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Effects on Physical Properties of Concrete having a partial replacement of Coarse Aggregates with Recycled Coarse Aggregates adding Coconut Fiber

Shivam A. Patel[1], Aviral Datta[2]

[1.] *Civil Engineering Department, Lovely Professional University, (India)*

[2.] *Civil Engineering Department, Lovely Professional University, (India)*

ABSTRACT

This research has been done by replacing the Coarse Aggregates by Recycled Coarse Aggregates and the addition of the Coconut Fiber is done in M20 concrete. Generally, M20 concrete is used for the household construction, therefore, M20 concrete was chosen. After replacement of Coarse Aggregates and addition of Coconut Fiber, the Physical Properties, i.e. Compressive Strength and Tensile Strength were studied and were compared to the standard Physical Properties of M20 concrete grade. The changes were observed and are plotted accordingly. As the ratio of RCA and CF was varied three times, therefore, different readings are observed. The basic idea of doing this research was to use the waste material. Recycled coarse Aggregates which are of no use at all were used in this research and played an important role for completion of this research. Also, along with this coconut fiber which is nothing but the husk of coconut is also used in this research and therefore has a major role in this research.

Keywords: Compressive Strength, Tensile Strength, Recycled Coarse Aggregates (RCA), Coconut Fiber

I. INTRODUCTION

M20 Concrete Grade which has the ratio 1:1.5:3 and gives compressive strength as 20 N/mm^2 after 28 days is the one which is most commonly used for the construction and is mostlyapplicable for Reinforced Cement Concrete (RCC) works for slabs, beams, columns and so on because of its moderate compressive strength and low cost of production.

Figure 1 - concrete cubes for testing

Since, M20 concrete mix is the one which is commonly used, therefore, many experiments like addition of additives and addition of other construction material is done so as to study the change in the behavior of physical properties of concrete like compressive strength and tensile strength and chemical properties like setting of concrete, hardening of concrete, etc. so that they can be analyzed properly and concrete with a better quality with less cost and with same specifications can be made. Therefore, we thought of adding the waste material i.e., Recycled Coarse Aggregates which can be easily available from a demolishing building or a concrete cube which is of no use at

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all. Along with it, Coconut Fiber which is nothing but the husk of coconut was also added. It is available from the market with a very minimal cost. Therefore, the combination of Recycled Coarse Aggregates and Coconut Fiber was added in the M20 Concrete with the same specifications.

The Coarse Aggregates were replaced by the Recycled Coarse Aggregates up to some percentage and some percentage of Coconut Fiber by weight to the cement was added to make concrete with the specification of M20. Cubes of 30%,3% ; 40%,4% ; 50%,5% Recycled Coarse Aggregates and Coconut Fiber, respectively, were made and proper testing of the cubes of dimension 150 X 150 X 150 mm was done after curing them for 7 days, 14 days and 28 days.

II. INTRODUCTION TO MATERIALS

2.1 Recycled Aggregates

Recycled aggregates are derived from crushing inert construction and demolition waste. It may be classified as recycled concrete aggregates (RCA) when consisting primarily of crushed concrete or more general recycled aggregates (RA) when it contains substantial quantities of materials other than crushed concrete. Currently, only the use of coarse aggregates derived from construction or demolition waste is recommended for use in new concrete construction.

Figure 2 - Recycled aggregates

2.2 Coconut Fiber

Coir or coconut fiber is a natural fiber extracted from the husk of coconut and used in products such as floor mats, doormats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut. Generally 5000 tons of coconut fibers are produced annually, mainly in India and Srilanka. Therefore, coir was easily available to be used as a construction material.

III. COMPOSITION OF MIXTURE

According to the specification of M20 concrete the Coconut Fiber and Recycled Aggregateswere added into the mixture. The ratio of M20 concrete is 1:1.5:3. Three variations were done in the concrete mix of M20 i.e.

- 30% of Coarse Aggregates were replaced by Recycled Aggregates and 3% of Untreated Coconut Fiber was added by the weight of cement. For example in M20 concrete grade which is having the ratio 1:1.5:3 where 1-cement, 1.5-Coarse Aggregates and 3-Fine Aggregates are mixed together to form the concrete, here , 30 grams of the coconut fiber was added in the mix and 450 grams of Coarse Aggregates were replaced by Recycled Aggregates.
- 40% of Coarse Aggregates were replaced by Recycled Aggregates and 4% of Untreated Coconut Fiber was added by the weight of cement. For example in M20 concrete grade which is having the ratio 1:1.5:3 where 1-cement, 1.5-Coarse Aggregates and 3-Fine

Figure 3 - Mixing of dry concrete with coconut fiber

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Aggregates are mixed together to form the concrete, here , 40 grams of the coconut fiber was added in the mix and 600 grams of Coarse Aggregates were replaced by Recycled Aggregates.

- 50% of Coarse Aggregates were replaced by Recycled Aggregates and 5% of Untreated Coconut Fiber was added by the weight of cement. For example in M20 concrete grade which is having the ratio 1:1.5:3 where 1-cement, 1.5-Coarse Aggregates and 3-Fine Aggregates are mixed together to form the concrete, here , 50 grams of the coconut fiber was added in the mix and 750 grams of Coarse Aggregates were replaced by Recycled Aggregates.

IV. RESULT AND ANALYSIS

4.1 Average Compressive Strength

TABLE 1

NAME	AT 7th DAY N/mm^2	AT 14thDAY N/mm^2	AT 28thDAY N/mm^2
M20 with 0%, 0%	13.5	16	20
M20 with 30%, 3%	10.51	13.33	20.23
M20 with 40%, 4%	9.59	12.39	16.11
M20 with 50%, 5%	8.51	10.73	14.23

It was analyzed that on replacing 30% coarse aggregates with recycled coarse aggregates and adding 3% coconut fiber gives a strength of 20.23 N/mm^2 for curing them for 28 days which is equivalent to the strength of basic M20 therefore the desired strength of M20 can also be achieved by replacing 30% of coarse aggregates with RCA and adding 3% of coconut fiber to it.

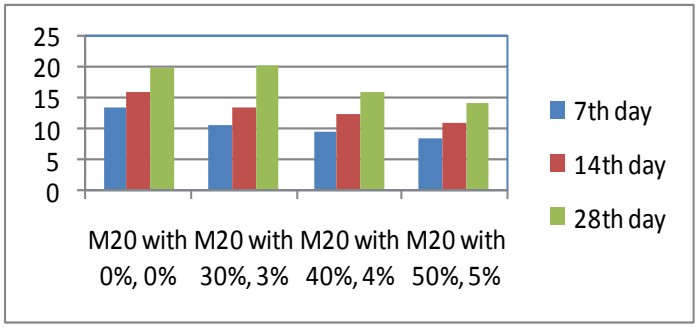

Chart 1 – Compressive strength v/s proportion

4.2 Average Tensile Strength

TABLE 2

NAME	AT 7th DAY N/mm^2	AT 14thDAY N/mm^2	AT 28thDAY N/mm^2
M20 with 0%, 0%	3.13	3.6	4.47
M20 with 30%, 3%	3	3.8	4.81
M20 with 40%, 4%	2.5	3.27	4.24
M20 with 50%, 5%	2.3	2.8	3.69

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It was analyzed that on replacing 30% coarse aggregates with Recycled Coarse Aggregates and adding 3% coconut fiber gives the tensile strength of 4.81 N/mm^2 for curing them for 28 days. It was also analyzed that the tensile strength was increasing when the cubes are cured for more days in water but the maximum tensile strength was achieved by M20 with 30%, 3% if cured for 28 days in water.

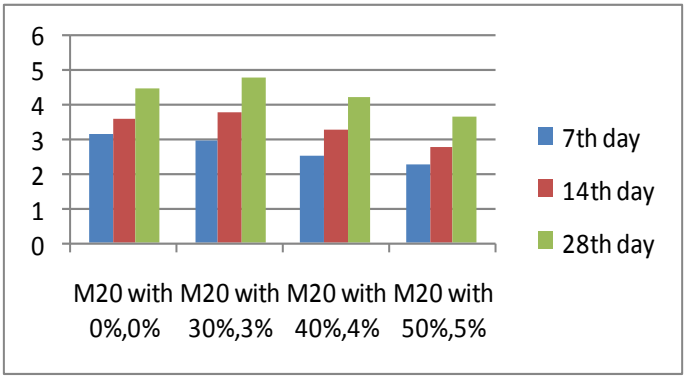

Chart 2 –Tensile strength v/s proportion

4.3 Slump Test Results

Slump test with different concrete made with the replacement of RCA and addition of Coconut fiber were done and therefore observations were taken. Following were the observations:-

M20 with 0%, 0% - 36mm

M20 with 30%, 3% - 22mm

M20 with 40%, 4% - 24mm

M20 with 50%, 5% - 26mm

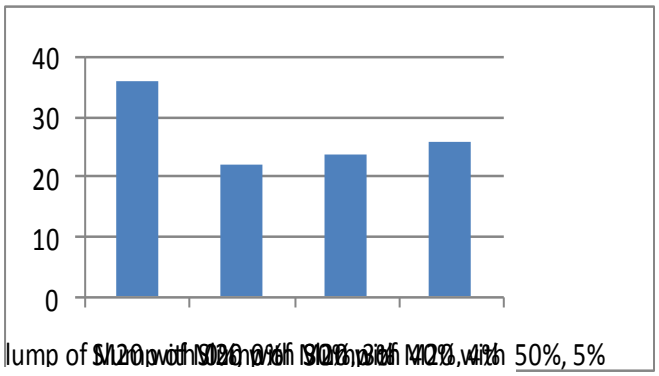

Chart 3 – Slump v/s proportion

It was observed that on increasing the quantity of RCA and Coconut fiber the slump value of the concrete mix is decreasing. This was due to the addition of more Coconut Fiber as they were absorbing water.

V. CONCLUSION

[1.] Following conclusions may be drawn based on the test results, observation and discussion for the grade of concrete (M20) investigated:

[2.] There is reduction in compressive and tensile strength of concrete with increase in the percentage replacement of natural Coarse Aggregates by Recycled Aggregates.

[3.] For replacement of natural Aggregates by Recycled Aggregates and adding Coconut Fiber to it upto 30% and 3% respectively, the strength of M20 concrete grade can be achieved.

[4.] This research had concluded that we can achieve the strength of M20 concrete grade if we replace Coarse Aggregates with RCA and add CF upto a certain extent. Therefore, concrete giving the same strength as M20 concrete with the partial composition of waste material.

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