

**CORRELATION STUDY OF MICROWAVE NON DESTRUCTIVE
TESTING (MNDT) AND ULTRASONIC PULSE VELOCITY (UPV)
ON CONCRETE BLOCK**

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IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

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ABSTRACT

The main objective of this project is to study the relationship of the electrical properties by using microwave non destructive testing (MNNDT) and ultrasonic pulse velocity (UPV). In this project, ten sample of concrete block are use. The electrical properties of interest in microwave non destructive testing (MNNDT) are dielectric constant, loss factor and loss tangent, but for ultrasonic pulse velocity (UPV) the properties that involved are path length, velocity and also the transit time that the wave propagate from transmitter to the receiver. In order to know this relationship, five stages of process are involved which is collecting the sample of the concrete block, measure by using microwave non destructive testing (MNNDT) , finding the electrical properties by using FORTRAN software based on S_{11} and S_{21} parameters, measure the properties of concrete block using ultrasonic pulse velocity (UPV) and correlation process. In this project, firstly the concrete block sample was measured the concrete block by using Free Space Measurement System (FSMM) via the method of microwave non destructive testing (MNNDT) at X-band which is 8 GHz to 12 GHz. The FSMM system consists of WILTRON 37269 Vector Network Analyzer (VNA), a pair of spot focusing antenna, mode transitions, coaxial cables, sample holder and computer. Each of the concrete blocks has a different of electrical properties. After done the measurement by using microwave non destructive testing (MNNDT) the same sample was remeasured by using Pundit Plus Ultrasonic Tester via the method of ultrasonic pulse velocity (UPV) in order to know its path length, velocity and transit time. From the result obtained, clearly the relationship by using microwave non destructive testing (MNNDT) and ultrasonic pulse velocity (UPV) can be made.

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CHAPTER 1

INTRODUCTION

Concrete is effectively an artificial stone or rock. Its primary properties are that it is workable before hardening, strong in compression and stays strong for extremely long timescales. Concrete is a strong hard building material composed of sand and gravel and cement and water. It is used for making buildings, roads, bridges, vessels pipes etc. As the concrete formulations develop concrete is increasing its range of applications such that it is making inroads into those presently monopolized by metals. Actually, concrete is a mixture of a binding agent which is generally cement to bond the other materials together such as fine aggregate (sand), coarse aggregate (gravel/stones), and water.

Non destructive testing (NDT) is the testing of materials to detect internal and surface defects or discontinuities using methods which do not damage or destroy the material under test. There are five major NDT methods namely; Radiography, Ultrasonic, Magnetic Particles, Liquid Penetrant and Eddy Current.

Non destructive testing (NDT) has been used widely in industrial sectors such as petroleum, petrochemical, ship construction, aircraft, railway, power station, gas pipeline etc. Materials used in these industries are mostly made from steel and aluminums which involved processes such as welding, casting, forging or machining during construction. The quality of the product was checked and evaluated by NDT methods. The use of NDT in inspecting concrete is not as common as in the metallic construction. This may be due to lack of demand or no specific requirement by code or standard from the related sectors as compared to metallic construction. However, research and development activities in various NDT methods indicate that NDT has a great potential to be applied on concrete structures.

Microwave is one of the nondestructive which is the method that used for measuring the electromagnetic properties of the materials. It can be performed in many ways such as