
ABSTRACT

A numerous methods of destructive and non-destructive testing have been carried out in the Laboratory. The need of evaluation the in-situ mechanical properties of the concrete together with the seismic vulnerability assessment were the reasons of carrying out such amount of test. As non-destructive testing, the surface hardness methods, the ultrasonic methods and the combined methods have been chosen for the purposes of quality control and in-situ concrete strength estimation. As destructive methods to determine the strength estimation. As destructive methods to determine the strength of the in –situ concrete, the extraction of cylindrical specimens (core) from some structural element has been employed. After having briefly described the structure under test and having presented the result of the testing campaign, we investigate the following aspects: the variation of the mechanical properties of the in-situ concrete, the reliability of the combined methods, the need to calibrate the resistance obtained Non destructive methods with the strength of cylindrical specimens (cores) extract from some structural elements in the proximities of the Non-destructive test.

KEYWORDS: Nondestructive and Destructive test

INTRODUCTION

An important feature of non- destructive test is that they permit re- testing at the same, or nearly the same, location so that changes with time can be monitored. The use of non – destructive tests leads to increased safety and allows better scheduling of construction, thus making it possible to progress faster and more economically. Broadly speaking, these tests can be categorized into those that assess the strength of the concrete in situ, and those that determine other characteristics of the concrete such as voids, cracks, and deterioration. With respect to strength, it should be noted that it can be only assessed, that not measured, because the non destructive test are, the most part, comparative in nature. Thus it is useful to established an experimental relation between the property being measured by a given test and the strength of the test specimens or cores from the actual concrete ; there after this relation can be used to converted the non destructive test results into strength value. An understanding Of the physical relation between the given non destructive the results and strength is essential. This relation for the various test will be discuss in what follows. One more general comment about the interpretation of the results of non destructive test is necessary. The test rarely given a number which can be unequivocally interpreted engineering judgment is necessary. Thus if the testing arises from a dispute between the parties involved in the construction the full test programmed should be determined in advanced and the interpretation of possible test result bearing in mind there variability, should also be agreed .Otherwise there is risk that one part is or another will seek addition test and the dissipate about the concrete in the structure will be compounded by a dissipate about the testing. Helpful advise about planning non-destructive testing is given in BS 1881:Part 201:1986,and BS 6089:1981 give a guide to the assessment of concrete strength in existing structure.

OBJECTIVE

- Assessing the likely compressive strength of concrete with the help of suitable correlation between rebound index and compressive strength.
- The main object of ultrasonic pulse velocity method is to be established the homogeneity of the concrete.
- Impact echo can be used to determine the location and extend of flaws such as cracks, delimitations, voids, honeycombing and deboning.
- Determine in-situ compressive strength of the concrete.

D. Breysewhy and how nondestructive testing (NDT) measurements can be used in order to assess on site strength of concrete.

SeungheePark^{etal}Two kinds of nondestructive evaluation (NDE) techniques are investigated for the effective maintenance of underwater concrete structures

J. Helal^{etal}The fundamentals of NDT methods are explored in regards to their potential, limitations, inspection techniques and interpretations. The factors that influence the success of NDT methods are discussed and ways to mediate their influence are recommended.

Lukasz Sadowski In this paper methodology for the non-destructive identification of the values of pull-off adhesion between concrete layers in floors on the basis of parameters determined using three NDT methods and artificial neural networks (ANN)

METHODOLOGY

Destructive test conducted on Concrete

- **Compressive Strength Test:**

A cube compression test is performed on standard cubes of size 150 x 150 x 150 mm after 3, 7 and 28 days of immersion in water for curing. The compressive strength of specimen is calculated by the following formula:

$$f_{cu} = P_c / A$$

Where

P_c = Failure load in compression, KN

A = Loaded area of cube, mm²

- **Split Tensile Test:**

The split tensile test is well known indirect test used to determine the tensile strength of concrete. Due to difficulties involved in conducting the direct tension test, a number of indirect methods have been developed to determine the tensile strength of concrete. In these tests, in general a compressive force is applied to a concrete specimen in such a way that the specimen fails due to tensile stresses induced in the specimen.

P

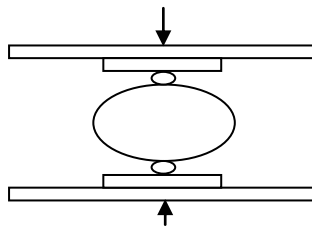


Fig 1 Cylinder split tensile test setup

The split tensile strength of cylinder is calculated by the following formula,

$$f_t = 2P / \pi LD$$

Where,

f_t = Tensile strength, MPa

P = Load at failure, N

L = Length of cylinder, mm

D = Diameter of cylinder, mm

- **Flexural Test:**

Standard beams of size 150 x 150 x 700mm are supported symmetrically over a span of 400mm and subjected two points loading till failure of the specimen.

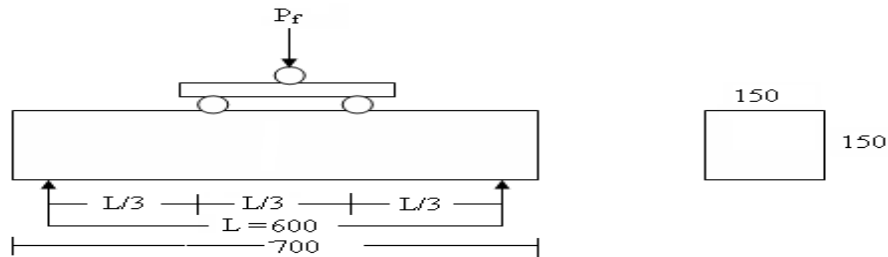


Fig 2 Two point loading setup in flexure test

The flexural strength is determined by the formula

$$f_{cr} = P_f L / bd^2$$

Where, f_{cr} = Flexural strength, MPa

P_f = Central point through two point loading system, KN

L = Span of beam, mm

b = Width of beam, mm

d = Depth of beam, mm

Non Destructive test conducted on Concrete

- **Rebound Hammer**

The most commonly used surface hardness procedure is the standard rebound hammer test. The test was developed in 1948 by Swiss engineer Ernst Schmidt and is commonly referred to as the Schmidt Rebound Hammer (Kolek, 1969). Upon impact with the concrete surface, the rebounded hammer records a rebound number which presents an indication of strength properties by referencing established empirical correlations between strength properties of concrete (compressive and flexural) and the rebound number.

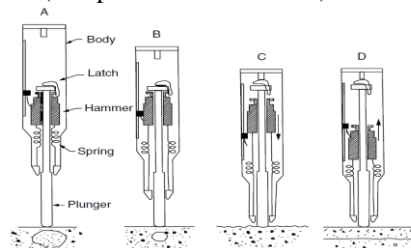


Fig 3 Rebound hammer

- **Ultrasonic Pulse Velocity Methods**

The method is based on measuring the velocity of compression stress waves P -waves. The pulse velocity is related to Young's modulus of elasticity by the well known law

$$V_p = \sqrt{\frac{E_d}{\rho}} f[v]$$

Where

V_p = velocity of compressional stress waves

E_d = dynamic Young's modulus of elasticity;

ρ = mass density

ν = Poisson's ratio

$f(\nu)$ = function dependent on the shape and dimensions of the solid

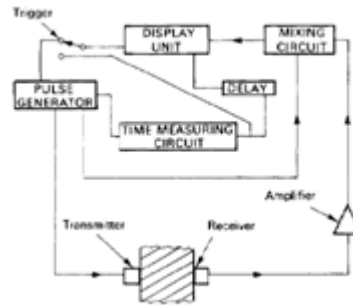


Fig 4 Typical UPV Testing Equipment

- **Pull-Out Bond Test**

Pull-out resistance methods measure the force required to extract standard embedded inserts from the concrete surface. Using established correlations, the force required to remove the inserts provides an estimate of concrete strength properties. The two types of inserts, cast-in and fixed-in-place, define the two types of pull-out methods. Cast-in tests require an insert to be positioned within the fresh concrete prior to its placement. Fixed-in-place tests require less foresight and involve positioning an insert into a drilled hole within hardened concrete.

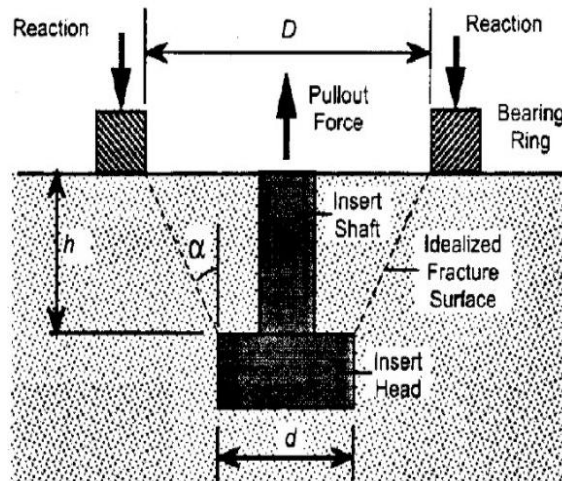


Fig 5 Pull out test

- **Carbonation Test**

The affected depth from the concrete surface can be readily shown by the use of phenolphthalein indicator solution. This is available from chemical suppliers. Phenolphthalein is a white or pale yellow crystalline material. For use as an indicator it is dissolved in a suitable solvent such as isopropyl alcohol (isopropanol) in a 1% solution.



Fig. 6 Phenolphthalein indicator solution applied to a fresh fracture surface through a concrete slab.

It has been shown (Ref.) that the depth of carbonation can be described by the following equation:

$$y = \sqrt{2D \frac{C_1}{C_2} t}$$

Where,

y = depth of carbonation [mm]

D = diffusion coefficient [mm²/a] (a=year)

C₁ = concentration of CO₂ in the air (approx. 0.6-0.8g/m³)

C₂ = amount of CO₂ to carbonate concrete (Approx. 10,000-50,000 g/m³)

t = time [years]

CONCLUSION

Non-destructive material testing (NDT) is an extremely effective means for the manufacturer or operator of a technical plant to quickly draw a firm conclusion about the quality of his product or the condition of his plant. This allows quality defects to be detected early and to prevent weaknesses causing disturbances of plant operation up to severe damage including unwelcome downtimes caused by component failure.

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