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## FINAL PAPER ON STRENGTH AND DURABILITY EVALUATION OF RECYCLED AGGREGATE CONCRETE

**Prof Vikas R. Bankar<sup>1</sup>, Nishchay Kamble<sup>2</sup>, Mrunal Vinod Thakre<sup>3</sup>,  
Pranita Manohar hadse<sup>4</sup>, Anurag Shantaram Sapate<sup>5</sup>, Sandesh Rajeshwar Ughade<sup>6</sup>,  
Balvant Sanjay Hemke<sup>7</sup>, Abhishek kesve<sup>8</sup>**

<sup>1</sup>Assistant professor Department of Civil Engineering Jagdambha Collage of Engineering and Technology  
Yavatmal – 445001

<sup>2,3,4,5,6,7,8</sup>Students, Department of Civil Engineering Jagdambha Collage of Engineering and  
Technology Yavatmal – 445001

DOI: <https://www.doi.org/10.58257/IJPREMS31517>

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### ABSTRACT

In this research work discussed comparison between RCA mixed concrete and NCA mixed concrete at an of 7- and 24-day curing period in this work different property of aggregate are tested in two phases i.e. phases 1 and phase 2 in phases 1 various test on the aggregate property are carried out and in phase 2 the mechanical test are carried out. Quality and strength of RCA is depending upon the loading and exposure condition of the demolished structure. In this work the proposition of concrete cube is 0%, 20%, 50%, 80% and 100%

The rising demand of primary aggregate is due to rapid industrialization in growth rates, coupled with construction boom in developing countries has given rise to an increase in the demand for primary aggregate and the serious effect to the environment degradation. Hence the usage of recycled aggregate is the best alternative for the aggregate which are obtain naturally.

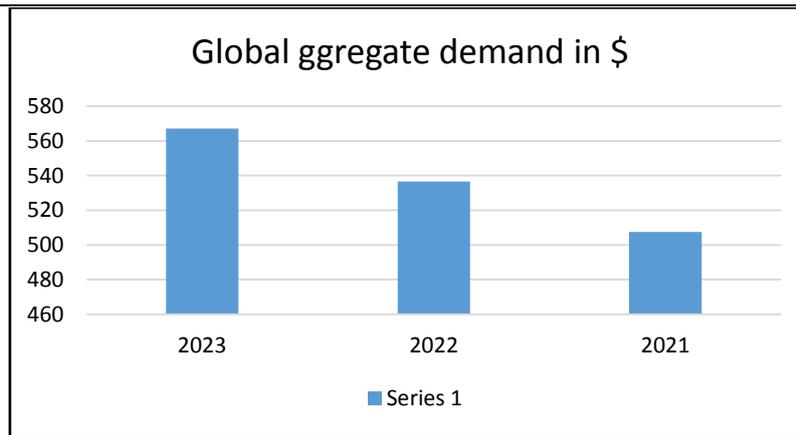
Recycled coarse aggregate (RCA) are basically made up of crushed demolished concrete and it make the structure economical as we are using waste concrete as recycled aggregate, the main focus of this paper is use to find compressive strength of recycled aggregate concrete. Here M25 grade concrete is taken and the natural aggregates were replaced with recycled aggregate in various percentage of 0%, 20%, 50%, 75%, 100% and IS 10262-2009 is used for mix design of these replacement ratio. In order to determine the compressive strength of RAC total 30 cubes are casted.

**Key words:** Recycled Aggregate, Compressive Strength, M25 grade.

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### 1. INTRODUCTION

Concrete is a mixture of a cement, sand and aggregate it is used in construction. Concrete is widely used in construction industry i.e., the second-most-used substance in the world after water, its usage worldwide, ton for ton, is twice that of steel, wood, plastics, and aluminium combined. RCA is used aggregate obtained from demolished concrete waste which can be used as an alternative source of aggregate The demand for construction aggregates is driven by the increasing urbanization, infrastructure development, and rising population in the developing countries. Also, the increasing demand for housing, coupled with the growing tourism industry, is driving the demand for construction aggregates. In India the construction aggregates demand is estimated to be around 4,500-5,000 million tones and the global demand for aggregate in world in 2023 is 47.5 billion metric tons and 2.3% rise is forecasted for per year. The aim of these research work is to compare a strength of RCA and NCA at an interval of 7- and 28-days curing period In this research work the whole work is divided into two phases in phase 1 various test needed for the work on the property of aggregate is carried out and in phase 2 test on concrete cube for compressive strength test are carried out



## 2. METHODOLOGY

This experimental programmed was carried out in two phases,

Phase 1: collection of required ingredients for the preparation of concrete and it includes all the physical and mechanical testing on recycled aggregate. as well as testing on other materials like cement, fine aggregate and coarse aggregate.

Phase 2: this phase includes workability test on concrete at various replacement ratio, casting of cubes and compressive strength testing.

1. In this project, the recycled concrete aggregates are obtained from the big concrete blocks.
2. These blocks are first crushed by using Hammer to a size of 40mm or less then it is crushed by using crusher. Due to this the recycled aggregates of size 10mm to 20mm are obtained.
3. These recycled aggregates are wet they are dried by keeping in oven for 24 days.
4. The different tests are carried out on finally obtained recycled aggregates
5. after the evaluation of properties of recycled and required testing on cement sand and coarse aggregate Mix design of concrete of grade M25 is done. by using IS 1260:2009 and 456:2000
6. once the mix design is done casting of cube is carried out with the various recycled aggregate replacement ratio (0%, 20%, 50%, 75%, 100%). And after 24hours cubes are left for curing in curing tank.
7. at the last, cubes are tested in CTM machine on 7<sup>th</sup> day and 28<sup>th</sup> day from casting and results are obtained.

## 3. MATERIAL USED

1. Fine aggregate: river sand of size passes through 4.75 mm IS sieve and retained on 150 microns is used.
2. Naturally Coarse aggregate and recycled coarse aggregate: here aggregate of 20 mm size is used. these aggregates are generally passing through 63 mm IS sieve and retained on 4.75 micron
3. Cement: PPC grade of cement 43 is used.
4. Water: potable water available in the campus.

## 4. RESULTS AND DISCUSSION

Comparison between the properties of RCA & NCA

The physical properties of both NCA and RCA were determined. The results of material properties of RCA and NCA are presented in Table.

**Table 1.** Comparison of the Properties of RCA and NCA

Sr no.	Material test	NCA	RCA
1.	Specific gravity	2.65	2.395
2.	Water absorption	0.60%	2.67%
3.	Aggregate crushing value	34.163%	26.141%
4.	Aggregate impact value	26.45%	35.54%
5.	Los Angeles abrasion value	26.72%	32.86%

**Discussion:** mechanical and physical properties of recycled coarse aggregate is comparatively poor than the natural coarse aggregate.

Specific gravity of recycled aggregate is about 10 % lower than NCA. Due to presence of old cement paste on the surface of aggregate.

RCA has more absorption capacity than NCA the reason behind it again the presence of adhere cement paste on it which leads to more absorption capacity.

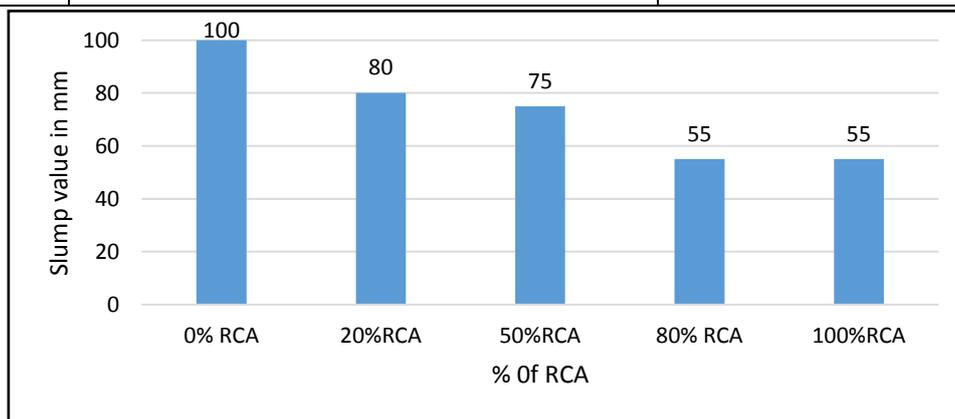
Likewise impact value crushing value and abrasion values of RCA are lower, as it contains about 30 to 60 % old cement paste mortar which affects the rate of crushing, impact and abrasion values.

**Properties of fresh concrete (workability test result)**

The result of workability for different percentage of recycled aggregate in concrete is presented in table no 4.1. bar chart of comparison for different percentages of recycled aggregate is presented in bar chart

**Table 2** results and comparison for different percentages of recycled aggregate.

Sr. no.	Types of specimens	Slump value in mm
1.	Nominal concrete	100 mm
2.	Concrete with 20% replacement	80 mm
3.	Concrete with 50 % replacement	75 mm
4.	Concrete with 80% replacement	55 mm
5.	Concrete with 100 % replacement	55 mm



Bar chart: - comparison of workability for different percentage of RCA

**Discussion as per workability test result for different percentage of RCA**

The slump values of all the mixtures are represented in table. The slump reduces with the increase in RCA content and it gives medium workability up to 50 % replacement at zero % replacement it gives maximum workability. But as RCA percentage increase the workability of concrete reduce due to its water absorbing nature.

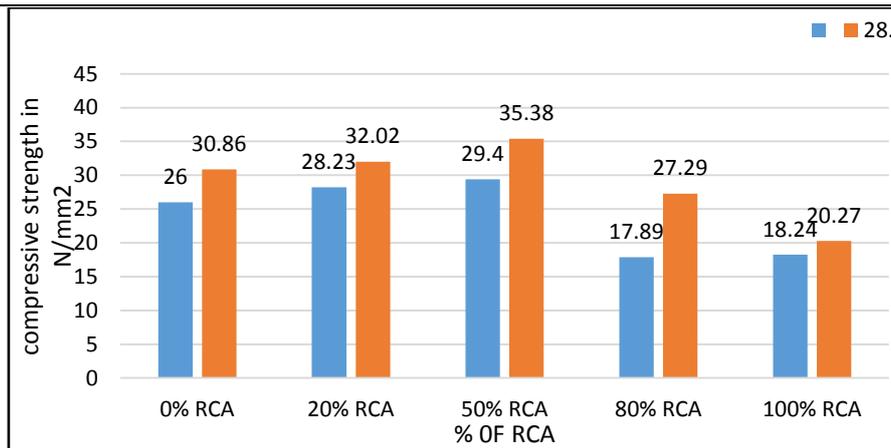
**Properties of hardened concrete (compressive strength test)**

**Compressive strength result for different percentage of recycled coarse aggregate**

The result of compressive strength for different percentages of recycled coarse aggregate in concrete is presented in table bar chart of comparison for different percentages of recycled coarse aggregate is presented in bar chart.

**Table 3:** - Result and comparison of compressive strength for different percentage of recycled aggregate.

SR. no.	Type of specimen	Compressive strength N/mm2	
		7 days	28days
1.	Nominal cube	26.00	33.86
2.	Concrete with 20% RCA	28.23	33.02
3.	Concrete with 50% RCA	29.40	35.38
4.	Concrete with 80% RCA	17.89	27.29
5.	Concrete with 100% RCA	18.24	20.27



Bar chart: - comparison of compressive strength for different percentage of RCA

Compressive strength of concrete with 50% replacement has the highest 7 days and 28 days strength which reaches 29.40 N/mm<sup>2</sup>, the Compressive strength of R.C with 50% replacement of RCA is in close proximity with that of the control concrete.

From the result obtained, it is observed that the development of Compressive strength of R.C is better during early stage but it exhibits lower Compressive strength during later stage

## 5. CONCLUSION

1. Use of recycled aggregate is proved to be a valuable building material in technical environmental and economical respects.
2. Recycled and reuse is an appropriate solution for the problem of dumping thousands of tons of demolition waste.
3. The shortage of natural aggregate can be addressed by recycled aggregate,
4. It is observed that properties of recycled aggregate are lower than the natural aggregate hence replacement up to certain extent is recommended.
5. With increase in replacement ratio of recycled aggregate with the natural aggregate leads to decrease in workability of concrete.
6. Countries like UAE, Saudi Arabia, India has also taken some serious urgent measures for the scope of recycled and if done so then concrete recycling will become one of the most important elements for construction sustainability.
7. As the tremendous increase in pollution and rapid industrialization the demolition waste is also increasing hence the research on the recycling of demolition waste is given a great importance now a days.
8. The work present in this paper evaluate the variation in compressive strength of conventional concrete after the partial replacement of recycled aggregate with natural aggregate.
9. By observing test results, it is concluded that the virgin aggregates can be replaced by recycled aggregate at some extent is being recommended since it attains near about similar strength compared to conventional concrete.

## 6. REFERENCES

- [1] ASTM C127. (2012a). Standard test method for density, relative density (specific gravity), and absorption of coarse aggregate. West Conshohocken, PA: ASTM International.
- [2] IS 10262-2009 (2009): guidelines for concrete mix design proportioning
- [3] IS 456- 2000 plain and reinforced concrete
- [4] Civil engineering NOC: integrated waste management for smart city.
- [5] IS 383 2016 coarse and fine aggregate for concrete – specification
- [6] IS 9013 (1978): method of making, curing and determine compressive strength of accelerated cured concrete test specimens [CED 2: cement and concrete]