

## **EXPERIMENTAL STUDY ON ROLLER COMPACTED CONCRETE BY PARTIAL REPLACEMENT OF AGGREGATE WITH CRUMB RUBBER**

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*Abstract—Concrete is a mixture of cement and aggregates which is widely used in construction industry. The aggregates used for concrete are mostly natural available. The continuous usage of natural resources results in depletion which entails the requirement of suitable substitute. In the current study, stone dust is used as fine aggregate and aggregate portion is partially replaced with crumb rubber. The moisture content required for roller compacted concrete is determined by Soil compaction method. Cylinders were casted with 10%, 15% & 20% cement content varying with 0% & 1% crumb rubber as a replacement of fine aggregate and coarse aggregate. Compressive strength was evaluated for 3, 7 & 28 days. Test results depict that partial replacement of fine aggregate with crumb rubber are satisfactory when compared to that of coarse aggregate replacement with crumb rubber.*

*Keywords: Crumb rubber, rigid pavement, Roller compaction, Roller compacted concrete pavement, Stone dust.*

### **INTRODUCTION**

Currently India has taken a major initiative on developing the infrastructures such as express highways, power projects, ports and harbours, to meet the requirements of globalization, in the construction of pavements and other structures concrete plays the key role and a large quantum of concrete is being utilized in every construction practices. River sand, which is one of the constituents used in the production of conventional concrete, has become very expensive and also becoming scarce due to depletion of river bed. In view of this, there is a need to identify suitable alternative material from waste in place of river sand. Today researches all over the world are focusing on ways of utilizing either industrial or agricultural wastes as a source of raw materials for the construction industry. The wastes utilization would not only be economical, but may also help to create a sustainable and pollution free environment. The main problem in the world is now or future existing is the downstream of the natural resources for building and constructing purpose. Basically, Countries like India should concern with these developments to undergone by replacing the materials of the industrial by products and waste products to minimize the use of the natural sources in the building and construction. Concrete is the material mostly used in the construction field for building and pavement construction. Natural sand is a very fine material which can contribute for a concrete to solidify to give the necessary strength for a certain structure. Natural sand fill up the pores or voids inside concrete which is also a contributing factor for the strength of the concrete

- **STONE DUST:**

Stone dust is obtained at crusher plants where the artificial crushing of the rock or gravels is done to obtain coarse aggregate. So the chemical composition of stone dust will be same as that of the coarse aggregate obtained from therein. Stone dust used for concrete should possess comparable fineness modulus as that of fine aggregate which is used in making concrete so that it will not absorb too much water from concrete or workability of concrete can be maintained. Stone dust is a waste material obtained from crusher plants during the process of making of coarse aggregate of different sizes, about 175 million tons stone dust is produced every year, which is kept in great quantity. This used quantity of stone dust requires a suitable disposal site for its easy and safe discarding a large land area is required to accomplish the requirement which would again be a great problem in a country of strongly populated like India.

• **CRUMB RUBBER:**

Crumb rubber concrete made up of tyre chips ,piece elastic and mix of tire chips. Rubber concrete can help to prevent pollution and to overcome the problem of storing used tyres. This reduces crack formation and widening which can withstand much larger tensile loads. These concrete gains importance rapidly due to the increasing demand of superior structural properties. This has the advantage of saving aggregates used in production of concrete which is becoming increasingly scarce .Rubber concrete gains good mechanical properties of concrete when compared to the conventional concrete.

Crumb rubber concrete is the concrete made out of piece elastic tire chips and scrap elastic where utilized to supplant mineral today in cement. The common use of waste rubber specifically tire chips have been in highway asphalt mixes. Material characterization experiments have been conducted to determine the practicality of using rubber in concrete. Research has shown that replacement of conventional aggregates with rubber results in a decrease in compressive strength and tensile strength and stiffness.

**LITERATURE REVIEW:**

1. Faisal Farooq Ratheret.al:

Roller-compacted concrete (RCC) is a stiff mixture of aggregates, cementitious materials, and water with zero slump. Usually, RCC mixtures for pavements contain less cementitious materials than conventional concrete mixtures. For effective compaction, the mix should be sufficiently dry so that it can support the load of vibratory equipment and on the other side it should be sufficiently wet also to allow adequate distribution of paste binder throughout the mass. RCC has got a lot of benefits including excellent durability, even under freeze-thaw conditions; eliminates seepage through pavement. It enhances construction, reduces cost and minimizes labour. It resists abrasion, eliminates need for surface course and reduces cost. RCC does not have the same appearance as other types of concrete but is not as pretty and smooth as regular concrete. The mix design and construction methods that make roller-compacted concrete so fast, easy, cheap, and durable also create a surface texture that gives it a characteristic coarse finish.

2. Shailendra singhet.al:

The addition of crumb rubber resulted in increase in workability. Its addition resulted in increase of compressive strength at first and then it reduced. The average increase in compressive strength of mix 2 for 7, 14 and 28 days is obtained as 4%, 5.47% and 6.34% respectively. The average reduction in compressive strength of mix 3 for 7, 14 and 28 days is obtained as 6%, 10.16% and 7.04% respectively.

3. Er.Arvindeer Singhet.al:

The compressive strength, flexural strength and split tensile strength of concrete grade M25 and m30 with stone dust as fine aggregate were found to be comparable with the concrete made with the river bed sand. The increase in compressive strength of concrete with 20% replacement and 50% replacement of the fine aggregate with stone dust is found to be 8 to 10%. Stone dust can be effectively used in plain cement concrete in place of fine aggregate.

**MATERIAL SPECIFICATIONS**

1. Cement:

OPC 43 grade cement is used according to the MORTH code.

TABLE 1  
PROPERTIES OF CEMENT

Specific gravity	3.11
Fineness	5%
Initial setting time	65 mins
Standard consistency	31%

2. Fine aggregate(stone dust):

TABLE 2  
PROPERTIES OF FINE AGGREGATES

Specific gravity	3.13
Voids ratio	0.299
Porosity	26.39
Zone	-

3. Coarse aggregate:

TABLE 3

PROPERTIES OF COARSE AGGREGATES

Specific gravity	2.66
Impact value	29.41%
Crushing value	32%

4. Crumb rubber:

TABLE 4

PROPERTIES OF CRUMB RUBBER

Specific gravity	1.89
Fineness	5.23%

### MIX DESIGN

The soil compaction method is the most widely used mixture proportioning method for RCC pavements. This proportioning method involves establishing a relationship between the density and moisture content of an RCC mixture to obtain the maximum density by compacting samples over a range of moisture contents. percentages are chosen as 10%, 15% and 20%.

- Gradation of Coarse aggregate

TABLE 5

GRADATION OF COARSE AGGREGATE

Sieve Designation	Percentage by weight passing the Sieve
31.5mm	100
26.5mm	85-95
19.0mm	68-88
9.5mm	45-55
4.75mm	30-55

- Gradation of fine aggregate

TABLE 6

GRADATION OF FINE AGGREGATE

Sieve Designation	Percentage by weight passing the Sieve
600 microns	8-30
150 microns	5-15
75 microns	0-5

Results obtained from soil compaction method are as follows:

TABLE 7

OPTIMUM MOISTURE CONTENT

Cement %	Optimum moisture content
10%	0.45
15%	0.5
20%	0.45

### I. RESULTS AND DISCURSIONS

The following are the results obtained as below:

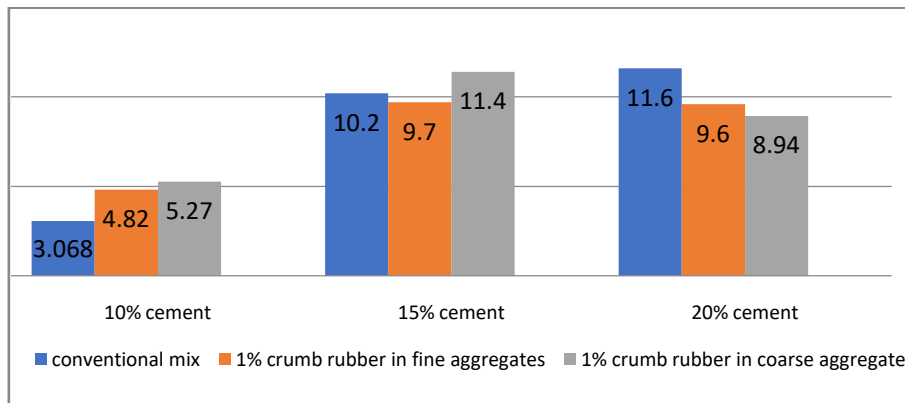


Fig.1: Compressive Strength (3 Days)

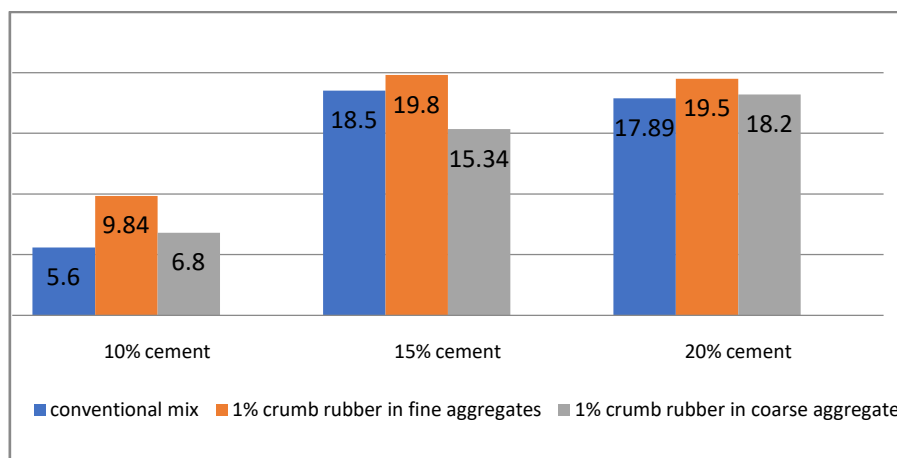


Fig.2: Compressive Strength (7 Days)

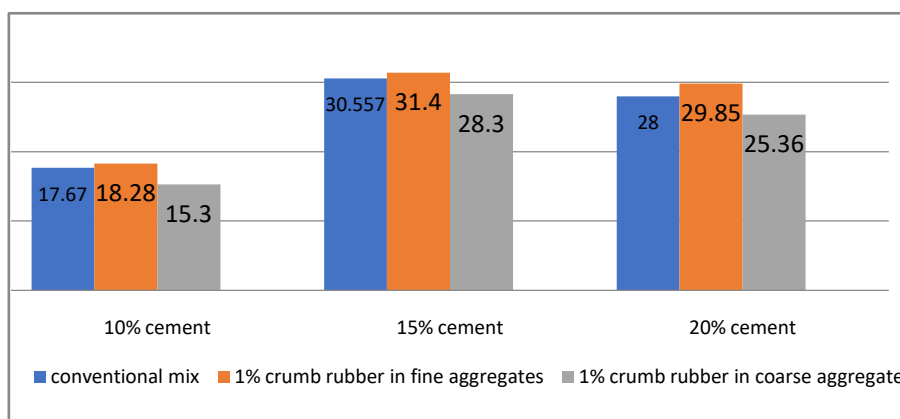


Fig.3: Compressive Strength (28 Days)

### CONCLUSIONS

- Even if rubber tyre waste is used in small quantity. Amount of tyre rubber waste could be greatly reduced due to very large market of concrete.
- Test results stated that 15% of cement with 1% of crumb rubber replacement in fine aggregate had achieved the maximum compressive strength at 28 days.
- Compressive strength decreased when coarse aggregate is partially replaced with crumb rubber.

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