Characteristic stresses for dry GL grades of glulam.**

Grade	Bending	Compression parallel	Tension	Shear in beams	Modulus of elasticity	Modulus of rigidity
	$f_b$	$f_c$	$f_t$	$f_s$	E	G
	(MP <sub>a</sub> )	(MP <sub>a</sub> )	(MP <sub>a</sub> )	(MP <sub>a</sub> )	(GP <sub>a</sub> )	(MP <sub>a</sub> )
GL18	50	50	25	5.0	18500	18.5
GL17	42	35	21	3.7	16700	16.7
GL13	33	33	16	3.7	13300	13.3
GL12	25	29	12.5	3.7	11500	11.5
GL10	22	26	11	3.7	10000	10.0
GL8	19	24	10	3.7	8000	8.0

GL grades greater than GL10 can be difficult to obtain in radiata pine.  
GL grades greater than GL12 can be difficult to obtain in Douglas fir.

GL grades are performance-based, meaning that they are manufactured to have the characteristic properties listed in Table 1. GL grades of glue laminated timber are verified for strength.

## DESIGN

In addition to factors  $k_1$  to  $k_5$  and  $k_8$  for sawn timber, the following  $k$  factors apply specifically to glue-laminated timber.

### Curvature factor $k_{23}$

The curvature factor allows for the additional stress induced in laminations that are bent to a tight radius to form curved glulam members. It is not applied to straight members with a slight camber.  $k_{23}$  is applied to the bending strength of curved members and is given by:

$$k_{23} = 1 - 2000 \frac{t_l^2}{R}$$

where  $t_l$  = lamination thickness

$R$  = radius of curvature

### Lamination and size factors $k_6$ and $k_{24}$

The previous lamination factor  $k_6$  and the size factor  $k_{24}$  have been deleted with the introduction of GL grades because the GL grades are performance grades which are specifically manufactured to give the assigned characteristic stresses.

### Radial stresses in curved or tapered members

The strength of curved glulam flexural members needs to be checked to ensure that failure does not occur due to stresses perpendicular to the grain. If the bending tends to increase the radius of curvature (bending in the opening mode), the stresses will be in tension perpendicular to the grain (splitting). If the bending tends to decrease the radius of curvature (bending in the closing mode), the stresses will be in compression perpendicular to the grain (crushing).

The design equation for curved members stressed in the opening mode is:

$$M^* \leq 2\phi k_1 k_4 f_s Rbd/9$$

The design equation for curved members stressed in the closing mode is:

$$M^* \leq 2\phi k_1 k_4 f_p Rbd/3$$

where

$\phi$  is the strength reduction factor

$k_1$  is the duration of load factor for strength

$k_4$  is the load sharing factor for number of beams

$f_s$  is the characteristic shear stress

$f_p$  is the characteristic bearing stress perpendicular to the grain

$R$  is the radius of curvature at mid-depth of the section

$b$  is the breadth of the section

$d$  is the depth of the section

Design equations for tapered or pitch cambered beams are given in NZS 3603.