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Non_Destructive Testing

Prof. ShivajiH. Kalyankar, prof. Bhanudas G.Abhale, prof. Chetan B.Pagar
prof. Vikas O.Patil, prof. Krishna S.Gosavi

Department of Civil Engineering Sandip polytechnic Nashik, Maharashtra, India.

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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 test was available for testing concrete from completely Nondestructive where there is no concrete damage to partially destructive tests such as core tests and Pull out & Pull-off tests where the surface has to be repaired after the test. Nondestructive testing can be applied to both old &new structures. For new structures, principle applications are likely to be for quality control or the resolution of doubts about materials and construction quality. The testing of Existing structures is usually related to an assessment of structural integrity.*

Keywords: *Non- destructive, no damage, strength, quality control, structural integrity.*

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I. Introduction

Health assessment of structures after natural and human-made hazards has become a challenge to the engineering profession. Commonly used or recommended visual inspections may not be appropriate for this purpose. Visual inspections are expected to be effective if the defects are major or their presence or locations are obvious. Furthermore, if defects are hidden behind the obstruction, they may not be evaluated properly due to accessibility. Also, all defects are not equally important in terms of the structural behavior in the damaged state.

II. Objectives

1. To avoid failure, prevent accidents, and save human life.
2. To check homogeneity of the concrete.
3. To detect cracks, voids, and other imperfections.
4. Monitoring changes in concrete with time.
5. Assessment of existing structures for rehabilitation planning

III. Practical Applications

1. Quality Control of Precast Units or Construction in Situ.
2. Confirming or neglecting doubts concerning the artistry involved in batching, mixing, placing, compacting, or curing concrete.
3. Monitoring of strength development concerning formwork removal.
4. Location and determination of the extent of cracks, Voids, honeycombing, and similar defects within concrete structures.
5. Determining the concrete uniformity, possibly preliminary to core cutting, load testing, or other more expansive or destructive tests.
6. Quality Control of Precast Units or Construction in Situ.
7. Confirming or neglecting doubts concerning the artistry involved in batching, mixing, placing, compacting, or curing concrete.
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9. Location and determination of the extent of cracks, Voids, honeycombing, and similar defects within concrete structures.
10. Determining the concrete uniformity, possibly preliminary to core cutting, load testing, or other more expansive or destructive tests

IV. Limitations

1. The smoothness of the test surface
2. Age of specimen
3. Surface and internal moisture condition of the concrete
4. Type of coarse aggregate
5. Type of Cement

V. Types of NDT

1. Rebound hammer test
2. the ultrasonic pulse velocity test
3. Acoustic emission test (AE)
4. Electromagnetic testing (ET)
5. Guided wave testing (GW)
6. Ground-penetrating radar (GPR)
7. Half-cell electrical potential method
8. Visual inspection
9. Carbonation depth measurement test
10. Penetration resistance or Windsor probe test
11. Cover meter test
12. Infrared thermography
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A. Rebound hammer test

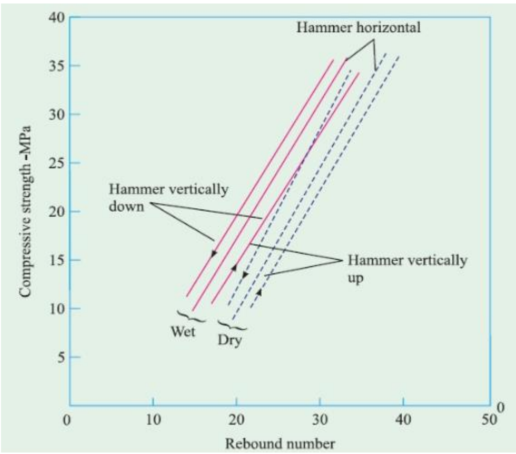
The hammer weighs about 1.8 kg and is suitable for use both in a laboratory and in the field. The main components include the outer body, the plunger, the hammer mass, and the mainspring. Other features include a latching mechanism that locks the hammer mass to the plunger rod and a sliding rider to measure the hammer mass's rebound. The rebound distance is measured on an arbitrary scale marked from 10 to 100. The rebound distance is recorded as a "rebound number" corresponding to the rider's position on the scale.

a) Limitations of Schmidt rebound hammer test

1. The accuracy of the predicted strength of concrete is (+/-) 25%.

2. Results are affected by the angle of the test, surface smoothness, and mix proportion.

3. It is suitable for close textured concreteGraph for rebound hammer is various conditions



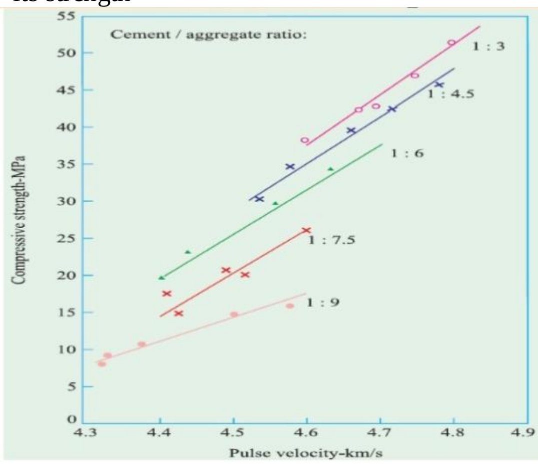
B. Ultrasonic pulse velocity test

The equipment consists of an electrical pulse generator, a pair of transducers, an amplifier, and an electronic timing device for measuring the time interval between the transmitting transducer and its arrival at the receiving transducer.

a) Applications of ultrasonic pulse test:-

The measurement of pulse velocity may be used to determine:

1. The homogeneity of the concrete.
2. Presence of voids cracks.
3. Changes in the concrete may occur with time (i.e., cement hydration) or through the fire, frost, or chemical attack.
4. Quality of concrete concerning specified standard requirements, which generally refer to its strength



Graph for ultrasonic pulse velocity test

C. Acoustic emission testing (AE)

Acoustic Emission Testing (AT) is a nondestructive testing and monitoring method to detect and locate hidden defects in LPG tanks and pressure equipment in good time. Acoustic Emission analysis provides overall information on the physical condition and leak proof of the tested object. Unfortunately, AE systems can only qualitatively gauge how much damage is contained in a structure.

D. Electromagnetic testing(ET)

Electromagnetic testing (ET), as a form of nondestructive testing, involves inducing electric currents or magnetic fields or inside a test object and observing the electromagnetic response. If the test is set up properly, a defect inside the test object creates a measurable response

E. Guided wave testing (GW)

Guided wave testing (GWT) is a nondestructive evaluation method. The method employs acoustic waves that propagate along with an elongated structure while guided by its boundaries. This allows the waves to travel a long distance with little loss in energy. Nowadays, GWT is widely used to inspect and screen many engineering structures

F. Ground-penetrating radar (GPR)

Ground-penetrating radar (GPR) is a geophysical method that uses radar pulses to image the subsurface. This nondestructive method uses electromagnetic radiation in the microwave band (UHF/VHF frequencies) of the radio spectrum and detects the reflected signals from subsurface structures. GPR can have various media applications, including rock, soil, ice, fresh water, pavements, and structures. In the right conditions, practitioners can use GPR to detect subsurface objects, changes in material properties, and voids and cracks

G. Half-cell electrical potential method

The method of half-cell potential measurements normally involves measuring the potential of an embedded reinforcing bar relative to a reference half-cell placed on the concrete surface

The testing apparatus consists of the following

a) Copper sulfate Half Cell
b) Voltmeter
c) Electrical lead wire

It is generally agreed that the half-cell potential measurements can be interpreted as follows:-

A) Less than -0.20 volts indicates a 90% probability of no corrosion.

B) Between -0.20 and -0.35 volts, corrosion activity is uncertain.

C) More than -0.35 volts is indicative of a greater than 90% probability that corrosion is occurring

H. Visual Inspection

Visual testing is probably the most important of all nondestructive tests. It can often provide valuable information to the well-trained eye. Visual features may be related to artistry, structural serviceability, and material deterioration. It is particularly important that the engineer can differentiate between the various signs of distress that may be encountered.

Tools and equipment for visual inspection

These involve a host of common accessories such as measuring tapes or rulers, markers, thermometers, anemometers, etc. Binoculars, telescopes, borescopes, and endoscopes or the more expensive fiber scopes may be useful where access is difficult. A crack width microscope or a crack width gauge is useful, while a magnifying glass or portable microscope is handy for close up examination.

I. Carbonation Depth Measurement Test:-

Carbonation of concrete occurs when the carbon dioxide, in the atmosphere in the presence of moisture, reacts with hydrated cement minerals to produce carbonates, e.g., calcium carbonate. The carbonation process is also called depassivation. Carbonation penetrates below the exposed surface of concrete extremely slowly.

Equipment for carbonation depth measurement test:-

Carbonation can be determined easily by spraying a freshly exposed surface of the concrete with a 1% phenolphthalein solution. The calcium hydroxide is colored pink, while the carbonated portion is uncolored.

J. Penetration resistance or Windsor probe test

Penetration resistance test rapidly and accurately determines the compressive strength of the concrete. The strength is found out by firing (shooting) a probe or pin on the concrete's surface with the known amount of force. Penetration resistance test is a modern system to measure the compressive strength of hardened concrete. It measures the concrete compressive strength up to 110 Mpa.

K. Cover meter test

The concrete surface is scanned, with the search head kept in contact with concrete, while the cover meter indicates, by digital means, the proximity of reinforcement.

Equipment for a cover meter test

1) Search head
2) Cover meter 3) Interconnecting cable

L. Infrared Thermography

To test concrete for subsurface anomalies, all that is needed is a sensitive contact thermometer. However, even for a small test area, thousands of readings would have to be made simultaneously to precisely outline the anomaly. Since this is not practical, Infrared thermographic cameras are used to inspect large areas of concrete efficiently and quickly

M. Radiography testing

Radiographic Testing (RT) is a nondestructive testing method that uses either x-rays or gamma rays to examine the internal structure of manufactured components identifying any flaws or defects. In Radiography Testing, the test-part is placed between the radiation source and film (or detector).

VI. Conclusion

One of the most important parameters that determine the safety of a building is its strength. In all cases, if the investigation finds the strength of concrete is less than the designed strength, the result to be presented to the engineer in charge, who must make a decision based on the results presented as well as other considerations

VII. REFERENCES

[1] IS 13311 part1

[2] IS 13311 part2

[3] Book of Concrete Technology, A.R. Santhakumar 2007.

[4] Book of Concrete Technology Theory and Practice, M.S.Shetty 2000.

[5] The second edition of PRACTICAL NONDESTRUCTIVE TESTING by Baldev Raj, T. Jayakumar, and M.thavasimuthu.

[6] Srinivas jetty,Likhitha.J,shara,,Sai laxmi, Destructive And Non-Destructive Evaluation Of Replacement Of Cement By Flyash, (M40)Gr Of Concrete", SSRG International Journal of Civil Engineering 6(11) (2019) 1-10.

[7] Book of concrete technology by A. M. Neville and J. J. Brooks.