

# STUDY ON STRENGTH OF CONCRETE BY USING RECYCLED AGGREGATE FROM DEMOLITION WASTE IN CONCRETE

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## Abstract

Concrete waste is generated whenever any demolition activities take place. Among various types of demolished waste materials, concrete waste accounts for about 50% of the total waste generated. The current practice of dumping construction waste materials for land filling affects the groundwater recharges and land degradation. Recycling concrete waste as recycled aggregate is one of the methods adopted to reduce the environmental impact. The aim of this study is to know the feasibility of using concrete waste as coarse aggregate for making new concrete. Metal coarse aggregate is replaced by recycled coarse aggregate by weight in M25 grade concrete. The Recycled Aggregate Concrete (RAC) specimens were tested for compressive strength, tensile strength and flexural strength and results obtained are compared with the conventional Concrete.

**Keywords:** Recycled Coarse Aggregate, Recycled Aggregate Concrete, Polypropylene Fibre, Coir Fibre, Silica Fume.

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## 1. INTRODUCTION

The environment should be protected from the hazard of getting polluted which is the real sustainable development. At present, infrastructural development results in serious problem of construction and demolition waste disposal. At the same time there is a great demand for the natural aggregates (NA). There is no substituent product for natural aggregate. To full fill this demand as well as to conserve the land from concrete waste as landfills the only way is to use recycled aggregates from concrete waste. This process will result in reduction of demand on natural aggregates as well as the disposal of waste in land as landfills.

Recycled Aggregate (RA) is obtained from the demolition of buildings, flexible pavements etc. The Recycled Aggregate (RA) is used for producing fresh concrete and it is known as Recycled Aggregate Concrete (RAC). Due to infrastructural development and urbanization many old buildings are demolished which produce large quantity of Recycled Aggregate (RA).

## 2 MATERIALS AND METHODS

### 2.1 Materials

The materials used in this research work are ordinary Portland cement of 53 grade, river sand, coarse aggregate of 20mm nominal size, recycled coarse aggregate of 20mm nominal size, polypropylene fibre, natural (coir) fibre, Silica fume.

### 2.2 Preparation of Specimens

Concrete mix proportions of ratio 1:1:2 is used for the preparation of specimens. Conventional specimens were casted. Recycled aggregate specimens, Recycled aggregate specimen with polypropylene fibre and 10% silica fume,

Recycled aggregate specimen with natural(coir) fibre and 10% silica fume where the coarse aggregate is replaced by the recycled coarse aggregate from concrete waste of about 10%, 20%, 30%, 40%, 50%, 75% and 100% are also casted in parallel. The specimens were cured under tap water at room temperature and tested at the age of 7, 14 and 28days.

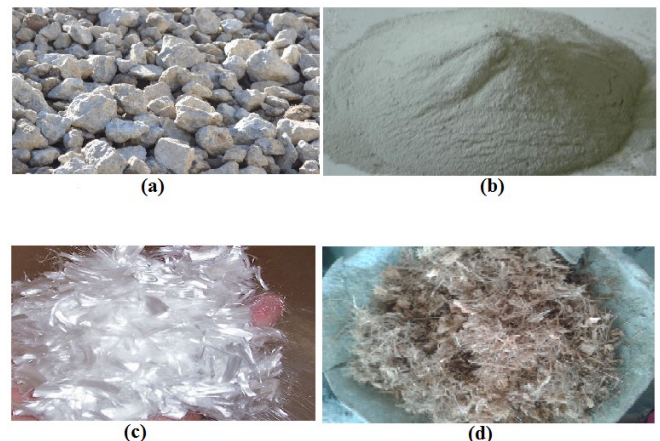


Fig -1: (a) Recycled aggregate (b) Silica fume  
(c) Polypropylene fibre (d) Coir fibre

## 3. TESTS ON CONCRETE

### 3.1 Compressive Strength Test

The casted specimens of size 150mm\*150mm\*150mm cubes were tested to determine the compressive strength at the age of 7, 14 and 28days.

### 3.2 Tensile Strength Test

The casted specimens of size 150mm\*300mm cylinders were tested to determine the tensile strength at the age of 7, 14 and 28days.

### 3.3 Flexural Strength Test

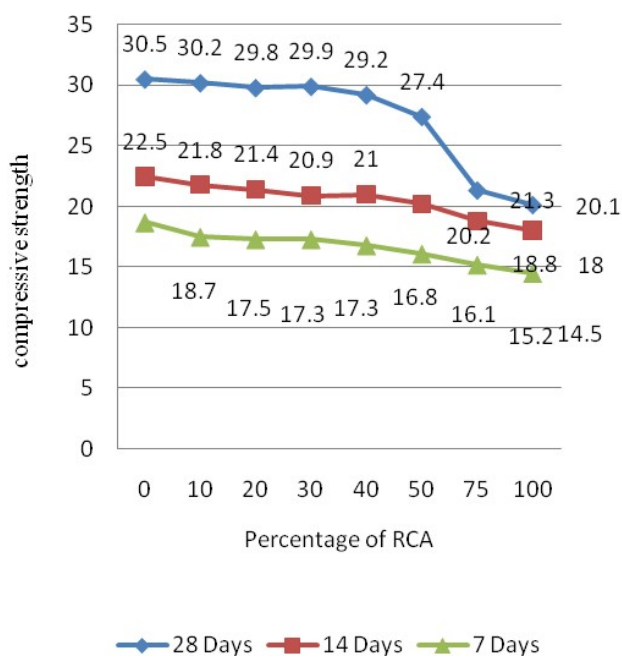
The casted specimens of size 1m\*0.15m\*0.15m beams were tested to determine the flexural strength at the age of 28days.

### 4. RESULTS AND DISCUSSION

The various results obtained from the compressive strength tests, tensile strength tests and flexural strength tests were discussed and tabulated. The charts representing the test results were also provided. The table 1,4 and 7 indicates the results of the compressive strength, tensile strength and flexural strength of the RCA concrete whereas the table 2, 3, 5 and 6 indicates the results of the compressive strength tensile strength, flexural strength of the RCA concrete with polypropylene fibre and natural fibre (coir) respectively.

**Table -1:** Compressive strength of RCA concrete

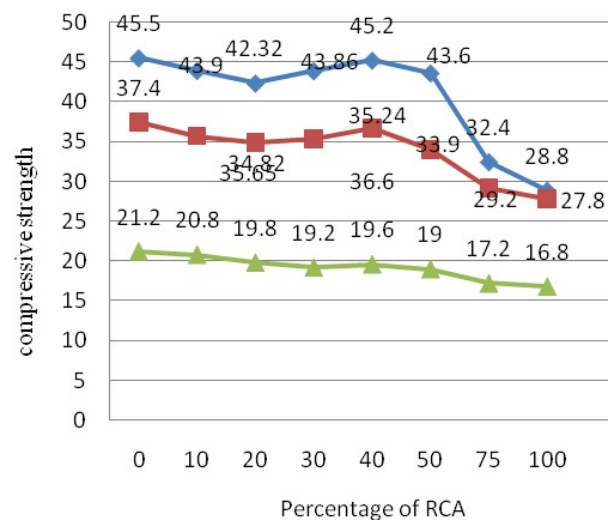
% of RCA	Compressive strength of RCA concrete N/mm <sup>2</sup>		
	7 Days	14 Days	28 Days
0	18.7	22.5	30.5
10	17.5	21.8	30.2
20	17.3	21.4	29.8
30	17.3	20.9	29.9
40	16.8	21	29.2
50	16.1	20.2	27.4
75	15.2	18.8	21.3
100	14.5	18	20.1



**Chart -1:** Compressive strength of RCA concrete

**Table -2:** Compressive Strength of RCA Concrete with Polypropylene Fibre and 10% Silica Fume

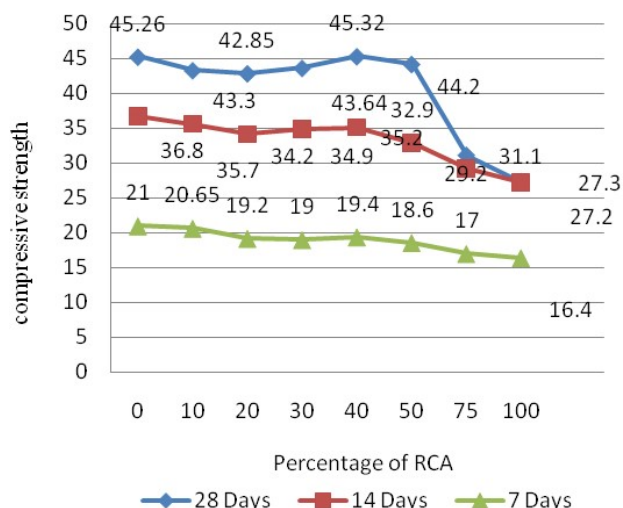
% of RCA	Compressive Strength of RCA Concrete with Polypropylene Fibre and 10% Silica Fume N/mm <sup>2</sup>		
	7 Days	14 Days	28 Days
0	21.2	37.4	45.5
10	20.8	35.65	43.9
20	19.8	34.82	42.32
30	19.2	35.24	43.86
40	19.6	36.6	45.2
50	19	33.9	43.6
75	17.2	29.2	32.4
100	16.8	27.8	28.8



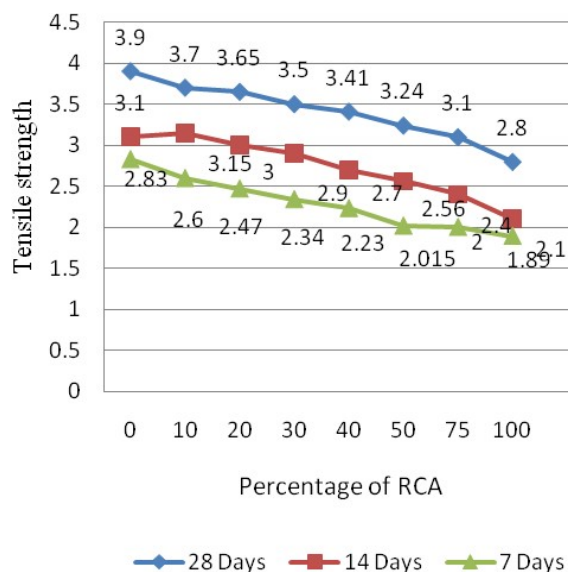
**Chart -2:** Compressive Strength of RCA Concrete with Polypropylene Fibre and 10% Silica Fume

**Table -3:** Compressive Strength of RCA Concrete with Natural Fibre (Coir) and 10% Silica Fume

% of RCA	Compressive Strength of RCA Concrete with Natural Fibre (Coir) And 10% Silica Fume N/mm <sup>2</sup>		
	7 Days	14 Days	28 Days
0	21	36.8	45.26
10	20.65	35.7	43.3
20	19.2	34.2	42.85
30	19	34.9	43.64
40	19.4	35.2	45.32
50	18.6	32.9	44.2
75	17	29.2	31.1
100	16.4	27.2	27.3



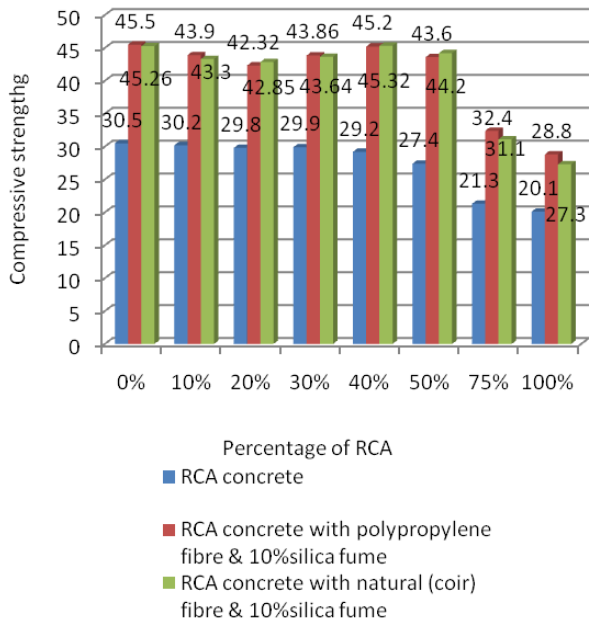
**Chart -3:** Compressive Strength of RCA Concrete with Natural Fibre (Coir) and 10% Silica Fume



**Chart -5:** Tensile strength of RCA concrete

**Table -5:** Tensile Strength of RCA Concrete with Polypropylene Fibre and 10% Silica Fume

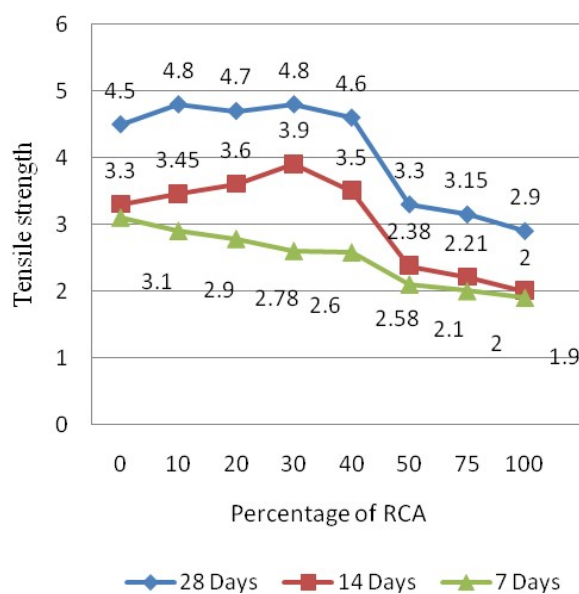
% of RCA	Tensile Strength of RCA Concrete with Polypropylene Fibre And 10% Silica Fume N/mm <sup>2</sup>		
	7 Days	14 Days	28 Days
0	3.1	3.3	4.5
10	2.9	3.45	4.8
20	2.78	3.6	4.7
30	2.6	3.9	4.8
40	2.58	3.5	4.6
50	2.1	2.38	3.3
75	2.0	2.21	3.15
100	1.9	2.0	2.9



**Chart -4:** Comparison of Compressive Strength of RCA Concrete

**Table -4:** Tensile strength of RCA concrete

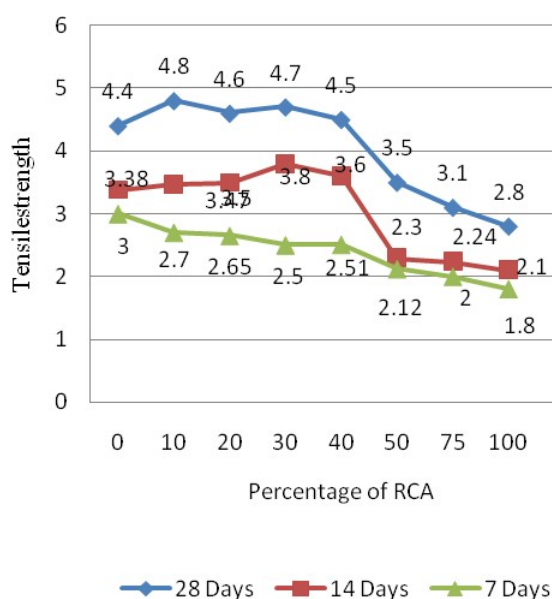
% of RCA	Tensile strength of RCA concrete N/mm <sup>2</sup>		
	7 Days	14 Days	28 Days
0	2.83	3.1	3.9
10	2.6	3.15	3.7
20	2.47	3.0	3.65
30	2.34	2.9	3.5
40	2.23	2.7	3.41
50	2.15	2.56	3.24
75	2	2.4	3.1
100	1.89	2.1	2.8



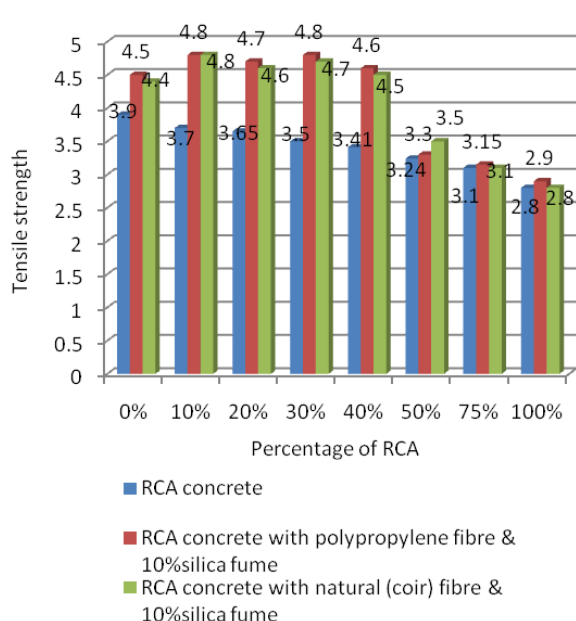
**Chart -6:** Tensile Strength of RCA Concrete with Polypropylene Fibre and 10% Silica Fume

**Table -6:** Tensile Strength of RCA Concrete with Natural Fibre (Coir) and 10% Silica Fume

% of RCA	Tensile Strength of RCA Concrete with Natural Fibre (Coir) and 10% Silica Fume N/mm <sup>2</sup>		
	7 Days	14 Days	28 Days
0	3.0	3.38	4.4
10	2.7	3.47	4.8
20	2.65	3.5	4.6
30	2.5	3.8	4.7
40	2.51	3.6	4.5
50	2.12	2.3	3.5
75	2.0	2.24	3.1
100	1.8	2.1	2.8



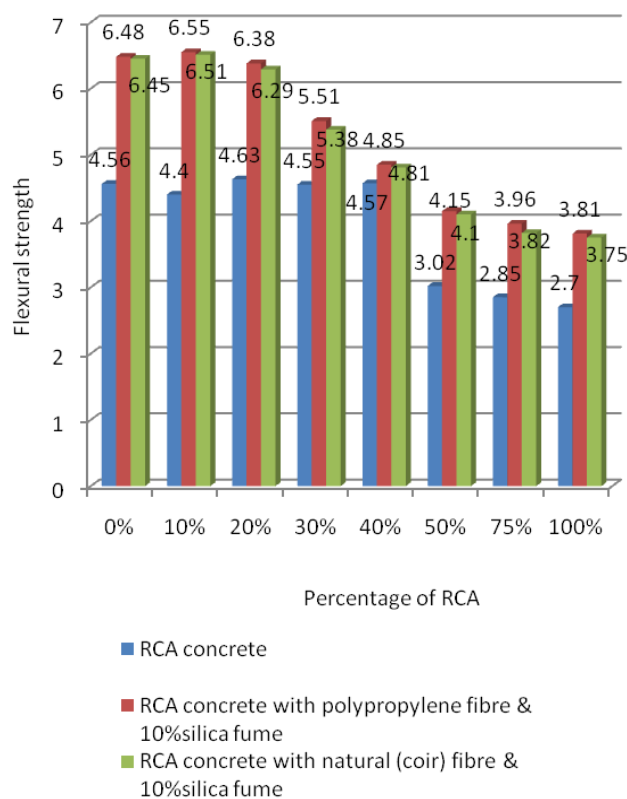
**Chart -7:** Tensile Strength of RCA Concrete with Natural Fibre (Coir) and 10% Silica Fume



**Chart -8:** Comparison of Tensile Strength of RCA Concrete

**Table -7:** Flexural strength of RCA concrete

% RCA	Flexural strength of RCA concrete MPa		
	RCA	RCA with polypropylene fibre and 10% silica fume	RCA with natural (coir) fibre and 10% silica fume
0	4.56	6.48	6.45
10	4.4	6.55	6.51
20	4.63	6.38	6.29
30	4.55	5.51	5.38
40	4.57	4.85	4.81
50	3.02	4.15	4.1
75	2.85	3.96	3.82
100	2.7	3.81	3.75



**Chart -9:** Comparison of Flexural Strength of RCA Concrete

Based on the results obtained, it is found that

- The workability was found to be in the decreasing order for RCA concrete. It may be due to the absorption of water by the recycled aggregate.
- The compressive strength of concrete in which the coarse aggregate is replaced with RCA decreases when the percentage of RCA increases.
- The split tensile strength of concrete decreases when the percentage of RCA in concrete increases.
- The flexural strength of concrete in which the coarse aggregate was replaced by RCA decreases when the percentage of RCA in concrete increase.

- But at the same time, compressive strength, Split tensile strength and flexural strength was found to be considerably increased when compared with nominal and RCA concrete for RCA concrete added with polypropylene fibre and 10% of silica fume as a replacement of cement.
- The compressive strength, Split tensile strength and flexural strength was also found to be considerably increased when compared with nominal and RCA concrete for RCA concrete added with natural (coir) fibre and 10% of silica fume as a replacement of cement.
- The increase in compressive strength, Split tensile strength and flexural strength of RCA with polypropylene fibre and natural (coir) fibre respectively along with 10% replacement of cement with silica fume was only up to 40% replacement of CA with RCA more than that the results were falling.
- Impact and Crushing values shows that the WCA shows considerable resistance against impact and gradual loads and these values are within the permissible limit to be used in the wearing surfaces.

## 5. CONCLUSION

From the discussion it is concluded that, the tests have been conducted for the prepared RCA and the results have been verified. The test results for the RCA and conventional concrete have been examined and compared. It is to be concluded that the compressive strength, split tensile strength and flexural strength are in the decreasing order when the percentage of RCA replacement increases. The compressive strength was found to be decreased by 10% for RCA. The split tensile strength was found to be decreased by 8% for RCA. The flexural was found to be decreased by 18% for RCA. The compressive strength, split tensile strength and flexural strength for RCA was more or less same compared to normal concrete when polypropylene fibre is added along with 10% replacement of cement by silica fume in RCA concrete. The compressive strength, split tensile strength and flexural strength for RCA was more or less same compared to normal concrete when natural (coir) fibre is added along with 10% replacement of cement by silica fume in RCA concrete. The increase in compressive tensile and flexural strength was noted till 40% replacement of RCA in concrete more than 40% result comes down. Before using the WCA it should be cleaned from the other materials carefully to get rid of debris. For larger structural work using WCA further study is required. Use of recycled aggregates in concrete provides a promising solution to the problem of C&D waste management. In conclusion, up to 40% of WCA along with polypropylene fibre and natural (coir) fibre respectively with 10% replacement of cement by silica fume gives good results over compressive tensile and flexural strength. Recycling WCAs in concrete production may help solve a vital environmental issue apart from being a solution to the problem of inadequate concrete aggregates in concrete.

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