



MISSISSIPPI STATE UNIVERSITY™

Department of Sustainable Bioproducts

Executive Summary

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Supplement to AWI-SMA 0643 Standard

From: Rubin Shmulsky, Mississippi State University

Re: Development and comparison of hardwood and southern pine design values

Summary

Since approximately 2015, Mississippi State University has worked closely with the Stairbuilders and Manufacturers Association and the USDA Forest Service, Forest Products Laboratory in an effort to investigate design values of stair parts. Of particular interest were the strength (as measured by modulus of rupture) and relative stiffness (as measured by modulus of elasticity, MOE) values of five species groups that are routinely used in stair building. Some 1500 unique specimens were collected as currently being used by the stair building industry and tested in the laboratory. This report provides summarized details of this work¹. The grades and sizes of lumber used in stair construction and manufacturing do not currently have published design values. As such, one must calculate them based on the average strength values of representative clear wood specimens. These specimens may be sampled extensively and carefully from production. Alternatively, small clear specimen values from the USDA FPL Wood Handbook² may be used. The Wood Handbook's average values are however classic. Many are derived from data that is more than 100 years old, circa early 1900s. As such a specific and major objective of this project sought to test the material properties of 5 species groups: hard maple, red oak, southern yellow pine, white oak, and yellow poplar. Some of these species groups have published design values for structurally graded dimension lumber. Some do not. Next the work sought to compare the mechanical properties of these species groups, as tested per ASTM D143³, to those listed in the Wood Handbook and determine whether any changes, particularly reductions, seemed apparent. In general, the tested specimens showed properties that were similar to those listed in the Wood Handbook. Results did not suggest any major changes in material strength properties were evident between Wood Handbook values and the materials sampled and tested herein. This finding suggests that the small clear mechanical property values shown in the Wood Handbook remain robust and more or less reflective of the resource in the USA that is currently going into the stair building and manufacturing sector.

¹ Additional findings and details are provided in: **1)** Franca, F. J. N., Shmulsky, R., Racliff, T., Farber B, Senalik C. A., Ross, R. J., Seale, R. D., Yellow pine small clear compression properties across five decades. Submitted/Under review (Wood and Fiber Science). **2)** Shmulsky, R., Franca, F. J. N., Racliff, T., Farber B, Senalik C. A., Ross, R. J., Seale, R. D., Yellow pine small clear flexural properties across five decades. Submitted/Under review (European Journal of Wood and Wood Products). **3)** Turkot, C.G.; Seale, R.D.; Shmulsky, R.; França, F.J.N. Non-destructive tests of Red Oak (*Quercus* spp.) and White Oak (*Quercus* spp.) (Forest Products Journal) **4)** Carmona, M.G.; Seale, R.D.; França, F.J.N. Physical and Mechanical Properties of Clear Wood from Red Oak (*Quercus* spp.) and White Oak (*Quercus* spp.) (Bioresources). **5)** Carmona, M.G.; Seale, R.D.; França, F.J.N. Physical and Mechanical Properties of Clear Wood from Hard Maple (*Acer* spp.) and Yellow Poplar (*Liriodendron* spp.) (Forest Products Journal). **6)** Franca, F. J. N., Shmulsky, R., Racliff, T., Farber B, Senalik C. A., Ross, R. J., Seale, R. D., Interrelationships of specific gravity, stiffness, and strength of yellow pine across five decades. (Manuscript being completed by the authors at the time of this reporting).

² Forest Products Laboratory. 2010. Wood handbook—Wood as an engineering material. General Technical Report FPL-GTR-190. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 508 p.

³ American Society of Testing and Materials. 2014. ASTM D-143-14 Standard test methods for small clear specimens of timber. Conshocken, PA.