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Strength Based Comparative Study of Green Concrete

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Abstract

Green concrete may be a revolutionary topic within the history of concrete trade. It is a kind of concrete that resembles the standard concrete however, the assembly or usage of such concrete needs minimum quantity of energy and causes least damage to atmosphere. Recycled coarse mixture may be employed by partly substitution natural concrete aggregates, so construction and demolition waste may be more used for aggregates in new construction. Recycled coarse aggregate includes brick, tile aggregates, crushed stone aggregates, glass aggregates, and demolished aggregates. In this paper, different recycled aggregates are used by 40 and 60% replacement with natural aggregates of size 20 mm. Granite stone, brick stone, concrete debris are used as recycled coarse aggregates (RCA) in this experimental work. Ordinary Portland Cement is replaced by 30% with fly ash and 10% replacement of silica fume is used, respectively. Test results show that under the equivalent mix proportions, the workability decreases with an increment in the recycled coarse aggregate as replacement percentages. Test results show that if government implements the projects for temporary shelters for those which are affected by natural disaster, this type of material can be used for economic feasibility.

Keywords: *Green concrete, Brick stone, Concrete debris, Fly ash, Silica fume, Workability, Compressive strength*

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INTRODUCTION

Construction materials are progressively judged by their ecological characteristics. Concrete exercise gains importance as a result of it protects natural resources associated in nursing eliminates the requirement for disposal by exploitation the pronto on the market concrete as a combination supply for brand new concrete or different applications [1, 2]. Exercise of concrete could be a comparatively easy method. It involves breaking, removing, and crushing existing concrete into a fabric with a nominal size and quality.

The standard of concrete with recycled coarse aggregates (RCA) is incredibly smitten by the standard of the recycled material used [3–5]. Reinforcing steel and different embedded things will be removed, and care should be taken to stop contamination by different materials, which will be hard, like asphalt, soil and clay balls, chlorides, glass, wallboard, plaster [6–8]. The crushing characteristics of hardened concrete are kind of like those of natural rock and do not seem to be considerably stricken by the grade or quality of the initial concrete. RCA produced from all but the poorest quality original concrete can be expected to pass the same tests required of conventional aggregates. One of the main reasons to use RCA in structural concrete is to make construction more "green" and environmentally friendly [9, 10]. Some major environmental issues associated with construction, as stated by Oikonomou, are that construction "Takes 50% of raw materials from nature, consumes 40% of total energy, creates 50% of total waste" [11].

The use of RCA on a large scale may help to reduce the effects of the construction on these factors by reusing waste materials and preventing more NA from being harvested [11–14].

MATERIAL USED

Cement

Ordinary Portland Cement of grade – 43 (Jaypee Cement) with the specifications of Indian standard IS: 8112-2013 has been used for the experimental work. It was fresh without any lumps. The various physical properties are given in Table 1.

Table 1: *Physical Properties of Ordinary Portland Cement.*

Sr. No.	Characteristics	Values Obtained	Standard Values
1.	Specific Gravity	3.15	-
2.	Normal Consistency	30%	-
3.	Initial Setting Time	1 h 18 min	Not to be less than 30 min
4.	Final Setting Time	3 h 45 min	Not to be greater than 600 min

Fly Ash

Fly ash is an industrial waste (by product of coal) and defined as a fine powder of mainly spherical, glassy particles. When not properly disposed, it is known to pollute air and water, and causes respiratory problems when inhaled. The fly ash used for the work was a low-calcium fly ash that is equivalent to ASTM Class F fly ash.

Silica Fumes

Silica fume, also known as microsilica or condensed silica fume is a relatively new material compared to fly ash, having come into increased use in the concrete industry only in the 1980s. Silica fume consists of spherical particles of an almost pure silicon dioxide, which are approximately 0.00015 mm in diameter.

Fine Aggregate

The material, which passes through 4.75 mm sieve, is termed as fine aggregate. Natural sand is used as a fine aggregate in this experimental work. Fine aggregates were collected from the local supplier, which is free from silt and clay particles. The physical properties of fine aggregate are tabulated in Table 2.

Coarse Aggregate

The aggregates which are retained over IS sieve 4.75 mm are called as coarse aggregate. The coarse aggregate used in the present study was locally available crushed stones of maximum size of 20 mm. Specific gravity and other physical properties of coarse aggregates are given in Table 3.

Recycled Coarse Aggregate

The enormous quantities of demolished concrete are available at various construction sites, which are now posing a serious problem of disposal in urban areas. This can easily be recycled as aggregate and used in concrete. Following are the three types of RCA material, which are used for the experimental work as shown in Figure 1.

1. Brick Aggregates
2. Crushed Granite stone
3. Tested concrete specimens(Concrete Debris) such as cubes and beams

Large amount of these RCA's are lying in the concrete laboratory of site. To make RCA, the specimens without reinforcement are manually broken down into small pieces. The crushed pieces of aggregates are measured and only 20 mm size aggregates are partially used for experiment. In this study, 40 and 60% recycled coarse aggregates are replaced by 20 mm size natural coarse aggregate. Specific gravity and impact value tests were performed in the laboratory and the results are given in Table 4.

Table 2: *Physical Properties of Fine Aggregate.*

Characteristics	Type	Specific gravity	Fineness Modulus	Grading Zone
Value	Natural Sand	2.45	2.55	II

Table 3: *Physical Properties of Coarse Aggregate.*

Characteristics	Color	Shape	Maximum Size	Specific Gravity	Fineness Modulus
Value	Grey	Angular	20 mm	2.63	6.42

Fig. 1: *Concrete Debris Aggregates.*

Table 4: *Physical Properties of RCA.*

S. No.	Tests	Granite Aggregate	Concrete Debris Aggregates	Brick Aggregates
1.	Specific Gravity	2.85	2. 47	2.41
2.	Impact Value	16.16%	22.6%	30.5%

Water

Tap water without any salts or chemicals was used in the study. Accordingly, potable water was used for making concrete available in material testing laboratory. It was free from any detrimental contaminants.

CONCRETE MIX DESIGN

The mix design of recycled coarse aggregate concrete is not different from that of conventional concrete and the same mix design procedure as per given in IS 10262:2000 adopted to the grade of concrete. The ratio of the ingredients material is 1:1.34:1.7 and the water/cement ratio is 0.5 the for all the mix proportions. The concrete specimens are prepared with natural aggregate and fully recycled aggregate for the M 35 grade of concrete and the mix proportions are shown in Table 5.

Table 5: *Proportions and Slump Values of the Concrete.*

Sr. No.	Concrete Mix	Materials Used in Mix	Grade of Concrete	Cement Content (kg/m^3)	W/C Ratio	Slump (mm)
1	Conventional	0% RCA, 0% FA, 0% SF	M-35	542	0.5	112
2	Fly Ash	0% RCA, 30% FA, 10% SF		325.2		105

TESTING

Work ability

The slump value is indication of the workability of concrete mix and all the slump value lies between 80–120 mm of the concrete mix. The effect of the recycled aggregate, percentage of the fly ash and silica fumes on workability are explained as follows:

- Recycled aggregates requires much water than natural aggregates because of their rough texture, angular, elongated particles and most importantly is the presence of old existing cement. Therefore, it renders the concrete less workable.

- Another factor is naturally low compaction, which is responsible for less workability because the sliding between aggregate is prevented due to the texture of cement.

Compressive Strength

Six cubes of 150*150*150 mm moulds are casted for each concrete mixture. Three identical specimens of each mix are crushed after 28 and 56 days curing to determine compressive strength. The CTM capacity of 2000 kN in concrete laboratory is used and the loading rate is 3 kN/s is applied on the concrete cubes for determining the maximum compressive strength.

RESULTS AND DISCUSSION

Compressive Strength

The compressive strength tests results are the average of three measurements of the concrete cubes are presented in Table 6 after 28 and 56 days. The compressive strength of the concrete cubes decreased with the increasing quantity of recycled aggregate content in concrete mixtures, respectively. Further, the use of fly ash and silica fumes as a partial replacement of cement also caused a reduction in the compressive strength whereas use of fly ash and silica fume without recycled aggregate content give better compressive strength as compared to the mix with RCA. A closer development observation shows that the concrete mixtures prepared with fly ash and silica fume has gained more compressive strength between 28 and 56 days as compared to the starting 28 days.

Figure 2 shows that compressive strength among M1, M2 and M3, the M1 with crushed granite stone aggregate has higher strength but it is less than the compressive strength of fly ash. In this case, when fly ash has 30% content and silica fume has 10% content, M3 with concrete debris aggregate has lowest compressive strength. As the days of curing increases, the strength gets increased too.

Table 6: *Compressive Strength of Concrete Mixtures (N/mm^2).*

Sr. no.	**1**	**2**	**3**	**4**	**5**
Mix	Conventional	Fly ash	M1 Brick	M2 Granite	M3 Debris
28 days	37	25.16	23.32	26.6	17.36
56 days	38.41	30.02	27.09	30.19	24.86

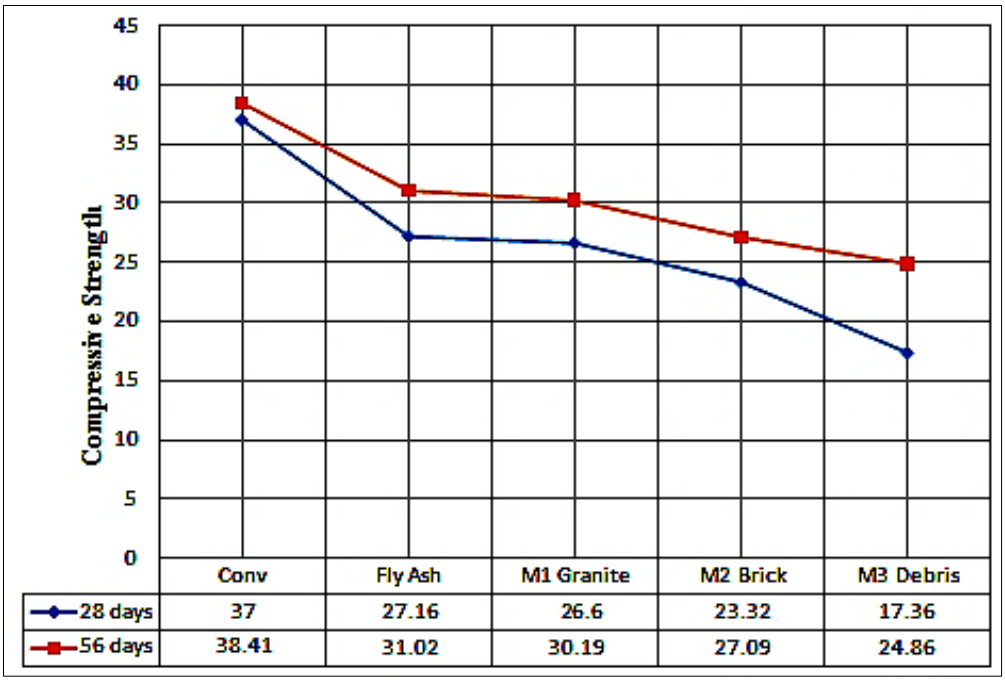

Fig. 2: *Comparison of Mix (containing FA=30%, SF=10% and RCA=40%) with compressive Strength.*

CONCLUSION

The fresh properties of recycled aggregate concrete with or without fly ash were investigated. The parameters tested slump and compressive strength. The main observations of this study are concluded below:

- The concrete produced with RCA achieved less compressive strength as compared to NCA by 21.4%.
- The compressive strength of green concrete increases with the increase of age because of fly ash and silica fumes gain strength at higher days of curing.
- As the percentage of recycled aggregate increases, compressive strength decreases.
- The compressive strength of green concrete is lower than conventional concrete but still it can be recommended for drain cover, kerb, etc.

REFERENCES

1. Abdelgadir Ahmed Abbas, Durability of Green Concrete as a Structural Material, *Constr Build Mater*. 2007, 18–22p.
2. Prasada Rao DV, Sindhu Desai PL. Experimental Investigations of Coarse Aggregate Recycled Concrete, *Int J Adv Eng Technol*. 2014; 7(5): 1522–1530p.
3. Katrina McNeil, Thomas H, Kang K, Recycled Concrete Aggregates: A Review, *Int J Concrete Struct Mater*. 2013; 7: 61–69p.
4. Huda S, Shahria Alam M. Mechanical and Durability Properties of Recycled And Repeated Recycled Coarse Aggregate, *Concrete Cement Concrete and Aggregates*, 1997, 156–159p.
5. Larbi Belagraa, Miloud Beddar, Study of the Mechanical Performance of a Recycled Aggregate Concrete with Admixture Addition. *Open J Civ Eng*. 2013; 3: 99–103p.
6. Lalit Gamashta, Swarna Gamashta, Reuse of Concrete and Masonry Waste Materials in Construction to Minimize Environmental Damages due to Quarrying. *J Environ Res Develop*. 2006, 65–67p.
7. Marget Mary, O'Mahony, Recycling of Materials in Civil Engineering, *Concrete Cement Concrete and Aggregates*, 1990, 4–7p.
8. IS10262:2009, Concrete Mix Proportioning-Guidelines, *Bureau of Indian Standards*, 2009, 7–10p.
9. IS3812:1981, Specification for Fly Ash for Use as Pozzolana and Admixture, *Bureau of Indian Standards*, 1981, 3–5p.
10. IS 8112:1989, Specifications for 43 grade Ordinary Portland Cement, *Bureau of Indian Standards*, 1989, 8–14p.
11. Oikonomou N, Recycled Concrete Aggregates, *Cement Concrete Comp*. 2005, 27: 315–318p.
12. Yadav SR, Pathak SR. Use of Recycled Aggregate in Making Concrete-An Overview. *34th Conference on Our World in Concrete and Structures*, Singapore, 2009.
13. Sachin Tiwari, Shilpa Pal, Pathak RP, Structural Health Monitoring of a Concrete Structures in Gautam Buddha University. *Int J Eng Sci Res Technol*. 2015; 4(4): 124–133p.
14. Vishwas Mishra, Sachin Tiwari, Pathak RP, Possible Effect of Ground Water on Concrete Structures of Noida and Greater Noida. *Int J Sci Eng Res*. 6(8): 84–93p.

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