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Strength Exhibition Of M25 Grade Concrete with Limestone Quarry Dust Utilization for Fine Aggregates

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ABSTRACT

As there is shortfalls in river sand fine aggregates for concrete constructions is noticed globally, author feels there be some substitution with locally available material as fine aggregates, By motivated with the issue this research work is carried out on M25 grade of concrete. Lime stone quarry dust is used as fine aggregate substitution. The compressive strength of concrete cubes at age of 7 , 21 and 28 days is obtained at room temperature. Split tensile strength and flexural strength of concrete are found at the age of 28 days. It is found that maximum compressive strength, tensile strength is obtained at 50% replacement of Lime stone quarry dust. This shows that the locally available lime stone quarry dust can be utilized in concrete mixtures as a good substitute for natural river sand, at 50% replacement with additional strength than control concrete.

KEYWORDS : Lime stones, quarry dust, Concrete, river sand, compressive strength.

I. INTRODUCTION

On account of rapid development of modern infrastructural facilities the acute shortage in the river sand is noticed in many parts of India and abroad. Hence because of this sharp rise in the prices of sand is noticed. This is hampering the construction activities. Specially poorest people are getting affected more, as still there is shortage of domestic dwellings in the many underdeveloped countries including India, where there are many people living without their own houses. Concrete is the most widely used construction material today. The constituents of concrete are coarse aggregate, fine aggregate binding material and water. Rapid increase in construction activities leads to acute shortage of conventional construction materials. It is conventional that sand is being used as fine aggregate in concrete. It is noticed that river sand cost is two to three times more than quarry dust. Herein it is studied that possibility of replacing sand with locally available quarry dust without sacrificing the strength and workability of concrete. Concrete is a composite material produced by the homogenous mixing of selected proportions of water, cement, and aggregates. Strength is the most desired quality of a good concrete. It should be strong enough, at hardened state, to resist the various stresses to which it would be subjected. Compressive strength of concrete, therefore, is the value of test strength below which not more than a prescribed percentage of the test results should fall [5]. Concrete is a mixture of water, cement or binder and aggregates (fine and coarse aggregate) and is a commonly used material for construction (1).The construction industries in the developing world is looking for alternative materials that can replace the demand for natural sand, thereby reduce environmental load, reduction of production cost as well as augmenting the quality of concrete (9).Aggregate is classified into two different types, coarse and fine. Coarse aggregate is usually greater than 4.75 mm, while fine aggregate is less than 4.75 mm. The compressive aggregate strength is an important factor in the selection of aggregate. When determining the strength of normal concrete, most concrete aggregates are several times stronger than the other components in concrete and therefore not a factor in the strength of normal strength concrete. Lightweight aggregate concrete may be more influenced by the compressive strength of the aggregates [10].To achieve economy, it is proposed to study with the use of crusher powder, a quarry waste as an alternative material to replace sand by crusher powder. There was a remarkable increase in compressive strength of concrete with 20% replacement of sand with manufactured sand[2], 40% replacement is possible[1] and 50% replacement gave higher strength[8]. Quarry dust fine aggregate decreased the compressive strength due to deficient grading and excessive flakiness [7]. The w/c ratio and slump value increased with the replacement of sand [6]. Voids present in quarry dust mortar were lesser as compared to that of sand hence higher compressive strength [4]. A comparatively good strength is expected when sand is replaced partially or fully with or without concrete admixtures. Coarse aggregate is an important material used in R.C.C work of all types of structures. This is obtained by crushing the stone boulders of size 100 to 150mm in the stone crushers. The aggregate is sieved and the sieved aggregates which is less than 4.75mm in size, used in building construction works is called quarry dust. In highways department the quarry dust is used to sprinkle over the newly laid bituminous road as a binding material between the bitumen and coarse aggregate. The fine powder from quarry dust is mixed with cement and used in grouting works. The quarry dust is used in the manufacturing of hollow blocks. Some mosaic companies use quarry dust partly for sand. In telecommunication department the quarry dust is used to refill the excavated pits after laying the telephone cables.

II. PROPERTIES OF MATERIALS

i). Cement

The cement used for this project work is Birla Super 53- grade PPC from Syed barey cement agency, qamar colony, kalburgi.

Table 1:- Properties of Cement

S.No	Description	Value
1	Normal Consistency	28 %
2	Initial setting time	30 min
3	Final setting time	225 min
4	Specific Gravity	3.0
5	Fineness	5.9%

ii). Aggregates

1) Coarse Aggregate: The crushed basalt aggregate of size passing through 20mm and retaining on 12.5mm standard sieve is used as coarse aggregate from quarry of kalburgi city, of Karnataka state of INDIA.

Table 2 : Coarse aggregate properties

S No	Description	Value
1	Specific Gravity	2.80
2	Fineness Modulus	6.26
3	Density	1.6 gm/cc

2) Fine Aggregate:

a) Sand: Sand collected from nearby river from shahpur area of kalburgi District, Karnataka state of INDIA, is utilised in this project.

Table 3 : Properties of fine aggregate

S No	Properties	Sand	Quarry dust
1	Specific Gravity	2.56	2.49
2	Fineness Modulus	3.02	2.61
3	Void ratio	0.53	0.41
4	Density	1.59	1.75

b) Quarry dust: Quarry dust an alternative for sand is collected from nearby quarry from Shahabad from lime stone terrain, at kalburgi district, Karnataka state of INDIA.

C. Water

Potable water from KCT Engineering college Gulbarga's Civil Engineering Department's Building material testing and Concrete testing Laboratory, of Kalburgi, Karnataka , INDIA is used.

III. EXPERIMENTAL INVESTIGATIONS

A. Mix proportioning

M20 Grade proportion 1:1:2 is used by weight and w/c ratio is fixed according to the slump of 60mm. For this concrete mix, quarry dust is added for replacement of sand at 0% to 100% in step of 10%.

B. Casting of specimen

As the aggregate of size less than 20 mm and greater than 12.5 mm are used, cubes mould of 150x150x150 mm are used. Cylindrical moulds of size 150 mm diameter and 300 mm height are used for casting specimen for split tensile test. Moulds are removed after 24hours of casting and cured in water up to the date of testing.

IV. TESTING PROCEDURE

A. Fresh concrete workability

For consistency of concrete, Slump test is done with varying water content and a particular w/c is fixed according to the slump of 60mm. The various w/c for different proportions of sand with quarry dust is tabulated.

Table 4: Concrete workability with slump of 60mm.

Fine aggregate Sand: Quarry dust	water cement ratio (w/c)
	M25
100:0	0.468
90:10	0.477
80:20	0.485
70:30	0.500
60:40	0.507
0:50	0.511
40:60	0.518
30:70	0.528
20:80	0.529
10:90	0.535
0:100	0.548

B. Compression test

The cube specimen was tested for compressive strength at the end of 7 days 21 days and 28 days. The specimen was tested after the surface gets dried. The load was applied on the smooth sides without shock and increased continuously till the specimen failed. The mean compressive strength is calculated and tabulated in Table V.

Table-5 Compressive strength of concrete (Mean) in MPa

Fine aggregate Sand: Quarry dust	M25 Grade concrete		
	7 days	21 days	28 days
100:0	21.28	22.98	27.56
90:10	22.16	24.15	28.68
80:20	22.62	24.70	28.30
70:30	22.60	24.30	27.95
60:40	22.56	24.60	28.60
50:50	24.00	26.12	30.01
40:60	21.80	23.78	27.28
30:70	19.94	34.89	25.24
20:80	18.28	19.90	23.19
10:90	18.10	19.89	22.25
0:100	16.78	18.20	21.56

From the tables it can be noticed that 7 days 21 days and 28 days compressive strength of concrete reached maximum value at 50% replacement.

C. Split tensile test which is also called "Brazilian Test". Placing a cylindrical specimen horizontally between the loading surfaces of a compression-testing machine and the load is applied till the cylinder fails along the vertical diameter.

Tensile strength = $2W /(\Pi DL)$

Table 6; The mean tensile strength of concrete in MPa

Fine aggregate Sand: Quarry dust	28 days
	M25
100:0	3.09
90:10	3.25
80:20	3.27
70:30	3.34
60:40	3.44
50:50	3.56
40:60	3.46
30:70	3.30
20:80	3.30
10:90	3.16
0:100	3.00

From table it can be noticed that increase in 28 days tensile strength of concrete reached the maximum value at 50% replacement of sand by Shahabad stone dust.

D. Flexure test

The flexural strength of the concrete was determined by using UTM. The test is carried out as per IS 516-1959.

The mean flexural strength is calculated and tabulated

Table 7 Flexural strength of concrete (Mpa)

Fine aggregate Sand: Quarry dust	28 days
	M25
100:0	3.56
90:10	3.66
80:20	3.70
70:30	3.82
60:40	3.95
50:50	4.05
40:60	4.00
30:70	3.78
20:80	3.74
10:90	3.66
0:100	3.44

It is observed that the 28 days flexural strength of concrete reached maximum value at 50% replacement.

Flat and elongated aggregate particles should be avoided (or) limited to 15% by mass of total aggregates. Quarry dust often contains flat and elongated particles require an increase in mixing water and thus it affect the flexural strength of concrete if the water cement ratio is not adjusted.

V. CONCLUSION

From the above discussion it is concluded that:

- Concrete acquires maximum increase in compressive strength at 50 % sand replacement. When compared with concrete with only river sand, the amount of increase in strength is 8.89%.

- Split tensile strength is maximum at 50 % replacement of natural sand by quarry dust. The percentage of increase with control concrete 15.2.
- Maximum flexural strength is also at 50 % replacement. The percentage of increase compared with control concrete is 13.76.

The derivation gives clear picture that lime stone quarry dust can be utilized in concrete mixture as a quality substitute instead of river sand to a high strength at 50% replacement.

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