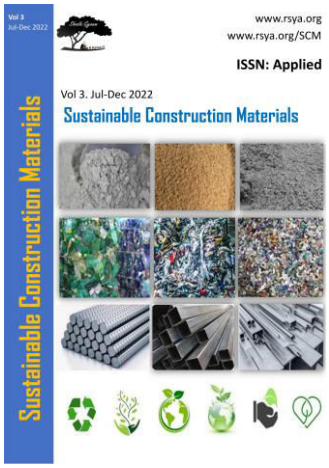

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Dust and River Sand Comparative Experimental Study in Concrete as Fine Aggregates

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Abstract: Using affordable, environmentally friendly materials to complete projects is a significant challenge for the Indian building sector. Due to its great strength and durability, the current study shows that stone dust can be employed as a fine aggregate material in concrete. The stone dust was gathered at a stone cutting facility near the Achnera cold storage in Bharatpur, Rajasthan. In the current study, the use of stone dust in place of sand in concrete has been compared in terms of both strength and cost. A cubic block made of river sand has a compressive strength of 26.66 N/mm2, whereas a cubic block made of stone dust has a compressive strength of 30.22 N/mm2. According to research, employing stone dust instead of river sand results in concrete increasing by 13.5 percent over the course of 28 days while increasing by 46.66 percent over the course of 7 days.

Keywords: Compressive strength, Stone dust, Aggregate

INTRODUCTION

Binding substance, fine aggregates, and coarse aggregates make up the concrete mixture. The size of the aggregate is crucial for achieving strength growth. The strength will be stronger if the aggregates are flaky, and the workability will be higher if they are rounded [1]–[2]. The binding materials fill the holes left by the coarse aggregate, while the fine aggregate fills those left by the binding materials [3], [4]. The granite industry employs the sawing and polishing procedures [5]. Roughly 40% of the stone slurry is generated up to the last operation[6], [7]. Because there is a significant problem to dispose of this slurry, especially close to residential areas [9]-[10]. Research has started on using this trash in concrete for better project management that doesn't rely on conventional materials because of the rising urbanisation of the world. Case studies have been done to use this waste in cement concrete since it is considerably more cost-effective than sand and may be used in projects without relying on conventional resources as cities continue to grow [11], [12]. Building costs are rising substantially as a result of the construction industry's explosive growth and rising construction material prices. Also noted is the steady reduction of naturally occurring materials [14]–[15]. Aggregate size has a significant impact on the plasticity and toughened properties of aggregate. While maintaining the strength and workability of concrete, replacing

natural aggregate will raise building costs[8], [16].
A concrete cylinder with varied quantities of sand and powder sand as well as a cement mortar cube's compressive strength were both created, and their strengths were compared. Concrete cylinders are cast in trials of (1:2+0:4), (1:1+1:4), (1:1.5+0.5+4), and (1:0+2:4), while cement mortar cubes are created in trials of (1:3+0), (1:2+1), (1:1+2), and (1:0+3). The study's conclusions suggest that powder sand was employed as an alternate material mix in place of sand and for concrete with less compressive strength. For medium-grade concrete, this mixture is appropriate [17]. Physical and chemical analyses of stone refuse were performed. In chemical and physical analyses, stone waste substitutes sand and comprises Al2O3, SiO2, Ca, and MgO. After subtracting 0 percent, 5 percent, 7 percent, and 10 percent from weight, the slump value is determined. A concrete cube's compressive strength was examined with the same replacement %. All cubes are produced and cured at the same temperature and humidity. The study came to the conclusion that stone dust can be utilised in concrete because it contains ingredients including Al2O3, SiO2, CaO, and MgO that have qualities similar to those of cement[18]. A concrete cube of M20 grade design mix made by totally swapping out fine aggregate with artificial materials, then adding an equal amount of artificial sand. A cube constructed of natural sand was tested for strength against other cubes made of various small particles. When utilised as fine aggregate, grit offered 5% higher strength than a cube of natural sand [19]. In the current study, the use of stone dust in place of sand in concrete has been compared in terms of both strength and cost.

MATERIAL USED IN THE STUDY

With a fineness modulus of 3.11, Yamuna River sand that was readily available locally and compliant with IS 383:1970 was employed in the current investigation. Stone dust with a fineness modulus of 3.21 was used in the current investigation. Stone dust analysis is shown in Table 1 while river sand analysis is shown in Table 2.

Table 1: Sieve analysis of Stone dust

Sieve Type(mm)	**Retained Weight (gm)**	**Cumulative retained Weight**	**Cumulative percentage retained**	**Percentage of passing (%)**
10.0 mm	0.0	0.0	0.0	100.0
4.75 mm	21.0	21.0	1.05	98.85
2.36 mm	8.0	29.0	1.45	98.55
1.18 mm	481	510	25.50	74.50
600 micron	1329	1839	91.95	8.05
300 micron	91	1930	96.50	3.5
150 micron	70	2000	100	0

Table 2: Sieve analysis of Yamuna river Sand

Sieve type	Retained Weight (gm)	Cumulative retained Weight	Cumulative percentage retained	Percentage of passing (%)
10.0 mm	0.0	0.0	0.0	100.0
4.75 mm	24.0	24.0	1.12	98.88
2.36 mm	8.0	32.0	1.6	98.40
1.18 mm	451	483	24.15	75.85
600 micron	1229	1712	85.6	14.40
300 micron	275	1986	99.3	0.7
150 micron	13	2000	100	0

Table 3: Percentage Bulking of Yamuna river sand

Item no	Sample No. 1	Sample No. 2	Sample No. 3
Moisture content (%)	2.0%	4.0%	8.0%
Bulking percentage	49%	80.18%	91.37%

Table 4 : Percentage Bulking of stone dust

Item no	Sample No. 1	Sample No. 2	Sample No. 3
% moisture content	2.0%	4.0%	8.0%
Bulking percentage	54 %	61 %	81%

DESIGN MIX OF CONCRETE

Concrete made to the M25 grade has a mix designed according to IS 10262:2009. When creating the specimens, all of the stone dust was replaced. For comparative reasons, a control mix without any form of partial replacement was made in compliance with the IS standard. Concrete's workability and durability must meet IS regulations, as well as the design mix of concrete needed to attain typical strength after 28 days. Stone dust was used to completely replace the cement in the production of 9 cubes of M25 concrete grade in order to perform comparative research. Yamuna sand was used to create nine sample specimens for this study's comparisons. Material specification ratios for the concrete design mix were the same as those for the conventional concrete cube designed. In this study, river sand was entirely replaced by

stone dust. Similar proportion ratios apply when mixing stone dust.

Table 5 descriptions mix proportion ratios

Item Name	**Cement**	**Fine aggregate**	**Coarse aggregate**
Quantity (gm)	437	710	1111
Ratio	1	1.62	2.52

RESULTS AND DISCUSSION

Experimental results have been illustrated in Table 6 and Table 7.

Compressive strength test Results

In this inquiry, a compressive strength test has been done. Table 6 details the test results for the compressive strength of concrete made with Yamuna river sand.

Table 6: Compressive strength test result of concrete using Yamuna river sand

Sample No	**3days Results**			**7 days Results**			**28 days Results**		
	Cube wt. kg	**Failure load (kN)**	**Strength (MPa)**	**Cube wt. kg**	**Failure load (kN)**	**Strength (MPa)**	**Cubewt. kg**	**Failure load (kN)**	**Compressive Strength (MPa)**
1	8.65	281	12.48	8.80	396	17.60	8.664	584	25.95
2	8.74	266	11.82	8.50	361	16.04	8.899	575	25.55
3	8.69	251	11.15	8.60	348	15.46	8.941	600	26.66

Table 7: Compressive strength test result of concrete using Stone dust

Sample No	**3days Results**			**7 days Results**			**28 days Results**		
	Cube wt. kg	**Failure load (kN)**	**Strength (MPa)**	**Cube wt. kg**	**Failure load (kN)**	**Strength (MPa)**	**Cube wt. kg**	**Failure load (kN)**	**Compressive Strength (MPa)**
1	8.12	426	18.93	8.035	591	26.26	8.084	666	29.6
2	7.90	481	21.37	8.019	502	22.31	8.035	650	28.8
3	7.91	515	22.88	7.998	496	22.04	8.021	680	30.22

According to research, employing stone dust instead of river sand increases concrete strength by a greater amount. According to research, employing stone dust instead of river sand results in concrete increasing by 13.5 percent over the course of 28 days while increasing by 46.66 percent over the course of 7 days. The outcome demonstrates that stone dust is a more efficient method of percentage increment than river sand. This is due to the fact that stone dust's irregularities in particle size can help create concrete with high strength. Compressive strength test results show that major particles in both sand and stone dust are and 1.18 mm in size, implying that stone dust as a useful alternative to sand.

Cost comparison analysis

One cost comparison analysis has been described in Table 8

Table 8: Rate comparison analysis of used materials

Material	Quantity	Rate	Price (Rs.)
Cement	65 Kg	7.0 per Kg	455
Coarse aggregate	169 Kg	3.0 per Kg	507
River Sand	109 (7.1 Sq.ft.)	1.91 Per sq. ft.	208.19
Stone Dust	109(7.1 sq. ft.)	1.29 Per sq. ft.	141

According to this cost comparison analysis, stone dust is less expensive than river sand. The compressive strength of stone dust increased, and it is also economic in nature. Stone dust is more cost effective than natural sand, costing 46% less than Yamuna River sand.

CONCLUSIONS

A comparison analysis of concrete using normal sand and stone dust has been performed in this study. According to the results of various laboratory tests, stone dust proves as a good quality material for medium graded concrete in terms of compressive strength and cost point of view than Yamuna river sand. The conclusion was reached after observing the following tests. Further for the construction time water cement ratio is same as bulking of stone dust similar to river sand. According to the findings of a sieve analysis test, the primary particles in sand and stone dust are 2.36 mm and 1.18 mm in size, respectively, suggesting that stone dust can be utilised as a substitute for sand. A cubic block made of river sand has a compressive strength of 26.66 N/mm2, whereas a cubic block made of stone dust has a compressive strength of 30.22 N/mm2. According to research, employing stone dust instead of river sand results in concrete increasing by 13.5 percent over the course of 28 days while increasing by 46.66 percent over the course of 7 days. Stone dust lowers the overall project cost because it is less expensive than river sand. In places where there is a dearth of natural sand, stone dust offers a significant cost advantage.

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