WHAT TIMBER, WHAT GRADE, WHAT SIZE, WHAT STRESSES?

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The sometime designer of timber structures can be easily confused by the options of what timber, what size, what grade and what moisture condition to specify, and what stresses to use with that choice. Simply asking local suppliers what is available might reduce the number of choices considerably so that is often the best starting point, since market demand determines what is stocked. An invaluable reference is the "Timber Design Guide", published by the NZ Timber Industry Federation. You will probably find that the choices are:

- NZ sizes in No. 1 Framing, green or dry, or
- Australian sizes in one grade, dry only; or
- Laminated Veneer Lumber (LVL), dry only.

What species?

Radiata pine is almost the only option in New Zealand. Douglas fir (sometimes called Oregon or Oregon pine) is the second option. Its strength and stiffness are practically the same as radiata. The major differences are that Douglas fir is more stable than radiata, it cannot effectively be treated with CCA, and its non-uniform texture makes it difficult to nail by hand. It is favoured for roof trusses because of these attributes. There are numerous minor species for which ***Forest Research*** can provide design data. Then there is Laminated Veneer Lumber (LVL), with highly reliable properties. This is made from radiata pine veneers.

What size?

- Nominal or call dimensions, e.g. 4x2 (inches) or 100x50 (millimeters). Rough sawn timber will have these dimensions with a tolerance of –1 to +3 mm. Timber treated to H4 for ground contact use is often available rough sawn, and unseasoned.
- Green gauged. When houses were commonly built with unseasoned framing, these were the common sizes, e.g. 100x50 is actually 94x47. NZ grades only. The arrises are rounded for nice handling. It can be assumed that these dimensions will reduce by 2.5% due to drying shrinkage.
- Dry dressed. Dry framing is produced in these dimensions. 100x50 is actually 90x45. NZ visual grades only.
- LVL. This is available in thicknesses of 36, 45 and 63 mm. It is intended to produce thicknesses of 90, 105 and 120 mm from the CHH plant at Marsden Point. Widths can be anything up to 1200 mm.
- Australian sizes. Pine is produced in the dry condition only, and the sizes are called by their actual dimensions. F-grades and MGP-grades are produced in the same dimensions.

What grade?

- NZS 3631 describes the visual grades of Engineering, No. 1 Framing and No. 2 Framing. Engineering is practically unobtainable and NZS 3603 does not list stresses for No. 2 Framing. Therefore for green gauged and dry dressed sizes consider No. 1 Framing only. NZS 3631 also lists stresses for the machine grades of F6 and F11. These are no longer available.
- Australia has a system of stress grades; F4, F5, F7, F8, F11, F14 etc. Their multitude of species are fitted into this system. Timber to meet a given stress grade can be visually graded to AS 2858 or machine graded to AS/NZS 1748. Because the F-grade system is based on the properties of visually graded hardwoods, it does not represent accurately the properties of machine-graded pine, so machine-graded F5, F8 and F11 pine was evaluated and renamed MGP 10, MGP 12 and MGP 15 respectively. F-grades and MGP-grades are not widely marketed in New Zealand but visually graded F7 and machine graded MGP 12 may be available locally.
- The two major corporates in NZ, Carter Holt Harvey Timber and Fletcher Challenge Forests, produce MGP 10 for Australia and put it on the NZ market as Laserframe™ and Origin Timeframe™.
- LVL comes in one grade only, Hyspan™.

To summarise, the possible combinations of size, grade and moisture condition are:

Table 1. Grade/size combinations available in New Zealand

New Zealand grades: Engineering (perhaps), and No. 1 Framing									
	Thickness	Widths							
Call size:	40, 50, 75, 100	75	100	125	150	200	225	250	300
Green gauged:	37, 47, 69, 94	69	94	119	144	194	219	244	294
Dry dressed:	35, 45, 65, 90	65	90	115	140	180	205	230	280
Dry framing: Laserframe™, Origin Timeframe™									
Actual size:	35 or 45	70	90	120	140	170	190	240	290
LVL: Hyspan™									
Actual size:	36, 45, 63, 120	150	200	240	300	360	400	450	600

What stresses?

The design stresses in Table 2 are extracted from NZS 3603 and trade literature. Note that the tension parallel stresses have been set to 50% of bending rather than 60% as in NZS 3603. This is in line with recent research results and the Australian code AS 1720.2:1999.

Table 2. Characteristic stresses for grades readily available in New Zealand (MPa)

Species	Grade	**Bending Strength**	**Tension Strength**	**Compression Strength parallel**	**Shear Strength**	**Compression Strength perpendicular**	**Bending MoE**
		f_b	f_t	f_c	f_s	f_p	E
Moisture condition: green							
Radiata	No. 1 Framing	14.8	7.4	12.7	2.4	5.3	6500
Douglas fir	No. 1 Framing	14.8	7.4	14.5	2.4	4.7	6500
Moisture condition: dry							
Radiata	No. 1 Framing	17.7	8.8	20.9	3.8	8.9	8000
Douglas fir	No. 1 Framing	17.7	8.8	22.1	3.0	8.9	8000
Radiata	Laserframe™, Origin Time frame™	16*	8.9	24	5.0	12	10000
LVL	Hyspan™	42	27	34	4.5	12	13200

*19 MPa for 45 mm thick timber.

Furthermore, shear can be the limiting factor in beam design but from experience in testing, it is very rare for radiata to fail in shear, even in beams with a span/depth ratio of 6:1. The shear stresses for No. 1 Framing are not based on in-grade tests (as are the other stresses) and are therefore too conservative. Adjustments will be made in the next amendment of NZS 3603.

Finally, for treated timber, only No. 1 Framing is treated although the other grades could be but are not normally supplied as such.

Where to from here?

Forest Research has proposed, and has developed a system to back up, two more MGP grades to better represent the New Zealand resource. They are MGP8, as equivalent to the present No. 1 Framing, and MGP6, as a replacement for No. 2 Framing. These would be produced dry, in Australian sizes and by means of some mechanical sorting device. The proposed stresses are given in Table 3 and are compared to suggested values for dry No. 2 Framing grade. Stresses for the scarcer MGP grades and F7 are also given.

Table 3. Proposed grade stresses (MPa)

Grade	Bending Strength	Tension Strength	Shear Strength	Compression Strength	Bending MoE
MGP 12	28.0	15.0	6.5	29.0	12700
MGP 10	16.0	8.9	5.0	24.0	10000
MGP 8	14.0	6.3	4.0	20.0	8000
MGP 6	10.0	4.0	2.5	16.0	6000
No 2Framing*	13.0	7.7	3.8	9.7	6100
F7	20.0	10.0	2.1	15.0	7900

* Assumed equal to F4 grade except shear equal to No. 1 Framing

Whether the proposed grades are ever produced, or some other grade/stress combination is introduced, depends on the timber industry. They need to determine the optimum balance between what can be obtained from the resource both here and in Australia, how a new grade might fit in with or replace existing grades, what remanufacturing can be done with lower or reject material, and how well the performance of any new grade can be guaranteed.

Another consideration for engineers designing members that are not load-sharing is the variability in MoE. While visual grading is reasonably efficient at sorting for strength, it is very poor at sorting for stiffness. To address this problem it has been proposed that values for a minimum (or lower 5 percentile) MoE be published. For visually graded timber this would be 50% of the currently-published (average) MoE. For machine graded timber it would be 80%, while for LVL it would be more than 90%.