EFFECTS OF POROSITY AND DISTRESSES IN CONCRETE ON ULTRASONIC PULSE VELOCITY READINGS

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Ultrasonic Pulse Velocity (UPV) testing is a crucial non-destructive technique employed in the evaluation of concrete structures, providing insights into concrete properties and identifying potential damage. In this study, we delve into the intricate relationship between UPV readings and various factors, such as concrete age, concrete mix type, and the presence of discontinuities like voids and cracks. Understanding the impact of these variables on UPV readings is essential for accurate and reliable assessments of concrete integrity. Concrete age plays a significant role in UPV measurements. Over time, the UPV values notably increase, reflecting the maturation and strengthening of the concrete. To establish a link between UPV and concrete strength, we analysed equations sourced from existing literature and compared their applicability, particularly for early age concrete. These equations proved invaluable in estimating concrete strength from UPV values, with minimal deviations observed in the case of 10% and 15% processed Sugarcane Bagasse Ash (SCBA) blended concrete mixes. However, a different trend emerged for 20% SCBA blends, where significant deviations were observed, suggesting that the UPV strength evaluation method may not be suitable for such high SCBA inclusion levels. The incorporation of processed SCBA into concrete mixes revealed intriguing results. SCBA, known for its pozzolanic properties, played a crucial role in enhancing UPV values, particularly in the case of 20% blends. This increase in UPV values can be attributed to additional chemical reactions promoted by SCBA and the improved compactness of the concrete. For 10% and 15% SCBA blended concrete, UPV equations from the literature demonstrated remarkable accuracy in estimating concrete strength, aligning closely with the results obtained from destructive concrete cube tests. This finding underscores the practical utility of UPV as a non-destructive strength assessment tool, especially for concrete blends incorporating moderate levels of SCBA. Another critical aspect explored in this study is the influence of discontinuities, such as voids and cracks, on UPV values. The presence of these flaws in concrete led to a noticeable decrease in UPV readings. This phenomenon allowed us to leverage UPV testing as an effective means of identifying damage locations within concrete structures and quantifying the severity of cracks. By doing so, UPV testing contributes significantly to the early detection of structural issues, facilitating timely repairs and maintenance.

In conclusion, Ultrasonic Pulse Velocity (UPV) testing emerges as a valuable and multifaceted non-destructive evaluation technique for assessing concrete properties and detecting damage. It provides a reliable means of correlating UPV values with concrete age, estimating concrete strength in SCBA blended mixes, and identifying the presence and severity of voids and cracks within structures. The findings of this study underscore the importance of UPV testing in enhancing our understanding of concrete structures and ensuring their long-term durability and safety. As the construction industry continues to evolve, the incorporation of UPV testing into standard inspection and maintenance protocols is a wise investment in the health and longevity of concrete infrastructure.

Keywords: Concrete properties, Non-destructive testing (NDT), Destructive Testing, Ultrasonic Pulse Velocity (UPV), Reliability of UPV

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Objectives

The following objectives are to be achieved:

1. Finding the response of UPV values at different ages of concrete
2. Investigate the variability of UPV measurements in concrete containing different percentages of SCBA (processed sugar cane bagasse ash) as a partial replacement for cement
3. Explore the response of UPV values to the presence of discontinuities such as voids and cracks within a concrete specimen

Methodology

Identifying the working principal of UPV. Investigating to recognize potential research gaps

collection of past data and information on the proposed research gap.

Conducting experiments to validate the information on literature.

Develop a theoretical measurement to improve UPV measurements and/or detecting distress conditions

RESULTS & ANALYSIS

2.3 Concrete strength evaluation through UPV method

UPV values can be utilized to obtain the concrete strength ;t researchers have proposed equations to correlate UPV values with the concrete compressive strength. In this study investigator has selected two of the most vastly used UPV strength evaluation equations. (Said & Ali, 2021)

(1) $c = 0.173e^{1.157D}$ (Said & Ali, 2021)

(2) $c = 1.19e^{0.715D}$ (Said & Ali, 2021)

Where 'c' denotes concrete strength and 'D' denotes UPV values.

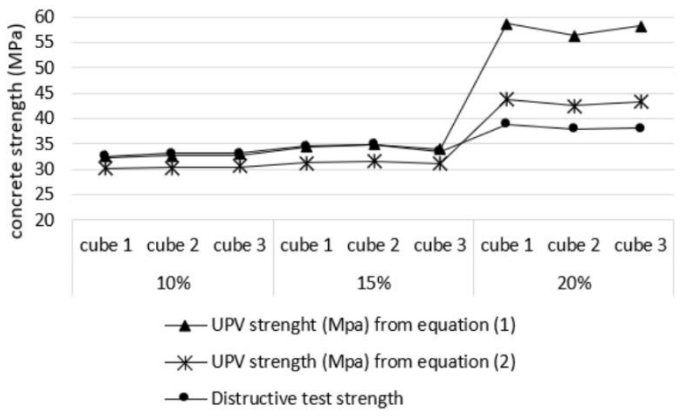

Figure: Comparison between UPV strength and destructive test strength for SCBA blended concrete

CONCLUSION: This research highlights the significance of Ultrasonic Pulse Velocity (UPV) testing in assessing concrete properties and detecting structural damage. UPV values exhibit a clear correlation with concrete age, but caution is advised when using UPV for strength evaluation in concrete blends with high SCBA content. Moreover, UPV testing proves effective in identifying and quantifying the severity of cracks within concrete structures, enhancing our understanding and assessment of their integrity.