**Methods of Non Destructive Test on Concrete**

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*Pooja P. Mahalle Poonam R. Gupta*

KDKCE, Student KDKCE, Student

Email: mahalle271992@gmail.com Email:guptarameshpoonam@gmail.com

*Himangi D.Rewatkar Shital Bhagat*

KDKCE, Student KDKCE, Student

Email:himangirewatkar92@gmail.com

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**ABSTRACT**

 It is often necessary to test concrete structures after the concrete has hardened to determine whether the structure is suitable for its designed use. Ideally such testing should be done without damaging the concrete, the effective method to prevent the premature failures of the structures which are very vital in all the plants. This can be evaluated through several nondestructive testing (NDT) techniques for monitoring civil infrastructures. The structures integrity have the tendency to change its properties after certain interval of time due to corrosion, section thinning, corrosive atmosphere etc, The non destructive based evaluation minimizes the premature failure and helps in restoration of the structure in available time period. NDT methods have been used for more than three decades for monitoring concrete structures. This paper deals with the methods of NDT test on concrete.

**KEYWORDS**

 NDT, UPVT, Rebound Hammer Test, Concrete material.

**INTRODUCTION**

 Non -destructive examination involves techniques to assess time dependent changes such as section thinning due to corrosion, or changes in component geometry and material properties. Knowing where to inspect and what type of degradation to anticipate often requires information about the design features of the structure as well as the materials of construction and environmental factors. Basic components of the continued service evaluation process include the damage detection and classification, root –cause determination and measurement.

Situations where NDT is used for investigation of in situ concrete

* to investigate the homogeneity of concrete mixing
* to determine the density and strength of concrete in a structure
* to determine the location of reinforcing bars and the cover over the bars
* to determine the number and size/diameter of reinforcing bars
* to determine the extent of defects such as corrosion
* to determine the location of in-built wiring, piping, ducting, etc.
* to determine whether internal defects such as voids, cracks, honeycombing, lack of bonding with reinforcing bars, etc. exist in concrete
* to determine if there is a bond between epoxy bonded steel plates and concrete members.

**METHODOLOGY**

The methods involved for condition assessment are:

1. Visual Inspection

2. NDT Methods

**Visual Examination**

The main objectives of visual investigations are to observe and note down all the deteriorated items and their locations. Record the damage with sketches and drawing and find out the cause of deterioration, Information should be collected and details including design, construction, utilization and maintenance if any.

 Defects that commonly need recording include:

* cracking which can vary widely in nature depending on the causative
* surface pitting and spalling
* surface staining
* differential movements or displacements
* variation in algal or vegetative growths
* surface voids
* honeycombing
* bleed marks
* constructional and lift joints

 **NDT Methods**

 The Non-Destructive methods for assessment of strength of RCC Structures are:

* Ultrasonic Pulse Velocity Test (USPV)
* Schmidt Rebound Hammer Test:
* Half Cell Potential Measurement Test
* Resistivity Measurement Test (RT)
* Carbonation Test (CT)
* CHEMICAL TEST – PH, Chlorides, Sulphates
* Level of pH & Potential on concrete samples

**1. SCHMIDT REBOUND HAMMER TEST:**

 **Principle**

 The Schmidt rebound hammer is principally a surface hardness tester. It works on the principle that the rebound of an elastic mass depends on the hardness of the surface against which the mass impinges. There is little apparent theoretical relationship between the strength of concrete and the rebound number of the hammer. However, within limits, empirical correlations have been established between strength properties and the rebound number.

**Applications Of Schmidt Rebound Hammer Test**

 The hammer can be used in the horizontal, vertically overhead or vertically downward positions as well as at any intermediate angle, provided the hammer is perpendicular to the surface under test. The position of the mass relative to the vertical, however, affects the rebound number due to the action of gravity on the mass in the hammer. Thus the rebound number of a floor would be expected to be smaller than that of a soffit and inclined and vertical surfaces would yield intermediate results. Although a high rebound number represents concrete with a higher compressive strength than concrete with a low rebound number, the test is only useful if a correlation can be developed between the rebound number and concrete made with the same coarse aggregate as that being tested. Too much reliance should not be placed on the calibration curve supplied with the hammer since the manufacturer develops this curve using standard cube specimens and the mix used could be very different from the one being tested.

**2. ULTRASONIC PULSE VELOCITY TEST (USPV)**

 A pulse of longitudinal vibrations is produced by an electro-acoustical transducer, which is held in contact with one surface of the concrete under test. When the pulse generated is transmitted into the concrete from the transducer using a liquid coupling material such as grease or cellulose paste, it undergoes multiple reflections at the boundaries of the different material phases within the concrete. A complex system of stress waves develops, which include both longitudinal and shear waves, and propagates through the concrete. The first waves to reach the receiving transducer are the longitudinal waves, which are converted into an electrical signal by a second transducer. Electronic timing circuits enable the transit time T of the pulse to be measured.The path length and transit time are measured to determine the pulse velocity of concrete.

**Pulse Velocity = Path Length / Transit Time**

The reference Concrete quality grading for different velocities as per IS: 13311(Part 1)1992 are:

|  |  |
| --- | --- |
| **Pulse Velocity (km/sec)** | **Concrete Quality Grading (N/mm^2)** |
| Below 3.0 | Doubtful |
| 3.1 to3.5 | Medium |
| 3.6 to 4.5 | Good |
| Above 4.5 | Excellent |

 **3. LEVEL OF PH & POTENTIAL ON CONCRETE SAMPLE:**

 The potential (V) against pH of concrete. The value of pH and potential decides the condition of reinforcement whether in

* Immunity
* Corrosion
* Passivation.

Positive and negative potential with pH greater than 8 is corrosion stage. pH less than 7 shall have acidic reaction.

**CONCLUSION**

* The condition assessment study can be immensely useful to study the present condition of structures & its healthiness.
* It can minimize the premature failure of the plant structures.
* The Rehabilitation and restoration program can be framed accordingly from the results of various NDT tests and should be analyzed based on their co-relation with the properties of concrete and corrosion of reinforcement.

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