MECHANICAL AND DURABILITY PROPERTIES OF HIGH PERFORMANCE CONCRETE USING HYBRID FIBRES

[1]A.RanjiniSelvameenal,[2]A.Ayyappan,[3]R.Kumar

Assistant Professor
Department of CivilEngineering,
Shivani Engineering College,Trichy, India

Abstract-A High performance concrete is something which demands much higher performance from concrete as compared to performance expected from routing concrete. Use of chemical admixtures reduces the water content, thereby reducing the porosity within the hydrated cement paste. Mineral admixtures also called as cement replacement material (CRM) such as fly ash, rice husk ash, Metakaolin, silica fume and additives such as metallic and non-metallic fibres are more commonly used in the development of High performance mixes, act as pozzolanic materials as well as fine fillers, thereby the microstructure of hardened cement matrix becomes denser and stronger. In this project, to replace the constituent materials by silica fume 0%, 10%, 20%, 30% and 40%, chemical admixtures and steel fibre and glass fibre 0%, 1%, 2%, 3% and 4% of additives also, it is proposed to use high performance concrete. Also High Performance concrete specimens with fiber and without fiber in size 150mmx150mmx150mm, cylinder of 150mmx300mm and prism of 100mmx100mmx500mm were cast and the strength tests were observed. An experimental result shows that the optimum strength attained on concrete with 30% of silica fume and 3% of steel and glass fibres. Where 40% of silica fume and 4% of steel and glass fibres result with decreased strength. HPC mixes 30% of silica fume and 3% of steel and glass fibres have better resist against Hcl and $MgSo_4$ compared to conventional concrete.

***Intexterms*: Cement Replacement Material (CRM) ,Fly Ash, Rice Husk Ash, Metakaolin, Silica Fume,Metallic And Non-Metallic Fibres.**

1.INTRODUCTION

Concrete is the most widely used man made construction material. It is obtained by mixing cement, water, aggregate and admixtures in required proportions. The mixer when placed in forms and allowed to cure becomes hard like stones. The strength, durability and other characteristics of concrete depend the properties of concrete ingredients, on the proportions of mix, the methods of compaction and other controls during placing and curing. Concrete is being extensively used in most of the construction activities. The usage of steel is far less than the concrete. Concrete has the advantage of easy handling and transportation. It can endure very high temperatures from fire for a long time without loss of structural integrity and performs well during both natural, manmade disasters and even under the impact of flying debris.With major development in the concrete industry, the waste materials utilization in the manufacturing of concrete, being used as replacement material for ingredients is being practiced extensively all over the world. Some of the composite materials are used to replace the cement such as flyash, rice husk ash, bagasse ash, slag, fibers, grit, dregs etc. The studies for using the waste materials as partial replacement of cement have started in many areas.Silica fume is a very fine pozzolanic material, composed of amorphous silica produced by electric arc furnaces as a byproduct of the production of elemental silicon or ferro silicon alloys. Silica fume, also known as micro silica, is a byproduct of the reduction of high-purity quartzwith coal in electric furnaces in the production of silicon and ferrosilicon alloys.

Micro silica is a byproduct of the manufacture of silicon and ferrosilicon alloys. It consists of grey powder having extremely fine spherical particles of amorphous silica (Sio_2).Silica fume has been recognized as a pozzolanic admixture that is effective in enhancing the mechanical properties to a great extent. Addition of silica fume to concrete improves the durability of concrete and also in protecting the embedded steel from corrosion.SteelFibres are available in various shapes and sizes. However the common ones are the hooked end and the crimped and round steel fibers. Steel Fibres are generally distributed throughout a given cross section whereas reinforcing bars or wires are placed only where required.Steelfibresare relatively short and closely spaced as compared with countinuous reinforcing bars of wires. It is generally not possible to achieve the same area of reinforcement to area of concrete using steel fibres as compared to using a network of reinforcing bars of wires.Steel Fibers are typically added to concrete in low volume dosages (often less than 1%), and have been shown to be effective in reducing plastic shrinkage cracking.Steel Fibers typically do not significantly alter free shrinkage of concrete, however at high enough dosages they can increase the resistance to cracking and decrease crack width.An electrically resistant glass fibre. Alumina-calcium-borosilicate glasses.Constitutes the majority of glass fibre production. Used in glass reinforced plastics as general purpose fibres where strength and high electrical resistivity are required.

Methodology

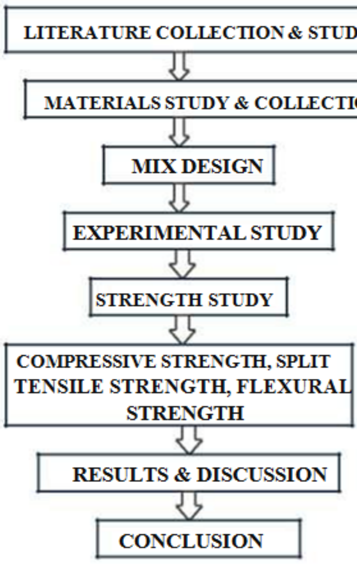


Figure 1.**Methodology**

2. LITERATURE REVIEW

DasariVenkateswara Reddy* Prashant Y.Pawade-2015-This paper “Combine Effect of Silica Fume and Steel Fiber on Mechanical Properties on Standard Grade of Concrete and Their Interrelations” investigation carried out on concrete due to the effect of silica fume with and without steel fibers on Portland Pozzolona cement. In this study we used concrete mixes with Silica Fume of with different ratios and with addition of crimped steel fibers of diameter 0.5 mm Ø with a aspect ratio of 60, at various percentages as by the volume of concrete on M35 grade of concrete. The effect of mineral admixture (silica fume) as cement replacement material with and without steel fibers on mechanical properties were analyzed and compared with normal concrete.

M.M. Kamal , M.A. Safan, Z.A. Etman, R.A. Salama-2014-In this paper “Behavior and Strength of Beams Cast with Ultra High Strength Concrete Containing Different Types of Fibers” carried out on Ultra-high performance concrete (UHPC) is a special type of concrete with extraordinary potentials in terms of strength and durability performance. Its production and application implement the most up-to-date knowledge and technology of concrete manufacturing. Sophisticated structural designs in bridges and high rise buildings, repair works and special structures like nuclear facilities are currently the main fields of applications of UHPC. This paper aimed to evaluate the behavior of ultra-high strength concrete beams. This paper also aimed to determine the effect of adding fibers and explore their effect upon the behavior and strength of the reinforced concrete beams.

R. Ramasubramani, P.Nagakishorereddy, S.Divya- 2014-This paper “A Study On Partial Replacement Of Cement With silica Fume In Steel Fibre Reinforced Concrete” investigates and evaluates the results for M-40 grade of concrete having mix proportion 1:1.45:3.12 with water cement ratio 0.35 of steel fibre reinforced concrete (SFRC) by partial replacing of cement with Silica Fume and containing steel fibres of volume fraction, steel fibres of 50 aspect ratio were used to study the compressive strength, flexural strength, Split tensile strength. A result data obtained has been analyzed and compared with control concrete specimens (0% fibre).

Er. Darole J. S., Prof. Kulkarni V.P., Prof. Shaikh A.P., Prof. Gite B.E-2013-In this paper “Effect of Hybrid Fiber on Mechanical Properties of Concrete” carried out and investigated Hybrid fibre can provide reinforcement at all the range of strains. Combination of low and high modulus fibres can arrest cracks at micro level as well as macro level. Overcome disadvantage of lower workability caused due to use of only higher percentage of steel fibres.Potential advantage in improving concrete properties as well as reducing the overall cost of concrete production. Compressive strength of HyFRC after 28days for 50-50 % (steel-polypropylene) hybridization ratio is maximum. It is increased by 21.41%with respect to normal concrete (i.e. Hybridization ratio 0-0 %). At 28 days Compressive strength of SFRC (i.e. Hybridization ratio 100-0 %) is increased by 7.37% with respect to normal concrete & compressive strength of PPFRC (i.e Hybridization ratio 0-100%) increased by 6.68% with respect to normal concrete.

R.L Ramesh, Nagaraja P.S-2013-In this paper “Experimental Investigation on Strength of Fiber Reinforced Concrete Cubes with Silica Fumes and High Reactive Metakaolin” investigation was carried out to study the cube compressive strength of fibre reinforced concrete cube incorporating Silica Fume and Metakaolin with and without steel fibres of grade M30. Ninety Six cubes of dimension 150*150*150mm with different combinations of materials were casted. The cubes were cured and tested under a Direct Compression Testing machine at time period of 3, 7, 14 and 28 days. The results were tabulated and a relative comparison was made and the conclusions were drawn. Silica Fume and Metakaolin generally requires addition of super plasticizer so that concrete could attain its desired workability. Since Silica Fume is found to consume water either by absorption or reaction.

MdAsif Ahmed, Prof.Syed Arafath-2012-The paper "An Experimental Investigation on Effect of Silica Fume and Steel Fibre on M30 Grade of Concrete" investigation carried out on concrete due to the effect of silica fume with and without steel fibers on ordinary Portland cement. In this study we used concrete mixes with Silica Fume of and with addition of crimped steel fibers of diameter 0.5 mm Ø with a aspect ratio of 60, at various percentages by the volume of concrete on M30 grade of concrete. The effect of mineral admixture (silica fume) as cement replacement material with and without steel fibers on mechanical properties were analyzed and compared with normal concrete.

Rahul.D.Pandit, S.S.Jamkar-2011-The use of High Strength Concrete (HSC) is on rise. It is observed "Mechanical Behavior of High Strength Fibre Reinforced Concrete" that HSC is relatively brittle material. Fibres are added to improve its ductility. Experimental study is carried out to assess mechanical properties of high strength fibre reinforced concrete (HSFRC) of grade M80. In addition to normal materials, silica fume, fly Ash and two types fibres viz. Hooked end steel Fibre (0.425mm) and Hooked end steel Fibre (160mm)having different aspect ratio are used to produce concrete. The content of silica fume and fly ash is 5% and 10% respectively by weight of cement. Water to cementitious material ratio was 0.25.Mixes are produced by varying types of fibres and for each type of fibre its volume fraction is varied from 0.5% to 4.0 % with an increment of 0.5% by weight of cementitious materials. 147 specimens each of cubes, cylinders and prisms are tested to study the effect fibres on compressive strength, split tensile strength and flexural strength of HSFRC. The results indicated significant improvement in mechanical properties of HSFRC.

Vishal, E, Prof.Jai Shankar, P-2010-In this paper "Influence Of Glass Fibres On High Performance Concrete" carried out on Normal concrete will have limited ductility, has little resistance to crack and low tensile strength. In order to improve these properties, an attempt was executed to study the effect of glass fibres in high performance concrete. The concrete mix design prepared is M40 grade. In this experimental investigation, glass fibres were added in different percentages such and their effect on mechanical properties of concrete were studied. A total of 54 specimens such as cubes of size 150x150x150 mm, cylinders of size 100x200 mm and prisms of size 500x100x100 mm were prepared and tests like compression test, flexural strength test, tensile strength test were Cubes and cylinders were tested in Compression Testing Machine. Prisms were tested under two point loading in Universal Testing Machine and the results were compared. From the test results, it was observed that 5% glass fibre concrete showed higher strength compared to control specimen. It is inferred that glass fibre imparts higher strength and more ductility to the concrete than plain M40 grade concrete.

T. Subbulakshmi, Dr. B. Vidivelli ,K. Nivetha-2009-In this paper "Strength Behaviour of High Performance Concrete using Fibres and Industrial by Products" carried out on High performance concrete is something which demands much higher performance from concrete as compared to performance expected from routing concrete. Use of chemical admixtures reduces the water content, thereby reducing the porosity within the hydrated cement paste. Mineral admixtures also called as cement replacement material (CRM) such as fly ash, rice husk ash, Metakaolin, silica fume and additives such as metallic and non-metallic fibres are more commonly used in the development of High performance mixes, act as pozzolanic materials as well as fine fillers, thereby the microstructure of hardened cement matrix becomes denser and stronger. In this study, to replace the constituent materials by mineral admixtures, chemical admixtures and additives also, it is proposed to use high performance concrete. Also High Performance concrete Specimens with fiber and without fiber in size of cube, cylinder and prism of were cast and the strength tests were observed. Finally mechanical properties of concrete were carried out by ANN modeling.

3. COLLECTION OF MATERIALS

Materials used in this study were chosen according to the specifications that meets the requirement of appropriate standards.

1. Silica fume.
2. Steel fibre.
3. Glass fibre.

3.1 Silica Fume

Silica fume utilized in our project was obtained from Astraa chemical, Chennai.

3.1.1. Manufacturing Process

Silica fume, also known as microsilica, is a byproduct of the reduction of high-purity quartz with coke in electric arc furnaces in the production of silicon and ferrosilicon alloys.Microsilica (MS) or, as it often called, silica fume is a second-hand product in the production of silicon metal (Si-met) and ferrosilicon (FeSi). The production process of Si-met and FeSi is very polluting, and microsilica was discovered during the process of how to avoid pollution. Microsilica has proven to be an excellent admixture for Portland cement concrete. Addition of microsilica to a concrete mix usually results in significant improvements in strength, durability and permeability. Some of the improvements to the concrete properties occur because microsilica is a pozzolan. Pozzolans are finely divided silica that combine with free lime (calcium hydroxide) to create morecalcium silicate hydrate. Microsilica is estimated to be about a hundred times finer than cement, giving it the ability to plug voids between cement particles,and helping it increase the density of the cement matrix. Silica fume can be used in a variety of cementitious products such as concrete, grouts, and mortars as well as elastomer, polymer,refractory, ceramic and rubber applications. Silica Fume is used in concrete to improve its properties. It has been found that Silica Fume improves compressive strength, bond strength, and abrasion resistance; reduces permeability; and therefore helps inprotecting reinforcing steel from corrosion. Silica fume is a by-product of producing silicon metal or ferrosilicon alloys in smelters using electric arc furnaces. These metals are used in many industrial applications to include aluminum and steel production, computer chip fabrication, and production of silicones,which are widely used in lubricants and sealants. The globalisation of the Indian economy paved the way for easy availability of micro-silica and latest superplasticisers in the country. M60 and higher grades of concrete are now becoming popular in the country with its proven utility in the construction of importantstructures. A major marketing firm of microsilica in the country has estimated its turnover in the current year be approximately seven to eight hundredmillionrupees.Most of the Indian fly ashes contain calcium oxide less than 5 percent. With the facility of RMC plants one can use large volumes of low calcium fly ashes with small percentage addition of micro-silica to produce high early strength and durable concretes.

3.1.2 Steel Fibre

Research and design of steel fiber reinforced concrete began to increase in importance in the 1970s, and since those days various types of steel fibers have been developed. They differ in material as well as in size, shape and surface structure, as shown in figure. Due to different manufacturing processes and different materials, there are differences in the mechanical properties such as tensile strength, grade of mechanical anchorage and capability of stress distribution and absorption.There are drawn wire fibers, cut sheet metal fibers and milled steel fibers. Melt extracted fibers are amorphous and thus stainless. In order to improve anchorage and adhesion with the concrete matrix, the shape can be designed with hooked ends, completely corrugated or provided with end cones. Furthermore, for some types, the cross section of the wire is deformed. Milled fibers have a completely irregular shape. Most of the fibers are supplied as 119 single fibers, however, some are magnetically aligned and some glued together in bundles in order to ensure a better distribution after casting.

3.1.3 Glass Fibre

A glass fibre or fibre glass can be defined as “A material consisting of extremely fine filament of glass that are combined in yarn and woven into fabrics, used in masses as a thermal and acoustical insulator, or embedded in various resins to make boat hulls, fishing rod.

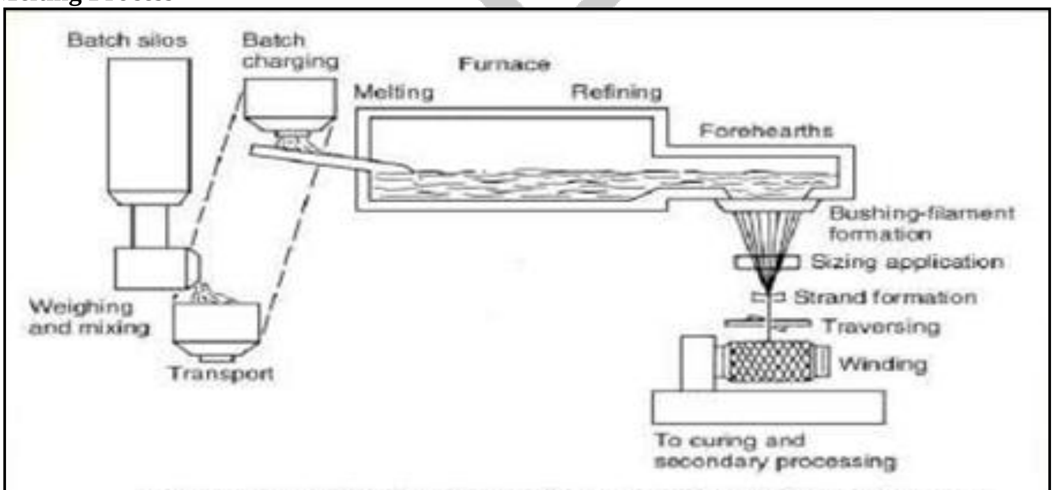
3.3.1 Manufacturing Process

1. Direct Melt Process.
2. Marble Melt.

 Thefibre manufacturing process has effectively two variants. One involves the preparation of marbles, which are remolded in the fabrication stage.

 The other uses the direct melting route, in which a furnace is continuously charged with raw materials which are melted and refined as that glass reaches the fore hearth above a set of platinum–rhodium bushings from which the fibres are drawn.

3.3.2 Direct Melting Process



6.3 Schematic of direct melt process for production of continuous filaments (after Mohr and Rowe[2]).

Fig.2 Direct Melting Process.

3.3.3 Marble Melting

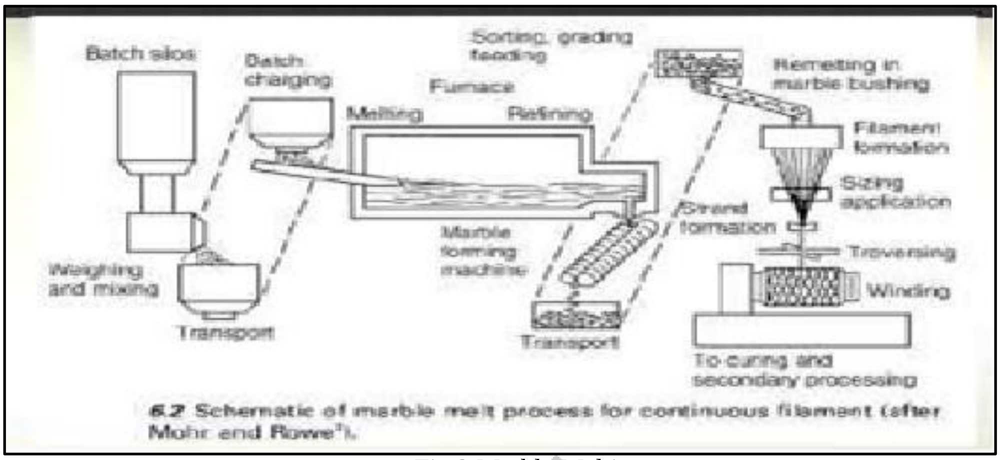


Fig.3 Marble Melting.

Step 1: Batching

In the initial stage of glass manufacture, materials must be carefully weighed in exact quantities and thoroughly mixed (batched). More than half the mix is silica sand, the basic building block of any glass.

Step 2: Melting

From the batch house, pneumatic conveyor sends the mixture to a high temperature (≈1400ºC) furnace for melting. The furnace is typically divided into three sections, with channels that aid glass flow. The first section receives the batch, where melting occurs anduniformity is increased, including removal of bubbles. The temperature is so high that the sand and other ingredients dissolve into molten glass. T h e m o l t e n glass then flows into the refiner, where its temperature is reduced to 1370ºC.

Step 3: Fiberization

Glass fiber formation, or fiberization, involves a combination ofextrusion and attenuation.In extrusion, the molten glass passes out of the fore hearth through a bushing made of an erosion-resistant platinum alloy with very fine orifices, in thousands. Bushing plates are heated electronically, and their temperature is precisely controlled to maintain a constant glass viscosity. Water jets cool the filaments as they exit the bushing at roughly 1204ºC. Attenuation is "the process of mechanically drawing the extruded streams of molten glass into fibrous elements" called filaments, with a diameter ranging from 4 µm to 34 µm(one-tenth the diameter of a human hair). A high-speed winder catches the molten streams and, because it revolves at a circumferential speed of ~2 miles/~3 km per minute (much faster than the molten glass exits the bushings), tension is applied, drawing them into thin filaments.

Step 4: Coating

In the final stage, a chemical coating, or size, is applied. Size is typically added at 0.5 to 2.0 percent by weight and may include lubricants, binders and/or coupling agents. The lubricants help to protect the filaments from abrading and breaking as they are collected and wound into forming packages and, later, when they areprocessed by weavers or other converters into fabrics or other reinforcement forms.

Step 5:Drying/packaging

Finally, the drawn, sized filaments are collected together into a bundle,forming a glass strand composed of 51 to 1,624 filaments. The strand is wound onto a drum into a forming package that resembles a spool of thread. The forming packages, still wet from water cooling and sizing, are then dried in an oven, and afterward they are ready to be palletized and shipped or further processed into chopped fiber, roving or yarn.

4.STUDY OF MATERIAL PROPERTIES

4.1. Introduction

The materials used for making concrete were tested before casting the specimen in order to design the mix proportions. The preliminary tests were conducted on the following materials.

4.2. Cement
Cement is a binder, a substance that sets and hardens independently, and can bind other materials together. The most important use of cement is the production of mortarand concrete the bonding of natural or artificial aggregates to form a strong building material that is durable in the face of normal environmental effects. There are varieties of cements available in market and each type is used under certain conditions due to its special properties.Ordinary Portland cement of 53- grade is used. This is used to develop high strength and has low setting time. It gives much better results and compressive strength in 28 days.Properties of cement obtained from the tests conducted as per relevant BIS codes are given below.

4.2.1. Standard Consistency

Fig.4.Vicat Apparatus.

Table 1 Standard Consistency.

Trial No	Weight of sample taken(gm)	Water added (%)	Weight of water added (ml)	Non-Penetration depth(mm)
1	300	25	75	37
2	300	27	81	35
3	300	29	87	28
4	300	31	93	17

The percentage of water required for obtaining cement rate of standard consistency 31%.

4.2.2. Setting Time

Initial setting time = 110 minute
Final setting time = 260 minutes.

4.2.3. Fineness
Weight of cementW1=100g
Weight of cement on 90 micron sieve W2= 6g
Fineness of cement= (W1/W2) x 100= (6/100) X100
Fineness of OPC 53 grade cement is 6%
As per IS 12269, fineness of cement shall not exceed 10%.

4.2.4. Specific Gravity Test

Fig.5. Le-Chatelier Flask Apparatus.

The specific gravity bottle was weighed dry as W_1 gram. The bottle filled with kerosene and weighed as W_2 gram. Some of the kerosene was poured out and a weighed quantity of cement was introduced and weighed as W3 grams.90grams weight of cement was taken as W_4.

Weight of empty bottle (W_1)	= 73 g
Weight of empty bottle + cement (W_2)	= 124 g
Weight of bottle + kerosene + cement (W_3)	= 327 g
Weight of bottle+ kerosene (W_4)	= 283 g
Specific gravity	$=W_2 - W1/(W_2 - W_1) -(W_3 - W_4)$
	=124-73/((124-73)-((327-283)*0.79))
Specific gravity of cement	= 3.13

4.3. Silica Fume

The American concrete institute (ACI) defines silica fume as a ‘‘very fine non-crystalline silica produced in electric arc furnaces as a byproduct of production of elemental silicon or alloys containing silicon’’. Silica fume is also known as micro silica, condensed silica fume, volatized silica or silica dust. It is usually a grey colored powder, somewhat similar to Portland cement or some fly ashes. It can exhibit both pozzolanic and cementitious properties. Silica fume has been recognized as a pozzolanic admixture that is effective in enhancing the mechanical properties to a great extent. Addition of silica fume to concrete improves the durability of concrete and also in protecting the embedded steel from corrosion.

Fig.6. Silica Fume.

4.3.1. Properties Of Silica Fume

Table 2 Properties Of Silica Fume.

S.No	Properties	Value
1	Specific Gravity	2.25
2	Bulk Density	70-145 kg/m^3
3	Fineness	2.3

4.4 Steel Fibre

Plain concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. It has been recognized that the addition of small, closely spaced and uniformly dispersed fibers to the concrete would act as crack arrester and would substantially improve its Compressive and flexural strength properties. This type of concrete is known as fiber reinforced concrete. Fiber reinforced concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed suitable fibers. Continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fibers.

Fig.7. Steel Fibre.

4.5 Glass Fibre

A Glass fibre or Fibre glass can be defined as “A material consisting of extremely fine filaments of glass that are combined in yarn and woven into fabrics, used in masses as a thermal and acoustical insulator, or embedded in various resins to make boat hulls, fishing rods, and the like.”Fiberglass materials are popular for their attributes of high strength compared to relatively light weight. Fiberglass really is made of glass, similar to windows or the drinking glasses. The glass is heated until it is molten, then it is forced through superfine holes, creating glass filaments that are very thin – so thin they are better measured in microns.

E-Glass

An electrically resistant glass fibre.Alumina-calcium-borosilicate glasses.Constitutes the majority of glass fibre production. Used in glass reinforced plastics as general purpose fibres where strength and high electrical resistivity are required.

Fig.8. Glass Fibre.

4.6. Fine Aggregate

To increase the density of the resulting mix, the aggregate is frequently used in two or more sizes. The aggregate serves as reinforcement to add strength to the overall composite material. Fine Aggregate may have more impact on the strength of the building than cement. Fine aggregate will consist of natural sand, manufactured sand, or a combination of the two, and will be composed of clean, hard, durable particles. Particles of the fine aggregate should be generally spherical or cubical in shape as practicable. Care must be taken to insure that contaminating substances are not present in fine aggregate stockpiles. Such substances would include dirt, dust, mud, and construction debris. The important functions of the fine aggregate are to assist in producing a dense workable and homogenous mixture. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.

4.6.1. Sieve Analysis Test

Table 3 Sieve Analysis Test Weight of sample = 1kg

Sieve size	WeightRetained On(gm)	Percentageweightretained	Ultimate percentageretained	Percentagefiner
4.75 mm	35.7	3.57	3.57	96.43
2.36 mm	48.3	4.83	8.4	91.6
1.18 mm	593.6	59.36	67.76	32.24
600 micron	215.3	21.53	89.29	10.71
300 micron	86.5	8.65	97.94	2.06
150 micron	18.1	1.81	99.75	0.25
75 micron	2.5	0.25	100	0
Pan	-	-	-	-

Tested results satisfies the Grading Zone I (IS: 383-1970)
Tested results satisfies the classification of soil as well graded soil
Fineness modulus= Cumulative weight retained/100=466.71/100=4.66.

4.6.2. Specific Gravity OfFineAggregete

Weight of empty pycnometer (W_1)	= 443 gm
Weight of pycnometer + Dry sand (W_2)	= 1489 gm
Weight of pycnometer + Dry sand + Water (W_3)	= 915 gm
Weight of pycnometer + Water (W_4)	= 1205 gm
Specific gravity of sand	= (W_2 - W_1 / [(W_{2-} W_1)-(W_{3-} W_4)]
	= (915-443) / [(917-443)-(1489-1205)=2.6

4.6.3. Bulk Density Of Fine Aggregete

The test shall normally be carried. Out on dry material when determining the voids, but when bulking tests are required material with a given percentage of moisture may be used.Rodded or Compacted Weight .The measure shall be filled about one-third full with thoroughly mixed aggregate and tamped with 25 strokes of the rounded end of the tamping rod. A further similar quantity of aggregate shall be added anda further tamping of 25 strokes given. Bulk Density Of Fine Aggregete= 1600 kg/ m^3

4.7. Coarse Aggregate

Coarse aggregate is a material that will pass the 20mm sieve and will be retained on the 12.5mm sieve. As with fine aggregate, for increased workability and economy as reflected by the use of less cement, the coarse aggregate should have a rounded shape. Use of the largest permissible maximum size of coarse aggregate permits a reduction in cement and water requirements.

4.7.1. Specific Gravityf CA

Weight of empty mould (W_1) = 7.7 kg

Weight of mould + coarse aggregate (W_2) = 26.4 kg

Weight of mould + coarse aggregate + Water (W_3) = 29.8 kg

Weight of mould + Water (W_4) = 18.8 kg

Specific gravity of CA = $(W_2 - W_1 / [(W_2 - W_1)-(W_3 - W_4)]$

=(26.4-7.7)/[(26.4-7.7)-(29.8-18.8)]=2.7

4.8. Water

Water is the most important and least expensive ingredient of concrete. A part of mixing water is utilized in the hydration of cement to form the binding matrix in which the inert aggregates are held in suspension until the matrix has hardened. The remaining water serves as lubricant between the fine and coarse aggregate and makes concrete workable i.e., readily place able in forms. The water used for mixing and curing of concrete should be free from deleterious materials.Generally cement requires about 3/10 of its weight of water for hydration. But the concrete containing water in this proportion will be very harsh and difficult to place. Additional water is required to lubricate the mix which makes the concrete workable; this additional water must be kept to the minimum. Since too much water reduced the strength of concrete.

4.9. Admixture

Admixtures are ingredients other than water, aggregates, hydraulic cement, and fibers that are added to the concrete batch immediately before or during mixing. Two basic types of admixtures are available: chemical and mineral. Chemical admixtures are used to enhance the properties of concrete in the plastic and hardened state. These properties may be modified to increase compressive and flexural strength at all ages, decrease permeability, improve,durability, inhibit corrosion, reduce shrinkage, accelerate or retards initial set, increase slump and workability and improve the economy of the mixture. By the above considerations we are using Conplast SP 430 as a chemical admixture.

Table 4 Properties Of Admixture.

S.No	Properties	Value
1	Specific Gravity	1.14
2	Chloride content	Nil
3	Air entrainment	1%

5.Mix Proportions –M40 Grade Concrete

Table 5 Mix Proportion.

Water	Cement	Fine Aggregate	Coarse Aggregate
191.6 kg/m^3	598 kg/m^3	495 kg/m^3	1108kg/m^3
0. 32	1	0.8	1.85

.

6.RESULTS AND DISCUSSION

The specimens were tested for compressive strength, tensile strength, flexural strength, water absorption, acid attack, sulphate attack, NDT. The results obtained were discussed in this chapter.

6.1. Compressive Strength Test Results

Compressive Strength Of Concrete Specimens In 7 &28 Days

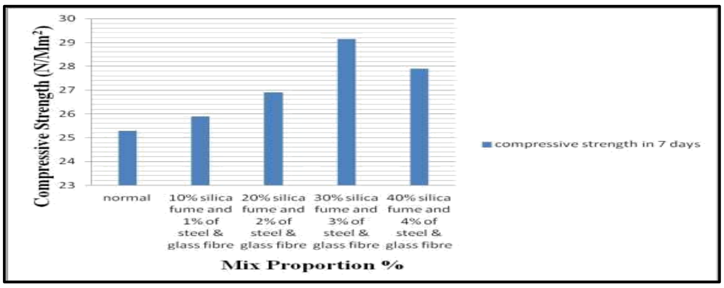


Fig.9. Compressive Strength Results Chat (7 days).

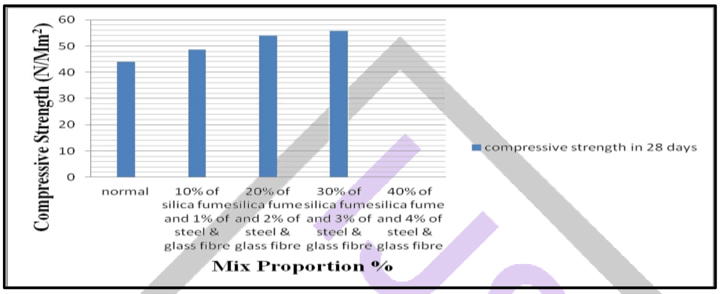


Fig.10. Compressive Strength Results Chat (28 days).

6.2. Split Tensile Strength Test Results

Split Tensile Strength Of Concrete Specimens In 7 &28 Days

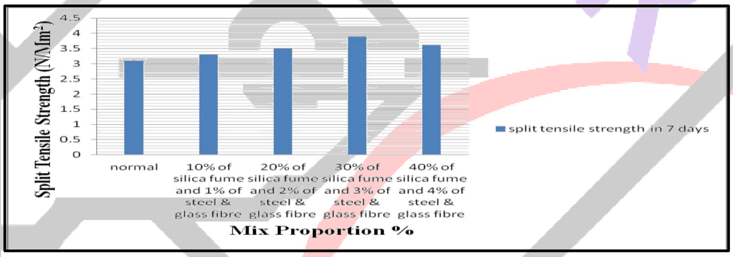


Fig.11. Split Tensile Strength Result chat (7 Days).

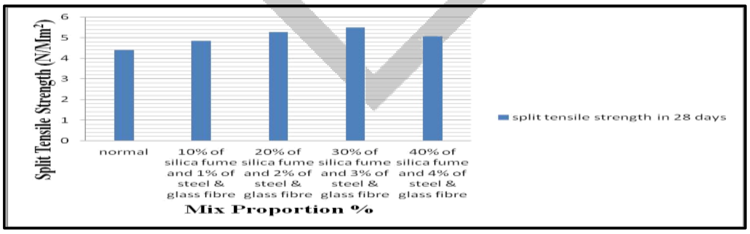


Fig.12. Split Tensile Strength Result Chat (28 Days).

6.3 Flexural Strength Test Result

Flexural Strength of Concrete Specimens In 7&28 Days

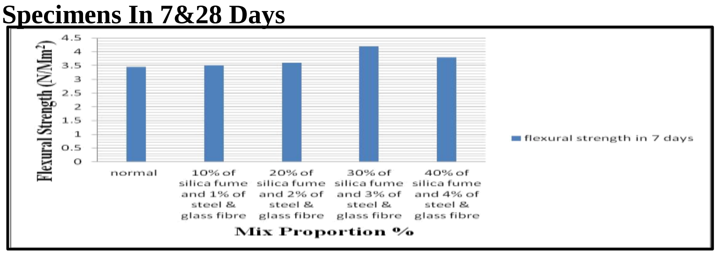


Fig.13. Flexural Strength Result Chat (7 Days).

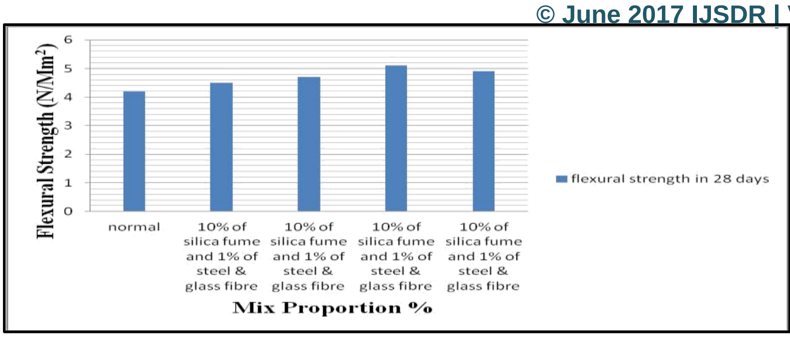


Fig.14.Flexural Strength Result Chat (28 Days).

6.4. Acid Attack Test Results

Reduction in Compressive Strength after Acid Attack

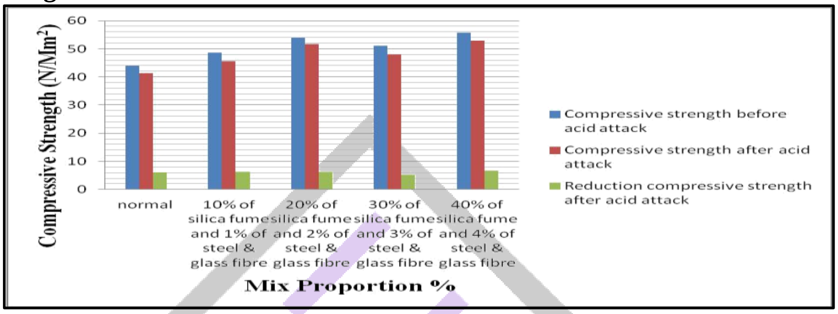


Fig.15. Reduction in Compressive Strength after Acid Attack.

6.4. Sulphate Attack Test Results

Reduction Of Weight Of Cubes After Sulphate Attack

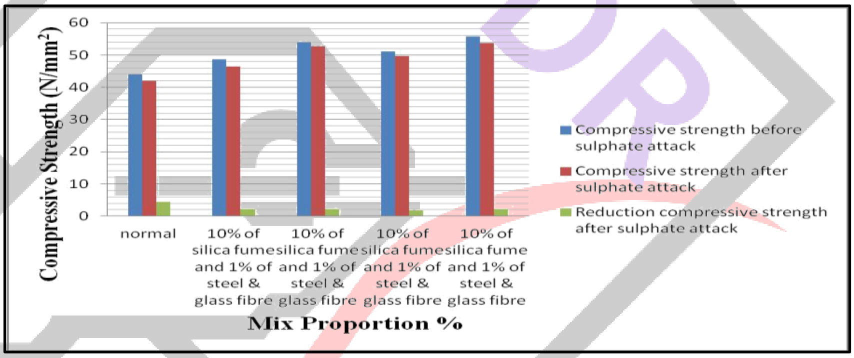


Fig.16. Reduction in Compressive Strength after Sulphate Attack.

7.CONCLUSION

Composite material has been used all over the world in the areawhere high strength and durable concrete were required.Silica Fume improves the characteristics of both fresh and hard concrete. It offers outstanding fatigue and durability potential and are in general very tolerant to environmental effects such as UV damage, moisture, chemical attack and temperature extremes.Glassfibre increases the tensile strength by controlling the occurrence of micro cracks into macro cracks. The use of glass fibre imparts strength to concrete and durability.Steelfibre in concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. It has been recognized that the addition of small closely spaced and uniformly dispersed fibers to the concrete would act as crack arrester and would substantially improve is compressive improve its compressive and flexural strength properties.In HPC with and without fibre of hybrid fibre of compressive strength of cube was in 126.93% and split tensile strength was increased 125% and flexural test of beam was increased 121.42% as compared to conventional concrete at 28 days.In this project aimed to conclude the strength product on concrete using silica fume and steel & glass fibres in the following percentage 10%,20%,30% and 40% of silica fume and 1%,2%,3% and 4% steel and glass fibresrespectively.An experimental result shows that the optimum strength attained on concrete with 30% of silica fume and 3% of steel and glass fibres. Where 40% of silica fume and 4% of steel and glass fibres result with decreased strength.Silica plays the major role in decreasing strength.

REFERENCES

1.“Concrete Technology” By M.S.Shetty.
2.Is 456-2000 (Plain And Reinforced Concrete).
3.Is 383-1970 (Specifications For Fine Aggregate And Coarse Aggregate).
4.Is 10086-1982 (Mould Details).
5.Is 12269-1987 (Specification For Ordinary Portland Cement).
6.Is 516-1959 (Method Of Test For Strength Of Concrete).
7.Is 10262-2009 (Concrete Mix Proportioning).
8.An Experimental Investigation On Effect Of Silica Fume And Steel Fibre On M30 Grade Of Concrete-M.D.AsifAhamed.
9.A Study On Partial Replacement Of Cement With Silica Fume In Steel Fibre Reinforced Concrete-R.Ramasubramani,P.NagaKishore,S.Divya.
10.Behavior And Strength Of Beams Cast With Ultra High Strength Concrete Containing Different Types Of Fibres-M.M.Kamal, M.A.Safan.
11.Combined Effect Of Silica Fume And Steel Fibre On Mechanical Properties On Standard Grade Of Concrete And Their Interrelations-dasarivenkateswarareddy, prashhant.
12.Experimental Investigation On Strength Of Fibre Reinforced Concrete Cubes With Silica Fume And High Reactive Metakaolin-R.L.Ramesh, NagarajaP.S.Mechanical Behavior Of High Strength Fibre Reinforced Concrete-Rahul.D, S.S Jamkar.
13.Mechanical Properties Of Ultra High Performance Concrete-Prabhat RANJAN, b.h.Bharatkumar, Nagesh.