

# TECHLINE

## Properties and Use of Wood, Composites, and Fiber Products

### Strength of Visually Graded Structural Lumber

Procedures for assigning allowable strength properties to visually graded lumber were initially established about 50 years ago. They involve testing small pieces of defect-free wood and then modifying the resulting strength estimates. Adjustments are made for knot size and other naturally occurring growth characteristics and for such factors as moisture content, duration of anticipated load, and manufacture and use considerations. This procedure has served the public well over the years. However, modern wood structures are being engineered more precisely and better estimates of structural lumber strength are required.

The Forest Products Laboratory, in cooperation with representatives of the lumber industry, has completed the "In-Grade" testing program. The objective of this program was to develop strength data from tests of full-size lumber that had already been graded for sale to the public. The program was divided into two parts: (1) overall strength property evaluations and (2) study of the effect of variables such as moisture content and temperature on lumber strength.

The In-Grade program data were used to assign strength properties to all grades and species of visually graded wood. Allowable strength numbers in the National Design Specification span tables and all other design aids were revised as a result of this program. Engineers, architects, and contractors use these revised numbers to calculate allowable loads and to design wood members in structures.

The strength properties of more than 42,000 pieces of lumber were evaluated; 21 softwood and 3 hardwood species were represented. The results indicate that visually graded nominal 2 by 4 (standard 38 by 89 mm) lumber is stronger than previously thought. The study also indicates, however, that wider width lumber is not as strong as assumed.

New procedures were developed for adjusting lumber properties for change in moisture content. The new research indicated that tensile strength parallel to the grain, a property important in the design of wooden trusses, is not nearly as sensitive to changes in moisture content as previously assumed.

A new standard, D1990, was approved by the American Society for Testing and Materials (ASTM) to derive allowable properties from In-Grade data. These allowable properties were first incorporated into a supplement to the 1991 edition of the *National Design Specification for Wood Construction* and have been included in all subsequent editions.

*For additional information, contact:*

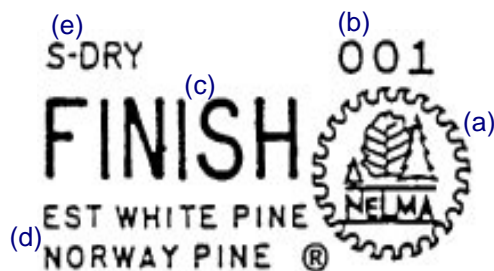
*Dave Green, Research Engineer*

*Forest Products Laboratory*

*One Gifford Pinchot Drive*

*Madison, WI 53705-2398*

*Phone: (608) 231-9261; FAX: (608) 231-9303*



*Sample grade stamp. (a) The trademark indicates agency quality supervision; (b) mill identification—firm name, brand, or assigned mill number; (c) grade designation—grade name, number, or abbreviation; (d) species identification—indicates species individually or in combination; and (e) condition of seasoning at time of surfacing.*

#### References

American Society for Testing and Materials. 1997. ASTM Standard D1990, Standard practice for establishing allowable properties for visually-graded dimension lumber from in-grade tests of full-size specimens. Annual Book of Standards, Vol. 4.10. West Conshohocken, PA.

American Forest and Paper Association. 1997. Supplement. National design specification for wood construction. 58 p.



United States  
Department of  
Agriculture

Forest  
Service

Forest Products  
Laboratory

Phone: (608) 231-9200; FAX: (608) 231-9592  
E-mail: mailroom/fpl@fs.fed.us  
Web site: <http://www.fpl.fs.fed.us/>