STRUCTURAL TIMBER

Summary

- Amended structural timber grading standards effective on 1 April 2007.
- The amended standards introduce a new suite of grades – the new grades are outlined and explained.
- All but one new grade requires verification of structural properties – an explanation of the verification process is given.
- Grade availability – Not all grades and sizes may be available – an explanation on why some sizes and grades may not be available is provided.
- Timber designers, builders and end users must specify and use grades correctly – key aspects are explained.

Amended Standards Cited In The B1 Compliance Document To The Building Code

Changes have been made to the way structural timber is graded with the introduction of amendments to New Zealand Standards governing structural timber grades.

The Department of Building and Housing has amended Compliance Document B1 Structure to the Building Code by referencing the following amended Standards:

Amendment 4 NZS 3603:1993 Timber Structures Standard.

Amendment 2 NZS 3604:1999 Timber Framed Buildings.

Amendment 1 NZS 3622: 2004 Verification of Timber Properties.

The amended Compliance Document will become effective on 1 April 2007. The amended standards will apply to building work consented on or after 1 April 2007.

Amendment 4 NZS 3603:1993 Timber Structures Standard

Amendment 4 NZS 3603 introduces the following new grades:

- Visually Stress Graded (VSG) 8 & 10.
- Machine Stress Graded (MSG) 6,8,10,12,15.
- G8 grade (this is a green version of a dry VSG/MSG8 grade where the timber is verified in its green or non dried condition).
- Unverified No1 Framing: This grade is visually graded to the No 1 Frame specifications in NZS 3631:1988 but its structural properties are not verified. Because this grade is not verified, its structural properties have been reduced from its previously established values.

Structural Timber Grades and their Characteristic Stresses (Obtained from Amendment 4 NZS3603:1993)

Grade	Colour Marks (MSG Only)	Average Modulus of Elasticity (Stiffness) (GPa)	Minimum Modulus of Elasticity (Stiffness) (GPa)	Bending Strength (MPa)	Compression Strength (MPa)	Tension Strength (MPa)
No 1 Framing (unverified) (Green)		4.8	3.2	7.5	11.0	3.0
No 1 Framing (unverified)		6.0	4.0	10.0	15.0	4.0
MSG6		6.0	4.0	10.0	15.0	4.0
G8 (Green)		6.5	4.4	11.7	12.0	4.0
VSG8		8.0	5.4	14.0	18.0	6.0
MSG8	Black	8.0	5.4	14.0	18.0	6.0
VSG10		10.0	6.7	20.0	20.0	8.0
MSG10	Green	10.0	7.5	20.0	20.0	8.0
MSG12	Purple	12.0	9.0	28.0	25.0	14.0
MSG15	Orange	15.2	11.5	41.0	35.0	23.0

Amendment 2 NZS 3604:1999 Timber Framed Buildings

Amendment 2 NZS 3604 provides design information in the form of tables for three sets of grades. Tables are provided for:

- MoE (Stiffness) 6 grades (MSG6 and Unverified No 1 Framing)
- MoE (Stiffness) 8 grades (MSG8,VSG8 and G8 (when dry))
- MoE (Stiffness) 6.5 grades (this is the value assigned for wetted in service 8 grades) (G8, MSG8, VSG8)
- MoE (Stiffness) 10 grades (MSG10 and VSG10)

NZS 3622:2004 Verification of Timber Properties

All of the new grades (except unverified No 1 Framing grade) require verification in accordance with the verification Standard NZS 3622:2004. The verification method and pass criteria are the same for both grading systems (VSG & MSG). The requirement to use a third party quality assurance audit organisation is mandatory.

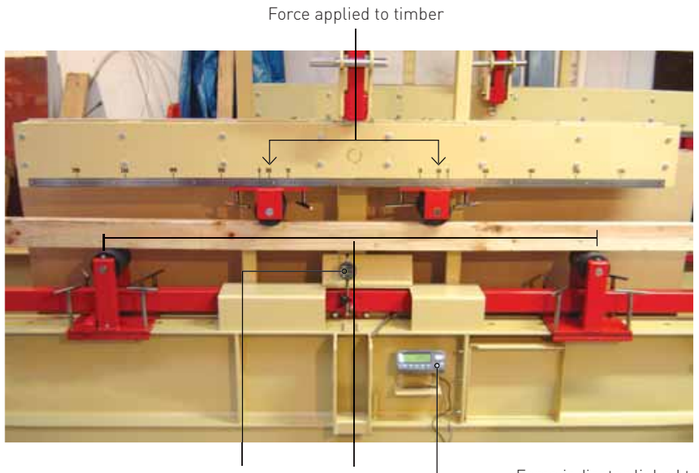
VSG And MSG Grades

Both grading systems assign timber into grades according to their stiffness and strength.

A machine stress grader is only capable of testing the stiffness of timber but not strength. There is correlation between stiffness and strength but visual characteristics such as knots are the main determinant of strength. Machine Stress Graded (MSG) timber is subject to visual grading ('visual override') in accordance with AS/NZS 1748 after it has been graded for stiffness although larger defects are allowed compared to VSG grades which must be graded to the No 1 Frame grade specifications of NZS 3631:1988.

In order to determine whether the strength properties for machine stress graded product are being achieved, samples of the production must be taken and tested on a separate static testing machine in accordance with the verification Standard NZS 3622:2004. The verification process is also important to check that the machine stress grader is assigning the correct stiffness values for the grade.

Quality Assurance Static Testing Machine used for Verifying Timber



VSG (Visual Stress Grades) are sorted on the basis of visual characteristics. Visual characteristics are good for determining strength but not so good for predicting stiffness. Whereas the quality assurance checking for machine stress grades is probably more important for ensuring the strength characteristics are achieved, in the case of visual stress grades, the verification process is more pertinent for checking the stiffness characteristics.

The key aspect to ensure both grading systems are compliant is the verification process and both grading systems are subject to the same rules and grade acceptance criteria set out in the verification Standard NZS 3622:2004.

There was no provision made for a VSG6 grade when the standards were designed as the rationale was that unverified No 1 Framing grade had the properties of MSG6 and therefore a VSG6 grade was not required. Some producers who have recognised the importance of verification and are choosing to verify the properties of No 1 Framing and marking it as Verified No 1 Framing. This grade is essentially a VSG6 grade but by marking it as Verified No 1 Framing it technically complies with the standards as there is no mention of a grade called VSG6.

The key aspect to ensure both grading systems are compliant is the verification process and both grading systems are subject to the same rules and grade acceptance criteria set out in the verification Standard NZS 3622:2004.

Outdoor Structural Grades

Where timber is used in a situation where it may be wetted in service (i.e. it will not remain dry throughout its design life) the green condition stresses and moduli values for the grade shall be used. NZS3603:1993 defines timber as being green at 25% moisture content and dry at 16% moisture content with a tolerance up to a maximum of 18%. NZS3604:1999 section 2.3.4 outlines a number of situations where timber can be wetted in service and also provides design tables based around the green condition stresses and moduli values. Bearers and joists for decks are an example of members that may be wetted in service.

NZS3603 only provides green condition stress values for VSG grades and not MSG grades. However, the wetted in service tables within NZS3604 include MSG grades alongside their VSG equivalents. It appears that when NZS3603 was amended the Standards committee did not anticipate MSG grades would be used in wet service situations. It should be noted that the durability requirements of NZS3602:3003 must be met when timber is used in a wet service situation.

G8 Grade

G8 graded timber is a verified visual grade which has been verified green to the green condition stresses and moduli values determined for equivalent dry MoE 8 grades VSG8 and MSG8. The G8 grade was provided to cater for producers of outdoor treated (H3.2) timber as often these timbers are not dried below 25% moisture content prior to treatment and will remain wet post treatment. Typically this grade of timber will be used in a wet service situation because it has been treated to hazard class H3.2. However, if dry, it may also be used as an equivalent to VSG8 and MSG8. Similarly, VSG8 and MSG8 are equivalent to G8 when in the green condition and can be used in the same wet service situations as long as they are treated to the appropriate hazard class.

How the Verification Process Works

The verification process described in NZS 3622:2004 is an output control system, which means that timber is continuously taken from production and tested for stiffness and strength. The verification Standard is based on random sampling and statistical analysis to ensure the population of timber within a stress grade is meeting the requirements of the grade.

Timber that has been randomly selected from production is tested on a static bending test machine (the same type of machine is used for both MSG and VSG systems). A test for stiffness and bending strength is performed on each sample and the results are analysed and plotted against the acceptance criteria for the grade.

The new verified grades in NZS 3603:1993 have an assigned modulus of elasticity (MoE) (stiffness) and a lower bound MoE.

For example VSG8 and MSG8 have an MoE of 8.0 GPa and a lower bound MoE of 5.4 GPa. For timber to be assigned into these grades it must maintain a characteristic average MoE of 8.0 GPa and a lower 5th percentile MoE of 5.4 GPa. In the case of the lower 5th percentile, the statistical power estimates that 95% of the product will exceed the minimum value with 75% confidence.

Essentially, each grade has an average and minimum MoE.

For strength properties, the values assigned are based on the same principle as the lower 5th percentile MoE, in that they are an estimate of the property value determined with 75% confidence that would be exceeded by 95% of the product. VSG8 and MSG8 must achieve a strength value of 14.0 MPa.

Verified Timber Ltd Quality Assurance Programme

The Verification Standard requires that companies producing verified timber appoint a third party organisation to carry out external audits of their internal monitoring system. Verified Timber Ltd administers a quality assurance programme based on the requirements of NZS3622:2004. Companies who are compliant with the programme are licensed to mark the Verified Timber Certification Trade Mark on their conforming structural timber. A register of licensed producers and the grades and sizes they are approved to produce is available on our web site.

Identification of Verified Timber

The Verified Timber Certification Trade Mark, along with the name or identification number of the licensed company, the grade and grading standard used to produce the grade will be marked along the face or edge of the timber. *Note: In the case of rough sawn timber, this information may be marked on the end of the timber.*

Company ID no. or name

Stress grade (may be indicated by colour for MSG grades)

Grading standard AS/NZS 1748 for MSG and NZS 3631 for VSG

Verified Timber Certification Trade Mark

Grade Specification and Availability

There are now multiple options of grades provided and there is a choice as to which grade to use for a particular design situation. In many cases a number of different grades may be suitable for the job as long as the design caters for the stress properties of the grade.

For example, in the situation of a 2.4 stud spaced at 600mm in a medium wind zone you could use 90x35 VSG8 or MSG8 grade for the job. A dimension of 90x45 No1 Frame or MSG6 grade spaced at 600mm would provide an equivalent solution. Which grade do you choose? A number of factors may influence your decision such as the type of design, the availability and maybe price of the various grades.

It should not be taken for granted that all grades and sizes listed in the standards will be available. There are a number of reasons why this may not be the case.

Due to the uncertainty surrounding the implementation of the new standards and the fact a final decision to cite them into the B1 Compliance Document to the Building Code was only made in mid September 2006 (implementation date is 1 April 2007), not all structural timber producers are ready to produce verified timber. Many companies are in the process of implementing systems and are at various stages of readiness. Some companies are approved to produce certain grades and sizes and will possibly broaden their scope of approval in time if they are able to do so.

It has yet to be determined what yield of grades and sizes the New Zealand forest resource is capable of producing. There are a wide range of factors that will determine what volume of grades and sizes will be available.

The structural properties of timber are determined from the logs the timber has been processed from and there are many aspects that can affect the structural properties within logs including: the trees genetics, the geographical location they are grown, how they are grown and the age they are felled. There is also variation between different logs within the same tree and also within the same log.

In respect of the variation, some very broad generalizations can be made about what aspects have positive effects on structural properties. In general, trees grown in the North of both islands tend to be better than those grown further South. Trees grown closer to the coast tend to be better than those grown further inland. Trees grown closer together and slower tend to be better than those grown faster at wider spacing. Older trees tend to be better than younger ones. Timber processed from the second and third logs tend to be better than that from the butt log and timber taken from the outside of the log tends to be better than that from the core.

Under the new regime, this variation must be controlled to ensure consistency of the structural properties of timber is achieved. Control can be achieved through using certain technologies and modifying various processes. The verification mechanism is designed to ensure this is achieved.

However, what can't be controlled is the current New Zealand forest resource and we are stuck with what structural properties it is capable of yielding. Silvicultural regimes can possibly modify crops of the future but the structural properties of today's trees have already been determined.

All this adds up to uncertainty about what grades and sizes will ultimately be available. There may well be differences in regional availability due to differences in regional forest resources. Due to the way different section sizes are processed from the log, it is more likely that smaller sizes (which are typically cut from the outside of the log) will be more readily available than wider sizes that must include more core wood.

Timber Designers

Designers should be aware there are now three sets of design tables within NZS3604 and they need to ensure plans and specifications are clear and include grade, size of timber, spacing etc. as this information is critical at consent and build stages. It is important that you check the availability of grades and sizes before specifying them. This will save you time and money in having to amend your design because the grade and size you have specified is not available.

In the case of VSG and MSG grades both are verified the same way against the same criteria. If you do not have a preference for one grade over the other then it is important to detail both VSG and MSG on your designs/plans as this will allow either grade to be used. The final choice of grade can be made at a later date based on availability and maybe price. You would also have the option to use a combination of VSG and MSG grades (of the same stiffness).

The choice is up to you as a designer but under the new standards it is important to make your choice of grade(s) accurately.

Note: NZS3604 has included some sizes of timber that are not currently produced (90x90, 90x70, 70x70) however options for building up these sizes by double studding are set out in sections 2.4.4.7 and 8.5.1.2. You should also be aware that the NZS3604 design tables have switched from call sizes to actual minimum dried sizes.

Timber Merchants

As a timber supplier, you may choose to stock grades and sizes according to your preference, limitations on space, grade/size availability and price. As a supplier it will be important to ensure you supply the exact grade ordered.

Builders

It will be the responsibility of the builder to purchase the correct grades from the supplier and install them according to the consented design/plan. In the case of pre-fabricated buildings, the responsibility rests with the frame and truss manufacturer.

Where grades which are not available have been specified, builders should ask the designer to redesign in available grades and amend the consent.