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Different Techniques for Non-Destructive Testing of Concrete

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Abstract- NDT on concrete determines how secure a particular structure is and whether future repairs or rebuilds are necessary. It is a method of testing existing concrete structures to assess the strength and durability of concrete structure. Testing of concrete serves a variety of purposes that pertain to the strength, durability, and estimated viability of the structure over time. These test results can be used to determine whether repairs should be made to a structure or if the integrity of the structure is sufficient as is. Although nondestructive tests are relatively simple to perform & instrument based, the analysis and interpretation of the test data are not easy, because concrete is a complex material. of the test data must always be carried out by trained specialists in NDT rather than by technicians performing the tests. In this study an effort is made to take review of some of popular methods of NDT.

Keywords:- Nondestructive testing, Concrete testing, forensics of concrete, Structural Audit.

I. INTRODUCTION

Nondestructive testing (NDT) methods are used to determine hardened concrete properties and to evaluate the condition of concrete in deep foundations, bridges, buildings, pavements, dams, and other concrete construction. NDT methods are applied to concrete construction to control quality of new construction, troubleshoot problems with new construction, evaluate condition of older concrete for rehabilitation purposes, and for quality assurance of concrete repairs. NDT methods include visual inspection, ultrasonic echo, and impact echo.

Nondestructive test is a method of testing existing concrete structures to assess the strength and durability of concrete structure. In the nondestructive method of testing, without loading the specimen to failure (i.e. without destructing the concrete) we can measure strength of concrete. Now days this method has become a part of quality control process. This method of testing also helps us to investigate crack depth, micro cracks and deterioration of concrete.

experienced persons having some special knowledge to interpret and analyze test results. The Importance of Non-Destructive Testing is as follow Testing hardened concrete in-place is often necessary to determine the suitability of a structure for its intended use. Non-destructive testing methods are used to evaluate concrete properties by assessing the strength and other properties such as corrosion of reinforcement, permeability, cracking, and void structure. This type of testing is important for the evaluation of both new and old structures.

For new structures, the principal applications are mainly used to determine the quality of materials. Testing existing structures is usually related to an assessment of structural integrity.

1. The Benefits of Non-Destructive Testing:

Non-destructive testing can also be used as an initial step to subsequent coring and more invasive measures such as:

- Gauging characteristics of pre-cast, cast-in-place, or in-situ construction.

- Determining the acceptability of supplied material and components.
- Locating and categorizing cracks, voids, honey combing, and other defects in a concrete structure.
- Determining the concrete uniformity prior to core cutting, load testing, or other more expensive or disruptive tests.
- Monitoring strength development related to formwork removal, cessation of curing, and load application.
- Determining the position, quantity, or condition of reinforcement.
- Confirming or locating suspected deterioration of concrete resulting from such factors as overloading, fatigue, external or internal chemical attack or change, fire, explosion, environmental effects.
- Assessing the potential durability of concrete while monitoring long-term changes in properties.

II. REBOUND HAMMER TESTING

This test measures the surface hardness of an area of concrete and requires a tool called a Schmidt Hammer. The hammer features a hammer head that is spring controlled that slides on a plunger device. When testing, the hammer head is forced into the concrete via the spring mechanism and then rebounds once it contacts the concrete surface. This rebound is measured to help determine concrete surface hardness. Again, this method is performed multiple times to determine and average which will be used to signify the surface hardness of the concrete area tested.

Fig 1. Rebound Hammer Testing.

When to use - The Test Hammer is best used to establish a relative strength profile of a structure. Ideally, one technician can quickly canvas large areas with potential strength problems and narrow down specific areas for more rigorous testing using this instrument. Areas with lower rebound numbers can then be economically assessed with cores, penetration tests, or pulse velocity measurements while areas showing higher strengths can be bypassed.

III. PENETRATION TESTING

While not technically a destructive testing method, penetration testing does involve a small probe being shot directly into the concrete via a loaded charge. Once the probe has been shot into the concrete, the depth the probe reaches is then measured, and this measurement is used to determine the compression strength of the structure. Care must be taken to ensure that the tool itself is properly calibrated, and several probes are often shot to achieve a solid average of depth to arrive at a final compression strength measurement.

When to use - 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 surface of the concrete with the known amount of force.

Fig 2. Penetration Testing.

IV. PULL OUT TESTING

The pull-out test can be considered a "semi-destructive test" as it involves a steel ram that is shot into the concrete a distance of 3 inches. Once it has been lodged inside, a winch device is employed to pull the rod back out and while doing so, measurements are made to determine the relative

compression strength of the concrete structure being tested. Such rests result in the need for minor repairs to the structure at the testing site.

When to use - Pull-out tests are typically performed to assess the anchorage or pull-out capacity of geosynthetics. This capacity is important in situations such as retaining walls, slopes and bridging over voids, where the geosynthetic is anchored into stable ground that is outside the zone of failure.

Fig 3. Pull-out Testing.

V. ULTRASONIC PULSE VELOCITY

Ultrasonic pulse velocity testing requires a pulse generator and a pulse receiver. The test is performed by shooting ultrasonic pulses through an area of concrete and the time is takes for the pulse to be received is then measured.

Such tests can determine if there are irregularities of the concrete (such as areas that have not cured yet, or cracked or crumbling, or if other materials are present inside that can impede the signal. This is a quality test to determine if a section of concrete is "TRUE" and solid, of if repairs are imminent. It must be noted that because temperatures are a factor, they must be considered when performing such reading to determine accurate results.

Fig 4. Ultrasonic Pulse Velocity.

When to use - Therefore first carry out non-destructive concrete tests like rebound hammer test which is suggestive of comparatively stronger and weaker areas. The doubtful areas than can be tested with ultrasonic testing or with the combination of tests. The core test would become a must where even the ultrasonic testing suggests poor concrete.

VI. RADIOGRAPHIC TESTING

Shooting gamma rays inside concrete is yet another non-destructive method of testing concrete. The equipment is initially expensive, but the testing cost of each test is quite small in comparison. These tests can be used to determine internal location of reinforcements, overall concrete density, and whether any honeycombing has occurred. (Honey combing is a process by which concrete has begun scaling or crumbling caused by incorrect material grading or poorly mixing before pouring.)

When to use - Concrete Imaging and Scanning are used to assess the location and extent of sub-surface defects.

Fig 5. Radiographic Testing.

VII. CONCLUSION

All these NDT methods, when used in conjunction, can be extremely vital in determining how secure a particular structure is and whether future repairs or rebuilds are necessary. Such tests, while sometimes cumbersome and somewhat expensive are incredibly useful when it comes to helping save lives and property due to failing concrete structures.

REFERENCES

[1] K. Subramanian, J.P. Menon, C.K. Shaw, S.P. Shah Ultrasonic technique for monitoring concrete strength gain at early age A. C. I. Materials Journal, 100 (1) (2003).

[2] Yichin lin, Chao-Peng Lai, Tsong Yen Prediction of Ultrasonic Pulse Velocity in Concrete A. C. I. Materials Journal, 100 (1) (2003).

[3] Raffaele Pucinotti Reinforced concrete structure: non-destructive in situ strength assessment of concrete Constr. Build. Mater., 75 (2015), pp. 331-341.