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Experimental Study on Concrete with Replacement Offine Aggregate by Quarry Dust

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Abstract: *Nowadays various researches achieved the strength of the concrete; the exposure on quarry dust plays a vital role in the field of construction. Concrete is the commonly used material in the construction industry. The widely used raw material in the concrete are cement, fine aggregate, coarse aggregate and water. River sand is at great rate of depletion and expansive, due to which there was a need for an effective alternative. Quarry dust, has been found as an economic alternative for sand. In fact we need high strength concrete to withstand to the heavy loads in a building.In this paper, we have investigated the study of quarry rock dust as partial replacement of fine aggregate in concrete. Mix design has been developed for M30 grade prepared as IS-10262, 2009 mix design procedure with and without replacement of quarry dust. The mix is performed by addition of 0 %, 10 %, 20 %, 30 %, and 40 % ofquarry dust. The compressive strength for 7, 14 and 28 days.Hence the usage of quarry dust are recommended as an alternate material to achieve the Optimum strength with optimum percentages of quantity mix.*

Keywords- *Quarry dust,Compressivestrength,Optimum strength*

I. Introduction

Concrete is the premier construction material across the world and the most widely used in all types of civil engineering works, including infrastructure, low and high-rise buildings, defense installations, environment protection and local/domestic developments. Concrete is a manufactured product, essentially consisting of cement, aggregates, water and admixtures. Among these, aggregates, i.e. inert granular materials such as sand, crushed stone or gravel form the major part. Traditionally aggregates have been readily available at economic price.

This is mainly because of the depletion of quality primary aggregates and greater awareness of environmental protection. In light of this, the availability of natural resources to future generations has also been realized. Many governments throughout the world have now introduced various measures aimed at reducing the use of primary aggregates and increasing reuse and recycling, where it is technically, economically, or environmentally acceptable.

Concrete is that pourable mix of cement, water, sand, and gravel that hardens into a super-strong building material. The most commonly used fine aggregate is sand derived from river banks. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but overuse of the material has led to environmental concerns, the depleting of river sand deposits and an increase in the price of the material. The developing country like India facing shortage of good quality natural sand and particularly in India, natural sand deposits are being used up and causing serious threat to environment as well as the society. The rapid extraction of sand from the river bed causes problems like deepening of the river beds, loss of vegetation on the bank of rivers, disturbance to the aquatic life as well as agriculture due to lowering the water table in the well etc.

Therefore, construction industries of developing countries are in stress to identify alternative materials to replace the demand for river sand. Quarry dust has been proposed as an alternative to river sand that gives additional benefit to concrete. Quarry dust is known to increase the strength of concrete over concrete made with equal quantities of river sand. The Compressive strength of quarry dust concrete continues to increase with age for all the percentage of quarry dust contents. The utilization of quarry dust as fine aggregate would turn this waste material that causes disposal problem into a valuable resource. It consisted of replacing completely fine sand aggregate with quarry dust and determining the mechanical properties of concrete. The utilization will also reduce the strain on supply of natural fine aggregate, which in turn will also reduce the cost of concrete.

The main aim of objective:

- To determine the experimental investigation on replacement of fine aggregate to quarry dust
- To find the optimum percentage of fine aggregate with quarry dust

II. Literature Review

- G. Balamurugan and Dr.P.Perumals (December 2013)- Study on the replacement of sand with quarry dust. To determine the compressive strength. Quarry dust can be effectively used for 50%.
- K. Shyam Prakash and Ch. Hanumantha Rao (September 2016)- Quarry dust can be used as a replacement for sand .To determine the strength and the workability of concrete. 40% gives maximum strength.
- AnzarHamidet al., (2015),- Concrete mixes by 10% and 20% of quarry dust, m20 To determine the suitability of quarry dust. increment is about 55% to 75% depending on replacement .
- Sumit L. Chauhan, RajuA.Bondre(July 2015)- study which investigated the partial replacement of sand with quarry dust.The results showed that the addition of quarry dust as fine aggregate ratio of 30%, 40% and 50% was found to enhance the compressive properties.
- Akshaya. waghmare ayushi r. Sharma sunil- aim of the study is to determine the workability tensile strength and compressive strength of concrete prepared by replacing natural sand with artificial sand at different replacement level (0%, 20%, 40%, 60%, 80% and 100%). The compressive strength increases upto 60% variation and then it decreases upto 100%.

III. Purpose Of Replaceing Sand By Quarry Dust:

The replacement of natural fine aggregate by using quarry dust leads to consumption of generated quarry dust, the requirement of land fill area can be reduced and solves the natural sand scarcity problem.

The sand availability as a fine aggregate at low cost which needs the reason to search as a alternative material.

Figure 1: Quarry Dust

IV. Experimental Investigation:

4.1 MATERIAL USED:

4.1.1 Cement:

Ordinary Portland cement of 53-grade is used.This is used to develop high strength and has low setting time. It gives much better results and compressive strength in 28 days.

Table 4.1: Physical properties of cement

PROPERTY TEST	VALUE
Specific gravity	3.15
Fineness	97.4
Initial setting time	55 min
Final setting time	218 min

4.1.2 Fine Aggregate:

Locally available river sand having density of 1550 kg/m 3 and fineness Modulus (FM) of 2.87 was used. The specific gravity was found to be 2.68. Moisture content of sand is 2.23 .The fine aggregate was found to be confirming to Zone III as per IS 383:1970.

4.1.3 Coarse Aggregate:

Natural granite aggregate having density of 1500 kg/m3 and fineness modules (FM) of 6.024 was used. Water absorption is 0.5%.The specific gravity was found to be 2.80 and maximum size of aggregate was 20mm.

4.1.4 Quarry Dust:

Quarry dust is fine rock particles. When boulders are broken into small pieces quarry dust is formed. It is grey in color and it is like fine aggregate. The physical a properties of quarry rock dust

Table 4.1:Physical properties of quarry dust and river sand:

PROPERTY	QUARRY DUST %	TEST METHOD
Specific gravity	2.60	IS2386 (part III)1963
Sieve analysis	ZONE III	IS 383-1970
Bulk density	1700	IS2386 (part III)1963
Water absorption	1.30	IS2386 (part III)1963

4.2 M30 GRADE MATERIAL FOR ONE CUBIC METER:

TABLE 4.2: MIX DESIGN

SL. NO	MATERIALS	QUANTITY
1	Cement	434Kg/m^3
2	Fine aggregate	778.27Kg/m^3
3	Coarse aggregate	1034.88 Kg/m^3
4	W/C ratio	0.45

Mix ratio: 1: 1.79: 2.40

4.3 PREPARATION OF SPECIMEN:

4.3.1 Mould details (As per IS 10086 - 1982)

In assembling the mould for use, the joints between the sections of mould shall be thinly coated with mould oil and similar coating of mould oil shall be applied between the contact surface of the bottom of the mould and the base plate in order to ensure that no water escapes during the filling. The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent the adhesion of the concrete.

4.3.2 Batching

Batching is the process of weighing or volumetrically measuring and introducing into a mixer the ingredients for a batch of concrete. To produce a uniform quality concrete mix, measure the ingredients accurately for each batch.Batching by using weight provides greater accuracy and avoids problems created by bulking of damp sand.

4.3.3 Mixing and Filling Of Concrete

After the batching process is done, water was added accordingly as per requirement and mixing was carried out by shovel by turning it over and over until uniformity in colour was achieved. The homogeneous mixture so formed was filled in the moulds in 3 layers by tamping each layer 25 times so that voids get filled within the moulds and concrete is compacted.

4.3.4 Compaction:

made as soon as practicable after mixing, and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance.

4.3.5 Curing

Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration. Curing is designed primarily to keep the concrete moist, by preventing the loss of moisture from the concrete during the period in which it is gaining strength. After this period, the specimens shall be marked and removed from the moulds and, unless required for test within 24 hours, immediately submerged in clean, fresh water and kept there until taken out prior to test.

The required materials were weighed and mixing of concrete was carried out manually. Cube specimens of size 150 mm x 150 mm x 150 mm. The specimens were mould after 24 hours of casting and the specimens were cured in a water tank at room temperature.

TABLE 4.3:Material required for making one cube(w/c=0.45)

% Of Quarry Dust	Cement Kg	Quarry Dust Kg	Fine Aggregate Kg	Coarse Aggregate Kg
0%	1.46	0	2.62	3.492
10%	1.46	0.262	2.358	3.492
20%	1.46	0.524	2.096	3.492
30%	1.46	0.786	1.834	3.492
40%	1.46	1.048	1.572	3.492

4.4 TEST PROCEDURE:

4.4.1 Compressive Strength Test:

For 7, 14 and 28 days of curing, the cubes were taken out of the curing tank, dried and tested using a compression machine. These cubes were loaded on their sides during compression testing such that the load was exerted perpendicularly to the direction of casting. The cubes were placed in the compression testing machine and the loads are applied gradually at a rate of 14 N/mm2 /min. The average value of the compression strength of three cubes was taken as
the compression strength

Figure 2: Casting of Concrete Cube

V. Results And Discussions

TABLE 5.1: Compressive Strength forConcrete Cube

Sl. No	Grade	% Quarry Dust	Ultimate Compressive Strength (N/mm^2)		
			7 days	14 days	28 days
1	M_{30}	0%	22.84	26.43	32.32
2		10%	21.74	25.39	30.84
3		20%	21.98	25.96	31.68
4		30%	18.23	22.63	26.08
5		40%	15.17	18.63	21.83

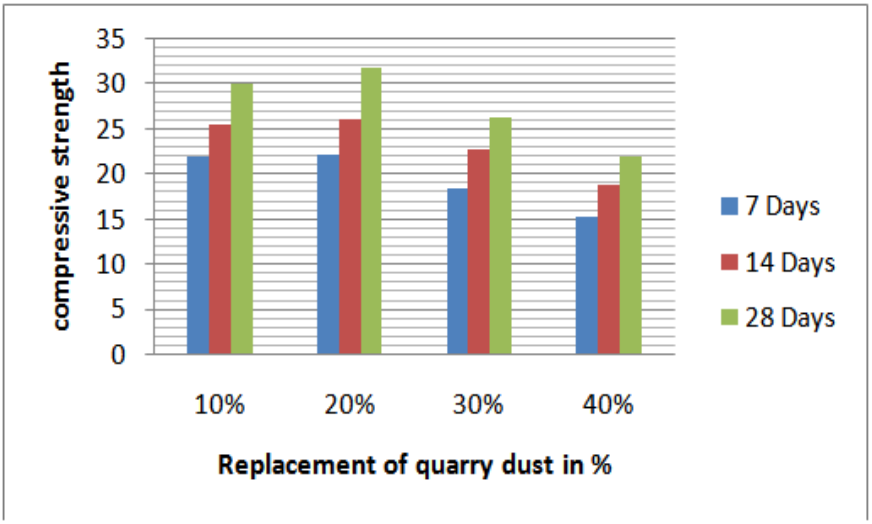

Figure 3.6 Graphical representation of compressive strength of concrete

VI. Conclusion

Mix design is prepared on M30 grade of concrete, that there is great potential for the utilization of quarry dust in concrete mixes in different percentages, ranging from 10%, 20%,30%,40%.

Based on present study, the following results, it concludes with 20% of quarry dust gives maximum compressive strength. The crushed stone dust provides the strength to the concrete mix. There will be strong bonding between the crushed stone dust and ultra-fine particles due to roughness of crushed stone dust particles.the cost of quarry dust is very less in comparison to the current cost of sand due to its shortage, quarry dust can be seen as an effective and optimistic alternative for the replacement of sand in concrete.

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