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Study of Destructive and Non-Destructive Test for Codal Base Minimum Grade of Concrete

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Abstract: In this project the learning of destructive and non-destructive test on actual specimen. The destructive test taken on cube, cylinder and beam. The non-destructive test reserved on cube, cylinder and beam. Subsequently the non-destructive test achieve the correct outcome of the concrete strength. Latest contemporary non-destructive tests are used in manufacturing, fabrication and in service assessments to confirm product veracity and consistency, to control manufacturing developments, inferior manufacture charges and to maintain unvarying quality level. During construction, NDT is used to confirm the quality of ingredients and joining processes through the fabrication and assembly phases, and in service NDT examinations are used to ensure that the products in use continue to take veracity necessary to ensure their worth and the security of the community. The greatest shared non-destructive testing (NDT) methods of concrete structures as applied by the structural engineering industry. The prerequisites of NDT methods are discovered in regards to their potential, restrictions, examination techniques and clarifications.

I. Introduction

The purpose of NDT is to determine the excellence and veracity of materials, components or gatherings without disturbing the ability to perform their intended functions. In construction, modern analytic methods are applied to building structural members and structures. Additional major diagnostic field is the non-destructive testing of building materials. Such materials as wood, masonry units, concrete and steel are exposed to tests for several reasons and at different times, e.g., during construction, but mainly during the service life. Several investigative methods are used for this purpose. An important feature of non- destructive test is that they authorized re- testing at the same, or nearly the same, location so that fluctuations with time can be observed. The use of non – destructive tests leads to improved protection and allows improved research of construction, thus making it conceivable to improvement faster and more economically. These tests can be characterized 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 is, the most part, comparative in nature. An understanding of the physical relation between the given NDT the results and strength is important. This relation for the several test will be deliberate in what follows. The test rarely given a number which can be clearly construed engineering judgment is necessary. Otherwise there is risk that one part is or another will pursue addition test and the disperse about the concrete in the structure will be compounded by a disperse about the testing. Importance and need of non-destructive testing: It is commonly essential to test concrete structures after the concrete has toughened to determine whether the structure is appropriate for its premeditated use. such type of testing must be done without damaging the concrete. .

II.OBJECTIVE

1. Detection of cracks, voids/ other imperfections
2. Monitoring changes in concrete with passage of time
3. To study the strength limitation of concrete.
4. To determine the appropriate and quicker NDT Methods.
5. The different percentage strength distinction for replacement of fly ash to the concrete.
6. To compare different bond strength of a concrete.

The material details are as follows.

A. Cement
B. Water
C. Fine Aggregate
D. Coarse Aggregate
E. Fly Ash

III .EXPERIMENTAL WORK AND TEST

DESTRUCTIVE TEST CONDUCTED ON CONCRETE :

In current study cube compression test, flexural test on beams and Cylindrical split tensile test on self-compacting concrete with constant fraction of steel fibre were carried out.

1. **Compressive Strength Test**:

Are used to determine the material performance under a load. The maximum stress a material can sustain over a period under a load. A cube compression test is performed on standard cubes of size 150 x 150 x 150 mm afterward 3, 7 and 28 days of absorption in water for curing.

The compressive strength of specimen is calculated by the following formula: fcu = Pc /A

Where Pc = Failure load in compression, KN A = Loaded area of cube, mm2

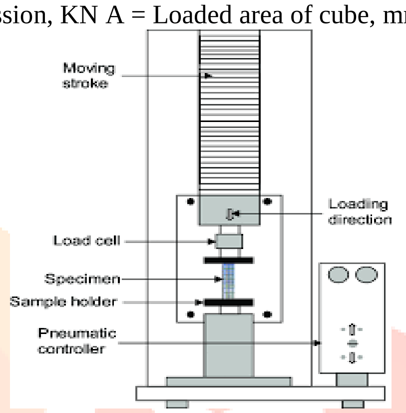

Fig. 1 Compressive strength

Compression tests are performed on brittle materials as these materials fail in shear. It is seen that the shear develops along a diagonal plane which is extreme on a plane inclined at 45° from the direction of compression load. In compression loading, the fracture of the specimen takes place due to bulging action. The property of a material to bulge under compressive loading is called malleability. It is the ductility that is accompanying with tensile loading while it is malleability that is associated with compressive loading.

2.**Flexural Test**:

The most communal purpose of a flexure test is to measure flexural strength and flexural modulus. Flexural strength is defined as the maximum stress at the outermost fibre on either the compression or tension side of the specimen. Flexural modulus is calculated from the slope of the stress vs. strain deflection curve .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. The deflection at the centre of the beam is measured with sensitive dial gauge on UTM. The two broken pieces (prisms) of flexure test are further used for equivalent cube compressive strength .(All Dimensions are in)

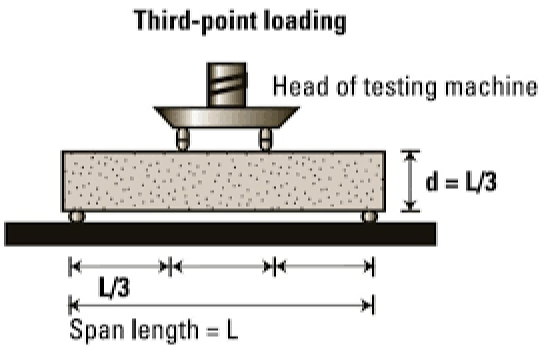

Fig. 2 Flexural Test

The flexural strength is determined by the formula cr f = Pf L / bd2

Where, cr f = Flexural strength, MPa Pf = Central point through two-point loading system, KN L = Span of beam, mm b = Width of beam, mm d = Depth of beam mm.

3.Split Tensile Test:

A method of determining the tensile strength of concrete using a cylinder which splits across the vertical diameter. It is an indirect method of testing tensile strength of concrete Due to complications involved in accompanying the direct tension test, a number of indirect methods have been developed to determine the tensile strength of concrete. In this 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.

Cylinder split tensile test setup The split tensile strength of cylinder is calculated by the following formula, ft = 2P /πLD

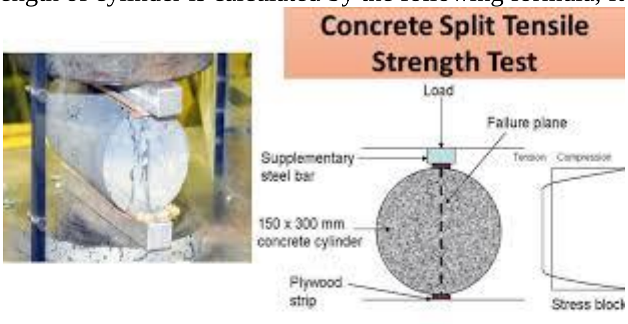

Fig.3 Split Tensile Test

Where, ft = Tensile strength, MPa P = Load at failure, N L = Length of cylinder, mm D = Diameter of cylinder, mm

Non Destructive test conducted on Concrete

A. Rebound Hammer:

Rebound Hammer test is a Non-destructive testing method of concrete which provide a suitable and rapid indication of the compressive strength of the concrete. The rebound hammer is also called as Schmidt hammer that consist of a spring controlled mass that slides on a plunger within a tubular housing .

It is a most frequently used surface hardness process is the standard rebound hammer test. Upon influence with the concrete surface, the rebounded hammer archives 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.

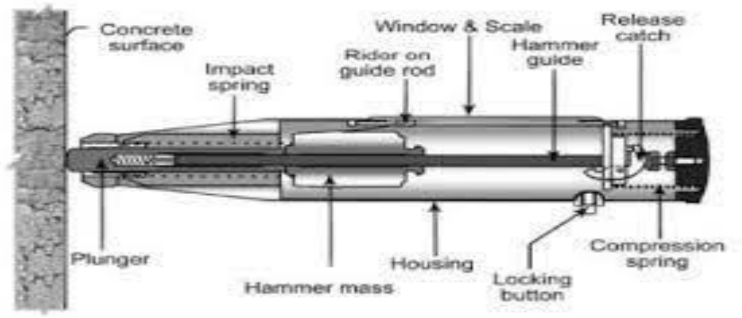

Fig.3 Split Tensile Test

Pull-Out Test:

Assessment of the bond between rebar and concrete by the pull-out test can be carried out conferring to different standards and references. In a pull-out test, rebar is fixed within a concrete prism or cylinder. During the test, rebar is pulled out by applyingtension force in a static loading rate and with a confined test setup. Pull-out resistance methods measure the force required to abstract standard embedded inserts from the concrete surface. Using conventional correlations, the force required to remove the inserts provides an estimate of concrete strength properties. There are 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 situated 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.

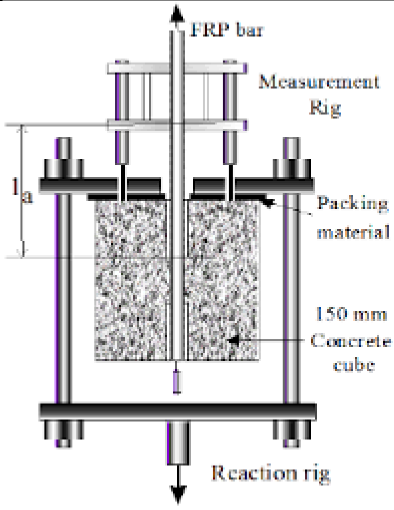

Fig.3 Pull-Out Test

Compressive strength test for cube

Tab. No. 1 Compressive strength test for cube 28 Days

Sr. No.	% of Fly Ash	C/s Area (mm^2)	Load (KN)	Compressive Strength (N/mm^2)	Avg. Compressive Strength (N/mm^2)
1.	0%	22500	612.01	26.9	27.33
2.			617.95	27.8	
3.			603.15	27.3	
4.	10%	22500	624.30	27.63	27.49
5.			621.85	27.87	
6.			620.20	26.96	
7.	20%	22500	636.65	28.37	28.44
8.			641.85	28.74	
9.			640.25	28.21	
10.	30%	22500	656.35	29.43	29.59
11.			658.00	29.71	
12.			661.85	29.63	
13.	40%	22500	610.55	27.33	27.08
14.			606.25	26.86	
15.			608.10	27.06	
16.	50%	22500	604.00	26.74	25.27
17.			600.45	26.21	
18.			507.95	22.88	

Split Tensile Test for cylinder:

Tab. No. *2* Split Tensile Test for cylinder 28 Days

Sr. No.	% of Fly Ash	Load at Failure (KN)	Tensile Strength(N/mm2)	Average Tensile Strength(N/mm2)	Remark
1.	0%	252	3.51	3.52	As per clause no.6.2.2-Page no. 16 of IS:456-2000 Split Tensile Strength of M20 grade concrete is 3.13 Mpa
2.		250	3.57		
3.		248	3.48		
4.	10%	254	3.56	3.59	
5.		256	3.60		
6.		258	3.63		
7.	20%	260	3.67	3.72	
8.		262	3.72		
9.		264	3.78		
10.	30%	278	3.95	3.95	
11.		276	3.91		
12.		280	3.98		
13.	40%	246	3.49	3.45	
14.		244	3.45		
15.		242	3.42		
16.	50%	240	3.37	3.34	
17.		238	3.34		
18.		236	3.31		

Flexural Test on beam:

Tab. No. 3 Flexural Test on beam 28 Days

Sr. No.	% of Fly Ash	Load at Failure (kN)	Flexural Strength (N/mm2)	Average Flexural Strength (N/mm2)	Remark
1.	0%	18	3.23	3.44	As per clause no.6.2.2 page no. 16 of IS: 456-2000 Flexural Strength for M20 grade concrete is **3.13MPa**
2.		19	3.97		
3.		16	3.11		
4.	10%	19	3.81	3.93	
5.		20	4.19		
6.		17	3.78		
7.	20%	21	4.94	4.00	
8.		16	3.12		
9.		18	3.94		
10.	30%	20	4.26	4.54	
11.		22	4.51		
12.		24	4.87		
13.	40%	16	3.11	3.25	
14.		18	3.67		
15.		14	2.97		
16.	50%	14	2.97	2.86	
17.		16	3.11		
18.		12	2.52		

Rebound Hammer Test:

Tab. No. 4 Rebound Hammer Test

Sr. No	% of Fly Ash	Rebound No.	Comp. Strength (N/mm^2)	Avg. Comp. Str. (N/mm^2)
1.	0%	37	28	26.66
2.		36	26	
3.		36	26	
4.	10%	39	32	30.00
5.		38	30	
6.		37	28	
7.	20%	40	33	31.66
8.		38	30	
9.		39	32	
10.	30%	42	38	37.00
11.		40	33	
12.		43	40	
13.	40%	35	24	25.33
14.		34	22	
15.		32	20	
16.	50%	34	22	22.00
17.		32	20	
18.		35	24	

Pull out Test

Tab. No. 6 Pull out Test

Sr. No.	Specimen	% of Fly Ash	Load (kN)	Pull Out Strength (N/mm^2)
1	Cube	0 %	128	4.06
2		10%	134	4.25
3		20%	138	4.38
4		30%	146	4.64
5		40%	126	4.01
6		50%	124	3.84

V.CONCLUSION

1. Non Destructive material testing is tremendously operative means for the manufacturer or operator of a technical plant to rapidly draw a firm conclusion about the superiority of his product or the state of his plant.
2. Using association method of ultrasonic pulse velocity and rebound hammer gives improved result than the only ultrasonic pulse velocity method.
3. The auxiliary of cement by fly ash in concrete correspondingly increases the rebound hammer test strength of concrete. It is pure that Compressive strength attained from the rebound hammer test is excellent and increases with addition of Fly Ash up to 30%.
4. The pull-out strength rises with the percentage increase of fly ash in concrete Beam. An increase of 4.25%, 7.78% and 14.3% strength was observed for 10%, 20% and 30% replacement of cement with fly ash respectively.

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