Condition Review through NDT Methods

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Abstract— Failure of concrete structures created associate degree dismaying scenario for researchers for that specialize in the durability affecting parameters beside crushing strength, varied uncontrollable factors like environmental or exposure conditions are equally essential for the service lifetime of structures. Corrosion of reinforcement in concrete decreases the service life and worsens concrete structures inflicting premature failure of structures. Thus, assessing current condition of concrete structures is crucial for designing, repairs and replacement of structures.

Key words: Compressive strength, Durability, Service life, Nondestructive testing

I. INTRODUCTION

Quality of concrete structures is normally evaluated by testing standard specimens. Thus, the direct examination of concrete strength needs preparation and testing of prepared samples. The standard test method gives an idea about the potential concrete strength. Though, the standard tests results may not be same as that of actual concrete strength since the compaction and curing regimes applied in situ and in standard technique are fairly different. Consequently, non-destructive tests are extensively utilized to evaluate the strength of concrete in structures. Besides, as the name indicates, non-destructive tests do not make any damage or harm to the concrete and neither influences the behavior of structure. These methods can also be utilized for the well-organized planning of the construction works in huge infrastructure projects, in which it may be required to know strength of concrete structures in order to determine the removal time of formwork, the stressing or releasing time for the wires in pre-stressed members, the loading time for the system in post-tensional elements or the time for opening the structure to service safely. There are various non-destructive techniques available in order to evaluate the strength of concrete structures.

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.

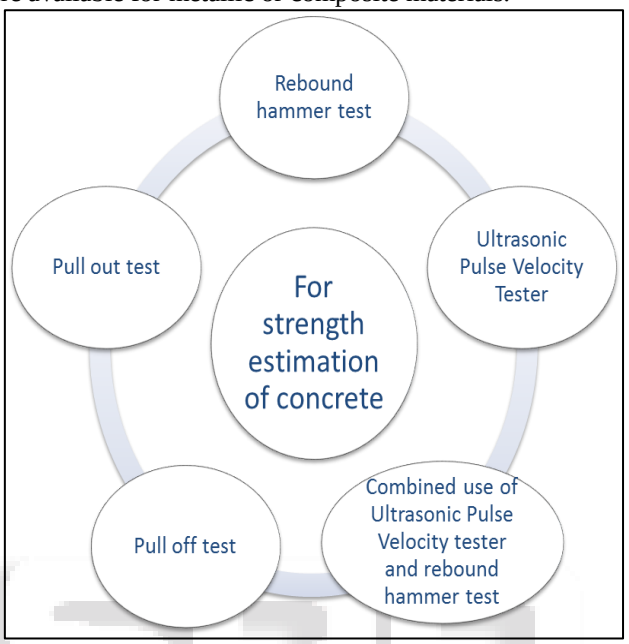

Fig. 1: Various NDT methods

III. LITERATURE REVIEW

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

It has been observed by williams (1993) that there are numerous NDT techniques are available to determine the reliability of concrete in a existing concrete structures. Each method has its own set of merits and restrictions. The methods observed are mainly for assessing voids of a structure. Structures that can be investigated using these techniques include concrete floor slabs, beams, walls and tunnel linings. Other NDT and partially destructive methods are accessible which can evaluate the in-situ strength of concrete to varying degrees of accuracy.

Rufino & Relunia (1999) observed that nondestructive testing of concrete is extremely complex and it is difficult to setup experimental procedures and to study the obtained data. However, latest study and research activities have revealed the different methods of NDT, like the electromagnetic method, ultrasonic pulse velocity test, pulse echo/impact echo test, infrared thermography, radar or short pulse radar techniques, neutron and gamma radiometry, radiography, carbonation test and half-cell potential method available for NDT of concrete structures.

Li et al. (1999) presented a comprehensive experimental program aiming to investigate strength and serviceability deterioration of concrete structures, based on following (1) half cell potential (2) depth of chloride penetration and (3) chloride concentration.

Liang (2002) categorized evaluated bridges in grades I, II, III, IV, and V, which are described as non damage, light damage, moderate damage, severe damage, and unfit for service, respectively.

Beek et al. (2003) distributed service life into two parts (i) Initiation period: during this lifetime extending measures are fully effective. (ii) Propagation period: during this lifetime extending measures loses its effectiveness.

The deterioration of concrete element due to reinforcement corrosion have been divided into two phases initiation and propagation by Roelfstra et al. (2004), initiation phase starts with the construction and ends with the depassivation of the reinforcing steel. Propagation phase begins with the depassivation of the reinforcing steel and ends with the structural failure or complete dissolution of reinforcing steel.

Han (2004) demonstrated the 'Two point Electrode Method' which has been applied regarding the service life design for constructing a tunnel. A simple statistical model has been developed, which can be put into practice. Also, several other NDT methods suitable for real structures to measure critical parameters in the service life design have been identified. The capabilities of two promising methods, spectral analysis of surface waves and spectral analysis of lamb waves, are discussed.

According to Shi et al. (2012) concrete has been recognized as a compound material which is porous and extremely heterogeneous. The durability of steel reinforced concrete in chloride environments is of high importance to researchers, building owners and maintenance engineers. In this work durability of reinforced concrete structures exposed to chloride environments, and the methods of measuring the chloride ingress into concrete structures have been studied.

IV. Conclusion

It has been observed from above literature that in order to find in-situ compressive strength of concrete structures, rebound hammer and UPV methods are used by various scholars. It has been found that the requirement for in-situ testing of concrete has been realized for evaluating the quality and factors influencing the behavior of existing structures.

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