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An Experimental Investigation on Steel fiber reinforced concrete with quarry dust as a Partial Replacement of Fine aggregate

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Abstract: ***It has been observed that quarry dust performs best when replaced for fine aggregate at a 40 percent level. Strength is greater than that of conventional concrete and begins to diminish at 60%. When replacing sand with quarry dust, the measurable compressive strength was utilised to establish the proportion and type of concrete employed. In the experimental study, quarry dust is utilised in percentages of 0%, 20%, 40%, and 60% in place of natural sand. Hook-end steel fibres made about 0.5% to 0.75% of the concrete's volume. Following tests on cube and cylinder specimens, it was discovered that 40% quarry dust increased strength.***

Keywords: Quarry dust, Hook - end steel fibers, compressive strength, split tensile strength.

I. INTRODUCTION

The engineering and construction materials must satisfy new and increased requirements. In terms of productivity, economy, quality, and the environment, they must compete with other building materials like plastic, steel, and wood. For concrete to be long-lasting, it needs to be resistant to weathering, chemical attack, and other deteriorating processes. Durable concrete will keep its original form quality and usefulness even when exposed to the elements.

Finding out how Nano-Silica (NS) behaves in concrete and how it affects the strength qualities has attracted a lot of study attention. In addition to working as a cementitious Pozzolonic additive, nano-silica fibres also have the astonishing ability to improve the pore structure of concrete. When the microstructure of the cement paste is densified, nano-silica can be extremely important. In this investigation, different combinations of Nano-Silica and Banana Fibers are used in concrete to create concrete with higher characteristics than conventional concrete. The strength properties of concrete are investigated and determined experimentally.

II. OBJECTIVES

1) Attempting to utilise the benefits of steel fibre reinforced concrete to the fullest.
2) Attempting to use quarry dust and fine aggregate as efficiently as possible.

III. MATERIALS

The properties of cement are presented in Table 1.

Table 1 Physical properties of cement

S. No.	Property	Cement (53 grade)
1	Specific gravity	3.141
2	Fineness	9.78%

A. Quarrydust

A by product of the crushing process is quarry dust, a material concentrated for use as aggregates for concreting operations, particularly as fine aggregate. Quarry dust is grey in colour, has a granular texture, and has a variety of particle sizes similar to sand. The specific gravity of Indian quarry dust ranges from 2.6 to 2.8 kg/m, which is comparable to the bulk density of conventional fine aggregate. The information in the table indicates that when used as a sand substitute, quarry dust has a specific gravity of 2.75, which is higher than that of sand (2.6). Additionally, sieve analysis is shown in the table for various sand-to-quarry-dust ratios. This suggests that quarry dust might require less water than sand in the concrete mix.

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B. Steel Fibre Reinforced Concrete

The term "steel fibre for reinforcing concrete" refers to short, discrete lengths of steel fibres with different cross-sections and an aspect ratio (ratio of length to diameter) between 20 and 100 that are small enough to be randomly dispensed in a mixture of unhardened concrete using common mixing materials. The ideal volume fraction for steel fibres in concrete is between 0.4% and 0.6%, which improves the material's compressive strength and splitting tensile strength. Steel fibres boost the toughness while also increasing the maximum load and maximum deflection.

IV. EXPERIMENTAL RESULTS

A. Compressive Strength Results

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 2 .

Table 2: Compressive strength of steel fibre reinforced concrete with quarry dust as partial replacement of fine aggregate in concrete.

Sl.no	Quarry dust	28 days N/mm^2		56 days N/mm^2		90 days N/mm^2	
		For Steel 0.5%	For Steel 0.75%	For Steel 0.5%	For Steel 0.75%	For Steel 0.5%	For Steel 0.75%
1	NC	39.54	39.54	43.07	43.07	46.17	46.17
2	0%	40.14	40.32	43.74	43.73	46.95	46.91
3	20%	40.76	41.06	44.34	44.85	47.54	47.86
4	40%	42.47	42.63	46.35	46.42	49.76	49.83
5	60%	41.01	40.78	44.63	44.34	47.97	47.61

B. Split tensile strength results

The split tensile strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 3.

Table 3: Split Tensile strength of steel fibre reinforced concrete with quarry dust as partial replacement Of fine aggregate in concrete.

Sl.no	Quarry dust	28 days N/mm^2		56 days N/mm^2		90 days N/mm^2	
		For Steel 0.5%	For Steel 0.75%	For Steel 0.5%	For Steel 0.75%	For Steel 0.5%	For Steel 0.75%
1	NC	3.93	3.93	4.28	4.28	4.59	4.59
2	0%	3.95	3.97	4.30	4.59	4.61	4.63
3	20%	4.02	4.04	4.37	4.38	4.70	4.72
4	40%	4.31	4.48	4.67	4.68	5.03	5.23
5	6%	3.97	4.01	4.32	4.36	4.31	4.65

V. CONCLUSION

In this study, the concrete ingredients like fine aggregate are partially replaced by quarry dust and steel fibres respectively. Quarry dust varied different percentages of NC 0%, 20%, 40%, 60%. And Steel fibres are varied with different percentages like 0.5%, 0.75%.

1) At 40% replacement of fine aggregate by Quarry dust For Steel 0.5% the achieved compressive strength of concrete is 42.47 N/mm^2 for 28 days, 46.35 N/mm^2 for 56 days and 49.76 N/mm^2 for 90 days.

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2) At 40% replacement of fine aggregate by Quarry dust For Steel 0.75% the achieved compressive strength of concrete is 42.63 N/mm^2 for 28 days, 46.42 N/mm^2 for 56 days and 49.83 N/mm^2 for 90 days.

3) At 40% replacement of fine aggregate by Quarry dust For Steel 0.5% the achieved split tensile strength of concrete is 4.31N/mm^2 for 28 days, 4.67 N/mm^2 for 56 days and 5.03 N/mm^2 for 90 days.

4) At 40% replacement of fine aggregate by Quarry dust For Steel 0.75% the achieved split tensile strength of concrete is 4.48 N/mm^2 for 28 days, 4.68 N/mm^2 for 56 days and 5.23 N/mm^2 for 90 days.

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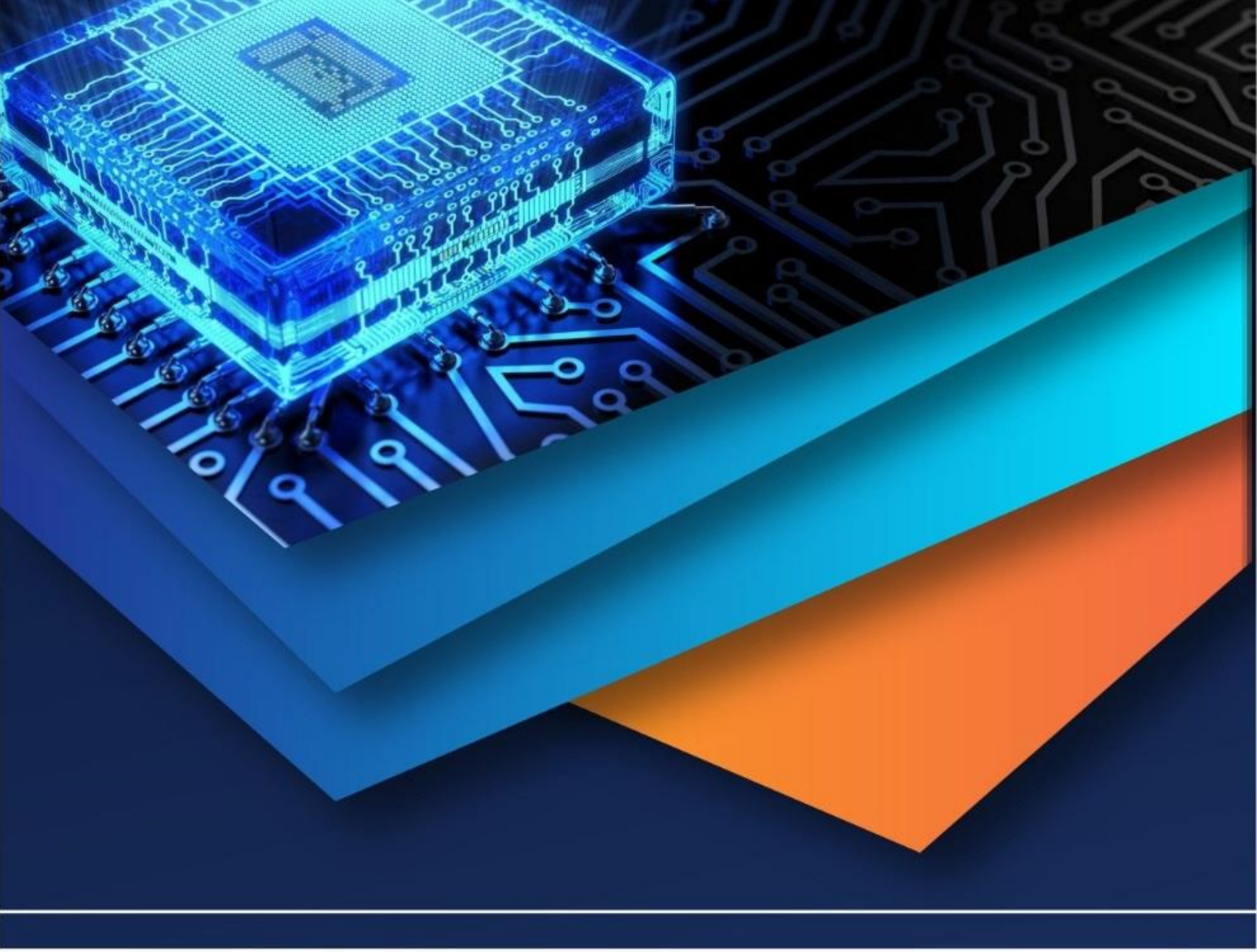
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