

**INVESTIGATION ON APPLICABILITY OF
ULTRASONIC PULSE VELOCITY MEASUREMENTS
TO ESTIMATE THICKNESS OF REINFORCED
CONCRETE WALL PANEL**

Z.T.M. FAZLI

(168907G)

Degree of Master of Science in Structural Engineering Design

Department of Civil Engineering

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Name of the Supervisor: Dr. Mrs. D. Nanayakkara

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ABSTRACT

In Sri Lanka, Concrete has been widely used as a construction material for more than hundred years and it is necessary to analyse some of these existing old structures to check their structural adequacy, for retrofitting works, repair works and rehabilitation works, etc. For these purposes it is necessary to know the sectional dimensions of structural elements and reinforcement details to evaluate the structural adequacy with the existing strength of concrete. In most of the cases it may not be possible to find the structural drawings to obtain these required structural details and also it may not be possible to measure the required thicknesses of structural elements due to accessibility problems. The objective of this research study is to establish a suitable non destructive method to estimate the thicknesses of various types of concrete members with accessibility problems. Hence, from a thorough literature study, it was found that using ultrasonic pulse velocity methods it could be possible to determine the uniform thicknesses of concrete walls. It is reported that this ultrasonic pulse velocity is affected by the concrete properties as well as the other factors such as temperature, stress history/ level of stress, path length, moisture and curing condition of concrete, presence of reinforcement and size and shape of the specimen.

Accordingly, testing was conducted to study the influence of reinforcement percentages and to observe the influence of some other parameters such as age of concrete, moisture condition and temperature on the accuracy of the thickness predictions using ultrasonic pulse velocity method. Further to verify the results, some existing structures were also investigated. From this experimental study and the field investigations, it is found that the UPV test method could be used to estimate the thickness of concrete walls with a reasonable accuracy.

Specially dedicated to my beloved family and friends...

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LIST OF ABBREVIATIONS

Principal List of Acronyms and Abbreviations are presented below.

Abbreviation	Description
ρ	Density
C	Velocity of sound on the specimen
d	Thickness of Sample
E	Moduli of elasticity
E_d	Dynamic modulus of elasticity
f	Fundamental frequency
f_1	Strength of a standard saturated specimen
f_2	Actual strength of the in-situ concrete
f_n	Corresponding Frequency
G	Moduli of elasticity
k	Constant relative to compaction control
L_s	Length of the r/f bar in mm
MIRA	Ultrasonic Tomography Device
NDT	Non Destructive Test
PUNDIT	Portable Ultrasonic Non- destructive Digital Indicating Tester
QA	Quality Assurance
QC	Quality Control

t	Thickness of the upper layer
UPV	Ultrasonic Pulse Velocity
USA	United States of America
V_1	Pulse velocity in upper layer
V_2	Pulse velocity in lower layer
V_c	Pulse velocity in concrete
V_m	Apparent pulse velocity
V_s	Pulse velocity in steel r/f bar
x	Spacing where the discontinuity of the plot is observed
ν	Dynamic Poisson's ratio
ν	Poisson's ratio
λ_n	Wave length