Characteristic Study Of Concrete By Replacing Glass Cullet And Ceramic Tiles Over Conventional Aggregates

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Abstract: Invention of various researches in concrete proves that compressive strength of concrete can be easily obtained using various wastes from environment into a great extent. Therefore, from these results the strength also obtained under sustainable rate without making any hazard to the environment. Here, a study was carried to improve the compressive strength of concrete by replacing coarse aggregate with ceramic wastes and fine aggregate with Glass cullet at different proportions. Thus, guidance from various reviews of papers and from various codes illustrates the preliminary design data's to carry this experimental test. Bureau of Indian standards are strictly followed throughout the experiments and the results are interpolated for the concrete mix for M30 Grade of concrete. Nine set of cubes and nine set of cylinders are casted and the strengths are studied for 7 and 28 days of curing. In this study, three different trials are studied 0%-0% replacement of Glass cullet and Ceramic wastes in concrete i.e., Conventional Mix of concrete, 10%-20% replacement of Glass cullet and Ceramic wastes in concrete and 20%-10% replacement of Glass cullet and Ceramic wastes in concrete. These, investigations proves that 20%-10% replacement of Glass cullet and Ceramic wastes in concrete shows that 20.28% higher that to the conventional mix of concrete and 10.7% of strength higher to the 10%-20% replacement of Glass cullet and Ceramic wastes in concrete. Hence, the replacement of 20%-10% replacement of Glass cullet and Ceramic wastes in concrete can be recommended for optimal strength under sustainable condition.

Index Terms: Glass cullet, Ceramic wastes, Physical properties and Mechanical properties.

1.INTRODUCTION

The combination of cement, coarse aggregate, Fine aggregate with different proportions of water makes the combined substance to resist the compressive stress is Known to be Concrete. Thus, under eco free considerations, various alternates are chosen by replacing these constituents thereby, the strength, durability's are also enhanced into a great extent (1,2,4). Here, M30 Grade of concrete being chosen for the strength determinations with 0%-0%, 10%-20% and 20%-10% replacement of Glass cullet and Ceramic wastes in concrete. This combined action increases the compressive stresses at higher level than to the conventional mix of concrete(2,3). Concrete samples of M-30 grade are prepared as per IS-10262, 2009 mix design procedure with and without replacement of Glass cullet and Ceramic wastes. The various step by step experimental Investigations are carried and the results are discussed as follows.

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2.PRELIMINARY TEST RESULTS

2.1 CEMENT

Ordinary Portland Cement of 53 Grade being used for this study and its Properties are studied. The Specific Gravity of cement is determined by using Density Bottle method using (IS-2720, part- iii, 1988).Thus ,Specific Gravity of cement founds to be 3.10.

2.2 FINE AGGREGATE

2.2.1 Specific Gravity of Fine aggregate: (IS 2386 –part III-1963)

To conform the used Fine aggregate, whether the substance is sand or clay a test was carried under the provisions from Indian standards (IS 2386 –part III-1963). Thus, using Pycnometer apparatus the specific Gravity of sand founds to be 2.615. For Glass Powder, the crystal glasses are finely grinded into a fine powder and are pulverized in Los Angeles abrasion apparatus and then sieved through 1.18mm IS sieve. The specific gravity of waste glass was found to be 2.42.

Fig.1 Specific Gravity of Natural river sand

Under, suggestions from IS 2386 Part- I, 1963, Fineness of river sand was carried and test results conforms that used particle was well graded material forming an perfect S curve and the table illustrates the substantial values.

Sieve Size	Empty Weight	Retained Weight	Weight of soil obtained	%Retained	Cumulative %	Final %
4.7	319	388	69	13.8	13.8	82.6
2.36	323	378	54	10.8	24.6	75.4
2	296	310	14	2.8	27.4	72.6
710	299	477	178	35.6	63	37
425	292	392	100	20	83	17
212	316	379	63	12.6	95.6	4.4
150	285	295	10	02	97.6	2.4
125	286	286	0	0	97.6	2.4
106	278	281	03	0.6	98.2	1.8
90	260	267	7	1.4	99.6	0.4
75	280	280	0	0	99.6	0.4
PAN	242	244	2	0.4	100	0

Table 1 Particle size distrubutation of a natural river sand

Fig.2 Glass Powder

2.2.2 Specific gravity of Coarse aggregate (IS 2386 - Part 3, 1963)

Jelly- the natural coarse aggregate being used up in this study in addition to the replacement of Ceramic tiles. Their physical properties are as follows:

Fig.3.a Specific Gravity Natural Coarse Aggregate

Fig.3.b. Specific Gravityof Ceramic Tile aggregate

Specimen Number	Trial	Trial
Mass of empty pycnometer,W1(gm)	630	630
Mass of empty pycnometer+dry sample ,W2(gm)	1478	1306
Mass of pycnometer+dry sample +waterW3(gm)	2059	1897
Mass of pycnometer+water,W4(gm)	1523	1523

Table 2 Specific gravity

Thus, the specific gravity of Natural coarse aggregate founds to be 2.7and the specific gravity of Ceramic Tile aggregate founds to be 2.23

2.3 WATER

Water is the predominant constituent and its qualities to be tested before to the use of experiments its PH value lies founds under neutral stage which means it lies between 6 to 7 i.e. neither acidic nor alkaline.

3 SLU MP CONE TEST

To determine the consistency of fresh concrete before it sets under conventional mix i.e, 0%-0% replacement of Glass cullet and Ceramic wastes in concrete, 10%-20% replacement of Glass cullet and Ceramic wastes in concrete and 20%-10% replacement of Glass cullet and Ceramic wastes in concrete are determined. They are furnished below:

Fig.4 True Slump

Concrete Mix	Slump Cone Value (mm)	Type of slump
Conventional	26	True
10%G+20%T	30	True
20%G+10%T	33	True

Table 3 Slump cone test

4. MIX DESIGN (Under Indian Standards)

Concrete Mix design can also being performed using some specialized software programs. Here, using the above preliminary physical properties and using Indian Standard Codes such as IS 10262:2009, IS456:2000 and IS 383: 1962 Concrete Mix for M30 Grade of concrete are determined. Thus, considering all the properties from the alternate materials the final Mix-proportion for M-30 Grade of Concrete is found to be: 1: 1.74: 2.85

5. Mechanical Properties of Concrete

5.1 COMPRESSIVE STRENGHT TEST

The compressive stress developed on concrete can be determined using this test. The compression load from the test with its corresponding size gives the developed stress for the given section. The various test results for various mix proportions are labelled below.

5.1.1 CONVENTIONAL CONCRETE MIX

The conventional for M30 grade of concrete is studied by cube testing using 150 mm x 150 mm x 150 mm size. Three trails

were done each for 7 days and 28 days. The Table below shows the compressive strength for 7 and 28 days of M30 concrete.

Fig 5.a Before Failure

Fig 5.b After Failure

Sl. No	Days	Compressive Strength (N/mm²)			Avg/Compressive Strength (N/mm²)	Types of concrete mix
		Cube - 1	Cube - 2	Cube - 3		
1	7	21.7	17.86	19.4	19.65	Conventional Mix
2	28	32	35.06	34	33.67	
3	7	22.3	22.6	22.1	22.3	10%Glass cullet and 20%Ceramic waste
4	28	36.4	36	37.6	36.6	
5	7	22.5	22.9	22.3	22.5	20%Glass cullet and 10%Ceramic waste
6	28	40.5	41.2	39.7	40.5	

Table 4 Cube test results with three different combinations

5.1.2 PARTIAL REPLACEMENT OF AGGREGATE

Alternate aggregates like Glass cullet and Ceramic tiles are used with different proportions and the mechanical Properties are studied. The various proportions like 20% glass cullet and 10% ceramics , 10% glass cullet and 20% ceramics.

Fig.6. Collection of Materials for concrete mix

5.2.1SPLIT TENSILE STRENGTH

The tensile stress developed on concrete are determined using the tensile load and the test results for various mix proportions under these three different trials are tabulated below.

Sl.No	Days	Tensile Strength (N/mm²)			Avg/ Tensile Strength (N/mm²)	Types of concrete mix
		Cube - 1	Cube - 2	Cube - 3		
1	7	1.87	1.86	1.88	1.87	Conventional Mix
2	28	2.42	2.44	2.45	2.43	
3	7	1.89	1.99	1.85	1.9	10%Glass cullet and 20%Ceramic waste
4	28	2.48	2.55	2.50	2.51	
5	7	1.9	2.3	1.88	2.0	20%Glass cullet and 10%Ceramic waste
6	28	2.68	2.89	2.76	2.78	

Table 5 Tensile strength results with three different combinations

6. RESULT

The observed test results for conventional mix i.e, 0%-0% replacement of Glass cullet and Ceramic wastes in concrete, 10%-20% replacement of Glass cullet and Ceramic wastes in concrete and 20%-10% replacement of Glass cullet and Ceramic wastes in concrete under Compressive strength test and split tensile test can be summarized as follows:

Sl.No	Days	Conventional Concrete	Glass cullet – 10% & ceramic waste – 20%	Glass cullet – 20% & ceramic waste – 10%
1	7	19.65/1.87	22.3/1.9	22.5/2.0
2	28	33.67/2.43	36.6/2.51	40.5/2.78

Table 6 compressive strength to the tensile strength

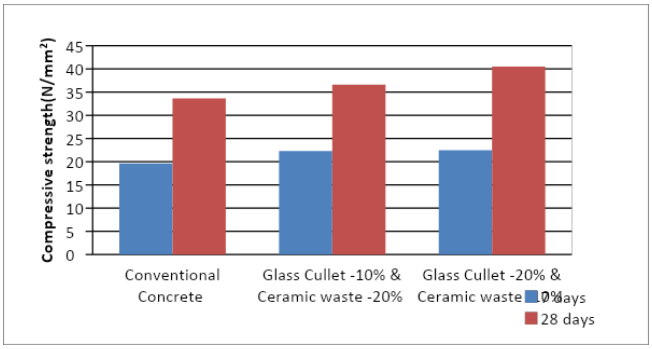

Fig.7, *Compressive Strength and Tensile Strength of concrete for 0%-0%, 10%-20% and 20%-10% Glass cullet and Ceramic wastes*

7. CONCLUSION

The strength behavior of concrete with and without addition of Glass cullet and Ceramic wastes in concrete are studied and it concludes that for M 30 Grade of Concrete partial replacement of concrete with 20% glass cullet and 10% ceramics used as fine and coarse aggregate respectively, shows the highest strength in both compressive and split tensile test. Due to the silica content in glass cullet, it can be replaced with cement too and the binding capacity also increases into a great extent and hence the durability of concrete will also be more. Thus, the usage of Glass cullet and Ceramic tiles on concrete founds eco-friendly and these wastes can be managed in a conservative manner.

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