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# Partial Replacement of Stone Dust as Fine Aggregate in Concrete

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**ABSTRACT-** The choice to carry out this investigation was made in response to the fact that natural aggregate (coarse and fine) that complies with Indian Standards is currently getting harder to find and more expensive because of its delayed availability caused by land use regulations, illegal dredging associated with the sand mafia, and accessibility to the river source during the rainy season. In light of this, a study was done to see what would happen if natural sand were largely replaced with stone dust in concrete. An experimental program using partial replacements of fine aggregate with stone dust at 30%, 40%, 50%, 60%, and 70% was undertaken for concrete of M25 grade with a 0.46 water cement ratio. In this investigation, sets of cubes and beams were cast for compressive.

**KEYWORDS-** Concrete, compressive strength, fine aggregate, split tensile strength, stone dust, moist curing.

## I. INTRODUCTION

Concrete has been an essential building element since its inception. There have been many concrete structures built over the course of the last three to four decades utilizing concrete with a compressive strength of 20 to 100 MPa. Additionally, the usage of concrete with compressive strengths between 20 and 85 MPa is preferred in the Indian building industry. The qualities of concrete are influenced by the features of the material and the ratio of water to cement. The substances that are used as additions in concrete but do not fall under the binding agent or aggregate categories. Concrete can benefit from better quality, increased frost and sulphate resistance, control over the development of strength, and improved workability when additives are utilized effectively. Solid waste in concrete is a concept that is gaining popularity. Due of the size and scope of these activities, there is a significant global demand for construction materials. Growth is accelerating daily. Sand and natural aggregate consumption has increased as a result of the rapid development in both concrete production and usage (Patel et al., 2013). Aggregate makes almost 75% of all the elements used to mix concrete, making it one of the essential ingredients. The strength of the concrete is influenced by the properties of the aggregates used (Sivakumar et al., 2014). Construction businesses are under pressure to develop alternatives to natural sand and aggregate because all of the components of concrete are of geological origin. Cement, sand, and aggregate are the main components of conventional concrete (Nagpal et al., 2013).

Quarry dust's potential as a sand substitute material demonstrates that its mechanical and elastic properties have both improved. According to Hmaid Mir [1], the compressive strength was best attained by replacing fine aggregate with quarry dust in a ratio of 60:40. • Felekoglu et al. [2] noted that adding quarry waste at the same cement content typically resulted in a reduction in the need for super plasticizers and an increase in the 28-day compressive strength of SCC. By using a lot of quarry waste, normal strength SCC mixtures that include about 300-310 Kg of cement per cubic meter can be successfully made. • [3] Manufactured sand was used as the FA in R.N. Mishra's study of the water needs and compressive strength of cement mortar, with FM varying from 0.50 to 2.0 and 75% and 100% flow of mortar. He came to the conclusion that the strength of mortar made with artificial sand is greater than that of the equivalent mix made with cement (sand) mortar based on the aforementioned in-depth experimental research. He has advised using produced sand for mortar and has issued a warning about removing excessive amounts of very fine particles. • [4] V.M. Malhotra investigates the performance of concrete using limestone dust as a partial replacement for natural sand (obtained from limestone quarries after crushing operations). On the basis of similar mass of recombined sand, three series of concrete mixes with w/c ratios of 0.70, 0.53, and 0.40, and adding lime stone dust from 5-20%, were created. Slump, unit weight, and air content (%) of fresh concrete were all identified. [5] (1996) According to T.S. Nagaraj et al., rock dust consumes more cement than sand because of its increased surface area, which improves workability. He investigated the impact of pebble and rock dust as aggregate in cement and discovered that crushed stone dust may be used in place of natural sand in concrete. According to Nagaraj T.S.'s mix design, there are three ways to guarantee workability: combining rock dust and sand, using super plasticizers, and changing the water content. Shukla et al. [6] studied the behavior of concrete formed by partially or completely substituting crushed stone dust for river sand as fine aggregate and found that up to 40% of the sand can be replaced without affecting the strength of the concrete. "Concrete built with a high percentage of minus 75-micron material will yield a more cohesive mix than concrete made with conventional natural sand," according to Hudson. [7] The impact of using rock dust as a fine aggregate in cement and concrete mixtures was investigated by Venugopal et al. They have offered a technique for distributing the concrete's fine aggregate utilizing rock dust. Environmentally hazardous stone dust use in building construction was investigated by M. Shukla et al. [8] It has been determined that partial replacement will not compromise strength and will also address the issue of stone dust disposal. With an increase in stone dust, concrete loses workability; however, this can be remedied by adding the right admixtures. (2004) A.K. Sahu et al. studied the fundamental characteristics of concrete created without quarry dust and concrete made with it. They studied the concretes M20 and M30.

## II. MATERIALS AND METHODS

### *A. Cement*

Cement\s Portland in this experiment, single batches of Pozzolana Cement (fly ash based) under the brand name Birla Gold that conform to IS 1489 (Part 1) 1991[4] were used. Table 1 lists the attributes.

Table 1: Properties of cement

| | |
|---|---|
| Standard Consistency | 32% |
| Initial Setting Time | 1 hour |
| Final Setting Time | 5.5 hours |
| 7 days Compressive Strength | 34 N/mm^2 |
| 28 days Compressive Strength | 44 N/mm^2 |
| Specific Gravity | 2.7 |

### *B. Fine Aggeregates*

Sand from the Amaravathi River that satisfies the requirements of zone II of IS 383-1997[5], the benchmark used in this inquiry. 4.75 mm sieve removed it entirely. The specific gravity and fineness modulus of this substance were 2.76 and 2.3, respectively.

### *C. Coarse Aggregate*

Two fractions of locally available coarse aggregate, measuring 20 mm and 10 mm, were independently sieved for the purposes of the current experiment. Using sieves of different sizes—20 mm and 10 mm—two fractions were divided. The coarse aggregate specific gravities of both fractions were 2.66. The fineness modulus of the aggregate was 6.9 for 10 mm and 7.7 for 20 mm. The coarse aggregate ratio in the concrete mix was 40% 10 mm aggregate and 60% 20 mm aggregate. mm. [9] The coarse aggregate ratio in the concrete mix was 40% 10 mm aggregate and 60% 20 mm aggregate.

### *D. Stone Dust*

Stone dust of a grey colour was gathered from nearby stone crushing operations in Chimakurthi, Ongole (Andhra Pradesh). Before making the mix, it was initially dry and completely kept on an IS 150 sieve. Zone II of IS 383-1997 was also validated by the stone dust. Stone dust had a fineness modulus of 2.85 and a specific gravity of 2.4.

### *E. Super Plasticizer*

Chembond Chemicals' KEM SUPLAST 101 S super plasticizer was to be utilised in the investigation. M25 grade of concrete is used as a benchmark and was designed in accordance with IS 10262 -2009[6] specifications. [10] It was a synthetic super plasticizer based on sulphonated naphthalene and instantaneously dispersible in water with a specific gravity of 1.2. The ratio of the components was 1:1.54:3, with a cement to water ratio of 0.42 and a super plasticizer dose of 0.65% by weight of cement. The 40:60 combination of coarse material was separately sieved using IS sieve sizes of particle size distribution of fine aggregate and stone dust was substantially same and confirmed the same zone [11]. 84 specimens total, 150 X 150 X concrete with different water cement ratios and cement per cubic metre. Then 66 identical specimens were cast to replace different percentages of fine aggregate with stone dust. 6cubes were cast for a percent replacement, 3 for 7 days and 3 for 28 days**.** The cube was manually divided into two pieces and vibrated on a table vibrator. The slump cone was used to gauge how workable new concrete was. During the mixing process and the test, precision and uniformity were upheld. After being cast for 24 hours, specimens were removed from the mould and placed in a water bath to cure. Concrete's compressive strength was tested for 7 and 28 days using an analogue compression testing machine that met IS 14858 - 2000[7]'s 2000kN capacity (See figure 1).

Figure 1: Digital compression testing machine

## III. METHODOLOGY

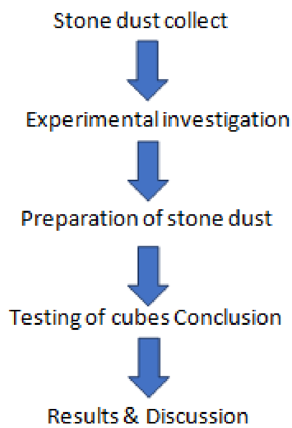


Figure 2: Flow chart of stone dust preparation

## IV. RESULT AND DISCUSSION

According to IS 516 - 2004[8], the average compressive strength of concrete was evaluated on days 7 and 28. Guidelines and outcomes are listed in table 2, which is shown graphically in figure 3. The compressive strength of specimens at all levels of replacement with natural fine aggregate and stone dust was found to be greater than. From the perspective of compressive strength, the specified value of traditional concrete demonstrates the viability of stone dust as a partial or whole replacement of natural fine aggregate in concrete. The maximum strength is reached when stone dust is substituted for fine aggregate to the extent of 30%, which results in changes in compressive strength over 7 days of 34.3 percent. The 28-day strength gradually rose, fluctuating between 9% and 40% of replacement level, reaching 50.

Table 2: Compressive Strength of Cubes with Different Percentage of Stone Dust

| Concretecube group | % of Stone Dust in Concrete | Compressive strength | |
|---|---|---|---|
| | | 7 days | 28 days |
| A0 | 0 | 27.11 | 38.57 |
| A1 | 10 | 26.41 | 38.81 |
| A2 | 20 | 27.21 | 39.01 |
| A3 | 30 | 31.79 | 41.52 |
| A4 | 40 | 26.53 | 41.11 |
| A5 | 50 | 27.55 | 38.65 |
| A6 | 60 | 26.57 | 45.05 |
| A7 | 70 | 28.09 | 42.23 |
| A8 | 80 | 27.45 | 41.61 |
| A9 | 90 | 26.85 | 44.28 |
| A10 | 100 | 23.67 | 42.21 |

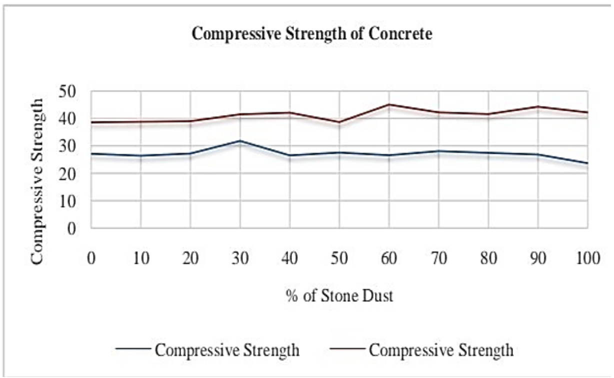


Figure 3: Compressive strength of concrete cubes with varying percentage of stone dust

## V. CONCLUSION

Based on the aforementioned analysis, it is possible to draw the following conclusion: Stone dust should be utilised as a partial or full replacement for fine aggregate in concrete. Stone dust used as fine aggregate in concrete has many advantages, including environmental benefits. Features, the lack of good-quality fine aggregate, and strength standards as well. On a level of 60 percent replacement of naturalsand with stone dust, the compressive strength of cubes with stone dust as fine aggregate replacement reaches its maximum value. It should be used in locations where setting time is not a major concern because using too much super plasticizer lengthens the setting time.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

## REFERENCES


[1] Usage of stone powder in concrete and mortar as an alternative to sand, African Journal of Environmental Science and Technology, Volume 5, Issue 5, pages 381-388. Mahzuz, H. M. A., Ahmed, A. A. M., and Yusuf, M. A.

[2] Franklin Kujur Stone dust as a Partial Replacement of Fine Aggregate in Concrete, Journal of Academic and Industrial Research (JAIR), Volume 3, Issue 3, Eric Srivastava, Vikas Agarwal, V.C. Anjelo F. Denis, and Ali, Ehsan.

[3] Syed Raziuddin Quadri and A.D.Pofale. International Journal of Scientific and Research Publications, Volume 3, Issue 8, (2013). Efficient use of crusher dust in concrete utilising Portland pozzolona cement.

[4] Board of Indian Standards, New Delhi, IS 1489 (Part 1) - 1991 Specification for Portland Pozzolana cement, Part 1:
- Flyash based.

[5] Bureau of Indian Standards, New Delhi, IS 383 - 1997 Specification for coarse and fine aggregate from natural sources for concrete.

[6] Bureau of Indian Standards, New Delhi, IS 10262 - 2009 Concrete Mix Proportioning Guidelines.

[7] Bureau of Indian Standards, New Delhi, IS 14858 - 2000): Specifications for Compression Testing Machine Used for Testing of Concrete and Mortar.

[8] [8] Bureau of Indian Standards, New Delhi, IS 516 - 2004 Method of Test for Strength of Concrete. IS4031 (part 6) – 2005, page.

[9] Bureau of Indian Standards, New Delhi, Method of Physical Tests of Hydraulic Cement, Part 6 Determination of Compressive Strength of Hydraulic Cement Other Than Masonry Cement. IS 4031(Part 5)-2000

[10] Establishing the start and ultimate setting Times for hydraulic cement using the Of physical tests method

[11] IS 2386-2002 Bureau of Indian standard, Standard, new Delhi, method of test for Aggregate for concreate, part 3 specific Gravity, dencity, voids and absorption.