HIGH PERFORMANCE CONCRETE WITH PARTIAL REPLACEMENT OF CEMENTEOUS MATERIAL BY SILICA FUMES.

Submitted in partial fulfillment of the requirements of the award of the degree of

Master of Technology

In

Civil Engineering

by

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CERTIFICATE

This is to certify that the project work entitled " **HIGH PERFORMANCE CONCRETE WITH PARTIAL REPLACEMENT OF CEMENTEOUS MATERIAL BY SILICA FUMES.**" submitted by **Priyanka Lohiya (18SOCE2010003)** to the School of Civil Engineering, Galgotias University, Greater Noida, for the award of the degree of **Master of Technology in Civil Engineering** is a bonafide work carried out by her under my supervision and guidance. The present work, in my opinion, has reached the requisite standard, fulfilling the requirements for the said degree.

The results contained in this report have not been submitted, in part or full, to any other university or institute for the award of any degree or diploma.

(Dr. Suprakash Biswas

Professor
Guide

(Prof. (Dr) Manju Dominic)

Dean,
School of Civil Engineering

External Examiner

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract: *Concretely implementing nanotechnology brings new material to attempts to boost efficiency. Owing to the limited scale of nanomaterial's it is necessary to adjust the microstructure on the properties of the concrete. The frequency of the early pressure and the total pressure tolerance of the concrete also improved considerably with these studies. When the silica level decreases, the intensity rises. The substance of today and of the future is real. The material system researched in the 21st century is commonly used from the house to the warehouse, from the bridge to the airport. The quality and durability of concrete must be strengthened urgently. Cement plays an important role in the size and adhesion of various materials used for concrete construction.*

Therefore, in order to improve the production of concrete, a reinforcement mechanism has been proposed and proposed. It is found that the compressive strength (both 7 days, 14Days and 28 days) increases with the increase in silica fume up to a certain limit of ceramic restoration by silica. When the volume increased again after 6%, it showed a strong dip in Silica Fume. So 6 % is the right amount for concrete installation.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Concrete Beton is a combination of clay, fine aggregates, coarse aggregates and water. In the plastic process it can be shaped in any shape. The relative number of components tested the wet and hardened stages of the concrete output.Two or three decades ago, in fact, without looking at the future of concrete structures, using OPC to produce concrete for construction can easily get the concrete composition regardless of quality. Nowadays, with recent investigations conducted by engineers and scientists over the past two to thirty years, with the structural stability of the structure, high quality concrete is needed while improving strength, durability and other characteristics. The need for these properties led to the search for complementary cement materials. Look for any suitable material in terms of local replacement of cement in order to achieve global sustainable development and reduce impact on the environment. Concrete cement is the majority of building materials today. It can be said that we live in a concrete era.

Betle consists of the combination of clay, resin and water. Beton is simple to manufacture, but concrete is a complex material, in reality. It is a matter produced in the field because, because of the usage of other natural materials than cement, its consistency, efficiency because output will significantly improve. Medium standard and lower value cement are also widely used for the accelerated growth of the country's infrastructure. Over the process of the study, the highest quality and most widely used cement products were silicone powder, fly ash, loose granule furnaces etc. A common usage of agricultural materials will also conserve resources and prices, beyond following environmental protection requirements. The most viable manufacturing component was found to be silica volcanic ash which could be used as a part-alternative to cement in concrete. In India and abroad, many experiments are being undertaken to research the impact of replacing cement with such pozzolan products, and the findings are promising. Adding silica smoke to concrete has numerous benefits, such as strong power, good resilience and decreased production of cement.

1.1.1 High performance concrete

Concrete with a high performance is a concrete blend with a greater strength and durability than conventional concrete. This cement comprises one or more cement ingredients. High-performance concrete is therefore not a specific concrete type. This uses the same ingredients as standard cement. Through utilizing such chemical and mineral blends including silica smokes and super plasticizers, energy, resilience and processing capacities can be dramatically improved. While the initial expense of high-performance concrete is greater than standard concrete, it is inexpensive because high quality cement will prolong the product 's life so less harm is done to the construction that decreases the cost overall.

Concrete is a long-lasting and versatile building tool. It's not only durable, inexpensive, and depends on the shape, but aesthetically pleasurable. Nonetheless, experience indicates that concrete will quickly deteriorate without taking preventive precautions during construction and manufacturing. For this, the impact of components on concrete efficiency and the processing of concrete substances in closely regulated tolerances must be recognized.It has been found that traditional Portland cement has lacking in the following aspects:

- Durability in harsh environments (shorter life and frequent maintenance)
- Construction time (slower density increase)
- Energy absorption capacity (for seismic structures)
- Repair and renovation work.

As a consequence, in addition to power, other, similarly essential criteria such as longevity, management capacity and resilience are being increasingly recognized. We are also referring to "good efficiency concrete," which may range from high strength to application and may be specific.This may be engineered to deliver an enhanced value that satisfies the quality, life and reliability criteria of a certain set of specifications for usage, use and display. The benefits of high-performance concrete include greater toughness and low breakage in contrast to standard quality concrete.

Any unique that satisfies any of the standards suggested to solve traditional concrete drawbacks may be considered high-efficiency concrete. Which may provide concrete that can be dramatically strengthened against environmental effects, while maintaining adequately robust, which can substantially increase structural efficiency. It may also involve concrete, which minimize building period significantly to facilitate the opening of fast roads without cooperating long-term maintenance capacity. Therefore, without following the consistency criteria for concrete usage, a consistent concept of high-performance concrete cannot be given.

"A Beton Meeting The American Concrete Association describes High-Performance Beton as" Beton which fulfills clear consistency and uniformity requirements and cannot always be accomplished by setting and methods of processing using only traditional and traditional materials. Betons with many of these properties can attain high resistance, though not generally good efficiency of high-resistance Betons. The following table present the Compressive strength (Mpa) with high performance class.

Compressive strength (Mpa)	50	75	100	125	150
High Performance Class	I	II	III	IV	V

1.2 Materials Selectivity Process

Following is the steps of production of concrete selection.

- Choose the correct concrete composition with the required rheology, strength, etc.
- Determine the relative amount of components to create durability.
- Carefully control quality at every stage of the concrete manufacturing procedure.

It is necessary to use sand and gravel from the water. In order to reduce porosity, sand particles must also accumulate, as the test findings indicate a need for more blended water for higher porosity.By setting the maximum substrate size and making the transition area stronger, this reduces the strength of the concrete. Through the use of mineral additives, cement concrete becomes more homogeneous, and the strength and durability properties of concrete can be greatly improved. The strength of high-performance concrete can be controlled by the strength of coarse aggregate, which is not usually the case with conventional cement concrete. In the end, extra water is only used for unnecessary voids in the concrete slurry, minimizing the volume of water compared to that which is necessary in order for the chemical reaction of anhydrous cement. Inhibitors help reduce the initial moisture rate of cement, thus keeping fresh concrete more useful for a lengthier period.

1.3 Behavior of Fresh Concrete

There is no inherent gap in the efficiency of fresh high presentation concrete from traditional concrete. Although several high-level concretes display rapid hardening and early strength development, other concretes may be held longer and have fewer early strength. Usability using the same raw materials is typically greater than standard concrete. While some high-performance concretes with strong early solidity properties are less processing prone, high-performance concrete treatment varies fundamentally from traditional concrete.

Workability

Even in low stagnation conditions, the high performance concrete is generally very good, and high performance concrete is usually well pumped due to the presence of large amounts of cement materials and chemical mixtures. High performance concrete was successfully pumped to 80 layers.

An emergency pump failure plan should be developed when pumping concrete. Superior concrete can fill parts of high-performance reinforced steel without creating internal or exterior disturbances, displacement and wide voids. It is also a valuable method to determine the mixture's consistency. Not all high-performance concrete needs, of course, liquid concrete, so the operability is typically not difficult.

Setting time

The processing time varies be contingent on the submission, the attendance of the processing rate and the proportion of mortar consisting of Portland cement. Using a large amount of a water reducing agent will significantly lengthen the preparation time and thus reduce its very early strength, even if the strength is higher than 24 hours may be relatively high. Mixtures containing large quantities of mineral additives should be used to closely monitor the doses to avoid excessive addition of Portland cement while adding chemical additives based on the entire cement substance.

1.4 Behavior of Hardened Concrete

With a long and short-term characteristics the behavior of hard concrete can be defined. Short range properties include pressure density, tensile strength and power of bonding. The long-term properties include spreading, deteriorating and comportment to exhaustion and hardness, such as porosity, permeability, tolerance to thawing and wear.

Strength

The strength of the concrete differs accordingly, including its composition and thickness, the degree of its hydration, its loading time, its measuring phase and the morphology of the sample. The consistency of fine and field aggregates, cement lining and bonding properties are the characteristics of the product materials that influence performance. Steps will then be taken to reinforce all three places to improve power.

The determined intensity would be significantly influenced by test factors like environment, load factor, test process and sample geometry. The intensity can be 25% to 35% higher than normal load levels under shock loads. The frequency of cube samples in cylindrical samples is typically 20 to 25 percent. Larger tests displayed a less strong average.

Strength development

The production of strength over time depends on the material variable and processing technologies. There is a need of adequate moisture in order to obtain the necessary intensity in the water to reduce the porosity to the desired amount. Although the cement mortar is not fully hydrated, it is intended to provide sufficient hydration for the procedure. Early rises in concrete levels typically improve intensity. Later, it's not plain the difference.

Durability Characteristics

High performance concrete's key characteristic is that it varies from traditional concrete because its toughness is superior. The effect is the fine-tuneing of the fine concrete framework, which creates a very thick, water, soil, oxygen, chlorides, sulfates and other hazardous substances content of very limited penetration. The steel bars are thus quite well covered in the high-performance concrete. With respect to thaw resistance, other factors need to be found in high-performance concrete. Firstly, there is absolutely no freezing water as per the construction of a water cement mortar. The compressed dirt, in addition to lowering the intensity of high-level concrete, cannot be accounted for by rising water levels as a consequence of the rise in ductility attributed to bubbles in the presence of super plasticizers. There are no gaps in the structural region of high-performance concrete to avoid bacterial development. High-performance concrete is claimed to be longer lasting than standard cement concrete for all the aforementioned purposes.

Use of High Performance Concrete

High performance concrete is principallycast-off to improve strength, which is not only a delinquent under extreme exposure situations, but also in standardconditions. This causes concrete to be charred, which may damage the reinforcing bars and cause corrosion. There is sometimes corrosive salt in the soil, which can lead to erosion.

1.5 Applications

In a vast range of construction applications in several countries, the solid and excellent toughness of high performance concrete has been utilized. Two uses of high-performance concrete are Bridges, High-rise building, Tunnels and Nuclear Structure.

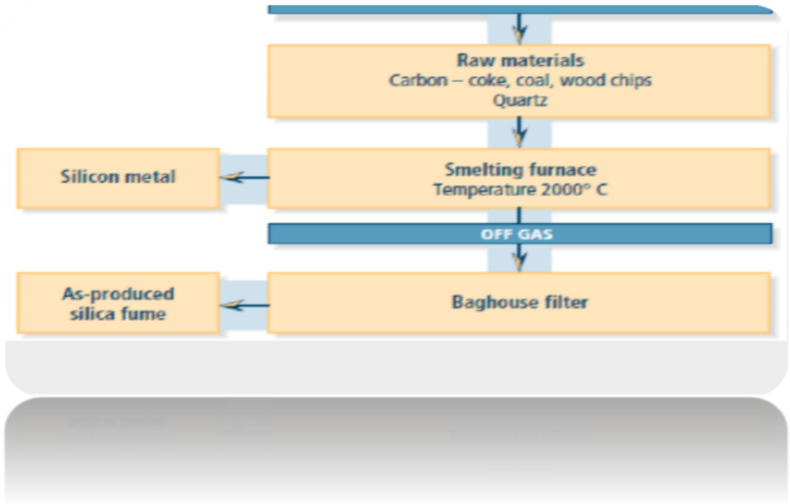
1.6 Silica Fume

The concept of Silica Fume: The American Concrete Institute (ACI) describes silica fume as "extremely finely not made, in electric arc furnaces, crystalline silicon as an additive to the manufacture of silicon or silicon-containing alloys." This is typically a gray material.

Figure 1. 1: Silica Fume

1.7 Production

Currently, the smoke from the factory is silica fume. The figure shows a diagram of silica fume development. Within the bag building, the silica particles are stored within incredibly wide filters and then put immediately or after additional processing for use in concrete.



PRODUCTION OF SILICA FUME

Figure 1. 2: Production of Silica Fume

1.8 Silica Fume Properties and Reactions in Concrete

1.8.1 Chemical Properties

A crystalline concrete content, which is chemical identical to silica dust, is available. This is the volatile substance that burns silica. Additional silica fume compounds may be dependent on the product that the gases are produced from in the smelter. In general, the production of silica fume in hormigon is not influenced by this content. Some products in this group can be restricted by regular requirements.

1.8.2 Physical Properties

The table displays the main physical features of silica gases. A discussion on each of these features follows.

Particle size

Silica gases are very tiny and about 95% of the particles are smaller than 1µm. The emissions are very tiny.

Bulk density

It is just another unit weight word. The amount of the silica fume produced depends on the metal produced in the oven and how the oven works. As the volume density of the processed fume is usually very small, transportation over long distances is not very economical.

Specific gravity

A relative amount that shows how fume of silica with a basic gravity of 1.00 is comparable with vapor. This is seen in construction proportioning. Silicon smoke is much thinner than Portland cement, and is much more than 2.2, with a common magnitude of about 3.15.

It is the average surface of a specified substance density. The surface area is very growing since silica fume particles are very tiny. When the particles become smaller, we realize that the need for water rises for air, as does silica fume. Therefore, silica fume must be used in conjunction with an additional mixture or super plasticizer that eliminates vapor. For the calculation of the precise surface of a silica fume, a procedure called BET or nitrogen adsorption process shall be used. Relevant surface measures are less important for silica smoking dependent on the application of sieve or air permeability studies.

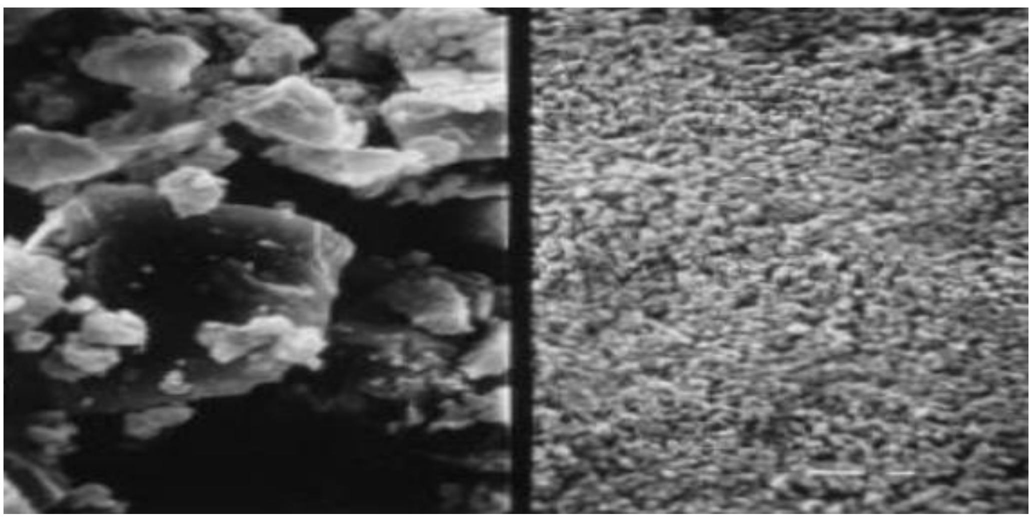


Figure 1. 3: Photo Micrograph of Portland cement

Form	Agglomerated
Particles Color/ Appearance	Grey
Specific Gravity	2.20
Size of particles	0.1 µ
Dosage	2 - 10 % by weight of cement
Chloride content	Nil

Figure 1. 4: Physical Properties of Silica Fume

1.9 Reactionsinconcrete

Changes in the concrete microstructure are the benefits of using silica fume. Such shifts are induced by two systems, which are similarly significant. The first is the actual component of silica fume and the other is the electronic component. The concise summary of these two things is as follows:

1.9.1 Physical contributions

The application of silica fume adds to a cement combination containing huge amount of small sized particle. Even without chemical reaction, silica fume will have a substantial change in the quality of concrete as a consequence of the micro fill effect. Table provides a contrast with certain specific components with silica fume particles to make you appreciate how tiny the particles are.

1.9.2 Chemical contributions

Properties	Cement	Silica fume
Physical Properties		
Specific gravity	3.15	2.2
Surface area, m^2/kg	320	20,000
Size, micron	-	0.1
Bulk density, kg/m	-	576
Initial setting Time (min)	45	-
Final setting Time(min)	375	-
Chemical Properties, Percentage		
SiO_2	90-96	20-25
Al_2O_3	0.5-0.8	4-8

Figure 1. 5: Compare of Size of Silica Fume vs. cement

As the concrete Portland and cement react chemically, calcium hydroxide is released. This calcium hydroxide binds to Silica Fume, which is actual much close to the Calcium Hydrate produced by Portland concrete, from an additional binding medium called silicate hydrate. In significant part, it is this extra binder that offers the excellent hardened properties of silica concrete.

1.10 Silica Fume Used in Concrete.

1.10.1Silica fume and fresh concrete

Two different results occur: the construction becomes more uniform with no leakage from the ground. Although certain endorsers may find this to make it easier to position and finish the concrete, they are simply benefits for fresh and hardened concrete.

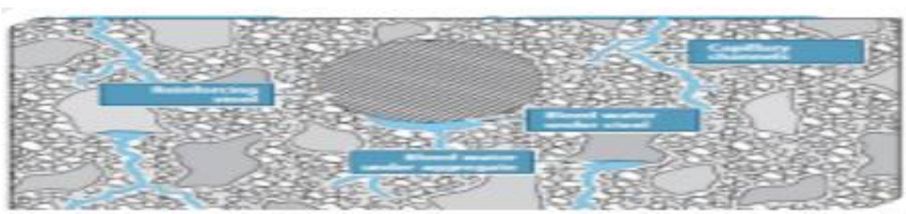


Figure 1. 6: Effects on Hardened Concrete

1.10.2 Silica fume and hardened concrete

The impact of silica fume on hardened concrete is seen in the chart. Two distinct results are present: improved mechanical properties, including resistance and elasticity board, and decreased permeability, which increases longevity directly. The paragraph addresses all these impacts.

1.11 Enhanced mechanical properties.

Initial attention was given to silica fume on the concrete sector owing to its ability in manufacturing concrete. Enhancementsmechanical properties are often visible in certain properties such as elasticity modules or bending power. Although concrete has been defined to benefit from changes in these other properties, the most important property is undoubtedly the quality of the compression.

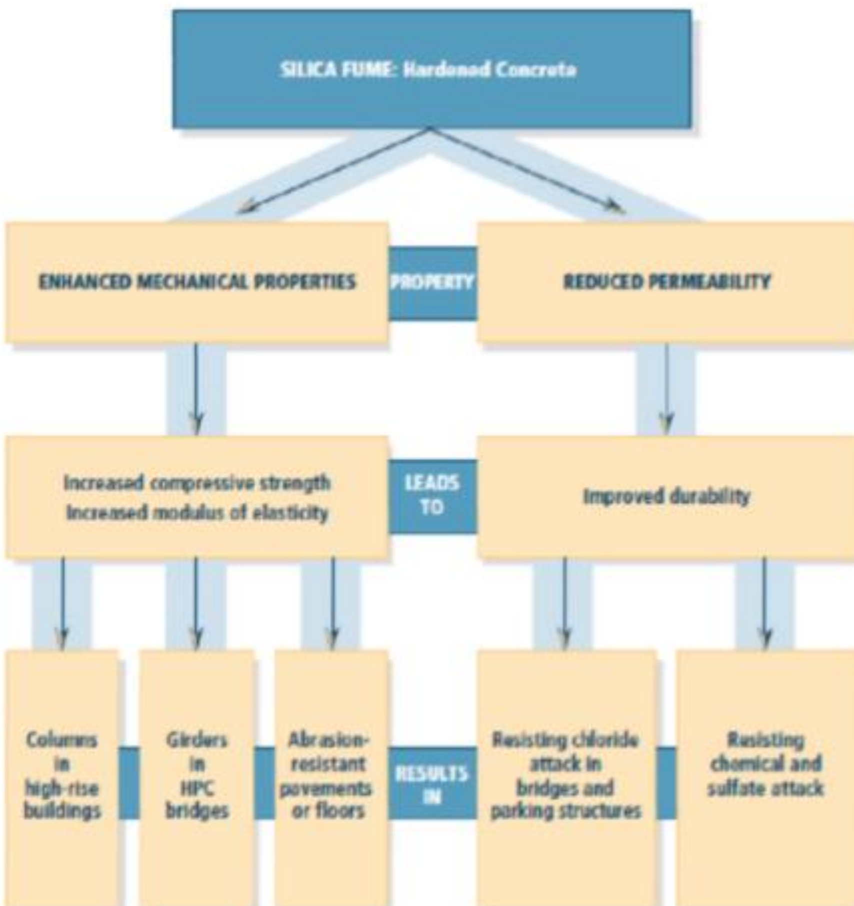


Figure 1. 7: Silica Fume and Hardened Concrete

CHAPTER 2

REVIEW OF LITERATURE

1. Saini & Nayak (2019) published a paper on “To Study Effects On The Mechanical Properties Of Concrete After Partially Replacing Cement By Silica Fume” The main purpose of this study is to use silica fume as a mineral admixture mixed into concrete to partially replace ordinary 43 ° Portland cement (OPC) in order to study silica fume’s influence on M55 & M60 grades of concrete that are currently widely used in high-gain construction. There were 50, 30 and 30 sets of tubes, cylinders and beams set for the research for Silica Fume effect on concrete. Such concrete experiments were thoroughly healed in water at natural air temperature

In M55, 157 mm (where the 0 percent silica fumes were substituted by OPC) is found to be a greater slump. For M60, the slump value was 169 mm (when OPC weighted up 0 percent silica fume). The density of concrete of M55 and M60 grades was greater than the control mix of grades M55 and M60 (when 10% of the silica fume was substituted for OPC). The break strength of the concrete has been improved in M55 & M60 mixtures, with the OPC being substituted by the silica fume (2, 5% to 10% of the silica’s for an rise of 2,5%).

2. Jagan, S. (2019) published a paper **“**Effect on blending of supplementary cementitious materials on performance of normal strength concrete**”** they emphasized/focused mainly sustainability, scarcity, permeability, M-sand, silica fume, fly ash and steel slag. The two main issues with successful usage of renewable products are resilience and shortages of capital in the present scenario. The percentages of such supplementary materials were varied and separate tests based on different mixtures were made. Various mechanical properties such as compressive strength, break strength and bending strength have been obtained to validate the blend of acceptable replacement levels of the additional materials for cement and fines. The mixing with optimal strength values was carried out with durability property such as water absorption test.

3. Shaikh, F. U. A. (2017) published a paper **“**Mechanical properties of recycled aggregate concrete containing ternary blended cementitious materials "they emphasized/focused mainly on Mechanical properties. This paper describes the influence of silica fume (SF) on the mechanical characteristics of early and long-term recycled slag-containing aggregate concrete. Six mixes are taken into consideration in this study. This paper describes the mechanical properties, which are already three days up to 3 months old, of an environment-friendly concrete producing 50.0 percent less OPC and 50.0 percent fewer normal coarser aggregates.

4. Khan, A. G., & Khan, B. (2017) published a paper **"**Effect of partial replacement of cement by mixture of glass powder and silica fume upon concrete strength.**"**Construction products are the most widely used in the entire world. The mixture of cement, aggregates and water is well-known to be concrete. Taking into account environmental pollution that can lead to serious health problems, it is therefore necessary to use pozolanic materials, which are locally available, as a partial substitute for cement, because they are economic in comparison with cement from Portland, and also environmentally friendly without sacrificing on concrete quality.

In concrete construction, numerous additional cement components can be partly substituted. For all samples of concrete with a water to binding ratio of 0.55, the 1:2:4 mixing ratio was used. Thus, the optimal amount to achieve higher strength is 30 percent cement substitution. SEM study of concrete samples indicates that all pozzolonic compounds lead to the hydration cycle and the findings of the resistance check have been further confirmed.

5. Kumar, R., & Dhaka, J. (2016) published a paper **"**To Study Effects on the Mechanical Properties of Concrete after Partially Replacing Cement by Silica Fume.**"** They emphasized/focused mainly Silica Fume, Compressive Strength, Split tensile Strength, flexural **Strength.** The purpose of the present study is to evaluate the output of Silica Fume as a concrete mixture in the light of the rising demand of the industry in concrete which is leading to large-scale cement production leading to environmental problems and natural resources degradation on the one side, and that costs, on the other. To overcome these issue issues, the usage of agricultural products/waste is studied. The industrial silica fume by-product became an enticing cementing medium, which is a result of silicon and ferrosilicon smelting. A blend of M-35 concrete in this work has been tested to partly remove silica fume and its impact on concrete properties. A comprehensive experimental research on compression power, bending resistance and break tensile strength for seven days and 28 days poses the key parameter studied in this analysis M-35 cement mix with a partial substitution by silica fume, with 0, 5, 9 and10 percent by weight of cement. The test findings show that the usage of silica fume in concrete improved strength and toughness in contrast to standard concrete at all ages. The usage of Silica Fume thus decreases the volume of cement for construction purposes and encourages its use both for better efficiency and environmental sustainability.

High performance concrete developed in this study by partial replacement of cement with silica fume. Compression pressure break tensile force and bending power measurements were found for blends at age 7 days and 28 days with the substitution of cement by 5 percent to 10 percent silica fume. This contributes to an improvement in compressive strength and flexural strength of the concrete by substitution of cement up to 12 percent silica fume. The intensity of the compressive is based on the silica fume level. High performance silica-fume concrete can be used effectively in high elevation buildings as the shortened construction time requires a strong early resistance. The compression strength increase is 17.76%, the break intensity is 20.74% and the flexural strength at age 28 is 40.67% as cement replacement is substituted by silica fume in half. For compressive and bending power the optimal proportion of cement partial replacement with silica fumes 12 percent and for break tensile concrete resistance 9 percent.

6. Pedro et al. (2017),analyze the Fly ash and super plasticizer (SP) have also been included in the concrete formulations in addition to natural silica fume. Each type of concrete is made up of a Referring Bet (RC) and 3 recycled (RAC) mixture of fine natural aggregate (FNA) fine recycled (FRA) substitution proportion (in volume) and cough natural aggregated (CNA) blends of 50/50, 100 and 100/100 coarse recycled aggregate(CRA) respectively. Taking into consideration the technical strength and resilience of concrete mixtures, the findings show that large amounts of FRA and CRA may be added.

7. Soliman & Tagnit-Hamou (2017),the nature of ULT depends essentially on the packing density and distribution of its ingredients in the packing density and particle size

(PSD). The cement PSD has a micro-scale division and must be packed with thinner products, including silica fume (SF). For this gap to be filled only with SF, high SF levels (25 to 30 percent by wt. of cement) are required because of their intense finesse. Concrete rheology is adversely influenced by large SF concentrations. Furthermore, the scarce capital and high costs of SF prohibit UHPC from being commonly utilized on the concrete industry. By removing SF particles with no absorbing glass particles, fresh UHPC rheology is enhanced.

The following assumptions may be taken on the basis of the findings obtained in this study:

• The replacement of 70% finely formed glass powder provided intensity close to that of the silica fume mixture alone. Under standard curing conditions in contrast to silica dust, the fine glass powder increased compression efficiency.

• The replacement of fresh-glass silica fume (mean particle sizes of 3.8 lm), leading to fewer nucleation locations, minimize the overall thermal flow and cumulative power.

• In designing the UHPC blend formula, three criteria should be taken into account: package length, fineness of substance and chemical reactions.

• Material transport may be minimized by the use of fine glass powder locally required for the manufacture of UHPC. In fact, the processing of glass decreases the amount and economic wealth of accumulated glass products. The replacement of fine glass powder for silica fume naturally will reduce the total cost of UHPC.

8. Ardalan et al. (2017), this article presents the findings of an experimental analysis to test the efficiency of mixtures creating self-compacting concrete (SCC) in various amounts utilizing pumice-containing mixtures. Pumice has pozzolanic qualities as a volcanic substance which can be applied to the concrete mixture efficiently. An analysis has been made of the effect of pumice powder on self-compatibility characteristics including slump pressure. In both mixtures, Portland cement was replaced by pumice, fly ash and slag from 10 percent to 50%. More than 30 percent pozzolanic products are used in a binary mixed Portland cement mixture and fresh and rough check findings are substantially decreased.

9. Ganjian et al. (2018), New technics such as Power Ultrasound (PUS) are under consideration in the mechanical, microstructural and transport characteristics field in order to increase the hydration of cemented materials as well as facilitate the quality of substitution of supplementary cementitious materials; This will strengthen the quality of cement composites, raising the volume of waste materials and raising the CO2 footprint of cemented products. A few studies have examined this interesting area and the processes by which the ultrasound operates on cement-based structures have no knowledge. This paper describes potential pathways for the impact of PUS as a means of supporting Portland cement and differential hydration kinetics. This also discusses and analyzes previous work on the delivery effects of PUS in cementitious structures.

This study reviewed recent work in the area of cementeous substance PUS applications.

• PUS influence is still not completely known on Portland cement hydration. More work will be carried out in order to affirm and explain the causes of cavitation on cemented surfaces. In addition, the writers conclude that now is the time to build on cement hydration items the scope of ultrasound research known as sonocrystallisation. The goal is to establish state-of-the-art hypotheses on homogenous, heterogeneous nucleation and cement-hydration development influenced by ultrasound.

• The primary emphasis of virtually all research performed utilizing PUS to support the properties of SCMs was on the de-agglomeration and improvement in particle sizing distribution. Moreover, a thorough study of hydration and characterization of mechanical and toughness properties have not been disclosed by microstructural studies of cement composite. The kinesis and mechanisms of the PUS affected by cement blending systems must therefore be studied in which a hydraulic reaction of SCMs in combination with caviting effects may result in more complex hydration phases. In the first step, an analytical method may be established in order to calibrate and measure the reaction of SCM irrespective of the phases of the cement clinker.

• Cementitious products have fresh state properties affecting the functional facets of their application on the land.

• In future research it will be appropriate to extend the application of sonic cement paste into a concrete environment. It would entail the production and construction, particularly scaled-up son chemical processes, of ultrasound equipment specialized for the concrete.

• The research will be achieved on the effect on the sonocristallisation of cement-based substance hydration both in high-frequency and low-frequency ultrasound mixture exposures.

• It is important to tackle the heat produced by the phenomena of cavitation during PUS activities that can adversely affect the initial location.

10. Gedam et al. (2016),Use high-performance concrete (HPCs) with supplementary cement materials (SCMs), which are accessible locally, has increased worldwide. The problems associated with different indigenous cement products are attributed to differences in their physical / chemical / mineralogical properties that could have a significant effect on time-dependent properties such as shrinking and creeping in HPC. A significant design parama to insure that structures constructed with such concrete are performing in a satisfactory manner, particularly in longer term, with a fairly reliable estimation of the actual shortening and creep and no overly big deformity or disturbance such as cracking in their planned service life. Consequently, it is very important to choose suitable SCMs for the HPC concrete mix.

11. Zhang & Zhao (2017), this research investigated mechanical properties and ultra-high-performance concrete microstructures (UHPCs) with additional cement materials. Tests also found that the physical properties of SCMs have a significant effect on flexural and compressive resistance with a common chemical structure. A predictor for predicting UHPC's power compressively with these SCMs was measured as an efficiency factor (k value). A strong association of compressive strength was found with the micro-structure from screening electronic microscopy and pore volume determined by BJH. The probability of replacement of SCM in UHPC (i.e., SF, RHA and KL) for comparable UHPC properties in comparative to the reference mixture was evaluated in this analysis.

12. Srivastava et al. (2018),Owing to growing construction needed for increasing developmental activities massive burden is being posed to the environment in terms of direct products and by products. Cement is prime construction material and its huge production to meet out the demand is of great concern for environmentalists. During the production of cement various harmful gases are emitted out of which CO2 is of prime concern. Several materials viz. fly ash, rice husk ash, GGBS, silica fume, met kaolin etc. can be used as partial replacement of cement in construction. The use of Supplementary cementitious materials in construction not only improves the mechanical property of cement matrix but also reduce the burden from environment. In this paper an attempt is made to explore the possibility of use of different materials as partial replacement of cement in construction.

From the above study following conclusions may be drawn.

1. Use of supplementary cementitious materials reduces the emission of CO2 due to reduction in production of cement.

2. The use of Supplementary cementitious materials reduces the cost of construction.

3. Partially solves the environmental pollution problems by consuming different wastes.

4. Generally the waste materials are stabilized in concrete matrix.

5. Use of Supplementary cementitious materials in concrete improves mechanical properties and durability characteristics and quality of matrix.

13. Liu et al. (2017),High-performances cement-based materials such as high-performance or ultra-high - performance concrete (HPC or UHPC) have been used widely and still threaten cracking, especially automatic declines. Internal healing is an efficient means of auto-reduction which has impacts on chemical shrinking, dry shrinkage, etc. Internal components that are widely used are super-absorbent polymers (SAPs) and polymers. Lightweight aggregate (LWA) and superfine porous powders reflect porous materials. In this article, the internal cure materials have been classified by water absorption process into two groups. The impact on shrinkage of high-performance cement-based materials of these two categories of interior curing materials was studied. In addition to internal healing materials, internal cure water is released, internal HR is delayed and autogenously shrinkage is decreased but the chemistry is increased. The inclusion of internal curing products with additional water improves the shrinking of drying. In addition, internal healing shrinkage processes are outlined and addressed. Such processes, though, focus exclusively on certain shrinkages. The relationship between different forms of shrinkages should be calculated in order to reduce the risk of cracking more effectively. The paper examines the effects of internal curing on retrenchment of cement-based high-performance products. It is important to make the following conclusions:

(1) The internal treatment medium could be classified into two category based on the process for water absorption: chemically adsorbed water substances such as SAP and porous materials. The pore materials contain LWA and superfine porous powders. The high performing cement-based materials will decrease strength due to the large pore structure SAP and lightweight aggregate. UHPC is appropriate for SAP and soft superfine material, usually UHPC is not appropriate for LWA with greater particle size.

2) The introduction of internal curing water may raise the degree of cement hydration and chemical shrinkage later on. The early and later self-shrinkage of high-performance cement-based materials after setting may effectively be decreased independently of the SCM type. The impact of the internal curing on the drying reduction is calculated by the application of extra water. The shrinkage would be enhanced if more water is applied. The overall loss is decreased, though. The form, composition and particle size of the internal curing material affects internal curing performance.

3) Drying shrinkage under the inner curing is attributed to water evaporation depending on the surface porosity of cement-based products of higher efficiency. The influence on the shrinkage automatically by the internal HR adjustment and the degree of saturating vital capillary pores can be clarified. More, shrinkage simulation persists in the forecast of automated shrinkage and drying, and a relationship between internal process and shrinkage needs further research.

2.1 Conclusion from literature Review

a. Use of Silica Fume & results in an increase in the compressive strength of concrete

b. With increase in compressive strength the workability of concrete gets reduced with the use of silica fume, as a result, admixtures are used to enhance workability.

CHAPTER 3

MATERIALS AND METHODOLOGY

3.1 Materials Used and Testing

3.1.1 Portland Cement

The cement used was commercially available TCI 43 grade. This cement complies with the requirements of IS: 8112-2013 for ordinary Portland cement 43 grade.

Figure 3. 1: Portland cement

Table 3. 1: Test Results of Materials Used for Test

Particulars	Test Results	Requirements of IS: 8112-2013
Chemical Requirements		
$CaO-0.7SO_3$	0.87	0.66 (max)
$2.8SiO_2+1.2Al_2O_3+0.65Fe_2O_3$		1.02 (min)
Al_2O_3 / Fe_2O_3	1.23	0.66 (min)
Insoluble residue (%by mass)	2.79	4.00 (max)
Magnesia (%by mass)	1.36	6.00 (max)
Sulphuric Anhydride (%by mass)	2.06	3.50 (max)
Loss on ignition (%by mass)	2.68	5.00 (max)

Total chlorides (%by mass)	0.02	0.10 (max)
Physical Requirements		
Fineness (%)	2.6	2.25 (min)
Standard Consistency (%)	25.5	
Setting Time (minutes)		
Initial setting time	135	30 (min)
Final setting time	255	600 (max)
Compressive strength(MPA)		
03 days strength	38.72	23 (min)
07 days strength	44.8	33(min)
28 days strength	50.3	43(min)

3.2 Coarse Aggregates

The coarse aggregate used were boulder crushed. Two types of coarse aggregates were used, 20 mm and 10 mm nominal size. The specific gravity of coarse aggregates was 2.71.

Figure 3. 2: Coarse Aggregate

3.3 Tests on Coarse Aggregates

3.3.1 Sieveanalysis

The aggregates used for making concrete are normally of the maximum size 80 mm, 40 mm, 20 mm ,10 mm, 4.75 mm, 2.36 mm, 600 micron, 300 micron and 150 micron.

The fraction between 80 and 4.75 mm is considered coarse aggregates and this fraction is considered fine aggregates between 4.75 mm and 150 microns. After shaking, the substance holding on each sieve represents the fraction of the aggregate which is quieter and finer than the seven above. You can control manually or mechanically. The sieve is shook during the manual process to allow all particles to move through the sieve in any direction possible. The process will proceed until almost no particle moves. The study of the sieve shows the distribution of particle size in an empirical sample. A concept called fine module is used in this relation

Figure 3. 3: Sieve Analysis

Table 3. 2: Gradation of Coarse Aggregate

AVERAGE INDIVIDUAL GRADATION OF 20mm Coarse Aggregates.					
AS PER IS:383-1970					
Source: Delhi			Proposed Use: Concrete Work.		
Total weight of sample: 5000 gms.					
IS Sieve size (mm)	Materials Retained	Retained	%	Passing	IS Limit
	(gms)	%	Retained cumulative	%	
40	0	0	0	100	100
20	700	14	14	86	85-100
10	3521	70.42	84.42	15.58	0-20
4.25	681	13.62	98.04	1.96	0-5
Pan	98	-	-	-	-

Table 3. 3: Gradation of Coarse Aggregate

Average individual gradation of 10mm Coarse Aggregates.					
AS PER IS: 383-1970					
Source: Delhi	Proposed Use: Concrete Work				
Total weight of sample: 5000 gms.					
IS Sieve size (mm)	Materials Retained	Retained	%	Passing	IS Limit
	(gms)	%	Retained cumulative	%	
12.5	0	0	0	100	100
10	374.5	7.49	7.49	92.51	85-100
4.75	4050	81	88.49	11.51	0-20
2.36	460	9.2	97.69	2.31	0-5
Pan	115.5	-	-	-	-

3.3.2 Fine Aggregates

The fine aggregates used in all the mixes was a natural sand compatible to grading Type II after sieve analysis. Its bulk specific gravity at SSD was 2.65 and its fineness modulus ranged from 2.9-3.2.

Figure 3. 4: Fine Aggregate

3.4 Tests on fine aggregates

3.4.1 Sieveanalysis

The sieve analysis of fine aggregates is conducted in the same way as for coarse aggregates except that the sieves finer than 4.75 mm are used.

GRADATION 1

Table 3. 4: Gradation of Fine aggregate

Total Weight of Sample:	1000 gms			
IS Sieve size in mm	Materials retained	% retained cumulative	% passing	Specification limits as per IS 383 Table No.- 04
10	0	0	0	100
4.75	68	6.8	93.2	90-100
2.36	86	15.4	84.6	60-95
1.18	195	34.9	65.1	30-70
0.6	168	51.7	48.3	15-34
0.3	371	88.8	11.2	20-05
0.15	78	96.6	3.4	0-10
Pan	34			
fineness modulus: 2.9				

GRADATION 2

Table 3. 5: Gradation of Fine Aggregate

Total Weight of samling	1000 gms

IS Sieve size	Materials	%retained	%	Specification limits as per IS 383 ,			
in mm	Retained	cumulative	passing	Table No.- 04			
10	0	0	0		100	100	100
4.75	59	5.9	94.1		90-100	90-100	90-100
2.36	143	20.02	79.8		60-95	75-100	85-100
1.18	203	40.6	59.4		30-70	55-90	75-100
0.6	193	59.9	40.1		15-34	35-59	60-100
0.3	273	87.2	12.8		February	march	April
0.15	94	96.6	3.4		0-10	0-10	0-10
Pan	35			ZONE –II			
Fineness Modulus : 3.10							

Gradation 3

Table 3. 6: Gradation of Fine Aggregate

Total weight of sample	**1000 gms**			
IS Sieve size in mm	Materials retained	% retained cumulative	% passing	Specification limits as per IS 383

				Table No.- 04		
10	0	0	0	Zone-I	Zone-II	Zone-III
4.75	59	5.9	94.1	100	100	100
2.36	98	15.7	84.3	90-100	90-100	90-100
1.18	161	31.8	68.2	60-95	75-100	85-100
0.6	180	49.8	50.2	30-70	55-90	75-100
0.3	394	89.2	10.8	15-34	35-59	60-100
0.15	89	98.1	1.9	20-05	30-08	12-40
Pan	19			0-10	0-10	0-10
Fineness Modulus : 2.91				**ZONE –II**		

3.4.2Water

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully.

3.4.3SilicaFume

Silica Fume, to be added at various dosages starting from 5% replacement of cement by weight so as to find the optimum dosage of silica fume replacement in concrete.Commercially available Silica Fume is Grade 920-D in India.

Figure 3. 5: Silica Fume

3.5 Properties of Silica Fume

Table 3. 7: Properties of Silica Fume

Physical & Chemical Characterisctics	**Unit**	**Silica Fume**
SiO2	%	85
CaO	%	0.94
Al2O3	%	0.61
Fe2O3	%	0.31
Loss on ignition	%	5
Bulk density	Kg/m^3	610
Specific gravity	-	2.2
Specific surface area	Cm^2/gm.	150000-300000

3.7 Mixing Procedure

To get better efficiency, the following sequence is adopted. This is achieved by distributing the complete volume of cement and sorting the remainder of the cough aggregate and small aggregate. Which stops the release of cement in the drum and therefore keeps the wind from moving away. The rest of the water, aside from a liter, is directly returned to the drum when the dry content is discharged. The sum of silica fumes measured is also pumped into the tank.

Figure 3.6: Quantity of Silica Fume Fed in Mixer

3.8 Properties of concrete

The properties of concrete can be studied under following headings:

- **Properties of fresh concrete**
- **Properties of concrete in hardened state.**

3.8.1 Properties of fresh concrete

The main and significant property of the fresh concrete is its workability. Workability of concrete is the ease with which it can be compacted or worked with. Workability depends on water content, aggregate, cementitious content and age, and can be modified by adding chemical admixtures, like super plasticizers. Workability of concrete is measured either by:

(a) Slump test apparatus,

(b) Compaction factor test.

(c) Slump Test: The test is popular due to the simplicity of apparatus used and simple procedure. Unfortunately, the simplicity of the test often allows a wide variability in the manner that the test is performed. In India it is accompanied as per IS specification.

(d) Compaction Factor Test: Compacting factor of fresh concrete is done to determine the workability of fresh concrete by compacting factor test as per IS: 199-1959. The apparatus used is compacting factor apparatus.

$$\text{Compacting factor} = \frac{\text{Weight of partially compacted concrete.}}{\text{Weight of fully compacted concrete}}$$

Higher the value of slump or compaction factor more workable will be the concrete grade and more easily will be it workable.

3.8.2 Properties of hardened concrete

The important properties of hardened concrete are its strength. Strength of concrete may be Compressive, Flexural or Splitting tensile. However, our prime focus is on compressive strength. Compressive strength of concrete is its resistance to resist compressive stresses. Strength of concrete in place in the structure is also greatly affected by quality control procedures for placement and inspection. Compressive strength of concrete is usually determined by the cube testing, cylinder testing or prism testing. However, cube testing is most common and easier one.

3.9 Casting of Cubes

In three cases, the 28-day intensity is the criterion for clear acceptance and rejection. 7 and 14 days testing compressive concrete performance may be done to provide a relatively quicker understanding testing concrete consistency.

Number of cubes

Six numbers 150 bis150 per 150 mm shall be set, three shall be set for seven days fourteen days and final twenty eight days. The measurement product of the study is the overall compressive power. The single variants of a group of 3 cubes shall not surpass ±15% of the average. In comparison, the experimental check outcome is null.

Casting of cube

The molding plates in the cube should be withdrawn, washed correctly, installed and all bolts fully ready. As a thin film of oil is added to either part of the mold. The cube faces should be parallel. It is necessary. The cubes shall be installed as soon as possible after taking concrete samples and combining them.

Casting and compaction by hand

The sample of cement shall be poured in 3 layers into the cube mould, roughly 5 cm in depth per sheet. The scooping shall be shifted to the top edge of each concrete scooping, while the concrete falls from it, to insure that the concrete is symmetrically spread inside the mould.

Figure 3. 7: Cube Casting

3.10 Curing

The casted cubes shall be stored under shed at a place free from vibration at a temperature 22 degree to 33 degrees for 24 hours. The cubes shall then be marked clearly. The cube shall be removed from the moulds at the end of 24 hours and immersed in clean water at a temperature 24- 30 degree Celsius.

Figure 3.8: (a) Curing of Concrete Cubes

Figure 3.8: (b) Curing of Concrete Cubes

3.11 Specification followed

Characteristic compressive strength of concrete = 30 N/mm

Maximum size of aggregate = 20 mm

Degree of workability (slump value) =100 mm

Degree of quality control= Good

Type of exposure = Moderate

Table 3. 8: Design Stipulations

S.No	Nameofmaterials	Source	Specific Gravity	Water Absorption (%)	Free Surface Water (%)
1	Cement(OPC 43)	TCI Cement	3.15	-	-
2	Coarse Aggregates 10mm	Delhi	2.71	1.10	-
3	Coarse Aggregates 20mm	Delhi	2.62	0.47	-
4	Fine Aggregate (ZoneII)	Delhi	2.65	1.40	To be calculated every day
5	Water	Bore well	1	-	-

3.12 Target mean strength of concrete

As per IS -10262 -2009 target mean strength of concrete is given by

FM = fck+1.65∂

Where ∂ is standard deviation of samples of cubes strength and fck the characteristic mean strength of concrete which means 95% of cube strength will fall under this strength.

For M30, characteristic mean strength

Target mean strength, fck =30 + 1.65(5) = 38.25MPa.

Water Cement Ratio = 0.45

Estimated water content for 100mm slump

=186 + (6/100)186

=197 Liter.

Cement content =197/0.45

= 437.77 kg/m3 > 320 kg/m3

Volume of Coarse aggregates corresponding to 20mm size aggregates and fine aggregates (zone II) for w/c ratio of 0.45

=0.63.

Volume of Fine aggregates = 1-0.63=0.37.

Mix Calculations

Volume of concrete = 1m3.

Volume of cement = (437.77/3.15) (1/1000) = 0.138 m3.

Volume of water = (197/1) (1/1000) =0.197 m3.

Volume of all-in-aggregates = [1- (0.138 + 0.197)] = 0.665 m3.

Mass of coarse aggregates

20mm @60% = 0.665 x 0.60 (2.72 x 0.63 x 1000) = 688.74 kg.

10mm @40% = 0.665 x 0.40 (2.71 x 0.63 x 1000) =459.16 kg.

Mass of fine aggregates = 0.665 (2.65 x 0.37 x 1000) = 674.17 kg.

Table 3. 9: Mix proportion of concrete

S.No	Materials	Quantity
1.	Cement	437.7 kg/m^3
2.	Water	197kg/m^3

3.	Fine Aggregate	674.17kg/m^3
4.	Coarse Aggregate 20 mm	688.74kg/m^3
5.	Coarse Aggregate 10 mm	459.16 kg/m^3
6.	Water Cement ratio	0.45

Table 3. 10: Percentage replacement materials

S. No	Type of mix	Silica Fume (%)	Cement (%)
1.	TM 1	0	100
2.	TM 2	2	95
3.	TM 3	4	90
4.	TM 4	6	85
5.	TM 5	8	80
6.	TM 6	10	75

Control mix batch:

Grade of concrete is M30

Target mean strength: 38.2 Mpa. Water cement ratio: 0.45

20mm: 10mm = 60: 40

Table 3. 11: Control Mix Batch

Ingredients		**Source**		**Specific gravity**	
Cement		TCI max		3.15	
Sand		Delhi		2.65	
CA 20mm		Delhi		2.71	
CA 1omm		Delhi		2.72	
Description	Cement	Sand	CA-10mm	CA-20mm	Water
Standard Design Quantities per m3	437.7	674.17	459.16	688.74	197

Table 3. 12 : Trial Mix1

Date of Casting: Feb 2020Grade of Concrete: M30.
Target Mean Strength: 38.25 MPa.W/C Ratio: 0.45.

20mm: 10mm-60:40.					
Description	Cement (Kg)	Sand (Kg)	CA 10mm (Kg)	CA 20mm (Kg)	Water (Kg)
Standard Design per m3	437.7	674.17	459.16	688.74	197
Moisture Content	-	2.56	0	0	-
Water Absorption	-	1.4	1.1	0.47	-
% of Adjustment	-	1.16	-1.1	-0.47	-
Correction Required	-	7.82	-5.5	-3.24	-0.47
Corrected Quantity	437.7	681.99	454.11	685.5	197.47

Testing Of Cubes

Figure 3.9: (a) Cube Testing on CTM

Figure 3.9: (b) Cube Testing on CTM

CHAPTER 4

RESULT AND DISCUSSION

4.1 Test Results

Table 4. 1: Test Results

Workability		
Slump value (mm)	Compacting factor	
80	0.92	
Compressive strength		
7-day strength	Mpa	
Cube_1	26.9	27.05
Cube _2	26.45	
Cube _3	27.8	
Average compressive strength	**27.05**	
14-day strength	Mpa	
Cube_1	30.03	30.89
Cube_2	31.23	
Cube_3	31.43	
Average compressive strength	**30.89**	
28-day strength	Mpa	
Cube_1	36.2	37.2
Cube_2	37.3	
Cube_3	38.2	
Average compressive strength	**37.2**	

Table 4. 2: Trial Mix2

Date of Casting: Feb -2020
Grade of Concrete: M30.

Target Mean Strength: 38.25 MPa.							
W/C Ratio: 0.45.							
20mm: 10mm-60:40.							
Description	Cement (Kg)	Sand (Kg)	CA-10mm (Kg)	CA-20mm (Kg)	Water	Silica Fume Dosage (kg)	
Standard Design per m3	415.88	674.17	459.16	688.74	197	5%	21.88
Moisture Content	-	6.31	2.12	1.79	-	-	
Water Absorption	-	1.4	1.1	0.47	-	-	
% of Adjustment	-	4.91	1.02	1.32	-	-	
Correction Required	-	33.101	4.68	9.0913	46.87	- - - - -	
Corrected Quantity	415.88	707.27	463.84	697.83	150.72	21.88	

Table 4. 3: Test results

Workability		
Slump value (mm)	Compacting factor	
63	0.89	
Compressive strength		
7-day strength	Mpa	
Cube_1	26.00	**27.81**
Cube _2	29.44	
Cube _3	28.00	
Average compressive strength	**27.81**	
14-Days Strength	Mpa	
Cube_1	31.22	31.25
Cube _2	32.32	

Cube _3	30.21	
Average compressive strength	31.25	
28- day strength	Mpa	
Cube_1	39.65	**39.02**
Cube _2	39.16	
Cube _3	38.25	
Average compressive strength	**39.02**	

Table 4. 4: Trial mix3

Date of Casting: Feb 2020							
Grade of Concrete: M30.							
Target Mean Strength: 38.25 MPa.							
W/C Ratio: 0.45.							
20mm: 10mm-60:40.							
Description	Cement	Sand	CA-10mm	CA-20mm	Water	Silica Fume Dosage	
Standard Design per m3	393.99	674.17	459.16	688.74	197	5%	32.83
Moisture Content	-	6.31	2.12	1.79	-	-	
Water Absorption	-	1.4	1.1	0.47	-	-	
% of Adjustment	-	4.91	1.02	1.32	-	-	
Correction Required	-	333.101	4.683	9.09	46.87	-	
Corrected Quantity	393.99	707.27	463.84	697.831	150.72	21.88	

Table 4. 5: Test results

Workability		
Slump value	**Compacting factor**	
40	**0.84**	
Compressive strength		
7-day strength	**Mpa**	
Cube_1	31.0	**30.4**
Cube _2	29.5	
Cube _3	30.9	
Average compressive strength	**30.4**	
14-Days Strength		

Cube_1	35.45	**35.45**
Cube _2	34.67	
Cube _3	35.90	
Average compressive strength	**35.45**	
28- day strength		
Cube_1	40.04	**40.78**
Cube _2	40.5	
Cube _3	41.8	
Average compressive strength	**40.78**	

Table 4. 6: Trial Mix4

Date of Casting: Feb 2020						
Grade of Concrete: M30.						
Target Mean Strength: 38.25 MPa.						
W/C Ratio: 0.45.						
20mm: 10mm-60:40.						
Description	Cement	Sand	CA-10mm	CA-20mm	Water	Silica Fume Dosage
Standard Design per m3	372.05	674.17	459.16	688.74	197	5%
Moisture Content	-	7.8	0.7	0	-	-
Water Absorption	-	1.4	1.1	0.47	-	-
% of Adjustment	-	6.4	-0.4	-0.47	-	-
Correction Required	-	43.14	-1.836	-3.237	38.07	-
Corrected Quantity	372.05	717.32	457.324	685.502	159.08	21.885

Table 4. 7 Test Results

Workability		
Slump value	Compacting factor	
25	0.8	
Compressive strength		
7 day strength		
Cube_1	31.5	Mpa

Cube _2	32.6	Mpa
Cube _3	33.0	Mpa
Average compressive strength	32.5	Mpa
14 Days Strength		
Cube_1	39.05	Mpa
Cube _2	38.90	Mpa
Cube _3	41.56	Mpa
Average compressive strength	39.83	
28 day strength		
Cube_1	44.7	Mpa
Cube _2	46.4	Mpa
Cube _3	47	Mpa
Average compressive strength	46.1	Mpa

Table 4. 8: Trial mix5

Date of Casting: Feb 2020							
Grade of Concrete: M30.							
Target Mean Strength: 38.25 MPa.							
W/C Ratio: 0.45.							
20mm: 10mm-60:40.							
Description	Cement	Sand	CA-10 mm	CA-20mm	Water	Silica Fume Dosage	
Standard Design per m3	350.17	674.17	459.16	688.74	197	5%	21.885
Moisture Content	-	2.56	0	0	-	-	
Water Absorption	-	1.4	1.1	0.47	-	-	
% of Adjustment	-	1.16	-1.1	-0.47	-	-	
Correction Required	-	7.82	-5.5	-3.24	-0.47	-	
Corrected Quantity	350.17	681.99	454.11	685.5	197.47	21.885	

Table 4. 9: Conclusion based on results

S.no	Dosage of Silica Fume (%)	7 day strength (Mpa)	14days (Mpa)	28 day strength (Mpa)
Trial no. 1(TM 1)	0	27.05	29.09	30.58
Trial no. 2(TM 2)	2	27.81	29.03	33.05
Trial no. 3(TM 3)	4	28.00	30.02	34.80
Trial no. 4(TM 4)	6	29.58	32.53	35.59
Trial no. 5(TM 5)	8	28.01	31.04	35.28
Trial no. 6 (TM 6)	10	27.00	27.99	33.30

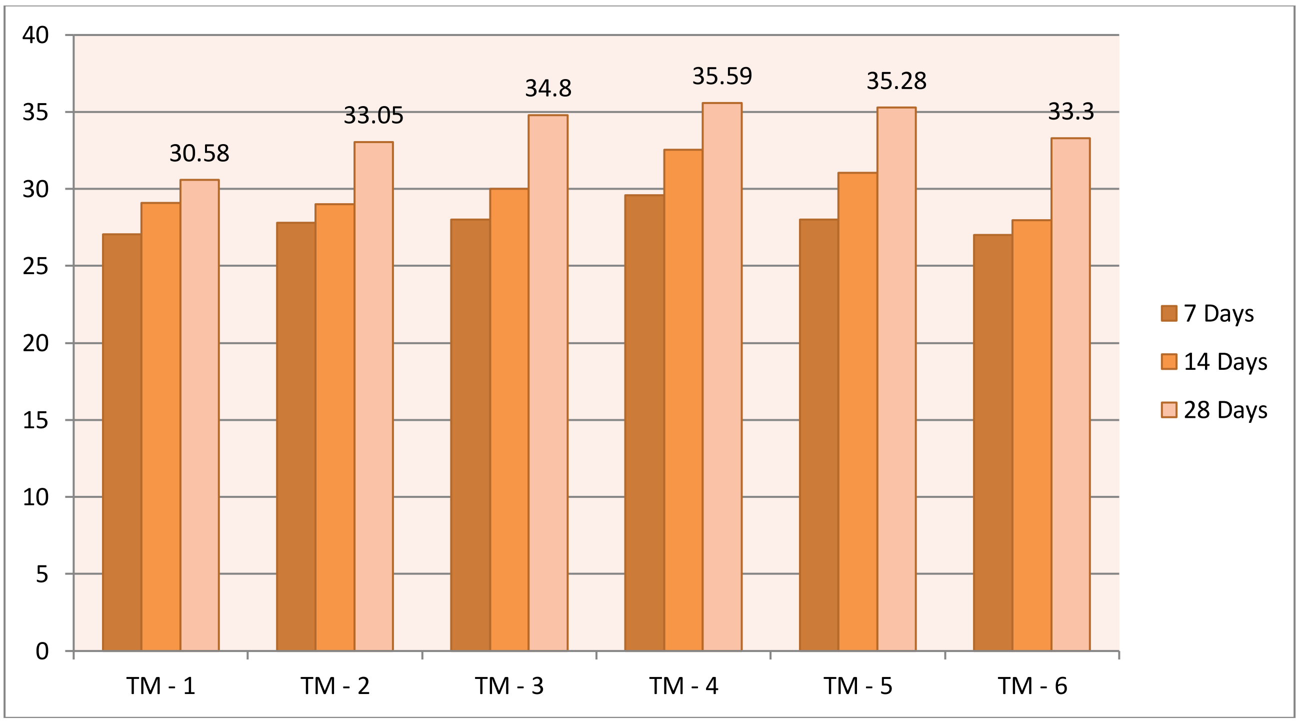


Fig 4.1: Compressive strength of concrete .

Table 4. 9: The net results considering workability criteria

Sr. No	Dosage of Silica Fume(%)	Slump value (mm)	Compacting factor (cf)
Trial no. 1	0	80	0.92
Trial no. 2	2	63	0.89

Trial no. 3	**4**	**40**	**0.84**
Trial no. 4	**6**	**32**	**0.82**
Trial no. 5	**8**	**25**	**0.80**
Trial no. 6	**10**	**24.99**	**0.79**

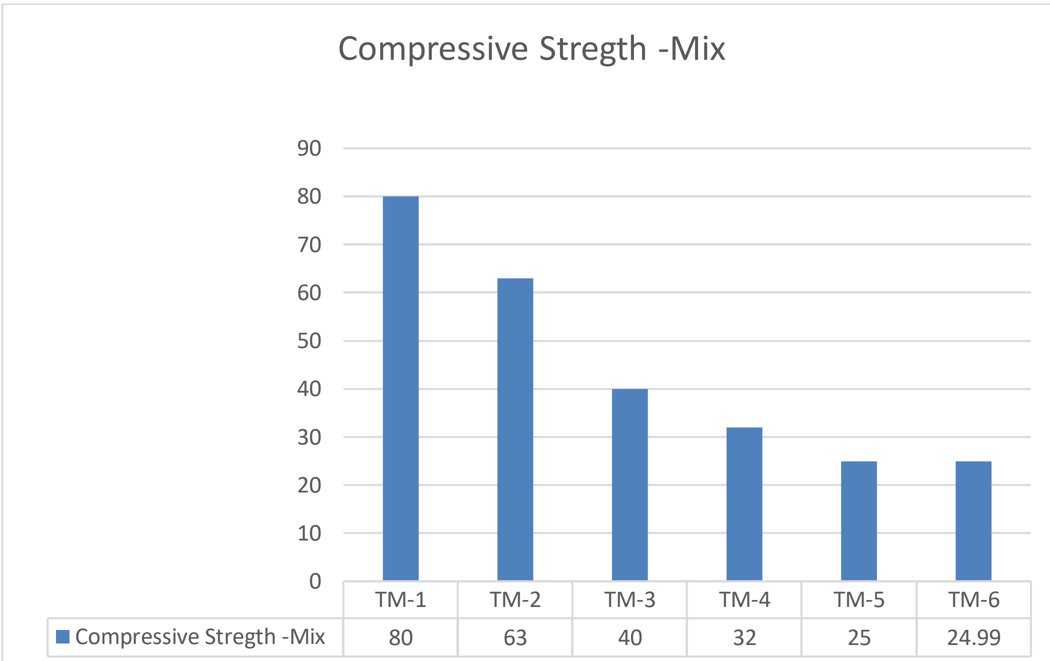


Figure 4. 1: Workability for Trial Mixes

CHAPTER 5
CONCLUSION AND FUTURE WORK

5.1 Discussion of Test Results

It is quite evident from the test results that there is increase in the compressive strength (both 7 Day, 14Days and 28 Day Compressive Strength) of the silica fume concrete as compared to the compressive strength of the conventional concrete. It is found that the compressive strength (both 7 day,14Days and 28 day) increased with the increase in the dosage of silica fume up to certain limit of replacement of cement by silica fume and when the dosage of was further increased after 6 %, it indicated plunge in the compressive quality of Silica Fume and Concrete. In any case, the joining of in concrete diminished the functionality of the solid. It is very apparent from the test outcomes that there is increment in the compressive quality (both 7 Day, 14Days and 28 Day Compressive Strength) of the silica rage concrete when contrasted with the compressive quality of the customary cement. It is discovered that the compressive quality (both 7 day,14Days and multi day) expanded with the expansion in the dose of silica rage up to certain furthest reaches of substitution of concrete by silica seethe and . At the point when the measurements of was additionally expanded after 6 %, it indicated plunge in the compressive quality of Silica Fume. Along these lines 6 % is the ideal dose of joining of in Concrete. Be that as it may, the consolidation of in concrete diminished the usefulness of the solid.

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