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WTCA QC

"Why Use ***WTCA QC***? Reason #7?" by Jay Edgar & Rachel Smith. EIT

REASON #7: GET A HANDLE ON YOUR LUMBER SUBSTITUTIONS

Imagine this scenario: Your production manager comes to you and asks, "This drawing calls for #1 SYP. We're all out. Can I use 1650 SYP MSR instead?"

What is the answer? How do you make decisions about lumber substitutions?

ANSI/TPI 1-1995, Section 4.3.1 states: "Truss lumber shall be of the minimum grade, size, moisture content and species combination specified by the truss design. Truss lumber of a higher stress grade of the same size and species combination is not prohibited from being substituted for the stress grade, size and species combination as specified."

Thus, any substitution you make to a higher grade is acceptable as long as it is the same species, size and grading method. Using a #1 SYP 2x4 in place of a #2 SYP 2x4 is clearly acceptable. What about the scenario stated in the first paragraph?

Many people assume that MSR is always an upgrade from a visual grade. This is a serious mistake. Since the grading methods are different between #1 and 1650, you cannot assume it is acceptable without further analysis.

CHECK THE NUMBERS!

If you have ever looked in a brochure or textbook about lumber, you have undoubtedly seen what we call the "engineering alphabet soup" of lumber values. These values indicate how well the lumber will perform in the final application by specifying its strength in several different ways, using the following variables: bending (F_b), tension (F_t), shear (F_v), compression perpendicular-to-grain ($F_{c\perp}$), compression parallel-to-grain ($F_{c||}$) and modulus of elasticity (MOE).

As long as all values increase or stay the same from the lumber specified to what is actually used, you are sure to have an acceptable substitution. When you move from #2 SYP 2x4 to #1 SYP 2x4, by definition, all six of these values increase or stay the same.

However, when you move from #1 SYP 2x4 to 1650 Fb-1.5 SYP 2x4, you are moving from a visual grade to a machine stress rated (MSR) grade. If you compare the six values between these two (see Figure 1), you will find that while $F_{c\perp}$ is the same between both pieces, every other value drops! Thus, 1650 is not an acceptable substitution for #1. The answer to the question posed in paragraph one is 'no.'

There may be instances where one value drops and the substitution is still acceptable. For instance, in a top

chord member, F_b may be controlling. As long as F_b is higher in the lumber used than what was specified, the substitution is acceptable, even if other factors drop. Since the other factors are not 'controlling' in the member, it does not disqualify the substitution.

CHANGING SPECIES

The ANSI standard goes on to state, "Changes in size and/or species combination or conversion to structural composite lumber shall require additional analysis by the truss designer and review by the building designer to prove equivalency."

	F_b	F_t	F_v	$F_{c\perp}$	$F_{c\parallel}$	MOE
#1 (specified)	1850	1050	100	565	1850	1,700,000
1650 (actual)	1650	1020	90	565	1700	1,500,000
comparison	drop	drop	drop	same	drop	drop

Figure 1. Sample Lumber Comparison

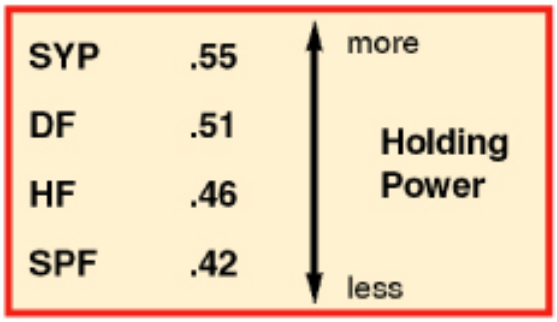

Figure 2. Specific Gravity (G)

When substituting a different species, even of a higher grade, more engineering analysis is required to ensure the substitution is acceptable. Along with a comparison of the six values discussed in Figure 1, specific gravity (G) must also be considered. G is an indication of the tooth holding power of the lumber—the higher the G, the greater the holding power and thus, the fewer teeth required. Because of this, changing your species may require a different size plate.

Figure 2 contains a summary of the different species families and their associated specific gravity. All other factors being equal, substituting SYP in place of HF is acceptable, while the reverse is not.

HOW CAN *WTCA QC* HELP?

The *WTCA QC* program contains a database of the first six properties discussed above for all the lumber combinations in existence when the program was released. (Newer combinations can be added by the user.) When the lumber specified and the lumber actually used are entered into an inspection form, the program checks this database and compares all six values. If any value drops, it sends up a red flag, so that you can check with engineering to ensure the substitution is acceptable.

Likewise, if the species changes between specified and actual, the program automatically sends up a red

flag, so that engineering can do further analysis of specific gravity. (In the next version of *WTCA QC*, the program will be able to compare G values as well.)

SETTING A POLICY

It is common for truss manufacturers to have stated guidelines about lumber substitution within their plants. When creating these guidelines, work with your truss engineer. Make sure the people using the guidelines understand them. If you are unsure of a substitution, don't make assumptions—always check it out. Have the truss designer re-analyze the truss with the substitution. As we saw above, some substitutions may affect plate sizes.

Finally, substitutions may also affect the veracity of your engineered truss drawings. If the lumber substitutions are not documented in the truss design drawings some building inspectors may not accept them. From a liability standpoint, it's probably a good idea to document any changes to the original design.

For further information on lumber properties, grading methods, etc., see the Metal Plate Connected Wood Truss Handbook, Section 3.0, Lumber and Wood, or contact WTCA at 608/274-4849.

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