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CHARACTERISTIC STRENGTH OF POLYMER IMPREGNATED CONCRETE

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Abstract - *Generally concrete have 2% air void, apart from that some time, due to poor workmanship it may be increased. In this conditions concrete quality, strength &durability is simultaneously decreasing. If reducing these voids the strength durability of concrete increasing. In our project the voids can filled with epoxy monomer. Besides, this method can be used in precast specimens after 28 days curing. After curing the concrete specimens are embedded in the epoxy solution with few seconds then take out from solution and keep in room temperature for setting 2 to 3 days. Then both conventional and impregnated concrete specimens such as cubes, cylinders and prisms are can be tested under compression, split tensile and flexural for determining the characteristic strength respectively. Then test results are can be compared.*

Key Words: Compressive strength, Flextural strength, Split tensile strength, Epoxy Resins(Monomer), Polymer Impregnated concrete.

1. INTRODUCTION:

Concrete is a composite material which consists of fine aggregate, coarse aggregate, cement paste, air, and free water. Approximately 75 % of the concrete volume is made up of the aggregates and the remainder is cement and free water.Concrete has served as an excellent construction material for many years. Deterioration of concrete involves a number and interaction of variable such as loading pattern, material characteristics, and environmental conditions.

There have been extensive investigations into the nature of deterioration of concrete. However, the most common types of deterioration are cracking, scaling, and spalling .

In recent years, the use of polymer in concrete has been investigated to improve the strength and durability performance of concrete. In general, concrete polymer materials can be divided into three types as follows;

1) polymer-impregnated concrete (PIC),
2) polymer-concrete (pc),
3) polymer-cement concrete (PCC).

Many monomer systems have been investigated. In general, the PIC has improved the following concrete properties;
1) Compressive strength,
2) Tensile strength;

The increase in durability of PIC results because the polymer in the concrete pores significantly reduces the intrusion of water.

2. POLYMER IMPREGNATED CONCRETE:

Polymer-impregnated concrete (PIC) is prepared by impregnating the dried conventional concrete with a liquid monomer system. Usually entrapped air is removed from the concrete prior to monomer application. After the pores of the concrete are filled with the monomer, polymerization of the monomer is completed by means of radiation or the thermal catalytic process.

Soaking the concrete surface with the monomer prior to curing is another important step of partial polymer-impregnation. It is well known that concrete is pervious to water. This is evidenced by its absorption of water by capillary action and by the passage of water under pressure through it. The porosity of the concrete is the major factor affecting the absorption ability of concrete.

3. MATERIALS:

- Cement : OPC43 grade
- Sand : less than 4.75mm
- Coarse Aggregate: greater than 4.75mm
- W/C ratio : 0.5
- Mix proportion : 1:1.56:3

3.2. PROPERTIES OF MATERIALS:

3.2.1. Fine aggregate:

Sand is a normally happening granular material made out of finely isolated rock and mineral particles. It is characterized by size, being better than rock and coarser than residue. Sand can likewise allude to a textural class of soil or soil sort; i.e. a dirt containing more than 85% sand-sized particles. Set up of sand we can likewise utilize base fiery remains which can be a substitution of sand up to a level of 20% substitution of sand gives a decent compressive quality.

Table 3.2.1 Fine aggregate

S .No	Properties	Value
1	Specific gravity	2.65
2	Fineness modulus	3.16
3	Water absorption	0.24
4	Surface texture	Smooth

3.3.2. Coarse aggregate:

Coarse aggregates are particles greater than 4.75mm, but generally range between 9.5mm to 37.5mm in diameter. They can either be from Primary, Secondary or Recycled sources.

Primary, or 'virgin', aggregates are either Land- or Marine-Won. Gravel is a coarse marine-won aggregate; land-won coarse aggregates include gravel and crushed rock. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the remainder. Additionally where the coarse total ought to adjust to IS-383-1970.

Table 3.3.2 Coarse aggregate

S. No	Properties	Value
1	Specific gravity	2.68
2	Fineness modulus	6.4
3	Water absorption (%)	0.24
4	Impact value	12.195
5	Particle shape	Angular
6	Crushing value	25.12

3.3.3. Water - The basic properties of water from the results of conducted tests confirming with IS 3025 (part 17)-1984, IS 3025 (part 24) -1986, IS 3025 (part 32) -1988 and IS 456 –2000

Table 3.3.3 water

S. no	Properties	Values	Permissible values
1	pH value	7.61	6-8
2	Chloride	420 ppm	2000 ppm for PCC 500 ppm for
3	Sulphates	10 ppm	400 ppm

3.3.4. Cement:

Cement acts as a binder material and main ingredient for concrete and mortar.

43 Grade Ordinary Portland cement was used in this experimental study. The properties of cement were determined based on the specifications of IS 8112-1989 and IS 4031(part 1, 3, 5 and 11) – 1988 and 1999. The important tests of cement such as Fineness Test (Sieve test and Air permeability method), Initial setting time, Final setting time, Specific gravity and Standard consistency were made on 43 grade OPC cement in laboratory.

Table 3.3.4 Cement

S..No	Properties	Value
1	Specific gravity	3.15
2	Fineness (m^2/ kg)	227.80
3	Initial setting time(minutes)	45
4	Final setting time (minutes)	585
5	Standard Consistency (%)	30

3.3.5. Epoxy Resin:

Epoxy resin is typically used in applications such as the aerospace industry, motor racing and yachts and takes the higher end of the performance spectrum. Epoxy polymer concrete has superior chemical resistance excellent structural properties and good adhesion to a variety of surface and exhibits a minimal degree shrinkage during curing. Epoxy polymer concretes show

cases a flexural strength up to ten times greater than that in cement concrete, super for structural engineering application. Its mainly used in highways industrial flooring and resurfacing of deteriorated structures. Mixing ratio 25 % weight of the epoxy resin.

4. DESIGN MIX:

As per Indian standard codes Mix design is to be prepared for M20 concrete grade to get a target mean strength of 26.6 N/mm2. Mix proportion of this study is 1:1.56:3:.5

5. CURING OF SPECIMENS:

Resultant specimens are to be casted and curing process is to be done at the age of 7 days and 28 days.

6. TEST OF SPECIMENS:

The test on hardened concrete to be conducted and it described below.

6.1. Cube Compression Test:

Resultant samples are to be casted in a cube set of specimen's size of 150mm*150mm*150mm are used. The test is to be conducted on cubes with different ages of curing and figure shows below.

Fig 6.1 Compression test

6.2. Flexural Strength Test:

Resultant samples are to be casted in a cylinder set of specimen's size of 150mm*500mm are used. The test is to be conducted on cylinders with different ages of curing and figure shows below.

Fig 6.2 Flexural test

6.3. Split Tensile Strength Test:

Resultant samples are to be casted in a cylinder set of specimen's size of 150mm*300mm are used. The test is to be conducted on cylinders with different ages of curing and figure shows below.

Fig 6.3 Split tensile test

7. RESULTS AND DISCUSSIONS:

7.1. Concrete Cube Strength:

Specimens are to be tested at the age of 28 days and their test results are to be tabulated in below respectively.

From the above results, the compression test results are to be compared with nominal mix of concrete for 28 days.

Table 7.1 Cube strength for 28 days

	Specimen	Compressive strength (n/mm2)	Result n/mm2
Conventional concrete	C1	27.85	27.85
	C2	27.764	
	C3	27.93	
Impregnated concrete	IC1	33.111	32.885
	IC2	32.680	
	IC3	32.860	

7.2. Flexural Strength:

Table 7.2 Flexural strength for 28 days

	Specimen	Modulus of rupture (n/mm2)	Result n/mm2
Conventional concrete	P1	8.5	8.5
	P2	8.25	
	P3	8.75	
Impregnated concrete	IP1	14	13.75
	IP2	14.25	
	IP3	13	

Specimens are to be tested at the age of 28 days and their test results are to be tabulated respectively. From the above results, the flexural test results are to be compared with nominal mix of concrete for 28 days.

7.3. Split Tensile Strength:

Specimens are to be tested at the age of 28 days and their test results are to be tabulated in below

Table7.3 Split tensile for 28days

	Specimen	Split tensile (n/mm 2)	Result n/mm2
Conventional concrete	CY1	2.781	2.847
	CY1	2.910	
	CY3	2.852	
Impregnated concrete	ICY1	3.819	3.894
	ICY2	3.961	
	ICY3	3.904	

From the above results, the Split Tensile test results are to be compared with nominal mix of concrete for 28 days.

8. CONCLUSION:

First we are going to compare the strength conventional concrete and impregnated concrete. After the completion of the test we got to know that impregnated concrete strength is increased than conventional concrete. The strength increased due to reduction of the porous in the concrete. The porous is reduced with the help of epoxy and harden. These concrete can be used in bridge construction, under water construction. Actually we have tested the strength of these concrete in further we can do durability test which use to find the durability of concrete.

9. REFERENCES:

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[3] IS: 383-1970 (Second Revision) Specifications for Coarse & Fine Aggregates from Natural Resources for Concrete