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IMPACT OF SILICA FUME AND FLY ASH AS PARTIAL REPLACEMENT OF CEMENT AND QUARRY DUST AS PARTIAL REPLACEMENT OF SAND IN CONCRETE

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ABSTRACT

This paper presents an exploratory investigation on concrete with substitution of concrete and sand by silica Fume, fly ash and quarry dust. The work includes five sorts of blends. Configuration blend of M25grade concrete with substitution of 0%, 10%, 15%, 20%, and 25% of silica fume ,fly ash and quarry dust sorted out as M1, M2, M3, M4 and M5 individually have been considered for research investigation for compressive strength of concrete . The outcomes show that solid with 20% of silica fume, fly ash and quarry dust invigorates higher estimations of compressive than those with different examples of various level of silica fume , fly ash and quarry dust.

Keywords: *Concrete, Silica fume, Fly ash, Quarry dust, Compressive strength*

1. INTRODUCTION

Among all materials, concrete is the most generally utilized in development industry. From a little house to the extensive foundation ventures like dams, burrows, multi story structures and so on cement is being utilized. Being a flexible material, it is hard to supplant concrete with other development materials[1]. Concrete is a finely powdered material, which without anyone else's input isn't a folio, creates restricting properties because of hydration. Worldwide ecological associations proceeding to expand weight on the concrete and total businesses to decrease CO_2 outflows, and lessen the extraction of normally happening totals, new and inventive arrangements are continually being tried to give substitution materials which can be substituted for the essential aggregates[2].

Amid the most recent three decades, extraordinary steps have been taken in improving the execution of concrete as a development material. Especially Silica Fume and fly ash remains independently or in mix are key underway of high quality cement for functional application[3]. The utilization of silica fume as a pozzolana has expanded overall consideration over the ongoing years since when appropriately utilized it as certain percent, it can upgrade different properties of cement both in the new just as in solidified states like cohesiveness, quality, porousness and solidness[4]. Silica fume concrete might be fitting in spots where high abrasion resistance and low are of most extreme significance or where exceptionally high cohesive mixes are required to stay away segregation and bleeding[5].

Change of an unadulterated limestone makes transformative shake called marble. Limestone is made exclusively out of calcite (100% CaCO3) is absolutely white in appearance. Synthetically, marbles are crystalline rocks made overwhelmingly out of calcite, dolomite or serpentine minerals[6]. Cutting procedure of stone produced a lot of marble dust part of natural related issues can be created as we leave this residue in the earth. The progression in solid innovation can decrease the weight of contaminations on the earth and lessen the utilization of regular assets[7]. A great deal of mineral admixtures are utilized in the solid creation like impact blast furnace slag, silica fume, fly ash to minimize their hazards. These waste have gainful impact on concrete properties incorporate mechanical and strength viewpoints. Marble and rock grains and residue are viewed as waste materials amid generation of marble and stone items[8].

2. MATERIALS

2.1. CEMENT

Conventional Portland Cement (53 Grade) is utilized Cement is a fine, dim powder. It is blended in with water and materials, for example, sand, and total to make concrete. The concrete and water structure a glue that ties different materials together as the solid solidifies. The normal Portland concrete contains two essential fixings to be specific argillaceous and calcareous. In argillaceous materials mud prevails and in calcareous materials calcium carbonate prevails.

The physical properties of the concrete tried by Indian principles methodology affirms to the necessities of IS 10262-2009 and the physical properties are given in Table 1.

Table 1. Physical Properties of Cement.

SR.NO	PROPERTIES	RESULTS OBTAINED	STANDARD VALUES
1	Normal Consistency	33%	-
2	Initial Setting Time (minutes)	52	Not be less than 30 minutes
3	Final Setting Time (minutes)	330	Not be greater than 600 minutes
4	Soundness (mm)	2.3	<10
5	Fineness	8.5	<10
6	Specific gravity	3.15	-

2.2.FINE AGGREGATES

The sand utilized for the trial program of sifter examination. The sand was first sieved through 4.75 mm strainer to eliminate any particles more noteworthy than 4.75 mm and afterward was washed to eliminate the residue. The sand adjusting to zone I according to May be 383-1970 was utilized for making reference concrete. Properties of the fine total utilized in the test work are arranged in Table 2.

Table 2.Physical Properties Of Fine Aggregates.

Sr. No.	PROPERTIES	RESULTS OBTAINED
1	Type	Natural
2	Specific Gravity	2.45
3	Bulking	5.26 %
4	Dry Loose Bulk Density	1460 kg/m^3
5	Fineness Modulus	3.18
6	Water Absorption	1.6 %
7	Surface Texture	Smooth
8	Particle Shape	Rounded

2.3. COARSE AGGREGATE

A wide range of totals are appropriate. The ordinary greatest size is commonly 10-20 mm. Consistency of reviewing is of indispensable significance. Coarse total adjusting to IS 383-1970.

With respect to attributes of various kinds of total, squashed totals will in general improve the quality on account of the interlocking of the rakish particles, while adjusted totals improve the stream as a result of lower inner rubbing.

Table 3.Physical Properties of Coarse Aggregates (20 mm)

Sr. No	PROPERTIES	RESULTS OBTAINED
1	Type	Natural
2	Specific Gravity	2.67
3	Dry Loose Bulk Density	1530 Kg/m^3
4	Fineness Modulus	6.86
5	Water Absorption	0.6 %
6	Surface Texture	Rough
7	Particle Shape	Angular

2.4. WATER

By and large, water that is reasonable for drinking is acceptable for use in concrete. Water from lakes and streams that contain marine life likewise normally is reasonable. At the point when water is gotten from sources referenced over, no testing is fundamental. At the point when it is suspected that water may contain sewage, mine water, or squanders from mechanical plants or canneries, it ought not be utilized in concrete except if tests demonstrate that it is acceptable. Water from such sources ought to be dodged since the nature of the water could change because of low water or by irregular faucet water is utilized for projecting.

2.5. QUARRY DUST

Quarry rock dust can be defined as residue, tailing or other non-voluble waste material after the extraction and progressing of rocks to form fine particles less than 4.75 mm. The basic tests on quarry dust were conducted as per IS-383-1970 and its specific gravity was around 2.5. Wet sieving of quarry dust through a 90 micron sieve was found to be 87%.

Table 4. Physical Properties of Quarry Dust

SR.NO	PROPERTIES	RESULTS OBTAINED
1	Specific Gravity	2.50
2	Bulking	5.33%
3	Dry Loose Bulk Density	1800 Kg/m^3
4	Fineness Modulus	2.90
5	Water Absorption	0.5 %
6	Surface Texture	Rough

2.6.SILICA FUME

Silica fume is a byproduct of the manufacture of silicon and ferrosilicon alloys from highquartz and coal in a submerged-curve electric heater. Mineral admixtures are added to concrete for different purposes.

Table 5. Physical Properties of Silica Fume

SR.NO	PROPERTIES	RESULTS
1	Specific Gravity	2.2
2	Mean grain size(µm)	0.15

2.7.Fly Ash

Fly ash is a remaining material of vitality generation utilizing coal, which has been found to have various preferred advantage for use in cement**.**

Table 6. Physical Properties of Fly Ash

SR.NO	PROPERTIES	RESULTS
1	Color	Dark Grey
2	Mean grain size(µm)	2.2

3. METHODOLOGY

A concrete mix design can be proportioned from existing statistical data using the same materials, proportions, and concreting conditions. When there are no existing records or they are insufficient, the concrete mixture must be determined by trial mixtures. In a laboratory class situation, no body of field experience with the materials is assumed to exist. In concrete proportioning by the method of trial mixtures, certain design objectives must be established beforehand. These are as follows:

1. Required 28-day compressive strength, fck or some other strength parameter such as the modulus of rupture.

2. Portland cement content based upon water/cement (w/c) ratio and under certain conditions the minimum specified cement content.

3. Maximum allowable water/cement ratio.

4. Maximum size of the large aggregates.

Table 7.Mix Proportion For 1 Cubic Meter

Sr.No.	**Items (**For **M25** Grade of Concrete:)	**By Volume for 1 m^3**	**By Weight (Kg/m^3)**	**Ratio**
1.	Cement	0.138	435.45	1
2.	Water	0.191	191.6	0.44
3.	Fine Aggregate	0.268	656.60	1.508
4.	Coarse Aggregate	0.402	1073.34	2.465

Table 8.Obtain Mix Proportion For 1 Cubic Meter of Concrete

Mixture	**Cement (Kg/m^3)**	**Silica Fume (Kg/m^3)**	**Fly Ash (Kg/m^3)**	**Sand (Kg/m^3)**	**Quarry dust(Kg/m^3)**	**Water**	**Coarse Aggregate (Kg/m^3)**
M_1	435.45	-	-	656.60	-	191.6	1073.34
M_2	348.36	43.54	43.54	590.94	65.66	191.6	1073.34
M_3	304.81	65.31	65.31	558.11	98.49	191.6	1073.34
M_4	259.65	87.09	87.09	525.28	131.32	191.6	1073.34
M_5	217.73	108.86	108.86	492.45	164.15	191.6	1073.34

Where,

M_1 =Conventional Concrete

M2 = Concrete with 10% replacement of cement by silica fume and fly ashand 10% replacement of sand by quarry dust

M3 = Concrete with 15% replacement of cement by silica fume and fly ash and 15% replacement of sand by quarry dust

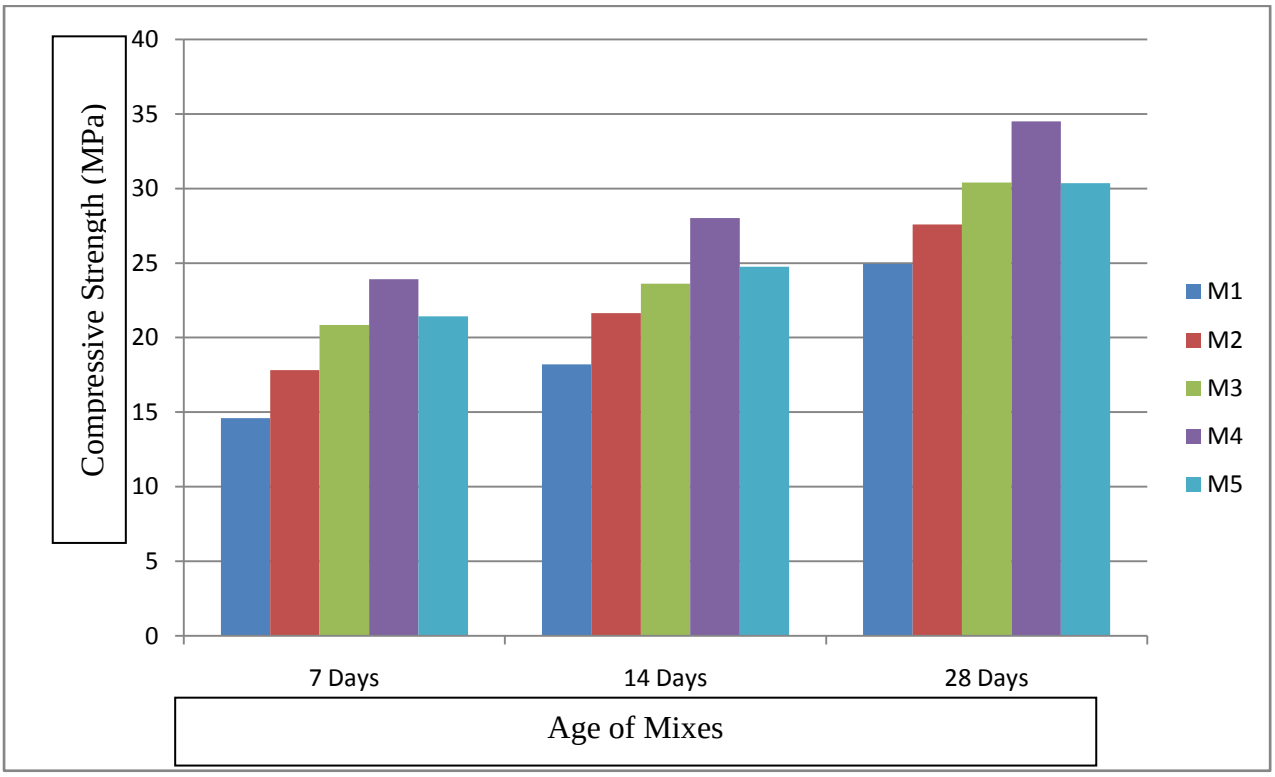
M4 = Concrete with 20% replacement of cement by silica fume and fly ash and 20% replacement of sand by quarry dust

M5 = Concrete with 25% replacement of cement by silica fume and fly ash and 15% replacement of sand by quarry dust

4.TEST RESULT AND INTERPRETATION

In order to study the effect on compressive strength when silica fume and fly ash is added into concrete as cement replacement and quarry dust as a replacement of sand the cubes of different proportion of concrete are prepared and kept for curing for 7,14 and 28 days. The test are conducted on compressive testing machine of capacity 2000 KN.

The results of compressive strength of cubes for (7, 14, 28) days curing are shown in Fig.1. It was observed that the compressive strength of cubes at 7 days curing for mixtures are 14.61,17.82,20.84,23.92 and 21.42 and for 14 days are 18.20,21.65,23.62,28.010and 27.75 and for 28 days 24.94,27.58,30.40,34.50 and 30.36. As the quarry dust content exceeds 25% the compressive strength decreases.



5. CONCULUSION

On the basis of experimentation work carried out, the following conclusions are drawn:

1. The increase in dust content up to 20% increases compressive strength of concrete, if the quarry dust content is more than 20% the compressive strength decreases gradually. But the compressive strength of quarry dust concrete continues to increase with age for all the percentage of quarry dust contents.

2. It is observed that by using environmental friendly material such as Fly ash and quarry dust the environmental pollution can bereduce.

3.The cost of a concrete gets decreased by using byproducts (fly ash and quarrydust)

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