STUDY ON MECHANICAL PROPERTIES OF SELF COMPACTING CONCRETE USING VARIOUS PROPOTIONS OF STEATITE POWDER

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Abstract- Self Compacting Concrete (SCC) is able to flow under its own weight and completely fill the formwork, even in the presence of congested reinforcement, without any compaction, while maintaining homogeneity of the concrete. Compaction is difficult to be done in conditions where there are dense reinforcement and large casting area. Usage of SCC will overcome the difficult casting conditions and reduce manpower required. Many different fresh concrete test methods slump flow, v-funnel and L-box have been developed in attempt to characterize the property of Self-Compacting concrete. The specimens of size 150mm x 150mm cube, 150mm diameter with 300mm height cylinder and 100mm x 100mm x 500mm beam are used. Then the specimen is to tested on 7th and 28th days. The Split Tensile Strength and Flexural Strength are being determined.

Keywords: steatite powder, concrete, split tensile strength, flexural strength.

1. INTRODUCTION

Self - consolidating concrete has recently been used in the pre - cast industry and in some commercial applications, however the relatively high material cost still hinders the wide spread use of such specialty concrete in various segments of the construction industry, including commercial and residential construction.

Self-Compacting Concrete (SCC), which flows under its own weight and does not require any external vibration for compaction, has revolutionized concrete placement. SCC, was first introduced in the late 1980‟s by Japanese researchers, is highly workable concrete that can flow under its own weight through restricted sections without segregation and bleeding. Such concrete should have a relatively low yield value to ensure high flow ability, a moderate viscosity to resist segregation and bleeding, and must maintain its homogeneity during transportation, placing and curing to ensure adequate structural performance and long term durability.

Self-compactibility is largely affected by the characteristics of materials and the mix proportions so it becomes necessary to evolve a procedure for mix design of SCC. Okamura and Ozawa have proposed a mix proportioning system for SCC. In this system, the coarse aggregate and fine aggregate contents are fixed and self- compactibility is to be achieved by adjusting the water /powder ratio and super plasticizer dosage. The coarse aggregate content in concrete is generally fixed at 50 percent of the total solid volume, the fine aggregate content is fixed at 40 percent of the mortar volume and the water /powder ratio is assumed to be0.9-1.0 by volume depending on the properties of the powder and the super plasticizer dosage.

The setting time and pozzolanic activity of cement when steatite powder. It is composed of hydrated magnesium silicate: Mg3Si4O10(OH)2 as a composite material for restoration of steatite elements and good mechanical strength is used as replacement for cement. Initial setting time, final setting time, and concrete strength were studied. Addition of steatite powder increases the viscosity and mechanical properties of feed stock. The addition of carbon fibres may overcome this issue and increase the flexural strength of the cement-steatite composite concrete.

Strength is one of the most important properties of concrete since the first consideration in structural design is that the structural elements must be capable of carrying the imposed loads. Furthermore, strength characteristic is also vital because it is related to several other important properties which are more difficult to measure directly.

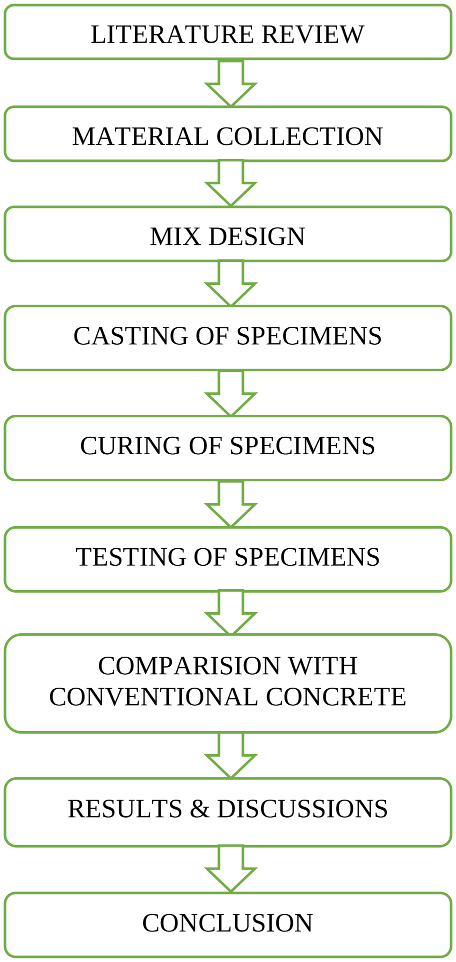
2. SCOPE AND OBJECTIVE

1) To investigate some admixtures as partial replacement of cement and determine their strength properties in self-compacting concrete.

2) To attain early stage of strength by self- compacting concrete.

3) To implement a simple method of mix design.

3. METHODOLOGY



4. LITERATURE REVIEW

"Behaviour of concrete partially replacement of cement by steatite and polypropylene fiber. (Dr. T. Bhagavathi pushpa and S. Rajesh Kumar., 2016)" [1], The interest in the use of fibers for the reinforcement of composites has increased during the last several years. Use of fibers show considerable improvement in tensile properties of concrete and also reduce shrinkage and cracks. In this study, the results of the Strength properties of concrete, setting time and pozzolanic activity of cement using polypropylene fiber and steatite have been presented. Steatite powder and polypropylene are used as a replacement for cement. Cement is replaced with steatite powder by 30%, 25%, 20%, and 15%, mass of cement and 0.5 % of polypropylene fiber by weight of concrete isconstantly added for all mixes. Ordinary Portland cement of 53 grade is used. The strength properties will be compared with the conventional concrete for curing periods of 7, 14 and 28 days. The grade of concrete used in this project is M30.

"Mechanical properties of self -compacting concrete containing silica fume and steatite powder (Padmanapam and N. Sakthieswaren., 2015)"[2], Self-Compacting Concrete which flows under its own weight and homogeneity while completely filling any formwork and passing around congested reinforcement. The experimentation is performed in M30 grade concrete, by nansu method for the volume fractions of Natural Steatite Powder were 0 to 15% by weight of cement content with 1.8% of conplast 430 as super plasticizer in SCC. Many different fresh concrete test methods slump flow, v-funnel and L-box have been developed in attempt to characterize the property of Self-Compacting concrete. The specimens of size 150mm x 150mm cube, 150mm diameter with 300mm height cylinder and 100mm x 100mm x 500mm beam are used. Then the specimen is to tested on 7th and 28th days. The compressive strength, Split Tensile Strength and Flexural Strength are being determined.

"Properties of green concrete containing quarry rock dust and marble sludge powder as fine aggregate. (M. Shahul Hameed and A. S. S. Sekar., 2009)" [3], Green concrete capable for sustainable development is characterized by application of industrial wastes to reduce consumption of natural resources and energy and pollution of the environment. Marble sludge powder can be used as filler and helps to reduce the total voids content in concrete. Natural sand in many parts of the country is not graded properly and has excessive silt on other hand quarry rock dust does not contain silt or organic impurities and can be produced to meet desired gradation and fineness as per requirement. Consequently, this contributes to improve the strength of concrete. Through reaction with the concrete admixture, Marble sludge powder and quarry rock dust improved pozzolanic reaction, micro-aggregate filling, and concrete durability. This paper presents the feasibility of the usage of quarry rock dust and marble sludge powder as hundred percent substitutes for natural sand in concrete. An attempt has been made to durability studies on green concrete compared with the natural sand concrete. It is found that the compressive, split tensile strength and durability studies of concrete made of quarry rock dust are nearly 14 % more than the conventional concrete. The concrete resistance to sulphate attack was enhanced greatly. Application of green concrete is an effective way to reduce environment pollution and improve durability of concrete under severe conditions.

"Self-compaction high performance green concrete for sustainable development (M. Shahul hameed and A. S. S. Sekar., 2010)" [4], Self-Compacting Concrete (SCC) as the name implies that the concrete requiring a very little or no vibration to fill the form homogeneously. SCC is defined by two primary properties: Ability to flow or deform under its own weight and the ability to remain homogeneous while doing so. A sustainable industrial growth will influence the cement and concrete industry in many respects as the construction industry has environmental impact due to high consumption of energy and other resources. One important issue is the use of environmental-friendly concrete ("green concrete") to enable worldwide infrastructure growth without affecting the environment. The potential environmental benefit to society of being able to build with green concrete is huge. Suitable environmental cost of producing concrete into the current price by adjusting the price of environment resources to elevate concrete's price, which will be helpful for protection of the environment and will promote the advancement of concrete technology. The problems of sustainable development should be considered on the society-economy-technology level. Fresh properties and basic strength characteristics, such as compressive strength, splitting tensile strength, with crusher rock and marble slurry dusts are the main focuses in this research.

"Development of Self Compacting Concrete, Goodier, Nov 2003 (L V A Seshasayi, et al ., 33rd Conference on OUR WORLD IN CONCRETE & STRUCTURES: 25-27 August 2008 Singapore)" [5], This paper outlines a history of SCC from its origins in Japanto the development of the material throughout Europe. Europe are discussed, together with a look at the future for the material in Europe and the rest the world. The history and development of SCC can be divided into two key stages; its initial development I japan in the late 1980s and its subsequent introduction into Europe. SCC was developed from the existing technology used for high workability and underwater concretes where additional cohesiveness is required. The main barrier to the increased use of SCC in the UK and Europe seems to be the lack of experience of process, and the lack of published guidance, codes and specifications.

"Experimental Methods on Glass Fiber Reinforced Self compacting Concrete (Deepak Raj A, et al IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2278-1684)" [6], The purpose of this study is to investigate the workability and mechanical properties of plain SCC and GFRSCC. The laboratory testing included slump flow test, L-Box test, sieve segregation resistance test, density test, ultrasonic pulse velocity test, compressive strength test, splitting tensile strength test, and flexural strength test. With reference to the obtained test result we conclude that the addition of glass fibers does not affect the filling ability, passing ability and segregation resistance of the SCC. The glass added is maximum 1% of glass fiber in all sizes.

"Effect of Polypropylene Fibers on Fresh and Hardened Properties of SCC at elevated temperatures (Arabic Nawwaf Saoud AL Qudi, et al., Australian Journal of Basic and Applied Science, 5(10): 378-384,2012)" [7], This research present the result from an experimental study on the optimum amount of Polypropylene (PP) to be used in SCC to prevent spalling when exposed to elevated temperatures. The compressive strength increased, when the polypropylene will be increased up to 10% at elevated temperatures.

"Rapid Chloride Permeability Test on Self-Compacting High Performance Green Concrete (M. Shahul Hameed, V.Saraswathi and A.S.S. Sekar.,2011)" [8], Self-compacting concrete (SCC) is one of the most significant advances in concrete technology in the last two decades. SCC was developed to ensure adequate compaction through self-consolidation and facilitate placement of concrete in structures with congested reinforcement and in restricted areas. Marble Sludge Powder (MSP) can be used as filler and helps to reduce the total voids content in concrete. Consequently, this contributes to improve the strength of concrete. An experimental investigation has been carried out to study the combined effect of addition of MSP and crusher rock dust (CRD) on the durability of self-compacting high performance green concrete SCHPGC. This paper aims to focus Chloride Permeability study of (SCHPGC) made with industrial wastes i.e. MSP and CRD from marble processing, and from stone crushing industries. Rapid Chloride Permeability test (RCPT) was conducted to measure thechloride permeability of SCHPGC and the results were compared with the normal concrete made up of river sand (NCRS).

5. EXPERIMENTAL WORK

This work includes the various test methods available for testing the fresh concrete mix and for testing the hardened concrete mix are studied in detail.

A) Fresh concrete tests

The measured slump flow, v-funnel and L-Box test for various volume fractions 15%, 20%, 25% and 30% of steatite powder and silica fume by weight of cement with 1.5 % super plasticizer are in the acceptable range.

Methods	Results	Units
Slump flow	673	mm
J-ring	3	mm
V-funnel	4	sec
L-box	1.0	(h2/h1)

B) Hardened concrete tests

Specimen Details are

- Size of cylinder -150mm diameter & 300mm height.
- Size of beam – 500mm x 100mm x 100mm.

The specimens are carefully casted and demoulded after 24 hours, without disturbing the specimen and these were cured in curing tank for 7 days and 28days and determine the split tensile and flexural strength of concrete.

6. RESULTS

A) Flexural test

The determination of flexural tensile strength is essential to estimate the load at which the concrete members may crack. As it is different to determine the tensile strength of concrete by conducting a direct tension test, it is computed by flexure testing. The flexure tensile strength at failure or the modulus of rupture is thus determined and used when necessary. Its knowledge is useful in the design of pavement slabs and airfield run way as flexural tension is critical in these cases. The modulus of rupture is determined by testing standard tests specimens of 150mm x 150mm x 700mm over a span of 600 mm or 100mm x 100mm x500mm over a span of 400mm, under symmetrical two-point loading. The modulus of rupture is determined from the moment at failures as fr = M/Z. Thus the computation of assumes a linear behavior of the material up to failure which is only a rough estimation. The results are affected by the size of the specimens; casting, curing and moisture conditions; manner of loading (third point or central point loading); rate of loading, etc. The test is conducted and the strength determined according to the prescribed standards. On the other hand, the direct test gives lower apparent tensile strength. In the direct tensile strength, as the entire volume of specimen is under maximum stress, the probability of weak element occurring in the body of specimen is high.

Table 6.1 Flexural Strength

Specimen	7 Days (N/mm2)	28 Days (N/mm2)
Conventional	4.4	6.1
S.P (30%)	3.3	4.5
S.P (25%)	3.8	5.2
S.P (20%)	4.1	5.7
S.P (15%)	4.7	6.5

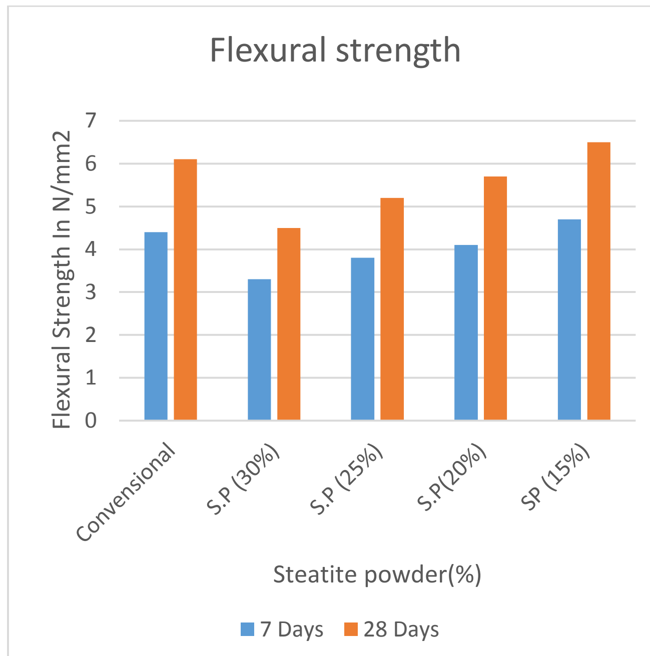


Fig: 6.1.Flexural Strength

C) Split- tensile strength

After curing of cylinders for respective days it was placed in testing machine having a maximum capacity of 1000 KN was applied on the cylinder specimens. The cylinder specimen was failed at ultimate load which was noted from dial gauge reading. From the result, it was found that the split tensile strength was increased at replacement of 15% of cement by steatite powder by weight of concrete when compared to the conventional mix. Split tensile strength is most important property of the hardened concrete.

The concrete cylinders were cast, cured and tested accordance with the IS standard and 7, & 28 days split tensile strength result of concrete are listed in Table 6.2. Based on the result, the highest split tensile strength value of 3.9 Mpa was obtained at 28 days by replacement of 15% of cement by steatite powder by weight of concrete when compared to the conventional mix. Fig 6.2 shows that the split tensile strength of concrete for various mixes. Strength was increased 34.4% than the conventional concrete.

Table 6.2 Split- tensile Strength

Specimen	7 Days (N/mm2)	28 Days (N/mm2)
Conventional	1.92	3.2
S.P (30%)	1.56	2.6
S.P (25%)	1.74	2.9
S.P (20%)	1.86	3.1
S.P (15%)	2.1	3.5

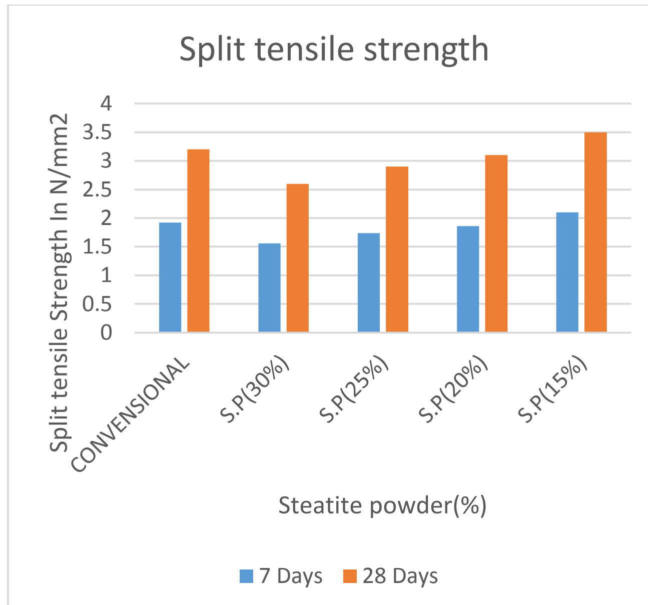


Fig: 6.2.Split- tensile Strength

7. CONCLUSION

Gradual increase in the split tensile strength and flexural strength for M 30 Grade of concrete at 7 and 28 days when 15%, 20%, 25%, 30% partial replacement of natural steatite powder with 1.5% of super plasticizer of SCC compared with controlled SCC.

Maximum split tensile strength of cylinder was found as 3.5 Mpa at the replacement of 15% steatite powder in the concrete and it was increased by 34.4% than the conventional concrete.

Maximum flexural strength of prism was obtained as 6.5 Mpa with replacement of 15% Steatite Powder for cement e was added by the weight of concrete and it was increased by 31.1% than the conventional concrete.

8. REFERANCES

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