

Technical Q & A

Questions about Stress-Graded Lumber



A look at stress-graded lumber.

by Ryan J. Dexter, P.E.

Lumber plays such a significant role in the design of metal plate connected wood trusses that it is no surprise that we often receive questions about it. The questions often simply refer to lumber design values; but sometimes the questions reflect the terminology used. We have all heard the term "stress-graded lumber" for example, but what does it mean? The term is used frequently in this industry. For instance, the *Building Component Safety Information (BCSI)* booklet states that the "minimum size of lumber used as lateral restraint and diagonal bracing is 2x4 stress-graded lumber unless other size is specified by the building designer."

Question

Is 2x4 Spruce-Pine Fir #1/#2 considered a stress-graded lumber? After all, it is visually graded in order to determine its structural capabilities, not for its appearance. Or does stress-graded lumber mean machine graded?

Answer

Any lumber that is graded to assign design properties would be considered stress-graded. It makes no difference whether the material is graded visually or mechanically (e.g., Machine Stress Rated [MSR] or Machine Evaluated Lumber [MEL]). Any material with listed design properties in the *National Design Standard for Wood Construction (NDS) Supplement* or in individual lumber use guides are considered stress-graded and are acceptable per the BCSI general requirements. If a product is only graded for appearance (i.e., boards) and design values have not been established for the grade, then that material, although graded, is not stress-graded.

Question

Is there a minimum grade recommended for truss members? Do tension members need to be machine stress rated lumber?

Answer

Truss members can be stud grade as long as the design values are equal to or less than the stresses that are actually going through the truss. And no, the lumber does not need to be machine stress rated, but stress values need to be associated with the lumber. ANSI/TPI 1-2002 Section 3.4.1 states:

Truss lumber shall be the grade and size specified on the truss design drawing. Truss lumber of a different grade shall be permitted to be substituted if the substitute grade does not exceed the coefficient of variation for modulus of elasticity (COVE) of the specified grade, and meets or exceeds the specified grade for each of the following properties:

- (a) allowable design value for bending (F_b);
- (b) allowable design value for tension (F_t);
- (c) allowable design value for compression parallel to grain (F_c);
- (d) allowable design value for compression perpendicular to grain ($F_{c\perp}$);
- (e) allowable design value for shear (F_v);
- (f) allowable design value for bearing (F_d);
- (g) specific gravity (G); and
- (h) average modulus of elasticity (MOE)

Any changes in grade not meeting the above requirements, or any changes to structural composite lumber products shall require the review and approval of a Truss Designer.

As long as the allowable design values of the lumber (which are based on the species and grade) are at least equal to the amount of stress that the lumber will be expected to resist in the truss design, the lumber is acceptable. The only way to know what the allowable stresses are is to use lumber graded by the lumber manufacturer. Typically, truss webs are at least Number 3 or stud grade and chords (whether bottom chords which are typically in tension or top chords which are typically in compression) are at least Number 2 grade.

You should expect to find the same quality lumber in trusses as you would in any other type of construction. The lumber used in trusses is sized and graded the same way all structural lumber is. Lumber species of Southern Pine, Spruce-Pine Fir, Hem-Fir, or Doug-Fir-Larch are common. These lumber species are often used in trusses and are available in structural grades such as Select Structural, No. 1, No. 2, etc. Metal connector plate strength values are tested in the various lumber species that they will be used in; truss design software must contain the species and grade dependent lumber and plate values in order to correctly perform to the truss design.

Ultimately, trusses can be designed with any stress-graded lumber. Depending on the design loads, certain grades of lumber may not be adequate to handle and transfer the given loads for a particular truss design and thus they would be unacceptable. These cases would require a higher grade of lumber to adequately resist the forces in the truss. **SBC**



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at a glance

- Any lumber that is graded to assign design properties is considered stress-graded, no matter if it was visually or mechanically graded.
- Material with design properties listed in the NDS Supplement or in individual lumber use guides is considered stress-graded.

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