Quality Assessment Of Concrete By Non Destructive Tests

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Abstract–Concrete is a basic material used for the great amount of engineering projects. The concrete performance is influenced by some building variables, such as: the water/cement ratio, the aggregate type and size, the humidity and the cement type.
These variables affect directly the compressive strength and make difficult the
identification of the concrete properties.The evaluation of the compressive strength of concrete in existing structures by coring is expensive, technically difficult in certain cases, and even impossible in others. The use of non-destructive testing (NDT) is an interesting alternative method (i.e. affordable cost, portable, fast, etc.).
Key words: Concrete,Quality, non-destructive testing ,Ultrasonic pulse velocity, compressive strength

I. INTRODUCTION

In the building and construction industry, reputation and trust are the cornerstones for continued growth. In order to build customer confidence, the industry must stand behind the quality of its work. Quality Assurance and quality Control Programs exist for that purpose. What is referred to today as "quality control," which is a part of a quality assurance program, is a function that has for years been recognized as the inspection and testing of materials and workmanship to see that the work meets the requirements of the drawings and specifications.

Non Destructive Testing (NDT) methods are those that do not cause damage to the element being tested or leave only small lesions that can be repaired easily after the test, not provoking, thus, significant loss of strength or performance of the element. In the case of new structures, these tests can be used for monitoring the strength evolution and to clarify doubts about the quality of the concrete. In existing structures, they aim to evaluate the integrity of the structure.there are some properties of concrete that can be evaluated with the use of NDT, among them we can mention: density, modulus of elasticity and compressive strength. The surface hardness, absorption, permeability, moisture conditions, the location of the reinforcement, the existence of gaps and cracking can also be investigate

II. Objective

The objective of this research paper are:

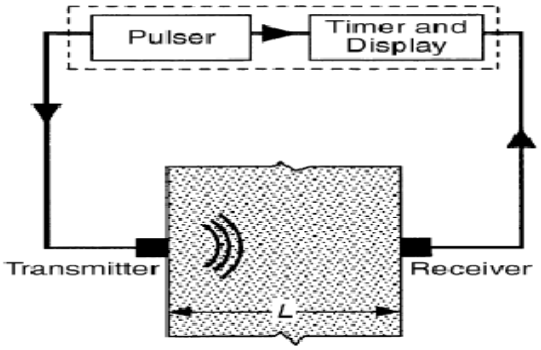
1. To study the non destructive testing method of assessing quality of concrete.

III. THEOROTICAL ASPECTS:

***Ultrasonic Pulse Velocity*:**The ultrasonic pulse is generated by an electroacoustical transducer. ,When the pulse is induced into the concrete from a transducer, it undergoes multiple reflections at the boundaries of the differ&t material phases within the concrete.

A complex system of stress waves is developed which includes longitudinal (compressional), shear (transverse) and surface (rayleigh) waves. The receiving transducer detects the onset of the longitudinal waves, which is the fastest.
Because the velocity of the pulses is almost independent of the geometry of the material through which they pass and depends only on its elastic properties, pulse velocity method is a convenient technique for investigating structural concrete.

The underlying principle of assessing the quality of concrete is that comparatively higher velocities are obtained when the quality of concrete in terms of density, homogeneity and uniformity is good. In case of poorer quality, lower velocities are obtained. If there is a crack, void or flaw inside the concrete which comes in the way of transmission of the pulses, the pulse strength is attenuated and it passes around the discontinuity, thereby making the path length longer. Consequently, lower velocities are obtained. The actual pulse velocity obtained depends
primarily upon the materials and mix proportions of concrete. Density and modulus of
elasticity of aggregate also significantly affect the pulse velocity.



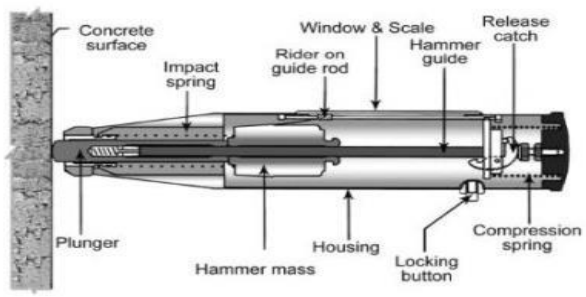
USPV Principle

The quality of concrete in terms of uniformity, incidence or absence of internal flaws, cracks and segregation, etc, indicative of the level of workmanship employed; can thus be assessed using the guidelines given in Table 1, which have been evolved for characterising the quality of concrete in structures in terms of the ultrasonic pulse velocity.

Pulse Velocity (km/sec)	Concrete Quality (Grading)
Above 4.5	Excellent
3.5-4.5	Good
3-3.5	Medium
Below 3	Doubtful

Table 1 Quality of concrete as per USPV test

Schmidt Rebound Hammer Test :This NDT method had been developed in 1948 and widely used because of itssimplicity. This method is inexpensive and can be done anywhere without anyadditional special instrument.In this method Schmidt hammer pushed against the concrete surface while theequipment plunger is pressed simultaneously. After a specified pressure of the plungeran impact is occurred and the equipment index jump according to rebound strength.This rebound can be read on the instrument. According to the Iranian Concrete Manual average of 10 rebound readings should be recorded as rebound numbers to evaluate the compression strength of concrete. Rebound numbers should be modified according to inclination from horizon.



Rebound Hammer

IV. LITERATURE SURVEY

Alexandre Lorenzi, Francisco TestonTisbierek and Luiz Carlos Pinto da Silva Filho "Ultrasonic Pulse Velocity Analysis in Concrete Specimens" Conferencia Panamericana de END Buenos Aires – October 2007
Studied different concrete types, with different characteristics, manufactured with portland cement andvarious types of aggregates. The data had been analyzed aiming to establish models tounderstand how the results of UPV are affected by variations at concrete conditions.The results show that it is possible to understand how the test condition variations affect the UPV outputs. This study indicates that UPV gives an important result of decisionmakeabout the conditions of concrete structures. It can be concluded that, by means ofUPV, it is possible to contribute with the deterioration control and concrete structuresquality.

Ashwin S. Balwaik "Efficiency of Ultrasonic pulse velocitytest in life of concrete structure" IOSR Journal of Mechanical and Civil EngineeringIOSR-JMCE e-ISSN:2278-1684,p-ISSN:2320-334X Volume 12& Ver 2 (July-Aug 2015)
Deals with the concept, methodologies, functioning, result of UPV test in understanding the condition of a structure.A random structure is taken and analysed with the Non-destructive testing (UPV), after the repair works carried out as per the analysis of UPV test, the structure is again taken under condition assessment test. The results of both Pre and Post Retrofitting of the RCC structure has been discussed in this paper.

Khoudja Ali-Benyahiaa,b,c, Zoubir-Mehdi Sbartaïc, Denys Breyssec,*, Said Kenaid, Mohamed Ghriciain "Analysis of the single and combined non-destructive test approaches for on-site concrete strength assessment: General statements based on a real case-study" Case Studies in Construction Materials 6 (2017) 109–119

This paper aims at identifying and optimizing the methodology of the calibration model on site. This paper is based on a broad campaign of auscultation using NDT (Rebound and Ultrasound) and coring on an existing construction with 205 triplets of data (strengths and NDT results). Statistical data analysis enables to quantify the role of: the number of cores (NC) used for the calibration, the use of only one or two-combined NDT techniques and the calibration method. The conclusions are focused on the improvement of the relevance and the effectiveness of NDT techniques in such operational situations.

Piotr Wiciaka,*, Giovanni Cascantea, Maria Anna Polaka "Sensor and dimensions effects in ultrasonic pulse velocity measurements in mortar specimens" Procedia Engineering 193 (2017) 409 – 416
This article the authors focus on the sensor and the dimensions effects. The results for UPV tests on 9 mortar specimens of different heights and diameters are presented. The specimens are tested with 54 kHz and 850

kHz resonant frequency (fc) transducers and the state-of-the-art laser vibrometer (response measurements).
The authors discuss the laser vibrometer readings and the influence of specimens' dimensions on the measured pulse velocities.
Practical recommendations for the minimal dimensions of the test object in order to minimize the error in the UPV tests are proposed.

V. Conlusion

The conlusion of this review paper is based on is the literature review and experiments conducted till date. Of the various NDT techniques which are very useful in estimating the quality and strength of existing concrete structures, Ultrasonic Pulse Velocity (UPV) method is a very popular technique used in Non-Destructive Testing (NDT) in Civil Engineering. Major benefit of the method is its simplicity.

VI. REFERENCES

1) J. Alexandre Bogas , M. Glória Gomes, Augusto Gomes. "Compressive strength evaluation of structural lightweight concrete by non-destructive ultrasonic pulse velocity method" Ultrasonics 53 (2013) 962–972

2) Rama SeshuD.a* and Dakshina Murthy N.R.."Non Destructive Testing of Bridge Pier - a Case Study"Procedia Engineering 54 (2013) 564 – 572

3) Khoudja Ali-Benyahiaa,b,c, Zoubir-Mehdi Sbartaïc, Denys Breyssec,*, Said Kenaid, Mohamed Ghricia. "Analysis of the single and combined non-destructive test approaches for on-site concrete strength assessment: General statements based on a real case-study". Case Studies in Construction Materials 6 (2017) 109–119

4) Piotr Wiciaka,*, Giovanni Cascantea, Maria Anna Polaka. "Sensor and dimensions effects in ultrasonic pulse velocity measurements in mortar specimens." Procedia Engineering 193 (2017) 409 – 416

5) Piotr Wiciaka,*, Giovanni Cascantea, Maria Anna Polaka "Sensor and dimensions effects in ultrasonic pulse velocity measurements in mortar specimens" Procedia Engineering 193 (2017) 409 – 416