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# A Review Paper on Detection of Crack Depth using Ultrasonic Pulse Velocity Test with different Grades of Concrete

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***Abstract:*** ***With the sudden changing of methods in construction of new infrastructures facilities all across the developing countries there is an increasing needs to assess the condition of structures to determine their safety and reliability using Non Destructive Testing methods. The major problems arises in safety of these structures is the presence of defects in the materials which can act as a cracks. The four criteria need to consider while deciding the type of defects are type, size and location. In many research works, it is indicated that Ultrasonic pulse velocity test are more preferable to determine the concrete properties. Many research works were studied regarding Ultrasonic Pulse test on structural elements and we need conclude that UPV test should be done using various grades of concrete on beams with cracks and to observe if we go higher on grade what effect of cracks gives us the difference in UPV values, crack depth and to determine concrete condition.***
***Keywords: Non Destructive Testing, Cracks, Ultrasonic Pulse Velocity Test.***

## I. INTRODUCTION

When performing an UPV test, an UPV waves can be passed through an object by means of probes at some velocity. The sound velocity of a given material is depend upon the modulus of elasticity. Application of UPV test causes an interaction between object with reflection of sound waves back to the probe. UPV test requires a probes for transmitting and receiving signals, to and from an structural member, a probe connected to an ultrasonic test machine and a monitor for viewing test results. Electronic pulse can be generated from transducers can be convert into ultrasonic pulses by ultrasonic transducers.

When the pulse is passed in the structural member from a transducer, it undergoes many reflections at different phases within the structural member. A system of sound waves are generated which includes longitudinal, shear and surface waves. The receiver detects the longitudinal waves which are fastest. The material without any defects results in a higher velocity and vice versa. Thus by calculating this velocity we can determine the conditions of concrete as the values of velocity ranging for quality of concrete is given in IS 1311 part 1-1992. This test is conducted by passing a pulse of ultrasonic through concrete to be tested and measuring the time taken by pulse to get through the structure. Higher velocities indicate good quality and continuity of the material, while slower velocities may indicate concrete with many cracks or voids. Ultrasonic testing equipment includes a pulse generation circuit, consisting of electronic circuit for generating pulses and a transducer for transforming electronic pulse into mechanical pulse having an oscillation frequency in range of 40 kHz to 50 kHz, and a pulse reception circuit that receives the signal.


Figure -1: Ultrasonic Testing on cracks

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## II. LITERATURE REVIEW

1) *T Sri Kalyan et al(2016)[9] :* Pulse velocity readings were taken at different positions in cube. He concluded that UPV test can be employed in detection of cracks but this cannot be used solely and should be accompanied by other NDT techniques for better accuracy.
2) *J. Wolf et al(2015)[8] :* The concrete beams was casted , two ultrasonic sensors are embedded 0.3m away from the longitudinal edge, 0.15m deep in the specimens middle resulting in a distance of 0.9m between them reinforcement bars covers the specimen length in 4 corners kept in place by stirrups every 0.14m. This test was carried out to test the sensitivity of the ultrasonic sensors to detect growing cracks within a concrete. The USPV of signals travelling through loaded beams indicate a faster drop than the USPV signals traveling through unloaded beams. This is due to crack opening every single time under compression.
3) *Wiistenburg et al(1979)[1] :* A method of determining depth propagation of a defect in a body by ultrasonic materials testing wherein a first angle probe having an ultrasonic wave transmitting oscillator produces a scatter signal at structural inhomogeneities of a body formed with a defect and the scatter signal is received by an ultrasonic wave receiving oscillator of a second angle probe, which comprises: transmitting an ultrasonic wave at a first angle along a first line in direction towards the defect so that the scatter signal there at is shadowed by the defect and diminished in intensity; receiving the diminished signal from the defect at a second angle in a direction along a second line intersecting with the first line at the defect, transmitting additional ultrasonic waves and receiving diminished scatter signals along respective lines intersecting at the defect at varying depths of the body.
4) *Ari Wibowo et al(2014) [6] :* Their aim was to study the accuracy of crack depth in RC beams measured by UPV. 4 variation of 15 concrete beams were tested and one variation of unreinforced concrete beam with various thickness cover of 2,3,4 cm. The concrete beam was of size 15*20*50 cm. Artificial crack was made by zinc plate and concrete was tested at 28 days with longitudinal having 8mm bars and transverse having 6mm bars. UPV test was done using indirect way and transducers were placed 5cm from the crack line. The frequency used was 54khz. Crack measurement was obtained by time and distance wave. The average relative error of reinforced concrete compared with unreinforced concrete was not significant. He concluded that higher thickness cover concrete the smaller relative error of UPV crack depth.
5) *Roberto C. Pinto et al(2014) [12] :* Three series of concrete specimens were cast. Series 1 consisted of 8 concrete prisms of 150 x 250 x 700 mm with vertical cracks of 75 and 100 mm of depth and crack width of 6 mm, with four replicates for each crack depth. Series 2 consisted of four concrete prisms of same size, with vertical cracks of 50, 75, 100, and 150 mm, and crack widths of 0.5 mm. These specimens were produced in order to verify the possible influence of crack widths in the estimate of crack depths. In order to apply Method B, a third series comprising of concrete prisms of greater length was produced. Four concrete prisms of 200 mm x 200 mm x 800 mm with vertical crack of depths of 50, 75, and 100 mm, and crack width of 2 mm were chosen. The results indicated that the method developed as an extension of the one in the BS 1881 standard with at least four readings was able to improve the overall estimation with an estimated error close to 10%, smaller than the errors from the others methods. This method also permits the estimation of the ultrasound pulse velocity in the region tested.
6) *S.K Ramamoorthy et al(2003)[3]:* They determined depth of surface breaking cracks in concrete using ultrasound diffusion technique. UPV test are conducted on beam and frequency used ranges from 400-600khz. At these frequencies ultrasound is scattered. The arrival of signal is delayed at the receiver due to presence of cracks. Numerical and analytical command were also used in comparisons. This technique is applicable to cracks greater than mean scattering path which is estimated about 1cm.

## III.CONCLUSION

By studying this literature studies we came to conclusion that Ultrasonic pulse test is a significant test to detect cracks, voids, inhomogeneity in structure but as of now UPV test is not performed on the different grades of concrete as from low grades to higher what values of UPV are observed when cracks of certain depth are made artificially and by changing some parameters including probe sizes, probe frequencies using standard methods of UPV test. UPV test should be conducted with different grades of concrete to observe the change in values of UPV with change in parameters.

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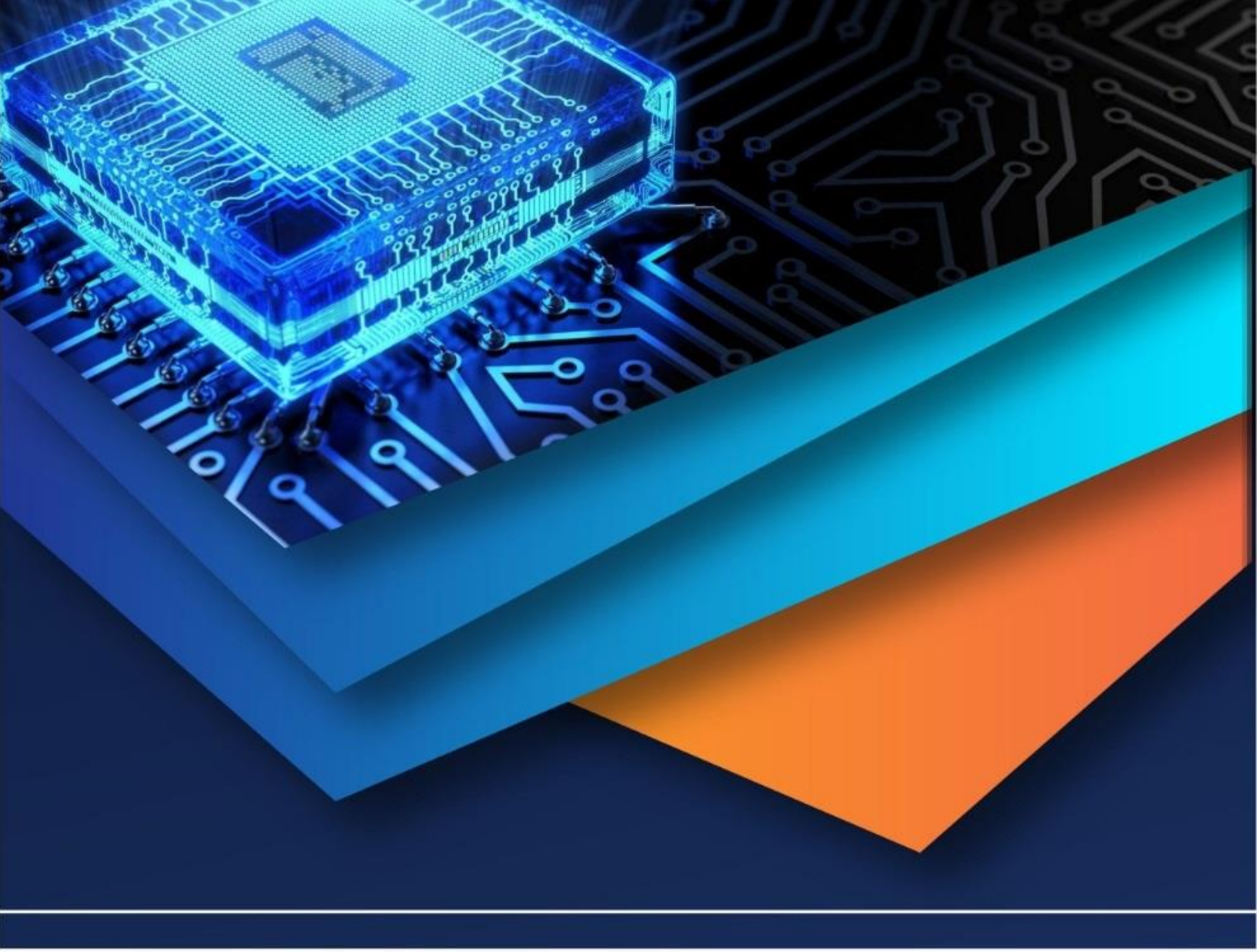

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