EEFECT OF COMPRESSIVE STRENGTH WITH AND WITHOUT COARSE AGGREGATE USING FLY ASH AND SILICA FUME ON HIGH STRENGTH CONCRETE

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Abstract - *The report presents an experimental study on the influence of aggregate sizes and silica fume compressive strength, flexural strength and split tensile strength which are the mechanical properties on concrete by using fly ash and super plasticizer to make a high strength concrete. The influences of silica fume, type, and size of aggregate on the pre peak and post peak response of high strength concretes in bending were investigated by measuring the fracture energy, the characteristic length, and brittleness index. Degradination of stiffness and strength were also measured, and unique focal point was determined using unloading-reloading cycles during the tests. The degradation of stiffness was correlated to the local fracture energy, strength degradation permanent crack mouth opening displacement (CMOD), and permanent displacement at mid span. It was shown that relations between normalized stiffness, load, local energy, CMOD, and deflection were independent of the partial replacement of cement by silica fume and of the type and size of aggregate. In gravel aggregate concretes with and without silica fume, cracks developed around the aggregates and generally did not traverse them, due to participle shape and smooth surface, however, in concretes with silica fume, crack surfaces were less tortuous and fracture was in a more brittle manner. Test results are reported from an experimental study in which the effect of four coarse aggregate types, on the mechanical properties of low water-cement ratio mixes, namely compressive strength and flexural strength was investigated. Firstly design of high strength concrete mix of M60 has made using Erntroy and Shock lock's Empirical Graphs .The 10mm granite chips have been employed for all mixes.*

1 .INTRODUCTION

For over ten years, the international community has taken great strides with implementing High Performance Concrete (HPC) technology in an effort to extend the service life of structures and bridges. Forty-five U.S. Departments of Transportation, the District of Columbia, Puerto Rico and several Federal agencies responded to a recent survey that they have incorporated HPC specifications in projects involving either bridge decks, superstructures and/or substructures (See enclosed map). These projects took advantage of either the high strength or high durability attributes of HPC, or both. The term HPC is used to describe concretes that are made with carefully selected high quality ingredients, optimized mixture designs, and which are batched, mixed, placed, consolidated and cured to the highest industry standards. Typically, HPC will have a water-cementations materials ratio (w/cm) of 0.4 or less. Achievement of these low w/cm concretes often depends on the effective use of admixtures to achieve high workability, another common characteristic of HPC mixes. HPC is advancement in concrete technology that has become commonplace and the state-of-the-practice, rather than the exception to the rule. It has provided transportation departments a construction material with characteristics engineered to ensure satisfactory performance throughout its intended service life.

1.1 High Performance Concrete Material and Performance Characteristics

Different characteristics of concrete in the fresh and hardened states affect performance. In the fresh state, flow ability is an important characteristic. It describes the ease or difficulty of placing the concrete depending on the equipment available. The adequacy of flow for a specific job will affect the quality of the finished product. Concrete with high flow ability is easy to place and facilitates the removal of undesirable air voids in concrete. In fact, self-consolidating concrete (SCC) is available that flows through heavily reinforced areas or demanding places and consolidates under its own mass. Well-consolidated concretes (either through mechanical vibration or mix design, as in SCC) are essential in achieving low permeability for long-lasting structures. The important characteristics of concrete in the hardened state mainly relate to durability and structural design. The performance characteristics related to durability include freeze-thaw resistance, scaling resistance, abrasion resistance, chloride ion penetration, alkali-silica reactivity, and sulfate resistance. The four structural design characteristics are compressive strength, modulus of elasticity, shrinkage, and creep. The characteristics are determined using standard test procedures, and grades of performance are suggested for each characteristic. Durability is of utmost importance for structures exposed to the environment and concrete for each structure may need one or more of these characteristics. The material characteristics and grades should be selected in accordance with the intended application and the concrete's environment. For example, a bridge deck supported on girders needs a specified compressive strength but is unlikely to require specified values for modulus of elasticity and creep. It is not necessary to require all performance characteristics for a given application.

1.2 Structural Design for High Performance Concert

More cost effective designs are possible with HPC. This is due to the enhanced mechanical properties and the improved durability characteristics of HPC. The performance benefits give the designers greater flexibility in selecting the type and size of a bridge and bridge elements. The designers are able to use less materials, fewer beams and longer spans for their HPC projects. The long-term durability of HPC results in lower maintenance and fewer repairs. All these sum up to lower construction and life-cycle costs. The three basic cost elements of a concrete structure are materials, labor, and markup. Each cost element is affected when HPC is used. The primary materials in a concrete structure are concrete, prestressing steel and non-prestressed steel reinforcement. The demand for higher performance naturally leads to higher material costs: (1) Concrete - An HPC mix is roughly 30 to 40 percent more expensive than a conventional concrete mix. This is primarily due to a higher cementitious material content. It is important for the designers to specify the minimum required concrete strength at each stage of construction, such as at release of prestress, at handling and shipping, form removal, and in service. This allows the contractor and fabricator to select the least expensive mix to achieve the design objectives and reduces the risk associated with achieving high concrete strengths. (2) Prestressing Steel - More prestressing steel is required to develop the higher prestress levels possible. The use of 0.6-inch diameter strand is often necessary to provide these higher prestress levels. Currently, 0.6-inch diameter strand costs slightly more than a ½-inch strand on a unit weight basis. However, since fewer strands are needed when using 0.6-inch strands, the overall cost may not be significantly different. The designers may consider optimizing the girder sections for greater economy. (3) Non-prestressed Reinforcement - The use of steel reinforcing bars in prestressed girders is nominal. No significant increase in cost is expected. The labor required for the construction and fabrication of an HPC structure is not much different than for conventional concrete structures. For fabrication plants that have not utilized HPC, the startup labor cost may be increased due to some changes in standard tooling

2. Meaning of Silica Fume

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. It is usually a gray colored powder somewhat similar to Portland cement or some fly ashes

2.1 Production of Silica Fume

Silicon metal and alloys are produced in electric furnaces .These metals are used in many industrial applications like steel production, aluminum production, and computer chip fabrication. The raw materials like quartz, coal and woodchips will be used to produce silica fume. The smoke that results from furnace operation is collected and sold as silica fume. Today in the United States, no silica fume is allowed to escape to the atmosphere

Table -1: Silica Fume Production Chart

Silica Fume: Production
↓
Raw Materials
(Quartz, Coal and Wood Chips)
↓
Furnace
(Temperature 2000c)
↓
Off Gas
↓
Bag House Filter
As Produced Silica Fume

2.2 Properties of Silica Fume

Silica fume consists of Amorphous and Silicon Dioxide ($Si0_2$) .The individual particles are extremely small, approximately 1/100th, the size of an average cement particles. Because of its fine particles, large surface area, and the high $Si0_2$ content, silica fume is a very reactive pozzolan when used in concrete. Amorphous: This term simply means that silica fume is not a crystalline material. A crystalline material will not dissolve in concrete, which must occur before the material can react. It should be noted that there is a crystalline material in concrete that is chemically similar to silica fume. That material is sand. Silicon Dioxide ($Si0_2$) .This is the reactive material in silica fume. Silicon Dioxide should be more than 85% in the silica fume. Silica fume particles are extremely small, with more than 95% of the particles being less than one micrometer. The particles size is extremely important for both the physical and chemical contribution of silica fume in concrete. The bulk density of the as-produced fume depends upon the metal being made in the furnace and upon how the furnace is operated. Because the bulk density of the as-produced silica fume is usually very low, it is not very economical to transport it for long distance. Specific Gravity is a relative number that tells how silica fume compares to water. Silica fume has a specific gravity of about 2.2, which is some what lighter than Portland cement, which has a specific gravity of 3.15 .Thus, adding silica fume to a concrete mixture will not "densify" the concrete in terms of increasing the density of the concrete. Adding silica fume bring million and millions of very small particles to a concrete mixture. Just like fine aggregates fills in the spaces between coarse aggregate particles, Silica Fume fills in the spaces between cement grains. Because of its very high amorphous silicon dioxide content silica fume is very reactive pozzolanic material in concrete. As the Portland cement in concrete begins to react chemically, it releases calcium hydroxide .The silica fume react with this calcium hydroxide to form additional binder material called calcium silicate hydrate.

3.0 STATEMENT OF THE PROBLEM

Keeping the importance of the Silica fume in view, an attempt has been made in the present study to examine the Effects of Compressive Strength With and Without Coarse Aggregate on High Strength Concrete by using Fly Ash and Silica Fume .More specifically the project work has been carried out. a) To find out the compressive strength of granite chips of 10mm. b) To find out the flexure strength of granite chips of 10mm.c)To find out the split tensile strength of granite chips of 10mm.

4.0 REVIEW OF LITERATURE

Aykut Cetin and Ramon L Carrasquillo reported the test results from the experimental study in which the effect of four coarse aggregate types, locally available in central texas, on the mechanical properties of low water cement ratio mixes, namely compressive strength, elastic modulus, and flexural strength was investigated. Crushed river gravel, trap rock, dolomitic limestone and calcitic limestone were used in high performance concrete production in varying amounts: 36, 40, and 44 percent by concrete volume. A constant water cement ratio of 0.28 was employed for all mixes

The mineralogical characteristics of coarse aggregate , as well as the aggregate shape, surface texture and hardness, appear to be responsible for the differences in the performances of HPC .It was observed that HPC with different coarse aggregates appears to lack single equation that estimates the elastic modulus with sufficient accuracy as in the case of normal strength concretes. This cloud be attributed to the increased role of coarse aggregate in concrete mixes with low water cement ratios as results of improved cement paste and transition zone. The Conclusions drawn are confined to the HPC defined and based on the experimental results described. Increasing the coarse aggregate content beyond 40 percent appears to reduce comp revise strength. Similar compressive strength test results for concretes with 36 and 40 percent aggregate content suggest that the optimum aggregate content is some where between 36 and 40 percent for the aggregate used and at this cement content level. Concretes incorporating crushed gravel exhibited low compressive strength. This could be explained by the lack of good mechanical bonding due to aggregate shape and surface texture. Concretes with smaller size aggregate exhibits higher compressive strength at a given aggregate content level. This could be attributed to the improved bound and more homogenous behavior of concrete. Increasing coarse aggregate content appears to result in a reduction in flexural strength for a given aggregate size. Increasing aggregate content translates into increased interfacial area that is potentially weaker in tension than mortar or aggregate. Elastic modules appear to be independent of aggregate size for a aggregate content. This is because bond strength is not likely to be a critical factor to influence the elastic modulus test results at such low loading level. No single equation seems to represent the elastic modulus of HPC with sufficient accuracy. This cloud be explained by the increased role of coarse aggregate in HPC's as a results of the improved paste. Due to the lack of a good estimation for the elastic modulus of HPC's , theses values need to be included in the specifications. For analysis, the measured values should be used instead of any predicted once the influence of aggregate on the compressive strength of concrete. A first distinction is made between topological and mechanical aspects. The quantitative measurement of the three effects of aggregate on compressive strength gives accuracy close to 2.2 mpa, on the studied mixes. Such a model is suitable to be incorporate into software for computer – aided mixture – purporting and quality – control of structural concrete, up to the high performance concrete range. Analysis may be surmised. The paste has a certain compressive strength, depending on mixture-proportioning parameters (water cement ratio amount of supplementary cementitious material, etc. Becoming the matrix of a granular skeleton, the strength of the paste undergoes a modification, due to its maximum thickness (mean distance between two adjacent coarse aggregates); the lower this distance, the higher the matrix strength. For high matrix strength, an additional effect is exceeded by some aggregate, when the desired concrete strength approaches the inherent strength of the rock. Ozkan Sengul,Canantasdemir , and Mehmet Ali Tasdemir investigated the Effect of aggregate type on the mechanical properties of both normal and high strength concretes under compressive loading.. Basalt, sandstone, and Triassic and Devonian crushed limestone coarse aggregate were used in the concretes. For each coarse aggregate type, six concrete mixtures were made with the same Portland cement and natural sand. In each classes, nominal slump, effective, water cement ratio, and cement content were kept constant. In all concrete mixtures, the grading and maximum particles size were the same.

In low-or moderate-strength concretes, Triassic limestone containing concrete had the highest compressive strength. In high-strength concrete, however, the compressive strength of basalt containing concrete had the highest value. In High-strength concrete, the hysteresis loops of Triassic and Devonian lime stone concrete are generally narrower than those of basalt and sandstone concrete. It can be concluded that the irreversible energy up to prepeak stress in compression decreases significantly and the loop becomes narrower with an increase in compressive strength. The brittleness index increases substantially with the compressive strength of concretes. The results obtained can be summarized.

In c18 and c25 concretes with Triassic crushed limestone aggregate, strength is significantly higher than those of Devonian limestone, sandstone, and basalt. In concretes with Devonian limestone, sandstone and basalt, elastic mismatch of aggregate matrix is significant. In concretes with Triassic crushed limestone, however, elastic modulus of aggregate is closer to that of the matrix; thus, more uniform stress concentration may occur at the aggregate matrix interface. Therefore cracks will be forced to pass through the aggregate, resulting in a more brittle behavior and transgranular type of fracture. The water absorption and the born characteristics of the triassic limestone may also play a positive role in the compressive strength. High values of the strength in these concretes with triassic limestone can be attributed to the strong interfacial zone between the aggregate and the mortar matrix. In each concrete class. Sandstone concrete has the lowest elastic modulus. In high strength concretes Devonian limestone, and especially basalt, give significantly higher elastic modulus value than sandstone and Triassic limestone. In high strength concrete hysteresis loops of Devonian and Triassic limestone concretes are generally narrower than those of the basalt and sandstone concretes. A narrow hysteresis loops can be considered as an indication of a strong matrix aggregate transition zone:] Based on the hysteresis loops obtained for each concrete class , it can be concluded that irreversible energy up to prepeak stress in compressive decreases significantly , and the loops become narrower with an increase in compressive strength of concrete. In each concrete class, sandstone concrete has the lowest elastic modulus E. In high-strength concrete, Devonian limestone, and especially basalt, gives significantly higher E value than sandstone and Triassic limestone. The brittleness index increases significantly with the compressive strength of concretes. Especially in concrete with silica fume, they become stronger and more homogeneous; as a result, fracture occurs in more brittle manner.

In an other investigation Nadoor Ghafoori and Hamidou Diawara evaluate the influence of silica fume content on the strength and the resistance of wear of 3- , 7-, 28- and 91 day moist cured concretes made with 0, 5, 10, 15, and 20% of silica fume replacing a portion of the fine aggregate: and influence of various combinations of curing schemes on the strength and resistance to abrasion of the selected fine aggregate replaced silica fumed concretes. A uniform cement factor of 385kg / m^3 and constant water cementitious material ratio of 0.325 are used in all trial mixtures. The fresh and bulk characteristics such as slump, air content, and time of setting, bleeding, unit weight and compressive strength are obtained to characterize the selected matrix. The procedure is used to evaluate the resistance to wear. The compressive strength and abrasion resistance of the fine aggregate replaced silica fume concretes cured under a continuous moist curing condition and various combinations of wet - dry curing cycles are compared. The relationships among depth of wear, compressive strength, percentage of silica fume content, and curing ages are also studied. The laboratory test results conclude that both the compressive strength and resistance to wear peaked at ten percent of silica fume content. The silica fume incorporation in concrete by way of fine aggregate replacement did not later the samples' compressive strength when subjected to various combinations of wet- dry curing cycles. When compared with continuous moist curing , the selected cycle wet , dry curing conditions caused a modest reduction in resistance to abrasion that are varied with silica fume contents , curing cycles, and curing schedules . There was statistically significant correlation between dependent variable and independent variable for the samples aged under continuous moist curing conditions. The results obtained can be summarized Independent of the curing type and age , the contribution of silica fume incorporated in concrete by the way of fine aggregate replacement peaked at 10% of the silica fume content for both compressive strength and resistance to wear . When a silica fume added was extended beyond the optimal dose of 10% of the weight of the Portland cement. Specimen experienced a gradual reduction in both and surface properties After 28 days of continuous moist curing specimens made with 5,10,15,20 % of silica fume (as a partial replacement of fine aggregate) showed grains in compressive strength of 25, 64, 42, and 25 % respectively. When compared with that of the reference mixture. The same silica fume concretes showed varied resistance improvement of 32, 49, 42 and 25 %. When compared with that of that of the control concrete. The result of the statistical regression studies revealed the presence of a strong relationship between dependent variable (ultimate depth of wear) and independent variables (compressive strength .silica fume addition and curing age).

Independent of the silica fume content and curing scheme, both compressive strength and abrasion resistance of fine aggregate-replaced silica fume concrete improved with increases in wet dry curing cycles. The average gains of 11, 13, and 10 % in compressive strength were experienced between two consecutive cycles of curing schemes respectively. Theses gains were approximately 11, 13, and 16% for the abrasion resistance recorded after 20 minutes of testing. Although strength developed and resistance to wear of fine aggregate replaced silica fume concretes were affected by cycled curing .The exposed surface of the test sample did not show any signs of micro cracking due to the drying and shrinkage from the air exposure . The lack of surface damage may be attributed to the super fineness and pozzolanic contributions of silica fume and selected with dry curing conditions Keeping the literature on silica fume in view, an attempt has been made in the present work to find out the compressive strength, flexure strength, and elastic modulus and split tensile strength of granite chips of 10mm.

5.0 Methodology

Design of High Strength Concrete Mix using Erntroy and Shocklock's Empirical Graphs

28 days cube strength = 60 N / mm^2

Very good quality control

Control factor = 0.8

Degree of workability – very low

Type of cement used – ordinary Portland

Type of fine aggregate used – Natural sand

Type of coarse aggregate used – Crushed Granite (Angular) 10mm

Specific gravity of cement = 3.15

Specific gravity of sand = 2.60

Specific gravity of coarse aggregate = 2.50

Free surface moisture: fine aggregate - 5%, coarse aggregate -1%,

Mix Design

Average strength (σ_t) = Strength / Control factor = 60 /0.8= 75N/mm^2

Water/cement ratio 0.32

Aggregate/cement ratio 2.3

(10mm C.A, Very low workability, Crushed Granite)

Fine Aggregate / Total Aggregate = 40%

By weight 1:2.3 * 0.4: 2.3 * 0.6 W/C = 0.32

1: 0.92: 1.38: 0.32

Weight per cubic meter

1=(C/3.15*10^3) + (0.92C/2.6*10^3) + (1.38C/2.5*10^3) + (0.32 C/ 10^3)

If C is the mass of cement required per m^3 of concrete

1= (3.175×10^{-4} + 3.58*10^{-4} +5.52*10^{-4} +3.2*10^{-4})*C

1=(15.43*10^{-4}) C

C=647.96 kg

Cement =647.96kg; Fine Aggregate =596.125kg; Coarse Aggregate =894.185kg; Water=207.347kg

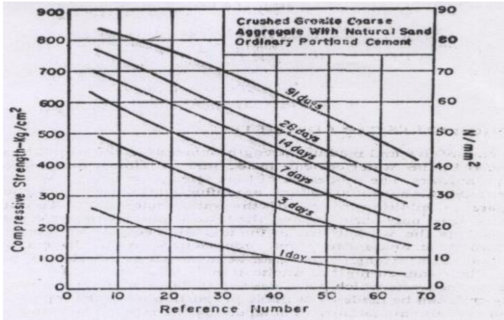


Fig-1: Relation between compressive strength and reference number for mixes containing crushed granite coarse aggregate natural sand and ordinary Portland cement.

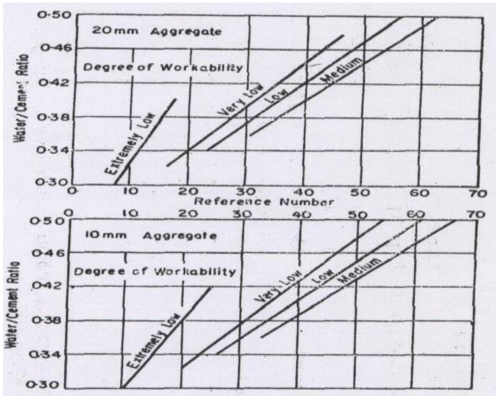


Fig-2: Relation between water/cement ratio and reference number for IO mm and 20mm maximum size aggregates

5.0 RESULTS OF THE TEST

Compressive Strength (10*10*10cm cubes)

1) By adding 0% of silica fume for 7 day

1) 437.5KN

2) 423.9KN

Compressive strength= load/area = 437.5*10^3/100*100 = 43.75N/mm^2

Compressive strength= load/area = 423.9*10^3/100*100 = 42.39N/mm^2

Average Compressive strength = (43.75+42.3)/2 = 43.07N/mm^2

2) By adding 0% of silica fume for 14 day

1) 469.3KN

2) 474.8KN

Compressive strength= load/area =469.3 $*10^3/100*100 = 46.93N/mm^2$

Compressive strength= load/area = 474.8$*10^3/100*100 = 47.48N/mm^2$

Average Compressive strength = (46.93+47.48)/2 = 47.43N/mm^2

3) By adding 0% of silica fume for 28 day

1) 626.5KN

2) 610.1KN

Compressive strength= load/area =626.5$*10^3/100*100 = 62.65N/mm^2$

Compressive strength= load/area = 610.1$*10^3/100*100 = 61.01N/mm^2$

Average Compressive strength = (62.65+61.01)/2

= 61.83N/mm^2

1) By adding 5% of silica fume for 7 day

1) 458.1KN

2) 460.9KN

Compressive strength= load/area = 458.1$*10^3/100*100 = 45.81N/mm^2$

Compressive strength= load/area = 460.9$*10^3/100*100 = 46.09N/mm^2$

Average Compressive strength = (45.81+46.09)/2 = 45.95N/mm^2

2) By adding 5% of silica fume for 14 day

1) 484.6KN

2) 495.1KN

Compressive strength= load/area = 484.6$*10^3/100*100 = 48.46N/mm^2$

Compressive strength= load/area = 495.1$*10^3/100*100 = 49.51N/mm^2$

Average Compressive strength = (48.46+49.51)/2 = 48.98N/mm^2

3) By adding 5% of silica fume for 28 day

1) 628.1KN

2) 635.9KN

Compressive strength= load/area = 628.1$*10^3/100*100 = 62.81N/mm^2$

Compressive strength= load/area = 635.9$*10^3/100*100 = 63.59N/mm^2$

Average Compressive strength = (62.81+63.59)/2 = 63.2N/mm^2

1) By adding 10% of silica fume for 7 day

1) 465.3KN

2) 459.8KN

Compressive strength= load/area = 465.3$*10^3/100*100 = 46.53N/mm^2$

Compressive strength= load/area = 459.8$*10^3/100*100 = 45.98N/mm^2$

Average Compressive strength = (46.53+45.98)/2 = 46.25N/mm^2

2) By adding 10% of silica fume for 14 day

1) 575.3KN

2) 575.3KN

Compressive strength= load/area = 575.3$*10^3/100*100 = 57.53N/mm^2$

Compressive strength= load/area = 575.3$*10^3/100*100 = 57.53N/mm$

Average Compressive strength = (57.53+57.53)/2 = 57.53N/mm^2

3) By adding 10% of silica fume for 28 day

1) 642.7KN

2) 640.7KN

Compressive strength= load/area = 642.7$*10^3/100*100 = 64.27N/mm^2$

Compressive strength= load/area = 640.7$*10^3/100*100 = 64.07N/mm^2$

Average Compressive strength = (64.27+64.07)/2 = 64.17N/mm^2

Flexure Strength (10*10*50cm Beams)

a = 13cm = 130mm

b = 10cm= 100mm

d = 10cm = 100mm

$fb=3p*a/bd^2$

1) By adding 0% of silica fume for 28 day

1) 15KN

2) 14.5KN

$fb = (3*15*10^3*130)/100*100^2 = 5.85N/mm^2$

$fb = (3*14.5*10^3*130)/100*100^2 = 5.67N/mm^2$

Average flexure strength = (5.85+5.67)/2 = 5.76N/mm^2

2) By adding 5% of silica fume for 28 day

1) 16KN

2) 16.5KN

$fb = (3*16*10^3*130)/100*100^2 = 6.24N/mm^2$

$fb = (3*16.5*10^3*130)/100*100^2 = 6.43N/mm^2$

Average flexure strength = (6.24+6.43)/2 =6.33N/mm^2

3) By adding 10% of silica fume for 28 day

1) 16KN

2) 16.5KN

$fb = (3*8.5*10^3*130)/100*100^2 = 3.315N/mm^2$

$fb = (3*8.75*10^3*130)/100*100^2 =3.41N/mm^2$

Average flexure strength = (6.24+6.43)/2 =6.33N/mm^2

Split tensile strength

(15cm Ø 30cm height cylinder)

1) By adding 0% of silica fume for 28 day

1) 262.3KN

2) 259.1KN

σsplit = 2P/∏DL

$σsplit = (2*262.3*10^3)/∏*150*300 = 3.71N/mm^2$

$σsplit = (2*259.1*10^3)/∏*150*300 = 3.67N/mm^2$

Average Compressive strength = (3.71+3.67)/2 = 3.69N/mm^2

2) By adding 5% of silica fume for 28 day

1) 259.1KN

2) 266.9KN

σsplit = 2P/∏DL

$σsplit = (2*259.1*10^3)/∏*150*300 = 3.67N/mm^2$

$σsplit = (2*266.9*10^3)/∏*150*300 = 3.77N/mm^2$

Average Compressive strength = (3.67+3.77)/2 = 3.72N/mm

3) By adding 10% of silica fume for 28 day

1) 301.9KN

2) 289.1KN

σsplit = 2P/

$σsplit = (2*301.9*10^3)/∏*150*300 = 4.27N/mm^2$

$σsplit = (2*289.1*10^3)/∏*150*300 = 4.08N/mm$

Average Compressive strength = (4.27+4.08)/2 = 4.17N/mm^2

5.1 Analysis of the Results

Effect of Silica Fume on variations in split tensile strength of high performance concrete with 0% ,5% and 10% silica fume for 28 days

Table -1: Effect of super plasticizer on compressive strength of high performance concrete

Super Plasticizer Days	20 ml	25 ml	30ml	35ml
3 days	15.72 N/mm^2	28.66	39.59	14.46
7 days	18.1 N/mm^2	38.55	47.49	26.76
14 days	19.24 N/mm^2	46.42	52.07	33.79
28 days	21.38 N/mm^2	58.31	56.69	34.15

The results furnished in table -1 show that when super plasticizer was mixed in water by 20 ml from 3 days to 28 then the compressive strength of high performance concrete varies from 15.72 N/mm^2 to 21.38 N/mm^2. When super plasticizer was mixed in water by 25 ml from 3 days to 28 then the compressive strength of high performance concrete varies from 28.66N/mm^2 to 58.31 N/mm^2. When super plasticizer was mixed in water by 30 ml from 3 days to 28 then the compressive strength of high performance concrete varies from 39.59N/mm² to 56.69 N/mm².When super plasticizer was mixed in water by 35 ml from 3 days to 28 then the compressive strength of high performance concrete varies from 14.46N/mm² to 34.15 N/mm². Thus with the changes in super plasticizer the compressive strength of high performance concrete varies.

Table-2: Effect of Silica Fume on compressive strength of high performance concrete

Silica Fume Days	0%	5%	10%
7 days	43.07	45.95	46.25
14 days	47.43	48.98	57.33
28 days	61.83	63.2	64.17

The results furnished in table -2 shows that by adding silica fume by 0 %, 5% and 10% respectively the compressive strength vary from 43.07 to 46.25 N/mm² in days, 47.43 to 57.33 N/mm² in 14 days and 61.83 to 64.17 N/mm² in 28 days.

Table-3: Effect of Silica Fume on flexure strength of high performance concrete

Silica Fume Days	0%	5%	10%
28 days	5.76	6.33	3.36

The results furnished in table -3 show that by adding silica fume by 0 %,5% and 10% the flexure strength varies from 5.76 to 3.36 N/mm² in 28 days.

Table- 4: Effect of Silica Fume on split tensile strength of high performance concrete

Silica Fume Days	0%	5%	10%
28 days	3.69	3.72	4.17

The results shown in table 4 show that by adding silica fume by 0 %,5% and 10% the split tensile strength varies from 3.69 to 4.17 N/mm² in 28 days.

5.2 The Effects of Super Plasticizer on compressive strength of high performance concrete for different days have been shown in the Charts 1,2,3 and 4

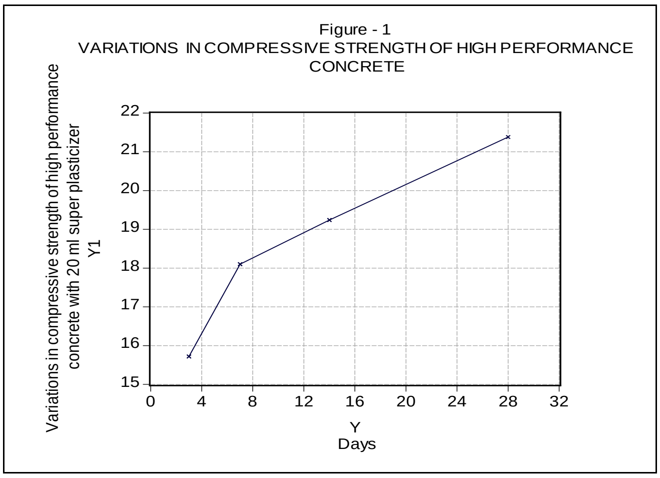


Chart -1: Variation in Compressive strength of High Performance Concrete.

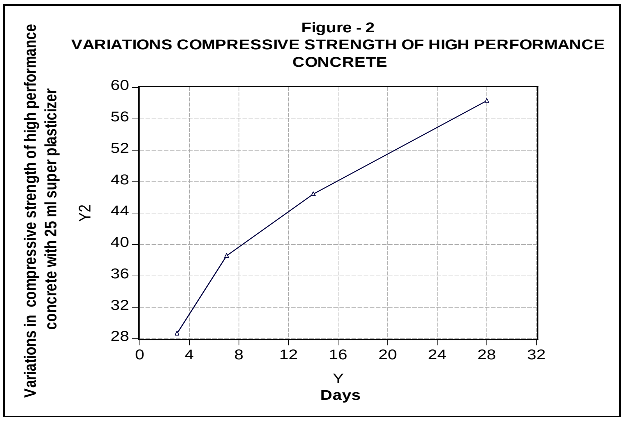


Chart-2: Variation in Compressive strength of High Performance Concrete

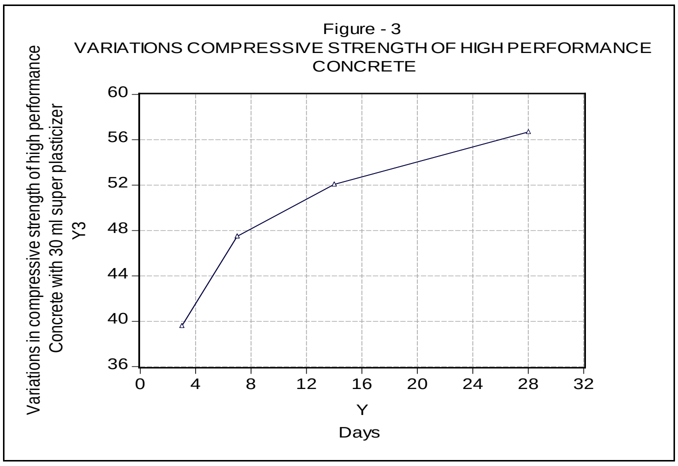


Chart-3: Variation in Compressive strength of High Performance Concrete

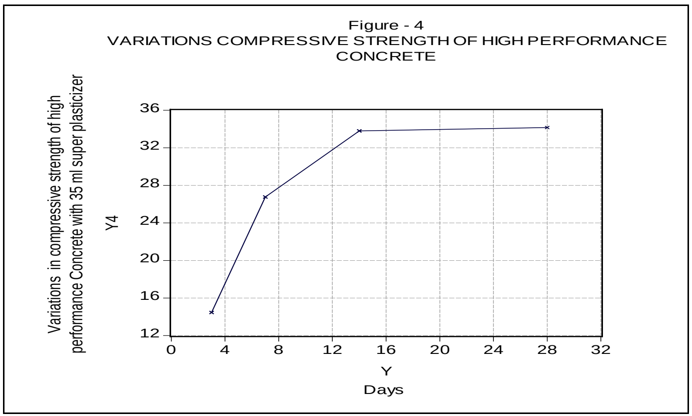


Chart-4: Variation in Compressive strength of High Performance Concrete

5.3 The Effects of Silica Fume on compressive strength of high performance concrete for different days have been shown in the Charts 5,6 and 7

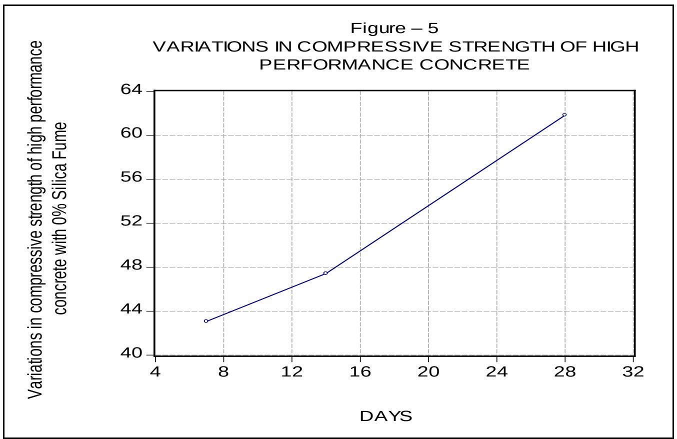
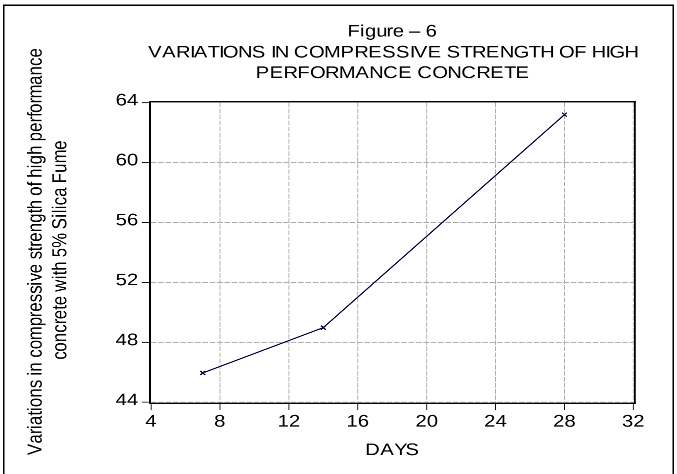


Chart-5: Variation in Compressive strength of High Performance Concrete.



Char-6: Variation in Compressive strength of High Performance Concrete.

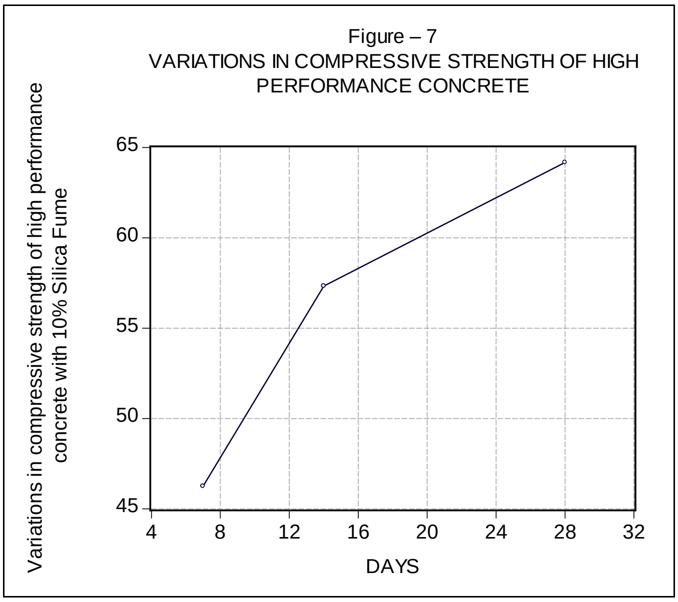


Chart -7: Variation in Compressive strength of High Performance Concrete

5.4 The Effects of Silica Fume on flexure strength of high performance concrete for 28 days have been shown in the Chart - 8

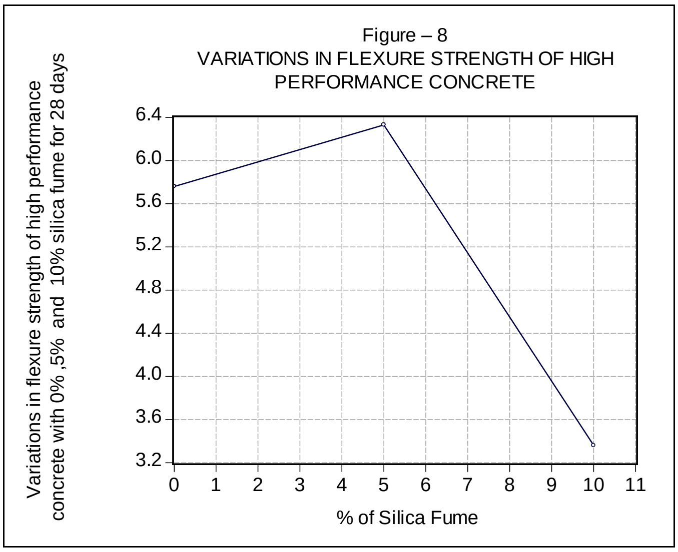


Chart-8: Variation in Compressive strength of High Performance Concrete

5.5 The Effects of Silica Fume on split tensile strength of high performance concrete for 28 days have been shown in the Chart - 9

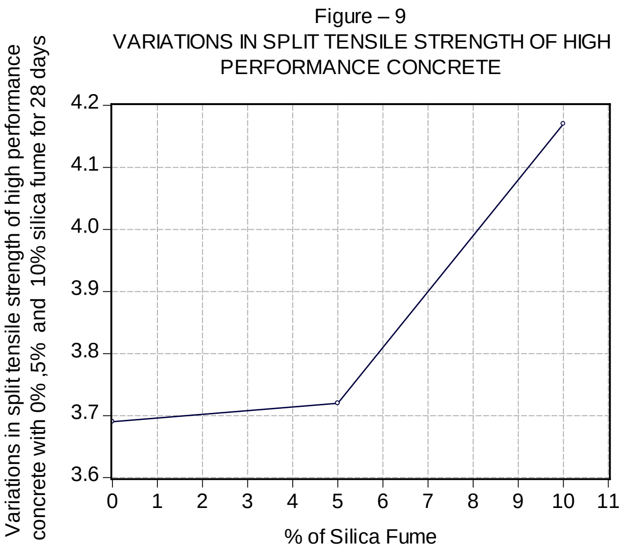


Chart -9: Variation in Compressive strength of High Performance Concrete

6.0 CONCLUSIONS

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. It is usually a gray colored powder somewhat similar to Portland cement or some fly ashes Keeping the importance of the Silica fume in view, an attempt has been made in the present study to examine the Effects of Compressive Strength With and Without Coarse Aggregate on High Strength Concrete by using Fly Ash and Silica Fume .More specifically the project work has been carried out. [1] To find out the compressive strength of granite chips of 10mm. [2] To find out the flexure strength of granite chips of 10mm and [3] To find out the split tensile strength of granite chips of 10mm.

The results show that when super plasticizer was mixed in water by 20 ml from 3 days to 28 then the compressive strength of high performance concrete varies from 15.72 N/mm^2 to 21.38 N/mm^2 .When super plasticizer was mixed in water by 25 ml from 3 days to 28 then the compressive strength of high performance concrete varies from 28.66N/mm^2 to 58.31 N/mm^2 . When super plasticizer was mixed in water by 30 ml from 3 days to 28 then the compressive strength of high performance concrete varies from 39.59N/mm^2 to 56.69 N/mm^2 . When super plasticizer was mixed in water by 35 ml from 3 days to 28 then the compressive strength of high performance concrete varies from 14.46N/mm^2 to 34.15 N/mm^2 .

By adding silica fume by 0 %, 5% and 10% respectively the compressive strength varies from 43.07 to 46.25 N/mm^2 in days,47.43 to 57.33 N/mm^2 in 14 days and 61.83 to 64.17 N/mm^2 in 28 days. By adding silica fume by 0 %, 5% and 10% the flexure strength varies from 5.76 to 3.36 N/mm^2 in 28 days. By adding silica fume by 0 %, 5% and 10% the split tensile strength varies from 3.69 to 4.17 N/mm^2 in 28 days. Thus the addition of silica fume by 0 %, 5% and 10% will lead to the variations in compressive strength, flexure strength and split tensile strength. Thus the results show that the percentage changes in super plasticizer and silica fume lead to the variations in compressive strength of high performance concrete, compressive strength, flexure strength and split tensile strength of granite chips of 10mm.

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