STRUCTURAL BUILDING COMPONENTS MAGAZINE
August 2003

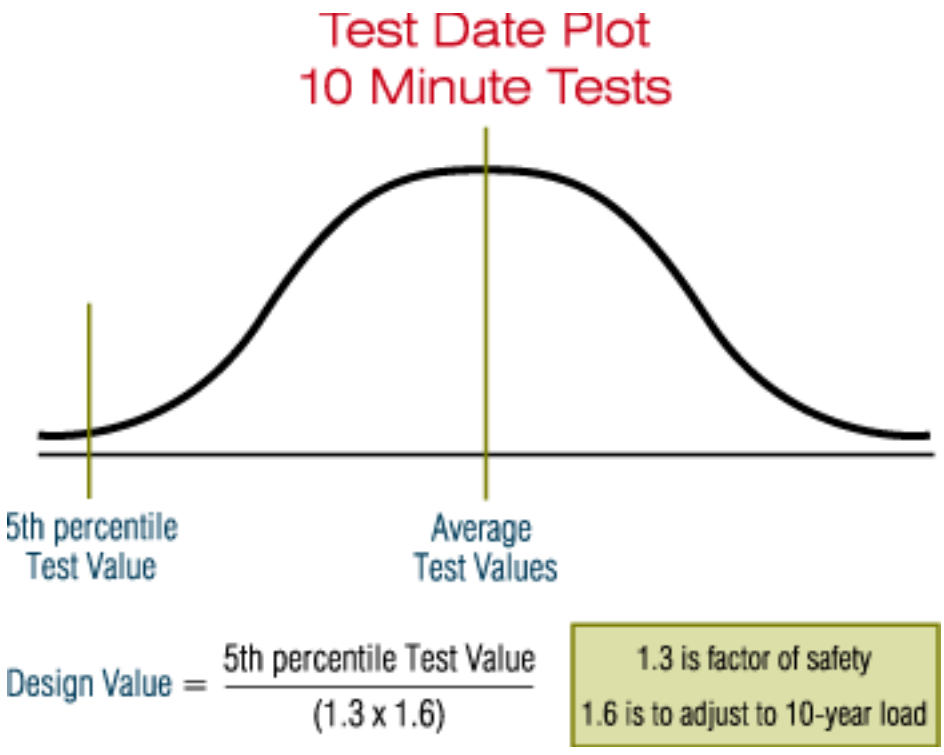
Frequently Asked Questions

Clarifying Factors of Safety by Ryan Dexter

"Both Cramer and Woeste's emails were intended to clarify the 2.1 factor of safety applied to the lower fifth percentile bending and tensile strength values."

We have received a few comments since publishing the March 2003 FAQ column entitled "Truss Design Factors of Safety." SBC staff wanted to clarify this issue especially after receiving email responses from two prominent engineering professors: Steven M. Cramer, P.E., University of Wisconsin-Madison and Frank Woeste, P.E., Virginia Tech.

Recall that the article stated: "According to ASTM D245 and ASTM D1990, the following factors of safety should be applied to the lower fifth percentile exclusion limit on clear softwood properties: 2.1 in bending and tensile strength parallel to grain, 1.9 in compressive strength parallel to grain, and 1.67 in compressive strength perpendicular to grain."



Both Cramer and Woeste's emails were intended to clarify the 2.1 factor of safety applied to the lower fifth percentile bending and tensile strength values. The non-mandatory commentary to the Standard for Testing Metal Plate Connected Wood Trusses ANSI/TPI 2-1995 addresses this topic:

"**§8.3.2** Failure loads for wood and tooth holding fracture are based on the nominal basic adjustment factor of 2.1 on the lower 5% exclusion limit given in Table 9 of ASTM D245 for tensile and bending stresses of softwood lumber and also used by ANSI/TPI 1-1995 [and ANSI/TPI 1-2002] in determination of the adjustment factors used in determining allowable tooth holding values. There are wood failure modes for which this adjustment factor is too high, i.e., compression parallel to grain of wood, which uses a factor of 1.9, and lateral buckling of wood, which uses a factor as low as 1.67. Although failures at these lower loads are possible, it is judged that since they occur rarely in most trusses, and seldom at these lowest levels, a factor of 2.1 is adequate to address all wood failure modes. However, if failure does occur in compression parallel to grain or lateral buckling or wood, it should be permitted that these lower adjustment factors be used, when such use is justified.

"...The design of wood members and wood fasteners is dependent upon the length of time the design load is imposed upon the wood. This is accounted for by the use of a duration of load factor."

Therefore, the 2.1 factor is the product of two separate factors: a 1.6 ten-year load duration factor and a 1.3 safety factor. Negating the load duration factor, the safety factor on the published allowable bending and tension stresses is 1.3, not 2.1. The only situation in which a truss design would have a safety factor of 2.1 would be if a short duration load (ten minutes or less) was the only load that was going to be applied to a truss designed for longer durations. For example, if trusses are designed for snow loads in Tennessee in an area that never sees any snow, then the factor of safety will be close to 2.1.

Are you more confused after this attempted clarification? Professor Cramer summed it up best with his assessment of this topic being a "complicated issue."

To pose a question for this column, email us at faq@woodtruss.com. To view other questions visit the WTCA website.

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