Experimental Investigation On Concrete With Partial Replacement Of Blast Furnace Slag And Ceramics Tiles As Coarse Aggregate.

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Abstract-*The Concrete is an engineering composite material made with cement, aggregates and admixtures in some cases. Due to the day by day innovative usages and developments in construction field, the world wide consumption of natural aggregates is very high and at the same time production of solid wastes from the demolitions and manufacturing units are also very high. Extensive use of concrete leads to the scarcity and unavailable of natural aggregates. Because of this reasons the reuse of demolished construction wastes and solid waste from manufacturing came into the trend to reduce the solid wastes from demolition and manufacturing units and as well as to decrease the scarcity of natural basic aggregate. To overcome the issues many research were done to use many industrial waste asalternative material for concreting. In thisproject control concrete is casted for M25 grade and thepartial replacement of concrete materials were decided to reuse industrial waste such as blast furnace slag and ceramics tiles as coarse aggregate replacement in range of 0%,10%,20%, 30%, 40% by weight of 20mm sieve size coarse aggregate. Concrete mixtures wereproduced, tested and compared in terms of durability testsand to find optimumpercentage of the partial replacement by replacing 0%,10%,20%, 30%, 40% of ceramic waste and blast furnace slag.*

Index Terms— Blast Furnace Slag, Coarse Aggregate, Compressive Strength,ceramicswaste,mechanical and durable properties.

1.INTRODUCTION

Generally in design of concrete mix, cement, fine aggregates and coarse aggregates are using from few years back, which plays a crucial role in designing of a particular grade of concrete. But now a days there is a scarcity in aggregates. So, some new materials which are locally available for low cost have to introduce for replacing the fine aggregates, coarse aggregates and as well as cement to get the same strength by using these basic materials So, we have to search for different materials to reduce the quantity of basic natural materials in the concrete mix without changing any mix design procedure and lack of considerations.

1.1 Blast Furnace Slag:

Blast furnace slag is a type of metallurgical furnace used for smelting to produce industrial metals, generally iron but also other such as copper or lead. At the end of furnace end product are usually metal and slag tapped from bottom and gases existing from top of furnace.It is produced by heating pig/cast iron with

1600 to 1800 degcelcius temperature.

Fig 1 Image Of Blast Furnace Slag

1.2 Ceramics Waste:

Ceramic waste can be used in concrete to improve its strength and other durability factors, to reduce cost and used as a partial replacement of cement or as a fine aggregate sand as a supplementary addition to achieve different properties of concrete.In this project study an attempt is to find suitability of the ceramic industrial wastes as a possible replacement of C.A.

Fig 2Images Of Ceramics Tiles

II. MATERIALS USED:

1.Cement

Ordinary Portland cement of 53 grade conforming to IS12269-1987 (with specific gravity of 3.15) were used. It is also necessary to ensure compatibility of the chemical and mineral admixture in cement.

2. Fine Aggregate

The fine aggregates belong to grading zone II. For the experimental study, sand acquired from natural River sand. Fine aggregate was confirming to IS 383: 1970. It was pass through 4.75 mm size of IS sieve having specific gravity of 2.31 was used.

3.Coarse Aggregate

Coarse aggregates are any particle greater than 4.75mm, but generally range between 10mm to 40mm in size. Coarse aggregate obtain from local sources 20 mm sieve size experimental purpose. Coarse Aggregate used in experimental study was confirming IS 383: 1970. The aggregate are sieved separately. Specific gravity and water absorption of these aggregate were 2.74 and 0.55 respectively

4.Blast Furnace Slag:

Blast furnace slag were obtained from local foundries and broken and crushed with 20mm sieve size. Its bulk density and water absorption were 1.305 g/ccand 2.59% respectively.And the value of impact strength and crushing strength of blast furnace slag is 14.70& 14.50 respectively.

Fig3.Image of blast furnace slag

5. Ceramic waste:

In this project study an attempt has been made to find the suitability of theceramic industrial wastes as a possible replacement for conventional coarse aggregate.Crushed ceramics tiles are replaced with 20mm size of coarse aggregate.

Fig.4 Image .cuushed ceramics tiles.

6.Super Plasticizer

Glenium B233is a carboxylic ether polymer super plasticizer.Dosage of super plasticizer was found by using marsh cone test.

7. Water:

Water is an important ingredient of concrete as it actively participates in chemical reaction with the cement to form the hydration products, calcium –silicate-hydrate(C-S-H)gel and to improve workability.

III. MIX DESIGN

M25 grade of concrete was designed by following the specification given in the IS 10262: 2009.Water – Cement ratio (w/c) was selected as 0.5 based onconducting slump tests for different design trials.

IV. EXPERIMENTAL PROGRAM

Total 5 type of mixes were prepared by changingpercentage of replacement by waste crushed tiles and blast furnace slag in coarse aggregates in order to find the durability properties of concrete respectively asshown in Table 1.

Table 1Percentages Of C.A Replaced

Mix 25	C.A%	B.F.S%	Crushed Tiles%
M0	100	0	0
M1	90	5	5
M2	80	10	10
M3	70	15	15
M4	60	20	20

A. Ultrasonic Pulse Velocity Test:

It is a Non-Destructive method of testing on hardenconcrete to measure the quality of the concrete. The test was conducted following the procedure and specifications given in as per table 2 in IS1311 part 1: 1992. This test was performed on all prism having different percentages of replacing materials after 28 days curing period. Velocities of different concrete mixes (M0 to M4) were calculated and the values are as follows

Table 2.Ultrasonic Pulse Velocity Test results:

Mix	Velocity (km/sec)		Concrete quality grading
	7 days	28 days	
M0	4.6	4.8	Excellent
M1	4.4	4.73	Excellent
M2	4.32	4.68	Excellent
M3	4.2	4.5	Excellent
M4	4.1	4.63	Excellent

B.Rapid Chloride Penetration Test:

Rapid chloride penetration test method is used to give the qualitative classification of concrete. This method is used to find the durability of concrete and the method used in RCPT is 100*200mm size cylinder specimen is taken andSpecimen subjected to a 60V potential for 6 hours and chargesNegative side filled with 3% NaCl solution and positive side filled with 0.3M NaOH solution.Current is measured in each half hour, from which the total charge passed is calculated and results are as follows

Table 3 RCPT Results:

MIX M25	Voltage	Charge Passed	Testing time	Permeability class
M0	60 v	1156	6Hours	Low
M1	60 v	859	6Hours	Very

				low
M2	60 v	801	6Hours	Very low
M3	60 v	400	6Hours	Very low
M4	60 v	6	6Hours	Negligible

So, finally concluded from the test is that the quality of all concrete mixes having good durability property.

C.Water Absorption Test:

The 150*150*150mm cube is casted after casting were immersed in water for 28 days curing.These specimens were then oven dried for 24 hours at the temperature110°C until the mass became constant and again weighed. And specimens are dried for 24 hrsat w1.Initialwt of specimen is taken as w2 then % water absorption = [(W2– W1) / W1] x 100 Where, W1 = initial weight of cubes in kilograms , W2 = specimens are dried in oven for 24 hrs at w2.


Fig 5: Setup of Oven&wt of specimen Table 4 Average % water absorption at 28 days for M25

Mix	Oven dry weight of specimen w1(kg)	Weight of specimen after curing w2(kg)	%of water absorption
M0	8.85	8.9	0.56
M1	8.95	9.09	1.73
M2	8.711	8.90	1.16
M3	8.45	8.73	1.946
M4	8.70	8.85	1.55

After completion of testing, Comparing with different mix percentages of concrete mix M2, has low percentage of water absorption but its percentage of water absorption is greater than control mix concrete.

D.Carbonation Test:

Measuring the depth of carbonation of concrete. Specimen with 150*150*150mm cubes were casted with different mix percentages upto 40% replacement of coarse aggregates with blast furnace slag and ceramics tiles.Measuring the depth of carbonation at different sections of the prismatic samples at different time intervals 28 days and Phenolphthalein used as indicator –colourless implies carbonated.

Fig 6.Carbonation test setup

After completing testing all mix percentages of concrete specimen turned to pink colour resembles that the concrete is good in durability.

E.Water Permeability Test:

Depth of water penetration is measured by using water permeability test apparatus. And 150*150*150mm dia specimens were casted and cured for 28 days and method is used to measure the resistance of concrete against the penetration of water exerting pressure. The test be done when the age of concrete is between 28 days. A water pressure of 0.5 N/mmis applied through a specimen for a period of 3 days.

After the pressure is released, the specimen is divided into two partsand the depth of water penetration is noted.

Fig7.permeability Test Setup

Table 5. Permeability Test Results

Mix	Depth of penetration(cm)
M0	3.45
M1	3.14
M2	3.04
M3	3.5
M4	3.57

Depth of penetration is less in M2 mix compared to other percentage mix of concrete respectively.

F.Conclusions

1. Replacement of coarse aggregate is done with blast furnace and ceramics tiles with 0 to 40% to find the durability property.
2. Specimens tested by RCPT shows results that comparing M0 and replacement mixes,permeability class is very low and negligible. Hence it proves that all mix types of concrete specimen has very low permeability.
3. After completion of water absorption test, Comparing with different mix percentages of concrete, mix M2 has low percentage of water absorption. But mix M2 percentage of water absorption is greater than M0.
4. Various Mix percentages of concrete specimen from M0 to M4 turned to pink colour resembles that the concrete is good in durability during carbonation test.
5. Depth of penetration is less in M2 mix compared to other percentage mix of concrete respectively .

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