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A Study On Properties Of Self-Compacting Concrete By Partial Replacement Of Fine Aggregates With Quartz Sand And Addition Of PP Fibers

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Abstract : Self-compacting concrete is the very flowable, non-isolating solid that can spread into put, fill formwork, and embody even the most congested support by methods for its own weight, with practically no vibration. It conveys these appealing advantages while keeping up or improving all of standard mechanical and solidness qualities of cement. Changes in accordance with customary blend plans and the utilization of super plasticizers make this solid that can meet stream execution necessities. The self-compacting concrete is perfect to be utilized for throwing vigorously fortified areas or be set where there can be no entrance to vibrators for compaction and in complex states of formwork which may some way or another be difficult to cast, giving a far better surface than regular concrete. Self-compacting concrete, likewise alluded to as self-uniting concrete, can stream and combine under its own particular weight and is deaerated totally while streaming in the formwork

The use of quartz sand as replacement for sand is an economical solution for making the concrete resistant to weathering. The Study Includes a concrete mix design procedure for partial replacement of sand with quartz sand and addition of PP Fibers by volume of cement. Present method was performed to evaluate the additional compressive, and Split Tensile Strength, flexural strength over conventional concrete. in which sand is replaced with 0%, 5%, 10%, 15%, 20%, 25%, by weight with 1% viscosity modifying agent. Compressive, Split Tensile and flexural strength tests were carried out to evaluate the strength properties of concrete at the age of 7, 14 and 28 days. Mix Proportions
0%QS+0.6PPF+1%VMA,5%QS+0.6PPF+1%VMA,10%QS+0.6PPF+1%VMA,15%QS+0.6PPF+1%VMA,
20%QS+0.6PPF+1%VMA,25 %QS+0.6PPF+1%VMA.

***IndexTerms* - Self Compacting Concrete, M30 Concrete, Quartz Sand.**

I. INTRODUCTION

GENERAL:

Self compacting concrete (SCC) is highly flowable, non-segregating concrete that fills uniformly and completely every corner of formwork by its own weight and encapsulate reinforcement without any vibration, whilst maintaining homogeneity.

1.1 Application Area

Self compacting concrete (SCC) may be used in precast concrete applications or for concrete placed on site. SCC is used to cast sections with highly congested reinforcement and in areas that present restricted access to placement and consolidation, including the construction of tunnel lining sections and the casting of hybrid concrete filled steel tubular columns. It may be manufactured in a site batching plant or in a ready-mixed concrete plant and delivered to site by truck mixer. It may be placed either by pumping or pouring into horizontal or vertical forms.

1.2 Features of Fresh Self Compacting Concrete

A concrete mix can only be classified as self compacting concrete, if the requirements for all below mentioned characteristics are fulfilled:

a) Filling ability (Flowability),
b) Passing ability,
c) Segregation resistance, and
d) Viscosity

The above tests shall be carried out as per IS 1199 (Part 6).

1.3 Filling Ability (flowability)

This is the ability of fresh concrete to flow into and fill all spaces within the formwork, under its own weight. Slump-flow test is performed to test the flowability. Slump-flow value describes the flowablity of a fresh mix in unconfined condition. Visual observation during the test can provide additional information on the segregation resistance and uniformity.

The following are typical slump-flow classes for a range of applications:

a) SF1 (slump flow 550 mm - 650 mm). This class of SCC is appropriate for:

1) Unreinforced or lightly reinforced concrete structures that are cast from the top with free displacement from the delivery point (for example, housing slabs).

2) Casting by a pump injection system (for example, tunnel linings).

3) Sections that is small enough to prevent long horizontal flow (for example, piles and some deep foundations).

b) SF2 (slump flow 660 mm - 750 mm) is suitable for normal applications (for example, walls, columns).

c) SF3 (slump flow 760 mm — 850 mm) is used for vertical applications in heavily reinforced structures, structures with complex shapes, or for filling under formwork. SF3 will often give better surface finish than SF2 for normal vertical applications but segregation resistance is more difficult to control.

1.4 Passing Ability (Free from Blocking at Reinforcement)

Passing ability describes the capacity of the fresh mix to flow through confined spaces and narrow openings such as areas of congested reinforcement without segregation. If there is little or no reinforcement, there may be no need to specify passing ability as a requirement. L-box test is performed to check the passing ability. The minimum ratio of the depth of the concrete in the horizontal section relative to the depth of concrete vertical section is considered to be 0.8. If the SCC flows as freely as water, it will be completely horizontal, and the ratio will be equal to 1.0.

1.5 Segregation Resistance (Stability)

This is the ability of fresh concrete to remain homogeneous in composition while in its fresh state. Segregation resistance (sieve) test is performed to check this property of fresh concrete. After sampling, the fresh concrete is allowed to stand for 15 min and any separation of bleed water is noted. The top part of the sample is then poured into a sieve with 4.75 mm square apertures. After 2 min, the weight of material which has passed through the sieve is recorded. The segregation ratio (SR) is then calculated as the proportion of the sample passing through the sieve.

There are two classes of segregation resistance, namely SR1 and SR2. SR1 is generally applicable for thin slabs and for vertical applications with a flow distance of less than 5 m and a confinement gap greater than 80 mm.

SR2 is preferred in vertical applications if the flow distance is more than 5 m with a confinement gap greater than 80 mm in order to take care of segregation during flow. For SR1 class segregation resistance shall be 15 to 20 percent and for SR2 it shall be less than 15 percent. SR2 may also be used for tall vertical applications with a confinement gap of less than 80 mm if the flow distance is less than 5 m, but if the flow is more than 5 m, a target SR value of less than 10 percent is recommended. Segregation resistance becomes an important parameter with higher slump-flow classes and/or the lower viscosity classes, or if placing conditions promotes segregation. If none of these apply, it is usually not necessary to specify a segregation resistance class.

1.6 Viscosity

Viscosity can be assessed by the V-funnel flow time as per IS 1199 (Part 6). Concrete with a low viscosity will have a very quick initial flow and then stop. Concrete with a high viscosity may continue to creep forward over an extended time. A V-shaped funnel is filled with fresh concrete and the time taken for the concrete to flow out of the funnel is measured and recorded as the V-funnel flow time. The viscosity is divided into two classes, that is, V1 and V2. V1 has good filling ability even with congested reinforcement. It is capable of self-leveling and generally has the best surface finish. V2 class viscosity is more likely to exhibit thixotropic effects, which may be helpful in limiting the formwork pressure or improving segregation resistance. But it may cause negative effects on surface finish and sensitivity to stoppages or delays between successive lifts. For V1 class, the time taken to pass the concrete from V-funnel shall be ≤ 8 s and for V2 class the time taken to pass the concrete from V-funnel shall be between 8 s and 25 s.

1.7 Mix Proportioning Principles

a) Lower coarse aggregate content,
b) Increased paste content,
c) Low water/powder ratio (*see* Note),
d) Increased super plasticiser, and
e) Sometimes a viscosity modifying admixture.

1.8 Mix Proportioning Approach

Laboratory trials shall be used to verify properties of the initial mix composition with respect to the specified characteristics and classes. If necessary, adjustments to the mix composition shall then be made. Once all requirements are fulfilled, the mix shall be tested at full scale in the concrete plant and if necessary, at site to verify both the fresh and hardened properties.

The mix design is generally based on the approach outlined below:

a) Determine the target average compressive strength.
b) Select the air content based on the specified nominal maximum size of aggregate and concrete grade.
c) Select water-cement/cementitious materials ratio.
d) Select the proportions for initial mix.
e) Select water content and cement/fly ash(or other supplementary cementitious material) content.
f) Select admixture content.
g) Select powder content and fine aggregate content.
h) Select coarse aggregate content.

j) Calculate volume of powder content and determine water powder ratio by volume, and make adjustments, if required.
k) Work out the mix proportions for trial 1.
m) Produce the fresh SCC in the laboratory mixer, perform the required tests as per **7.2,** and make adjustments.
n) Test the properties of the SCC in the hardened state.
p) Produce trial mixes in the plant mixer.

1.9 Typical Ranges of Mix Constituents

a) Sufficient amount of fines (< 0.125 mm) preferably in the range of 400 kg/m3 to 600 kg/m3, inclusive of suitable quantities of fine aggregate and mineral admixtures like fly ash in suitable proportions, may be used for flowability while ensuring compliance with engineering properties particularly shrinkage.
Fine aggregate content, typically, 48 to 60 percent by mass of the total aggregate, balances the volume of the other constituents.
b) Water content between 150 to 210 kg/m3.
c) Use of high range water reducing admixture like polycarboxylate ether based high range water reducing admixture (water reduction > 30 percent) and sometimes also using a viscosity modifying admixture (VMA) in appropriate dosages.
In the event that satisfactory performance is not obtained, consideration shall be given to a fundamental redesign of the mix. Depending on the apparent problem, the following courses of action might be appropriate:
1) Adjust the water/powder ratio and test the flow and other properties of the paste.
2) Try different types of additions (if available).
3) Adjust the proportions of the fine aggregate and the dosage of super plasticiser.
4) Consider using a viscosity modifying agent to reduce sensitivity of the mix.
5) Adjust the proportion or grading of the coarse aggregate.

QUARTZ SAND:

Quartz is the most abundant silica mineral. Pure Quartz is colourless and transparent. It occurs in most igneous and practically all metamorphic and sedimentary rocks. Quartz is mainly made up of silica. The formula for it is SiO_2. It has a hardness of 7 on the Mohs scale. It is highly resistant to both mechanical and chemical weathering. This durability makes it the dominant mineral of mountaintops and the primary constituent of beach, river and desert sand. Quartz is ubiquitous, plentiful and durable.

Sand becomes a scarce material, alternative for sand is needed all over, and also providing good strength than conventional concrete and some additional advantages, this experiment is done. This study gives a new alternative for fine aggregate. Resistant nature to weathering is very useful for buildings in future.

It is also used in glass manufacturing, petroleum industry, as an abrasive. Quartz sand is used as filler in the manufacture of rubber, paint and putty. Quartz is very resistant to both chemicals and heat. It is used as a foundry sand with a melting temperature higher than most metals. Refractory brick are often made of quartz sand because of its high heat resistance.

Figure 1.2 Quartz Sand

1.2.1 Properties of Quartz sand

Table 1.1 Properties of Quartz sand

Properties of Quartz sand		
S.No	Property	Value
1	Specific gravity	2.45
2	Water absorption	1.98%
3	Fineness modulus	4.2

1.2.3 Chemical Analysis of Raw Materials:

Table 1.2 Properties of Quartz sand

Main constituents (wt.%)	**Granite waste**	**OPC**
SiO_2	67.85	20.55
TiO_2	0.44	–
Al_2O_3	15.68	4.01
$Fe_2O_3^{tot.}$	3.13	3.27
MnO	0.07	–
MgO	0.63	1.75
CaO	1.43	62.67
Na_2O	4.51	0.44
K_2O	4.82	0.24
P_2O_5	0.11	–
SO_3	0.09	3.15
Cl	0.05	0.02
BaO	0.171	–
ZrO_2	0.149	–
Minor other oxides	0.14	–
L.O.I	0.73	3.84
Total	100	99.94

Objective s

1. Collection of Quartz Sand.
2. Testing of the collected samples for various physical
3. Testing of fresh concrete containing Quartz Sand for workability.
4. Identification and usage of admixture for better workability and strength.
5. Testing of hardened concrete cubes for strength at different ages.

II.LITERATURE REVIEW

E.Divya R.Shanthini, and S.Arulkumaran, have Studied on Behaviour of concrete partially replacing quartz sand as fine aggregate. Their study was performed to evaluate the additional compressive, flexural strength with higher slump over conventional concrete.

Nimitha Vijayaraghavan and A S Wayal have studied on Effects Of Manufactured Sand On Compressive Strength and Workability Of Concrete. This study includes experimental investigation of partial and full replacement of natural sand by manufactured sand.

Shewaferaw Dinku Belay (2006) found that the hardened properties of the concrete mixes with partial replacement of natural sand with manufactured sand achieved higher compressive strength.

S.Rukmangadhara Rao et al. Int. Journal of Engineering Research and Applications , Vol. 5, Issue 12, (Part - 1) December 2015, pp.84-88, done his research on Study on Strength of Concrete Using Robo Sand as a Partial Replacement of Fine Aggregate.

Review of work done by various researchers discusses the mechanism of fibre-matrix interaction, where various models are used to compute the bonding between the fibres and cement matrix. As the bonding of fibre and the matrix plays a major role in the composite behavior. Furthermore, this chapter also presents a review of literature relevant to the investigation and tests done for fibre reinforced concrete in general with a prominence of civil engineering application.

Fiber reinforced concrete was successfully used in variety of engineering applications, because of its satisfactory and outstanding performance in the industry and construction field. However, most of the engineers and researchers have thought that how and why the fibers perform so successfully. So, to recognize the usage of fibers in concrete, in these last four decades, most of the research was done on mechanical behavior of fiber reinforced concrete and the fibers itself.

According to Balaguru (1988) the uniaxial compression test is normally used to evaluate the behavior of concrete in compression. This produces a combination of shear failure near the ends of the specimen with lateral swelling of the unconfined central section accompanied by cracking parallel to the loading axis when the lateral strain exceeds the matrix cracking strain in tension. Fibers can affect these facets of uniaxial compressive behavior that involve shear stress and tensile strain. This can be seen from the increased strain capacity and also from the increased toughness (area under the curve) in the post-crack portion of the stress-strain curve.

Khajuria and Balaguru, (1989) .in some instances, if more water is added to fiber concrete to improve its workability, a reduction in compressive strength can occur. This reduction should be attributed to additional water or due to an increase in entrapped air, not fiber addition.

Johnston and Skarendahl, (1992). The addition of fibers up to a volume fraction of 0.1% does not affect the compressive strength. When tested under compression, failure occurs at or soon after the peak load providing very little toughness. It is found that the fibers have very little effect on compressive strength calculated from the peak load, and both slight increase and decrease in strength have been reported with increase in fiber content. The decrease in strength is mostly reasoned due to incomplete consolidation.

Bentur, (2007). (Hasan Et Al., 2011 Roesler Et Al. (2006), the addition of polypropylene fibres does not have a significant effect on the direct tensile cracking strength (Bentur, 2007). However, in moderate volume replacements (0.33-0.5%) the addition of macro-synthetic polypropylene fibres showed a 10 to 15% increase in splitting tensile strength.

Kolli.Ramujee (2013) The interest in the use of fibers for the reinforcement of composites has increased during the last several years. A combination of high strength, stiffness and thermal resistance favorably characterizes the fibers. In this study, the results of the Strength properties of Polypropylene fiber reinforced concrete have been presented. The compressive strength, splitting tensile strength of concrete samples made with different fibers amounts varies from 0%, 0.5%,1% 1.5% and 2.0% were studied. The samples with added Polypropylene fibers of 1.5 % showed better results in comparison with the others.

Milind V. Mohod (2015) This paper presents an experimental study on performance of polypropylene fiber reinforced concrete. In this study [2] Milind V. Mohod (2015) This paper presents an experimental study on performance of polypropylene fiber reinforced concrete. In this study

Amit Rai, Dr. Y.P.Joshi (2014) conducted the experimental studies and application of fibers reinforced concrete. They study different types of fibers and their application. The improvement in concrete properties by polypropylene fibers, they analysed that compressive strength which is increased about 16%. The flexural strength of polypropylene fibers is improved about 30%.They studies the different types of fibres and the concrete properties. Fiber addition improves ductility of concrete Slump test were examined to find out the workability and consistency of fresh concrete. The efficiency of all fiber reinforcement is dependent upon achievement of a uniform distribution of the fibers in the concrete, their interaction with the cement matrix, and the ability of the concrete to be successfully cast or sprayed.

Komal Bedi (2014) Experimental studied on flexure strength on polypropylene fiber Reinforced concrete and considered the impacts of polypropylene fiber on the flexure strength of cement. The trial customized was under taken to test standard concrete beam (150 X 150) mm with a span 700 mm for examining strength in flexure. The specimens were contrasted with no fiber and polypropylenes fiber of force 0.89 kg for each cum of cement. To give a premise to flexure, reference examples were thrown without polypropylene fiber. The test outcomes demonstrated that the mechanical properties of flexural strength coming about because of included of polypropylene fiber was generally high.

Kolli, Ramujee (2013) conducted the experimental studies on the strength properties of polypropylene fibre reinforced concrete. A combination of high strength, stiffness and thermal resistance polypropylene fibers are preferred for the fibre reinforced concrete. In this study, the results of the Strength properties of Polypropylene fiber reinforced concrete have been studied. The compressive strength, splitting tensile strength of concrete samples made with different fibers amounts of percentage varies from 0%, 0.5%, 1% 1.5% and 2.0% were studied. The samples with added Polypropylene fibers of 1.5 % showed better results in comparison with the other fibre percentage.

Peng Zhang et al (2013) studied on the Fracture Properties of Polypropylene Fiber Reinforced Concrete. The goal of this paper is to Used 0.04%, 0.06%, 0.08%, 0.1% and 0.12% of polypropylene fibers in concrete containing 15% fly ash and 6% silica fume. They reported by testing beam specimens under three point loading, that addition of fibers greatly improved the fracture parameters of concrete composite such as fracture toughness, fracture energy, effective crack length, maximum mid-span deflection, critical crack opening displacement etc. With increase in fiber volume fraction from 0 to 0.12%, there is increase in fracture parameters. The fibers embedded in concrete affect the stress and strain, enhancing the stress redistribution and reducing strain localization. The addition of polypropylene fibers to plain concrete reduces the crack width to an extent of 21% to 74%.

MR. Mehul J. Patel et al (2013) studied the effect of polypropylene fibre on the high strength concrete. The paper deals with the effects of addition of various proportions of polypropylene fibers on the properties of high strength concrete. An experimental program was carried out to explore its effects on compressive, tensile, flexural, shear strength and plastic shrinkage cracking. A notable increase in flexural, tensile and shear strength was found. The main aim of the investigation program is first to prepare the strength of concrete of grade M40 with locally available ingredient and then to study the effect of different proportion of Polypropylene fiber in the mix and to find optimum range of Polypropylene fiber content is 0.5%,1.0%,1.5% in the mix. The concrete specimens were tested at different age level for mechanical properties of concrete, namely, cube compressive strength, split tensile strength, flexural strength and other test were conducted for cement, chemical admixture, coarse aggregate & fine aggregate.

P. Sathe et al (2013) experimentally investigated on Polypropylene Fiber Reinforced Concrete with Artificial and exploration work of trial examination on polypropylene fiber strengthened cement by supplanting river sand to manufactured sand with and without admixture. Utilization of fiber strengthen polymer in structural designing increment quickly. Different kind of fiber is utilized, for example, glass, and carbon, steel, asbestos, polyester and polypropylene. The different trial examinations for determination of properties of polypropylene fiber are talked about in paper work. This paper introduces the impact of polypropylene (PP) fibers on different properties of cement, for example, compressive strength, elasticity, workability, and fracture properties with different substance of fiber (0%, 0.5%, 1.0%, and 1.5%). The consequence of this present examination demonstrates that by including of 0.5% of polypropylene fiber indicates greatest compressive and rigidity strength.

N Pannirselvam et al (2009) conducted the experimental strength behaviour of fibre reinforced polymer strengthened beam. They found that strengthening of structures using fibre reinforced polymer. The objective of their work is to determine the strength of structural behaviour of reinforced concrete beams. They observed that in the beam the deflection duclity values for beams showed increases over the corresponding the reference beams

K. Vamshi Krishna et al studied on behaviour of fiber reinforced concrete for rigid pavementsî This paper deals with experimental investigation on mechanical properties of M20 grade concrete by incorporating polyester fibers in the mix. Polyester fibers of 0.1%, 0.2%, 0.3%, and 0.4% by weight of cement are added to the mix. A comparative analysis has been carried out for conventional concrete to that of the fiber reinforced in relation to compressive, split tensile, flexural strengths. As the fiber content increases compressive, split tensile and flexural strengths are proportionally increasing. It is observed that 0.3% fibers by weight of cement is the optimum dosage. It is found that with 0.3% fiber content results in 20% reduction of pavement thickness.

S.A Kanalli et al studied on polymer fibre reinforced Concrete with conventional concrete pavement. Road transportation is undoubtedly the lifeline of the nation and its development is a crucial concern. The traditional bituminous pavements and their needs for continuous maintenance and rehabilitation operations points towards the scope for cement concrete pavements. There are several advantages of cement concrete pavements over bituminous pavements. This paper emphasizes on POLYMER FIBRE REINFORCED CONCRETE PAVEMENTS, which is a recent advancement in the field of reinforced concrete pavement design. A comparative study of these pavements with the conventional concrete pavements has been made using Polypropylene fiber waste as fiber reinforcement.

Chintan Patel et al studied the performance Evaluation of Polymer Fiber ìRECRON-3Sî in Pavement Quality Concreteî Road transportation is undoubtedly the lifeline of the nation and its development is a crucial concern. The traditional bituminous pavements and their needs for continuous maintenance and rehabilitation operations points towards the scope for cement concrete pavements. There are several advantages of cement concrete pavements over bituminous pavements. But, there are also some problems outcomes with concrete pavement like micro-shrinkage, cracking, and low water permeability. To overcome this kind of problems, the secondary construction material ìRecron-3Sî is preferable to add in concrete for making stronger and batter road pavement. Present paper focuses how the compressive and flexural strength of the Pavement Quality Concrete (PQC) increases using Recron-3S fiber with compression test of the concrete. The testing results of the prepared sample cube with Recron-3S has compared with other samples which is without the mixture of the Recron-3S

Analysis of work complete by many investigates deliberates the instrument of fibre-matrix interface, wherever’s numerous presentations remain used to calculate the attachment amongst the fibres and cement conditions. As the attachment of fibre and the background productions a main part in the compound performance. Also, this episode also present a review of literature applicable to the exploration and trials completed for fibre reinforced concrete in universal with a eminence of civil engineering applications, fibre reinforced concrete was effectively used in variation of engineering presentation, as of its reasonable and outstanding routine in the production and building field. However, most of the engineers and examines have supposed that by what method and why the fibres achieve so magnificently.

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S. Panda, N. H. S. Ray (2014) recognised an experiment on design process and operations of polymer fibre reinforced concrete. PPFRC is appropriate substantial which may be used for cement concrete and it consist the extra strength in flexural fatigue and impact etc. There are two constituent of PFRC. one is the existing mix and other is polymer fibres .The polymer fibres rises the compressive strong point 12 to 16% and also the flexural strength 7 to 14% over the regular concrete.

J.A. Larbi and R.B. PolderEffects of Polypropylene fibres in concrete:- Microstructure after fire testing and chloride migration revealed that the amount of explosive spalling and the extent of cracking can considerably be reduced by use of suitable amount of polypropylene fibres.

Milind V. Mohod (2015), presents an experimental study on performance of polypropylene fiber reinforced concrete. In this studymdeals with the effects of addition of various proportions of polypropylene fibers on the properties of High strength concrete (M30and M40 mixes). An experimental program was carried out to explore its effects on compressive, tensile, flexural strength under different curing condition. The main aim of the investigation program is to study the effect of Polypropylene fiber mix by varying content such as 0% ,0.5%,1%,1.5% & 2% and finding the optimum Polypropylene fiber content. A notable increase in the compressive, tensile and flexural strength was observed. However, further investigations were highly recommended and should be carried out to understand more mechanical properties of fiber reinforced concrete

Over the years, in order to increase concrete’s flexural behavior, ductility and energy absorption many researches were made and ongoing. As a result of past research FRC has been introduced which resulted in increased tensile strength, fatigue strength, and impact strength.

Nagabhushanam (1989) investigated the flexural fatigue strength of fibrillated polypropylene fiber reinforced concrete. The test program included the evaluation of flexural fatigue strength and endurance limit. The test results indicatedthat there is an increase in flexural fatigue strength.

Johnston and Zemp (1991) investigated the flexural performance under static loads for 9 mixtures. The results indicated that increasing in fibre content from 0.5% to 1.5% had a significant beneficial effect on the first crack strength despite the required W/C to meet workability requirements.

Bayasi and Ceilk (1993) investigated the effect of silica fume on the flexural strength of synthetic fiber-reinforced concrete. Two types of fibresviz, polypropylene fibres and polyester fibres were used with the amount of fibres ranged from 0 to 0.6% by volume. Silica fume was used as partial replacement of OPC at 0, 5, 10 & 25%. The results indicated that polyester and polypropylene fibres have an inconsistent effect on the flexural strength but significantly increased the flexural toughness and the post-peak resistance of concrete. Priti A. patelstudied that the compressive, split tensile and flexural strength will improve on addition of 1.5 % of polypropylene fiber in the concrete [5].

VinodKumar and Dr. M. Muthukannan have done experimental Investigations on Hybrid fibers using steel, glass and polypropylene fibres in different combinations to study the mechanical properties of Hybrid Fiber Reinforced Concrete as compared to the conventional concrete.

Kumar conducted experimental work on M15, M20 and M25 grade fly ash concrete reinforced with 0%, 0.5% and 1% polypropylene fibers. From the experiments it was concluded that compression strength increase for all the three grades used upto 1% addition of polypropylene fiber content.
Mehul and Kulkarni conducted experiments using fibrillated polypropylene fiber of length 12mm and diameter 34 micron and low density of 0.9 kN/m3, in percentages of 0.5%, 1% and 1.5% in high strength concrete. They found that the compressive strength of concrete increased with addition of fibers [2].

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S.Rukmangadhara Rao et al. Int. Journal of Engineering Research and Applications , Vol. 5, Issue 12, (Part - 1) December 2015, pp.84-88, done his research on Study on Strength of Concrete Using Robo Sand as a Partial Replacement of Fine Aggregate.
1.2 Literature Review A brief review of available studies related to the present strength properties of concrete materials is as follows: Pauslon josph et al. (2017) In this studies attempt has been made to compare the mechanical strength of concrete of M30 grade by replacing cement by quartz powder. Specimen were cast by replacing cement by quartz powder 0%,5%,10%,15%,20%,30% percentage by weight cement. When 5%, 10% 15% percentage of quartz powder is added the compressive strength is increases by 9 6% At 10% than the normal concrete. The cement can be partially with 10% so that the required quantity for cement can be replaced by 134gms than 150*150*150 cubes. When the cement is replaced by textile sludge alone by 5%, 10%, 15% the maximum compressive strength is attained 5% and the value decreases as the percentage increases.
Run-sheng lin xiao-young wang et al. (2018) The paper compares the effects of the water to-binding (w/b) ratio and quartz contents on the properties of cement-quartz paste. The w/b ratio of the paste mixtures specimens are 0.5 and 0.2, and the quartz powder content are 0,10and 20%. At the age of 1, 3, 7 and 28 days, compressive strength, (SEM) XRF, XRD MIP and TG analysis were performed. When the w/b is 0 5 the compressive strength of the paste with quartz powder significantly decreases. from MIP and SEM test, the porosity of the paste is increases significantly due to the incorporation of the quartz powder. How were when the w/b ratio is 0.2 the strength of the paste mixed with quartz powder show no significant differences from that of the control paste and porosity is almost the same,
R.L. Ramesh et al. (2013) The experimental investigation was carried out to study the cube compressive strength of fibre reinforced concrete cube incorporating silica fume and metakaolin with and without steel fibers of grade M70. Using different combination of materials were casted. The cube was cured and tested under a direct compression testing machine at time period of 3, 7, 14, and 28 days. They use different mix proportion tested for 3, 7, 14and 28 days compression strength test found to gain more strength than any other. quarry refuse or vegetable matter. The pieces of aggregates should be cubical, or rounded shaped and should have granular or crystalline or smooth (but not glossy) nonpowdery surfaces. Aggregates should be 10 properly screened and if necessary washed clean before use. Coarse aggregates containing flat, elongated or flaky pieces or mica should be rejected. The grading of coarse aggregates should be as per specifications after 24-hrs immersion in water, a previously dried sample of the coarse aggregate should not gain in weight more than 5%. Aggregates should be stored in such a way as to prevent segregation of sizes and avoid contamination with fines.

III.TESTS ON MATERIALS

3.1.1 FINENESS OF CEMENT:

Aim: To find out the fineness of cement.
Apparatus: 90 microns sieve , weighing balance.
Procedure:-

i. Weigh 100g of cement, place it on the sieve.
ii. Agitate the sieve by swirling, planetary and linear movements, until no more fine material passes through it.
iii. Weigh the residue and express its mass as a percentage R1, of the quantity first placed on the sieve to the nearest 0.1 percent.
iv. Gently brush all the fine material off the base of the sieve.
v. Repeat the whole procedure using a fresh 10g sample to obtain R2. Then calculate R as the mean of R1 and R2 as a percentage, expressed to the nearest 0.1 percent. When the results differ by more than 1 percent absolute, carry out a third sieving and calculate the mean of the three values.

Observation:

Table 3.1 Fineness of cement test Values

Description	Trail no		
	1	2	3
Weight of cement(gm)	100	100	100
Weight of passing in I.S. sieve No.9(gm)	91	95	94
Quality of cement retained(%)	9	3	4

The average value for fineness of cement is = $\frac{91+95+94}{3}$ = 93.33%. = 94%

=(100 -94) %

Result: Fineness of the cement = 6%

3.1.2 SOUNDNESS OF CEMENT (BY LECHATLIER METHOD):

Aim: To find out the soundness of cement

Apparatus: Lechatelier Mould, Two glass plates, water both, weighing balance, oil, measuring scale.

Procedure:

i. Place the on a glass sheet and fill it with the cement paste formed by gauging cement with 0.78 times the water required to give a paste of standard consistency.
ii. Cover the mould with another piece of glass sheet, place a small weight on this covering glass sheet and immediately submerge the whole assembly in water at a temperature of 27 to 32ºC and keep it there for 24 hrs.
iii. Measure the distance separating the indicator points to the nearest 0.5mm (say d_1).
iv. Submerge the mould again in water at the temperature prescribed above. Bring the water to boiling point in 25 – 30 minutes and keep it boiling for 3 hrs.
v. Remove the mould from the water, allow it to cool and measure the distance b/w the indicator points (say d_2).
vi. ($d_2 - d_1$) represents the expansion of cement.

Observation:

Normal consistency=42%.

Water required for soundness test = $\frac{(0.78\times42\times400)}{100}$ = 131.04 ~ 132ml

=132 ml

Initial distance (d_1) =12mm.

Final distance (d_2) =15mm.

Expansion of cement is = $d_2 - d_1$

= 15 – 12 = 3mm.

Results:

Soundness of cement = 3 mm

3.1.3 NORMAL CONSISTENCY OF CEMENT

The main objective of this test is to determine the quantity of water required to produce a cement paste of standard consistency. The standard consistency of a cement paste is defined as percentage water which will permit the vicat plunger having 10mm diameter and 50mm long to penetrate to a depth of 5 to 7 mm from the bottom of the vicat mould or 33-35mm from the top of the mould.

Figure 3.1 Vicat apparatus and plunger for determining normal consistency of cement

For finding out initial setting time, final setting time, soundness of cement and compressive strength of cement, it is necessary to fix the quantity of water to be mixed in cement in each case. This experiment is intended to find out the quantity of water to be mixed for a given cement to give a cement paste of normal consistency and can be done with the help of vicat's apparatus.

Apparatus :

The apparatus used in this test are Vicat's apparatus, Plunger, Mould, Glass plate and Weighing balance.

Test procedure:

i. Take 400gms of weighted quantity of cement.
ii. Add calculated quantity of water (28% by weight of cement) to cement and prepare a paste.
iii. The paste mus4t be prepared in a standard manner and filled in to the vicat's mould within 3-5 minutes after completing filling the mould, shake the mould to expel air.
iv. A standard plunger is attached and brought down to touch the surface of the paste by its own weight.

v. Note down the depth of penetration of the plunger with the help of graduations provided to the vicat's apparatus.

vi. Conduct a second trail by increasing percentage of water (33%) and find out the depth of penetration of plunger.

vii. Similarly conduct number of trails with higher percentage of water quantity up to plunger penetrates a depth of 33mmto 35mm from the top or 5mm to 7mm from the bottom of the mould.

viii. The test is conducted in a temperature in the range of 25ºCto 29ºC and constant humidity (90%).

ix. For each trail of the experiment fresh cement is to be taken.

Observations:

Table 3.2 Normal Consistency Values

S. No	Weight of Cement (gm)	% of Water	Volume of Water (ml)	Depth of Penetration from Bottom (mm)
1	400	28	84	45
2	400	30	120	40
3	400	32	128	28
4	400	34	136	6

Result : Normal consistency of the cement sample used in this study is **34%.**

3.1.4 INITIAL AND FINAL SETTING TIMES OF CEMENT:

The objective of this test is to determine the initial and final setting times of the cement. The time interval for which the cement products remain in plastic condition is known as the setting time. The final setting time is the time elapsed between the moment the water is added to the cement, and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain pressure.

The time should not be more than 10 hours which is referred to as final setting time. Initial setting time should not be less than 30 minutes. The procedure adopted for finding out initial and final setting times of cement is as follows.

Apparatus :

The apparatus used in this test are Vicat's apparatus with needles for initial and final setting time, Measuring jar, Weighing balance, Stop watch and Glass plates.

Test Procedure For Initial Setting Time:

i. Take 300gms of cement and prepare a cement paste of 0.85 times of water required for normal consistency.

ii. Place the vicat's mould on a non-porous plate and place the cement paste in the mould and level the surface.

iii. For determining the initial setting time, the needle of $1mm^2$ or (1.13mm diameter) is fitted to the vicat's apparatus. Place the mould filled with cement paste under the needle. Lower the needle gently to touch the surface at the cement and allows it to penetrate in to the paste.

iv. Repeat the procedure at regular intervals till the needle stops penetrating 5 to 7 mm from the bottom or 33 to 35 mm from the top of the mould.

v. The time period elapsed, is known as "initial setting time".

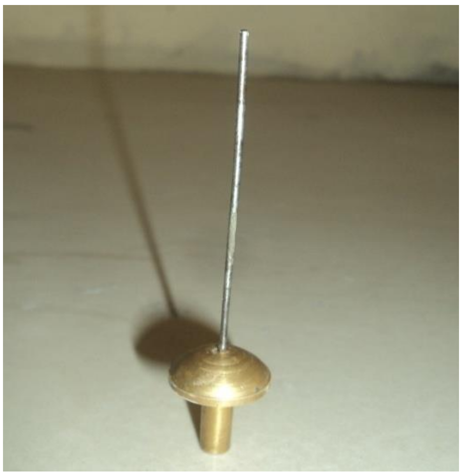


Figure 3.2 Needle for determining the initial setting time of cement.

Test Procedure For Final setting time

a. For determining the final setting time needle (a needle with angular ring) to the mould rod, release the needle gently and note down the time when the needle gently makes an impression on the mould surface and the angular ring fails to do so. In other words paste has attained such hardness that centre needle does not penetrate through the paste not more than 0.5mm.

b. The final setting time is the time elapsed between the time of addition of water to the cement and the time at which needle makes an impression on the surface of the sample and the angular ring fails to do so.

Figure 3.3 Needle for determining the final setting time of cement

Observations:

Weight of cement taken = 400gm
Water required for standard consistency (P) = 34% = 136ml
Weight of water taken for preparing the specimen = 0.45×P = 60ml

Table 3.3 Initial Setting Time Readings

S. No	Time in Minutes	Depth of Penetration (mm)
1	5	0
2	10	2
3	15	3
4	20	4
5	30	5
6	31	6
7	32	7

Result: The initial and final setting times of the cement used in this study are 50 mins and 8 hrs respectively.

3.1.5 SPECIFIC GRAVITY OF CEMENT

Aim

The main objective of this test is to determine the specific gravity of the given sample cement.

Apparatus

The apparatus used in this test are specific gravity bottle, Weighing balance, water and kerosene.

Test Procedure

i. Clean and dry the specific gravity bottle and weigh it with the stopper (W_1).

ii. Fill the specific gravity bottle with cement sample at least half of the bottle and weigh with stopper (W_2).

iii. Fill the specific gravity bottle containing the cement, with kerosene (free of water) placing the stopper and weigh it (W_3).

iv. Then fill it with fresh kerosene and weigh it with stopper (W_4).

Figure 3.4 Specific gravity bottle

Observations

W_1 = empty weight of specific gravity bottle = 20gms
W_2 = weight of bottle filled with 1/3rd of cement sample = 50gms
W_3 = weight of bottle + cement + kerosene = 90gms
W_4 = weight of bottle completely filled with kerosene = 70gms
Specific gravity of cement = $\{(W_2-W_1) \div [(W_2-W_1)-(W_3-W_4)]\}$ = 313.

Result: The Specific gravity of cement used in this study is 3.13

SOUNDNESS OF CEMENT


CONSISTENCY OF CEMENT

3.2 TEST ON FINE AGGREGATE

3.2.1 Fineness modulus of sand

The main objective of this test is to determine the fineness modulus of sand to find out the sand zone. The main object of finding fineness modulus is to grade the given aggregate for the most economical mix and workability with minimum quantity of cement.

Aim To find out the fineness modulus of sand

Apparatus

The apparatus used in this test are IS test sieves of 4.75mm, 2.36mm, 1.18mm, 600µm, 300µm, 150µm and pan. Weighing balance, sieve shaker and tray plates.

Test Procedure

i. Take 1 Kg of sand from sample by quartering in clean dry plate.
ii. Arrange the sieves in order of 4.75mm, 2.36mm, 1.18mm, 600µm, 300µm, 150µm, 75µm and pan keeping sieve 4.75mm at top and 75µm at bottom.
iii. Fix them in the sieve shaking machine with the pan at the bottom and cover at the top.
iv. Keep the sand in the top sieve of 4.75mm, carry out the sieving in the set of sieves.
v. Find the weight retained in each sieve.

Figure 3.5 Set of sieves assembled on sieve shaker

The percentage of particles retained on each sieve was calculated on the basis of the total weight of aggregates taken for the testing.

Let these percentages be P_1, P_2, P_3…… P_n. Then cumulative percentage of material retained each sieve was found out which is equal to the sum of percentages of aggregates retained on that sieve and that retained on all sieves coarser than that sieve.

Now fineness modulus can be obtained from the formula, Fineness modulus= (sum of cumulative % of weight retained)/100.

Observations

Weight of sample = 1000gms

The following observations are obtained by sand

Table 3.4

Table 3.5

Table 3.6 Sieve Analysis

Sieve size	Weight retained (gm)	% cumulative weight retained	Sum of % cumulative weight retained	% finer
4.75mm	0	…..	…..	100
2.36mm	30	30	3	97
1.18mm	280	310	31	69
600µm	210	520	52	48
300µm	330	850	85	15
150µm	90	940	94	6
Pan	2	942	9.42	5.8

Result:

The fineness modulus of sand = 2.43. Sand Zone = Zone 2 (from IS 383:1970)

3.2.2 SPECIFIC GRAVITY OF FINE AGGREGATE

Aim

To determine the specific gravity of sand of a given sample.

Apparatus

The apparatus used in this test are sand sample, pycnometer, water and weighing balance.

Test Procedure

i. Find the weight of empty pycnometer (W1).

ii. Fill up the pycnometer with fine aggregate (W2).

iii. Now fill the pycnometer with fine aggregate and water (W3).

iv. Now fill the pycnometer with only water (W4).

v. Finally the specific gravity of the aggregates is calculated as Specific gravity= $(W_2-W_1)/ [(W_4-W_1)-(W_3-W_2)]$.

Figure 3.6 Pycnometer

Observations

Following observations are obtained for sand

Weight of empty pycnometer = W_1 = 650gm

Weight of pycnometer + 1/3rd of sand = W_2 =1380gm

Weight of pycnometer + sand + water = W_3 = 1954gm

Weight of pycnometer + water = W_4 = 1500gm

Result

The specific gravity of sand are 2.64

3.2.3 BULKING OF SAND

Aim To determine the moisture content at with bulking of sand

Apparatus

The apparatus used in this test are sand sample**,** weighing balance and measuring jar, mixing pan, trowel.

Test Procedure

i. Take 500ml of sand in measuring jar and take the weight of sand.

ii. Add water is two percentage of the weight (sand) and mix thoroughly and measure the increasing volume.

iii. Add 2%,4%,6%,8% and the process is repeated for number of times and each increase in volume is taken.

iv. After the increase in volume there is a slow decrease volume then pure water is added to the sand to increase it. That will give original volume.

v. When water added the volume of sand increased and an optimum volume of a sand reached.

Observations

Table 3.7 Bulking of Sand Readings

S.NO	Weight of sand (V1)	Percentage of water	Readings (V2)	V2-V1/V1
1	500	2%	550	0.1
2	500	4%	570	0.14
3	500	6%	520	0.04
4	500	8%	510	0.02

Result

The maximum bulking of sand given fine aggregate is 570 at 0.14% moisture content.

3.2.4 WATER ABSORPTION

Aim

The main objective of this test is to determine the water absorption of the fine aggregate.

Apparatus

The apparatus are used in sand sample and weighing balance and pycnometer.

Test procedure

i. Find the weight of pycnometer (W1).

ii. Fill up the pycnometer with 1/3rd of sand and then weight is calculated(W2).

iii. Fill up of the pycnometer with sand and water and weight is calculated(W3).

iv. fill up of the pycnometer with only water(W4).

Observations

Following observations are obtained for sand

Weight saturated fine aggregate W_1 =640gms

Weight of dry fine aggregate W_2 =630gms

Water absorption=W_1-W_2/W_{2*100}

=640-630/610*100

=1.63%

Result: The water absorptions of sand value is =1.63%

3.3 TEST ON COARSE AGGREGATE

3.3.1 Specific Gravity on a coarse aggregate

Aim: To determine the specific gravity of coarse aggregate of a given sample.

Apparatus: The apparatus used in this test are aggregate sample**,** pycnometer**,** water and weighing balance.

Test Procedure

a. Find the weight of empty pycnometer (W1).

b. Fill up the pycnometer with coarse aggregate (W2).

c. Now fill the pycnometer with coarse aggregate and water (W3).

d. Now fill the pycnometer with only water (W4).

e. Finally the specific gravity of the aggregates is calculated as Specific gravity= $(W_2-W_1)/[(W_4-W_1)-(W_3-W_2)]$.

Observations

Following observations are obtained for coarse aggregate

Weight of empty pycnometer = W_1 = 650gm

Weight of pycnometer + 1/3rd of coarse aggregate = W_2 =1320gm

Weight of pycnometer + coarse aggregate + water = W_3 = 1925gm

Weight of pycnometer + water = W_4 = 1500gm

Specific gravity of coarse aggregate =$(w_2\text{-}w)_1/(w_2\text{-}w_1) - (w_3\text{-}w_4)$

= (1320-650\(1320-650)-(1925-1500)

= 2.73

Result

The specific gravity of a coarse aggregate are 2.73

3.3.2 WATER ABSORPTION TEST ON COARSE AGGREGATE

Aim

The main objective of this test is to determine the water absorption of the coarse aggregate.

Apparatus

The apparatus are used in coarse aggregate sample and weighing balance and pycnometer.

Test procedure

a. Find the weight of Pycnometer (W1).

b. Fill up the with Pycnometer 1/3rd of coarse aggregate and then weight is calculated (W2).

c. Fill up of the Pycnometer with coarse aggregate and water and weight is calculated (W3).

d. Fill up of the Pycnometer with only water (W4).

Observations

Following observations are obtained for coarse aggregate

Weight saturated coarse aggregate W_1 =640gms

Weight of dry coarse aggregate W_2 =630gms

Water absorption=W_1-W_2/W_{2*100}

=640-630/630*100

=1.58%

Result: The water absorptions of a coarse aggregate value is =1.58%.

IV.MIX DESIGN

STIPULATIONS FOR PROPORTIONING

a) Grade designation : M30
b) Type of cement : OPC 43 grade conforming to IS 269
c) Nominal maximum size of aggregate : 20mm
d) Exposure conditions as per Table 3and Table 5 of IS 456 : Severe (for reinforced concrete)
e) Characteristics of SCC
1) Slump flow class : SF3 (slump flow 760 mm – 850 mm)
2) Passing ability by L box test : Ratio of h2/h1 = 0.9
3) V- Funnel flow time (Viscosity) : Class V1 (flow time ≤ 8s)
4) Sieve segregation resistance : SR1(<15percent)
f) Degree of site control : Good
g) Type of aggregate : Crushed angular aggregate
h) Maximum cement content (OPC Content) : 450 kg/m3
j) Chemical admixtures type : Viscosity modifying agent

k) Mineral admixture : NA

TEST DATA FOR MATERIALS

a) Cement used : OPC 43 Grade conforming to IS 269
b) Specific gravity of cement : 3.13
c) Chemical admixture : viscosity modifying agent
d) Specific gravity of
1) Coarse aggregate (at SSD condition) : 2.73
2) Fine aggregate (at SSD condition) : 2.64
3) Chemical admixture : 1
e) Water absorption
1) Coarse aggregate : 1.48 percent
2) Fine aggregate : 1.61 percent
f) Free (surface) moisture
1) Coarse aggregate: Nil (absorbed moisture also nil)
2) Fine aggregate: Nil (absorbed moisture also nil)

TARGET STRENGTH FOR MIX PROPORTIONING

$$f'_{ck} = f_{ck} + 1.65\,S$$

or

$$f'_{ck} = f_{ck} + X$$

whichever is higher.
where
f'_{ck} = target average compressive strength at 28 days,
f_{ck} = characteristic compressive strength at 28 days,
S = standard deviation, and
X = factor based on grade of concrete.
From Table 2, standard deviation, S = 5 N/mm2.
From Table 1, X = 6.5.
Therefore, target strength using both equations, that is

a) $f'_{ck} = f_{ck} + 1.65\,S$
$= 30 + 1.65 \times 5 = 38.25$ N/mm2
b) $f'_{ck} = f_{ck} + 6.5$
$= 30 + 6.5 = 36.5$ N/mm2

The higher value is to be adopted.
Therefore, target strength will be 38.25 N/mm2 as 38.25 N/mm2 > 36.5 N/mm2.

APPROXIMATE AIR CONTENT

From Table 3, the approximate amount of entrapped air to be expected in normal (non-air-entrained) concrete is 1.0 percent for 16 mm nominal maximum size of aggregate.

SELECTION OF WATER-CEMENT RATIO

From Fig. 1, the free water-cement ratio required for the target strength of 38.25 N/mm2 is 0.43 for OPC 43 grade curve. This is lower than the maximum value of 0.45 prescribed for 'severe' exposure for reinforced concrete as per Table 5 of IS 456. 0.43 < 0.45, hence O.K. **SELECTION OF CEMENT CONTENT :**

The class of slump flow is specified to be SF3 having a slump flow between 750 and 850 mm. To start with, a water content of 190 kg/m3 along with a viscosity modifying agent@ 0.6 percent by mass of cementitious material content is selected for the initial mix. However, the water content can be reduced further by increasing the dose of viscosity modifying agent. This water content of 190 kg/m3 will correspond to a cement content of kg/m3 for water cement ratio of 0.43 as worked out in 190 / 0.43 = 442 kg

SELECTION OF ADMIXTURE CONTENT

Taking an admixture dose of 0.6 percent by mass of cementitious material, the mass of admixture

= 0.6/100 × 442 = 2.65 kg/m3.

SELECTION OF POWDER CONTENT AND FINE AGGREGATE CONTENT

The powder content (fines < 0.125 mm) required for SCC is generally in the range of 400 to 600 kg/m3. Since, the SR of class 1 and viscosity of V1 is required; the mix shall be sufficiently cohesive, (having enough fines). Therefore a powder content of 520 kg/m3 is selected. This powder content will constitute the entire OPC, entire fly ash, and around 10 percent of Zone II fine aggregates.

Fines required to be contributed by fine aggregate = Total powder content – (cement content)

= 520 – (442) = 78 kg/m^3

The fine aggregate has 8 percent materials < 0.125 mm. Therefore, the fine aggregate quantity = 78/0.08 = 975 kg/m^3.

SELECTION OF COARSE AGGREGATE CONTENT

Let *V*ca be the volume of coarse aggregate.

Assuming 1 m3 of concrete, *V*ca = (1 - Air content) -(Vol of water + Vol of cement + Vol of admixture + Volume of fine aggregate).

$$V_{ca} = (1-0.01) - \frac{190}{1 \times 1000} + \frac{442}{3.13 \times 1000} + \frac{2.65}{1.08 \times 1000} + \frac{975}{2.64 \times 1000}$$

= 0.99 – (0.19 + 0.141+ 0.002 5 + 0.374)

= 0.28 m3

Mass of coarse aggregate

= *V*ca x specific gravity of coarse aggregate × 1 000

= 0.28 × 2.73 × 1 000

= 764.8 kg/m3 ≈ 765 kg/m3

CALCULATION OF VOLUME OF POWDER CONTENT

Vol of powder content = Vol of OPC + Vol of portion of fine aggregate < 0.125 mm

$$= \frac{442}{3.13 \times 1000} + \frac{78}{2.64 \times 1000}$$

= 0.170 m3

Ratio of water to powder by volume

= 0.190/ 0.191 = 1.11

MIX PROPORTIONS FOR TRIAL NUMBER

Cement	= 442 kg/m3
Water (net mixing)	= 190 kg/m3
Fine aggregate (SSD)	= 975 kg/m3
Coarse aggregate (SSD)	= 765 kg/m3
Chemical admixture	= 2.65 kg/m3,
Free water-cement ratio	= 0.43
Powder content	= 520 kg/m3
Water powder ratio by volume	= 1.11

442: 975:765:2.65

1: 2.20:1.73: 0.43

Cement	Fine Aggregate	Coarse Aggregate	Chemical Admixture (VMA)	Water
1	2.20	1.73	1%	0.43

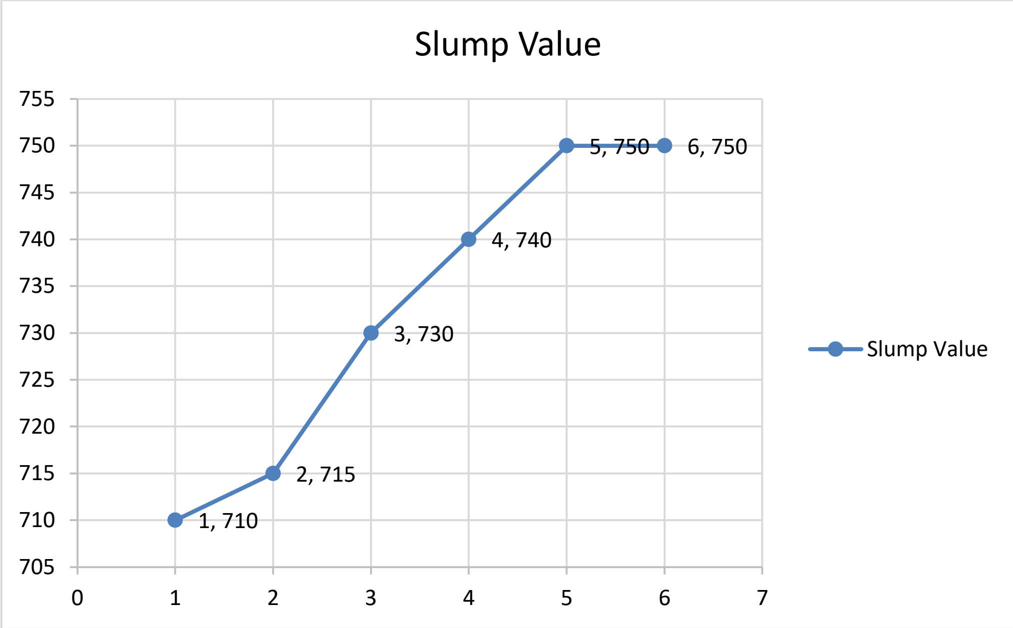
Chapter-5Experimental Investigation

5.1 Workability Tests on Self Compacting Concrete

5.1.1 Slump Test

Table 5.1 Showing the Values of Slump Test of SCC

S.No	Mix	Slump Value
1	0% QS+0.6PPF+1%VMA	710
2	5%QS+0.6PPF+1%VMA	715
3	10%QS+0.6PPF+1%VMA	730
4	15%QS+0.6PPF+1%VMA	740
5	20%QS+0.6PPF+1%VMA	750
6	25%QS+0.6PPF+1%VMA	750



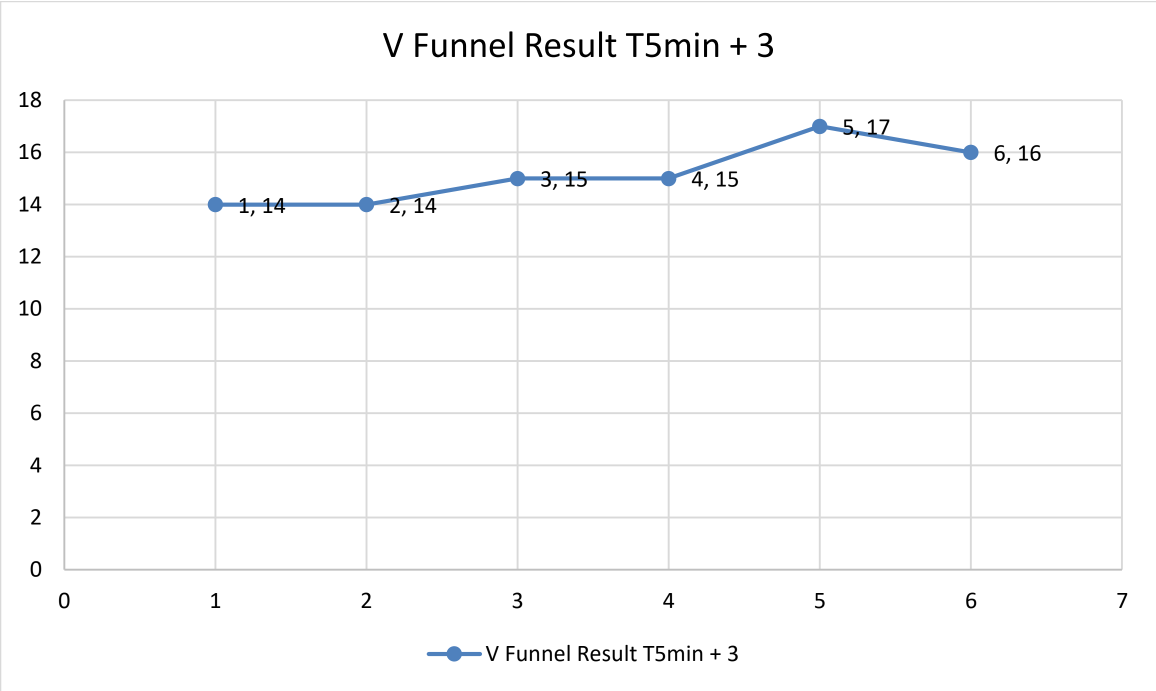
Graph 5.1 Showing the variation of slump of SCC

L – BOX TEST

V- FUNNEL TEST

Table 5.2 Showing the Values of V-Funnel Test for SCC

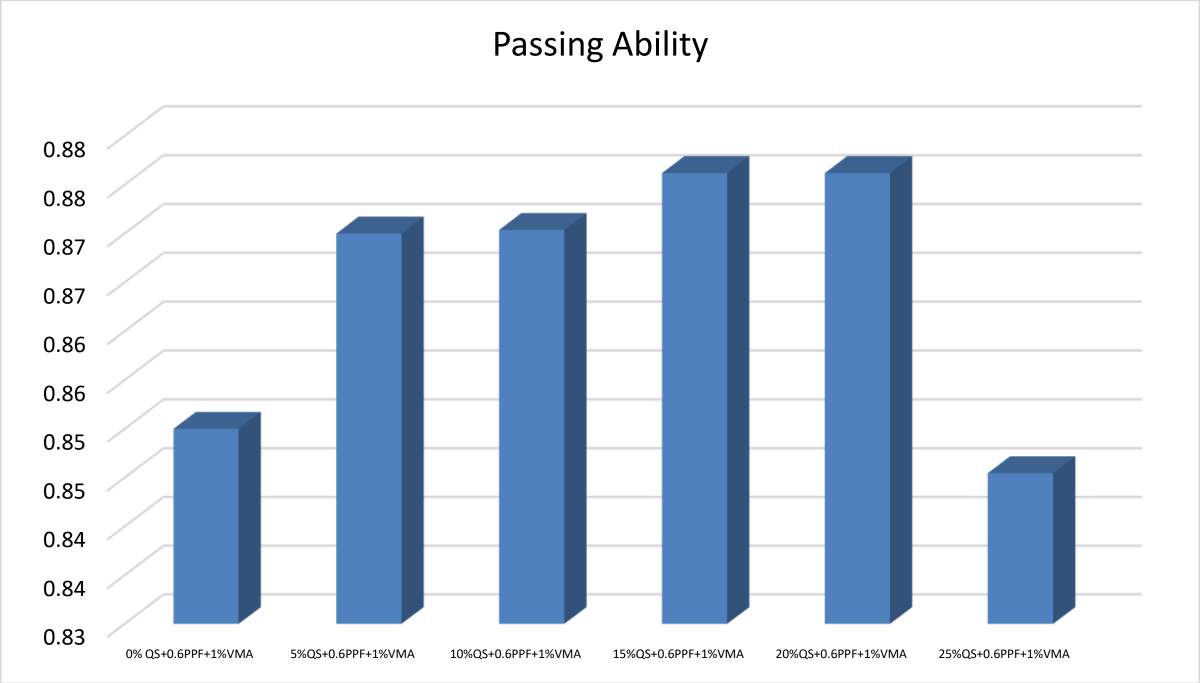
S. No	Mix ID	V Funnel Result $T5_{min}$ + 3
1	0% QS+0.6PPF+1%VMA	14
2	5%QS+0.6PPF+1%VMA	14
3	10%QS+0.6PPF+1%VMA	15
4	15%QS+0.6PPF+1%VMA	15
5	20%QS+0.6PPF+1%VMA	17
6	25%QS+0.6PPF+1%VMA	16



Graph 5.2 Showing the variation of time in V-Funnel of SCC

Table 5.1 Showing the Values of L-Box Test for SCC

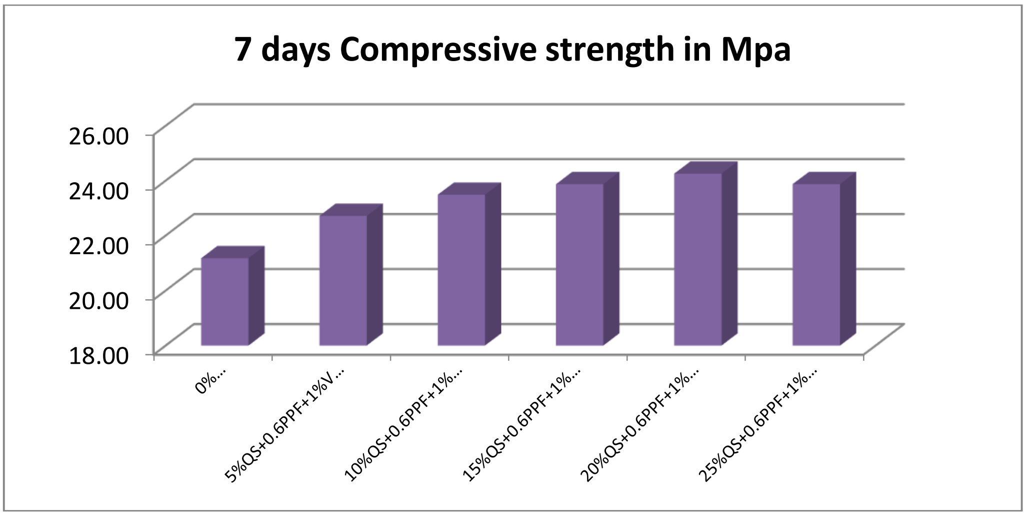
S. No	Mix ID	L Box Test Result			Recommended Value
		H1	H2	Passing Ability	
1	0% QS+0.6PPF+1%VMA	600 - 491= 109	93	0.85	More than 0.8
2	5%QS+0.6PPF+1%VMA	600 - 493 = 107	93	0.87	
3	10%QS+0.6PPF+1%VMA	600- 492 = 108	94	0.87	
4	15%QS+0.6PPF+1%VMA	600 - 495 = 105	92	0.88	
5	20%QS+0.6PPF+1%VMA	600 - 495 = 105	92	0.88	
6	25%QS+0.6PPF+1%VMA	600 - 490 = 110	93	0.85	



Graph 5.3 Showing the variation of Passing Ability of SCC through L-Box Test

Table 5.2 Showing the Values of Compressive Strength Test of SCC after curing 7 Days

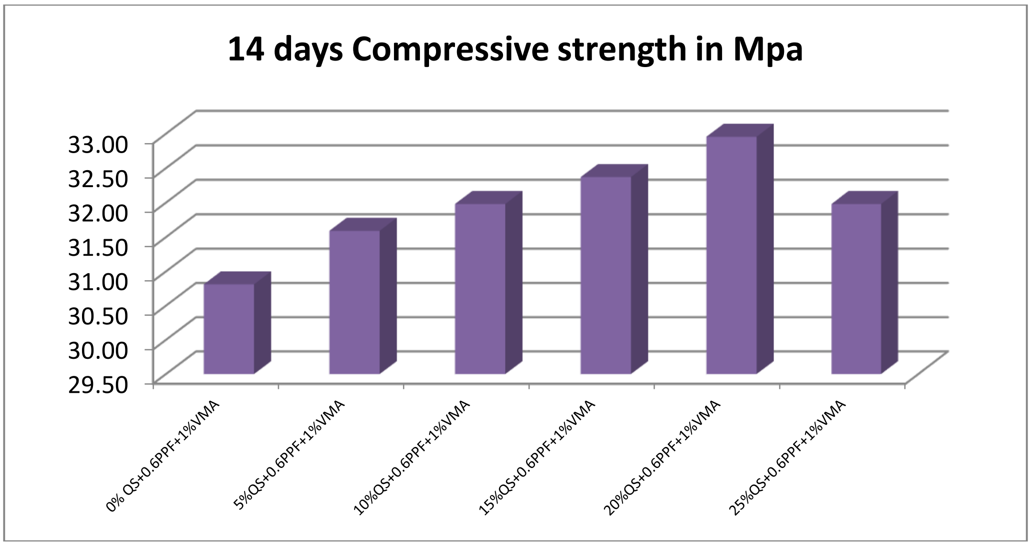
S. No	Mix ID	7 days Compressive strength in Mpa
1	0% QS+0.6PPF+1%VMA	21.18
2	5%QS+0.6PPF+1%VMA	22.72
3	10%QS+0.6PPF+1%VMA	23.49
4	15%QS+0.6PPF+1%VMA	23.87
5	20%QS+0.6PPF+1%VMA	24.26
6	25%QS+0.6PPF+1%VMA	23.87



Graph 5.4 Showing the variation of Compressive Strength Test of SCC after curing 7 Days

Table 5.3 Showing the Values of Compressive Strength Test of SCC after curing 14 Days

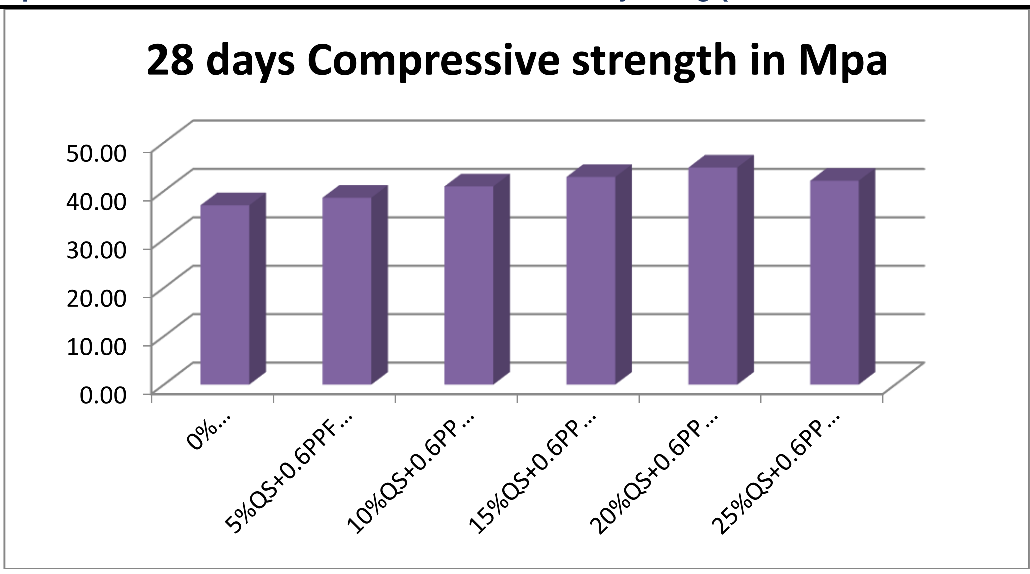
S. No	Mix ID	14 days Compressive strength in Mpa
1	0% QS+0.6PPF+1%VMA	30.81
2	5%QS+0.6PPF+1%VMA	31.59
3	10%QS+0.6PPF+1%VMA	31.98
4	15%QS+0.6PPF+1%VMA	32.37
5	20%QS+0.6PPF+1%VMA	32.96
6	25%QS+0.6PPF+1%VMA	31.98



Graph 5.5 Showing the variation of Compressive Strength Test of SCC after curing 14 Days

Table 5.4 Showing the Values of Compressive Strength Test of SCC after curing 28 Days

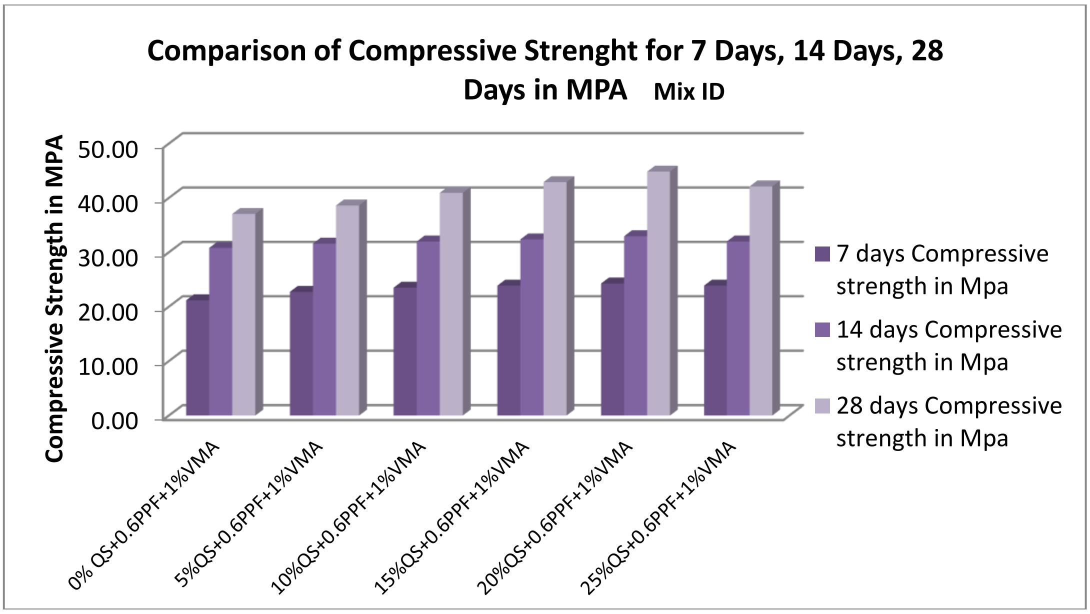
S. No	Mix ID	28 days Compressive strength in Mpa
1	0% QS+0.6PPF+1%VMA	37.05
2	5%QS+0.6PPF+1%VMA	38.61
3	10%QS+0.6PPF+1%VMA	40.95
4	15%QS+0.6PPF+1%VMA	42.90
5	20%QS+0.6PPF+1%VMA	44.85
6	25%QS+0.6PPF+1%VMA	42.12



Graph 5.6 Showing the variation of Compressive Strength Test of SCC after curing 28 Days

Table 5.5 Showing the Values of Compressive Strength Test of SCC after curing 7,14,28 Days

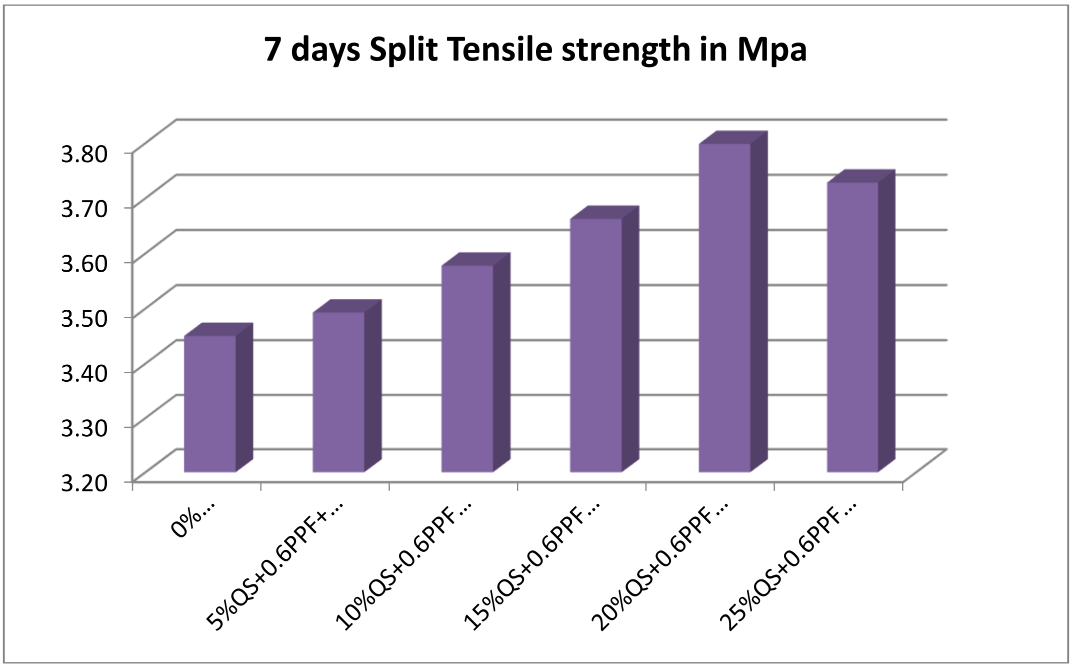
S. No	Mix ID	7 days Compressive strength in Mpa	14 days Compressive strength in Mpa	28 days Compressive strength in Mpa
1	0% QS+0.6PPF+1%VMA	21.18	30.81	37.05
2	5%QS+0.6PPF+1%VMA	22.715	31.59	38.61
3	10%QS+0.6PPF+1%VMA	23.49	31.98	40.95
4	15%QS+0.6PPF+1%VMA	23.87	32.37	42.90
5	20%QS+0.6PPF+1%VMA	24.26	32.96	44.85
6	25%QS+0.6PPF+1%VMA	23.87	31.98	42.12



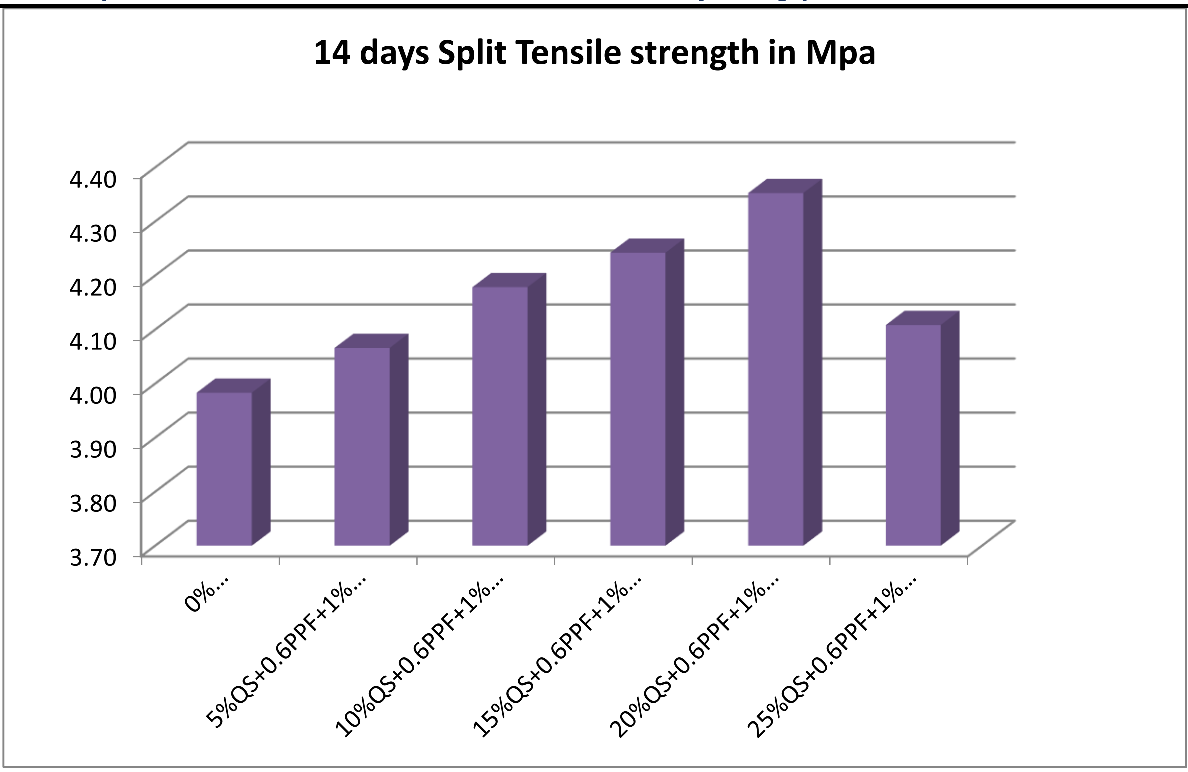
Graph 5.5 Showing the variation of Compressive Strength Test of SCC after curing 7,14, 28 Days

SPLIT TENSILE STRENGTH

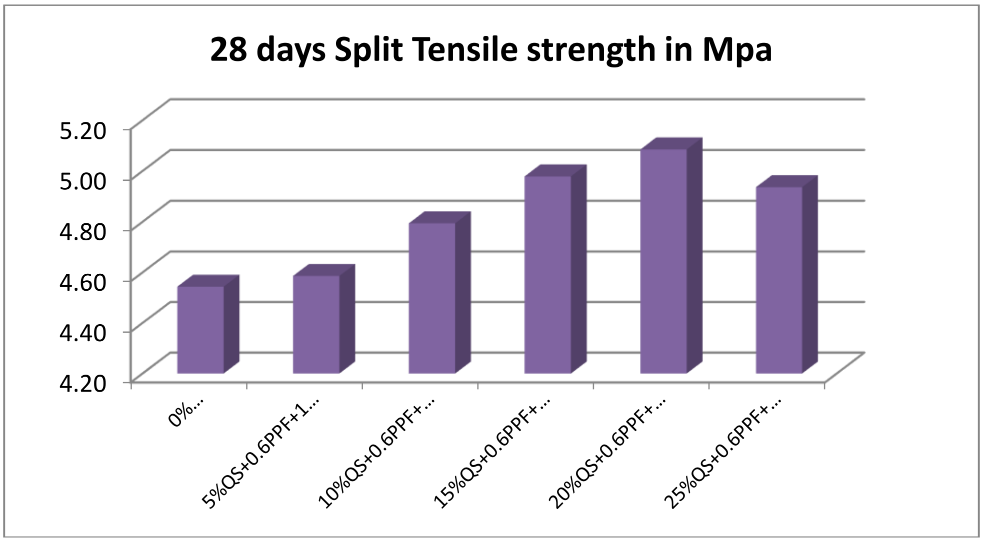
S. No	Mix ID	7 days Split Tensile strength in Mpa
1	0% QS+0.6PPF+1%VMA	3.45
2	5%QS+0.6PPF+1%VMA	3.49
3	10%QS+0.6PPF+1%VMA	3.58
4	15%QS+0.6PPF+1%VMA	3.66
5	20%QS+0.6PPF+1%VMA	3.80
6	25%QS+0.6PPF+1%VMA	3.73



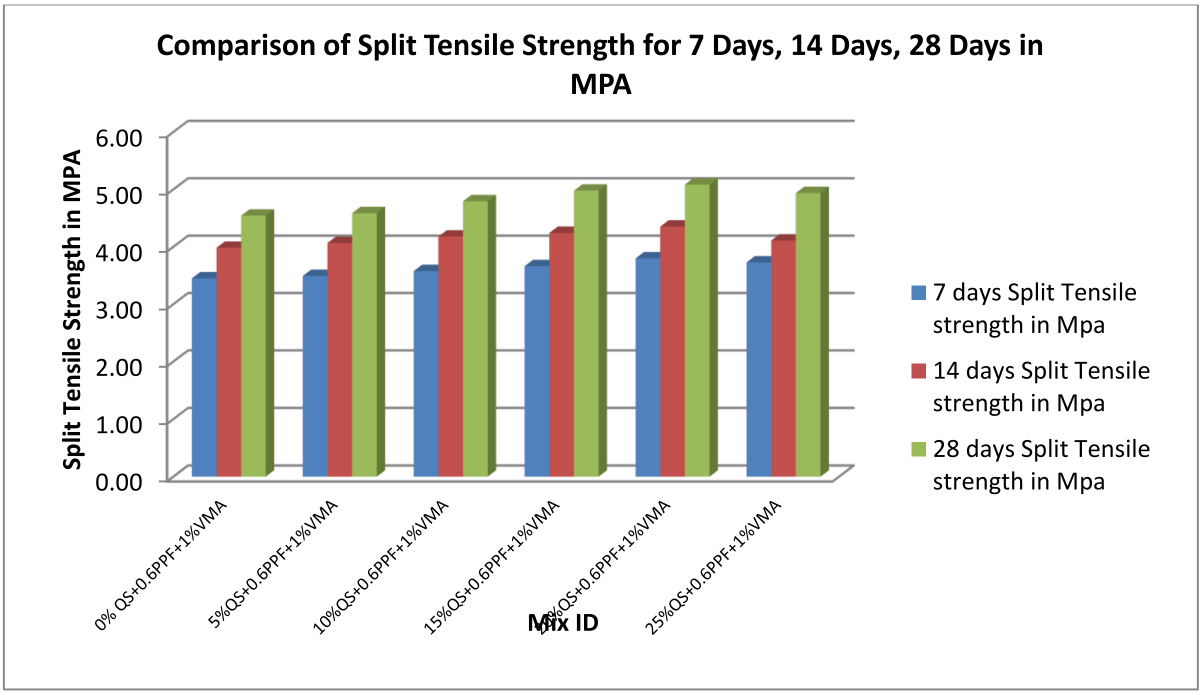
S. No	Mix ID	14 days Split Tensile strength in Mpa
1	0% QS+0.6PPF+1%VMA	3.98
2	5%QS+0.6PPF+1%VMA	4.07
3	10%QS+0.6PPF+1%VMA	4.18
4	15%QS+0.6PPF+1%VMA	4.24
5	20%QS+0.6PPF+1%VMA	4.35
6	25%QS+0.6PPF+1%VMA	4.11



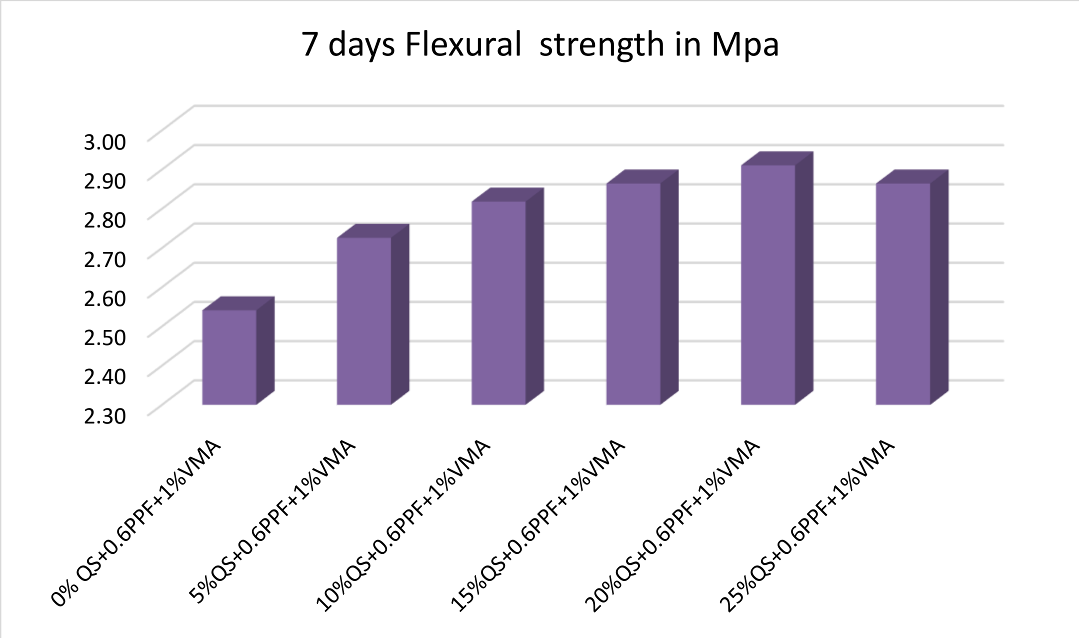
S. No	Mix ID	28 days Split Tensile strength in Mpa
1	0% QS+0.6PPF+1%VMA	4.54
2	5%QS+0.6PPF+1%VMA	4.59
3	10%QS+0.6PPF+1%VMA	4.79
4	15%QS+0.6PPF+1%VMA	4.98
5	20%QS+0.6PPF+1%VMA	5.08
6	25%QS+0.6PPF+1%VMA	4.94



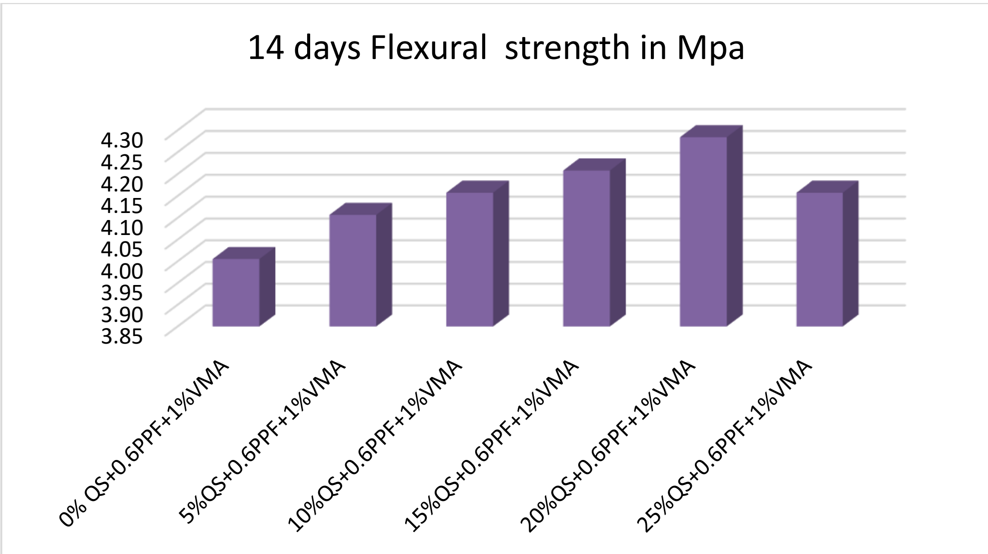
S. No	Mix ID	7 days Split Tensile strength in Mpa	14 days Split Tensile strength in Mpa	28 days Split Tensile strength in Mpa
1	0% QS+0.6PPF+1%VMA	3.45	3.98	4.54
2	5%QS+0.6PPF+1%VMA	3.49	4.07	4.59
3	10%QS+0.6PPF+1%VMA	3.58	4.18	4.79
4	15%QS+0.6PPF+1%VMA	3.66	4.24	4.98
5	20%QS+0.6PPF+1%VMA	3.80	4.35	5.08
6	25%QS+0.6PPF+1%VMA	3.73	4.11	4.94



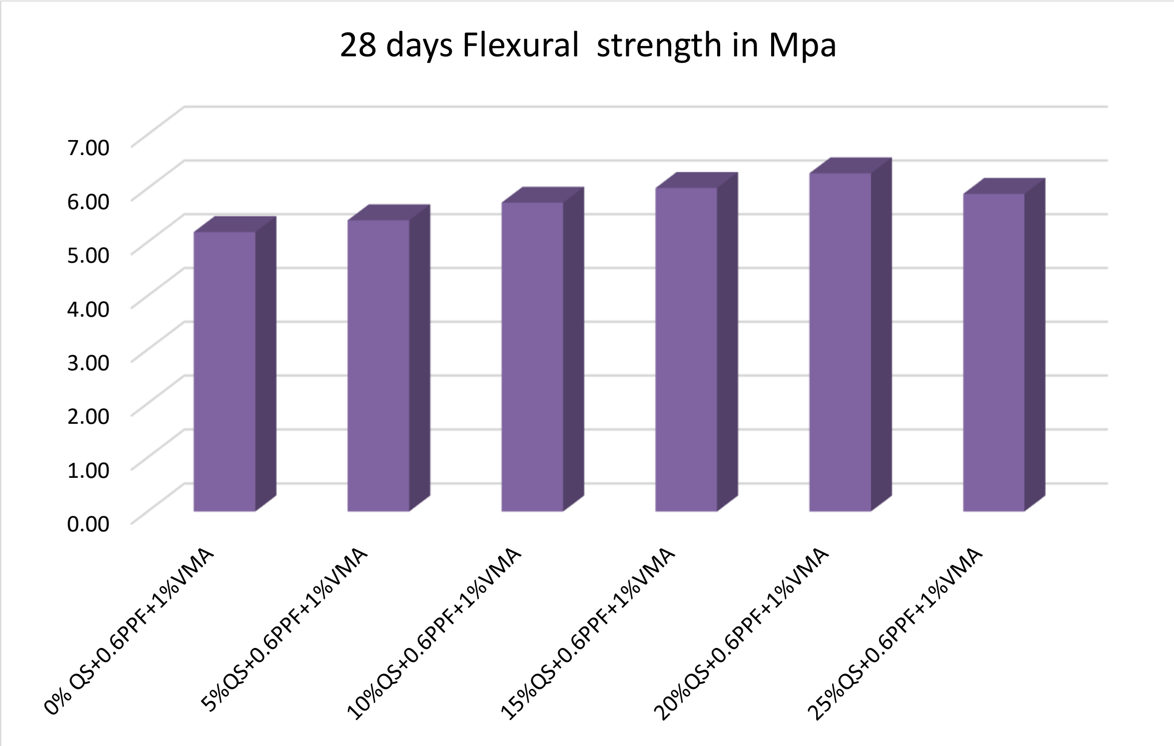
S. No	Mix ID	7 days Flexural strength in Mpa
1	0% QS+0.6PPF+1%VMA	2.54
2	5%QS+0.6PPF+1%VMA	2.73
3	10%QS+0.6PPF+1%VMA	2.82
4	15%QS+0.6PPF+1%VMA	2.86
5	20%QS+0.6PPF+1%VMA	2.91
6	25%QS+0.6PPF+1%VMA	2.86



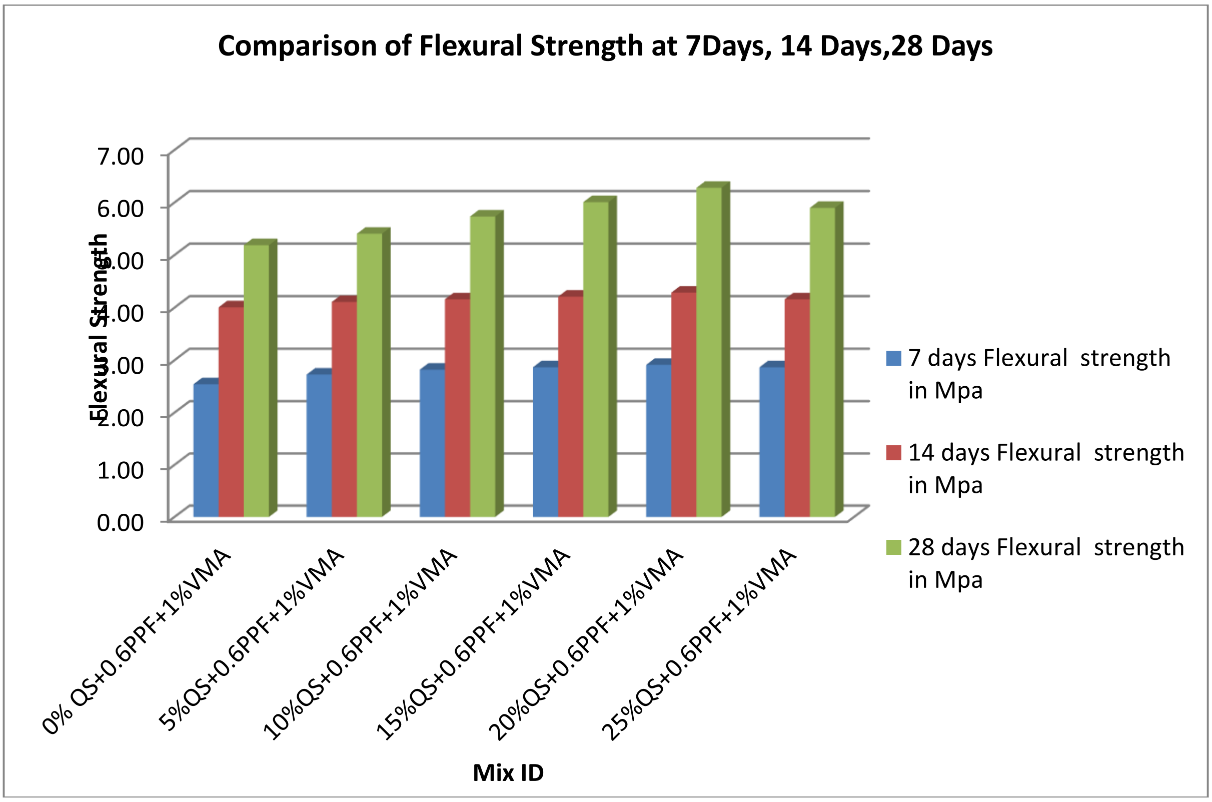
S. No	Mix ID	14 days Flexural strength in Mpa
1	0% QS+0.6PPF+1%VMA	4.01
2	5%QS+0.6PPF+1%VMA	4.11
3	10%QS+0.6PPF+1%VMA	4.16
4	15%QS+0.6PPF+1%VMA	4.21
5	20%QS+0.6PPF+1%VMA	4.28
6	25%QS+0.6PPF+1%VMA	4.16



S. No	Mix ID	28 days Flexural strength in Mpa
1	0% QS+0.6PPF+1%VMA	5.19
2	5%QS+0.6PPF+1%VMA	5.41
3	10%QS+0.6PPF+1%VMA	5.73
4	15%QS+0.6PPF+1%VMA	6.01
5	20%QS+0.6PPF+1%VMA	6.28
6	25%QS+0.6PPF+1%VMA	5.90



S. No	Mix ID	7 days Flexural strength in Mpa	14 days Flexural strength in Mpa	28 days Flexural strength in Mpa
1	0% QS+0.6PPF+1%VMA	2.54	4.01	5.19
2	5%QS+0.6PPF+1%VMA	2.73	4.11	5.41
3	10%QS+0.6PPF+1%VMA	2.82	4.16	5.73
4	15%QS+0.6PPF+1%VMA	2.86	4.21	6.01
5	20%QS+0.6PPF+1%VMA	2.91	4.28	6.28
6	25%QS+0.6PPF+1%VMA	2.86	4.16	5.90



CONCLUSIONS:

1. It is clearly seen from the results obtained for various tests of workability of SCC control specimen and SCC with Quartz Sand and addition of PP Fibers that for control specimen workability observed is within the permissible range specified by Indian Code. Hence it approves the mix design of SCC.
2. The same behavior of workability was observed in other methods of workability determination. Hence it can be said that the SCC is less workable with PP Fibers.
3. The average compressive strength of concrete at 7 days 14 Days and 28Days was determined on compression testing machine. The result obtained for average compressive strength is more achieved the target mean strength.
4. Optimum Value of Compressive strength is obtained at 20%QS+0.6PPF+1%VMA
5. The average Split Tensile strength of concrete at 7 days 14 Days and 28Days was determined on compression testing machine. The Maximum Value obtained for average Split Tensile strength of concrete is at 20%QS+0.6PPF+1%VMA
6. The average Flexural strength of concrete at 7 days 14 Days and 28 Days was determined on compression testing machine. The Maximum Value obtained for average Flexural strength of concrete is at 20%QS+0.6PPF+1%VMA

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