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A Study on Compressive Axial Behavior of Short Column using Reshaped Waste Tyre Rubber as Partial Replacement of Coarse Aggregate

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Abstract

The increasing demand of natural resources for the concrete production has impacted the surroundings and the concern to protect these natural resources is increasing. Lately, handling and management of scrap is the primary issue faced by the countries worldwide. The waste problem is the most important problems facing the world as a source of the environmental pollution. One of the censorious wastes to be control in today is 'waste tyre' because; recent development in transportation has create big number of vehicles, which produce huge quantities of used tyres. Disposing such waste tyres is a critical waste management concern around the world at the moment. Various research works had been conducted in the past which had results that showed reduction in the mechanical energy of the concrete. The present study aims to use scrap tyre rubber by reshaping it as fractional replacement of coarse gravel in the concrete and to examine the outcome of providing a mooring hole of 10 mm in diameter on the surface of the rubber gravel which makes the cement plaster to form a cylindrical mooring between the gravel and the concrete as well work as a rebar to the rubber gravel thereby, increase withstanding power to failure under load which simultaneously increase the strength. The partial replacements of coarse aggregates are done at zero %, five %, ten %, fifteen % and twenty % by quantity of coarse gravel. The resulting concrete beams are tested for the physical characteristics of concrete. The compressive axial behaviour of short column are made with ordinary Portland cement concrete (OPCC)and Reshaped Waste Tyre Rubber Aggregate Concrete (RWTRAC)for various compositions of Reshaped Waste Tyre Rubber Aggregate replacement to coarse aggregate. Consequently the tests on RWTRAC short column of 10 % rubber aggregate replacement are conducted. The load and axial deformation of short column are discussed. The cracking strength of 10% RWTRA alternative concrete was found to be higher than traditional concrete. The initial and ultimate crack of replacement concrete attains higher than conventional concrete. The effect of coarse aggregate substitution by RWTRA will enhance the performance of the short column.

Keywords: Anchorage hole • Conventional short column • Axial deformation • Ultimate crack

Introduction

The most opted material for construction is concrete. The term "concrete" has its origin from the Latin term "concretes", which means to grow together. Nearly twelve million tonnes a year is the estimated concrete utilization worldwide [1]. Different countries in the universe have various stages of making rubber, for example US produce 3.6M tons of rubber per annum. Incineration is a possible solution for disposing nevertheless it harms the environment. Considering these disposal problems, the scrap tyre rubber may serve as partial coarse aggregate replacement in concrete [2,3]. However the availability of its ingredients is gradually decreasing with more and more demand for concrete. Commented that the recycled tyre rubber waste is an optimistic material in the growing industry of construction and the unique reason for this is the lightweight of the concrete finally produced when the tyre rubber is comprised in it as gravel substitute (partial). Coarse aggregate is one among the ingredients facing acute shortage [4,5]. So the need to search for a new and viable alternative is important for conservation of innate resources and reduction in manufacturing costs. Steel slag, Shells of coconut and fourth class bricks have been used in the testing of the coarse aggregate alternatives. Tyre rubber is a optimistic material in the building industries as partial substitution of coarse aggregate due to its light weight, energy absorption, elasticity also this has other advantage of preserving the innate aggregate used for the preparation of concrete. In this study, investigations were conducted to estimate the tyre rubber as additional coarse material which will be useful for the future utilization of innate coarse gravel in the concrete. This experimental investigation reports the effects of partial replacement of coarse gravel by scrap tyre rubber on the compressive strength of concrete [7-9].

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Materials and Methods

Cement

A binding medium that adheres the other components together in the concrete. This study used OPC 53 grade as per IS code 12269, 1987 in every experiment [10].

Coarse aggregates [Natural]

The 20 mm well graded was made use in this study. The aggregate were tested according to the Indian Standards 383-1970 [11].

Fine aggregate [M-sand]

The M-sand which was available locally that passed in 4.75 mm sieve corresponding to IS sieve used as fine gravel. This fine aggregate satisfies the Zone-II category grouping. Table 1 shows the sensible properties of fine aggregate and coarse aggregate [12].

Reshaped tyre rubber

The truck tyres which contained thread fibres in it were shredded to acquire the rubber chips. The tyres are then cut to form small cubes of 20 × 20 × 10 mm size. A 10 mm dia bore was made on the rubber aggregate's surface. Table 2 represents the physical characteristics of the rubber chips (Figure 1).

Results and Discussion

The present study on investigations of short column concrete under axial loading condition with the substitute for coarse aggregate by RWTRA. The potency of the column can be investigated with varying coarse aggregate replacement by 0% and 10%, of RWTRA for M25. A total of six columns consisting of three conventional RCC columns, three RCC columns with 10% replacement, were tested. Observational research has been performed for short column behavior having 100 × 100 × 600 mm sizes of M25 mixes and replacement of coarse aggregate by RWTRA (0% and 10%) [13]. Short column was tested on a UTM of capacity 2000 kN (Table 3). The load was added until the malfunction happened. The deflection of the column is observed at frequent intervals by slowly raising the load which is shown in Figures 2-4.

Table 1. Properties of aggregate.

Description	FA	CA
Specific gravity	2.64	2.84
Bulk density	1450 kg/m^3	1665kg/m^3

Table 2. Mechanical Characteristics of Rubber Chips.

Properties	CA
Specific gravity	1.11
Bulk density	480 kg/m^3

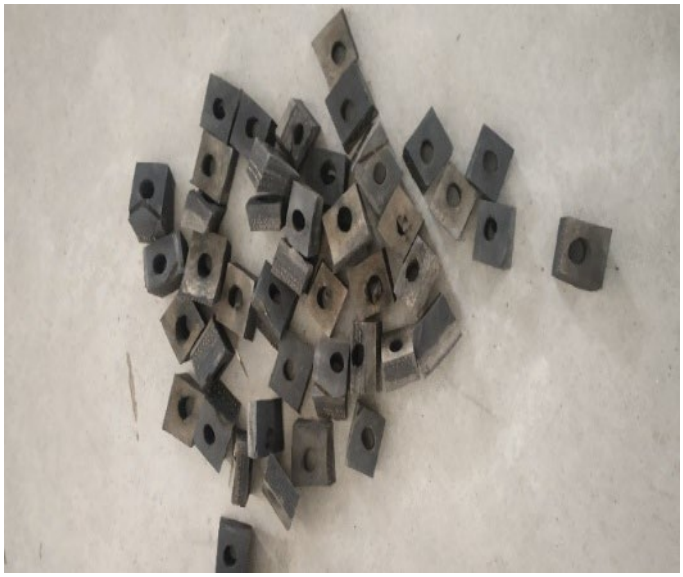

Figure 1. 10 mm diameter hole on the surface of the reshaped tyre rubber.

Table 3. Comparison of load *vs*. deflection in cc and 10% RWTRAC.

Identification	Specimens	Load (KN)	Axial Deformation (mm)	Remarks
CC (100+ 0%)	CC-1	110	4.12	Initial crack
		263	5.88	Ultimate crack
	CC-2	115	4.25	Initial crack
		258	5.68	Ultimate crack
	CC-3	108	4.45	Initial crack
		261	5.88	Ultimate crack
RWTRAC (90+10%)	RWTRAC-1	120	4.05	Initial crack
		266.5	5.80	Ultimate crack
	RWTRAC-2	110	4.10	Initial crack
		265	5.78	Ultimate crack
	RWTRAC-3	125.5	4.25	Initial crack
		262	5.72	Ultimate crack

Figure 2. Testing of short column.

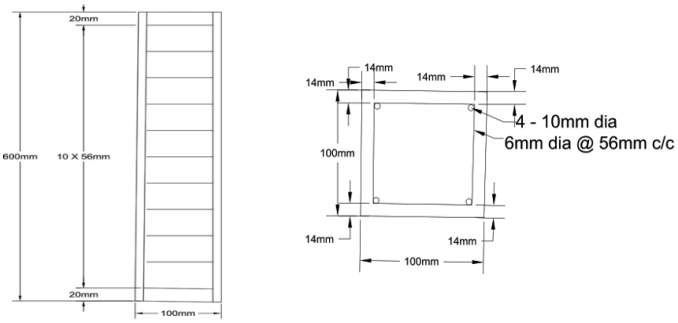

Figure 3. Reinforcement details of short column.

Figure 4. Reinforcement details of short column.

Conclusion

The common need of this study is to examine and analyze the physical characteristics of the concrete which was prepared by partially altering the coarse gravel with locally available reshaped rubber chips in various percentages.

The following inferences were obtained from the results of the RCC short column tests performed on the concrete specimens.

The following inferences are made out of the results:

• For RCC short column, the compressive strength of 10% RWTRA Replacement concrete is more than a conventional column. The initial and ultimate crack of replacement concrete attains 6.7% and 2.13% than conventional column. It concludes that RWTRA increases the strength property than coarse aggregate.

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