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PERFORMANCE OF CONCRETE BY PARTIAL REPLACEMENT WITH RECYCLED AGGREGATE

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ABSTRACT

Since the construction and demolition activities are increasing day by day with an increase in industrialization and urbanization. With the increase of this pressure on the construction material is also increasing Hence it is the need of time to utilize the construction and demolition(C &D) wastes after its proper treatment. This will not only save the materials and energy but also save our environment from further pollution. Keeping in mind, this project work is carried out with the aim to test the strength and workability of concrete after replacing a part of it by demolition wastes. Here we replaced fresh aggregate by recycled aggregate in two proportions, i.e. 10% and 20% and find that the upto 10% addition of recycled aggregate the compressive strength is nearly same but by addition of 20% recycled aggregate in concrete, the compressive strength is reached to 90% .The use of this recycled waste will not only reduce the cost but also save energy and environment by reducing the mining of our non renewable resources.

KEYWORDS: Construction & demolition wastes, concrete, aggregates, compressive strength, environment.

1. INTRODUCTION

According to U.S Governmental Protection Agency, the waste materials that consist debris generated during construction, renovation and destruction of buildings, road, bridges etc are termed as Construction and Demolition (C&D) Waste. It consists of materials like concrete, wood, asphalt, metal, gypsum, plastic and salvaged building components, but the main

component and the major part of C&D waste is Concrete.[1] Since the Concrete is heavy, bulk and inert material therefore it is challenging task for its disposal. Concrete is made up of various natural components therefore disposing this concrete waste by land filling will led to loss in following 3 different aspects:

1. Extraction of construction material from natural resources for new construction.
2. Wasting the used natural components obtained from C&D wastes.
3. Due to land filling the concrete waste, the landfill area cannot be used for irrigation and will not be easy to remove it because of heavier weight.

Keeping in view the 3R's philosophy of Reduce, Reuse and Recycle, C&D waste is being started to recycle but a very few percentage is being recycled even after publication of lot of papers related to this, the majority of waste is still disposed by landfill method.

2. MATERIALS AND METHODS

Following tests have been performed in the laboratory.

2.1 Tests on Cement

2.1.1 Fineness Test

Fineness test of cement was carried out using 90 micron sieve and the results are given below in table I.

Table I: Fineness of cement.

S. No.	Weight of cement sample	Weight of Sample retained on sieve	Fineness of cement
1	100gm	8	8%
2	100gm	9	9%
3	100gm	7	7%
		Average	8%

Fineness = 8 %

So this cement can be considered as good as it's fineness is lesser than 10%.

2.1.2 Consistency test

Consistency of the cement is indicated by the Vicat plunger reading 5 to 7mm from the bottom of the mould.[2] From the result of this test, water content was found to be 27%.

2.1.3 Setting time

Initial setting time is also calculated using Vicat apparatus,[3] and the results found were as follows: The experimental result shows that initial setting time of cement was 35 minutes.

2.1.4 Soundness test

This test is used to find the excess of lime in the cement. This test has been performed by using the Le-Chatelier apparatus and the result found to be within the limit. The experimental results show that the soundness of the cement was 8 mm.

2.2 Tests on Standard Coarse Aggregate

2.2.1 Moisture Content

The moisture content of aggregate in fresh and recycled aggregates is given in table II.

Table II: Moisture Content of Aggregate.

Specimen condition	Fresh Aggregate	Recycled Aggregate
wet sample	156gm	180 gm
oven dried sample	154gm	172 gm

Moisture content of fresh aggregate = 1.2%

Moisture content of Recycled aggregate = 4%

2.2.2 Specific Gravity

Specific gravity of fresh as well as recycled aggregates is also measured.[4] and compared. It was found that the specific gravity of recycled aggregate is bit lesser than fresh one.

Specific gravity of fresh aggregate= 2.7

Specific gravity of Recycled aggregate= 2.53

2.3 Tests on Standard fine aggregate

2.3.1 Moisture Content

The moisture content of the fresh as well as recycled fine aggregate was also carried and the results are shown below in table III.

Table III: Moisture Content of fine Aggregate.

Specimen Condition	Fresh Fine Aggregate	Recycled Fine Aggregate
Weight of wet sample	170gm	200gm
Weight of oven dried sample	158gm	182gm

Moisture content of Fresh fine aggregate = 7.7%

Moisture content of Recycled fine aggregate =9%

2.3.2 Specific Gravity

Specific gravity of fine aggregate is also taken and observed that there is insignificant change in the two.

Specific Gravity of fine aggregate = 2.46

Specific Gravity of fine recycled aggregate = 2.33

2.4 Test on concrete

2.4.1 Slump Test

The slump was found to be 25 mm for both fresh as well as recycled aggregate.[5] Here it was observed that the workability of concrete is not affected by replacing the fresh aggregate by recycled one.

2.4.2 Compressive Strength

Compressive strength was tested on the cube specimens of size 150mm x 150mm x 150mm. After that they are placed on the platform of the compression testing machine as per IS: 516-1959 [6]. The load was then applied gradually till specimen failure. The results are noted for all the cubes after 7 days, 14 days and 28 days. Average compressive strength of cube of fresh aggregate concrete is given in the table IV.

Table IV: Compressive Strength of fresh aggregate concrete.

Age of cubes	7 days	14 days	28 days
Compressive Strength	21.35 N/mm^2	24.55 N/mm^2	27.37 N/mm^2

After the replacement of fine aggregate at different proportions in concrete following strengths are obtained given below in table V.

Table V: Compressive Strength of concrete after replacement by recycled concrete (10% & 20%).

Age of cubes	0%	10%	20%
7 days	21.35 N/mm^2	13.50 N/mm^2	16.25 N/mm^2
14 days	24.55 N/mm^2	21.25 N/mm^2	22.55 N/mm^2
28 days	27.37 N/mm^2	23.0 N/mm^2	24.20 N/mm^2

3. RESULT AND DISCUSSION

Compressive Strength

The compressive strength of concrete is given in terms of the characteristic compressive strength of 150 mm size cubes tested at 28 days as per Indian Standards (ACI standards) use cylinder of diameter 150 mm and height 300 mm. Compressive strength test of concrete is used to determine the strength of the concrete.

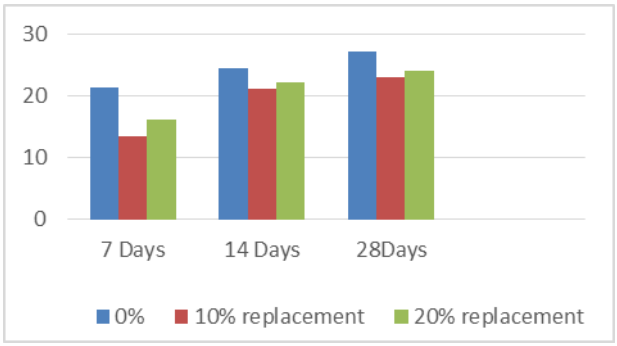

Chart-1: Compressive Strength of Concrete.

4. CONCLUSION

After performing different tests on the recycled aggregate we can say that the strength of the concrete is compromised at 20% only. We are getting almost 80% of the strength by replacing coarse aggregate only. So, we can also conclude that by using recycled aggregate we are reducing the cost of construction, mining and environmental hazards.

On replacing the fresh fine aggregate with recycled fine aggregate at different proportions we came to conclusions that at specific proportion of replacement we can gain the desired strength of concrete.

From the above data, it is clear that if the fine aggregate is at 10% replacement is not giving the desired strength but after replacing it with 20% in early stage the strength is desirably less but in later stage it almost gained more than 90% of the strength. This way the results give the reduction of cost of the construction with the use of lesser fresh aggregate which directly reduces mining of aggregates and thus will conserve the energy along with conservation of natural resources and our environment.

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