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# Mechanical Properties of Steel Fiber Reinforced Concrete with Quarry Dust as a Partial Replacement of Fine Aggregate

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**Abstract:** *It has been determined that quarry dust can be used as a fine aggregate replacement based on the findings of an experimental inquiry. It has been discovered that substituting quarry dust for fine aggregate at 40% yields the best results. Strength then normal concrete and then decreases from 50%. The compressive strength quantified for verifying percentage and grades of concrete for replacement of sand with quarry dust. This present work is an attempt to use Quarry Dust as partial replacement for sand in concrete along with the steel fibers. Attempts have been made to study the properties of concrete and to investigate some properties of quarry dust reinforced with steel fibers; this article presents the compressive and split tensile strengths of hook end steel fiber reinforced concrete with Quarry Dust. In the experimental work natural sand is replaced by Quarry dust in the proportions of 0%, 30%, and 60%. The hook end steel fibers were used in concrete by 0.5%, 0.75% volume fraction. After conduction of experiments on the cube and cylinder specimens, the results showed that, the incorporation of hook end steel fiber reinforced concrete with 30% Quarry dust for M30 grade concrete.*

**Keywords:** Steel Fibers, Quarry Dust, Compressive Strength, Split Tensile Strength

## I. INTRODUCTION

The construction and the engineering materials must meet new and higher demands. As far as productivity, economy, quality and environment is concerned, they have to compete with other construction materials too like plastic, steel and wood. The durability of concrete means it should have resistance to weathering action, chemical attack or any other process of deterioration. Durable concrete will retain its original form quality, and serviceability when exposed to environment. These materials include traditional Portland cement and other cementations materials, such as Quarry dust, steel fibers. Quarry dust is a by-product obtained during the crushing of stone has been reported by Biswas and Davenport (2002). The major constituent of a stone are sulphides and oxides of iron. The charge also contains oxides such as SiO2, Al2O3, CaO and MgO, which are either present in original concentrated. Steel fiber reinforced concrete is a composite material having fibers as the additional ingredients, dispersed uniformly at random in small percentages ,i.e. between 0.3% and 2.5% by volume in plain concrete. Steel fibers are generally found to have aggregate much greater effect on the flexural strength of SFRC than on either the compressive or tensile strength, with increases of more than100%havingbeenreported.

## II. OBJECTIVES

The objectives of this study are as follows

1. To optimize the usage of properties of steel fiber reinforced concrete.
2. To optimize the usage of fine aggregate with quarry dust
3. To evaluate the compressive and spilt tensile strength of concrete.

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## 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 | 3.142 |
| 2 | Fineness | 9.75% |

### 3.1 Quarry Dust

Quarry dust is a byproduct of the crushing process which is a concentrated material to use as aggregates for concreting purpose, especially as fine aggregate. In quarrying activities, the rock has been crushed into various sizes; during the process the dust generated is called quarry dust. Quarry dust is gray in color and granular in nature and has a Similar Particle size range likes and. The specific gravity of Indian quarry dust lies between 2.6 to 2.8 kg/m which is almost similar to the bulk density of conventional fine aggregate. Tests to determine specific gravity for quarry dust and sand were carried out in accordance with ASTM C128. The results presented in table shows that quarry dust has a Specific gravity of 2.75 which is higher than that of sand (2.6) & density when used as sand substitution table shows sieve analysis for various proportions of sand by quarry dust. This suggests that quarry dust would demand less water than that required by sand in the concrete mix.

### 3.2 Steel Fibre Reinforced Concrete

Steel fiber for reinforcing concrete is defined as short, discrete lengths of steel fibers with an aspect ratio (ratio of length to diameter) from about 20 to 100, with different cross-sections, and that are sufficiently small to be randomly dispersed in an unhardened concrete mixture using the usual mixing products. Steel fibres are generally found to have aggregate much greater effect on the flexural strength of SFRC than on either the compressive or tensile strength, with increases of more than 100% having been reported. The best amount of steel fibers is with volume fraction from (0.4% to0.6%), enhances properties of concrete in compressive strength, splitting tensile, flexural strength, abrasion and absorption.9.Adding steel fibers increases maximum load and maximum deflection as well as increases the toughness.

## IV. EXPERIMENTAL INVESTIGATIONS

### 4.1 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$^2$ | | 56days N/mm$^2$ | | 90 days N/mm$^2$ | |
|---|---|---|---|---|---|---|---|
| | | For Steel0.5% | For Stee l0.75% | For Steel 0.5% | For Steel 0.75% | For Steel 0.5% | For Steel 0.75% |
| **1** | **NC** | 49.07 | 49.07 | 53.46 | 53.46 | 57.20 | 57.20 |
| 2 | 0% | 50.04 | 50.13 | 54.53 | 54.88 | 58.49 | 58.85 |
| 3 | 20% | 50.70 | 51.25 | 55.10 | 55.84 | 59.18 | 59.68 |
| 4 | 40% | 52.94 | 53.11 | 57.87 | 58.34 | 62.31 | 62.67 |
| 5 | 60% | 50.82 | 50.92 | 55.21 | 55.33 | 59.17 | 59.49 |

### 4.2 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.

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**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$^2$ | | 56days 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** | 4.85 | 4.85 | 5.27 | 5.27 | 5.66 | 5.66 |
| 2 | 0% | 4.92 | 4.95 | 5.38 | 5.39 | 5.75 | 5.81 |
| 3 | 20% | 4.96 | 5.01 | 5.42 | 5.45 | 5.82 | 5.86 |
| 4 | 40% | 5.34 | 5.57 | 5.81 | 6.06 | 6.24 | 6.50 |
| 5 | 6% | 4.95 | 5.03 | 5.41 | 5.88 | 5.77 | 6.31 |

## 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 NC0%, 20%, 40%, 60%. And a Steel fibre is varied with different percentages like0.5%, 0.75%.

1. At 40% replacement of fine aggregate by Quarry dust For Steel 0.5%the achieved compressive strength of concrete is 52.94 N/mm$^2$ for 28 days, 57.87 N/mm$^2$ for 56 days and 62.31N/mm$^2$for90 days.
2. At 40% replacement of fine aggregate by Quarry dust For Steel 0.75%the achieved compressive strength of concrete is 53.11 N/mm$^2$ for 28 days, 58.34 N/mm$^2$ for 56 days and 62.67N/mm$^2$for90 days.
3. At 40% replacement of fine aggregate by Quarry dust For Steel 0.5%the achieved split tensile strength of concrete is 5.34N/mm$^2$ for 28 days, 5.81N/mm$^2$ for 56 days and 6.24N/mm$^2$for90 days.
4. At 40% replacement of fine aggregate by Quarry dust For Steel 0.75%the achieved split tensile strength of concrete is 5.57 N/mm$^2$ for 28 days, 6.06N/mm$^2$ for 56 days and 6.50N/mm$^2$ for 90 days.

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