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An Experimental Investigation on The Properties of Concrete By Partial Replacement of Cement With Silica Fume and Fine Aggregate with Quarry Dust

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ABSTRACT

Concrete is a construction material which is extremely used worldwide in most of constructions. Preparation of concrete involves the use of natural resources like sand, natural aggregates, water etc. The present boom in day by day growing constructions is leading to excessive use of concrete, thereby resulting in depletion of natural resources such as sand and natural aggregates. In fact, there is acute shortage of natural aggregates and this problem is faced by many countries in the world. On the other hand, due to demolition of old structures, many times it is very difficult to find a dumping place for such a huge amount of waste concrete. To overcome such kind of situation it may be a better approach to retrieve aggregates from the demolished waste and use it again in the preparation of concrete in any possible manner. This process may also help to preserve the natural aggregates to some extent and also in the reduction of cost of material. Practically, the quality of recycled aggregate concrete is not comparable due to the low density, high water absorption resulting low strength concrete. But this issue can be resolved using various kinds of admixtures which may improve the microstructure of concrete and hence will lead to improved quality of recycled aggregate concrete The aim of this experimental investigation is to find the influence of silica fume on the properties of recycled coarse aggregate concrete. The main purpose of this investigation is that using the recycled coarse aggregate is to minimize the waste disposal and to preserve natural resources

Keywords: Experimental Investigation, Partial Replacement of Cement With Silica Fume and Fine Aggregate with Quarry Dust, Water, Cement, etc.,

INTRODUCTION

Concrete is the most commonly used material in various types of constructions. Concrete is widely used for the construction of buildings, foundations, pavements, bridges, motorways, runways, parking structures, dams, reservoirs, pipes, fences and poles. The present day concrete demands high performance with economy. Concrete is a material with which any shape can be cast. It is the material of choice where strength, performance, durability, impermeability, fire resistance and abrasion resistance are required. It is difficult to find out other material of construction which is as versatile as concrete. Concrete is one of the seemingly simple but actually complex material. The properties of the concrete mainly depend on its constituents. The main important materials used for making concrete are cement, fine aggregate, coarse aggregate and water. The properties of cement, sand, crushed stone and water influences the quality of concrete. In addition to this, workmanship, quality control and method of placing also plays leading role on the properties of concrete. Cement is a hydraulic binder, i.e., an inorganic, non-metallic, finely ground substance which, after mixing with water, sets and hardens independently as a result of chemical reactions and, after hardening, the strength and stability remains the same even under water. The most important area of application is therefore the production of mortar and concrete, i.e., the bonding of natural or artificial aggregates to form a strong building material which is durable in the face of normal environmental effects. Each of the compound composition components of cement reacts at a different rate and tends to form different solid phases when it hydrates. The behaviour of each of these compounds have been studied by synthesizing it in its pure form and hydrating it under controlled conditions. 7 It should be noted that during the actual cement hydration process all the minerals dissolve into the same pore solution, and thus the solid hydration products are associated with the pore solution as whole rather than particular cement mineral. However, the individual reactions provide a good approximation of the overall hydration behaviour of cement. The water enters into chemical action with cement and this action causes the setting and hardening of concrete. The water lubricates the aggregates and it facilitates the passage of cement through voids of aggregates. This means that water makes the concrete workable. When water is added to cement, the ingredients of cement react chemically and form various complicated chemical compounds. The formation of these compounds is not simultaneous. The compounds are tricalcium aluminate, tetra-calcium alumino-ferrite, tricalcium silicate, dicalcium silicate. Tricalcium silicate is mainly responsible for imparting strength to the cement in early period of setting. Dicalcium silicate is responsible for giving progressive strength to the cement. The C-S-H gel is not only the most abundant reaction product, occupying about 50% of the paste volume, but it is also responsible for most of the engineering properties of cement paste. This is not because it is an intrinsically strong or stable phase but because it forms a continuous layer that binds together the original cement particles into a cohesive whole. All the other hydration products form as discrete crystals that are intrinsically strong but do not form strong connections to the solid phases they are in contact with and so cannot contribute much to the overall strength. The cement particles in fresh concrete, which are suspended in the mix water, cannot pack together as efficiently when they are in the close vicinity of a much larger solid object, such an aggregate particle. This effect is magnified by the shearing stresses exerted on the cement paste by the aggregate particles during mixing, which tend to cause the water to separate from the cement particles. The result is a narrow region around the aggregate particles with fewer cement particles, and thus more water. This is called the interfacial transition zone (ITZ). Thus the lower strength and stiffness of the ITZ translate directly into lower strength and stiffness values for concrete as compared to cement paste. The total volume of ITZ in a concrete increases with the total amount of large aggregate and with the average size of the aggregate, which explains why the strength is observed to decrease with both of these parameters. The ITZ is also more permeable than the bulk paste, due to its higher porosity. In most concretes the ITZs are linked (percolated), creating a continuous high permeability phase across the structure. As aresult, the permeability of concrete can be 1000 times greater than that of the pure cement paste it contains. The durability of concrete is inversely related to the permeability.

The organizational framework of this study divides the research work in the different sections. The Literature review is presented in section 2. Further, in section 3 shown Properties of material, in section 4 shown Results and discussions. Conclusion and future work are presented by last sections 5.

LITERATURE REVIEW

Abdulaziz A. Bubshait et al., (2002) investigated that the advantages of using micro silica can be considerable as it reduces thermal cracking caused by the heat of cement hydration and can improve durability to attack by sulphate and acidic water, giving increase in performance of concrete. The optimum replacement of cement by silica fume gave high durability, permeability, high compressive strength.

Faseyemi Victor Ajileye, (2012) concluded cement replacement up to 10% with silica fume leads to increase in compressive strength for M30 grade of concrete. From 15% there is a decrease in compressive strength for 3, 7, 14 and 28 days curing period. It was observed that the compressive strength of M30 grade of concrete was increased from 16.15% to 29.24% and 23 decrease from 23.98% to 20.22%. The maximum replacement level of silica fume was 10% for M30 grade of concrete.

N.K. Amudhavalli and Jeena Mathew, (2013) this research concluded that with increase in fineness of cement consistency increases. Silica fume is having greater fineness than cement and greater surface area so the consistency increases greatly, when silica fume percentage increases. The normal consistency increases about 40% when silica fume percentage increases. The normal consistency increases about 40% when silica fume percentage increases from 0% to 20%. The 7 and 28 days compressive strength and flexural strength was obtained in the range of 10% to 15% silica fume replacement level. Increase in split tensile strength beyond 10% silica fume replacement was almost unsatisfactory whereas increase in flexural tensile strength occurred up to 15% replacement. Silica Fume to have a more satisfactory effect on the flexural strength as compared to tensile strength. When the mix was compared to another mix the weight loss and compressive strength percentage was found to be reduced by 2.23 and 7.69 respectively when cement was replaced by 10% of silica fume.

Des King, (2012) investigated the impact of silica fume in concrete under various properties such as workability, permeability, durability, bleeding, heat of hydration, sensitivity to curing, acid resistance, tensile strength, flexural strength etc. He concluded that the 28th day strength of concrete with silica fume gives a higher strength of compressive strength as compared to any other material such as fly ash, GGBS etc. With addition of silica fume early high compressive strength can be achieved, further a very high strength can be achieved after 28 days with proper concrete mix design method.

Vikas Srivastava et al., (2012) worked out the workability of concrete on optimum replacement of silica fume by cement. Their research concluded that the workability reduces with the addition of silica fume. However in some cases improved workability was observed. With the addition and variation of replacement levels of silica fume the compressive strength significantly increased by (6-57%). There was no change observed in the tensile and flexural strength of the concrete as compared to the conventional concrete.

Debabrata Pradhan and D. Dutta, (2013) investigated the effects of silica fume on conventional concrete, concluded the optimum compressive strength was obtained at 20% cement replacement by silica fume at 24 hours, 7days and 28 days. Higher compressive strength resembles that the concrete incorporated with silica fume was high strength concrete.

Alaa M. Rashad et al., (2014) in his investigation the compressive strength and abrasion resistance of PC concrete, HVFA concrete and HVFA concrete blends with SF and slag was studied. He concluded that abrasion resistance was highly influenced irrespective of pozzoloan material. Both compressive strength and abrasion resistance decreased with the incorporation of 70 % FA compared to F70, especially at early age. The reduction rate decreased as curing time progressed. The replacement of 20 % SF gave good compressive strength and abrasion resistance and came in the second place, incorporation of 10 % SF came in the third place and incorporation of 10 % of equally combination of SF and slag (i.e. 5 % SF and 5 % slag) came in the fourth place.

Vishal S. Ghutke et al., (2014) concluded from their result that silica fume was a better replacement of cement. The strength of concrete gained in silica fume was high as compared to the concrete of only cement. They performed various tests by varying the water-cement ratio from 0.5 to 0.6 and analyzed their results which concluded -As the water-cement ratio increases the strength of concrete decreases. The target value of compressive strength can be achieved at 10% replacement of silica fume. The strength of 15% replacement of cement by silica fume was greater than the normal concrete. Therefore the optimum silica fume replacement percentage varies from 10% to 15%. Compressive strength decreases when the cement replacement was above 15% silica fume.

Celik et al., (1996) have reported that on increasing the dust content up to 10%, improved the compressive strength, flexural strength of concrete and drying shrinkage improved. However, the dust content exceeding 10 % decreased the compressive strength, flexural strength and drying shrinkage gradually. 25 Jain et al., (1999) reported that the use of quarry dust in concrete is desirable because of its benefits such as useful disposal of byproducts, reduction of river sand consumption as well as increasing the strength parameters and increasing the workability of concrete.

Sahu et al., (2009) concluded that adding 40% sand may be replaced by stone waste in concrete without compromising quality of concrete. It is used for different activities in the construction industries such as road construction, manufacture of building materials, bricks, tiles and autoclave blocks.

Patel et al., (2013) reported that the construction activities are taking place on huge scale all over the world and demand of construction materials are increasing day-by-day. Production of concrete and utilization of concrete has rapidly increased, which results in increased consumption of natural aggregate and sand.

Pofale and Quadri (2013) reported that compressive strength of concrete (M25 & M30) made using crusher dust increased at all the replacement level between 30 to 60% at a interval of 10%. However maximum increased in strength is observed at a replacement level of 40%.

Raman et al., (2005) studied the effect of quarry dust and found that the partial replacement of river sand with quarry dust without the inclusion of fly ash resulted in a reduction in the compressive strength of concrete specimen. It has also been reported that the reduction in the compressive strength of quarry dust concrete was compensated by the inclusion of fly ash into the concrete mix.

Reddy and Reddy, (2007) reported an increasing compressive strength by use of rock flour as fine aggregate instead of river sand. Ilangovana et al., 2008 reported strength of quarry rock dust concrete was comparably 10.12 % more than that of similar mix of conventional concrete.

Hameed and Sekar, (2009) studied effect of crushed stone dust as fine sand and found the flexural strength increases than the concrete with natural sand but the values decreases as 26 percentage of crusher dust increases. It has been reported by Reddy and Reddy, 2007 from their experimental study on use of rock flow and insulator ceramic scrap in concrete that the rock flow when used as fine aggregate increases the modulus of rapture thus the flexural strength. From the study of green concrete posses containing quarry dust and marble sludge powder it has been reported that the split tensile strength of green concrete was 14.62% higher at 7days and 8.66% higher at 28 days. But split tensile strength was found to be lesser by 10.41% at 3days than controlled concrete. Also reported the resistance of Green concrete containing crusher dust against sulfate attack ($MgSO_4$ and Na_2SO_4) is higher than the conventional concrete. Also they have reported acid resistance (H_2SO_4) is higher than the conventional concrete. The durability of quarry rock dust concrete under sulphate and acid action is higher than the conventional concrete. Similarly water Absorption found to be more in the concrete containing crusher dust. The overall workability value of quarry rock dust concrete in terms of slump as well as compaction factor was less in comparison to conventional concrete (Ilangovana et al., 2008).

Patel and Pitroda (2013) reported that every year 200-400 tons of Quarry Dust is generated by the stone cutting plants, and is dumped as waste. This leads to serious environmental and dust pollution. So it is necessary to dispose the Quarry Dust waste quickly and efficiently.

PROPERTIES OF MATERIAL

A. General

Concrete is a construction material composed of Portland cement, sand, crushed stone and water. The cement and water form a paste which hardens by chemical reaction into a strong, stone-like mass. No more cement paste should be used than necessary to coat all the aggregate surfaces and to fill all the voids. The concrete paste is plastic and easily molded into any form or trowelled to produce a smooth surface. Hardening begins immediately, but precautions are taken, usually by covering, to avoid rapid loss of moisture since the presence of water is necessary to continue the chemical reaction and increase the strength. Too much water, however, produces a concrete that is more porous and weaker. The quality of the paste formed by the cement and water largely determines the character of the concrete. Proportioning of the ingredients of concrete is referred to as designing the mixture. Concrete may be produced as a dense mass which is practically artificial rock, and chemicals may be added to make it waterproof, or it can be made porous and highly permeable for such use as filter beds. An air-entraining chemical may be added to produce minute bubbles for porosity or light weight. The gradual increase in strength is due to the hydration of the Tricalcium aluminates and silicates. Sand used in concrete was originally specified as roughly angular, but rounded grains are now preferred. The stone is usually sharply broken. The unit weight of concrete varies with the type and amount of rock and sand. Concrete is stronger in compression than in tension, and steel bar, called rebar or mesh is embedded in 32 structural members to increase the tensile and flexural Strengths. In addition to the structural uses, concrete is widely used in precast units such as block, tile, sewer, and water pipe, and ornamental products.

B. Cement

Grade (OPC – Ultratech Cement) was used for the investigation. It was tested for its physical properties in accordance with Indian Standard specifications. The properties of cement shown in Table 1.

Table 1: Table Type Styles Properties of Cement

S. No.	Property	Value
1	Specific Gravity	3.12
2	Normal Consistency	30 %
3	Setting Time i) Initial Setting time ii) Final setting time	90mins 330mins

C. Fine Aggregate

Fine aggregate / sand is an accumulation of grains of mineral matter derived from the disintegration of rocks. It is distinguished from gravel only by the size of the grains or particles, but is distinct from clays which contain organic materials. Sands that have been sorted out and 33 separated from the organic material by the action of currents of water or by winds across arid lands are generally quite uniform in size of grains. Usually commercial sand is obtained from river beds or from sand dunes originally formed by the action of winds. Much of the earth's surface is sandy, and these sands are usually quartz and other siliceous materials. The commercially used silica sand is 98% pure. Beach sands usually have smooth, spherical to ovaloid particles from the abrasive action of waves and tides and are free of organic matter. The white beach sands are largely silica but may also be of zircon, monazite, garnet, and other minerals, and are used for extracting various elements. Sand is used for making mortar, concrete, polishing and sandblasting. Standard sand is silica sand used in making concrete and cement tests. The fine aggregate obtained from river bed, clear from all sorts of organic impurities was used in this experimental program. The fine aggregate was passing through 4.75 mm sieve and the grading zone of fine aggregate was zone II as per Indian Standard specifications. The properties of fine aggregate is shown in Table 2, the sieve analysis of fine aggregate is shown in Table 3 and also the grading curves of fine aggregate is shown in Fig. 2.

Table 2: Properties of Fine Aggregate

S. No.	Property	Value
1	Specific Gravity	2.56
2	Fineness Modulus	2.6
3	Grading of Sand	Zone – II

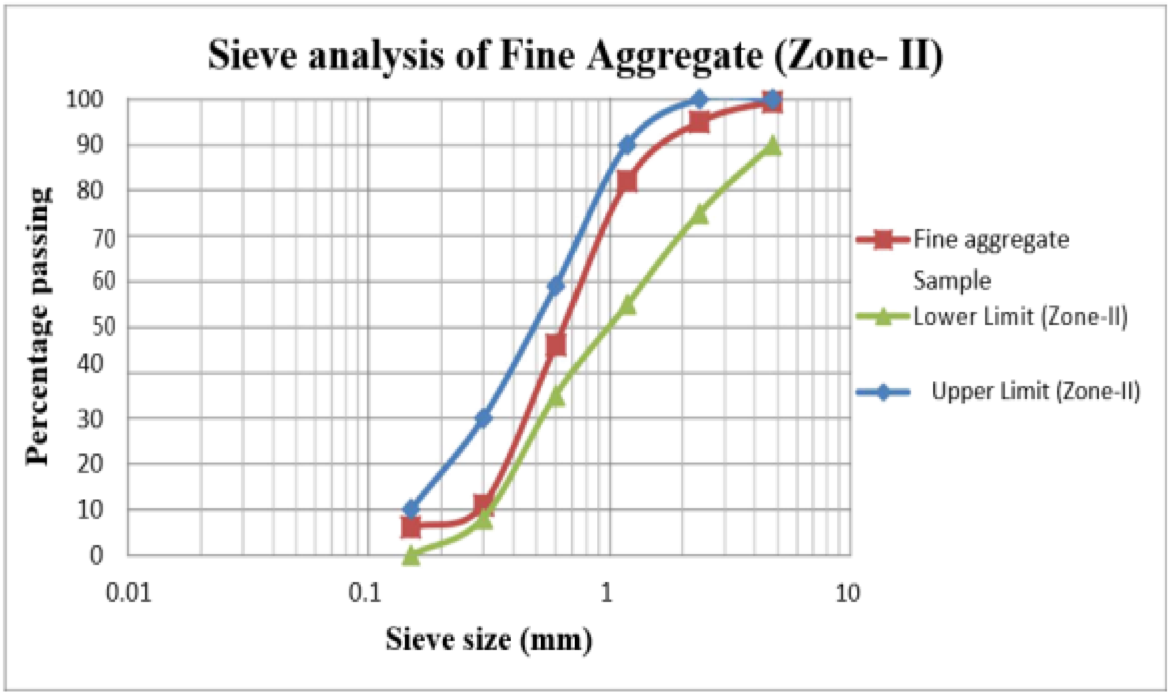

Figure 1. Particle size distribution of fine aggregate

D. **Coarse Aggregate**

Coarse aggregate are the crushed stone is used for making concrete. The commercial stone is quarried, crushed and graded. Much of the crushed stone used is granite, limestone and trap rock. Graded crushed stone usually consists of only one kind of rock and is broken with sharp edges. Machine crushed granite broken stone angular in shape was used as coarse aggregate. The maximum size of coarse aggregate was 20 mm .

E. Water

Water fit for drinking is generally considered fit for making concrete. Water should be free from acids, oils, alkalies, vegetables or other organic Impurities. Soft waters also produce weaker concrete. Water has two functions in a concrete mix. Firstly, it reacts with the cement to form cement paste in which the inert aggregates are held in suspension until the cement paste has hardened. Secondly, it serves as a vehicle or lubricant in the mixture of fine aggregates and cement.

F. Silica Fume

Silica Fume is highly pozzolanic mineral admixture, which is mainly utilized to improve concrete strength and durability of concrete. Silica Fume reacts with calcium hydroxide formed during hydration of cement results in the increase in strength and also the Silica Fume fills the voids between cement particles leads to increase in the durability. Silica Fume is procured from ASTRRA CHEMICALS, Chennai. The properties of Silica Fume are shown in Table 3 Fig. 2 shows the Silica Fume sample used for concrete preparation

Figure 2. Silica fume sample

Table 3: Physical Properties of Silica Fume

S. No.	Property	Result
1	Physical State	Micronised Powder
2	Odour	Odourless
3	Appearance	White Colour Powder
4	Colour	White
5	Pack Density	0.76 gm/cc
6	PH of 5% SOLUTION	6.90
7	Specific Gravity	2.63

G. Quarry Dust

The Quarry Dust used in the investigation is obtained from the quarry at Chandragiri near Tirupati Andhra Pradesh. The properties of Quarry Dust is shown in Table 4, the sieve analysis of Quarry Dust is shown in Table 4 and also the grading curves of Quarry Dust is shown in Fig. 3.

Table 4: Properties of fine aggregate (query dust)

S. No.	Property	Value
1	Specific Gravity	2.55
2	Fineness Modulus	3.3
3	Grading of Sand	Zone – I

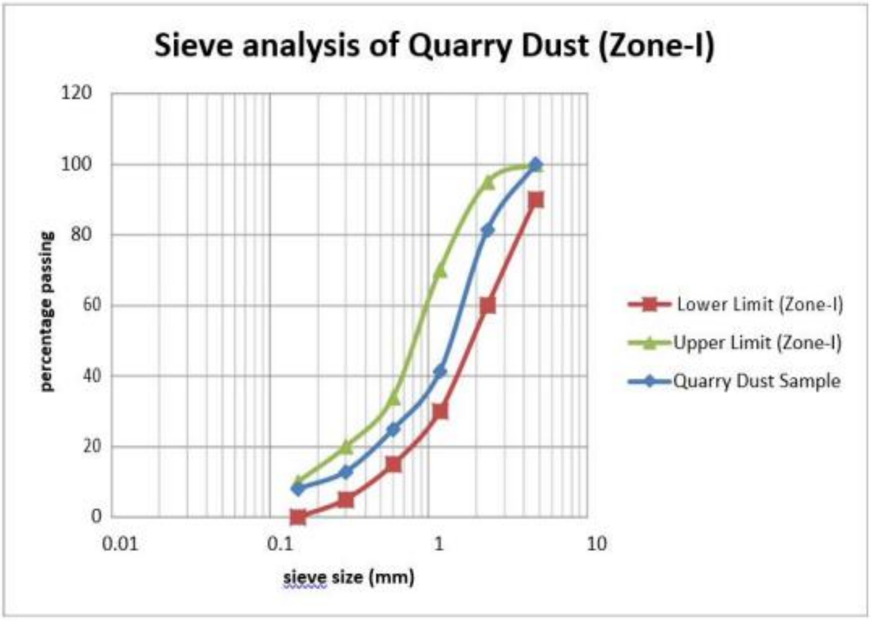

Figure 3. Particle size distribution of querry dust (zero-I)

RESULTS AND DISCUSSIONS

A. General

Tests were conducted on hardened concrete specimens to obtain the compressive strength, split tensile strength, flexural strength and modulus of elasticity. Standard procedures were adopted for testing.

B. Discussion of The Results

The results of the experimental investigations are presented and discussed herein. The experimental program was designed to compare the properties of compressive strength of cubes and cylinders, flexural strength, splitting tensile strength and modulus of elasticity of M30 grade concrete and with different replacement levels of ordinary Portland cement (Ultratech cement 53 grade) with Silica Fume and fine aggregate with Quarry.

C. Compressive Strength

The test results of compressive strength of M30 grade concrete with various proportions of Quarry Dust and Silica Fume is shown in Table 5. The variation of compressive strength of M30 grade concrete with different percentages of Quarry Dust and varying percentages of Silica Fume is shown in Fig. 4. The cube compressive strength indicates the average of three test results. It can be observed that the compressive strength of concrete prepared using Quarry Dust and Silica Fume exhibits more strength than the control concrete up to 10% of Silica Fume if the percentage of 60 Quarry Dust is 30%, 60% and with further increase in Silica Fume the compressive strength decreases.

Table 5: Cube Compressive Strengths of different types of concrete

Type of Concrete Mix	Silica Fume (%)	Quarry Dust (%)	Compressive Strength (MPa)				
			3 Days	7 Days	28 Days	56 Days	90 Days
Control Concrete	0	0	17.1	25.8	38.5	39.7	42.4
SF 0 % + QD 30 %	0	30	17.7	26.1	38.9	40.3	42.5
SF 0 % + QD 60 %	0	60	18.2	28.0	40.4	42.9	44.6
SF 0 % + QD 100 %	0	100	15.8	23.1	34.8	36.3	37.9
SF 5 % + QD 30 %	5	30	20.6	28.4	40.7	42.1	43.1
SF 10 % + QD 30 %	10	30	21.9	30.3	43.7	45.3	47.4
SF 15 % + QD 30 %	15	30	19.2	28.0	40.1	41.6	42.5
SF 5 % + QD 60 %	5	60	21.6	31.8	42.6	43.7	46.8
SF 10 % + QD 60 %	10	60	23.5	33.0	46.9	48.4	50.2
SF 15 % + QD 60 %	15	60	19.4	29.3	41.5	43.1	44.6

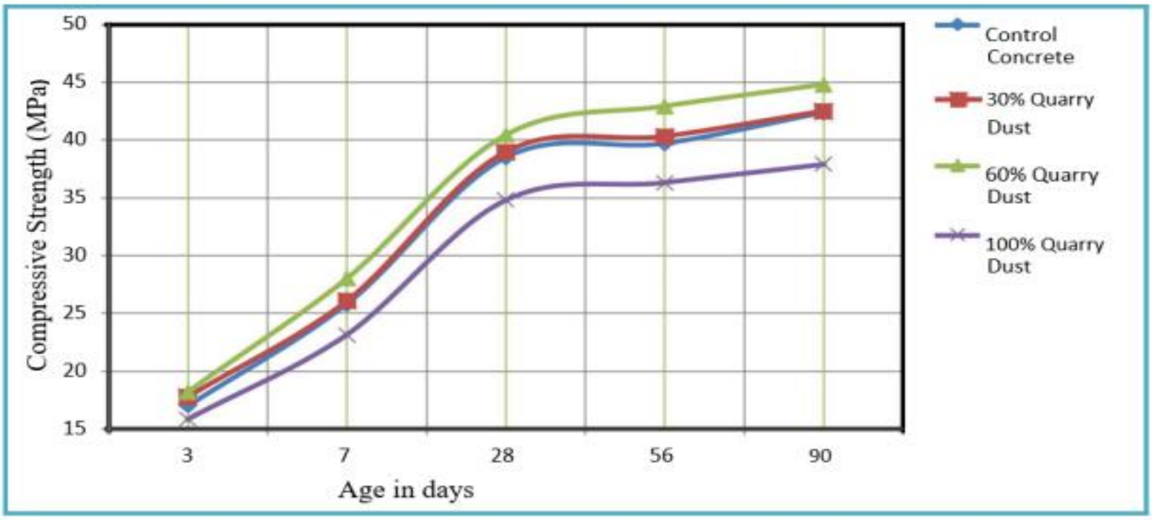

Figure 4. (i) Different percentages of querry dust

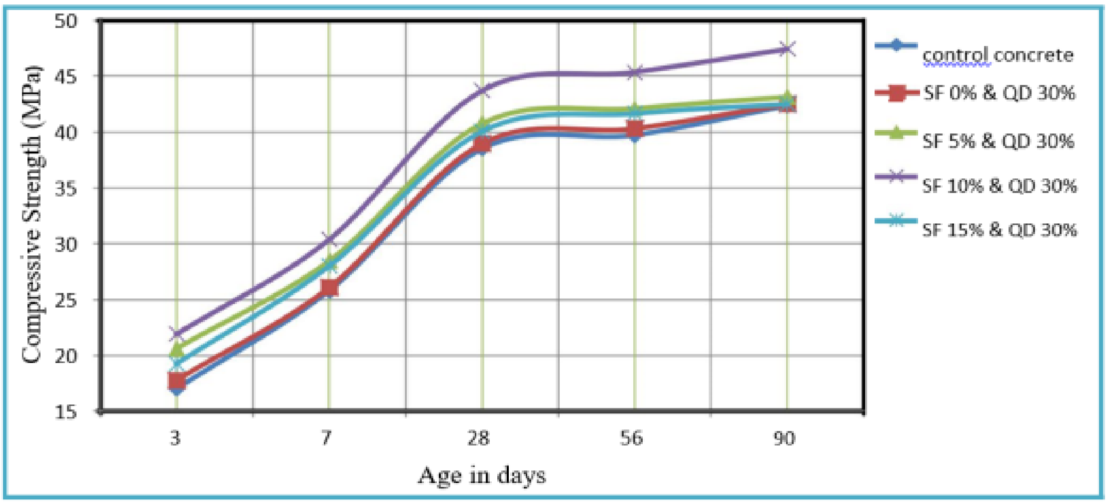

Figure 4. (ii) 30% quarry Dust

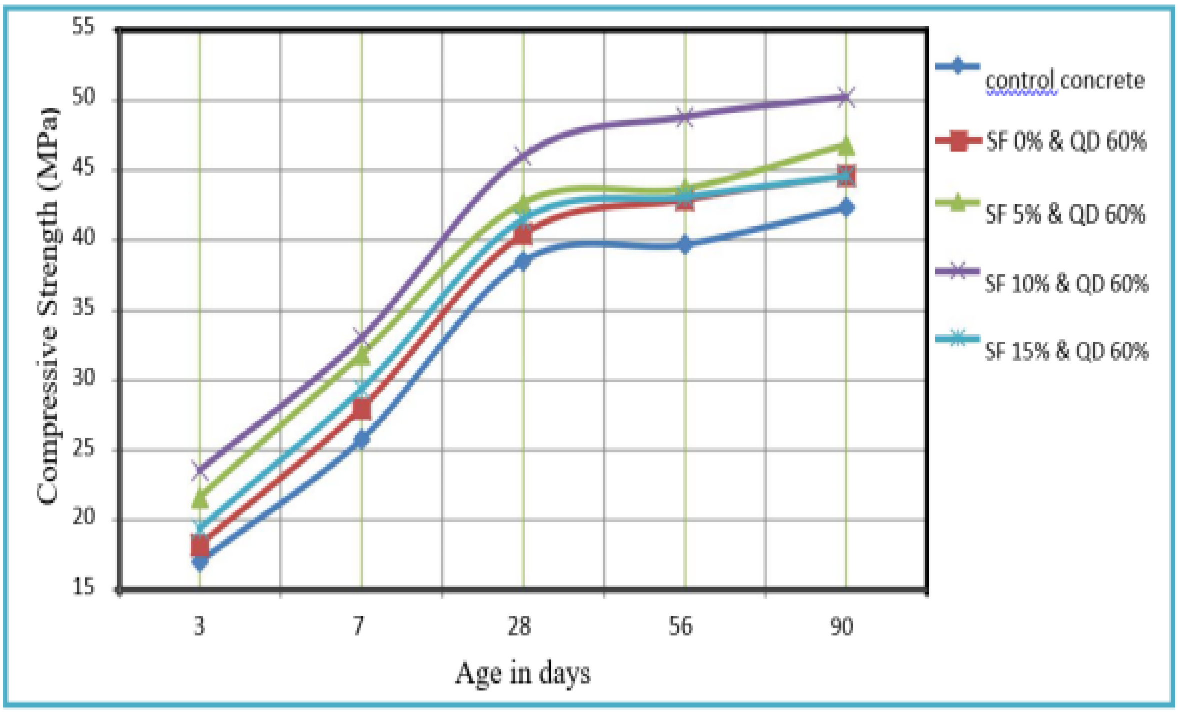

Figure 4. (iii) 60% Quarry Dust

D. Split Tensile Strength

The test results of split tensile strength of M30 grade concrete with various proportions of Quarry Dust and Silica Fume is shown in Table 6. The variation of split tensile strength of M30 grade concrete with different percentages of Quarry Dust and varying percentages of Silica Fume is shown in Fig. 5. The split tensile strength test was conducted at 28 days of curing. The split tensile strength of control concrete is 3.7 MPa. The split tensile strength of concrete initially increased up to 10% of Silica Fume for the given percentage of Quarry Dust and beyond which the split tensile strength decreases with increase in the Silica Fume. It can also be observed that at a combination of 10% of Silica Fume and 60% Quarry Dust combination maximum split tensile strength can be obtained.

Table 6: Split Tensile Strengths of different types of concrete mixex

Type of Concrete Mix	Silica Fume (%)	Quarry dust (%)	Split Tensile Strength (MPa)
Control Concrete	0	0	3.7
SF 0 % + QD 30 %	0	30	3.9
SF 0 % + QD 60 %	0	60	4.0
SF 0 % + QD 100 %	0	100	2.8
SF 5 % + QD 30 %	5	30	4.1
SF 10 % + QD 30 %	10	30	4.3
SF 15 % + QD 30 %	15	30	3.8
SF 5 % + QD 60 %	5	60	4.2
SF 10 % + QD 60 %	10	60	4.3
SF 15 % + QD 60 %	15	60	4.0

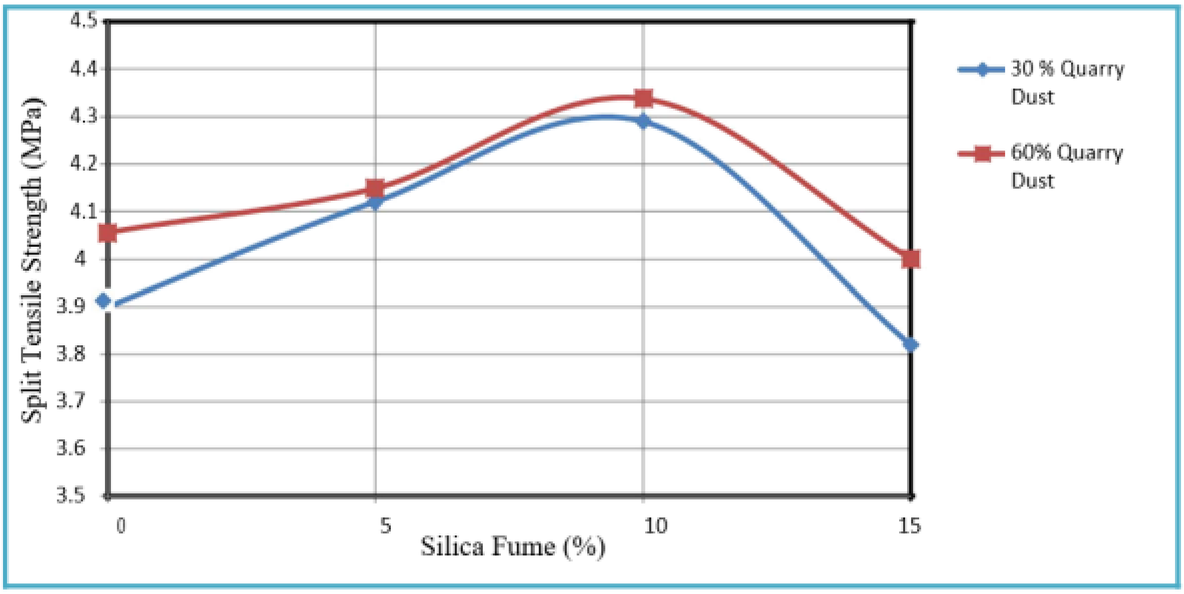

Figure 5. Variation of split tensile strength of concrete with different percentages of silicon fume and quarry dust

E. Flexural Strength

The test results of flexural strength of M30 grade concrete with various proportions of Quarry Dust and Silica Fume is shown in Table 7. The variation of flexural strength of M30 grade concrete with different percentages of Quarry Dust and varying percentages of Silica Fume is shown in Fig. 6. The flexural strength test was conducted at 28 days of curing. The flexural strength of control concrete is 4.6 MPa. The variation of flexural strength of concrete initially increases up to 10% percentage of Silica Fume for different percentage of Quarry Dust and then with further increase in the Silica Fumes the flexural strength decreases. The recommended combination for maximum split tensile strength is 10% of Silica Fume and 60% Quarry Dust.

Table 7: Flexural strengths of different types of concrete mixex

Type of Concrete Mix	Silica Fume (%)	Quarry dust (%)	Flexural Strength (MPa)
Control Concrete	0	0	4.6
SF 0 % + QD 30 %	0	30	4.8
SF 0 % + QD 60 %	0	60	5.0
SF 0 % + QD 100 %	0	100	3.6
SF 5 % + QD 30 %	5	30	5.9
SF 10 % + QD 30 %	10	30	6.3
SF 15 % + QD 30 %	15	30	5.2
SF 5 % + QD 60 %	5	60	6.0
SF 10 % + QD 60 %	10	60	7.2
SF 15 % + QD 60 %	15	60	5.8

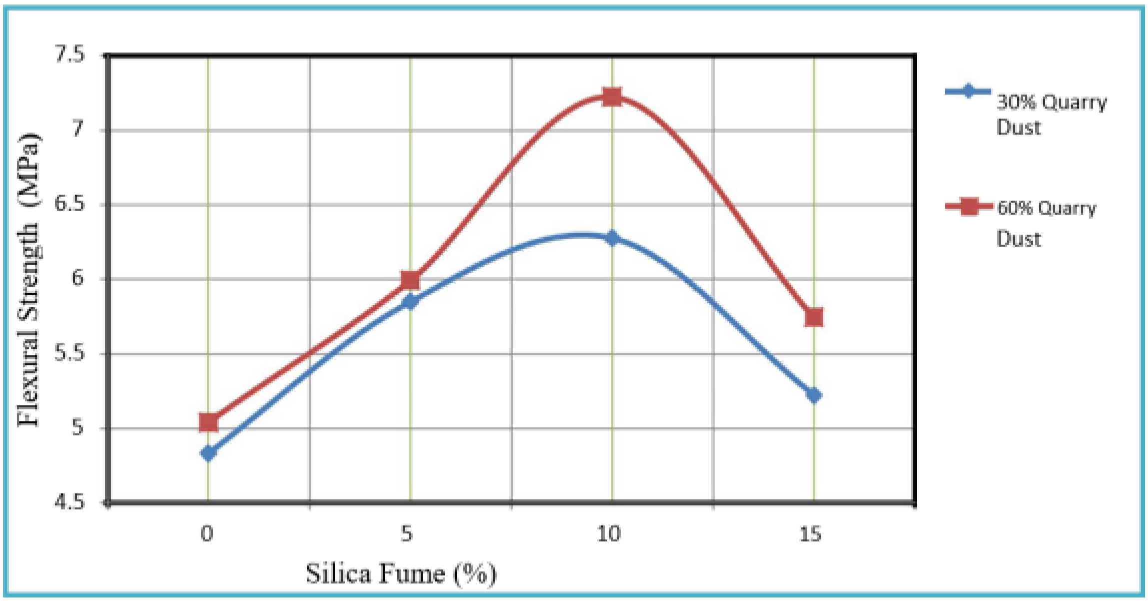

Figure 6. Variation of flexural strenghts of concretev with different percentages of silica Fume and Quarry dust

F. Modulus of Elasticity

The test results of modulus of elasticity of M30 grade concrete with various proportions of Quarry Dust and Silica Fume is shown in Table 8. The variation of modulus of elasticity of M30 grade concrete with different percentages of Quarry Dust and varying percentages of Silica Fume is shown in Fig. 7. The modulus of elasticity test was conducted at 28 days of curing. It can be observed that the modulus of elasticity of concrete increases with Silica Fume for the given content of Quarry Dust. The maximum value is obtained at 10% Silica Fume and 60% Quarry Dust. The M30 grade control concrete has modulus of elasticity of 24.9 GPa.

Table 8: Modulus of Elasticity of different types of concrete mixes

Type of Concrete Mix	Silica Fume (%)	Quarry Dust (%)	Modulus of Elasticity (GPa)
Control Concrete	0	0	27.0
SF 0 % + QD 30 %	0	30	27.1
SF 0 % + QD 60 %	0	60	27.5
SF 0 % + QD 100 %	0	100	25.9
SF 5 % + QD 30 %	5	30	27.9
SF 10 % + QD 30 %	10	30	28.5
SF 15 % + QD 30 %	15	30	27.5
SF 5 % + QD 60 %	5	60	28.3
SF 10 % + QD 60 %	10	60	29.2
SF 15 % + QD 60 %	15	60	28.2

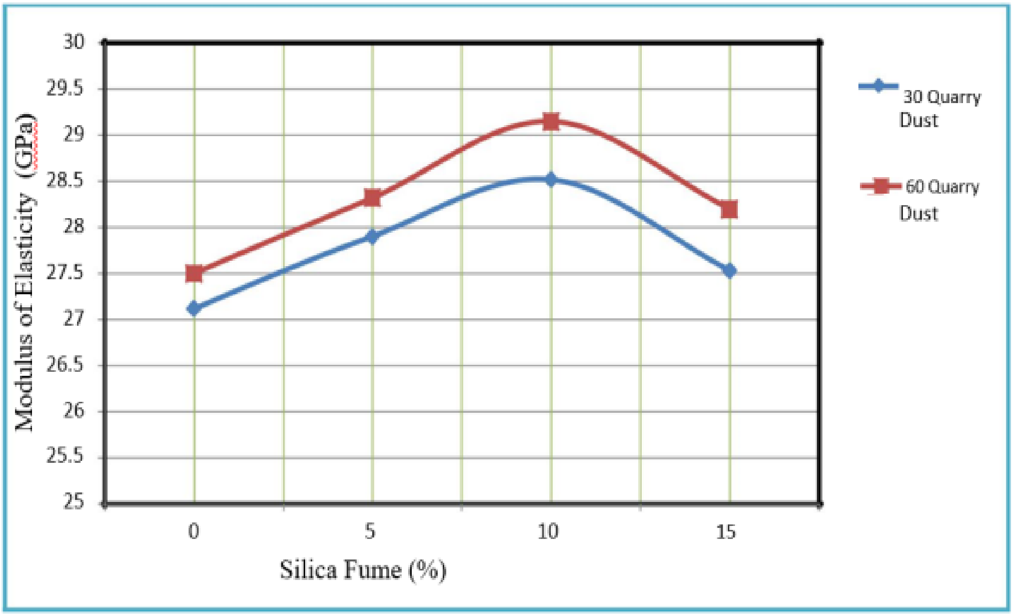

Figure 7. Variation of modulus of elasticity of concrete with silica Fume for different percentages quarry dust

CONCLUSION

The results of the experimental investigation indicate that the combination of Quarry Dust can be used as partial replacement of fine aggregate and Silica Fume can be used as Ordinary Portland cement replacement for concrete preparation.

1. Using the test results, it can be concluded that with the increase in the percentage of Silica Fume for different percentages of Quarry Dust, the various strength properties of concrete are increased up to 10% of Silica Fume and with further increase in the Silica Fume the properties of concrete are decreased.
2. It is very interesting to note that the variation of compressive strength, split tensile strength, flexural strength and modulus of elasticity of M30 grade Quarry Dust concrete with various percentages of Silica Fume indicates the similar trend.
3. The increase in various strength properties of concrete containing Quarry Dust with increase in the Silica Fume content can be due to the availability of additional binder in the presence of Silica Fume. The Silica Fume reacts with the calcium hydroxide to form additional binder material. The availability of additional binder leads to increase in the paste-aggregate bond, results in improved strength properties of the concrete prepared with Silica Fume.
4. The decrease in the strength characteristics of concrete with increase in the Silica Fume content beyond 10% is due to the poor quality of binder formed in the presence of high content of Silica Fume.
5. The various strength characteristics of concrete can be improved by the combined application of 10% Silica Fume and 60% Quarry Dust.

Future Work

The influence of Silica Fume and Quarry Dust can be investigated on durability properties of concrete. The impact resistance of the concrete can be also determined.

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