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Analysis of Concrete Made from Quarry Dust

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***Abstract*— The scope of this analysis is to achieve the industry taking into consideration the feasible use of quarry dust, and to search out any gaps in present situation. The term feasible use means the use of quarry dust to their maximum capacity to adapt up to the demands of this, unexpectedly preserving natural assets and finding answers for limit the environmental effects connected each with quarry dust creation and its disposal. The usage of quarry dust in bond and cement gives potential natural further financial points of interest for every related industry, especially in zones wherever a considerable amount of quarry dust is composed. In this analysis, the experiment work is performed by using cement, fine aggregate, coarse aggregate, quarry dust. The examples were casted for M25 grade of concrete by supplanting the cement 0%, 5%, 10%, 15% and 20% by quarry dust and tested for workability by slump test, compressive strength, flexure strength and split tensile test at the age of 7, 14, 28 and 50 days. It is seen that the strength results represents that concrete casted with in M25 grade of concrete at 7 days are decreases with replacement of 5%, 15% and 20% at 10% have increments, and 14, 28 days have decreased with replacement of 5%, 15% to 20% and increase at 10%, when the percentage of the quarry dust increase from 0% to 15% and slightly decreased with 20% replacement at 50 days.**

Keywords*— *Compressive Strength, Flexure Strength, Quarry Dust, Split Tensile Strength, Workability.

I. INTRODUCTION

The main Ingredients of conventional concrete are cement, sand and aggregate. Performance of concrete is affected by properties of aggregate, therefore fine aggregate is an important part of concrete. The mostly used fine aggregate is the sand extracted from river banks. Natural sand value is expensive because of the excessive cost of transportation from natural sources. Also large-scale extraction of river banks depletes natural resources. To endeavor this aim , one way is to go for long lasting solutions i.e., To opt for sustainable building materials for construction from the byproducts that are generated by manufacturing industries, mines , as waste is certainly a good potential resource and a lot of energy can be recovered from it; and the term 'green' in the present scenario implies to take into consideration use of long term materials like stone dust or recycled stone, recycled metal and other products that are not harmful , can be reused and recycled. In addition to this suitable substitution for the replacement of natural aggregates in concrete is a matter of concern. As a result reasonable researches with intended solutions have been done to find the feasibility of quarry dust in conventional concrete. Quarry dust is a byproduct that is generated from the crushing plants and which is abundantly available to an extent of millions of tons per year associated with disposal problems and serious environmental effects. [1]

Mineral aggregate production produces a major amount of environmental waste within the form of fine material (quarry dust powder) this is especially a concern for the aggregate the mixture process for factory-made fine aggregate to be used in Portland cement concrete because of standards and performance requirements.

A. *Benefits of using Quarry Dust*

This paper presents results on the utilization of granite fines as part of the powder content and discusses their compatibility with super plasticizers in SCC applications. These granite fines are often referred to as quarry or rock dust, a by-product in the production of concrete aggregates during the crushing process of rocks. This residue generally represents less than 1% of aggregate production. In normal concrete, the introduction of quarry dust to mixes is limited due to its high fineness. Its addition to fresh concrete would increase the water demand and consequently the cement content for given workability and strength requirements. Thus, the successful utilization of quarry dust in SCC could turn this waste material into a valuable resource. [2]

Another potential benefit in the utilization of quarry dust is the cost saving. Obviously, the material costs vary depending on the source. In Singapore, the price of limestone powder as delivered can be as high as Portland cement (OPC). In this respect, the utilization of quarry dust could play a part in lowering the supply cost of SCC, which is currently some 80–150% higher than that of normal concrete. In Sweden, the application of SCC is well established and according to Petersson, the cost of SCC is only 10% – 15% higher, while in France. The cost is 50% – 100% higher than normal concrete. Although SCC offers many technical and overall economical benefits, the higher supplied cost of SCC over normal concrete has limited its applications. Attempt to reduce the cost of construction with SCC based on a sandwich concept need to be made. [3]

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II. LITERATURE

Al-Jabri KS et.al [4] was undertaken to study the effect of copper slag (CS) and cement by-pass dust (CBPD) addition on concrete properties Results showed that 5% copper slag substitution for Portland cement gave a similar strength performance as the control mixture, especially at low w/b ratios (0.5 and 0.6). Higher copper slag (13.5%) replacement yielded lower strength values. Results also demonstrated that the use of CS and CBPD as partial replacements of Portland cement has no significant effect on the modulus of elasticity of concrete, especially at small quantities substitution.

B. Felekoglu [5] has found the usability of a quarry dust limestone powder in self-compacting paste and concrete applications was investigated Results showed that, it is possible to successfully utilize high amounts of quarry waste limestone powder in producing normal-strength SCCs. Among its observed mechanical advantages, employment of quarry waste limestone powders improved the economical feasibility of SCC production.

D.W.S. Ho et. al. [3] has deals with the utilization of alternative materials, such as quarry dust, for SCC applications. Results from rheological measurements on pastes and concrete mixes incorporating limestone or quarry dust were compared. It was found that the quarry dust, as supplied, could be used successfully in the production of SCC. However, due to its shape and particle size distribution, mixes with quarry dust required a higher dosage of super plasticizer to achieve similar flow properties.

M. Galetakis et. al. [6] has focused on the development of a simple method for the production of building elements in order to massively recycle quarry dust was investigated at laboratory scale: the production of building blocks by means of compaction mouldings. The optimal mix design, as well as the compaction pressure and water content were determined during the experimental procedure. The produced specimens were cured and tested in order to evaluate their major mechanical and physical properties. Results indicated that the production of building elements with market-acceptable quality characteristics is feasible.

III. METHODOLOGY USED

A. Compressive Strength Test

Many of the important properties of concrete like the modulus of elasticity, resistance to shrinkage, and creep and durability improve with the increase in compressive strength. This is most extreme imperative which gives a thought regarding all the qualities of concrete. By this single test we can judge that whether concreting has been carried out legitimately or not. For block test two sorts of examples either samples of (15 x 15 x15) cm^3 alternately 10 cm x 10 cm x 10 cm size of aggregate are utilized. For the greater part of the works cubical moulds of size (15x15x15) cm^3 are generally used. This concrete is spilled in the mould and tempered appropriately so as not to have any voids. Following 24 hours these moulds are uprooted and test examples are placed in water for curing. The surface of these samples ought to be made even and smooth. This is carried out by putting cement paste and spreading easily on entire zone of specimen. These examples are tried by pressure testing machine following 7 days curing or 28 curing. Burden ought to be connected progressively at the rate of 140 kg/cm^2 every moment till the specimens falls flat. Load at the disappointment partitioned by region of example gives the compressive quality of concrete. In this work the compressive strength were tested at the age of 7, 14, 28 and 50 days of the curing.

B. Flexure Strength Test

It is defined as the normal tensile stress in concrete, when cracking occurs in a flexure test. This tensile stress is the flexural strength of concrete and is calculated by the utilization of formulas that assumes that the section is consistent.

$$f = (M/I)\, y \tag{1}$$

Where, f = Stress in the extreme fiber.

M = Bending moment at the failure section.

y = extreme fiber-distance from the neutral axis.

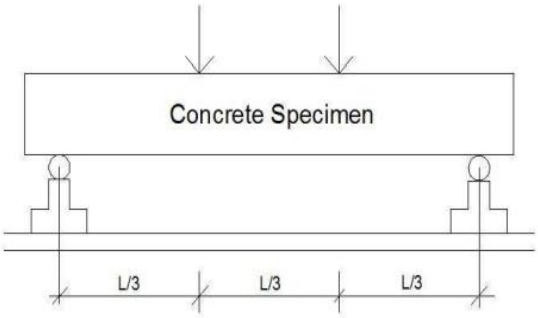

Fig. 1. Arrangements of Third Point Loading

In this work three specimens were casted in the as per the size specified above. And it tested after 7, 14, 28 and 50 days of curing.

C. Split Tensile Test

The elasticity of cement can be obtained indirectly, by subjecting a solid barrel to the activity of compressive drive along to inverse closures of a generator as shown in the Fig. 2.

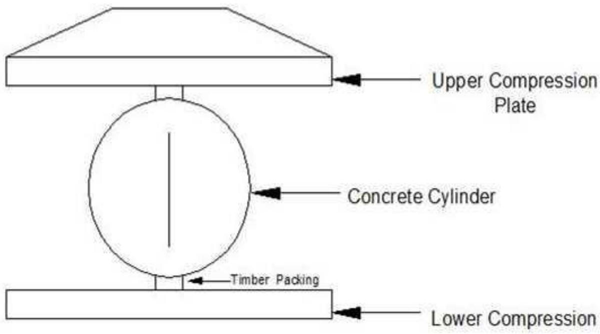

Fig. 2. Arrangements for Tensile Test

Due to the compressive force the cylinder is subjected to an oversized magnitude of compressive stress close to the loading region. The large portion is subjected to a uniform tensile stress acting horizontally. This tensile s tress is taken as an index of the tensile strength of concrete and is given by the formula.

$$S_t = 2P/ \pi D \quad (2)$$

Where,
S_t = the indirect tensile strength of concrete
P = load causing rupture.
D = diameter of cylinder.
L = length of cylinder.

In this work the cylinder of diameter 15 cm and length 30 cm (IS: 5816-1999) is threw in the is determined shape. [7] For each example three examples is threw and their normal esteem is consider as the outcome. Subsequent to filling the form with the crisp solid it is compacted and after 24 hrs it is kept in the curing tank. The tensile strength is tested at 7, 14, 28 and 50 days of curing.

D. Preparation of Mould

- The mould which is utilized for concrete cube, beam and cylinder are arranged after cleans the inner surface of mould with the utilization of brush.
- The interior surface of mould is covered with oil to avoid grip of concrete.
- The prepared mixed concrete is filled in mould in 3 layers and every layer must be compacted with the utilization of table vibrator.
- The concrete will be left for 24 hours setting.
- It strides repeated for another cubes with diverse mixed extent.
- Record the date of mixture for each cube and submerge in all cubes in curing water.

IV. RESULT ANALYSIS

In this case the trial work is done by utilizing cement, fine aggregate, coarse aggregate, quarry dust. The examples were casted for M25 grade of concrete by supplanting the cement 0%, 5%, 10%, 15% and 20% by quarry dust. The new concrete is tried for workability by slump test, compressive strength, flexure strength and split tensile strength at the age of 7, 14, 28 and 50 days.

A. Consistency of Concrete Mix

The purpose of this test is to determine the percentage of water required for preparing cement pastes for other tests. Normal consistency of pastes containing quarry dust.

TABLE I. CONSISTENCY OF CEMENT

Consistency of concrete mix					
% Replacement	0 %	5%	10%	15%	20%
Quarry Dust	32	32.5	34	34.5	35

Up to 5% 10%, and 15% replacement the normal consistency was mostly constant minor differences, at 20% replacement the normal consistency had shown a slight increment to 35%.

B. Workability

TABLE II. WORKABILITY OF QUARRY DUST

Workability of Concrete					
Replacement	*0 %*	*5%*	*10%*	*15%*	*20%*
Slump in [mm]	65	88	135	158	182

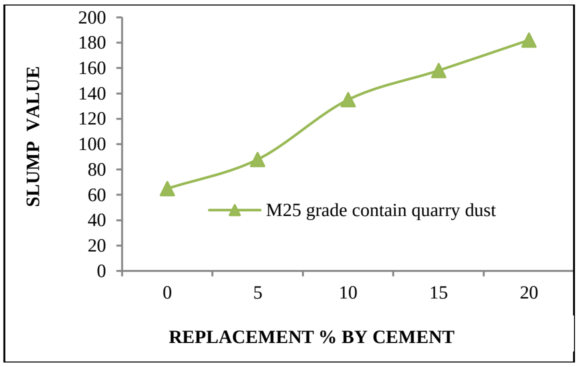

Fig. 3. Slump Values of Quarry Dust

From the above fig.3 outcomes for slump demonstrates that the workability increments with the expansion in the rates of contain of quarry dust.

C. Compressive Strength

TABLE III. COMPRESSIVE STREGTH OF QUARRY DUST

Compressive Strength					
Days	*0 %*	*5 %*	*10 %*	*15 %*	*20 %*
7	20.08	19.31	22.74	19.78	19.43
14	26.36	24.52	29.36	25.98	23.82
28	36.3	33.20	37.10	31.95	29.22
50	41.9	43.62	49.16	42.94	39.30

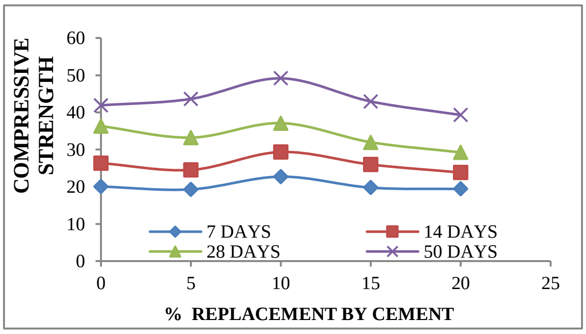

Fig. 4. Compressive Strength of Quarry Dust

From the above fig. 4 is seen that the compressive strength results represents that concrete casted with in M25 grade of concrete at 7 days are decreases with replacement of 5%, 15% and 20% at 10% have increments in 10%, and 14, 28 days have decreased with replacement of 5%, 15% to 20% and increments when the percentage of the quarry dust increase from 0% to 20% at 50 days.

D. Split Tensile Strength

TABLE IV. TENSILE STRENGTH TEST OF QUARRY DUST

Tensile Strength of Concrete					
% Replacement	*0 %*	*5%*	*10%*	*15%*	*20%*
Tensile Strength (N/mm^2)	*2.17*	*2.40*	*2.75*	*2.23*	*2.51*

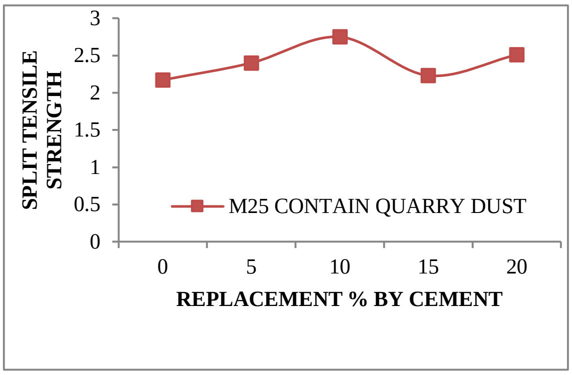

Fig. 5. Tensile Strength of Quarry Dust

Tensile strength is expanded with the replacement of quarry dust increments with the age of 28 days.

E. Flexure Strength Test

TABLE V. FLEXURE STRENGTH OF QUARRY DUST

Flexure strength in (N/mm^2)					
% Replacement	*0%*	*5%*	*10%*	*15%*	*20%*
Flexure Strength (N/mm^2)	3.2	4.62	4	2.28	5.11

TABLE V. FLEXURE STRENGTH OF QUARRY DUST

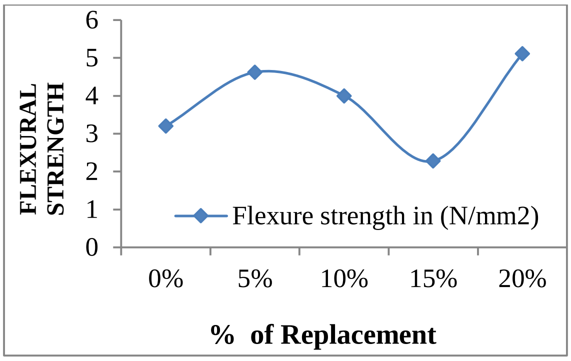

Fig. 6. Split Tensile Strength of Quarry Dust

In this test works absolutely 39-beams of size 700 x 150 x 150 are casted of M25 grades concrete and other level of replacements concerning 5%, 10%, 15% and 20% by quarry dust with cement. At that point analyze the estimations of both plan blends. The flexural estimation of various blends. Flexural strength is increments when the 5% 10%and 20% of level of the quarry dust increment and reduction from 15% used of quarry dust with the age of 28 days

V. CONCLUSION

- The Consistency of Concrete containing quarry dust has slightly increment up to 3% more than conventional concrete.
- Slump shows that the workability increases with the increase in the percentages of quarry dust.
- In the compressive strength of quarry dust, the 10% of quarry dust greater strength than the convention concrete.
- Tensile strength shows that the strength is increasing as the percentages increases with the age of 28 days.
- Flexural Strength is increases in 5%, 10% and 20% replacement and decrease at 15% replacement with the age 28 days.

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