EXPERIMENTAL INVESTIGATION OF RECYCLED COARSEAGGREGATE

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Abstract

In India, the availability of Natural Aggregate is becoming low, the demolition wastes produced are in huge amount every year. Utilizing these demolition waste as the Recycled Coarse Aggregate will reduce the impact of dumping, as well as the natural resources can be conserved. In future the Recycled coarse aggregate will have a huge impact in the construction industry. This research paper gives the basic properties of Natural Aggregate & Recycled Coarse Aggregate and the Comparison of the basic concrete properties like Compressive Strength, Split Tensile Strength for 7 days & 28 days respectively. In this paper the Coarse aggregate has been replaced with Recycled Coarse Aggregate with 30%, 40%, 50% which gave strength lesser than conventional concrete. In order to improve the Compressive strength Fly ash is added along with the Recycled coarse aggregate in 10% which gave an increase in compressive strength. So, in future the recycled coarse aggregate will be used widely in construction industry.

Keywords: *Recycled Coarse Aggregate, Compressive Strength.*

Introduction

Today, there are critical shortages of natural resources in present scenario. Production of concrete and utilization of concrete has rapidly increased, which results in increased consumption of natural aggregate as the major concrete component. The use of recycled coarse aggregate from the construction and demolition wastes is showing prospective application in construction as an alternative to the natural aggregate. It conserves natural resources and reduces the space required for the landfill disposal. India is presently generating construction and demolition (C &D) waste of 25.55 million tons annually and these figures are likely to double in the next 7 years. C&D waste, specifically concrete, has been seen as a resource in developed countries. Coarse aggregate is important material in concrete for compressive strength, so there are utilization of demolished concrete in replaced by natural coarse aggregate. Due to shortage of Natural Coarse aggregate and increasing transportation costs, there is continued pressure to use recycled materials in the construction industry as these materials can provide cost effective and environmentally friendly alternatives to the natural aggregate.

Concrete is the most widely used construction material across the world. It isused in all types of civil engineering works like infrastructure, low and high-rise buildings, defence structure, and environment protection structure. Concrete is a man-made product, essentially consisting of cement, coarse & fine aggregates, water and/or admixture.

The aim of this project is to determine the strength characteristic of recycled aggregates, for application in structural concrete. The basic properties of aggregates, such as water absorption and specific gravity, mechanical properties, such as abrasion resistance, effect, and crushing values were also calculated. The preceding properties were tested for three different periods of curing of 7 & 28

days. All these mixes were designed for M25 grade of concrete. In the present work, a comparison was made between the results of a laboratory investigation on various physical properties of concrete made with recycled aggregate concrete with fresh aggregate concrete and found that the results are encouraging to use concrete with RCA.

Experimental Materials

Cement

The most common cement used is an ordinary Portland cement. The Ordinary Portland Cement of 53 grade conforming to IS: 8112-1989 is being used. Test conducted on cement are consistency tests, setting tests, soundness tests, etc.

Table 1 Properties of Cement

S.No	Physical Properties of Cement	Results
1.	Specific gravity	3.15
2.	Standard consistency	32 %
3.	Initial setting time	30 Minutes
4.	Final setting time	600 Minutes
5.	Compressive strength	55 N/mm^2
6.		

Coarse Aggregate

Aggregates are the important and large used constituents in concrete. They give bond to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is good gradation of aggregates. It indicates that fractions of aggregates in required proportion such that the sample contains minimum voids.

Table 2 Properties of Coarse Aggregate

S. No.	Particulars	Natural Aggregate	Recycled Aggregate
1.	Max. Aggregate Size	20mm	20mm
2.	Specific Gravity	2.81	2.73
3.	Density	1800 kg/m^3	1650 kg/m^3

Fine Aggregate

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand and crushed sand is being used in combination as fine aggregate conforming to the requirements of IS: 383. The river sand is wash and screen, to eliminate deleterious materials and over size particles.

Table 3 Properties of Fine Aggregate

Sl.No	Particulars	Fine Aggregate
1.	Zone	Zone II
2.	Specific Gravity	2.54
3.	Density	1762 kg/m^3

Design Mix Methodology

A mix M25 grade was designed as per IS 10262:2009 and the same was used to prepare the test samples. The design mix proportion is shown in Table 4

Table 4 Mix Proportions

Particulars	Weight (Kg/M^3)
Cement	320
Fine aggregate	751
Coarse aggregate	1355
water	170

Table 5 Details of M25 Grade Concrete Mix

Mix	Recycled coarse aggregate	Fly ash
RCA 0	0%	0%
RCA 1	20%	0%
RCA 2	40%	0%
RCA 3	60%	0%
RCAF 1	20%	10%
RCAF 2	40%	10%
RCAF 3	60%	10%

Experimental Work

The experimental study was divided into three segments

- Materials and their testing
- Concrete mix design
- Tests on Hardened concrete specimens: Compressive Strength Test, Split tensile Strength.

Experimental results

Compressive strength test

The specimens were tested for compressive strength for 7 days & 28 days. A set of specimens in triplicate in each proportion were tested and an average value of compressive strength were taken.

The compressive strength of a specimen is given by

$F_{cu} = P_{cu} / A$

where,

F_{cu}= Compressive Strength in N/mm^2.

P_{cu} = Compressive load at failure in KN.

A = contact area of load and specimen in mm^2

Figure 1 Cube Specimen Testing

Table 6 Different Concrete Mix Vs. Compressive Strength

Sl.No	Mix	Average Compressive Strength (N/mm^2)	
		7 days	28 days
1.	RCA 0	17.85	28.30
2.	RCA 1	18.23	25.48
3.	RCA 2	18.74	25.85
4.	RCA 3	17.63	22.59
5.	RCAF 1	19.24	26.73
6.	RCAF 2	19.81	26.92
7.	RCAF 3	18.50	25.35

Split Tensile Strength Test

The specimen was tested for split tensile strength after 7days & 28 days. A set of specimen in triplicate in each proportion were tested and an average value of split strength were taken.

The split tensile strength is given by

$F = 2P / (\pi DL)$

where,
P = Load at failure in KN
D = Diameter of cylinder in mm
L = Length of cylinder in mm

Figure 2 Cylinder Specimen Testing

Table 7 Different Concrete Mix Vs Split Tensile Strength

S. No.	Mix	Average Split Tensile Strength (N/mm^2)	
		7 days	28 days
1.	RCA 0	1.96	2.39
2.	RCA 1	1.73	1.99
3.	RCA 2	1.68	1.94
4.	RCA 3	1.42	1.72
5.	RCAF 1	1.91	2.50
6.	RCAF 2	1.88	2.12
7.	RCAF 3	1.76	1.92

Conclusion

Research on the usage of waste construction materials is very important due to the materials waste is gradually increasing with the increase of population and urban development. The reasons that many investigations and analysis had been made on recycled aggregate are because recycled aggregate is easy to obtain and the cost is cheap

- After detailed study of the result and analysis the following conclusions were made for M 25 grade concrete.

- The experimental results show that the early compressive strength of concrete made of natural coarse aggregate and recycled coarse aggregate is approximately same.
- It can be observed that there is an increase in strength with addition of 10% fly ash.
- The results also show that the concrete specimens with 40% replacement of recycled aggregate get the highest strength when compared to the concrete specimens with different percentage of recycled aggregate. From the obtained result, it is possible to use 40% recycled aggregate for higher strength of
- Hence the recycled aggregate can be used in concrete with 40% replacement of natural coarse aggregate individually as well as it can be used in addition with fly ash to get increase in compressive strength.

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