MEASUREMENT OF MOISTURE CONTENT OF MALAYSIAN TIMBER USING A FREE-SPACE TECHNIQUE

Thesis presented in partial of fulfillment for the award of
Bachelor of Electrical Engineering (Hons) by
MARA INSTITUTE OF TECHNOLOGY

SANADI BIN ZAINOL
FACULTY OF ELECTRICAL ENGINEERING
MARA INSTITUTE OF TECHNOLOGY
40450 SHAH ALAM
SELANGOR
NOV 1998

ACKNOWLEDGMENT

In the name of Allah and His Messenger, I would like to thank Allah for giving me strength and health to conduct this project and to finish my thesis.

I would like to express my sincere gratitude to my project supervisor Dr.Deepak Kumar Ghodgaonkar for his continuous support and guidance during working on this project. Also Prof. Ir. Dr. Hj. Wan Mahmood B. Wan Abd. Majid and Pn. Norasimah Bt. Khadri for their guidance towards the completion of my thesis.

I would like to thank all the staffs of communications laboratory and to the workshop staff of school of Mechanical Engineering, En. Ramli for their cooperation. Also to my friends Munawir and Mohd. Noor for their supports and helps during working on this project.

Finally, my deepest thank to my family for their support.

ABSTRACT

From dielectric constant and loss tangent data, characteristics of timbers such as moisture content and slope of the grain can be measured. Microwave nondestructive testing was used in this experiment to obtain the dielectric constants and loss tangents. Malaysian timbers: Light red meranti, Yellow meranti and keruing were used. Wiltron Vector Network Analyzer, a pair of spot-focusing horn lens antenna, coaxial cables, transitions and a printer were the equipment used in this experiment. A free-space microwave measurement system was used for reflection coefficient measurements of metal-backed specimens in frequency range of 7.5 GHz to 14 GHz. The dielectric constant and loss tangent were calculated when the grain angle of the sample was parallel and perpendicular to the polarization of electric field intensity, E. From the result of dielectric constant, moisture content of the wood can be calculated, by using dielectric mixture theory.

Contents

CHAPTER 1

1. INTRODUCTION. [1]

The use of wood as a structural material is handicapped by its large and difficult-to-predict variation in mechanical properties. Substantial safety margins have to be applied to all wood members to guard against failure of the very weakest pieces. As a result, wood structural design is forced to be very conservative, often to the point of being uneconomical or uncompetitive. This wasteful practice seriously under-utilizes the large majority of the pieces having strengths greatly exceeding those of the few very weak ones. Accurate strength grading increases the uniformity of strength among a batch of lumber, and therefore allows wood structural design to be less conservative and more economical while still maintaining the same level of structural safety.

Conventional grading system generally use statistical strength correlation based on coarse-resolution measurements of a single wood property, usually bending stiffness. Such systems have only modest wood strength identification capabilities because they measure only one strength indicating factor at a resolution much coarser than the size of strength controlling features such as knots and grain distortions. Also, the conventional grading systems heavily rely on statistical calibration. Thus, they are prone to additional error when individual production runs of lumber deviate from the characteristics of the sample used for the initial statistical calibrations.