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Performance Assessment of Concrete Utilizing Recycled Aggregate and Artificial Sand

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Abstract
Concrete stands as the foremost construction material globally, representing the most prevalent choice for all types of civil engineering projects. Among the essential ingredients of concrete, aggregates defined as inert granular materials like sand, crushed stone, or gravel constitute the bulk. However, in recent years, the extensive extraction and utilization of aggregates from natural sources have raised international concerns. The declines in the quality of primary aggregates and heightened awareness of environmental conservation have underscored the need for change.
In this paper the experimental program is done for overall investigation of compressive strengthening and flexural strengthening of total seventy-two reinforced concrete cubes and beam for partial replacement of recycled aggregate for 0,30,60&100 percent respectively. The casting of cubes having size 150 x 150 x 150 mm and beam having size 500 x 100 x 100 mm has done with use of M 20 grade of concrete as per IS 456:2000 and IS 10262:2019. Compressive strength and flexural strength is improved at 60 percent replacement of recycled aggregate with use of 100% artificial sand.

Keywords: Recycled Aggregate, Artificial Sand, Partial Replacement, Compressive Strength, Flexural Strength.

1. Introduction

Consequently, there is a growing momentum towards utilizing recycled aggregates sourced from construction and demolition waste (C&D waste) in concrete production. This shift towards recycled aggregate concrete reflects a strategic response to environmental challenges and the imperative to preserve natural resources. As sustainable practices gain prominence in construction, recycled aggregates offer a viable solution to curb reliance on virgin materials.
The utilization of recycled aggregates in concrete not only helps in mitigating environmental impacts but also addresses the issue of waste management in the construction sector. This approach aligns with global efforts to promote circular economy principles, wherein materials are reused and recycled to minimize resource depletion and waste generation.

2. Objectives

The investigation has been carried out with following objectives.

- To determine compressive strength of M20 grade of concrete for 0%,30%,60%&100% replacement

of recycled aggregate.

- To determine flexural strength of M20 grade of concrete for 0%,30%,60%&100% replacement of recycled aggregate.
- To study & compare the mechanical properties compressive strength and flexural strength of concrete specimen with and without recycled aggregate.

3. Scope of study

After studying various literatures, it has been shown that recycled aggregate can be used to replace normal aggregate. However, some research suggests that recycled aggregate can be used with different materials and admixtures at varying percentages.

This study focuses on producing M20 grade strong concrete by replacing recycled aggregate at different percentages and using 100% artificial sand in the concrete. The goal is to compare the compressive and flexural strength of concrete at each percentage of replacement.

4. Material and methodology

Laboratory investigation carried out on various properties of various material used throughout the experimental work such as cement, artificial sand, natural aggregate and recycled aggregate. In this project, by using mix proportion of M20 grade concrete cube of 150 mm X 150 mm X 150 mm & flexural beam of 500mm X 100mm X100 mm is prepared for determination of compressive strength & flexural strength. In this test one sample taken for 7, 14 and 28 days.

1. Cement

Cement is an adhesive material available in powder form and that can be made into a paste usually by the addition of water. In this dissertation work Birla Shakti Cement of PPC 43 Grade is used which is collected from Shree Construction, Phaltan.

Table 1: Physical characteristics of cement

Sr. no	Tests	Results
1.	Specific Gravity	2.73
2.	Consistency (%)	33
3.	Initial Setting time (min)	175
4.	Final Setting Time (min)	330
5.	Fineness (%)	7
6.	Soundness (mm)	1

2. Fine aggregate (Artificial sand)

Artificial sand is one of the building sands, which refers to rock particles with a particle size of less than 4.75 mm and is made by artificial crushing and sieving after soil removal treatment. In preparation of this specimen, artificial sand is used which is collected from site of Shree Construction, Phaltan.

Table 2: Physical characteristics of fine aggregate

Sr. no	Tests	Results
1.	Specific gravity	2.26
2.	Water absorption (%)	15.38 %

3. Natural Coarse aggregate

Coarse aggregates refer to irregular and granular materials such as sand, gravel, or crushed stone, and are used for making concrete. In most cases, Coarse is naturally occurring and can be obtained by blasting quarries or crushing them by hand or crushers. In this work, coarse aggregate is collected from, Prasad Stone Crusher Phaltan.

Table 3: Physical characteristics of coarse aggregate

Sr. no	Tests	Results
1.	Specific gravity	3.007
2.	Water absorption (%)	0.98 %

4. Recycled Coarse Aggregate

The demolished concrete was derived from the waste concrete present in Concrete Technology lab of COEP engineering, college is used throughout the project work.

Table 4: Physical characteristic of recycled aggregate

Sr. no	Test	Result
1.	Specific gravity	2.93
2.	Water absorption	2.72%

5. Water

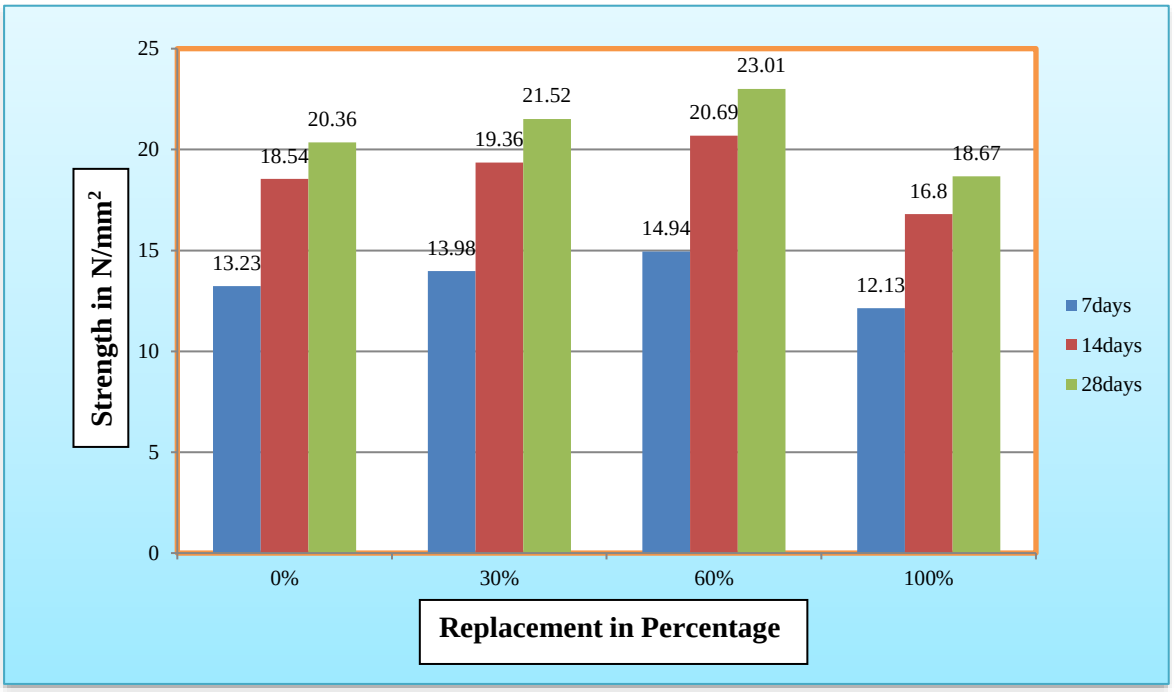
Portable water is used for making the concrete mixture. Water should be free from acids, oils, alkalis vegetables or other organic impurities used for mixing the concrete.

5. Result and discussion

1. Compressive strength of concrete cubes

Total 36 specimens were casted. After curing period of 7, 14, 28 days tested respectively.

Table 5: Comparative study of Compressive strength in N / mm ^{2}

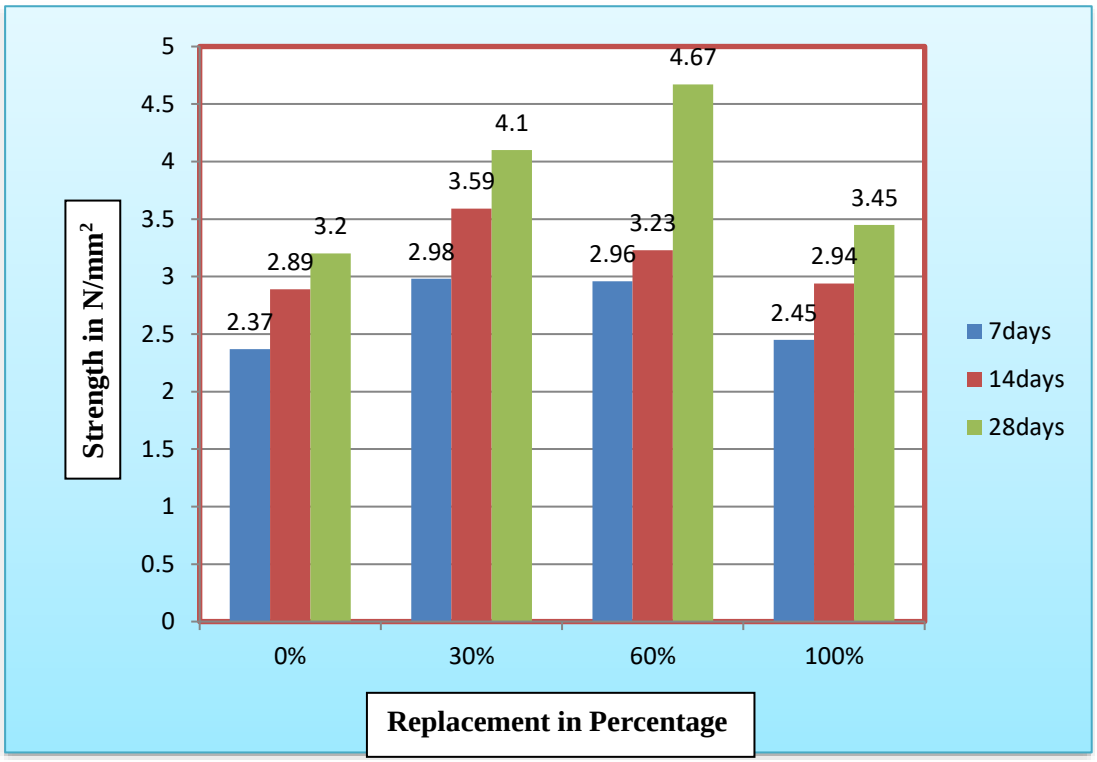


Compressive strength of concrete is increased at 60 % replacement of normal aggregate with recycled aggregate and then it is reduced.

2. Flexural strength of concrete beam

Total 36 specimens were casted. After curing period of 7, 14, 28 days tested respectively.

Table 6: Comparative Study of Flexural strength in N / mm ^{2}



Flexural strength of concrete is increased at 60% replacement of Normal aggregate with recycled aggregate and then it is reduced.

6. Acknowledgement

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7. Conclusion

Compressive strength and flexural strength of concrete is improved at replacement of normal aggregate with 60 % of recycled aggregate. Hence, we can replace normal aggregate by recycled coarse aggregate up to 60%. After increasing percentage of recycled aggregate compressive strength and flexural strength goes on reducing

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