

Influence of Quarry Dust on Compressive Strength of Concrete

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Abstract

Objectives: In the present study, by-product of stone crushed, quarry dust is replaced as a fine aggregate with 20%, 30%, 40%, 50% replacement. **Methods/Analysis:** The fine aggregate is being replaced with fine aggregate and the compressive strength is determined for the concrete by testing the sample cube. The properties such as the specific gravity, fineness modulus, moisture content etc. are determined for the sample. **Findings:** Quarry dust is a decent option for normal sand and it is likewise very temperate, as quarry dust is a waste left from quarries. **Novelty/Improvement:** The quarry dust displays better quality because of good holding attributes.

Keywords: Cement, Compressive Strength, Fine Aggregates, Quarry dust, Sand

1. Introduction

Cement is the most broadly utilized development substantial in the present world. The elements of cement are coarse total, fine total, tying material and water. Fast increment in development exercises prompts intense deficiency of ordinary development resources. It is usual that the natural sand is being utilized as a fine total as a part of cement. For as far back as a couple of years, the acceleration in expense of sand because of regulatory confinements in India, requests relatively more noteworthy expense at around a few times the expense of quarry tidy even at spots where waterway sand is accessible close-by. To accomplish economy, utilization of the by-product of stone crushers, quarry waste as an optional substituent to replace the sand with the by-product of stone crusher powder. There is a facing augmentation in compressive quality with substitution of 0-100% waterway sand by the M-sand¹. The investigation of the properties of motor and cement, wherein which the crushed rock powder CRP was used as part swap and complete substitution

for characteristic/waterway sand. The substitutions made were 20%, 40%, 60%, 80% and 100%. The rudimentary quality properties were examined by supplanting of normal sand with 20%, 30% and 40%. The quality of mortar supplanted with 40% of CRP is much higher than that of the ordinary mortar containing just typical sand as the fine total². There was an exceptional increment in compressive quality of concrete with 10% supplanting the sand with Quarry Dust³, it was found that quarry waste fine aggregate enhanced the slump value and the flow of the fresh concretes. But the unit weight and the air content of the concrete was not affected⁴, the economic feasibility, and also the results proved that river sand replaced with 20% of the granite fine total is endorsed for its use in making of concrete⁵. The stone dust because of its higher surface region devours more concrete in contrast with sand which builds workability. He contemplated to impact of rock dust and rock as total in bond and concrete and found that pulverized stone dust could be utilized to supplant the common sand in cement⁶. The impact of rock dust as fine total in bond and cement blends. They have

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proposed a strategy to extent the solid utilizing rock dust as fine total⁷. The vital and the crucial properties of ordinary concrete as well as the cement made utilizing quarry dust. They have considered M20, M30 grades cements. Test results exhibit capable usage of stone dust with same compressive quality, for all intents and purposes indistinguishable inflexibility and the modulus of splitting. Workability of 40% supplanting of stone dust with 2% of Superplasticizer is equal to the workability of a normal bond. Workability is stretched out by the expanding the substance of Superplasticizer⁸.

2. Material Properties

2.1 Cement

In the test examination Pozzolona Portland of 53 grade was utilized. The concrete secured was tried for physical properties and test outcomes acquired are fulfilling the code necessities.

2.2 Fine Aggregate

The fine totals utilized as a part of the present work are quarry dust; normal sand is presented in the following Table 1.

Table 1. Properties of materials

	Cement	Sand	Quarry dust	Coarse aggregate
Specific Gravity	2.62	2.55	2.9	2.72
Fineness Modulus	6%	2.06	3.44	3.83

3. Test Results of Materials

3.1 Cement

Consistency is a term which shows the level of smoothness. Consistency quality ought to be between 5-7 mm and henceforth 25% of water is chosen as the % of water to create an average consistent cement. The fineness is measured by sieving the bond through a strainer. Beginning setting time is characterized as the period between when water added to concrete and the time taken for the needle infiltration, to an acuity of 33 to 35 mm measured from the top is considered as starting setting time. Table 2 discusses various test results of the cement used for the study.

Table 2. Test results of cement

Sl. No.	Test	Result
1	Consistency.	25%
2	Fineness	6%
3	Initial Setting Time	55min
4	Final Setting Time	5hr
5	Specific gravity	2.62

3.2 Sand

Fine aggregate obtained from local market was used in the present study. The properties such as specific gravity, Moisture content were determined in according to IS: 2368-1963 and tabulated in Table 3. The fineness modulus is thus obtained by the summation of the cumulative percentages of aggregates retained on each sieve and then dividing the whole by 100.

Table 3. Test results of sand

Sl. No.	Test	Result
1	Sieve analysis of sand	Zone-II
2	Moisture content	2%
3	Bulk age of sand	8.667
4	Specific gravity	2.55

3.3 Quarry Dust

Quarry dust is an end-product obtained from the quarrying activities Quarry dust was obtained from nearby quarry in and around Paritala region, Kanchikacherla Mandal, Vijayawada (rural) of Andhra Pradesh in India. The test consequences of quarry dust are presented as below in Table 4.

Table 4. Test results of quarry dust

Sl. No.	Test	Result
1	Sieve analysis of Quarry dust	10.4% passing through 150 μ
2	Specific gravity	2.90

3.4 Coarse Aggregate

The coarse aggregate is tested of its specific gravity and water absorption. The test consequences are tabulated as below in 0020 Table 5.

Table 5. Test results of coarse aggregate

Sl. No.	Test	Result
1	Specific gravity	2.72
2	Water absorption	0.5%

4. Tests on Concrete

4.1 Workability of Fresh Concrete

Workability can be demarcated as the quantifiable internal work essential to wholly compact the mass of concrete without the effect of bleeding or segregation, for a freshly prepared concrete, which can be tested by many test like slump cone apparatus and the compaction factor analysis.

4.1.1 Slump Test

The slump cone test determines the workability of a freshly mixed concrete compiling to the standards of IS: 1199- 1959, which measures the consistency of concrete in a particular and specific batch. The test results of slump cone are tabulated in Table 6.

Table 6. Slump values for W/C 0.45

Sl. No.	% of FA replaced by Quarry dust			Slump (mm)		
	M20	M25	M30	M20	M25	M30
1	0	0	0	6	8	6
2	20	20	20	6	9	8.5
3	30	30	30	6	8	6
4	40	40	40	10	8	6
5	50	50	50	15	7	6

Any specimen of slump, which shears or collapses, gives unfitting results and if happens, the trial ought to be reconducted for a fresh sample. If, the same scenario continues, the specimen shears, the value of the slump should be noted and recorded.

4.1.2 Compaction Factor Test

Compaction factor test determines the workability of a freshly mixed concrete by compacting factor test as specified in IS: 1199 - 1959. The test results are shown in the Table 7.

Table 7. Compaction factor values

% of quarry dust	Compaction Factor		
	M20	M25	M30
0	0.93	0.97	0.93
20	0.90	0.95	0.92
30	0.87	0.91	0.88
40	0.84	0.90	0.88
50	0.83	0.89	0.87

$$C.F = (\text{Weight of partially compacted concrete}) / (\text{Weight of fully compacted concrete})$$

4.2 Tests on Hardened Concrete

Concrete stays as an amalgamation of cement total, coarse aggregate, fine aggregate and water. Normally concrete is weak in tension. In the concrete structures design, engineers refers to the hardened state properties like compressive strength, flexural strength and split tensile strength of concrete. The compressive strength test results for M20, M25 and M30 grade concrete are shown in the Tables 8, 9 and 10 respectively.

Table 8. M20 grade of concrete at 28 days

% Quarry Dust	Average Load	Average Weight	Compressive Strength [N/mm ²]
0	853.3	8.78	37.93
20	853.33	8.588	37.93
30	853.3	8.95	37.92
40	906.66	8.82	40.29
50	890	8.83	39.5

Table 9. M25 grade of concrete at 28 days

% Quarry Dust	Average Load	Average Weight	Compressive Strength [N/mm ²]
0	846.66	8.442	37.3
20	846.67	8.390	37.74
30	843.33	8.516	37.40
40	893.33	8.571	39.70
50	866.67	8.515	38.40

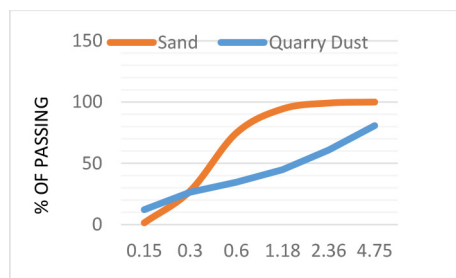
Table 10. M30 grade of concrete at 28 days

% Quarry Dust	Average Load	Average Weight	Compressive Strength [N/mm ²]
0	823.33	8.584	36.59
20	863.33	8.582	38.37
30	853.3	8.95	37.92
40	903.33	8.682	40.18
50	886.33	8.756	39.27

5. Results and Discussions

5.1 Particle Size Distribution

Based on values of particle size gradation, the graph is drawn between fine aggregate and quarry dust. Figure 1 shows the graphical representation of particle size distribution for both sand and quarry dust.

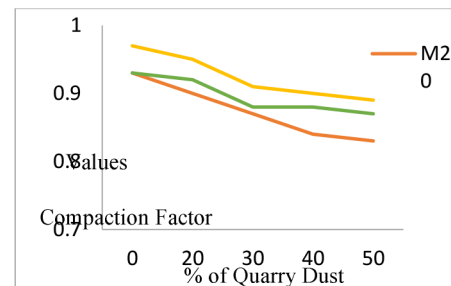
**Figure 1.** Particle size distribution of sand and quarry dust.

From the above chart it is watched that the % of fineness of quarry dust is more contrasted with fine total. The fineness modulus of quarry-dust and fine total are 2.02 and 3.40.

5.2 Workability of Concrete

As in chart represented it is watched that, as the quarry dust rate expands, the workability of solid abatements. As the water bond proportion diminishes, the workability diminishes. Manufactured sand uses more amount of water to fulfil the workability. The compaction component as well as the droop values have demonstrated the same declination. The graphical representation of workability is shown in Figure 2.

For M20 evaluation and w/c 0.45, customary solid workability is observed to be 0.93. For 20% quarry dust workability is 0.90. Further workability is diminished

**Figure 2.** Compaction factor for various percentages of quarry dust for w/c 0.45.

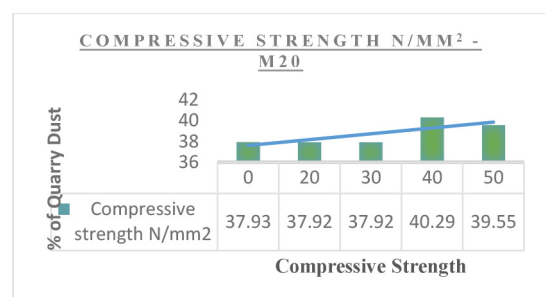
to 0.87 for 30% supplanted concrete. For 40% quarry dust solid workability is 0.84 and for half substitution of quarry dust concrete 0.83 compacting variable was watched.

For M25 evaluation and w/c 0.45, ordinary solid workability is observed to be 0.97. For 20% quarry dust workability is 0.95. Further workability is diminished to 0.91 for 30% supplanted concrete. For 40% quarry dust solid workability is 0.90 and for half substitution of quarry dust concrete 0.89 compacting element was watched.

For M30 evaluation and w/c 0.45, traditional solid workability is observed to be 0.93. For 20% quarry dust workability is 0.92. Further workability is diminished to 0.88 for 30% supplanted concrete. For 40% quarry dust solid workability is 0.88 and for half substitution of quarry dust concrete 0.87 compacting component was watched.

5.3 Graphical Representation of Results

The results of concrete cubes with quarry dust replacement obtained at age of 28 days is as represented in Figures 3, 4 and 5 respectively.

**Figure 3.** Compressive strength of M20 grade concrete.

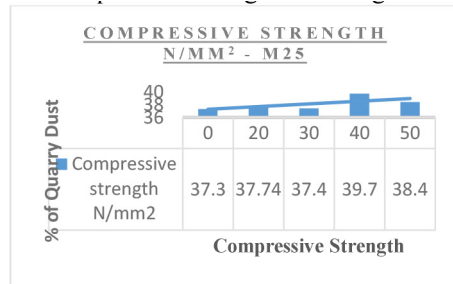


Figure 4. Compressive strength of M25 grade concrete.

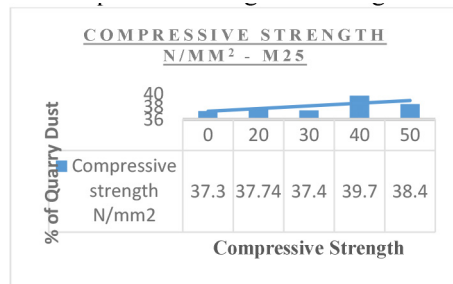


Figure 5. Compressive strength of M30 grade concrete.

5.4 Compressive Strength of Concrete Cubes

Variety of compressive quality with ordinary cement and quarry dust cement is appeared in Figure 6. It is watched that the variety is around 10-15% addition of compressive quality for quarry dust concrete (40%) when contrasted with ordinary cement.

It was noticed that, as percentage of quarry dust increases, compressive strength values also increases. The fractional replacement of quarry dust with natural sand has a 28 days peak compressive strength at 40% replacement level and decreases for 50% replacement. The graph shows that compressive strength relation for both quarrydust concrete and conventional concrete, at the age of 28 days for M20, M25 and M30 grade of concrete for different w/c ratios of 0.45. Figure 6 shows the graphical representation of compressive strength of M20, M25 and M30 grade of concretes for 20%, 30%, 40% and 50% replacement with quarry dust.

From the chart it is watched that the compressive quality of concrete having quarry dust increments upto 40% and after that declines for half. Greatest quality is acquired for M20 grade concrete than other two evaluations i.e., M25 and M30.

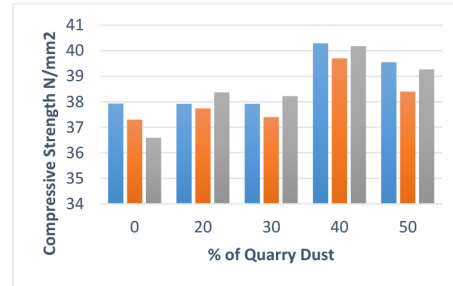


Figure 6. Compressive strength of concretes of Grades M20, M25, M30.

6. Conclusion

From the trial examinations it was prompted that quarry dust can be used as an option for sand (fine total). It is found that 40% substitution of fine total by quarry dust give most extreme result in quality than customary concrete and afterward diminishes for half. The outcomes demonstrated that up to 40% substitution of fine total by the quarry dust impelled higher compressive quality and the workability of solid reductions as substitution increments. As the amount of water expands the compressive quality declines when supplanted with quarry dust. This is a result of the water retention property of quarry dust.

7. References

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