Non-Destructive Testing on Six Tropical Woods using Ultrasonic Method

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Non destructive testing (NDT) using ultrasonic method was carried out on six tropical wood species consisting of four hardwood species, Sengon (*Paraserianthes falcataria*), Meranti (*Shorea sp.*), Manii (*Maesopsis eminii*) and Mangium (*Acacia mangium*), and two softwood species, Agathis (*Agathis loranthifolia*) and Pine (*Pinus merkusii*). The ultrasonic velocities propagation was measured to determine the dynamic modulus of elasticity (MOEd). Static modulus of elasticity (MOEs) and modulus of rupture (MOR) were also observed.

The objective of this study was to obtain correlations between dynamic test by ultrasonic (MOEd) and static bending test (MOEs and MOR) on small clear wood specimens.

Results showed that softwoods have higher velocities value and better reproducibility than those hardwoods. Poor correlation was found between ultrasonic velocities value and MOEs for each species. Meanwhile, MOEd has 50% higher value than that of static MOE (MOEs). However, there were significant correlation ($\alpha = 0.05$) between MOEd and MOEs, as well as between MOEd and MOR for all wood tested, except for Meranti and Manii wood species. The compared data for ultrasonic velocity and bending strength between hardwoods and softwood species denoted that for all parameters developed were highly statistically significant ($\alpha = 0.05$), except for relationship between ultrasonic velocity and MOEs in hardwood was non significant.

Key words: non-destructive testing, ultrasonic velocity, dynamic MOE (MOEd), static MOE (MOEs), MOR

Introduction

Non-destructive testing or evaluation is defined as the science of identifying the physical and mechanical properties of an element of a given material without altering its final application capacity (Ross et al., 1998). Non-destructive testing method has been extensively used for sorting or grading of wood products. Examples include visual grading and machining stress rating (MSR) of lumber. Dynamic modulus of elasticity (MOEd) and ultrasonic method also have been used for the same purpose. Ultrasonic stress wave is similar to the sonic stress wave approach except that is applied at higher frequencies. Ultrasonic is a high frequency sound at the inaudible frequency range. The ultrasonic method is very popular with homogenous, nonporous materials for detection of flaws (Bodig, 2000). In case of wood the frequency is between 20 kHz-500 kHz. The two most frequently used methods are the through transmission and the pulse-echo methods (Zombori, 2001). The through transmission method requires two piezoelectric transducers (mainly quartz crystals) on each side of the subject being inspected. In case