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PERFORMANCE OF CONCRETE BY REPLACING COARSE AGGREGATE AND FINE AGGREGATE WITH CERAMIC WASTE

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Abstract — *Now a days, in India growth rate of infrastructure is increase rapidly so larger quantity of concrete is used for the high rise building so it's necessary to use a high strength concrete. Also larger quantity of the natural resources is used and pollution of the environment is increased day to day. Ceramic waste is one of them which pollute the environment and also waste for industries. Here in this research paper an attempt has been made to study the effect of ceramic waste tile on properties of concrete by replacing coarse aggregate and fine aggregate. For the study purpose, replacement of a coarse aggregate and fine aggregate by different percentage of Ceramic waste has been done for water cement ratio of 0.35. Concrete made from a ceramic waste (tiles) has been tested and experimentally evaluated for compressive strength, Tensile strength, flexure strength and under water flexure strength. The percentage of aggregate replaced by a 20% of ceramic waste achieve a high compression strength than the other percentage replacement of coarse aggregate. Therefore replacement of coarse aggregate kept fixed to 20% and replacement of fine aggregate for different percentage has been considered. OPC-53 grade cement and high range water reducer is used for the proper workability of high strength concrete. In this research investigate a fresh and hardened property of a concrete. Cube, beam and cylinder are casted and tested for compressive strength, flexure strength, under water flexure strength and split tensile strength.*

Keywords- *Ceramic Waste, Concrete, Compression strength, Flexural Strength. Split tensile strength*

I. INTRODUCTION

In an earlier day time period cement made from a crude gypsum or lime stone. Lime stone additionally discuss with as an overwhelmed, burned lime stone and water have been delivered to the cement, they become a mortar and use as adhesive material. Over thousand of a year these substances progressed upon combined with other cloth and, ultimately grow to be a Modern concrete. Basically concrete is a manmade product consist with a mixture of cement, aggregate, sand, water and admixture. Admixtures are chemical added to the concrete for the purpose of a workability of a concrete. Granular material like sand, gravel and crushed stone is a major part. Aggregate is a readily available in a financial rate and required quality.

Now these days, in India growth rate of infrastructure is increase rapidly so larger quantity of concrete is used for the high rise building so it's necessary to use a high strength concrete. Also larger quantity of the natural resources is used and pollution of the environment is increased day to day. Ceramic waste is one of them which pollute the environment and also waste for industries. A ceramic waste tile is a waste generated during the manufacture of the tile because of a brittleness nature of the tile. Tiles have a bending and rupture present because of the manufacturing fault. This ceramic waste is not recycled. Ceramic waste is only used to fill the dug on the earth surface. Here in this research paper an attempt has been made to study the effect of ceramic waste tile on properties of concrete by replacing coarse aggregate and fine aggregate. For the study purpose, replacement of a coarse aggregate and fine aggregate by different percentage of Ceramic waste has been done for water cement ratio of 0.35. Concrete made from a ceramic waste (tiles) has been tested and experimentally evaluated for compressive strength, Tensile strength, flexure strength and under water flexure strength. The percentage of aggregate replaced by a 20% of ceramic waste achieve a high compression strength than the other percentage replacement of coarse aggregate. Therefore replacement of coarse aggregate kept fixed to 20% and replacement of fine aggregate for different percentage has been considered. OPC-53 grade cement and high range water reducer is used for the proper workability of high strength concrete. In this research investigate a fresh and hardened property of a concrete. Cube, beam and cylinder are casted and tested for compressive strength, flexure strength, under water flexure strength and split tensile strength.

II. MATERIAL USED FOR EXPERIMENTAL WORK

For current study purpose Ordinary Portland Cement of 53 grade conforming to IS: 8112 is used which has specific gravity of 3.14. Maximum 20mm size of coarse aggregate conforming to IS 383:1963 is used for concrete. Coarse aggregate has recorded specific gravity of 2.70. Fine aggregate used in current work is of zone II conforming to

IS 383:1963 Table number IV. Ceramic waste is waste of ceramic industries which pollute the environment and also it is available in large quantity with no cost. So, with aim of utilizing it in to concrete, coarse and fine aggregates are replaced with ceramic waste. Ceramic waste has a specific gravity of 2.51 and water absorption of 17%. For better workability of high strength concrete, Super plasticizer Conplast SP430 G8 (Fosroc) is used.

III. EXPERIMENTAL PROGRAM

The aim of the experimental programme is to compare the properties of concrete with partial replacement of coarse and fine aggregate with ceramic waste. The concrete mix design and different batch mix considered for casting concrete samples are discussed in Table 1 and 2 given below:

For the purpose to investigation of a fresh property of a concrete, perform a slump test and compaction factor test for the every mix of the concrete. The technique adopted for this study was Hand mixing and by using concrete mixer for the mix proportion of w/c ratio 0.35. The ceramic waste aggregates are added in amount of 0%, 10%, 20%, 30%, 40% and 50% by the weight of cement in mixed. The mould was assembled prior to mixing and properly lubricated for easy removal of hardened concrete. To investigate hardened properties of concrete, cubes of standard mould size of 150x150x150 mm, 150 X 300 mm cylinders and beams of 100 X 100 X 500 mm are used to prepare the specimen. The mixture was properly turned with shovel until it reached a plastic state and slump test was carried to find the W/C ratio of mix and then it was fed into the lubricated cast iron mould, water curing method was adopted. The moulded concrete cubes were given 24 hrs to set before demoulding. They were then immerse into a curing tank in order to increase the strength of the concrete, promote hydration, eliminate shrinkage, and absorb heat of hydration until the age of test. Here under water flexure strength of concrete is performed in the water proof box made by iron and plate-glass.

Table 1. Design Mix for Concrete

W/C	Volume (m^3)	Cement (kg)	Water (kg)	Fine aggregate (kg)	Coarse aggregate (kg)	Superplasticizer (kg)
0.35	1 m^3	479	168	676	1151	7.6

Table 2. Batch Mix Detail of Experimental work

Sr. No	Concrete type	Coarse aggregate replacement
0	M0	0% replacement of CA
1	M1	10% replacement of CA
2	M2	20% replacement of CA
3	M3	30% replacement of CA
4	M4	40% replacement of CA
5	M5	50% replacement of CA
6	M6	20% replacement of CA + 10% replacement of FA
7	M7	20% replacement of CA + 20% replacement of FA
8	M8	20% replacement of CA + 30% replacement of FA
9	M9	20% replacement of CA + 40% replacement of FA
10	M10	20% replacement of CA + 50% replacement of FA

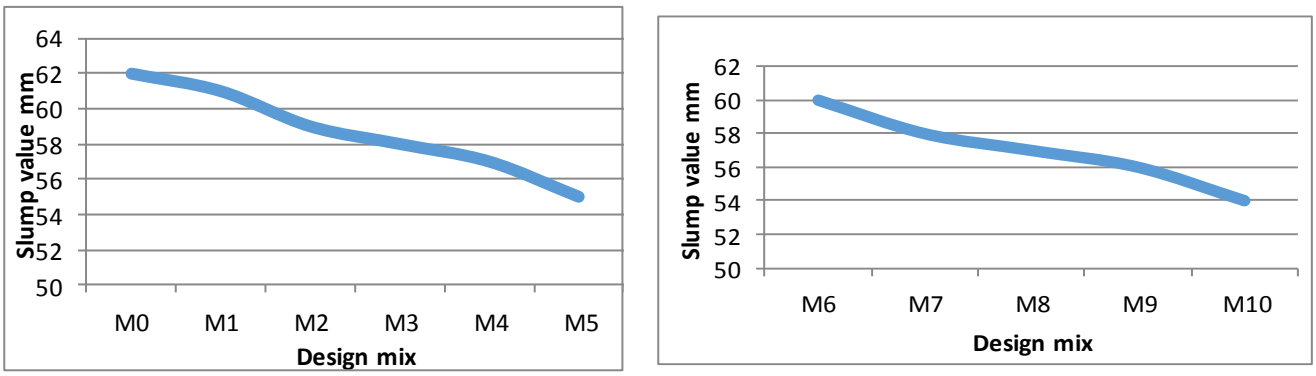
CA- Coarse aggregate FA- Fine aggregate

IV. EXPERIMENTAL RESULT AND DISCUSSION

A concrete design mix proportion is obtained by Indian Standard method of mix design. The mix proportion obtained for w/c ratio 0.35. Ceramic waste was added in amount of 0%, 10%, 20%, 30%, 40% and 50% by the weight of coarse aggregate in mix. The percentage of aggregate replaced by a 20% of ceramic waste achieve a high compression strength than the other percentage replacement of coarse aggregate. Therefore replacement of coarse aggregate kept fixed to 20% and replacement of fine aggregate for different percentage has been considered.

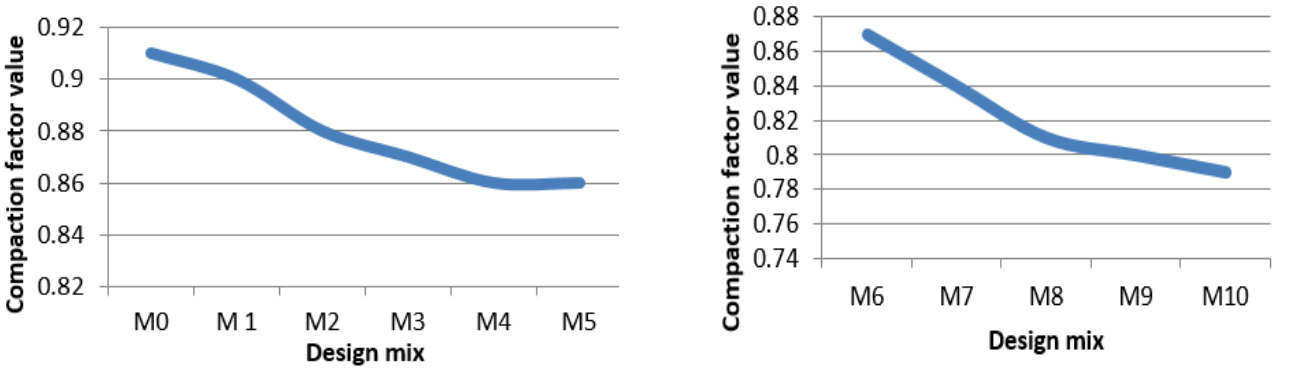
Workability test results:

Slump test was conducted for different percentage of ceramic waste to know the workability of concrete. The values of slump obtained from experiment are represented in Figure 1 for both coarse and fine aggregate replacement with ceramic waste. From Test results, it is represented that the Slump value is decreased up to 12.90% than the design mix. Slump value of concrete is decreased because of the larger absorption rate of replacement of the ceramic waste



(a) For CA Replacement *(b) For FA Replacement*

Figure 1. Slump Value



(a) For CA Replacement *(b) For FA Replacement*

Figure 2. Compaction Factor Value

Figure 2 represents compaction factor value for both coarse and fine aggregate replacement with ceramic waste. Compaction factor of concrete is decrease with the increased ceramic tile aggregate in both cases of replacement coarse and fine. From results of compaction factor it concluded that the workability is reduced up to 13.39 percentages than the design mix.

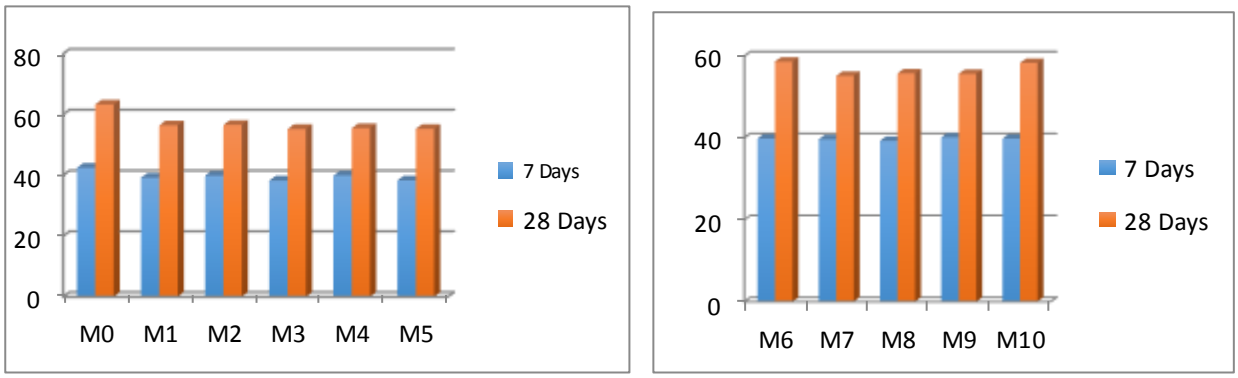
Hardened Properties of Concrete

To evaluate hardened properties of concrete - Cube, beam and cylinder are casted and tested for compressive strength, flexure strength, under water flexure strength and split tensile strength. Results obtained for all these experiments are summarized in Table 3.

Table 3. Hardened Properties of Concrete

Sr. no	Mix name	Compressive strength (N/mm^2)		Split tensile strength (N/mm^2)	Flexure strength (N/mm^2)	Under water flexure test (N/mm^2)
		7 Days	28 Days			
1	M0	42.46	63.25	3.27	5.55	7.56
2	M 1	39.22	56.41	3.45	5.67	7.68
3	M2	39.86	56.60	3.49	5.87	7.74
4	M3	38.25	55.21	3.62	5.98	7.52
5	M4	39.91	55.47	3.22	5.51	7.49
6	M5	38.31	55.25	3.19	5.48	7.42
7	M6	39.86	58.65	3.61	5.93	7.98
8	M7	39.66	55.15	3.68	5.97	7.95
9	M8	39.28	55.77	3.23	5.51	7.49
10	M9	40.11	55.66	3.21	5.48	7.47
11	M10	39.82	58.32	3.19	5.46	7.41

The compressive strength of the concrete specimens at 7 days and 28 days were illustrated in Fig. 3 depicts that the compressive strength of concrete specimens decreases in all replacements of coarse and fine aggregate. But in case of coarse aggregate replacement, It gives a higher compressive strength with replacement of the 20% of the ceramic. For fine aggregate with the 20% replacement of the coarse aggregate, better result at the 10% replacement of the fine aggregate as ceramic waste is obtained.



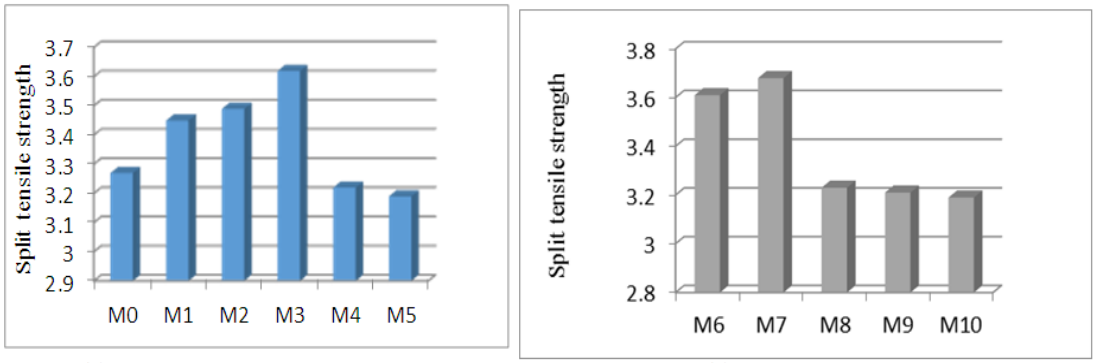
(a) For CA Replacement *(b) For FA Replacement*

Figure 3. Compression Strength Comparison

Split tensile strength of concrete is gives a higher result at 30% replacement of ceramic waste as a coarse aggregate. The test result for Split tensile are mentioned in Figure 4.

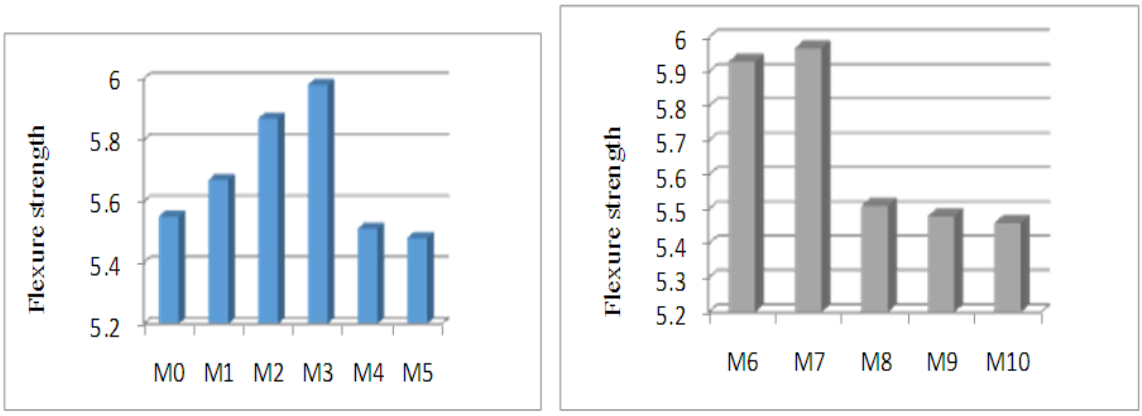
Figure 5 represents experimental results for flexural test. Flexure strength of concrete is increased at replacement of the 30% of ceramic waste as a coarse aggregate. For replacement of the coarse aggregate 20% with the 20% replacement of the fine aggregate gives a higher flexural strength than the conventional concrete.

Under water flexure strength of concrete is carried out and result for same is indicated in Figure 6. Higher strength has been observed that is because of an uplift pressure of water. Its gives higher flexural strength than the conventional concrete at a replacement of the ceramic waste as a coarse aggregate.



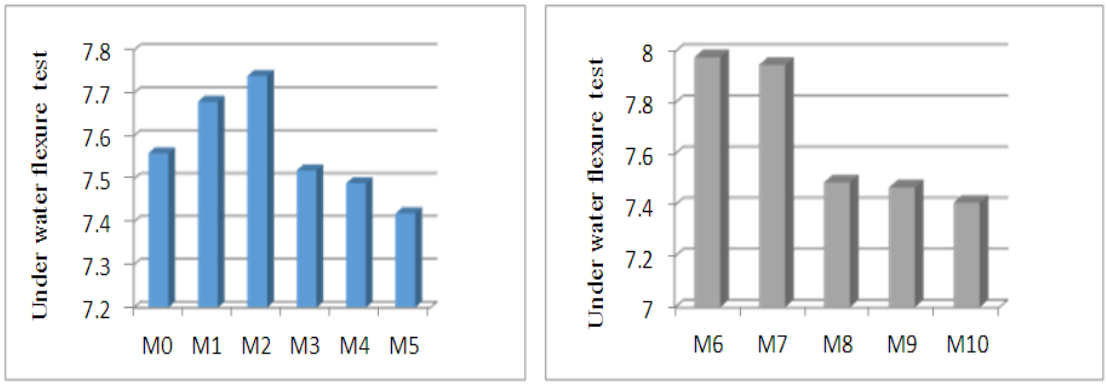
(a) For CA Replacement *(b) For FA Replacement*

Figure 4. Split Tensile Strength Comparison



(a) For CA Replacement *(b) For FA Replacement*

Figure 5. Flexural Strength Comparison



(a) For CA Replacement *(b) For FA Replacement*

Figure 6. Under water Flexural test Comparison

VIII. CONCLUSIONS

From the above study following conclusions can be made

- Compressive strength of concrete is decrease with the replacement of the ceramic waste as a coarse aggregate. Compressive strength of concrete decrease up to 10.33% to 12.53% with the replacement of the coarse aggregate. It gives a higher compressive strength with replacement of the 20% of the ceramic waste as a coarse aggregate. For replacement of the fine aggregate with the 20% replacement of the coarse aggregate ceramic waste, it gives a better result at the 10% replacement of the fine aggregate as ceramic waste.

- Split tensile strength of concrete gives a higher tensile strength at 30% replacement of ceramic waste as a coarse aggregate. Split tensile strength is increased up to 10.70% at a 30% replacement of the ceramic waste as a coarse aggregate. At 20% replacement of both coarse aggregate and fine aggregate, tensile strength increased up to 12.54% than the normal concrete.

- Flexure strength of concrete is increased up to 7.75% at replacement of the 30% of ceramic waste as a coarse aggregate. When replacement of the both coarse and fine aggregate by 20% provides higher flexural strength than the conventional concrete.

- Higher strength obtained in case of Under-water flexure strength of concrete that is due to uplift pressure of water which is 2.38% higher than the conventional concrete at a replacement of the ceramic waste as a coarse aggregate.

- Workability of concrete is decrease with the increase in percentage replacement of the ceramic waste as a coarse aggregate and fine aggregate because larger water absorption rate of the ceramic aggregate.

- Additional water is required for the concrete because of a larger water absorption rate of concrete.

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