Condition Estimation through UPV

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Abstract**—***Testing of ultrasonic pulse velocity (UPV) is one of the most popular and actual non-destructive techniques used in the estimation of the concrete properties in structures. Failure of concrete structures made an alarming situation for researchers for focusing on the durability affecting parameters along with crushing strength, various uncontrollable factors like environmental or exposure conditions are equally essential for the service life of structures. Thus, assessing present condition of reinforced concrete structures is essential for planning, repairs and replacement of structures.*

Keywords—Compressive Strength, Durability, Service Life, Nondestructive Testing

I. INTRODUCTION

Determination of the present condition of concrete requires different actions such as highly skilled visual inspection for monitoring the cracks, finding pattern of cracks, investigating causes of cracks, finding corrosion activity under the concrete near rebar's, investing other properties which influences the durability of concrete.

Other than these methods there are several destructive and non-destructive methods are available to assess the in-situ condition of structures. UPV test is one of the most popular nondestructive techniques used in the assessment of the concrete properties in structures. The interpretation of the test results, however, is very difficult since UPV values are influenced by a number of factors although the UPV test is fairly simple and easy to apply.

II. NON-DESTRUCTIVE TESTING

Non-destructive testing (NDT) is a method to locate indirectly the dissimilar parameters of hardened concrete like strength, durability and other elastic properties without loading the specimen till it fails. These methods are based on the principle that few physical and chemical properties of material can be related to the strength and other properties of the concrete. These methods have the great potential to be part of such a technology. A range of advanced NDT methods have been initiated and are accessible for studying and evaluating the different parameters.

NDT methods are broadly used in numerous industry branches. Aircrafts, chemical plants, electronic devices, nuclear facilities and extra protection critical installations are tested regularly with rapid and dependable testing methods. Several highly developed NDT methods are available for metallic or composite materials.

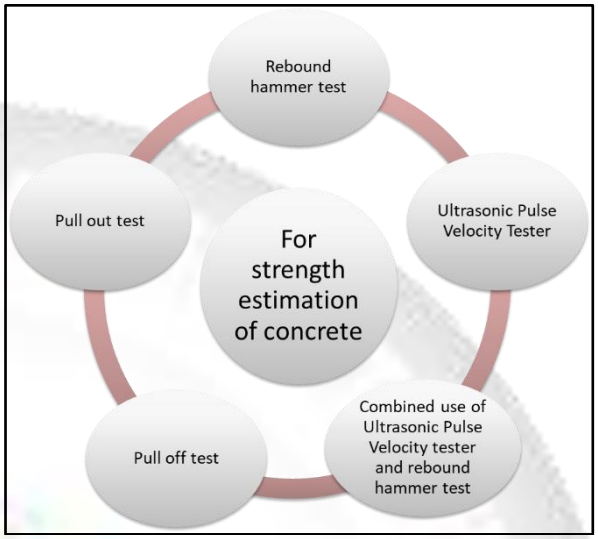

Fig. 1: Various NDT methods

III. LITERATURE REVIEW

Several researchers used different NDT equipments in order to assess the condition of RC structures.

An experimental study has been conducted by Malek and Kaouther (2014) for assessing the compressive strength of concrete through destructive and non-destructive testing at 7, 14 and 28 days. For destructive testing compression test and for nondestructive testing rebound hammer tests have been conducted. Effect of several parameters on the modulus of elasticity has been investigated through pulse velocity test. These parameters are the age of concrete and the water/ cement ratio.

The compressive strength of several concrete mixes produced using lightweight aggregate has been evaluated using the non-destructive ultrasonic pulse velocity method byBogas et al. (2013). In this study almost 84 separate compositions have been tested after 3 and 180 days of curing, compressive strengths of these samples is ranging about 30 to 80 MPa.

In an experimental study performed by Jain et al. (2013) evaluated the effects of concrete ingredients, proportion of concrete mix,and variables related to workmanship on the Rebound Number and Ultrasonic Pulse Velocity of concrete. In this study combined use of both the NDT techniques had been determined.

A relationship between experimentally obtained strength and forecasted strength by the model has been presented by Singh and Kotiyal (2013). NDT are those that can be used to calculate the strength without damaging the structure. In this research paper, the compressive strength of concrete is forecasted by using Artificial Neural Network. The forecasted strength was compared with the experimentally acquired actual compressive strength of concrete and equations are developed for dissimilar models. In addition to this, relation has been developed using two

NDT techniques for calculation of strength by regression analysis.

A relation has been presented between the compressive strength of structure through DT and NDT by Shariati et al. (2011). The NDT testing has been done to test the eminence of concrete structure and the correlation has been done using regression analysis method between test values and actual in situ value of crushing strength of structure. The structural members tested are Beams, Column and Slabs. The obtained results are compared with the test values to observe the dissimilarity in both the results. Finally, the result shows that Rebound Hammer test is found to be more efficient. But combination of both NDT test results provides more reliable results.

Cheung et al. (2009) developed a 2-D FE coupled model to evaluate the chloride penetration process in varying environment to predict the corrosion initiation time.

Liang et al. (2009) proposed a mathematical model based on Fick's 2nd law of diffusion and other previous models to study the service life of RC bridges. The corrosion process has three stages, the initiation time (tc), the depassivation time (tp), and the corrosion (propagation) time (tcorr). The total service life of pier for the existing RC bridge can be expressed as t = tc+ tp+ tcorr.

Breysse (2009) utilized rebound hammer, UPV and many empirical strength-NDT and it has been concluded that the model error were much lesser than that due to the measurement uncertainties and highlighted on the lessening of NDT measurement error. Synthetic simulations have presented that the quality of NDT measurements directly impacts the quality of evaluation both for NDT used alone and in combination.

Stergiopoulou et al. (2008) presented a procedure for NDT of urban concrete infrastructures using UPV measurements, and applied to concrete garages. UPV has been used as an indicator of concrete quality.

IV. CONCLUSION

From the above literature review it has been observed that in order to find in-situ compressive strength of concrete elements, UPV methods is widely by several researchers. It has also been noted that the need for in-situ testing of concrete has been realized for determining the eminence and parameters influencing the behavior of existing structures.

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