

NON-DESTRUCTIVE TESTING TECHNIQUES

Powerful method for evaluating existing concrete structures with regard to their strength and durability apart from assessment and control of quality of hardened concrete. In certain cases, the investigation of crack depth, micro cracks, and progressive deterioration are also studied by this method.

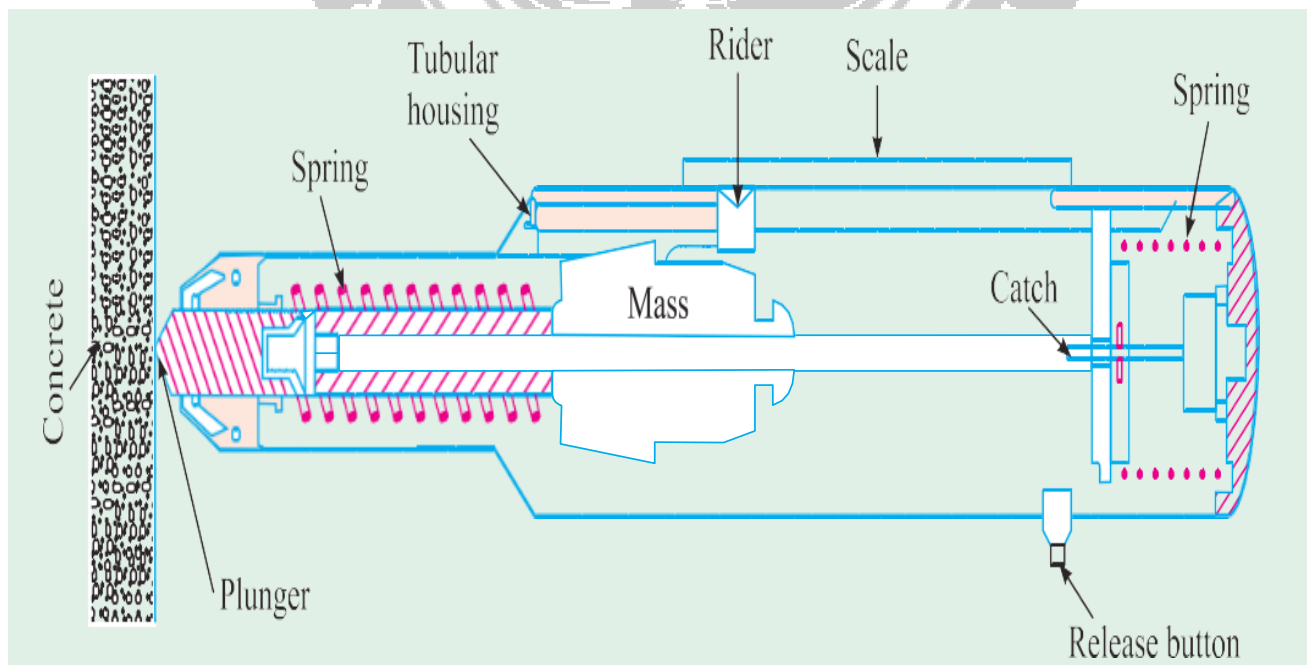
Non-destructive testing methods are relatively simple to perform, the analysis and interpretation of test results are not so easy. In the non-destructive methods of testing, the specimens are not loaded to failure and as such the strength inferred or estimated cannot be expected to yield absolute values of strength.

Various non-destructive methods of testing concrete have been developed.

1. **Surface hardness tests:** These are of indentation type, include the Williams testing pistol and impact hammers, and are used only for estimation of concrete strength.

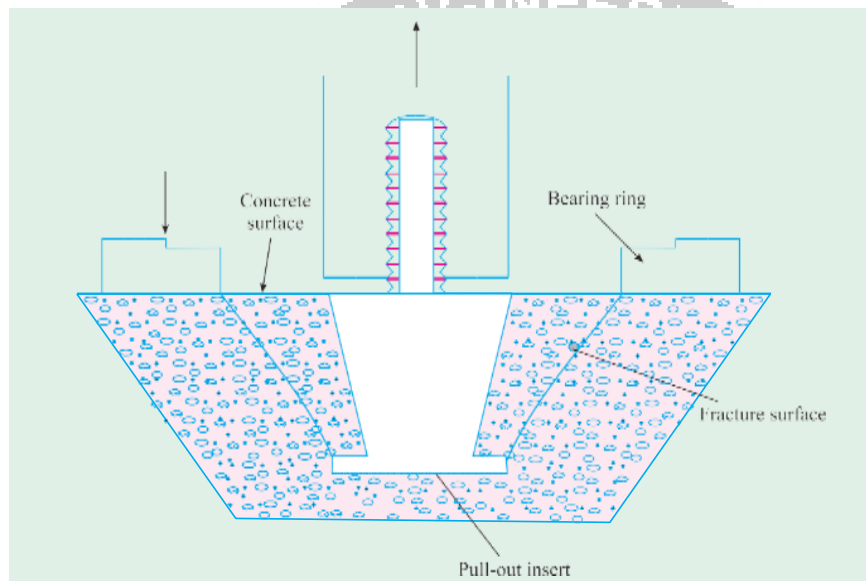
2. Rebound test:

It consist of a spring control hammer that slides on a plunger within a tubular housing. When the plunger is pressed against the surface of the concrete, the mass rebound from the plunger. It retracts against the force of the spring. The hammer impacts against the concrete and the spring control mass rebounds, taking the rider with it along the guide scale. By pushing a button, the rider can be held in position to allow the reading to be taken. The distance travelled by the mass, is called the rebound number. It is indicated by the rider moving along a graduated scale.



3. Penetration and Pull out techniques:

Two techniques were used. In one case, a hammer known as, “Simbi” was used to perforate concrete and the depth of borehole was correlated to compressive strength of concrete cubes. In the other technique, the probing of concrete was achieved by blasting with spit pins and the depth of penetration of the pins was correlated with compressive strength of concrete. The accuracy of this test was found to be $\pm 25\%$. However, it is further seen that, “Simbi” and spit pins were more effected by the arrangement of coarse aggregate, than the tests using rebound hammers.



4. Dynamic or vibration tests: This is the important non-destructive method used in testing concrete strength and other properties. The fundamental principle on these methods are based is velocity of sound through a material. A mathematical relationship could be established between the velocity of sound through specimen and its resonant frequency and the relationships of these two to the modulus of elasticity of the material. The relationships which are derived for solid mediums considered to be homogeneous, isotropic and perfectly elastic, but they may be applied to heterogeneous materials like concrete.

5. Resonant Frequency Method: This method is based upon the determination of the fundamental resonant frequency of vibration of a specimen. The equipment used for this is usually known as ‘Sonometer’. Resonant frequency methods are mostly used in the laboratory.

6. Combined methods: The combined methods involving ultrasonic pulse velocity and rebound hammer have been used to estimate strength of concrete.

7. Radioactive and nuclear methods: These include the X-ray and Gamma-ray penetration tests for measurement of density and thickness of concrete. Also, the neutron scattering and neutron activation methods are used for moisture and cement content determination.

7. Magnetic and electrical methods: The magnetic methods are primarily concerned with determining cover of reinforcement in concrete, whereas the electrical methods, including microwave absorption techniques, have been used to measure moisture content and thickness of concrete.

8. Acoustic emission techniques: These have been used to study the initiation and growth of cracks in concrete.

9. Surfaces Hardness Methods: The fact that concrete hardens with increase in age, the measure of hardness of surface may indicate the strength of concrete. Various methods and equipment's are devised to measure hardness of concrete surface.

