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COMPARATIVE STUDY OF HIGH STRENGTH SELF COMPACTING CONCRETE VS HIGH STRENGTH SELF COMPACTING CONCRETE USING GLASS FIBRE

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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. Majority of concrete cast rely on compaction to produce good quality concrete. However, 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. Addition of fibers will enhance the tensile strength & reduce cracking. SCC will be added with relatively short, discrete, and discontinuous glass fibers to produce Glass Fiber Reinforced Self Compacting Concrete (GFRSCC). The purpose of this study is to investigate the workability and mechanical properties of conventional SCC and GFRSCC. Conventional SCC and GFRSCC samples will be prepared. The laboratory testing included slump flow test, U-Box test, Vfunnel test, Compressive strength test, Split tensile strength test & Flexural strength test. After the tests, results were compared and 0.75% fiber dosage has been proven to be optimum for flexural and compressive strength.

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I INTRODUCTION

Self-compacting concrete is one of the subjects of concrete techneology.Selfcompacting concrete has been used in practical structures. In this Project, a brief introduction to self-compacting concrete using fibers (SCC) is given. And also the definition and motive for development of SCC have been discussed. The SCC has more advantages over normal concrete than disadvantages. An approach has been made to study the various aspects of SCC, such as types of SCC, materials used and testing methods, in detail. When large quantity of heavy reinforcement is to be placed in RC member it is difficult to ensure that the formworks get completely filled with concrete which is fully compacted without voids of honeycombs. This problem can now be solved with self-compacting concrete. Self-compacting concrete is placed or poured in the same way as ordinary concrete but without vibration. It is very fluid and can pass around obstructions and fill all the nooks and corners without the risk of either mortar or other ingredients of concrete separating out. At the same time there is no entrapped air or rock pockets. This type of concrete mixtures does not require any compaction & it saves time,labour, energy. The surface finish produced by SCC is exceptionally good and patching will not be necessary.Thus, Self-compacting concrete (SCC) can be defined as concrete that is able to flow and fill every part and corner of the formwork, (even in the presence of dense reinforcement) purely by means of its own weight and without the need for any vibration or other type of compaction.

II OBJECTIVE

FRSCC has great potential and wider applications in construction industry due to the combined benefits of both SCC and FRC. FRSCC with elimination of compaction and improved toughness of hardened concrete make it more suitable for use in construction of structures with dense reinforcements and subjected to impact and earthquake loads. The results of this study will present the physical and mechanical properties of the plain SCC and GFRSCC. For GFRSCC, the optimum fiber content will be determined from the test results and applied to the mix proportions of the reinforced concrete slabs. 1. To study three key fresh properties of SCC -filling ability, passing ability and resistance to segregation -for mix design purposes in the lab and for compliance purposes on site. 2. To determine experimentalstudies on M80of concrete for SCC and SSC with glass fiber. 3. To carry out comparative study between self-compacting concrete with glass fiber and Conventional Self-compacting concrete. 4. To obtain experimental conclusions and results.

III HISTORICAL STUDY

For several years beginning in 1983, the problem of the durability of concrete structures was a major topic of interest in Japan. To make durable concrete structures, sufficient compaction by skilled workers is required. However, the gradual reduction in the number of skilled workers in Japan's construction industry has led to a similar reduction in the

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quality of construction work. One solution for the achievement of durable concrete structures independent of the quality of construction work is the employment of self-compacting concrete, which can be compacted into every corner of a formwork, purely by means of its own weight and without the need for vibrating compaction. Prof. Aijaz Ahmad Zende1, Dr R. B. Khadirnaikar (2014) Almost all countries in the world are facing an acute decline in the availability of skilled labor in the construction industry, and hence the need of Special Concretes becomes very essential in this world where the use of concrete is just next to the water. The word ―Special Concrete‖ refers to the concrete which meets the special performance and requirements which may not be possible by using conventional materials and normal methods of concreting. VenketewaraRao et al (2010) Aims at developing standard and high strength SCC with different sizes of aggregate based on Nan Su's mix design procedure. SCC can be developedwith all sizes of graded aggregate satisfying the SCC characteristics. Hajime Okamura et al (2008) In early 1980s,the problem of the durability of concrete structures was a major topic of interest in Japan. The creation of durable concrete structures requires adequate compaction by skilled workers .Lack of uniform and complete compaction is the primary factor responsible for poor performance of concrete structure. Okamura solved the issue of degrading quality of concrete construction due to lack of compaction by employment of SCC with independent of the quality of construction work and introduced SCC in later 1980

IV IMPORTANCE

The majority of concrete cast requires compaction to ensure the development of adequate strength and durability. Generally, the purpose of compaction of concrete is to achieve the highest possible density of the concrete. Dense microstructure of concrete will results in low permeability, high strength, high resistance to chloride and sulphate attacks, low carbonation, and improved durability. Insufficient compaction will lead to the formation of voids, which results in negative impact on the physical and mechanical properties of concrete. Inclusion of voids will also influence the protection of the embedded steel reinforcement. Compaction of concrete is done manually by using vibrators in construction site. However, compaction will be difficult to be carried out at conditions as follows:

1. Large concrete casting areas.
2. Presence of congested reinforcement
3. Inaccessible areas and spaces

V METHODOLOGY

Materials used :Cement:Ordinary Portland cement (Grade 53) is generally used in the production of SCC. It has a relative density of 3.15.Hydration Reaction:2 C3S (Tri Calcium silicate)+ 11H (Water)→C3S2H8 (Calcium Silicate Hydrate)+ 3CH2C2S (Di Calcium silicate) + 9H (Water) → C3S2H8 (Calcium Silicate Hydrate) + CHWater:The water used in the mix design was potable water from the water-supply network system. So, it was free from suspended solids and organic materials, which might have affected the properties of the fresh and hardened concrete.Aggregates:In general, SCC has got less Coarse Aggregates, more Fine Aggregates when compared to normal concrete.Coarse aggregate:Aggregates size is bigger than 4.75mm are considered as coarse aggregates. Regarding the characteristics of different types of aggregates, crushed aggregates tend to improve the strength because of the interlocking angular particles, but at the same time reduce the flow ability, while lower aggregates improve the flow because of the lower internal friction and lesser surface area per mass.Fine aggregate:Aggregate smaller than 4.75mm to 0.075mm are considered as fine aggregates (sand). Sand in SCC is generally finer than in normal concrete. The ratio of weight of sand to that of coarse aggregates could be in the range of 1.1-1.6.

Minerals admixtures:Mineral admixtures are added to concrete as part of the total cement system. They may be used in addition to or as a partial replacement of Portland cement in concrete depending on the properties of the materials and the desired effect on concrete. Mineral admixtures are used to improve a particular concrete property such as workability, strength or compact ability. The optimum amount to use should be established by testing to determine.

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Fly ash:The key benefits of using Fly ash in concrete are- •Reduced Water Demand •Increased Workability •Reduced Permeability •Increased Durability •Reduced Heat of Hydration

Glass fibre:GFRC is similar to chopped fiberglass (the kind used to form boat hulls and other complex three-dimensional shapes), although much weaker. It's made by combining a mixture of fine sand, cement, polymer (usually an acrylic polymer), water, other admixtures and alkali-resistant (AR) glass fibers. Many mix designs are available online, but you'll find that all share similarities in the ingredients and proportions used.

NEED OF GLASS FIBRES IN SELF COMPACTING CONCRETE:Self-compacting concrete develops micro cracks with curing and these cracks propagate rapidly under applied stress resulting in low tensile strength of concrete. Hence addition of fibers improves the strength of concrete and these problems can be overcome by use of glass fibers in concrete. Application of glass fibers provides strength to the concrete while the matrix protects the fibers. The primary role of fibers in a cementations composite is to control cracks, increase the tensile strength, toughness and to improve the deformation characteristics of the composite. The performance of fiber reinforced self-compacting concrete depends on the type of the fibers used. Inclusion of glass fibers reduces the water permeability, increases the flexural strength due to its high modulus of elasticity. In the post cracking stage, as the fibers are pulled out, energy is absorbed and cracking isreduced.6.

VI PROCESS OF MAKING SELF-COMPACTING CONCRETE

Aggregate test: During production of SCC, tests of aggregate grading and moisture content should be carried out more frequently than usual, since SCC is more sensitive than normal concrete to variations.Mixing process:At the start of a contract and in the absence of previous experience with the particular mix design, additional resources may be needed for supervision of all aspects of initial production of SCC. Since the quality of freshly mixed concrete may fluctuate at the beginning of production, it is recommended that workability tests should be conducted by the producer on every load, until consistent and compliant results are obtained. Subsequently, every delivered batch should be visually checked before transportation to site, and routine testing carried out to the frequency specified in EN206. More frequent adjustment of mix proportions, particularly water content, may need to be made, depending on the results from monitoring aggregate moisture content.Delivery and transportation:Depending on the size of the concrete structure to be produced in SCC, production capacity, journey time and placing capability need to be balanced. Unexpected production stops can result in consistence variations that adversely affect the end result. SCC should be designed so that workability is maintained to meet the requirements of the contract. Placing is faster, especially if a pump is used, but it is still essential to make sure that delivery and placing can be completed within the workability-retention(self-compatibility) time of the concrete.Placing:Before placing SCC, It should be confirmed that reinforcement and formwork are arranged as planned. The formwork must be in good condition but no special measures are necessary to prevent grout loss. Contractors may wish to consider possible advantages of pumping from the bottom of formwork. If concrete is placed by skip, attention should be paid to the closure of the gate. For forms in excess of 3 m in depth, the full hydrostatic head should be taken into consideration. This may require modification of the formwork design and/or the SCC.Surface finishing:Surfaces of SCC should be roughly leveled to the specified dimensions, and the finishing should then be applied at an appropriate time before the concrete stiffens. Difficulty may be encountered with the conventional process of final surface hardening of horizontal areas of concrete by repeated steel toweling. Alternative procedures or different tools may be required.Curing:SCC tends to dry faster thanconventional concrete because there is little or no bleed water at the surface. Initial curing should therefore be commenced as soon as practicable after placing in order to minimize the risk of shrinkage cracking.

VII EXPERIMENTAL PROCESS

The most commonly used are: 1)Slump flow test:This is one of the simplest tests initially developed in Japan for assessment of underwater concrete. It is the most ct so commonly used test for SCC and gives a good assessment of filling ability. This test can be used at site to assess the consistency of supply of ready mixed concrete, which has been assessment of various characteristics like filling ability, passing ability and homogeneity. The concrete sample placed into the mould is not rodded and when the slump cone is removed the sample collapses .The diameter of the spread of the sample is measured, i.e a horizontal distance is determined as opposed to the vertical distance in the conventional Slump test. The Slump Flow test can give an indication as to the consistency, filling ability and workability of SCC. The SCC is assumed of having a good filing ability and consistency if the diameter of the spread reaches values between 650mm to 800mm2) V-funnel test :This test is designed to assess the flow ability and alsosegregation resistance of SCC. Viscosity of the self-compacting concrete is obtained by using a V-funnel apparatus, which has certain dimensions, in order for a given amount of concrete to pass through an orifice .The amount of concrete needed is 12 liters and the maximum aggregate diameter is 20 mm. The time for the amount of concrete to flow through the orifice is being measured. If the concrete starts moving through the orifice, it means that the stress is higher than the yield stress; therefore, this test measures a value that is related to the viscosity. If the concrete does not move, it shows that the yield stress is greater than the weight of the volume used. An equivalent test using smaller funnels (side of only 5 mm) is used for cement paste as an empirical test to determine the effect of chemical admixtures on the flow of cement pastes.3) U-box test :The test is used to assess the passing ability of SCC. the U-type test is the most appropriate, due to the small amount of concrete used, compared to others .In this test, the degree of compact ability can be indicated by the height that the concrete reaches after flowing through obstacles.

4) Compression test:This test is performed to determine compressive strength of concrete. The compressive strength is most important characteristic strength of concrete. The compressive strength increases if the cement content is increased. Compressive strength is influenced by several factors such as a) W/C ratio b) Type of cement and its quality c) Type and structure of aggregate d) Degree of compaction e) Efficiency of crushing f) Time required for hardening.5) Split Tensile Strength test:Tensile splitting strength test is carried out for all the concrete cylinders after achieving certain curing age. Thedimension of concrete cylinder prepared will be 200 x 100 mm. The testing machine for splitting tensile strength is the same as compressive strength test. Excess moisture on the surface of the specimen is wiped before placing in the testing machine. The surface of specimen should be free from any loose grit or other extraneous materials. The test specimen is placed centrally in the testing machine. The upper platen and lower platen has to be parallel during loading. Constant loading rate of KN/s is appliedto the specimen and the maximum load shown by the machine is recorded.6) Flexural Strength test:This test method describes the procedure used for determining the flexural strength of concrete by two different methods. 1) A simple beam with center-pointloading. 2) A simple beam with third point loading. Both tests are intended to be used to determine Modulus of rupture and are considered to give equivalent answers.

VIII CONCLUDED

1)Self compacting concrete (M80 grade) has been modified with glass fiber with variation ranging from 0.25% to 1% of the volume of concrete. 2)From the test performed on fresh concrete, it has been concluded that the increase in fiber content increases the cohesiveness of concrete which adversely affects its flow ability. 3)From the test performed on hardened concrete, it has been concluded that along with the increase in fiber content; linear increase is noted in tensile strength and in case of compressive and flexural strengths, drastic increase is seen. 0.75% fiber dosage has been proven to be optimum for flexural and compressive strength. 4)In terms of cost; it has been be concluded that with every 0.25% increase in fiber content, there is an increase of 35% of the original cost of SCC; which pays off by the corresponding flexural and compressive strength increase. 5)Thus the overall conclusion is that the initial cost of GFRSCC is more than the normal SCC but the maintenance cost of GFRSCC is quite less or negligible as the micro cracks are avoided

.REFRENCES

[1].Specification and Guidelines for Self-Compacting Concrete February 2002.‖ European Federation of Specialist Construction Chemicals and Concrete Systems, EFNARC.

[2]The European Guidelines for Self-Compacting Concrete – Specification, Production and Use May 2005.‖ BIBM, CEMBUREAU, ERMCO, EFCA, and EFNARC.

[3] Ding, Y., Liu, S., Zhang, Y. and Thomas, A. (2008). ―The investigation on the Workability of Fiber Cocktail Reinforced Self-Compacting High Performance Concrete.‖ Construction and Building Material Volume 22, 2008, pg. 1462-1470.

[4] Ding, Y., Zhang, et al.(2009). ―The Investigation on Strength and Flexural Toughness of Fiber Cocktail Reinforced Self-Compacting High Performance Concrete.‖ Construction and Building Materials Volume 23, 2009, pg. 448-452.

[5] M.Sahmaran,,Yurtseven, et al, I.O. (2005). ―Workability of Hybrid Fiber Reinforced Self Compacting Concrete.‖ Building and Environment Volume 40, 2005, pg. 1672-1677.

[6] Schutter, G.,et al (2008). ―Self-Compacting Concrete.‖ Whittles Publishing, Dunbeath, Caithness KW6 6EY, Scotland, UK.

[7] Domone, P.L. (2006). ―Self-Compacting Concrete: An Analysis of 11 years of Case Studies.‖ Cement and Concrete Composites, Volume 28, 2006, pg. 197–208.

[8] Parra, C., Valcuende, M. and Gomez, F. (2011). ―Splitting Tensile Strength and Modulus of Elasticity of Self-Compacting Concrete.‖ Construction and Building Material, Volume 25, 2011, pg. 201-207.

[9] Okamura. H, Ouchi. M, 'Self Compacting Concrete', Journal of Advanced Concrete Technology, Vol-1, April 2003, pp 5-15 Sekha , Dr. P. Sravana and Dr. SrinivasaRao P r.T

[10] Okamura H, Ouchi M, Self Compacting Conrete Development, Present and Future, In: Å. Skarendahl, Ö. Petersson (eds.), Proceeding of 1st International Rilem Symposium on Self Compacting Concrete; Stockholm, Sweden, 1999, p. 804. e-ISBN: 2912143721