Experimental Study on Ceramic Tiles Waste in Concrete Replacing of Coarse Aggregate

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Abstract— In this project we utilise the waste ceramic tiles to replace with coarse aggregate in concrete. Waste Ceramic is one of the most active research areas that encompass a number of disciplines including civil engineering and construction materials. The waste ceramic crushed tiles were partially replaced in place of coarse aggregates by 10%, 20%, 30%,and 40% .M30 grade of concrete was designed and tested.. Experimental investigations like workability, Compressive strength test, Split tensile strength test, Flexural strength test for different concrete mixes with different percentages of waste crushed ceramic tiles after 14 and 28 days curing period has to be done. By the usage of optimum dosage of waste ceramic tiles, structural behaviour and ductility properties will be evaluated.

Keywords: Ceramic Tiles Waste, Concrete, Coarse Aggregate

I. INTRODUCTION

A ceramic material is an inorganic, non-metallic, often crystalline oxide, nitride or carbide material. Ceramic materials are brittle, hard, strong in compression, and weak in shearing and tension. They withstand chemical erosion that occurs in other materials subjected to acidic or caustic environments.

There is a growing interest in using waste materials such as ceramics as alternative aggregate materials for construction. Ceramic wastes sourced from construction and demolition wastes were separated from other debris and crushed using a quarry metal hammer.

A. *Uses of Waste Ceramic Waste in Concrete*

Ceramic waste can be used in concrete to improve its strength and other durability factors. Ceramic waste can be used as a partial replacement of cement or as a partial replacement of fine aggregate sand as a supplementary addition to achieve different properties of concrete. Ceramic products are hard, porous, and brittle. As a result, they are used to make pottery, bricks, tiles, cements, and glass. Ceramics are also used at many places in gas turbine engines. Bio-ceramics are used as dental implants and synthetic bones.

II. METHODOLOGY

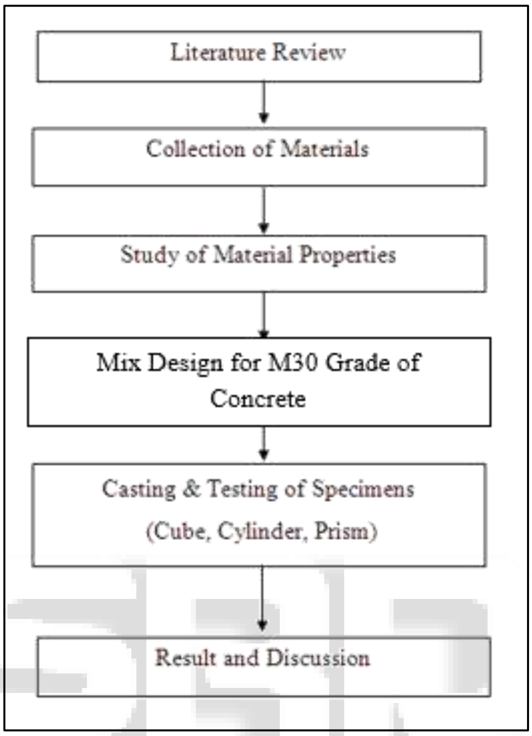


Fig. 1: Methodology flow chart

III. MATERIALS USED

A. *Cement*

Cement is a binding material which possesses very good adhesion and cohesive properties which make it possible to bond with other materials. In this project ordinary Portland cement of 43 grades is used for experimental work. The specific gravity of ordinary Portland cement is 3.15 Initial and final setting time of the cement was 30 min and 360 min. percentage of fineness in cement 96%

B. *Fine Aggregate*

In this project manufacture sand has been used as fine aggregate.

C. *Coarse Aggregate*

In this project size of aggregate about 20mm has been used as coarse aggregate.

Impact strength of normal coarse aggregate is 10.5%, crushing strength of normal coarse aggregate 20.9%

D. *Ceramic Waste*

Ceramic wastes are classified as non-recyclable waste which used for the normal use as filling material. Based on research regarding recyclable Construction and Demolition (C&D) wastes, ceramic wastes have the potential to be used in concrete production. Impact strength of ceramic waste coarse aggregate is 12.5%, crushing strength of ceramic waste coarse aggregate 25%

E. WATER

Portable water used as water in the concrete

S.No.	Description	Fine aggregate	Coarse aggregate
1	Specific gravity	2.58	2.60
2	Water absorption	0.50%	0.50%
3	Fineness modulus	2.84	4.13

Table 3.1: Properties of Aggregates

IV. MIX PROPORTIONS

The quantity required for M30 grade of concrete is determined as per IS code and listed below

WATER CEMENT RATIO	CEMENT	FINE AGGREGATE	COARSE AGGREAGATE
186 lit/m^3	531.42 Kg/m^3	571.064 Kg/m^3	1108.536 Kg/m^3
0.35	1	1.07	2.08

Table 4.1: Mix proportion of concrete

Different types of mixes were prepared by changing the percentage of replacement of coarse aggregate with waste ceramic tiles. The coarse aggregates are replaced by 10%, 20%, 30%, and 40% of crushed tiles and the. The details of mix designations are as follows:

Mix Code	Percentage of replacement of coarse aggregate with crushed tiles	Cement (Kg/m^3)	Coarse Aggregate (Kg/m^3)		Fine Aggregate (Kg/m^3)	Water (Kg/m^3)
			Natural Coarse Aggregate	Crushed Tiles		
M0	0	531.42	1108.536	0	571.064	186
M1	10	531.42	997.68	110.85	571.064	186
M2	20	531.42	886.79	221.70	571.064	186
M3	30	531.42	775.97	332.55	571.064	186
M4	40	531.42	665.13	443.43	571.064	186

V. RESULT AND DISCUSSION

A. Workability Properties Test of Concrete

Slump cone test and Compaction factor test conduct for workability properties test of concrete

Water Cement Ratio	Conventional Concrete	Concrete By Ceramic Waste
0.35	8 Mm Slump	19 Mm Slump

Table 5.1: slump Value

Water Cement Ratio	Conventional Concrete	Concrete By Ceramic Waste
0.35	0.837	0.897

Table 5.2: Compaction Factor Test

B. Harden Strength Properties Test of Concrete

The cube of size 100 x 100 x 500mm conduct for compressive strength test, then specimen kept for curing in water and then tested for 14 days and 28 days. The cylinder size of diameter about 150 mm and height about 300 mm conduct for split strength test and the prism of size 100 x 100 x 500mm conduct for flexural strength test.

S. No	Mix Designation	Percentage of replacement of coarse aggregate with crushed tiles	Compressive strength of M30 grade in N/mm^2	
			14 days	28 days
1.	M0	0	29.14	34.38
2.	M1	10	31.99	37.7
3.	M2	20	33.4	40.7
4.	M3	30	38.13	44.34
5.	M4	40	32.37	38.36

Table 5.3: Compressive Strength of Concrtre

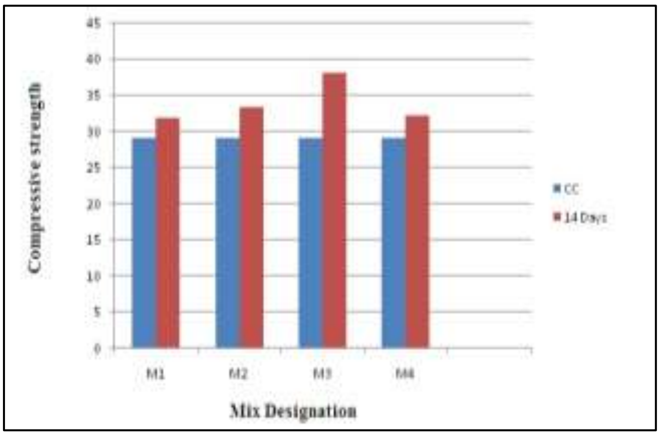
S. No	Mix Designation	Percentage of replacement of coarse aggregate with crushed tiles	Split tensile strength of M30 grade in N/mm^2	
			14 days	28 days
1.	M0	0	2.28	2.66
2.	M1	10	2.29	2.71
3.	M2	20	2.34	2.715
4.	M3	30	2.36	2.75
5.	M4	40	2.31	2.69

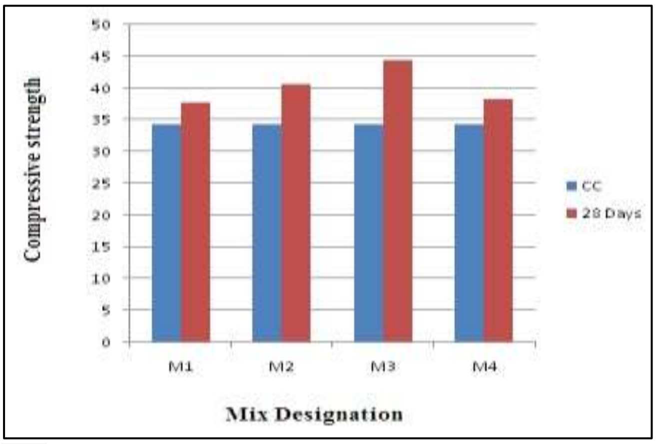
Table 5.4: Split Tensile Strength of Concrtre

S. No	Mix Designation	Percentage of replacement of coarse aggregate with crushed tiles	Flexural strength of M30 grade in N/mm^2	
			14 days	28 days
1.	M0	0	4.30	5.85
2.	M1	10	4.51	6.13
3.	M2	20	4.62	6.46
4.	M3	30	4.92	7.28
5.	M4	40	4.56	6.38

Table 5.5: Flexural Strength of Concrete

C. Graph





= CONVENTIONAL CONCRETE

= OTHER MIX OF CONCRETE

Mix Designation	Percentage of replacement of coarse aggregate with crushed tiles
M0	0
M1	10
M2	20
M3	30
M4	40

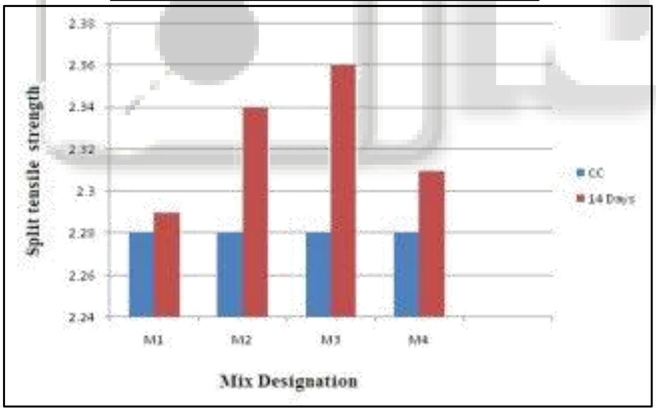


Fig. 6.1: split tensile strength at 14 days

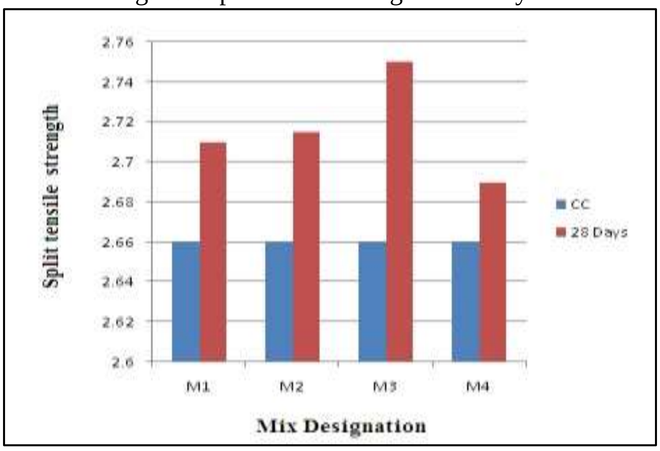


Fig. 6.2: split tensile strength at 28 days

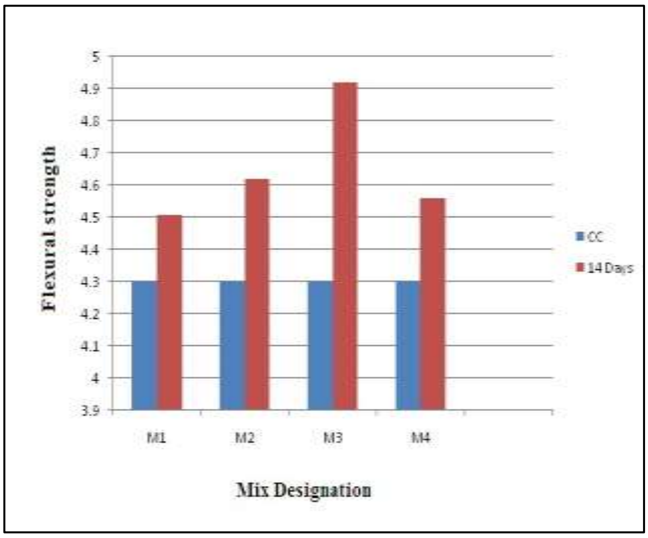


Fig. 6.3: flexural strength at 14 days

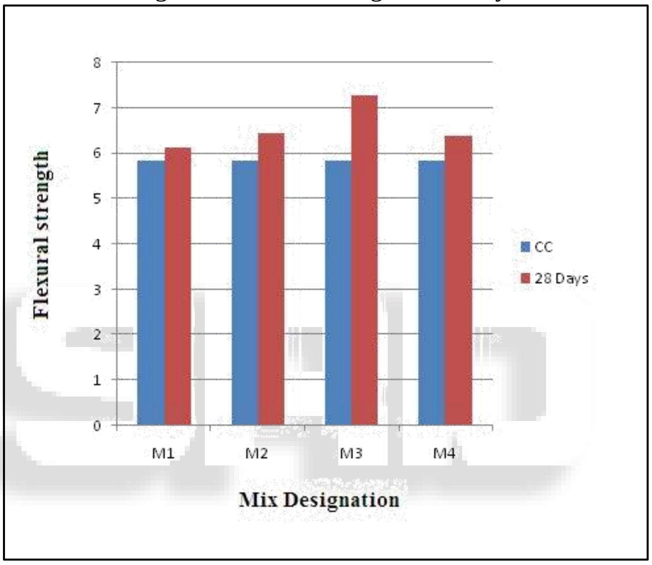


Fig. 6.4: flexural strength at 28 days

VI. CONCLUSIONS

- The properties of concrete increased linearly with the increase in ceramic aggregate up to 30% replacement later it is decreased linearly.
- Concrete with 30% of waste ceramic tiles replaced with coarse aggregate which produced high of compressive strength, split tensile strength and flexural strength compare other mix of concrete
- Concrete with 40% of waste ceramic tiles replaced with coarse aggregate which produced low of compressive strength split tensile strength and flexural strength compare other mix of concrete due crushing strength of waste tiles

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