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Effect of Marble Dust and Banana Fiber on Strength Characteristics of Pavement Quality Concrete

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ABSTRACT- This study shows developing pavement quality concrete mixtures incorporating marble dust as partial replacement of cement as well as banana fiber. There is a growing interest in the construction of concrete pavements due to its high strength, durability, and better serviceability and overall economy in the long run. This study also shows that in view of the high flexural strength, high values of compressive strength and high values of split tensile strength, higher load carrying capacity and higher life expectancy, the combination of 10 to 15% marble dust replacement along with addition of 0.5 banana fiber is ideal for design of Pavement Quality Concrete (PQC). By replacing cement with marble dust and adding fibers it has been possible to achieve savings in cement. To produce thinner and green pavement sections of better quality, which can carry the heavy loads, is nowadays thrust.

KEYWORDS- Pavement quality concrete (PQC), High strength concrete, Aggregates, Banana Fibre, Marble Dust.

I. INTRODUCTION

A. General

Concrete may be defined as hard, strong construction material which consists of sand, gravel, broken stone, cement etc. It is used for construction of foundations, beams, columns, slab etc. The word concrete comes from the Latin word "concretes" (meaning compact). During Roman Empire, roman concrete was made from quicklime, pozzolana an aggregate of pumice. Concrete is a composite construction material composed primarily of aggregate, cement and water. The aggregate is generally coarse gravel or crushed rocks as limestone, or granite, along with a fine aggregate such as sand. The cement, commonly Portland cement and other cementations materials such as fly ash and slag cement serve as a binder for the aggregate. To achieve varied properties various chemical admixtures are also added. Concrete is reinforced with materials that are strong in tension because concrete has relatively high compressive strength. Concrete can be damaged by many processes such as freezing of tapped water. Concrete can make energy efficient housing as it has high thermal mass and very low permeability. Structures made of concrete can have long service life. It is very important to design a higher proportion of the available strength of concrete with efficiency and effectively rather than a smaller proportion of much strength concrete as per economic point of view. Concrete is identified by the type of cement, aggregate used and the methods employed to produce it. The character of concrete is mainly resolved by water cement ratio in ordinary structural concrete. It is necessary that the mixture have sufficient water so that each particle is completely surrounded by cement. Strength of concrete is accomplished by environmental factors like temperature and moisture [6]. Due to fluidity of concrete it is possible to position the steel near the point where greatest stress is predicted. In my thesis I have partially replaced cement with the marble dust with addition of banana fibre.

II. LITERATURE REVIEW

A. Marble Dust

Manju Pawaret.al (2014) a study was conducted on periodic research, the effect of replacement of cement with marble dust. They replaced cement by varying percentage of marble powder which results in increased strength. The compressive strength of concrete is increased with addition of marble dust up to 12.5% replace by weight of cement as per the study [1].

B.V.M.Sounthararajan et.al (2013) they concluded that the marble dust powder up to 10% by weight of cement was investigated foe hardened properties of concrete. Different percentage of cement replaced with marble dust to determine the compressive strength, tensile strength and flexural strength was evaluated. They found that the fine to coarse aggregate ratio and cement to total aggregate ratio had higher influence on improvement in strength properties [2].

Corinaldesi V et.al (2010) in palaces and monuments marble was used as a building material since ages. However, the use is limited as stone bricks in wall or lining slabs in walls, roofs or floors leaving its wastage. They concluded that the mass which is 40% of total marble quarried has reached as high as millions of tons [3].

B. Banana Fibre

N.Venkateshwaean et.al this paper presents a summary of research work published in the field of banana fibre with special references to physical properties, mechanical properties. They studied that due to low density, high tensile strength, high tensile modulus fibres are very have good potential use in various sectors like construction, machinery etc. [4].

Satish Pujari et.al they concluded that the use of cheaper goods is very useful in fields like engineering, high performance applications such as shipping, sporting goods, aerospace, leisure etc. The present review explores the potential of jute and banana fibre on both physical, mechanical properties and chemical composition [5].

III. SELECTION OF MATERIALS AND METHODOLOGY

A. Cement

From strength and workability point of view the development of high strength concrete (HSC) will require the utilization of Portland cement of optimum quality. In my thesis work I have used OPC (Ordinary Portland Cement) 43 grade cement.

B. Aggregates

Aggregates are broadly classified into two types depending on size of particles discussed below: -

- Coarse Aggregates
- Fine Aggregates

1) Coarse Aggregates

Sand, natural gravel and crushed stone are used for this purpose. Coarse aggregates make up bulk of a concrete mixture. The ideal aggregates should be angular, clean, cubical, 100% crushed and continuously graded.

2) Fine Aggregates

The properties of concrete in fresh as well as in hardened state are affected by the characteristic property and quality of fine aggregates. Sand is most commonly used fine aggregate in concrete.

C. Water

Water acts as important constituent in concrete. I used tap water with properties same as that of normal water of specific gravity 1.0.

D. Marble Dust

Since ancient times marble dust has been commonly used as building material. As a by-product marble dust is a very important material. Marble dust is a waste product formed during the production of marble, a large quantity of powder is generated during cutting process.

E. Banana Fibres

Banana fibre mainly consists of cellulose, hemicellulose, and lignin. It is highly strong fiber. Depending upon the extraction and spinning process banana fibre has shiny appearance.

IV. TEST METHODS

- Sieve Analysis of Course and Fine: Sieve analysis is done to find out the fineness modulus for the Coarse and Fine aggregates. This gives the idea about the quality of the coarse and fine aggregate.
- Slump Test: Slump test is done to find out the workability of concrete with different mixes.
- Compressive Strength of Concrete: Compressive strength of concrete is done on 7 days & 28 days.
- Split-Tensile Strength of Concrete: Split Tensile strength of concrete is done on 7 days & 28 days.

V. RESULTS

A. Slump Test

Fig 1 shows the results of slump flow for the variable mixes of marble dust:

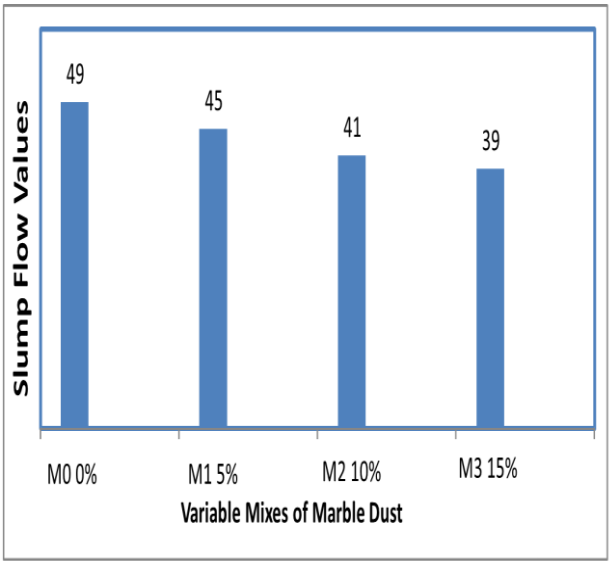

Figure 1: shows the results of slump test

B. Compressive Strength Test

Fig 2 shows the combined bar chart of compressive strength of various specimens with different % of banana fibre and marble dust

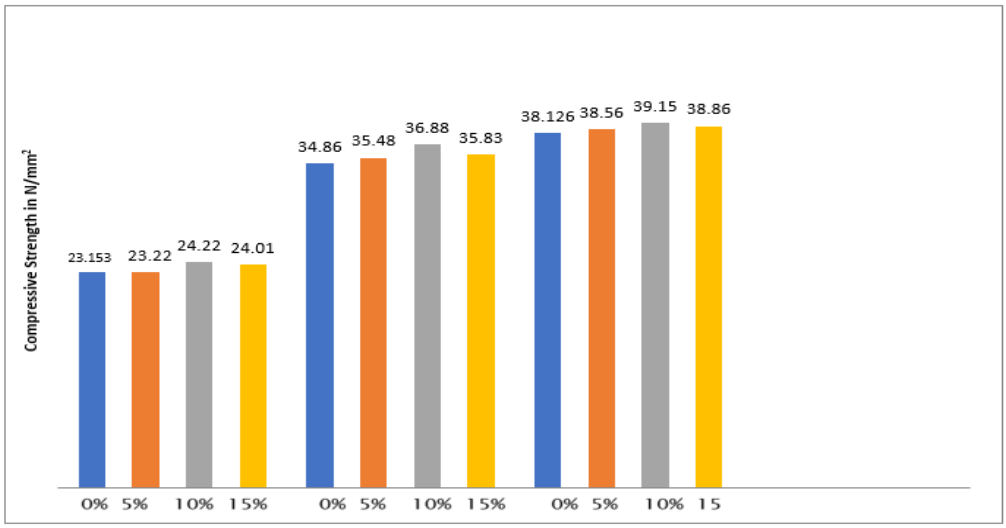

Figure 2: Combined compressive strength results

C. Split Tensile Strenght Results

Fig 3 shows the combined bar chart of split tensile strength of various specimens with different % of banana fibre and marble dust

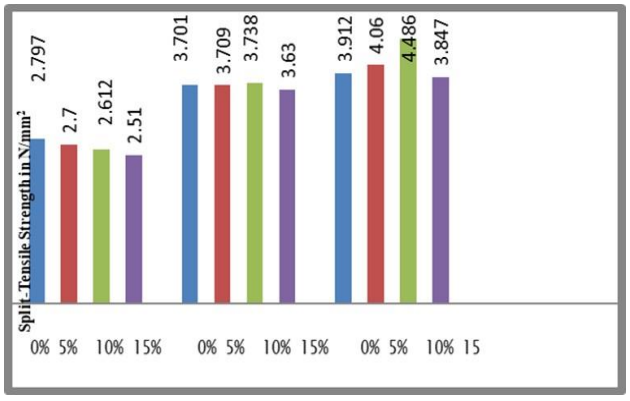

Figure 3: Split tensile strength result

VI. CONCLUSION

This whole experimentation were carried about to know the combined effect of Marble Dust and Banana Fibre on M-30 Grade concrete.

This whole evaluation was done by evaluating the representatives for Workability, Compressive Strength, SplitTensile Strength and Flexural Strength.

After completion of this process the results obtained from these investigations were differentiated with normal concrete.

Given below results were concluded from the whole experiment:-

- Decrease in workability of concrete was found when there is increase in percentage of Marble Dust up to 15% and keeping Banana Fibre at constant rate of 0.5%.
- Rise in Compressive Strength of concrete specimen when cement was succeed by 10% of Marble Dust by weight. Moreover, at replacement of 15% of cement by Marble Dust decrease in compressive strength was marked.
- After 7 days Split-Tensile strength decreased but after 14 days and 28 days the Split-Tensile Strength increases by replacement of cement by 10% Marble Dust.
- Flexural Strength of concrete samples decreases after 7 days but increases after 14 days and 28 days.
- At the end it was concluded that maximum strength was gained at replacement of cement by 10% of Marble Dust and keeping Banana Fibre constant at0.5 %.

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