



# A Study on the Arrival Time of Ultrasonic Waves in Concrete Material

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**Abstract.** Concrete is one of the most critical materials being used in construction project. Ultrasonic testing is a conventional non-destructive test method, that is adopted to evaluate the condition and quality of concrete structure. This is important to ensure the strength and resilience of built structures. This paper aims to assess the arrival time of the ultrasonic waves in concrete structure by employing ultrasonic through-transmission method. A simulation study was performed in COMSOL Multiphysics software. Data were collected and structured into three sections, including in homogenous concrete model, as well as concrete model with inclusion of air voids and cracks. This study investigates the influence of size of air voids and position of cracks on the arrival time of the received ultrasonic signal. The waves diffraction at the defects increase the arrival time of the received signal.

**Keywords:** Arrival time · Concrete · Through-transmission · Ultrasonic

## 1 Introduction

Concrete is mainly composed of Portland cement and aggregates (gravel, sand, or rock) that mixed together with water to form a workable paste that solidifies and hardens over time. It is the most reliable manmade material which has been extensively used in the construction, such as buildings, roads, bridges, dams, and other structures. It is used to provide strength, durability, and versatility during the construction process [1]. However, concrete may degrade over time due to various reasons, including mechanical overloading, high-temperature exposure, environmental factors, deicing salts