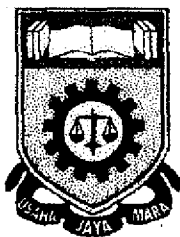


**MEASUREMENT OF DIELECTRIC CONSTANT AND LOSS
TANGENT OF CONCRETE USING LCR METER**

**Project ilmiah presented in partial fulfillment for the award of the
Bachelor of Electrical Engineering (Honours)
UNIVERSITI TEKNOLOGI MARA**



MOHD ROZAIMAN RAZALI
Faculty of Electrical Engineering
UNIVERSITI TEKNOLOGI MARA
40450 Shah Alam
Selangor Darul Ehsan
October 1999.

ACKNOWLEDGEMENT

**In the Name of Allah
Most Gracious Most Merciful**

Firstly, I wish to express my gratitude toward my supervisor, Associate Professor Dr Deepak Kumar Ghodgaonkar, for allowing the chance to work under his guidance, opinion and full support in completing this thesis.

Hereby, I would like to express my deepest thank to my family, especially my parents for their understanding, support and encouragement in completing this course and this final year thesis.

My sincere and special thanks to all my colleagues, friends, lecturers, staffs of Communication Lab, Faculty of Electrical Engineering for their support and providing access to required materials for the completion of this thesis.

ABSTRACT

Moisture content of concrete can be a quality factor reference in determining the strength of a structure. Moisture content too, plays an important role in contribution of electrical properties of insulating materials such as concrete. Thus, we are developing simple measurement technique using low frequency device (LCR meter) to obtain the quality of concrete used in a structure.

The objective of this project is to offer an on-site assistant option especially for the civil engineer to determine the quality of concrete used by measuring its electrical property.

TABLE OF CONTENTS

Declaration	i
Acknowledgement	ii
Abstract	iii
Table of Content	iv
List of Figures	vii
Notation	ix

CHAPTER 1 INTRODUCTION

1.1	Measurement Of Dielectric Constant and Loss Tangent of Concrete	1
1.2	Scope of the Project	2

CHAPTER 2 BASIC THEORY OF ELECTRICAL PROPERTIES

2.1	Frequency Definition	3
2.2	Wavelength Definition	3
2.3	Conductivity	4
2.4	Complex Permittivity	5
2.5	Dielectric Constant	7
2.6	Loss Tangent	9

CHAPTER 1

INTRODUCTION

1.1 Measurement of Dielectric Constant and Loss Tangent of Concrete [1]

The need for accurate and easy on-site measurement method for the determination of concrete used or hardened concrete arises in connection with the shrinkage and thermal conductivity of the concrete. Because dielectric properties of hardened concrete, like a wide variety of other material, changes with the moisture content, a number of investigators have used dielectric measurement to determine the moisture content and the quality of concrete used in building a structure. The parameter defining these measurements is dielectric constant and loss tangent.

Hammond and Robson,[2] in the United Kingdom, were the first to report the result of dielectric measurement on concrete. Their result indicated that the dielectric constant values for different types of cement concrete had different values. They also reported that the dielectric constant of all specimens, irrespective of the type of concrete, decreased with age as frequency increased. Also within the range relatively low water content tested the dielectric constant increased with increasing water content.

In North America, Bell et al. [3] have measured capacitance and loss tangent for 3 inch (76-mm) diameter disks of mortar and concrete at different moisture contents at a frequency of 10^6 Hz, using a General Radio Type 1610 AH-assembly. Except for unusually severe drying of concrete or high salt content of pore water, these properties indicated moisture content below about 6 percent, with an accuracy of about ± 0.25 percent. Bell et al. also performed