

“Experimental Investigation of Concrete with Recycled Aggregate for Suitability of Concrete Structure”

Abhishek Rai¹, Anant Bharadwaj², Shantanu Mehta³, Siddharth Pastariya⁴

¹M.Tech Scholar, Department of Civil Engineering, Sri Aurobindo Institute of Technology Indore M.P.

²Assistant Professor, Department of Civil Engineering, Sri Aurobindo Institute of Technology Indore M.P.

³Assistant Professor, Department of Civil Engineering, Sri Aurobindo Institute of Technology, Indore M.P.

⁴Assistant Professor, Department of Civil Engineering, Sri Aurobindo Institute of Technology, Indore, M.P.

Abstract: Due to the reduction of natural coarse aggregates, there is a replacement of coarse aggregate by construction demolition waste or recycled aggregate. Demolition waste is generated from construction, renovation, repair, and demolition of houses, large building structures, roads, bridges, dams, etc., only 5% of C & D waste has been recycled & reused. Recycled aggregate concrete consists of crushed concrete, inorganic particles processed from the materials that have been already used in the structural constructions and demolition waste. The concrete is made with concrete wastes which are eco-friendly to environment is known as Recycled aggregate concrete. For this purpose recycled coarse aggregate is replaced by 0%, 15%, 30%, 45%, 60% & 75% by natural coarse aggregate. Water binder ratio is taken 0.42 for M-45 grade of concrete. Various tests were conducted in the research which showed the results of the same percentage at the different of 0%, 15%, 30%, 45%, 60% & 75% for the time period of 7 and 28 days curing as a substitution of NCA by recycled aggregate on compressive strength, flexural strength, split tensile strength. The results show the maximum increase in strength of concrete occurred when 15% NCA replacement was done with RCA.

Keywords: Recycled aggregate, compressive strength, flexural strength, tensile strength, workability

I. INTRODUCTION

If recycled aggregates were practically useful in construction area, two aspects would be expected. One is illustrated at the beginning of introduction; the other one is that we could reduce consumption of natural aggregate resources. Although using recycled aggregates has great opportunity to preserve healthy environment, the properties and characteristics of recycled aggregates has not been fully investigated yet. Since it is hard to standardize the characteristic of recycled aggregates, all the researchers who study recycled aggregate should perform experiment of their concrete, which will be used for recycled aggregate, to gain the characteristics of their specimens. The characteristic of recycled aggregates could be different by its parent concrete because the parent concrete was designed for its purposes such as permeable, durable and high strength concrete..

II. MATERIAL USED

2.1 Cement: In this research work, OPC conforming to IS: 8112-1989 is used. The properties of cement used are shown in Table 1.

Table 1: Properties of cement

Physical Property	Result
Fineness of cement	8%
Normal Consistency	28%
Initial setting time (minutes)	38
Final setting time (minutes)	420
Specific Gravity	3.15

2.2 Sand: Locally existing sand with 4.75 mm maximum dimension is used as FA, having specific gravity, fineness modulus and unit weight as given in Table 2

Table 2: Properties of sand (FA)

Physical Property	Result
Fineness modulus	3.6
Specific Gravity	2.67
Surface Texture	Even
Particle shape	Curved

2.3 Natural Aggregate: Crushed stone with 20 mm maximum size having specific gravity, fineness modulus and unit weight as given in Table 3 are used as natural aggregate.

Table 3: Properties of sand (FA)

Physical Property	Result
Fineness modulus	8.56
Specific Gravity	2.71
Particle shape	Angular

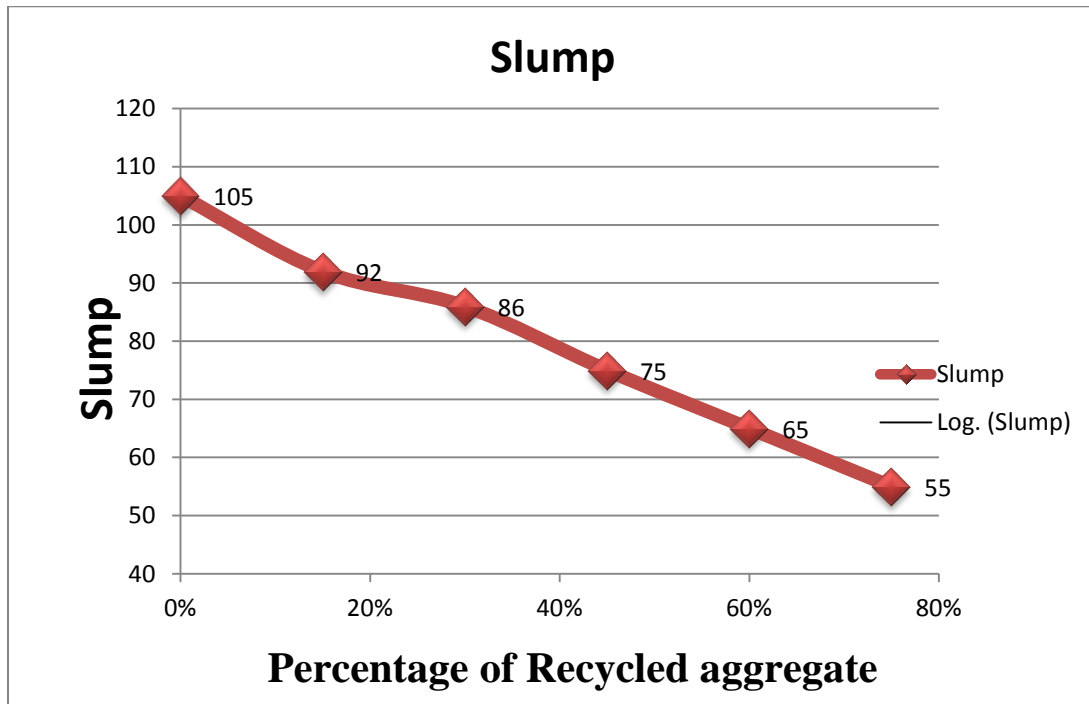
2.4 Recycled Aggregate: The RAC passing through 20mm and retained on 4.75mm size aggregate is used.

III. EXPERIMENTAL WORK & RESULT

3.1 Slump Test: From the below table 3.1 shows that the result of slump test the value of slump decrease when percentage of recycled aggregate increases.

Table 3.1: Slump Test Result

Percentage of Recycled Aggregate in the mix	Slump (mm)
0%	105
15%	92
30%	86
45%	75
60%	65
75%	55



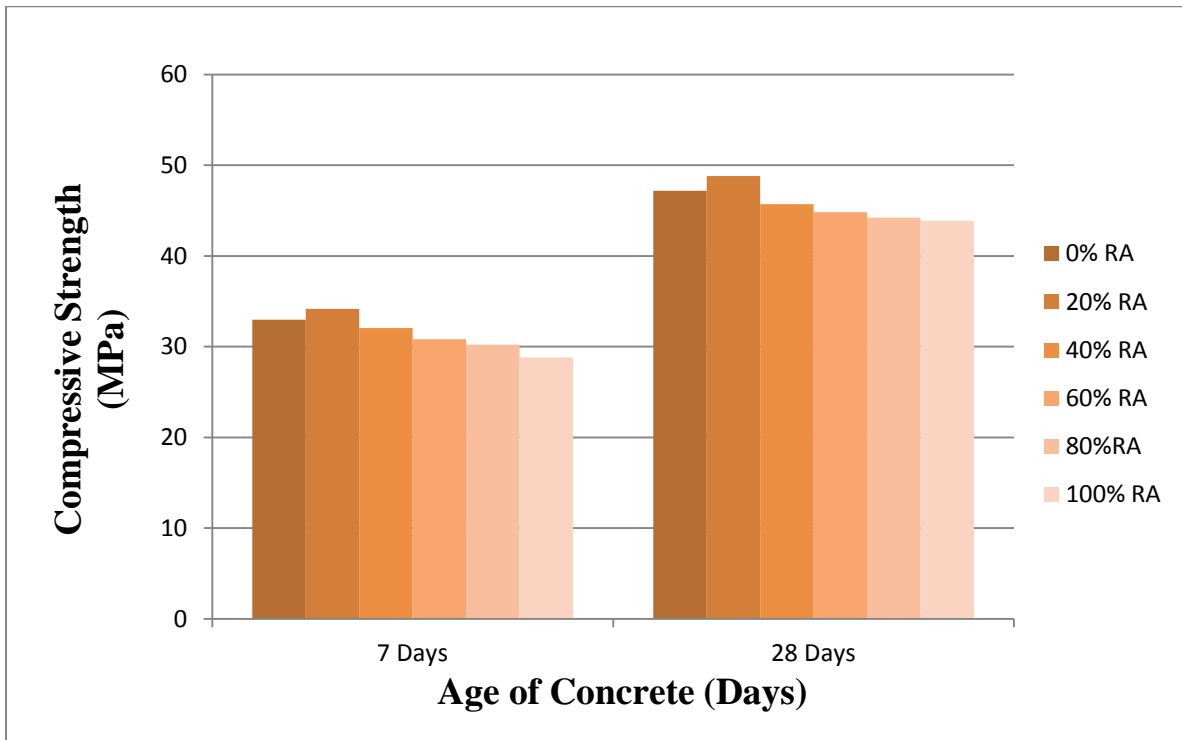
Graph 1: Variation in Slump value

3.2 Testing of Concrete:

3.2.1 Compressive Strength: The compressive strength test by Compression Testing machine shows an increasing trend of the compressive strength with age of the concrete specimens. Table-3.2 below shows the increase of the compressive strength with age recorded during the test.

Table 3.2: Variation of compressive strength with age

% of RA	0%	15%	30%	45%	60%	75%
7 Days	32.96 MPa	35.16 MPa	31.07MPa	30.75 MPa	30.33MPa	29.72MPa
28 Days	48.18MPa	49.72MPa	46.70MPa	45.69MPa	44.22MPa	42.88MPa



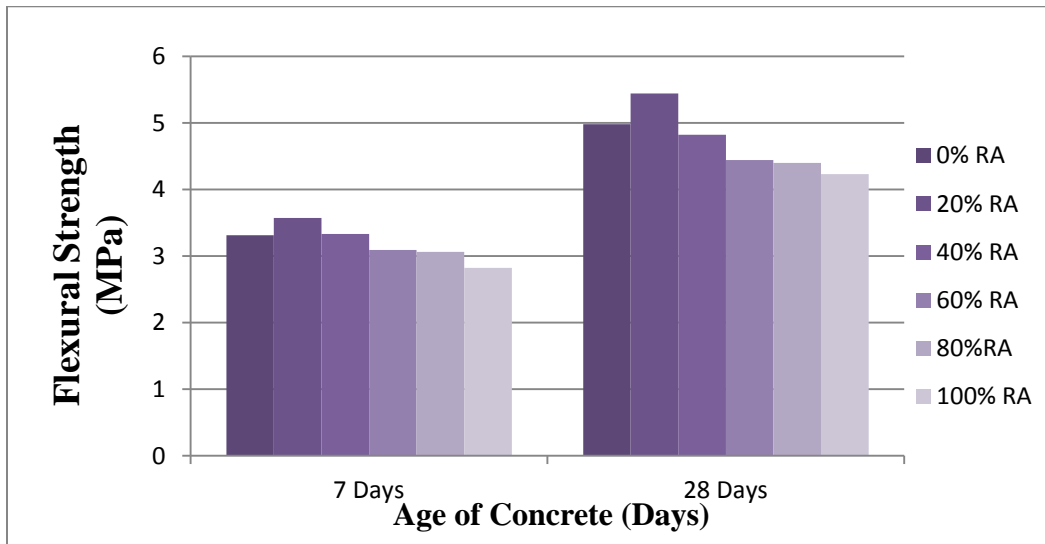
Graph 2: Variation in Compressive Strength with increasing % of Recycled Aggregate

3.2.2 Flexural Strength

Flexural strength test is performed on 2 beams of each batch mix for 7 days & 28 days. An average of 3 values as tabulated in table 3.3, are considered for discussions

Table 3.3: Variation of flexural strength with age

% of RA	0%	15%	30%	45%	60%	75%
7 Days	3.31MPa	3.57 MPa	3.33MPa	3.09MPa	3.06MPa	2.82MPa
28 Days	4.98MPa	5.44MPa	4.82MPa	4.44MPa	4.40MPa	4.23MPa



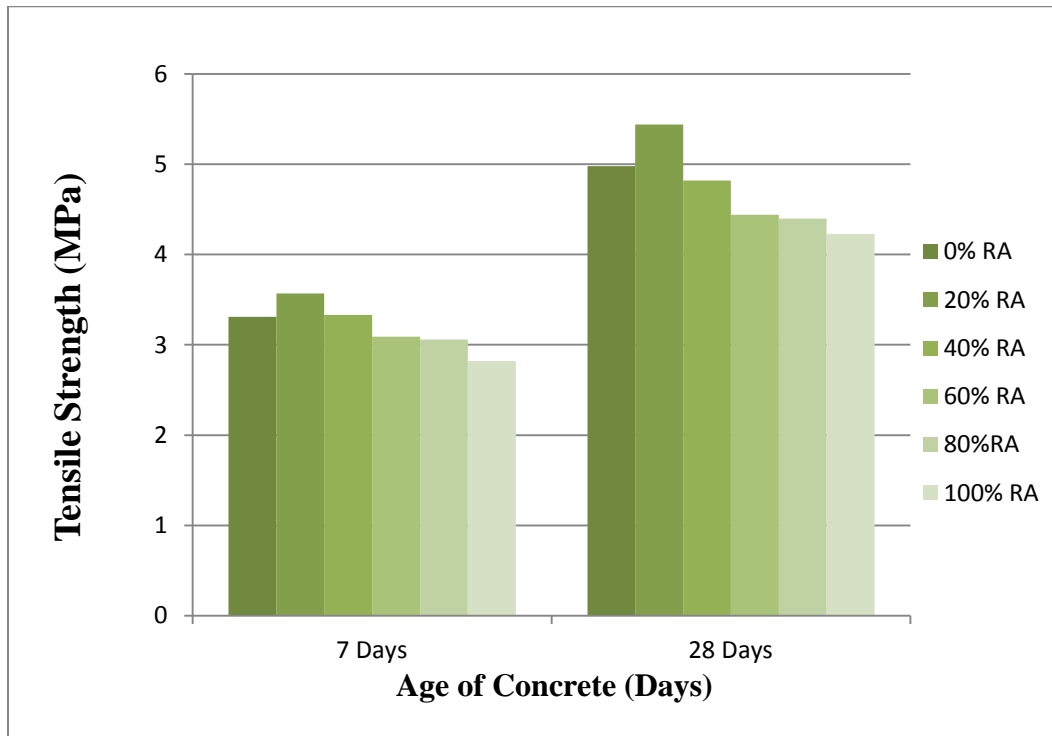
Graph 3: Variation in Flexural Strength with increasing % of Recycled Aggregate

3.2.3 Split Tensile Strength

Split Tensile Strength is performed on 3 cylinders of each batch mix for 7 days & 28 days. An average of 3 values as tabulated in table 3.4, are considered for discussions.

Table 3.4: Variation of Split Tensile strength with age

% of RA	0%	15%	30%	45%	60%	75%
7 Days	2.63 MPa	3.38MPa	3.29MPa	2.89MPa	2.72MPa	2.58MPa
28 Days	5.29MPa	5.72MPa	5.15MPa	4.58MPa	4.48MPa	4.38MPa



Graph 4: Variation in Tensile Strength with increasing % of Recycled Aggregate

IV. CONCLUSIONS

Based on experimental observations, following conclusions can be drawn

1. The workability of the concrete considerably reduces as the amount of recycled aggregate increases in the concrete mixture.
2. Compressive strength 4.99 % & 9.85% increases at 7 & 28 days when percentage upto 15%.
3. Split Tensile strength 21 % & 15% increases at 7 & 28 days when percentage upto 15%.
4. Flexural strength 11 % & 14% increases at 7 & 28 days when percentage upto 15%.

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