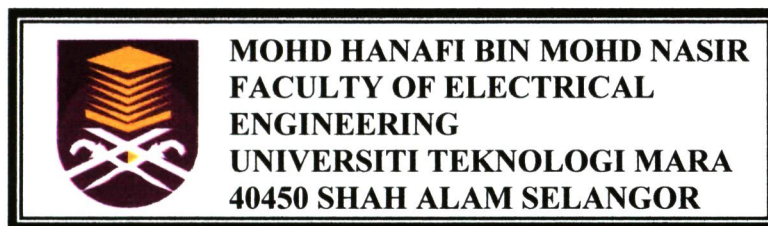


**SIMULATION OF MICROWAVE NO DESTRUCTIVE TESTING
ENVIRONMENT (MNDT) TO DETERMINE DIELECTRIC
CONSTANT OF CONCRETE BLOCK USING WAVEGUIDE
PORT APPROXIMATION AT 8-12 GHz (X-BAND) IN CST
MICROWAVE STUDIO**

**A thesis submitted in partial fulfilment of the requirement for the awards of the
Bachelor Engineering (Hons.) in Electrical**



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ABSTRACT

The main objective of this research is to determine the dielectric constant of a concrete block using the CST Microwave Studio at frequency 8-12GHz(X-Band) and thus compare the result from the real environment measurement setup. Microwave non Destructive testing is a method used to determine the characteristic of a material without changing its natural properties. Concrete block has an ideal characteristic of dielectric constant which is in between 2.1 – 2.3. For this particular research, 2.2 is chosen as the benchmark to be obeyed. Besides the dielectric constant, the behaviour of wave propagating through a Gaussian Optic Lens antenna is also studied and how the wave penetrates the concrete block is also focussed on. The simulations are done using the CST Microwave Studio software and Microwave Non destructive Testing (MNDT) environment is modelled accordingly to get the results. There are 10 concrete blocks which are chosen to be the sample for this research. The values of dielectric constant of each sample are obtained from the real measurement setup. The most flexible solver is chosen which is the transient solver and with this solver it is possible to obtain the broadband frequency behaviour of the simulated device from only one calculation run. All results from simulation are observed and discussions are made from the result. From the simulation, the average value of dielectric constant is 2.5874 which is greater than the benchmark for this research set at 2.2 and the average percentage error between simulation and real measurement is 0.24754%. From this research, a conclusion can be made where the Free Space Measurement Method environment modelling using CST Simulation is only possible to be recreated when enough information about the antenna design is provided. Therefore a close approximation is taken, where waveguide port approximation method is used, in order to meet the objective of this research where dielectric constant value needed to be determine thus compare all simulated values to the real measurement values.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Microwave non Destructive Testing is a contactless technique which can be implemented by measuring electrical parameters such as complex permittivity and complex permeability as a function of frequency and temperature. Some of the advantages of applying this method are saving both money and time in product evaluation, troubleshooting, and research. In this research, the environment of the MNMT techniques were simulated using CST Microwave and S-parameter results were observed. From the results, dielectric constant of the simulated concrete block can be determined. This simulation is basically done to show that the value from real measurement setup and value from simulation are the same or almost the same. Therefore, an appropriate design was taken into consideration and in this simulation, waveguide port approximation is used. From the simulation, the wave propagation can also be observed.

1.1.1 Microwave Non Destructive Testing

Microwave non Destructive Testing can be performed in many ways such as free space and rectangular or coaxial waveguide. This method is widely used for geometrical sized and quality control of different material such as liquids, polymers, fibreglass, ceramics, water etc. This quality control process may be performed either during the fabrication of product which target to change some technological parameters or after the fabrication to determine the quality of a product. Microwave