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Comparision of Strength For Concrete With Rock Dust And Natural Sand Concrete As Fine Aggregate

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Abstract
The Quarry rock dust can be an economic alternative to the river sand. Quarry Rock Dust can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of rocks to form fine particles less than 4.75mm. Usually, Quarry Rock Dust is used in large scale in the highways as a surface finishing material and also used for manufacturing of hollow blocks and lightweight concrete prefabricated Elements. This project presents the feasibility of the usage of Quarry Rock Dust as hundred percent substitutes for Natural Sand in concrete. Design Mix for M30 and M40 has been calculated using IS 10262-2009 for both conventional concrete and quarry dust concrete. Tests were conducted on cubes, cylinders and beams to study the strength of concrete by using Quarry Rock Dust and the results were compared with the Natural Sand Concrete. Cement motor ratios of 1:3 and 1:6 are prepared and observe the percentage of water absorption in both Quarry Rock Dust and Natural sand for plastering.
Keywords: Quarry rock dust, Natural sand, Replacement, Mix design..

I. INTRODUCTION

Concrete is an artificial conglomera test one made essentially of Portland cement, water, fine and coarse aggregates. The mixture of the materials results in a chemical reaction called hydration and a change in the mixture from plastic to a solid state occurs over a period of time. The cost of concrete can be reduced by reducing cost alternative material, instead of conventional materials. The world wide consumption of fine aggregate in concrete production is very high, and several developing countries have encountered difficulties in meeting the supply of natural fine aggregate in order to satisfy the increasing needs of infrastructural development in recent years. To overcome the stress and demand for river fine aggregate, research and practitioners in the construction industries have identified some a lternative materials such as fly ash, slag, limestone powder and siliceous stone powder. In India attempts have been made to replace river sand with quarry dust. The successful utilization of quarry dust as fine aggregate would turn this was material that causes disposal problem in to a valuable resource. The utilization will also reduce the strain on supply of natural fine aggregate, which will also reduce the cost of concrete. The main objective of the present investigation is to evaluate the possibilities of using quarry dust as a replacement to fine aggregate. During the present study, 0%, 50%, 75% and 100% of traditional fine aggregate was replaced with quarry dust. Compression, split and flexural strengths were found after 7 days and 28days of curing.

II. LITRATURE REVIEW

Previous Studies
Ilangovanaet al (2008) studied the feasibility of usage of quarry rock dust as hundred percent substitutes for natural sand in concrete. It is found that the compressive, flexural strength and durability studies of concrete made of quarry rock dust are nearly 10% more than the conventional concrete. Sivakumaret al (2011)presented a paper on the hardened and durable properties of concrete using quarry dust. His paper reports the experimental study which investigated the influence of 100% replacement of sand with quarry dust. Initially cement mortar cube was studied with various proportions of quarry dust (CM 1:3, CM 1:2, and CM 1:1). The experimental results showed that the addition of quarry dust for a fine to coarse aggregate ratio of 0.6 was found to enhance the compressive properties as well as elastic modulus.

Present Study
In the present investigation we design mix for M30 and M40 has been calculated using IS 10262-

2009 for both conventional concrete and quarry dust concrete. Tests were conducted on cubes, cylinders and beams to study the strength of concrete by using Quarry Rock Dust and the results were compared with the Natural Sand Concrete. Cement motor ratios of 1:3 and 1:6 are prepared and observe the percentage of water absorption in both Quarry Rock Dust and Natural sand for plastering. During the present study, 0%, 50%, 75% and 100% of traditional fine aggregate was replaced with quarry dust. Compression, split and flexural strengths were found after 7 days and 28days of curing.

III. MATERIAL AND METHODOLOGY

The materials used in research are:

1. Portland cement (53 grade)
2. Fine aggregate (4.75 mm down)
3. Coarse aggregate (20 mm down)
4. Quarry rock dust
5. Water
6. Admixtures

Cement:

Ordinary Portland cement of 53 grade conforming to Indian Standard IS 12269-1987 was used throughout the experimental program. Cement must develop the appropriate strength. It must represent the appropriate rheological behavior. Generally same types of cements have quite different rheological and strength characteristics, particularly when used in combination with admixtures and cementing material.

Fine Aggregate

Fine aggregate (sand) used for this entire investigation for concrete was river sand conforming to zone-II of IS: 383-1970. Fine aggregate normally consists of natural, crushed, or manufactured sand. The physical properties of fine aggregate like specific gravity, gradation and fineness modulus are tested in accordance with IS :2386.

Coarse Aggregate

Coarse aggregate crushed granite of 20 mm down size has been used as coarse aggregate. The physical properties of coarse aggregate like specific gravity, Bulk density, impact value, gradation and fineness modulus are tested in accordance with IS: 2386.

Quarry Rock Dust

Quarry Rock Dust can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of rocks to form fine particles less than Is Sieve 4.75mm. Quarry dust is fine rock particles. When boulders are broken into small pieces quarry dust is formed. It is gray in color and it is like fine aggregate. Quarry dusts are produced during the extraction and processing of aggregates.

Application of Quarry rock dust;

1.It is being used as surface dressing in highway work.
2. It is also used in the manufacturing of building material, such as lightweight aggregates, bricks, tiles and autoclave blocks.
3. Fiberrein forced pre-cast units are also made up of this.
4. It is used in synthetic rock and kerbs.
5. Few more uses are in embankment construction, landfill capping, filler applications,manufactured sand, cement making, green roofs, straw and clay blocks.

Properties of Quarry rock dust:

a. Resistant to heat and fire
b. Alkaline in presence of moisture
c. Non-plastic
d. Consistent chemistry
e. Excellent load bearing capacity

Water

The water, which is used for making concrete and for curing, should be clean and free from harmful impurities such as oil, alkali, acid, etc, in general, the water, which is fit for drinking should be used for making concrete.

Methodology

Concrete specimens were casted using 0%, 50%, 75% and 100% of replacement fine aggregate with Quarry rock dust.

Number of specimens required for the experiment:

No of cubes casted for compressive test is 96. No of cylinders casted for split tensile strength is 48.

No of prisms casted for flexural strength is 28.

CHARACTERISTICS OF INGREDIENT MATERIALS VAREID

Cement:

a) Specific Gravity Test: According to IS 2720 – part – 3.Specific gravity is the ratio of the density of a substance compared to the density (mass of the same unit volume) of a reference substance. Apparent specific gravity is the ratio of the weight of a volume of the substance to the weight of an equal volume of the reference substance. The reference substance is nearly always water for liquids or air for gases.
b) Fineness Test: According to IS 4031-1968. Fineness is defined as the surface area of cement particles per unit weight, means more number of particles per unit weight. If the percentage of fineness is more than 90 % the cement is supposed to be fresh, if it is less than 90 % than that Cement should be avoided to use . **c) Standard consistency Test:** According toIS 4031

(Part 4) 1988 . The standard consistency of a cement paste is defined as that consistency which will permit the vicat plunger to penetrate to a depth of 5 to 7mm from the bottom of the vicatmould

Coarse Aggregates:

a) Sieve Analysis(IS: 383- 1970) A sieve analysis (or gradation test) is a practice or procedure used (commonly used in civil engineering) to assess the particle size distribution (also called gradation) of a granular material. The size distribution is often of critical importance to the way the material performs in use. A sieve analysis can be performed on any type of non-organic or organic granular materials including sands, crushed rock, clays, granite, feldspars, coal, and soil, a wide range of manufactured powders, grain and seeds, down to a minimum size depending on the exact method. Being such a simple technique of particle sizing, it is probably the most common method.

b) Crushing Value: IS: 2386 -PART- 4) the aggregate crushing value provides a relative measure of resistance to crushing under a gradually applied compressive load. To achieve a high quality of concrete, aggregate possessing low aggregate crushing value should be preferred.

FineAggregates:

a) Fineness modulus: Fineness Modulus(FM)is used in determining the degree of uniformity of the aggregate gradation. It is an empirical number relating to the fineness of the aggregate. The higher the FM is, the coarser the aggregate. **b) Specific Gravity:** (IS: 2386- PART- 3).The specific gravity of an aggregate is considered to beam ea sure of strength or quality of the material. The specific gravity test helps in the identification of stone.

Physical properties of cement (OPC 563 Grade)

S.No	Type of Aggregate	Specific gravity	Fineness modulus
1	Coarse aggregate	2.85	6.65
2	Fine aggregate	2.59	2.44
3	Crusher dust	2.57	2.75

Physical properties of cement(OPC 53 grade)

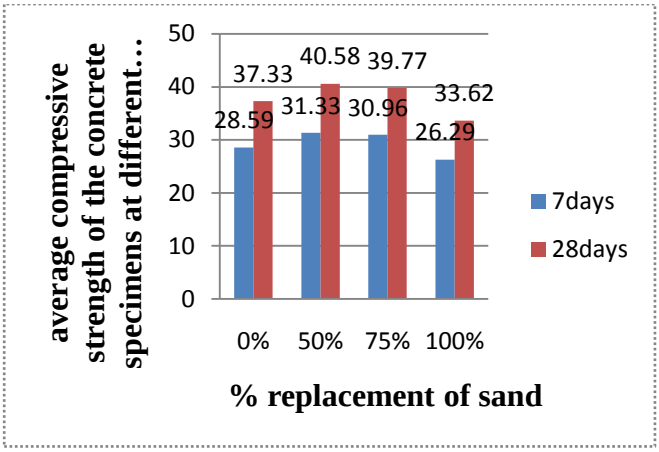
S.No	Property	Value
1	Specific Gravity	3.12
2	Fineness of Cement by sieving	2.5
3	Standard Consistency	31 %
4	Setting Time i) Initial Setting time ii) Final setting time	 140 min 260 min
5	Compressive Strength i) 3 days ii) 7 days iii) 28days	 27 Mpa 37 Mpa 53 Mpa

IV. RESULTS AND TABLES :

Compressive strength:

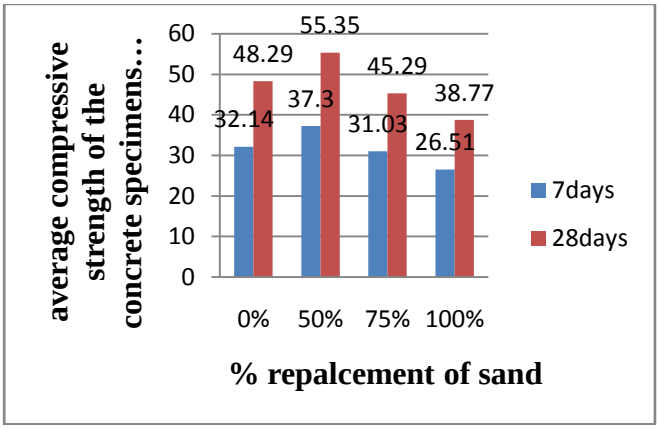
Average Compressive Strength of Concrete with Quarry Rock Dust in M30 Grade.

% of replacement Sand with Quarry Rock Dust	Average Compressive strength of the concrete at different ages(N/mm2)	
% of replacement	7 days	28 days
0	28.59	37.33
50	31.33	40.58
75	30.96	39.77
100	26.29	33.62



Average Compressive Strength of Concrete with Quarry Rock Dust in M40 Grade.

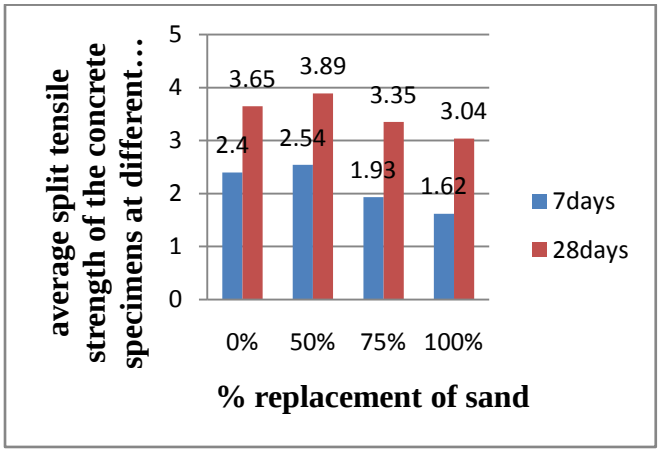
% of replacement Sand with Quarry Rock Dust	Average Compressive strength of the concrete at different ages(N/mm2)	
% of replacement	7 days	28 days
0	32.14	48.29
50	37.30	55.35
75	31.03	45.29
100	26.51	38.77



Split tensile strength:

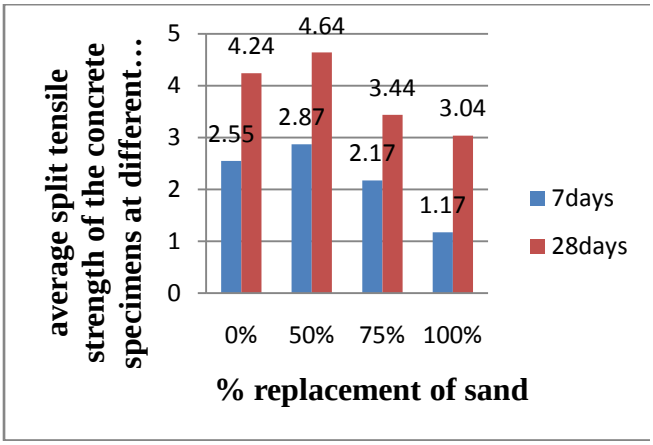
Average Split tensile Strength of Concrete with Quarry Rock Dust in M30 Grade.

% of replacement Sand with Quarry Rock Dust	Average Split tensile strength of the concrete at different ages(N/mm2)	
% of replacement	7 days	28 days
0	2.40	3.65
50	2.54	3.89
75	1.93	3.35
100	1.62	3.04



Average Split tensile Strength of Concrete with Quarry Rock Dust in M40 Grade.

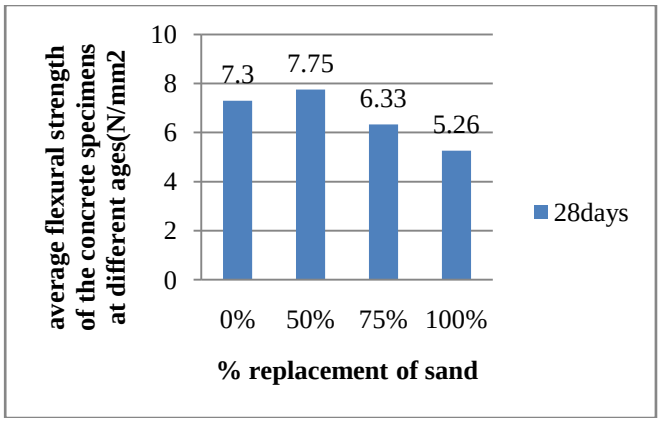
% of replacement Sand with Quarry Rock Dust	Average Split tensile strength of the concrete at different ages(N/mm2)	
% of replacement	7 days	28 days
0	2.55	4.24
50	2.87	4.64
75	2.17	3.44
100	1.17	3.04



Flexural strength test:

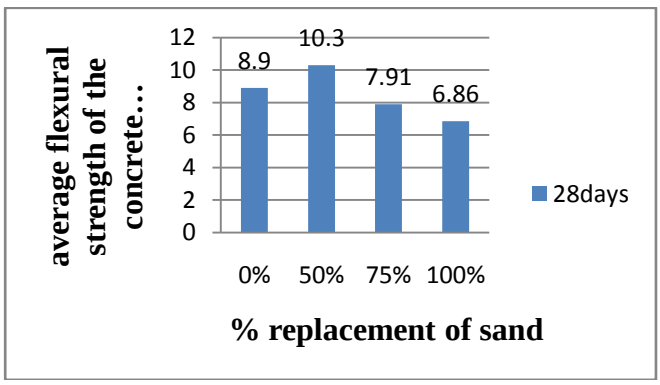
Average Flexural Strength of Concrete with Quarry Rock Dust in M30 Grade.

% of replacement Sand with Quarry Rock Dust	Average Flexural strength of the concrete at different ages(N/mm2)
0	7.3
50	7.75
75	6.33
100	5.26



Average Flexural Strength of Concrete with Quarry Rock Dust in M40 Grade.

% of replacement Sand with Quarry Rock Dust	Average Flexural strength of the concrete at different ages(N/mm2)
0	8.90
50	10.30
75	7.91
100	6.86



By this table and graphs shows that there is an increase in compressive strength, split tensile strength, flexural strength with 0%, 50%, 75%, 100% replacement of sand with quarry rock dust and it decreases with after 50% replacement in both M30 and M40 grade of concrete.

CONCLUSION:

- Based on this experimental investigation it is found that Quarry Rock Dust as an alternative material to the natural sand.

- The physical and chemical properties of Quarry Rock Dust are satisfied the requirements of fine aggregate.
- If Quarry Rock Dust is replaced 50% of natural sand from the Quarry has obtained higher results then the normal conventional concrete.
- The strength of the Quarry Rock Dust concrete is comparatively 8-12% more than that of similar mix of conventional concrete.

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