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EVALUATION OF STRUCTURAL STRENGTH USING TECHNIQUES OF NON DESTRUCTIVE TESTING OF CONCRETE

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Abstract: Structures are assemblies of load carrying members capable of safely transferring the superimposed loads to the foundations. Their main and most looked after property is the strength of the material that they are made of. Concrete, as we all know, is an integral material used for construction purposes. Thus, strength of concrete used, is required to be 'known' before starting with any kind of analysis. In the recent past, various methods and techniques, called as Non-Destructive Evaluation (NDE) techniques, are being used for Structural Health Monitoring (SHM). The concept of nondestructive testing (NDT) is to obtain material properties of in place specimens without the destruction of the specimen nor the structure from which it is taken. However, one problem that has been prevalent within the concrete industry for years is that the true properties of an in-place specimen have never been tested without leaving a certain degree of damage on the structure. For most cast-in-place concrete structures, construction specifications require that test cylinders be cast for 28-day strength determination. Usually, representative test specimens are cast from the same concrete mix as the larger structural elements. Unfortunately, test specimens are not an exact representation of in-situ concrete, and may be affected by variations in specimen type, size, and curing procedures.
The use of the combined methods produces results that lie close to the true values when compared with other methods. The method can be extended to test existing structures by taking direct measurements on concrete elements.

I. INTRODUCTION

INTRODUCTION To keep a high level of structural safety, durability and performance of the infrastructure in each country, an efficient system for early and regular structural assessment is urgently required. The quality assurance during and after the construction of new structures and after reconstruction processes and the characterisation of material properties and damage as a function of time and environmental influences is more and more becoming a serious concern. Nondestructive testing (NDT) methods have a large potential to be part of such a system. NDT methods in general are widely used in several industry branches. Aircrafts, nuclear facilities, chemical plants, electronic devices and other safety critical installations are tested regularly with fast and reliable testing technologies. A variety of advanced NDT methods are available for metallic or composite materials. In recent years, innovative NDT methods, which can be used for the assessment of existing structures, have become available for concrete structures, but are still not established for regular inspections. Therefore, the objective of this project is to study the applicability, performance, availability, complexity and restrictions of NDT

Objective: The ultrasonic pulse velocity method could be used to establish: (a) the homogeneity of the concrete (b) the presence of cracks, voids and other imperfections (c) change in the structure of the concrete which may occur with time (d) the quality of concrete in relation to standard requirement (e) the quality of one element of concrete in relation to another (f) the values of dynamic elastic modulus of the concrete

NON DESTRUCTIVE EVALUATION (NDE) METHODS Rebound Hammer (Schmidt Hammer) This is a simple, handy tool, which can be used to provide a convenient and rapid indication of the compressive strength of concrete. It consists of a spring controlled mass that slides on a plunger within a tubular housing.

Hence, they do not directly give the absolute values of strength. Damage detection by NDE methods: Global techniques: These techniques rely on global structural response for damage identification. Their main drawback is that since they rely on global response, they are not sensitive to localized damages. Thus, it is possible that some damages which may be present at various locations remain un-noticed. Local techniques: These techniques employ localized structural analysis, for damage detection. Their main drawback is that accessories like probes and fixtures are required to be physically carried around the test structure for data recording. Thus, it no longer remains autonomous application of the technique. These techniques are often applied at few selected locations, by the instincts/experience

of the engineer coupled with visual inspection. Hence, randomness creeps into the resulting data.

Path Length: The path length (the distance between two transducers) should be long enough not to be significantly influenced by the heterogeneous nature of the concrete. It is recommended that the minimum path length should be 100mm for concrete with 20mm or less nominal maximum size of aggregate and 150mm for concrete with 20mm and 40mm nominal maximum size of aggregate. The pulse velocity is not generally influenced by changes in path length, although the electronic timing apparatus may indicate a tendency for slight reduction in velocity with increased path length. This is because the higher frequency components of the pulse are attenuated more than the lower frequency components and the shapes of the onset of the pulses becomes more rounded with increased distance travelled. This apparent reduction in velocity is usually small and well within the tolerance of time measurement accuracy.

II. CONCLUSION

Considerable engineering judgment is needed to properly evaluate a measurement. Misinterpretation is possible when poor contact is made. For example, in some cases it may not be possible to identify severely corroded reinforcing bar in poor quality concrete. However, it is possible to identify poor quality concrete which could be the cause of reinforcing bar problems. The poor quality concrete allows the ingress of moisture and oxygen to the reinforcing bars, and hence corrosion occurs. Presently the system is limited to penetration depths of 1 ft. Research is ongoing to develop a system that can penetrate to a depth of 10 ft or more. When variation in properties of concrete affect the test results, (especially in opposite directions), the use of one method alone would not be sufficient to study and evaluate the required property. Therefore, the use of more than one method yields more reliable results. For example, the increase in moisture content of concrete increases the ultrasonic pulse velocity but decreases the rebound number . Hence, using both methods together will reduce the errors produced by using one method alone to evaluate concrete. Attempts have been done to relate rebound number and ultrasonic pulse velocity to concrete strength. Unfortunately, the equation requires previous knowledge of concrete constituents in order to obtain reliable and predictable results. The Schmidt hammer provides an inexpensive, simple and quick method of obtaining an indication of concrete strength, but accuracy of ±15 to ±20 per cent is possible only for specimens cast cured and tested under conditions for which calibration curves have been established. The results are affected by factors such as smoothness of surface, size and shape of specimen, moisture condition of the concrete, type of cement and coarse aggregate, and extent of Corbonation of surfaces

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