Properties of Fresh and Harden Concrete made by using Waste Concrete Aggregate

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***Abstract* -** Today environmental studies discussing the recycling and reuse of waste materials are getting great importance. Concrete waste, fly ash, rice husk and other different types of waste material produce a large amount of waste. Natural disaster such as earth quakes produce large amount of waste concrete. Removing the waste materials away from the disaster site causes financial and environment problems. In order to prevent these problems waste material should be recycled and reused . According to a study commissioned by Technology Information Forecasting and Assessment Council (TIFAC) 70% of the construction industry is not aware of recycling techniques. Central Pollution Board has estimated current quantum of solid waste generation in India to the tune 48 million tons per annum out of which waste from construction industry accounts for more than 25%. The total quantum of waste from industry in India is estimated to be 12 to 14.7 million tons per annum out of which 7-8 million tons are concrete and brick waste (Naguchi, 2012). In Present study the potential usage of waste concrete aggregate for making new concrete was researched. The properties of recycled aggregates were tested for use in concrete. M-25 grade concrete mix was designed by IS code method and new concrete were made with 30%,40%and 50% coarse recycled aggregates replacing the natural aggregate. Various tests were performed on fresh and hardened concretes. The results indicate that the properties of the concretes made with natural aggregate and waste concrete aggregate up to 50% have only slight differences.

***Key words;* Waste concrete aggregate (WCA); Compressive strength; Workability.**

1. INTRODUCTION

In most parts of the world, construction industry consumes huge amount of natural resources. Activities like construction , renovation, demolition of structure generate a mixture of inert and non-inert material which are particularly defined as construction waste. Natural disaster also generate huge amount of construction waste. These waste materials include iron, wood, glass, aluminum, PVC, Bricks and concrete. The debris from these demolished buildings is thrown away, causing environmental pollution or is used as filling materials. By reduction in use of the natural aggregate, concrete construction can be made sustainable by utilizing the aggregate from the demolished concrete which is about 70-80% of the volume of concrete. Use of aggregate from waste concrete will result in significant saving by means of reduction in cost of aggregate, cost of transportation, cost of waste disposal etc. Aggregate influence the properties of concrete significantly therefore properties of WCA to be used for making new concrete should be checked. The WCA used in this work taken from demolished structure is tested for grain size, specific gravity, density, water absorption, crushing value and abrasion. Properties of fresh and hardened concrete made by replacing natural aggregate in a M-25 grade concrete with WCA is investigated.

2. REVIEW OF LITERATURE

Frondistou Yannas[6] reporated 4 -14 % reduced Compressive strength and 40% reduction in modulus of elasticity of concrete made with WCA concrete.

Parekh and Modhera (2011)[11], Gonzalez and Martinez (2003)[12], Yong and Teo (2009)[13] Rasheeduzzafar and Khan[5] have studies the properties of WCA concrete and revealed that the waste aggregate drastically lowers the workability of WCA . It may be attributed to higher water absorption of recycled aggregate

Nixon[8] reported that the compressive strength of WCA concrete decreases by 20% or more when compared to normal aggregate concrete. Gerardu and Hendriks[7] and Topcu[4] found that the compressive strength of WCA concrete is about 80-95% of normal concrete .

3. EXPERIMENTAL INVESTIGATION : MATERIAL USED IN EXPERIMENT

3.1 *Cement*

Fly ash based Portland Pozzolana Cement confirming to (IS: 1489-1991) with specific gravity 3.04 was used as the cementitious material .The physical properties of cement obtained by conducting appropriate tests. The test results and requirement as per IS: 1489-1991 are given in table no.1

3.2 *Aggregate:*

Locally available 20 mm size crushed granite and river sand were used as natural coarse and fine aggregate respectively. Properties of coarse and fine aggregates are given in table no.2 Sieve analysis performed for fine and coarse aggregates, the grading curve are shown in Fig- 1. Sand is found to be in Zone-I. The grading curves of all in aggregates are show in Fig-2. The proportion of natural aggregate, waste concrete aggregate and sand are given in

Table 3. Properties of natural aggregate and waste concrete aggregate are given in Table 2.

3.2 Water :

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Potable drinking water with pH value ranging between 6 to 7 available in laboratory of Institute was used for making all mixes.

4. Mix Proportioning :

M-25 grade concrete mix was designed as per IS 10262 : 2009 mix design approach 3 WCA concretes were prepared by replacing 30%, 40%, and 50% of coarse natural aggregate with waste concrete aggregate. Proportion are presented in the table no.3

5. TEST ON FRESH CONCRETE :

5.1 Workability of concrete by Slump Flow and Compacting factor Test :

A standard slump cone test was used to measure slump flow. The slump value for different concrete mixes are given in table 4. Workability of concrete also determined by compaction factor test. Value of compaction factor for various concrete mixes are given table 4.

5. 2. Workability of concrete by Flow Table Test :

It gives an indication of the quality of concrete with respect to consistency, cohesiveness and the proneness to segregation. In this test, a standard mass of concrete is subjected to jolting. The flow of the concrete is measured and this flow is related to workability. The flow %of different concrete are given in table 5.

Test Result on Hardened Concrete;

The compressive strength of concrete mixes obtained by casting concrete cubes in 150mm moulds. The cubes were compacted by means of standard vibration machine. The compressive strength of different concrete is determined at the age of 3days, 7days, and 28days .Figure 3 shows the variation in compressive strength of concrete when WCA used.

6. CONCLUSION:

Properties of waste concrete aggregates were found satisfactory for use in new concrete. Lower value of specific gravity of WCA may be to mortar attached to aggregates. Workability tests on fresh concrete show that WCA reduce the workability of concrete mix. This celeries is workability may be due to high water absorption by WCA. The compressive strength of concretes made by using WCA in place of normal aggregate is slightly lower than the compressive strength of concrete made with natural aggregate at age of 3days, 7days. At 28days age the compressive strength of WCA concrete id found to be reduced by 20%, 20.9% and 25% in 30% WCA, 40%WCA, 50%WCA concrete respectively.

Low cost techniques for separately the aggregate from the demolished concrete structures is needed to use waste concrete aggregate in new construction. More research is needed to standardize the use of WCA in preparing new concrete.

Table - 1

Physical Properties of Procured PPC

Particulars	*Test Results*	*Requirement of IS: 1489-1991*
Fineness	*5%*	*>10% residue on sieve no.9*
Setting time (min.) ❖ *Initial* ❖ *Final*	 *45* *385*	 *30 minimum.* *600minutes maximum.*
Soundness ❖ *Le-chatlier expansion*	*2 mm*	*10mm max.*
Compressive strength *3days* *7days* *28days*	 *35* *45* *59*	 *16MPa (minimum)* *22MPa (minimum)* *33MPa(minimum)*

Table - 2

Properties of Aggregates

Particulars	**Test Results**	
	N.A.	**WCA**
Water absorption	0.5%(24Hr.)	5.35% (30 Min) 1.24%(24Hr.)
Crushing value	17%	27%
Specific gravity	2.73	2.63
Fineness modulus	4.11(C.A.) 3.26(F.A.)	5.30
Abrasion Value	21%	17%

Table-3

Mix proportion for various WCA mixes.

Replacement of aggregate	W/C	Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate		Water
				NA	WCA	
Control	0.40	493	743	1140	-	197
WCA30%	0.40	493	728	798	342	197
WCA 40%	0.40	493	718	684	456	197
WCA 50%	0.45	493	708	570	570	202

Table -4
Slump and compaction factor

Particulars	W/C ratio	Slump mm	Compacting factor
Control	0.40	25	0.95
WCA30%	0.40	15	0.87
WCA40%	0.40	20	0.85
WCA50%	0.45	20	0.85

Table -5
Flow Table for workability

Particulars	W/C ratio	Flow in %
NA	0.40	76%
WCA30%	0.40	72%
WCA40%	0.40	68%
WCA50%	0.45	68%

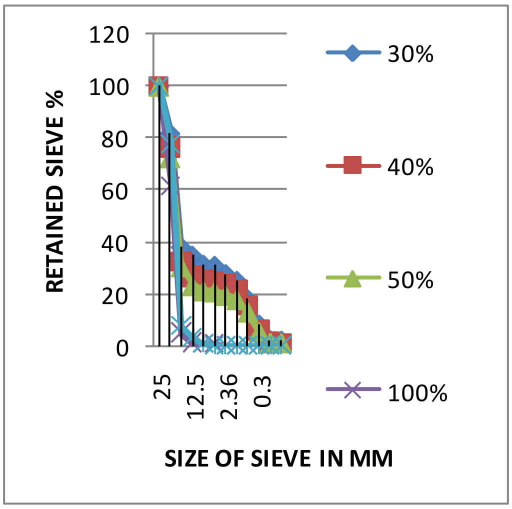

Fig. 1
Grading curve of all in aggregates

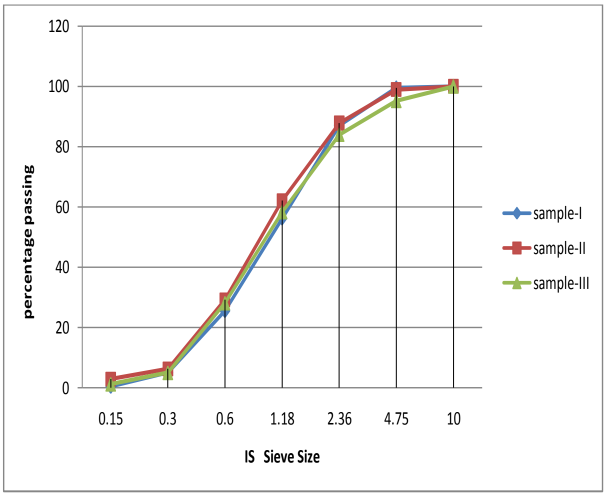

Fig. 2 Grading curve of Sand

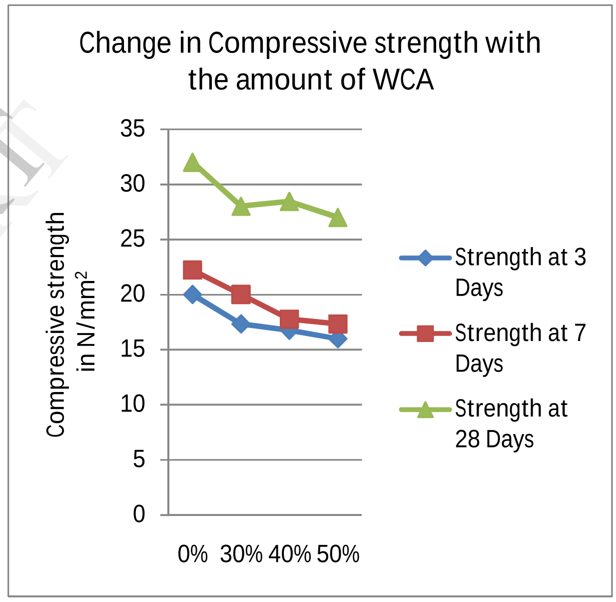

Fig3
Compressive Strength

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