Direct Measurement of Wood Stiffness and MOE from Small Wood Samples

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ABSTRACT

Wood and fiber stiffness is one of the most important mechanical properties for the use of wood and fibrous materials. We describe a novel ultrasound based method for measuring wood stiffness with very high resolution. The velocity of sound travel through a material is directly proportional to the stiffness of the material. Stiffer materials transmit ultrasonic waves faster than flexible materials. Ultrasonic measurements are independent of mass, but when density is known the modulus of elasticity (MOE) can be directly calculated. We have developed an ultrasonic instrument that measures the longitudinal stiffness of small wood samples with a resolution of 1mm. Wood stiffness measured with ultrasound is highly correlated with stiffness obtained from traditional bending stiffness methods. On average latewood is 1.5 to 2 times stiffer than earlywood in loblolly pine. The MOE for latewood is on average 2-3 times greater. We have found that in the lowest log, (butt log) that the low stiffness juvenile core remains for more years of growth (~12) versus ~5 years in the 2nd and 3rd logs. Differences in stiffness are theoretically highly dependent on the cellulose microfibril angle of fibers. Preliminary results confirm that higher stiffness wood has a lower MFA.