

**UNIVERSITI TEKNOLOGI MARA**

**EVALUATION OF SELECTED TIMBER  
PROPERTIES USING DIELECTRIC CONSTANT  
BY LOW FREQUENCY TECHNIQUES**

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## **ABSTRACT**

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Currently, nondestructive studies have been carried out in various fields in timber engineering. However, fewer of the research focus on non-destructive evaluation by means of electromagnetic field in low frequencies. This research is focuses on the application and development of Capacitor Probe and Parallel Plate Electrode System in low frequency range of 1 kHz to 100 kHz. A Capacitor Probe and Parallel Plate Electrode System developed at Universiti Teknologi MARA were used to measure the electromagnetic property that is the dielectric constant of wood.

For this study, 61 selected small-size specimens from seven strength groups of timber were taken for observation. Another 120 selected full-size specimens from Strength Group 5, 6 and 7 specified in MS 544:2001 were taken for static bending test. The experimental results proved that 100 kHz is the most suitable frequency for timber application. The dielectric constant with respect to timber grade, strength group, moisture content, density, timber defects and modulus of elasticity were discussed. The results indicated that dielectric constant has strong significance relations to the moisture content and density. Moderate relation was found between MOE and the dielectric constant. However, it shows potential for prediction of timber grade, strength group and defects detection in timber. Nonetheless, the use of the measured dielectric constant shows the ability of the approach systems in the evaluation of the properties of timber.

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# CHAPTER 1

## INTRODUCTION

### 1.1 General

Malaysia is a tropical country covered with tropical rain forest. It is estimated that there are more than 2500 species of timber in this country (Anon 2002c). About 94 species of timbers have been studied and categorised into seven main strength groups based on the physical and mechanical properties by the Forest Research Institute of Malaysia (FRIM). Nevertheless, the physical and mechanical properties of timber have been difficult to measure since its properties are in tri-directions and classified as an anisotropic material (Kermani 1999).

Information on the properties of woods either the physical or the mechanical properties are important for construction and industrial purposes. There are two types of measurements in examining wood properties, namely destructive and non destructive. Current practice in Malaysia for the non-destructive method is by using Visual Stress Grading (VSG). VSG is a method applied to determine the physical properties of wood such as types and sizes of wood defects. This method is currently applied for the purpose of timber grading. Other physical properties such as moisture content (MC) and density can be evaluated using both methods that are non-destructive and destructive. The non-destructive method is by using the existing equipment currently available that is the Resistance Measuring Moisture Meter. Whilst the destructive method is the conventional oven dry method.

Mechanical properties of wood are mainly measured using the universal testing machine. Some of the mechanical strength properties of wood are static bending, impact or dynamic bending, compression parallel or perpendicular to the grain, shear parallel to the grain, hardness test and tension parallel to the grain. This study focuses on the static bending test since the strength of wood is often thought of in terms of bending strength (Pun 1997).