Wood Strength Analysis Based on Non Destructive Testing

Lina Karlinasari, Surjono Surjokusumo,
Yusuf S. Hadi and Naresworo Nugroho

Department Forest Products, Faculty of Forestry, Bogor Agricultural University
Email: karlinasari@ipb.ac.id

Strength wood analysis facilitates predicting residual strength. For the progress of durability and service life of wooden constructions through appropriate maintenance, it is important to detect deterioration, both physic and biology, of wooden constructions members quantitatively and precisely, and to accurately estimate/evaluate reductions in strength. For this purpose, establishment of reliable and practical methods to evaluate residual strength of wood is essential. These methods must be not only accurate but also non destructive and practical.

The finite element method (FEM) with beam analysis was used successively to simulate and model the fracture of wood (Launay, et al., 2002; Vasic, Smith and Landis, 2005). The finite element method (FEM) is a numerical analysis technique used by engineers, scientist, and mathematicians for solving which are described by partial differential equation or can be formulated as functional minimization.

The objective of this study is to obtain correlations between dynamic test by ultrasonic (MOEd) and static bending test (MOEs and MOR); and to analyze wood strength obtained both non-destructive and destructive testing through finite element (FEM) approaches.

The pieces are boards, which is pattern as plank and small wood specimens. The non-destructive testing is developed through ultrasonic wave velocity measurement. Determination of the mechanical properties of wood by ultrasonic propagation is based on the correlation between the velocities of ultrasonic wave, the density and the MOE. The ultrasonic velocity is used to express the dynamic modulus of elasticity (MOEd). Static bending test is done to determine the static modulus of elasticity (MOEs) and modulus of rupture (MOR).

Relationship between MOEd and MOEs; MOEd and MOR are assessed to find statistical correlation between statically and dynamically established moduli. Least squares regression analyses are used in this study. Data from MOEd and MOEs are used as input for stress analysis through FEM approaches. Bending stresses as a function of beam geometry and load location, which is useful for beam design, can be assed. Beams with various defect detected by ultrasonic velocity are modeled with the load present at the center of the beam. The numerical model is used to analyze the effect inner condition expressed by ultrasonic velocity on stresses. Some FEM software facilitates a modeling of beam stress, such as Nastran and Abaqus software.

Key words: non-destructive testing, MOEd, MOEs, MOR, finite element method.