Study On Steel Fiber Reinforced Self-Compacted Concrete In Short Column

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***Abstract* — This study paper we have a tendency to present the experimental results of a study on large- scale confined self-compacting concrete columns; this survey is a component of a large programme concerning the behavior of self-compacting concrete and therefore the structural effects thanks to its utilization. The examined variables have enclosed concrete kind SCC. SCC is principally used once a good fluidity is requested (for example high steel reinforcement proportion. The results show that once a SCC is employed rather than high flowability concrete, each the fabric and therefore the structural behavior square measure on the average similar; often a larger scatter of the experimental quantities distinguishes the results of the tests on SCC members. We have a tendency to conjointly work on completely different methodology like, Steel fiber. Slump Test, V-funnel take a look at, L-Box Test, J-Ring take a look at, Self Compacted Concrete, Short Column. The goal that expected from the paper is to compile the recent innovations in SCC, study their impact on the properties of SCC and establish a world benchmarking for additional analysis work in this regard.**

Keywords—SCC; compressive strength; Mix Design; super plasticizer;

I. INTRODUCTION

Though concrete possess high compressive strength, stiffness, low thermal and electrical conduction, low combustibility and toxicity however 2 characteristics restricted its use square measure, it's brittle and weak in tension. but the developments of Fiber strengthened Composites (FRC) have provided a technical basis for up these deficiencies. Fibers square measure little items of reinforcing materials more to a concrete combine that commonly contains cement, water, fine and course mixture.

Among the foremost common fibers used is steel, glass, asbestos, polypropene etc. once the hundreds obligatory on the concrete approach that for failure, crack can propagate, generally apace, fibers in concrete provide a method of sensational the crack growth. If the modulus of physical property of fiber is high with relation to the modulus of physical property of concrete or mortar binder the fiber helps to hold the load, thereby increasing the enduringness of the fabric. Fibers increase the toughness, the flexural strength, and cut back the creep strain and shrinkage of concrete.

Many European countries recognized the importance and potentials of SCC developed in Japan. Throughout 1989, they based European federation of natural trade associations representing producers and applicators of specialist building merchandise (EFNARC). The use of SCC started growing apace. EFNARC, creating use of board sensible experiences of all members of European federation with SCC, has necessitated specification and guide lines to produce a framework for style and use of prime quality SCC, throughout 2002.

The main options of Self-Compacting Concrete (SCC) concern the recent state condition (high flow ability that avoids external vibration and a decent segregation resistance); however within the last twenty years several researches are meted out concerning the options of the hardened state of the SCC and also the structural effects as a result of its utilization. The behavior of structural components fictional exploitation SCC, like walls beams, beam-column nodes and frames has been analyzed by means that of experimental tests and analytical studies.

The aim of the studies was to focus on potential variations of the behavior of the SCC members, compared to the conventional vibrate Concrete (NVC) – underneath a similar conditions -, as a result of the bigger compactness and also the higher bond to the steel bars of the SCC. Some researchers refers that the SCC members have a stronger structural performance than a NVC members, as a result of the SCC permits to get a stronger crack management ability, however generally a lot of brittle behavior appeared.

There are several benefits of exploitation SCC, particularly once the fabric value is reduced. These include:

1. Reducing the development time and labor value.
2. Eliminating the necessity for vibration.
3. Reducing the pollution.
4. The filling capability of extremely full structural members.
5. Facilitating constructability and guaranteeing smart structural performance.

II. LITERATURE REVIEW

The conception of mistreatment fibers in an exceedingly brittle matrix was initial recorded with the traditional Egyptians UN agency used the hair of animals and straw as reinforcement for mud bricks and walls in housing. This dates back to 1500 B.C. (Balaguru et al, 1992).

Nan Su proposes a replacement combine style methodology for self-compacting concrete (SCC). First, the number of aggregates needed is decided, and therefore the paste of binders is then crammed into the voids of aggregates to make sure that the concrete so obtained has flowability, self-compacting ability and different desired SCC properties. the number of aggregates, binders and compounding water, similarly as sort and dose of super plasticizer (SP) to be used area unit the foremost factors influencing the properties of SCC. Slump flow, V-funnel, L-flow, U-box and compressive strength tests were dispensed to look at the performance of SCC, and therefore the results indicate that the planned methodology may turn out with success SCC of prime quality. during this methodology use of super softener area unit used for up the flow or workability for attenuate water cement quantitative relation while not sacrifice within the compressive strength, additionally used viciousness modifying agent (VMA) for giving additional risk of dominant segregation.

Dr.Mrs. S.A. Bhalchandra studied concerning the Steel Fiber reinforced Self Compacting Concrete (SFRSCC) within the recent and in hardened state. The super plasticizer used for this study & The consistency modifying agent generally, the numerous improvement in numerous strengths is determined with the inclusion of Hooked finish steel fibers within the plain concrete. However, most gain in strength of concrete is found to rely upon the number of fiber content. The optimum fiber content to impart most gain in numerous strengths varies with sort of the strengths. generally the compressive strength and therefore the flexural strength increase with increase within the proportion of fiber content. Satisfactory workability was maintained with increasing volume fraction of fibers by victimization super plasticizer.

Ahmed Fathi studied that the Self-compacting concrete (SCC) could be a quite concrete combine that eliminate the desired for the vibration tools as their high liquidness and moderate consistency throughout the recent qualities Fiber reinforcement primarily enhances the post cracking qualities of concrete and gains within a lot of ductile material behavior, many studies have created a innovative plan to extend the concrete plasticity and it's energy absorption capability, to be ready to improve overall plasticity. In his analysis the mechanical-properties because of further distinct discontinues fiber to traditional concrete, the addition of fiber can facilitate the mixes of traditional concrete to avoid the cracks that developed through it as a result of the concrete could be a brittle material with an occasional strain capability and an occasional durability. He pointed out that the fiber concrete (FRC) will carry vital stresses over comparatively massive strain capability if the fibers square measure effectively sturdy and with success secured to material.

Raghu. H. studied the results of various sorts of fibers on the properties of Self-compacting concrete (SCC). Self - compacting concrete containing fibers could be a high performance artefact that has the combined properties of SCC having improved characteristics with the addition of fibers. Steel fibers improve the standard of hardened state concrete by showing increase in strength up to bound volume fraction. Usage of additional fibers fraction in SCC improves the hardened state however reduces the contemporary state properties, thence optimum share of fibers square measure to be used whereas making SCC. Steel fibers strengthened self-compacting concrete shows glorious lastingness, flexural strength, shock resistance, fatigue resistance, malleability and crack arrest.

Anette Jansson tested on pull-out tests with short embedment length exploitation self-compacting steel-fiber-reinforced concrete. The bra reinforcement failed to disturb or improve the bond properties at the interface layer. Thus, the pre-peak behavior appears to be unaffected by the inclusion of steel fibers. One in every of the most benefits of exploitation fiber reinforcement depends to an outsized extent on the concrete– rebar bond. Pull-out tests of specimens with short embedment length were dole out and also the results showed no impact from the fibers on the normalized bond–slip behavior before peak load.

Vasudev R. Comparative study between normal concrete and steel fiber concrete. The fibers that were employed in the study were the flip fibers. They were the scraps from the shaping machine outlets. Experimental investigations and analysis of results were conducted to check the compressive & tensile behavior of composite concrete with variable share of such fibers intercalary thereto. On the analysis of check results the concrete with flip steel fibers had improved performance as compared to the concrete with standard steel fibers that were without delay offered in market. These property enhancements or modifications can be simply adopted by the human in their regular constructions.

Osman Gencela Steel fibers modification the properties of hardened concrete significantly. However, addition of fibers to recent concrete leads to a loss of workability. Self-compacting concrete (SCC) is associate degree innovative concrete that's ready to flow below its own weight, utterly filling formwork and achieving full compaction while not vibration. Slump flow, J-ring and V-funnel tests were conducted for evaluating the fluidity, filling ability and segregation risk of the recent concretes. there have been no issues with compounding or workability whereas the fiber distribution was uniform. Steel fibers will significantly enhance toughness of SCC and inhibit the initiation and growth of cracks

B. Fathima experimented within the analysis work that the properties of fibers and discusses the quality of these properties to alter steel fibers to be employed in the concrete. the extra of steel reinforcement considerably increase the strength of concrete, however to supply concrete with homogenized tensile properties, the event of small cracks may be a should to suppress. Fibers square measure most usually discontinuous, indiscriminately distributed throughout the cements matrices. The term 'Fiber reinforced Concrete' (FRC) is formed up with cement, twenty millimeter sizes of combination, that incorporate with separate, discontinuous fibers. The operate of the irregular fibers distributed indiscriminately is to fill the cracks within the composite. They conjointly lower the permeableness of concrete and thus cut back the flow of water. Some varieties of fibers produce

bigger impact, abrasion and shatter resistance within the concrete. the number of fibers needed for a concrete combine is often determined as a proportion of the overall volume of the composite materials.

Satish Rathod studied concerning the planning of associate degree applicable combine proportion and evaluating the properties of the concrete so obtained. Steel fiber ferroconcrete (SFRC) has been with success employed in varied varieties of construction thanks to the actual fact that adding steel fibers improves the sturdiness and mechanical properties of hardened concrete, notably flexural strength, toughness, impact strength, resistance to fatigue, and vulnerability to cracking and spalling. However, the addition of steel fibers conjointly reduces the workability of recent concrete; thus the employment of SFRC as concrete infill is inappropriate.

Akshay P. Mote experimented the study associated with the strengthening of R C short columns strong with BFRP wrap underneath axial loading .The columns were secured with BFRP sheets in single layer and double layers with numerous configurations. The experimental results show that the columns strong with BFRP show high load carrying capability and plasticity index.

Payal Painuly studied to extend the soundness of recent concrete (cohesiveness) victimization exaggerated quantity of fine materials within the mixes. To development of self-compacting concrete with reduced segregation potential. The systematic experimental approach showed that partial replacement of coarse and fine combination with finer materials may manufacture self-compacting concrete with low segregation potential as assessed by the V-Funnel check. it's been verified, by victimization the slump flow, T50 cm slump flow J-ring check, L-box check and U-tube tests, that self-compacting concrete (SCC) achieved consistency and self-compatibility underneath its own weight, with none external vibration or compaction. SCC with mineral admixture exhibited satisfactory ends up in workability, thanks to little particle size and additional area.

III. EXPERIMENTAL PROGRAM

A. Cement - Ordinary Portland Cement (OPC) of 53-grade, conforming to IS: 12269 were used.

B. Fine aggregate- domestically on the market sand from man river with 4.75 mm maximum size. with specific gravity 2.55, Fineness Modulus = 2.65.confirming to IS 383– 1987.

C. Coarse aggregate- having a maximum size of 20mm were employed in this project work wherever 40 % of it had been passing through 20mm IS sieve and retentive on 12.5mm IS sieve and remaining was passing on 12.5mm IS sieve and preserved on 4.75mm sieve.

D. Super plasticizer- CICO Plast super c 300, the particular gravity and pH scale of super plasticizer used are 1.12 and 5.0 severally. additional book of cementitous material. Super-plasticisers or high-range water-reducing admixtures (HRWRAs) contribute to the accomplishment of denser packing and lower consistency in concrete by increasing the flow-ability and raising the association through larger dispersion of the cement particles, and so aiding in manufacturing SCCs of high strength and smart sturdiness.

E. Viscosity modifying agent (VMA) - SPL BS 3000, having a pH of 5.0-6.0 and Density 1.20-1.30. else 5 exploit cementitous material. VMA, conjointly referred to as anti-washout admixtures, may be else to the concrete mixtures to boost segregation resistance, cohesiveness and scale back bleeding.

A. Mix design procedure by is 10262-2009

Details of choosing an acceptable SCC combine for evaluating its performance in terms of strength and sturdiness area unit delineate. for choosing an acceptable combine victimization native aggregates, three trial mixes were thought of by variable the combo parameters, like constant dose of super softener, consistency modifying agent with the various water/cement magnitude relation. every combine was tested for self compatibility and compressive strength. Finally, an acceptable combine was elite supported the self-compatibility and strength check results.

The procedures of the proposed mix design method can be summarized in the following steps.

Step 1-Calculate Target Strength for Mix Proportioning

f'ck =fck + 1.65 s
Therefore, target strength = 30 + 1.65 x 5 =38.25 N/mm2

Step 2-Selection of Water-Cement Ratio

From Table 5 of IS 456, maximum water-cement ratio = 0.45.
Based on experience, adopt water-cement ratio as 0.40.
0.40 < 0.45, hence O.K.

Step 3-Selection of Water Content

From Table 2, maximum water content =186 liter (for 25 to 50 mm slump range) for 20 mm aggregate Estimated water content for 100 mm slump =186+(6/100) x 186 =197 liter
As super plasticizer is used, the water content can be reduced up 20 percent and above.
Based on trials with super plasticizer water content reduction of 29 percent has been achieved. Hence, the arrived water content =197 x 0.71 =140 liter

Step 4-Calculation of Cement Content

Water-cement ratio= 0.40
Cement content = (180/0.40) = 350 kg/m3
From Table 5 of IS 456, minimum cement content for 'severe' exposure condition = 320 kg/m3
350 kg/m3 > 320 kg/m3, hence, O.K.

Step 5-Proportion of Volume of Coarse Aggregate and Fine Aggregate Content

From Table 3.volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone II)
for water-cement ratio of 0.40 =0.62.
Therefore, corrected proportion of volume of coarse aggregate for the water-cement ratio of 0.40 = 0.62.
For pumpable concrete these values should be reduced by 10 percent.

Therefore, volume of coarse aggregate = 0.62 x 0.9 = 0.56.
Volume of fine aggregate content =I - 0.56 =0.44.
From this we get Mix Proportion For SCC for trial 1.

Similarly,

For trial 2 w/c ratio should be decrease by 10 % and For trial w/c ratio should be increase by 10 %.

The mix calculations per unit volume of concrete shall be as follows:

Volume of concrete = 1 M^3
Volume of cement = (Mass of cement)/(Specific gravity of cement) X 1/1000
= 350/3.15 X 1/1000 = 0.111 m^3
Volume of water = (Mass of water)/(Specific gravity of water) X 1/1000
= 140/1 X 1/1000 = 0.140 m^3

Volume of chemical admixture(Super plasticizers) (@ 2 percent By mass of cementitous material) = (Mass of Chemical Admixture)/(Specific gravity of Admixture) X 1/1000
= 7/1.12 X 1/1000 = 0.006 m^3

Volume of dead mixture = [a- (b +c +d)]
= 1-(0.111 +0.140+0.006)
= 0.743 m^3

Mass of coarse aggregate = e X volume of fine aggregate X Sp.Gravity of fine aggregate 1000
= 0.743 x 0.56 x 2.74 x 1000
= 1140 kg/m^3

Mass of fine aggregate = e X volume of fine aggregate X Sp. Gravity of fine aggregate 1000
= 0.743 x 0.44 x 2.55 x 1000
= 896 kg/m^3

Table1 : Mix Proportion For SCC for 3 trials

Mix Proportion	Cement kg/m^3	Fine Aggregate kg/m^3	Coarse Aggregate kg/m^3	W/C ratio	Compressive Strength N/mm^2
Trial-1	350	896	1140	0.40	31.4
Trial-2	388.88	849.24	1153.69	0.36	33.53
Trial-3	318.18	949.08	1114.13	0.44	29.13

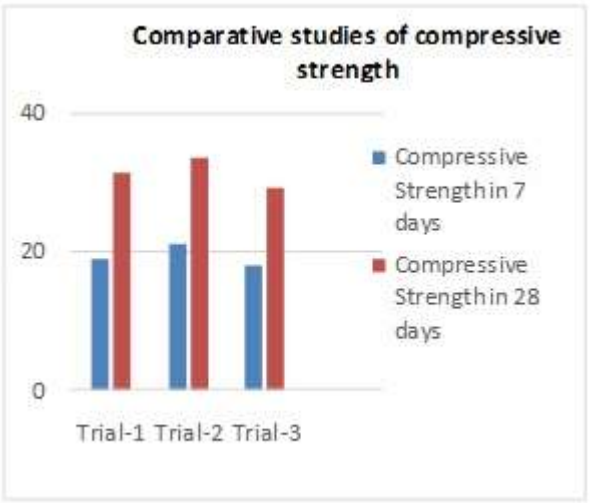

Fig. 1 : Comparative Study of Compressive Strength

IV. CONCLUTION

The following conclusions area unit drawn from the literature review done on fibers inclusion in self compacting concrete:

- From these 3 trials we tend to conclude that the compressive strength for trial-2 is most as compared to alternative trials.
- Steel fibers improve the standard of hardened state concrete by showing increase in strength upto bound volume fraction.
- Usage of a lot of fibers fraction in SCC improves the hardened state however reduces the contemporary state properties, thus optimum share of fibers area unit to be used whereas making SCC.
- Fibres kind a bridge between small cracks and thus they resist in enlargement of the crack dimension.
- Hooked or crimped steel fibers area unit established simpler than straight steel fibers as higher bonding is seen within the matrix.
- Steel fibers strengthened self-compacting concrete shows glorious tensile strength, flexural strength, shock resistance, fatigue resistance, plasticity and crack arrest.
- Slump flow, V-funnel, L-flow, U-box and compressive strength tests were dispensed to look at the performance of SCC
- If we tend to add the mineral admixture replacement for we are able to have a stronger practicable concrete.
- SCC with mineral admixture exhibited satisfactory ends up in workability, thanks to tiny particle size and a lot of surface area.

V. FUTURE SCOPE

The application of SCC facilitates the assembly method and its conditions, since vibration is eliminated. The advantages of SCC additionally apply for SFRSCC just in case the result of the fibers on the key characteristics filling ability, passing ability and segregation resistance is taken into consideration. Will increase in compressive strength were ascertained within the experiment by the addition of Steel fiber. More studies may be created by variable the share of Steel fiber within the combine. Fibers cut back the cracks throughout plastic and hardening stage. This property may be studied for more analysis.

SCC additionally contains a future within the formed trade providing sturdy concrete at a lower price due to lower initial investments of vibratory facilities and lower continual prices attributable to quicker restage of moulds. Steel fiber controls the crack propagation in inflexible vary.

In this study the rise in compressive strength, and better load carrying capability with higher ductility of column were ascertained during this analysis work by the addition of Steel fiber to the M30 designed concrete. More studies may be created by variable the share of Steel fiber within the short column.

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