Experimental analysis of utilization of Shahabad stone waste in concrete

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Utilization of Shahabad stone waste, produced by dressing of stones in concrete as partial replacement for coarse aggregate is taken into consideration to ensure environmental safety in Shahabad, a town in north Karnataka. 20mm downsized Shahabad stones were replaced to coarse aggregates in percentages of 5%, 10%, 15%, 20% and 25% in M20 grade concrete. The study shows that Shahabad stone replacement to coarse aggregate can be adopted to effectively eliminate the waste accumulation in Shahabad region consequently reducing the aggregate transport cost and thereby reducing the total cost of construction.

INTRODUCTION

Concrete is a composite material which is widely used in construction, is made primarily with aggregate, cement, and water. There are many formulations of concrete, which provide varied properties regarding strength and usage. One of the important constituents of concrete are the aggregates which are the large chunks of material in a concrete mix, generally coarse gravel or crushed rocks such as limestone or granite, along with finer materials such as sand. In recent years, to account for the sustainability and protection of the environment alternatives have been developed to help partially replace cement, fine aggregate and coarse aggregate. The government of India commissioned a study in the year 1999 which has reported that by 1989 -1990 about 97 million tones of stone waste was produced all over India, by 1993-1997 it had touched 118.6 million tones and by the year 2000 it had reached 139 million and the Shahabad stone waste contributes 1/3rd of the total stone waste. The handling and disposing off of the waste has arisen as a big problem in the last 5 years. In the present study an attempt has been made to replace the coarse aggregate partially by the Shahabad stone waste which is produced during the tiling process. Studies has been carried out by Soundarya (2013) for the properties of concrete by replacing coarse aggregate by 20 mm size Shahabad stone, experimental study was done by replacing 25%, 50%, 75% and 100% of coarse aggregates using Shahabad stones in M25 grade concrete. The results have proven that 25% replacement has achieved highest compressive strength.

SHAHABAD STONE

India is very rich in stone reserves. Most notable stones are Kota stones, Cudappah stones and Shahabad stone reserves. These Shahabad stones are used as tiling stones and also in the north Karnataka region it is being used as a roofing material. This stone, when used as a roofing material has the property of maintaining lower temperatures even in hot summer times. Shahabad is a small town lying in the north of Karnataka, near Gulbarga. This town has the reserves of Shahabad stones and major activity of this area is stone quarrying. Hand dressing is done in site and lot of small stones of sizes 20 mm to big slabs of irregular shapes lie scattered all over the quarry. This waste occupies space, hence they dump it all over the town and they find it difficult to dispose it off. Widely used techniques for reusing practiced in the region is using it to lay pathways in gardens and using 20 mm - 80 mm stones in flower pots for decorative purposes. The quarry owners find it very difficult to get rid of this waste as every day they quarry out stone, they dress them in the site and everyday huge amount of waste is produced. These stones are dumped into the nearby Kakini River; hence, this causes contamination of water resources. Improper practice of disposal has also lead to drainage problems when the waste is dumped in the drainage passage. Extension of quarry has also become a problem as they are not able to effectively dispose the waste and the waste lie in the quarry itself creating a lack of space for extension, production and the processing of these stones.

There is an urgent need to utilize this waste effectively in an environment friendly way and also gain a beneficial use. [1]

In the present study, Shahabad stones 20 mm downsized as shown in Figure 1 were collected. The material passed through 20 mm sieve and retained in 4.75 mm sieve was used for the replacement of coarse aggregate. The specific gravity of Shahabad stone was found to be 2.56. Since the main focus of the study is on the use of Shahabad stone as replacement to conventional aggregate, it is important to study the characteristics of Shahabad stone such as crushing strength value, impact strength abrasion value sieve analysis for fines modulus and water absorption and the same is presented in Table 1 [4]. It has a high resistance to delaminating and failure under freezing and thawing conditions.

OBJECTIVES

To study the hardened properties of the concrete like compressive strength and split tensile strength and comparing the results of different mix proportioning of Shahabad stone waste.

To study the cost comparison between Shahabad stone replaced concrete and conventional concrete.

RESULT AND DISCUSSION

Compressive strength is the capacity of a material or structure to withstand axially directed pushing forces. Compressive strength and split tensile strength tests were carried out for the various mix proportions of M20 grade concrete. In the present study cube specimens of size 15 x 15 x 15 cm are used and the test is carried out according to IS 516:1959. The cubes were filled in three layers by tamping each layer by 35 strokes using a tamper. Moulds were filled completely till the top and the top surface was smoothed off evenly. Total of 36 cubes were cast to test for compression. After 24 hours the cubes were removed from moulds and were water cured for 7 days and 28 days. [2, 3, 5]

Similarly split tensile test on cylindrical specimens were carried according to IS 516:1959, IS 1199:1959, SP 23:1982, IS 10086:1982. The length of the specimens not less than the diameter and not more than twice the diameter were used.

Table 1. Properties of Shahabad stone

Tests	Results
Crushing strength value	24
Impact strength value	10.50
Abrasion value	18.12
Fines modulus	7.73
Water absorption	0.17%

For testing and comparison of results, cylindrical specimens were cast using moulds of dimension 100 mm in diameter and 200 mm long. After curing for 7 days and 28 days, specimens were tested for split tensile strength. 36 numbers of cylindrical specimens were cast to test for split tensile strength.

Figures 2 and 3 shows the results of compressive strength test for 7 and 28 days respectively.

Figure 1. Shahabad stone

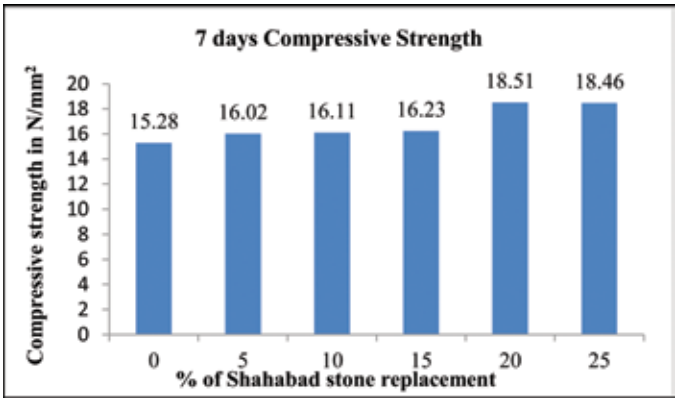

Figure 2. Compressive strength test results of 7 days cured Shahabad stone replaced concrete

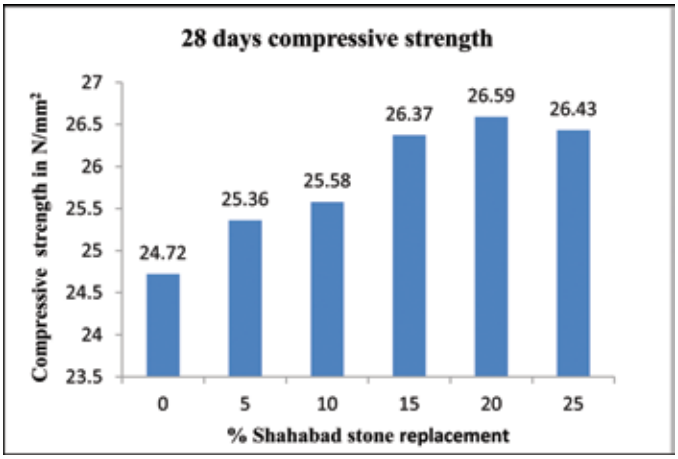

Figure 3. Compressive strength test results of 28 days cured Shahabad stone replaced concrete

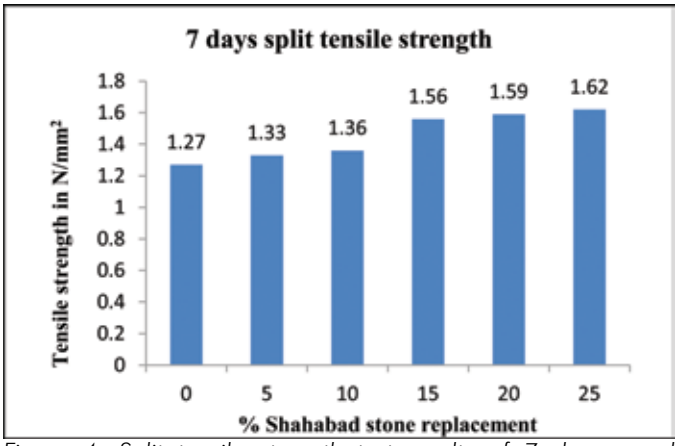

Figure 4. Split tensile strength test results of 7 days cured Shahabad stone replaced concrete

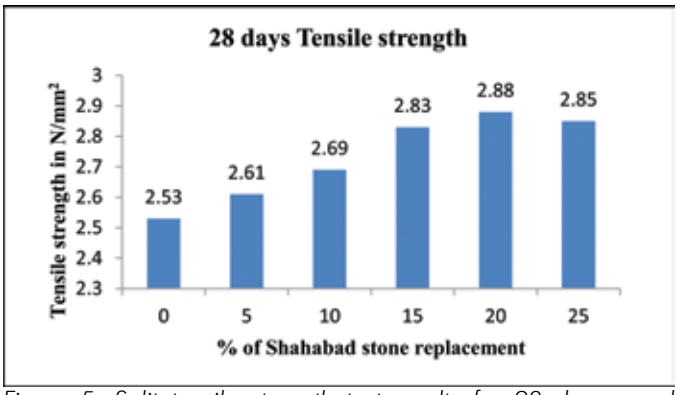

Figure 5. Split tensile strength test results for 28 days cured Shahabad stone replaced concrete

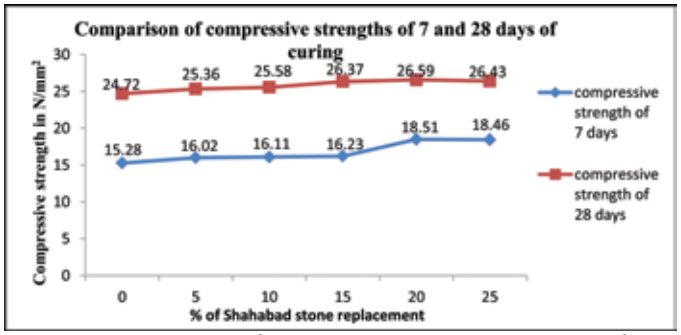

Figure 6. Comparison of compressive strength test results of 7 and 28 days of curing

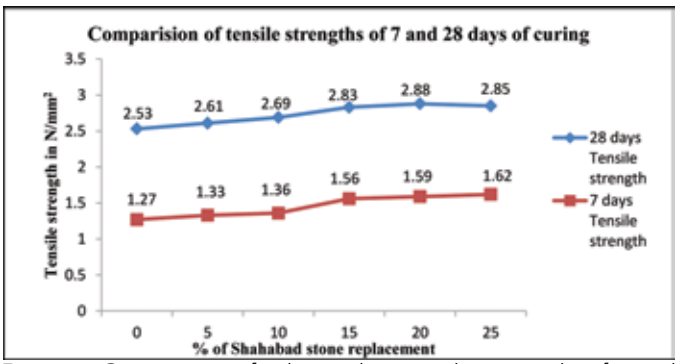

Figure 7. Comparison of split tensile strength test results of 7 and 28 days of curing

Table 2. Comparison of cost between conventional and Shahabad stone replaced concrete

No	Materials	Quantity per m^3	Rate per m^3	Amount
1	Cement	0.28(8.4 bags)	350/bag	2940
2	Fine aggregate	0.453	1600	725
3	Coarse aggregate	0.786	1700	1350

No	Cost of normal concrete	% of Shahabad stone added in concrete	Cost of Shahabad stone replaced concrete	% difference
1	5000	5	4920	1.6
2	5000	10	4855	3
3	5000	15	4785	4.5
4	5000	20	4720	5.6
5	5000	25	4665	6.7

Similarly Figures 4 and 5 shows the results of split tensile strength test for various percentages of Shahabad stones.

From the results of compressive strength test and split tensile strength test it is observed that 20% replacement of Shahabad stones to coarse aggregate has provided the maximum strength compared to all other varied percentages which is represented in Figures 6 and 7.

From Table 2 it can be observed that there is a considerable reduction in the cost of Shahabad stone replaced concrete making it both economical and environmental friendly.

Conclusion

From the above study, the following conclusion can be drawn.

1. As the strength has not much varied by replacing Shahabad stone waste, it could be replaced for coarse aggregate thus reducing the quarrying of stones for aggregates which in turn reduces the environmental hazard due to quarrying.

2. The Shahabad stone waste can be effectively utilized in concrete to reduce the total cost of concreting.

3. By the usage of Shahabad stone as coarse aggregate one can effectively eliminate the waste accumulation in Shahabad region.

References

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