STUDY OF AGE OF CONCRETE BY VARIOUS ULTRASONIC PULSE VELOCITY TESTS METHODS ON CONCRETE

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ABSTRACT

Ultrasonic pulse velocity test has been employed for evaluation of quality of concrete in terms of its Homogeneity. The test has been conducted at various age of concrete element to decide the quality. As such the Guidelines are silent about the right age of concrete for such Testing; it has been observed that Ultrasonic Pulse Velocity on the same element varies with age.

An attempt is made to study the variation of UPV versus Age. Series of Experimental were conducted on CC Cubes, Beams of Concrete as well as mortar, to evaluate the effect of Age. Experiments were carried on 7, 28 and 56 days after casting. Results were analyzed to evaluate the Variation in Ultrasonic Pulse Velocity diff. Methods namely Direct, Indirect & Semi-direct employed for the experimentation. The paper presents detail methodology, results & Conclusion.

Keywords: UPV test, Age of Concrete and Homogeneity.

1.0 INTRODUCTION

Non-destructive test methods for concrete are based on different fundamental principles like electrical, mechanical, optical, magnetic, radiographic, acoustic, and thermal. In this study the Properties of concrete has been finding out by the fundamental principle of Sound or acoustic which is Ultrasonic Pulse Velocity Test Method.

The properties of concrete including Homogeneity of Concrete, Presence of cracks, voids, segregation etc can be evaluating by the Ultrasonic Pulse Velocity Method. Tests can be carried out either by direct or indirect method. Study was carried by determining Ultrasonic pulse velocity at various age of concrete.
1.1 Aim and Objective

Concrete material consist of two separate constituents i.e. matrix and aggregates which have their own modulus of elasticity and acoustic impedance. Thus the mortar samples may be considered more homogeneous than that of concrete. Effect of age on the UP velocity was found both using concrete and mortar specimens. UPV depends on Frequency of Waves, Acoustic properties of material, Modulus of Elasticity and Density of Material however the same is free from the influence of geometry of Material.

2.0 EXPERIMENTAL PROCEDURE AND APPARATUS

Experimental Procedure consists of casting of cubes and beams of cement concrete as well as mortar. The grade for concrete was kept M25 while the mortar proportion was 1:6. Ordinary Portland cement was used. Locally available 10 and 20 mm down aggregates and river sand were used. Concrete proportion used for study was as follows,

<table>
<thead>
<tr>
<th>Material</th>
<th>Per m³ Concrete Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>340kg</td>
</tr>
<tr>
<td>Sand</td>
<td>689kg</td>
</tr>
<tr>
<td>CA 20mm</td>
<td>789kg</td>
</tr>
<tr>
<td>CA 10mm</td>
<td>526kg</td>
</tr>
<tr>
<td>Water</td>
<td>181 litre</td>
</tr>
</tbody>
</table>

2.1 Casting and curing of concrete Specimens

Casting of concrete and mortar specimens was done in drum mixture. The purpose of casting of large scale and small scale specimens was to know the scale effect and geometry effect if any on UPV results. Total six nos. of concrete beams of size 150X150X700 mm and six nos. of concrete cube of size 150X150X150mm were cast. Similarly mortar cubes of similar size were also cast. All specimens of concrete or mortar as the case may be were subjected to same condition. Specimens were compacted and cured at ambient temperature until the date of testing.

2.2 Testing Apparatus and Procedure

Ultrasonic stress (compression or shear) waves were produced by electro acoustic transducers made up of piezoelectric material. Transducers convert electric energy to the mechanical energy in form of stress wave.

PUNDIT 7 was used for UPV testing of specimens. Piezoelectric Transducers having 54 kHz frequency were employed. As a coupling agent petroleum gel was used. Gel facilitates an airtight bond between concrete or mortar specimen and Transducers.
The Testing Procedure is consisting of UPV test by Direct, Indirect and Semi-direct method at ages of 7, 28 and 56 days interval. In Direct method, Transmitting and Receiving Transducers are kept on its opposite faces. While in Semi direct method, Transmitting and Receiving Transducers are kept on adjacent faces. And in Indirect method, Transducers are kept on the same face. The readings are taken by putting transmitter and receiving transducer on opposite faces in case of direct method. While in semi direct method, the readings are taken by putting transmitter on top and bottom faces sequentially and by varying receiver transducers on adjacent faces. In Indirect method, the receiving and transmitting Transducers are kept on same face with different interval. And it has been varied by 150 mm distance on same face.

3.0 RESULTS AND DISCUSSION

UPV results by different three methods at different age. The results were taken at 7, 28 and 56 days. Results have been plotted in graph and best suitable linear line has been plotted and from it equation has been derived.

![Fig.3: Relation between UPV to the Age of M25 Concrete Cubes](image-url)
4.0 CONCLUSION

Ultrasonic pulse velocity is observed to increase from 7 day to 28 days of casting. The UP Velocity continuously increasing 56 days however much slower rate that observed between 7 and 28 days of casting.

The Relation between velocity & Age of concrete is given by $y = 0.0244\ln(x) + 4.6277$.
The Relation between velocity & Age of mortar is given by $y = 0.1132\ln(x) + 3.2871$.
The rate of Increase of UP velocity with the age in case of mortar is more than that of concrete.
It has been observed that on a same element of concrete, UP Velocity when measured by keeping transducers either on top and bottom surface in case of semi-direct method, gives diff. Results.

The relation between velocity & age of concrete of Transducer on top face in case of semi-direct method is \( y = 0.1051 \ln(x) + 4.7836 \).

The relation between velocity & age of concrete of Transducer on bottom face in case of semi-direct method is \( y = 0.0469 \ln(x) + 5.0426 \).

REFERENCES