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# Deflection Behaviour of RC Beams 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 work had been conducted in the past which had results that showed reduction in the mechanical energy of the concrete. The motive of this study is to use the reshaped waste tyre rubber as partial alteration of coarse aggregate in the concrete and to examine the outcome of providing an mooring hole of10mm in dia 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 are bar 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 0%, 5%, 10%, 15% and 20% by quantity of coarse gravel. The resulting concrete beams are tested for the physical characteristics of concrete. The Comparison of flexural response of beams 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 beams of 10 % rubber aggregate replacement are conducted and results indicated that all the beams are failed in pure bending region and gives deflection nearly same as the conventional beam with the influence of the ultimate moment. Based on the observations during testing, the beams failed in pure flexural compression failure mode. Ductility factor of RWTRAC beam also showed enhanced performance when compared with the performance of conventional concrete. After testing it is inferred that till 10% of RWTRA replacement, the compressive and flexural strength of concrete is nearly same as the conventional concrete, but from 10 to 20% the strengths are abruptly fallen.***

***Keywords: Keywords- Anchorage hole, Conventional beam, flexural response, Ductility facto***

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## I. INTRODUCTION

Concrete is the most desired building material. 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. Different countries in the universe has various stages of making rubber, for example US produce 3.6M tons of rubber per annum. One possibility of decomposition is burning, but that would also outcome in harmful to environment. Rooted on these problems, un worthy tyres rubber can be utilize as gravel in the concrete mix. 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 an gravel substitute (partial).Coarse aggregate is one among the ingredients facing acute shortage. So the need to search for a new and viable alternative is important for conservation of innate resources and reduction in manufacturing cost. Stell 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 and this will be useful for future use of innate aggregate in concrete. In this experimental investigation, the influence of partially replaced coarse aggregate through waste tyre rubber on the concrete's compressive energy is reported. production industry. To reduce the effect of greenhouse gases on the environment, several substitute materials are used for cement. Among all the other cementitious materials, MK is white in color and has strong pozzolanic activity derived from kaolinite rocks [Siddique, R. (2008)].The use of natural aggregates leads to exploitation of natural resources in the large manner and creates various social and environmental problems [Malik et al (2013)]. The demand for the new building is consistently increasing at steady state as the population increases. So the need for the eco-friendly aggregates has become a challenge. By considering these aspects, the future of the construction sector looks bleak. In India, the amount of solid waste is increasing rapidly due to population growth. Among solid wastes, plastics account for 8% by weight of total solid waste [Asoka, P et al (2007)].

In order to solve the problem of disposal of large quantities of plastic and to solve the growing demand for aggregates in concrete, application of plastic waste material in concrete can be considered a viable application. Based on the detailed investigation on the literatures, it was concluded that the cement can be replaced by MK which has the higher pozzolanic properties than other substitute materials. Disposal waste plastics directly on the environment creates various problems and takes hundreds of years to decompose naturally. As per the previous literatures, it is possible to use the waste plastics as a coarse aggregate in the concrete. In this study, it was proposed that, the cement was partially substituted by MK upto 10% at an intervals of 2.5% and shredded plastic wastes are replaces the coarse aggregate by 0.5% and detailed investigations has been carried out on various properties of concrete.

## II. MATERIALS USED

### A. Cement

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

### B. Coarse Aggregate (Natural)

The 20 mm well graded and smaller size were made use in this study. The gravel were tested according to the Indian Standards 383 – 1970.

### C. Fine Aggregate (M Sand)

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

Table.1: Properties of Aggregate

| DESCRIPTION | FA | CA |
|---|---|---|
| SG | 2.64 | 2.84 |
| Bulk density | 1450 kg/m$^3$ | 1665kg/m$^3$ |

### D. Tyre Chipped 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 20x20x10 mm size. A 10mm dia bore was made on the rubber aggregate's surface. Table 2 represents the physical characteristics of the rubber chips.

**Table. 2:.Physical Properties of Rubber Chips**

| DESCRIPTION | CA |
|---|---|
| Specific Gravity | 1.11 |
| Bulk density | 480kg/m3 |

**Table 3.Typical Composition by Weight**

| COMPOSITION | AUTOMOBILE TIRE IN % | TRUCK TIRE IN % |
|---|---|---|
| Innate rubber | 14 | 27 |
| Mane made Rubber | 27 | 14 |
| Coal black | 28 | 28 |
| Steel | 14 to 15 | 14 to 15 |
| Fabric, filler, accelerators, | 16 to 17 | 16 to 17 |
| Zinc | 1 | 2 |
| oxide Sulphur | 1 | 1 |

**Fig.1: 10 mm diameter hole on the surface of the reshaped tyre rubber**

## III. SAMPLE PROCEDURE

The current study is focussed to analyse the properties such as crushing strength, tensile strength and behaviour of RCC beams produced with same percentage of reinforcement for the different composition of RWTRA replacement to coarse aggregate for the concrete of grade M25. The specimens for testing were casted for different proportions of RWTRA replacement to coarse aggregate at percentages from 0 to 20 at every 5% intervals. The specimens to be tested are made and subjected to curing for 28 days. They are tested on the 28$^{th}$ day under standard conditions. For every mix, batch of 3 beams measuring 1.8m in length and 125 x 225 mm in cross section with reinforcement are casted to assess the flexural strength of RCC beams. The different blends adopted are provided in table no. 3. The results are also tabulated and the necessary study of comparison is made.

**Table 6.Various Combinations Used**

| S.NO | % of RWTRA | % of COARSE AGGREGATE |
|---|---|---|
| 1. | 0% | 100% |
| 2. | 5% | 95% |
| 3. | 10% | 90% |
| 4. | 15% | 85% |

| | | |
|---|---|---|
| 5. | 20% | 80% |

**Fig.2: Reinforcement Details of Beams**

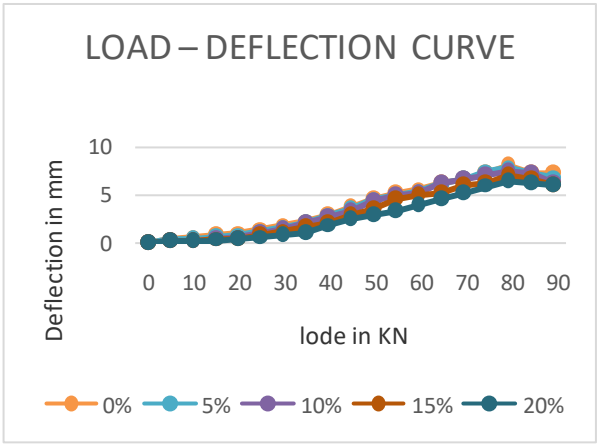


Fig 3: Figure shows Load verses Deflection for different % of RWTRA replacement to Coarse aggregate in RCC Beams

**Fig 4: Experimental set-up for the test specimen**

**Fig 5: Failure Pattern of the beams**

## IV. 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 beam tests performed on the concrete specimens.

The following inferences are made out of the results

- It is inferred that in spite of a slight decrease in strength when the coarse aggregate is being replaced up to 10% with reshaped rubber aggregate, there is sudden fall in strength above 10%. So that a 10% replacement concrete may be utilised for various structural applications in the construction industry.
- It is observed that the RCC beams underwent deflection, but the deflection is under serviceable limits as per IS 456-2000even though there placement of reshaped rubber aggregate is about 10% to coarse aggregate.
- It is observed that the strengths have suddenly fallen from 10% to 20% replacement of coarse aggregate with reshaped rubber aggregate, for more economical purpose the concrete may be used for non-structural works by replacing coarse aggregate with reshaped rubber aggregate up to 60%, so that about 24% saving in cost per cubic meter of concrete.

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