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Exploration of the Properties of Concrete by Replacing Fine Aggregate (River Sand) With Sand Stone Powder Partially

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Abstract-Concrete is widely used composite material in civil engineering world. The components of concrete are cement, fine aggregate, coarse aggregate and water. The river deposits are the most common source of fine aggregate. River Sand is most commonly used as fine aggregate. Now-a-days the natural river sand has become scarce and very costly due to excessive use. Going for an alternative or supplementary material which can be used as partial or full replacement of conventional material can play an important role in conservation of natural resources. This paper investigates the exploration of the properties of concrete by replacing natural river sand (fine aggregate) with stone powder in different ratios. In this investigation river sand was replaced by locally available stone powder. The workability of fresh concrete was determined by slump cone. Compressive strength was determined at the age 7 & 28 days. Splitting tensile strength & flexural strength was determined at the age of 28 days. From experimental results it was observed that workability of concrete decreases with increase in stone powder content. Results showed up to 45% replacement the strength increases. The maximum compressive strength was achieved at 45% replacement.

Index Terms-Concrete, Stone Powder, Workability, Compressive Strength, Splitting Tensile Strength, Flexural Strength.

1. INTRODUCTION

Concrete is widely used composite material in civil engineering world. The components of concrete are cement, fine aggregate, coarse aggregate and water. River Sand is most commonly used as fine aggregate. In present days the demand for natural sand has consequently increased in construction industry due to excessive use of concrete resulting in reduction of sand sources. The naturally available sources of fine aggregate are limited and therefore their conservation is unavoidable. Therefore the construction industry in the developing world needs an alternative material that can replace the demand for sand thereby reduce environmental load. It is necessary to replace natural sand in concrete by an alternate material either partially or completely without compromising the quality of concrete. In the near future the concrete industry may come to halt if an alternative source of fine aggregate is not explored. Stone powder has been proposed as an alternative to river sand. Stone Crushers are operating in many parts of India to supply coarse aggregates for various types of construction especially for concrete construction.Stone powder is considered a waste product obtained by breaking down larger size stones into smaller sizes for making coarse aggregate. In India Stone powder is produced in large quantity and therefore their consumption becomes necessary in order to reduce environmental problems. By utilizing stone powder as replacement of sand would reduce the environmental problems and also results in economical concrete.

2. LITERATURE REVIEW

V. Syam et al (2007) investigated the influence of fine stone dust on high strength concrete. They investigated the compressive strength and found that 60% of addition of fine stone dust is optimum to produce high strength concrete without much reduction in strength.

MohaiminulHaque, Sourav Roy et al (2012) studied the effect on compressive strength of mortar and concrete replacing sand with stone powder by different percentages in different mix proportions. From experimental results they observed that mixture of sand & powder can be used for making desired strength mortar.

G.Balamurugan and Dr.P.Perumal (2013) replaced sand by quarry dust and made a replacement level from 0% - 100%. From experimental study they showed that both 7 days and 28 days compressive strength increases with increase in quarry dust up to 50% replacement, beyond that compressive strength starts decreasing with increase in quarry dust.

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Aditya Rana, PawanKalla, H.K. Verma, J.K. Mohnot (2016) studied the effect of different kinds of stone waste (lime stone, granite stone, marble etc.) on the properties of concrete and observed that these different kinds of stone wastes can be used in concrete partially as their partial incorporation in concrete showed increment in strengths and even greater resistance to acid attacks.

M. Lokeshwari, K.S. Jagadish (2016) studied the effect of granite fines on compressive strength of building blocks and concrete. From test results they found that the incorporation of granite fines increased the compressive strength of blocks compared to conventional blocks.

3. OBJECTIVE

The main aim of this study is to explore the feasibility of utilizing stone powder as an alternative of natural river sand in concrete and assess the properties of concrete in fresh and hardened state. This study has been carried out at 0%, 15%, 30%, 45% and 60% replacement of natural river sand.

4. OBJECTIVE

Ordinary Portland cement (OPC) 43 grade conforming IS 8112: 1989 was used. The cement used in this study was supplied by Trumbo cement industries (TCI max). The fineness of cement was 2.59.

Fine aggregate locally available natural sand having maximum size 4.75mm was used throughout the investigation.

Table 1 Properties of fine aggregate (natural river sand)

Properties	Sand
Fineness Modulus	2.68
Specific gravity	2.62
Water absorption	1.21 %

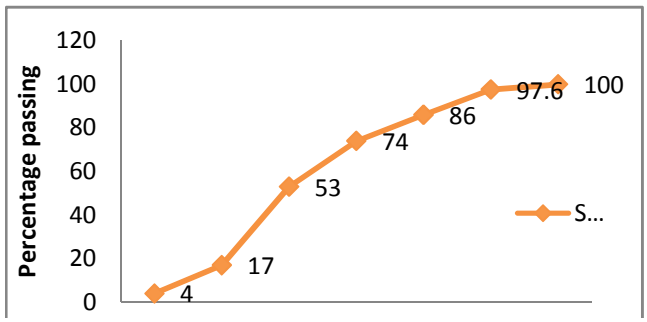

Fig. 1 Particle size distribution curve of fine aggregate

Coarse aggregate in this study, coarse aggregate having maximum size 20mm was used.

Table 2 Properties of coarse aggregate

Properties	Coarse aggregate
Fineness Modulus	6.90
Specific gravity	2.65
Water absorption	0.81%

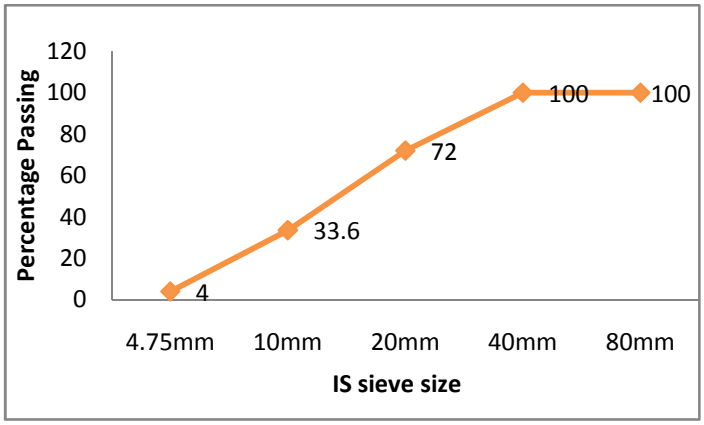

Fig. 2 particle size distribution curve of Coarse aggregate

Stone powder locally available sand stone powder was used for carrying out this study. The different properties of stone powder are presented in table 3.

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Table 3 Properties of stone powder

Properties	Stone powder
Fineness	2.13
Specific gravity	2.51
Water absorption	1.83

5. EXPERIMENTAL INVESTIGATION

Workability of each batch of concrete mix was determined by carrying out slump test. The test was carried out as per specifications conforming IS: 1199 – 1959. Slump measured was recorded in terms of millimeters.For compression test Cube mound of standard size 150mm for making test specimens, for splitting tensile strength cylindrical mounds of size 150mm x 300mm and for flexural test concrete beam of size 700mm x 150mm x 150mm was used throughout the investigation. Weight batching for weighing of materials was adopted. After casting of test specimens, these were demoded after 24 hours and were kept in a curing tank for their respective test days. The compression test was carried out by compression testing machine, splitting tensile test and flexural test were carried out by Universal testing machine (UTM).The compressive strength was determined at the age 7 & 28 days whereas splitting tensile strength and flexural strength were carried out at the age of 28 days. A total number of 60 cubes, 15 cylindrical specimens and 15 beam specimens were casted for carrying out compressive strength, splitting tensile strength and flexural strength of concrete. The natural sand was replaced with stone powder by different proportions (0%, 15%, 30%, 45% & 60%).

6. RESULTS AND DISCUSSIONS

Workability ofeach batch of concrete mix was determinec carrying out slump test. The test was carried out as specifications conforming IS: 1199 – 1959. Slump measu was recorded in terms of millimetres. From experime results it has been observed that the workability of conc decreases with increase in stone powder content. The slu values are presented in fig. 3 and the percentage decreas slump values are presented in fig. 4

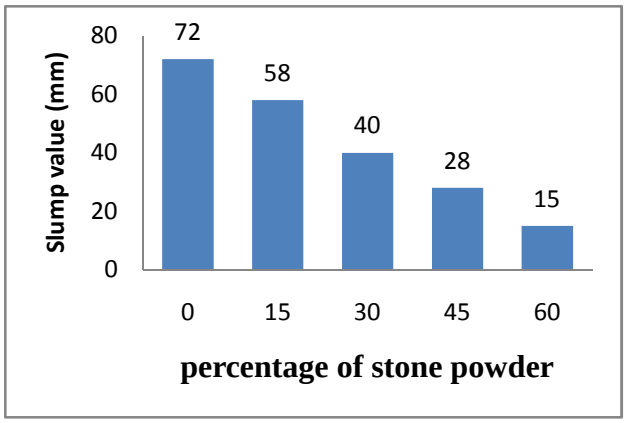

Fig. 3 slump values

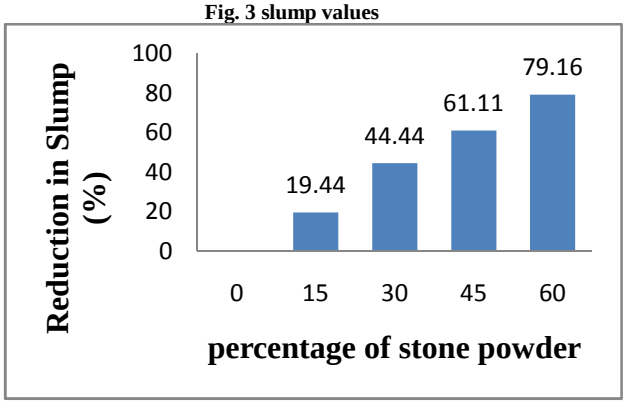

Fig. 4 percentage decrease in slump

Compressive strength was carried out at the age of 7 and 28 days. The results are presented in fig. 5 and 6.

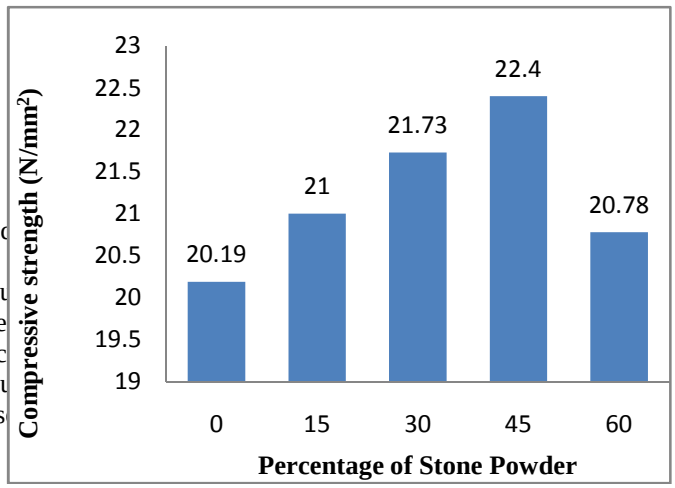

Fig.5 - 7 days compressive strength

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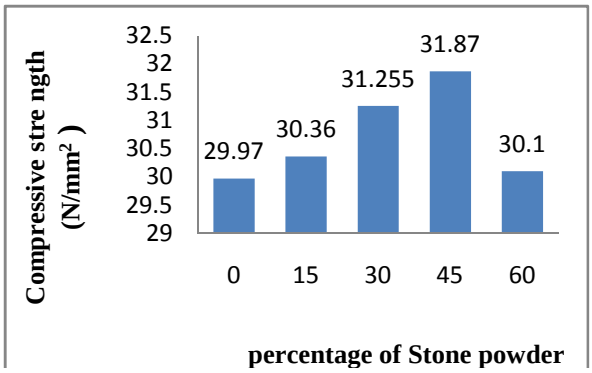

From experimental results it is observed that up to 45% incorporation of sand stone powder as an alternative of natural sand compressive strength of concrete increases after that it decreases.

Splitting tensile strength & flexural strength has been investigated at the age of 28 days. The results are presented in fig.6 & 7.

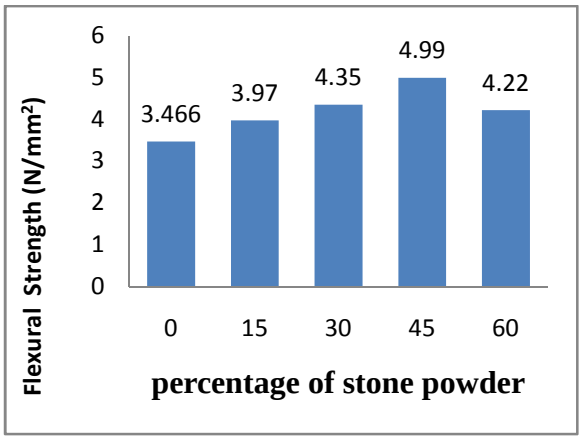

Fig. 7 – 28 days flexural strength

The maximum splitting tensile strength and flexural strength was obtained at 45% replacement of natural sand by stone powder, beyond that both showed reduction.

7. Conclusion

From experimental results the following conclusions can be drawn

- ❖Workability of concrete decreases with increase in stone powder content. The decrease in workability may be attributed to finer particle size of stone powder than normal sand.
- ❖Compressive strength of concrete increases with increase in stone powder content.
- ❖Splitting tensile strength and flexural strength shows increment with incorporation of stone powder.
- ❖ Optimum replacement of natural sand with stone powder is 45%.
- ❖ Stone powder can be used as an alternative of natural sand without compromising with the properties of concrete**.**

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