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A Review on Steel Fiber Reinforced High Strength Self - compacting Concrete

Sajal Mamidwar[1], Rushabh Patil[2], Jayraj Choudhary[3], Naved Momin[4], Prof Manasi Chavan[5]

[1,2,3,4] *Research Scholar, Department of Civil engineering, Indira College of Engineering College, Parandwadi, University of SavitriBaiPhule Pune University, Pune, India*

[5]*Professor, Department of Civil Engineering, Indira College of Engineering College, Parandwadi, University of SavitriBaiPhule Pune University, Pune, India*

ABSTRACT

Self-compacting concrete (SCC) is considered as a concrete which can be placed and compacted under its self-weight with little or no vibration effort, and which is at the same time cohesive enough to be handled without segregation or bleeding. Fibre-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibres that are uniformly distributed and randomly oriented. Fibres include steel fibres, glass fibres, synthetic fibres and natural fibres each of which lend varying properties to the concrete. With addition of steel fibres to concrete, its properties are altered from brittle to ductile. Fibbers are known to significantly affect the workability of concrete. Therefore, an investigation was performed to compare the properties of plain normal compacting Concrete (NCC) and SCC with steel fibre. To study the effect of addition of steel fibre on fresh concrete and mechanical properties of SCC. To study the addition of steel on load deformation behaviour under compression. Four SCC mixtures and one NCC were investigated in this study. The variables in this study were aspect ratio (0, 15, 25 and 35) and percentage of volume fraction (0, 0.5, 1.0 and 1.5) of steel fibres.

Keywords: *Self compacting concrete, Fibre reinforced concrete, workability, mechanical properties*

I.INTRODUCTION

Self-compacting concrete (SCC) has been widely employed to produce beams of complex shapes and/or with high density of reinforcement structures. From a mechanical viewpoint, both the conventional and self-compacting concretes perform less satisfactorily when they are subjected to tensile effects. The application of Steel Fiber Reinforced Self-compacting Concrete (SFRSC) in the construction of structural elements is seen as

an alternative solution to the complication in placing the reinforcement and compaction of normally vibrated concrete. The main advantage of SFRSC is the ability to be properly poured in place, filling the formwork corners and small voids between reinforcement bars by means of its own weight. Many research had been done in exploring the structural performance of SFRSC due to the enhanced engineering and mechanical properties. The incorporation of steel fibres in the mix has been found to enhance the hardened properties of self-compacting concrete in terms of its tensile strength, ductility, toughness, energy absorption capacity and as well as fracture toughness.

Use of high strength concrete for the construction of high-rise buildings and long-span reinforced and pre-stressed concrete bridges for metro, or high speed rail corridor is wide spread. Features of high-strength concrete include high early-age and ultimate strengths, low chloride permeability, hence improved resistance to aggressive environmental penetration. However, it is known to be less ductile compared to medium strength concrete.

In recent decades, steel fibre reinforced high strength self-compacting concrete (SFHSSCC) is considered a very important material in the structural engineering field. High strength concrete attracts designers and architects as it offers good durability and the aesthetics of a construction as well. One of the advantages using the SFHSSCC is to provide high ductile behavior. SFHSSCC has also a high toughness, with improvement in workability, and high residual strengths after the initiation of the first crack. The main challenge in many past studies is to select the effective fibre contents that should be added to the concrete mixture. In the present study, a Hooked shape steel fibers are used; the hooked

steel fibers were evaluated using the volume fractions, which varied between 0.0%, 0.75% and 1.5%.

Generally, a typical high strength concrete mix consists of the cement content about 550kg/m3. With the use of super plasticizer, the water content could be significantly reduced (up to 30%) to produce workable high-strength concrete and this consequently reduces the cement content without affecting the strength of concrete.

II.LITERATURE REVIEW

H. Okamura and M. Ouchi, "Self-Compacting Concrete," J. Adv. Concrete. Technol., 1, 1, pp. 5–15 (2003): Carried out investigations for establishing a rational mic design method and self-compatibility testing methods have been carried out from the viewpoint of making self-compaction concrete a standard concrete

Dr. Mrs. S.A. Bhalchandra, Pawase Amit Bajirao(2012): studied the performance of steel fibre reinforced self-compacting concrete as plain self-compacting concrete is studied in depth but the fibre reinforced self-compacting concrete is not studied to that extent. Self-Compacting Concrete achieves this by its unique fresh state properties. In the plastic state, it flows under its own weight and homogeneity while completely filling any formwork and passing around congested reinforcement. In the hardened state, it equals or excels standard concrete with respect to strength and durability. In general, the significant improvement in various strengths is observed with the inclusion of Hooked end steel fibres in the plain concrete. However, maximum gain in

strength of concrete is found to depend upon the amount of fibre content. The optimum fibre content to impart maximum gain in various strengths varies with type of the strengths.

B Krishna Rao and V. Ravindra (2010): Found that the addition of steel fibre reinforcement and mineral admixtures like fly ash to the concrete improve the mechanical properties of steel fibre reinforced self-compacting concrete. It was also observed that the incorporation of high volume fly ash reduced the water requirement of a SCC mixture. In other words, using high-volumes of a fly ash increased the workability characteristics of SCC mixtures. Ten SCC mixtures and one NCC were investigated in this study. The content of the cementitious materials was maintained constant (600 kg/m3), while the water/ cementitious material ratio is kept constant 0.31. The self-compacting mixtures had a cement replacement of 35% by weight of Class F fly ash. The variables in this study were aspect ratio (0, 15, 25 and 35) and percentage of volume fraction (0, 0.5, 1.0 and 1.5) of steel fibres. Investigation has shown that it is possible to design a steel fibre reinforced self-compacting concrete incorporating high volumes of class F fly ash. The HVFA SCCs have a slump flow in the range of 565-715mm, a flow time ranging from 3.3 to 5 s, a J-Ring test value ranging from 5 to 10mm, a L-Box ratio ranging from 0.8 to 0.94, and V-funnel flow in the ranging from 7.1 to 12s. It was observed that it is possible to achieve self-compaction with steel fibre (three different aspect ratio (15,25and 35) and three different volume fraction (0.5%,1%,and1.5%)) inclusion. Although results obtained from all of the mixes satisfy the lower and upper limits suggested by EFNARC.

BhoopathiVivek Reddy, MadadiRajenderReddy (2016):- Self-Compacting Concrete is an innovative concrete that doesn't need vibration for placing and compaction. It is able to flow underneath its own weight, completely filling formwork and achieving full compaction, even within the presence of engorged reinforcement. This paper presents an experimental investigation on strength aspects like compressive, flexural and split tensile strength of self-compacting concrete containing totally different mineral admixtures and workability tests for various mineral admixtures (slump, L-box, V-funnel, U-box and T50) are carried out. The methodology adopted is “Nan–Su” method of mix design as per “EFNARC” specifications (i.e., 55, 56, 57, 58 percentages) that satisfies the fresh properties and additionally the hardened properties of SCC confine the water/powder ratio is constant. After the analysis of the results of the experimental program the subsequent conclusions arrived. Mix proportions for M40 and M60 grade of self-compacting concrete were developed victimization Nan Su methodology of mix design that satisfied the fresh properties of SCC as per “EFNARC” specifications

Mallesh M, Shwetha G C, Reena K, Madhukaran (2015) : Self-compacting concrete (SCC) becomes a very popular choice in concrete industry because of its easy replacement in highly congested reinforcement structures without undergoing any consolidation, reduced labours, non-segregation property and smooth finishing. In this paper, experimental study has been carried out to achieve target compressive strength and durability requirements for M30 grade SCC. Nan-Su mix design method was used by changing the Nan-Su coefficient and water cement ratio by keeping all other parameters constant. Cubes were casted for Nan-Su coefficient 7,8,9,10,11 and 12 for M30 grade SCC and achieved expected results for 7-days & 28-days

compressive0strength for Nan-Su coefficient 7,8,9,10,11 and 12. Finally got the required strength of about 39.56 MPa for M30 grade of self-compacting concrete for Nan-Su coefficient 11, with w/c ratio 0.5 and super plasticizer dosage 0.8.

BathamGeeta, Bhadauria S. S., Akhtar Saleem (2013): The use of agro-industrial waste materials in concrete is common solution for waste disposal as well as economy purpose. Various research studies have been conducted on the use of agro-industrial waste as an innovative material to produce good quality of concrete whether it is plain concrete or self-compacting concrete. The present paper explores the recent innovations in self-compacting concrete containing agro-industrial waste materials. The paper also reviewed latest application of admixtures and their performance on SCC quality. Recent innovations in SCC using various agro-industrial wastes and their effect on fresh and hardened properties have been reviewed. In summary the use of various agro-industrial wastes in SCC has positive effect on fresh and hardened properties. It is possible to produce medium strength, high strength and even ultra-high strength good quality of SCC using the wastes.

Andrea Kustermann, Manfred Keuser(2004): Experimentally investigated that addition of Fibers in HSC gives a significant increase of ductility, reduces shrinkage effects and ameliorates the resistance against Mechanical attacks. Experimental studies with different thickness and HSC mixtures show clearly that the resistance against impact loading does not only depend on the uniaxial compressive strength. As the failure mechanisms strongly depends on local and global stiffness distribution the increase of ductility is a promising way to develop a safe protective system using HSFRC slabs.

III.ORIGIN OF RESEARCH PROBLEM

The need to compact normal concrete by the use of vibration has considerable impact on the working conditions, the required labor costs, and sometimes on the quality of concrete. For these reasons, self-compacting concrete offers interesting perspective to the construction industry. High strength Self-compacting concrete (HSSCC) is considered as a concrete which can be placed and compacted under its self-weight with little or no vibration effort, and which is at the same time cohesive enough to be handled without segregation or bleeding. Self-Compacting Concrete offers a rapid rate of concrete placement, with faster construction times and ease of flow around congested reinforcement. The elimination of vibrating equipment improves the environment on and near construction and precast sites where concrete is being placed, reducing the exposure of workers to noise and vibration. The improved construction practice and performance, combined with the health and safety benefits, make SCC a very attractive solution for both precast concrete and civil engineering construction. Use of fibers in to SCC mixes has been presented by many researchers. Depending on properties of concrete and the fibers. The properties of fibers that are usually of interest are fiber concentration many parameters such as maximum aggregate size , fiber volume , fiber type , fiber geometry , and fiber aspect ratio, fiber inclusion to concrete reduces the workability of concrete. Reduction of workability in FRC is a handicap for onsite applications. However, the combination of hybrid fibers reinforced self-compacting concrete with superior properties in not only hardened state but also fresh state. High strength concrete can be achieved by using super

plasticizers to reduce the water binder ratio and by using supplementary cementing materials such as silica fume, fly ash, granulated blast furnace slag, nanoparticles and natural pozzolan in order to create extra strength by pozzolanic reaction. The use of hybrid fibers in SCC containing steel and polypropylene fiber where in the steel fiber will contribute to the strength characteristics and PPF will be helpful in optimizing the self-weight of the SCC due to its light weight.

IV.SUMMARY

The results of the laboratory study and theoretical analysis are expected to lead to design a steel fibre reinforced self-compacting concrete. This study will be helpful to suggest recommendation of guideline to design the self-compacted steel fibre reinforced concrete.

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