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Review on Utilization and Management of Scrap Steel in Form Construction Fiber Concrete

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Abstract- In the construction of any industry or structure there is a common material used as concrete. And concrete is is used in very huge amount in the construction and industries. Many property of the the concrete like brittleness sometimes fails to bear tensile load which is the cause of brittle failure. Since the fibre have the property to increase the toughness of the concrete. In many experiments it is found that, steel fibre reinforced concrete have high resistance to cracking so the reason behind the increasing uses of steel fibre reinforced concrete to increase the hardness or toughness and to reduce the crack deformation characteristics. So I present this paper for theoretical discussion on the subject of of steel fibre reinforced concrete. And here we discuss use terms and models of behaviour that form ambitious for understanding material performance without mathematical details. Here we shown that flexural strength of steel fibre reinforced concrete is directly proportional to the the steel fibre content and inversely proportional to the water cement ratio. Why the different references from early and old authors are included as a means of tying the subject together along a timeline. In the current time by the historical review to build a background for what is currently understood about steel fibre reinforced concrete.

Keywords- Steel Fibers, Fiber reinforced concrete, Cement, Ductility, Strength, Toughness.

I. INTRODUCTION

Fiber reinforced concrete (FRC) is the composite material obtained after mixing of Portland cementconcrete with more or less randomly distributed fibers. In FRC, thousands of small fibers are dispersed anddistributed randomly in the concrete during mixing, and thus improving properties of concrete in all directions. FRC is cement- based composite material that has been developed in recent years.

It main advantages are itsexcellent flexural-tensile strength, resistance to spitting, impact resistance and excellent permeability and frost resistance. It is an effective technique to increase toughness, shock resistance and resistance to plastic shrinkage cracking of the mortar. Fiber is a small short cut piece of reinforcing material possessing certain characteristicsproperties. They can be circular, triangular or flat in cross-section. The fibre is described by a convenient parameter called aspect ratio.

The aspect ratio of the fiber is the ratio of its length to its diameter. The principle motive behind incorporating fibers into a cement matrix is to increase the toughness and tensile strength andimprove the cracking deformation characteristics of the resultant composite.

For FRC to be a valuable construction material, it must be able to compete economically with existing reinforcing system. FRC composite properties, such as crack resistance, reinforcement and increase in toughness are dependent on the mechanical properties of the fiber, bonding properties of the fiber and matrix, as well as the quantity and distribution withinthe matrix of the fibers.

II. LITERATURE REVIEW

Qinglin Tao, Experimental and theoretical study on flexural behavior of high strength concrete encased steel beams with steel fibers: In this study, the flexural behavior of high strength concrete encased steel beams with steel fibers (HSCSBSF) under bending is investigated. The experiments of four HSCSBSF including one HSCSBSF without steel fiber (0% volume ratio of steel fiber) are carried out to investigate the effect of the volume ratio of steel fiber on the flexural behavior of HSCSBSF. All specimens fail by the yielding of reinforcement in tension zone and the crushing of concrete in compression zone. Due to the positive effect of steel fiber on the internal bonding strength of concrete, HSCSBSF with higher volume ratio of steel fiber shows higher cracking load. The bearing capacity (bending capacity) of HSCSBSF increases by 34.3% when the volume ratio of steel fiber varies from 0% to 2%.

Compared with HSCSBSF with 0% volume ratio of steel fiber, the flexural stiffness of HSCSBSF with higher volume ratio of steel fiber is obviously improved and the ductility coefficient (the ratio of the displacement at failure load to the displacement at the yield load) of HSCSBSF with 2% volume ratio of steel fiber increases by 25%.

Based on the material test of concrete, a value for the influence coefficient of steel fiber on the tensile strength of concrete is suggested. A model for predicting the bearing capacity of HSCSBSF is then derived from theoretical analysis of HSCSBSF. A good agreement between the proposed model and various test data is made.

Vajrala Kavya Sameera, Properties and performance of steel fiber reinforced concrete beam structure – Review: In present days, different types of steels were used to improve the performance of concrete structures. The steel fibers are used to increase the strength and structural integrity of the concrete beam.

The performance of concrete structures was enhanced due to the accumulation of steel fiber reinforced elements. The economical steel fiber reinforced concrete structure was developed with exceptional ultimate strength and shear strength. The dissipation of energy and stress were uniformly distributed along the beam under different cyclic loading. The present topic was used to review the properties and performance on steel fiber reinforced concrete beam structure. The compressive and flexural strength was increased by 20% using steel fiber reinforcement in concrete. The reinforcement mechanism and composition of concrete was the most influential factor on quality and performance of the concrete beam structure.

Jinping Zhuang, Dynamic stress–strain relationship of steel fiber-reinforced rubber self-compacting concrete: Rubber has good elastic properties; however, its incorporation reduces the strength of concrete. Due to the high elasticity of rubber and the good crack resistance of steel fibers, the mixing of steel fibers and rubber can effectively improve the impact toughness index of concrete with sufficient strength. An impact test of steel fiber-reinforced rubber self-compacting concrete (SRSCC) was carried out using a split Hopkinson pressure bar (SHPB) in the present work, in which the strain rate ranges from 65.3 s^{-1} to 137.6 s^{-1} and steel fibers with four volume fractions of 0%, 0.5%, 1.0% and 2.0% and rubber contents with four volume fractions of 0%, 10%, 20% and 30% are considered.

Experimental results revealed that, (i) the dynamic compressive strength, toughness index, stress impact factor (DIF-σ) as well as strain impact factor (DIF-ε) of SRSCC increase obviously with the increase of strain rate; (ii) with the increase of rubber content, the dynamic compressive strength decreases and the toughness index increases. When the rubber content reached 30%, the dynamic compressive strength decreased by 40–50% and the toughness index increased by 20–30%; (iii) the DIF-σ increases first and then decreases slightly with the increase of rubber content, which reaches the maximum value when the rubber content is 20%. What's more, the effect of rubber content on DIF-σ at high strain rate is more obvious; (iv) the steel fiber content shows strengthening effects on the dynamic compressive strength and toughness index and almost has no effects on the DIF-σ and DIF-ε of SRSCC. Finally, the dynamic stress–strain relationship of SRSCC was proposed.

Yun Sik Jang, Effects of nano-SiO_2 coating and induced corrosion of steel fiber on the interfacial bond and tensile properties of ultra-high-performance concrete (UHPC): In this study, the effects of nano-silica (SiO_2) coating and induced corrosion of steel fibers on the interfacial bond and tensile properties of ultra-high-performance concrete (UHPC) were investigated. Two different types of steel fibers were prepared: plain and nano-SiO_2-coated. Corrosion was induced in each of these to two different degrees (2% and 5% by weight) using a 3.5% standard sodium chloride (NaCl) solution.

The test results indicate that nano-SiO_2 coating increases the bond strengths of steel fibers embedded in UHPC by approximately 50%. Furthermore, more scratches and higher hydrate contents were detected on the surface of nano-SiO_2 coated steel fibers after pulling out from UHPC. Under tension, the UHPC containing nano-SiO_2-coated steel fibers exhibited double the strain energy density, compared to those containing plain steel fibers. Moderately corroded steel fibers resulted in higher interfacial bond strength and energy absorption capacity owing to the increased surface roughness.

In addition, the nano-SiO_2 coating enhanced the tensile performance of UHPC even under corrosive environments. This enhancement was however diminished by steel fiber corrosion, so that fiber corrosion needs to be carefully controlled when nano-SiO_2-coated steel fibers are used for UHPC.

Yongcheng Ji, Investigation on steel fiber strengthening of waste brick aggregate cementitious composites: The waste red brick aggregate substituted with natural coarse aggregate can effectively alleviate environmental pollution in engineering concrete constructions. However, its mechanical performance lags far behind natural coarse aggregate due to micro-pore voids and micro-cracks. Three types of steel fiber contents (0, 1%, and 2%) are selected to improve the mechanical behavior of recycled concrete in this study. Cubic compression test, splitting tensile test, prism compression test, and static compressive elastic modulus test are carried out to study the influence of steel fiber content and replacement rate of recycled coarse aggregate.

In addition, the stress-strain behavior and failure mechanism of steel fiber recycled brick aggregate concrete are discussed, and microscopic crack development is also analyzed. Test results show that the specimens without steel fiber are prone to aggregate destruction under loading. The cubic and prismatic compressive strength decreased by 48% and 34%, while the splitting tensile strength reduced by 40%. The mechanical properties substantially improve when the steel fiber content is 1%. The finite element model of steel fiber recycled brick aggregate concrete under uniaxial compression is established. The constitutive model for predicting uniaxial compression of steel fiber recycled brick aggregate concrete is also proposed.

Tamjeed Ahmed, Shear strength of steel fiber reinforced concrete beam– A review: The use of randomly distributed and discrete steel fibers in concrete (SFRC) offers better resistance to early crack growth and possesses better post peak strain capacity. The crack bridging effect of steel fiber due to the fiber matrix interaction reduces the rate of crack growth and restricts spalling of concrete which improves the toughness characteristics. The deployment of SFRC in RC beams, columns and beam-column joints improves the shear resistance by acting as secondary shear reinforcement along with the optimum conventional confining reinforcement.

The ductility enhancement and damping properties of SFRC becomes an effective solution for enhancing the seismic resistance of structural member. The shear resistance capacity of SFRC elements is mainly controlled by the volume of fiber, profile and steel fiber aspect ratio. Many studies have been conducted to examine the shear strength of RC beams with SFRC and empirical models have been proposed to estimate the contribution of steel fiber in shear resistance. This research article summarizes the different empirical models in shear strength evaluation of SFRC beams with and without stirrups.

Minglei Zhao, Effect of vibration time on steel fibre distribution and flexural behaviours of steel fibre reinforced concrete with different flowability: The present study aimed to evaluate the effect of vibration time on steel fibre distribution and flexural behaviours of steel fibre reinforced concrete (SFRC) with different flowability, three different vibration times (i.e., 10 s, 30 s and 60 s) were selected to compact SFRC specimens on the vibration table in this study. The flowability of SFRC was represented by the varying slump from 80 mm to 200 mm. The flexural performance tests were conducted on beam specimens under four-point loading.

The steel fibres distributed on the cut section of the specimen were counted, and the distribution rate of steel fibre in each layer was statistically analysed. The results showed that a correlation existed between the vibration time and the flowability of SFRC.

Increasing the vibration time led to a downward settlement of steel fibres to the bottom layer of specimens and segregation of the concrete matrix of high-flowing SFRC. This resulted in a reduction of flexural strength, toughness and fracture energy. An optimal vibration time should be determined corresponding with the flowability of SFRC to achieve a better flexural performance.

RamkumarK.B. Reinforcing self-compacting concrete with hybrid hooked-end and micro-steel fibres for improving workability and preventing cracks in construction: Fibre-reinforced concrete is increasingly employed in construction in recent times. Adding steel fibres to self-compacting concrete (SCC) increases the latter’s strength and toughness but does not confer the SCC mix with the desired flow properties. When more than one type of fibres is added to the concrete mix in appropriate proportions, its mechanical properties improve. Research on the impact of hybrid fibres on concrete’s mechanical properties is sparse. Therefore, in this paper, the workability of high-flowable 60 and 80 MPa SCC prepared using hybrid steel fibres is studied.

The experimental results are then compared with the output obtained from the regression model that was developed. We found that the addition of 0.40 % and 0.10 % of hybrid hooked and micro-steel fibres improves the performance of the fresh and hardened concrete. The values for split tensile, flexural strength and elastic modulus in the regression model developed were found to be in consonance with their experimental values.

LakhvirKaur, Mixed influence of steel fiber (SF) and metakaolin (MK) incorporation on mechanical properties of concrete: In this study, the influence of experimental analysis on the engineering properties of concrete containing metakaolin (MK) in different proportions, with and without steel fiber, is examined. Ordinary Portland cement is partially restored with MK 0, 5, 10, 15, and 20% by weight to produce metakaolin reinforced concrete, and the mechanical qualities of Steel fibers reinforcement are selected based on their mechanical characteristics at ideal proportions. To produce fiber-reinforced concrete, two distinct types of steel fibers are introduced into the admixtures. In terms of length and diameter, steel fiber SF1 measured 48 mm and 0.80 mm, whereas steel fiber SF2 measured 64 mm and 0.80 mm, respectively.

According to the findings of the current investigation, using metakaolin in a proportion of around 10% by weight of cement in conjunction with 1.5 percent steel by weight of cement result in the optimum compression and split tensile strength of concrete. When we compare MK 10 percent to MK 20 percent, we see that there is a 4.28 percent reduction in strength. For trial mix 1, which was made of conventional concrete, the split tensile strength values were around 2.8 MPa after 7, 14 and 28 days of curing, and 3.1 MPa after 14 and 28 days of curing. When MK 5 percent is added, the STS increases by 12.5 percent, and when MK 10 percent is added, the STS increases by 28.6 percent. In contrasted to other mixes, the combination containing 10 percent MK has a higher level of potency. Strength is reduced by 2.85% when comparing the MK 20 percent mixture to the corresponding MK 5% combination. Therefore, we may infer that MK 10% should be considered the best proportion for cement inclusion. The findings clearly revealed that it enhances the strength capabilities of the concrete at various stages, with the amount of replacement largely determining the final strength capability.

Ibrahim M.H.Alshaikh, Progressive collapse behavior of steel fiber-reinforced rubberized concrete frames: The efficiency of combining fine aggregate's (sand) partial replacements with waste crumb rubber (CR) and steel fiber (SF) has been investigated in this paper. The study aims to enhance the RC frame's deformability, as well as its structural ductility to achieve progressive collapse resistance. To this end, a total of four RC frames' behavior at one-third scale under a situation of a middle-column removal was experimentally tested.

Two frames were made of 0% CR and SF. Another two frames were made by incorporating CR at 20% by volume for the sand replacement and 0.5% SF fraction volume. The findings of the study reported an enhanced structural ductility, which was stimulated by incorporating CR and SF in normal concrete. The tested steel fiber-reinforced rubberized concrete frames, however, showed further deflection by 29.5% compared with the conventional frames.

YuriiTsybrii, Airborne wear particle emission from train brake friction materials with different contents of steel and copper fibres: This study investigated the influence of the amount of steel and copper fibres in a train brake friction material on the tribological performance, emission intensity and characteristics of airborne wear particles. The particles were generated on a pin-on-disc tribometer under controlled friction and environmental conditions. It was found that the steel fibre results in a more intensive emission of 0.3–10 µm particles compared to the copper fibre. The abrasive wear of the steel disc sample is a predominating source of iron in 1–10 µm particles. The content of iron in these particles is proportional to the relative wear of the disc sample, whilst the content of copper increases with that in the friction material.

MasoodAbu-Bakr, Investigation of metakaolin and steel fiber addition on some mechanical and durability properties of roller compacted concrete: In this experimental study, physical, strength and durability properties of roller compacted concrete (RCC) containing metakaolin with or without steel fiber are investigated. For this purpose, seven different mixes were designed and tested in the lab. To assess properties of compressive strength, splitting tensile strength, water permeability and freezing and thawing resistance in terms of weight and compressive strength losses. There is an increasing compressive strength of RCC containing MK with or without steel fiber with increasing ages. 15% MK 45 kg/m3 steel fiber was found the best dosage for RCC at the age of 90 days. Also, there is a splitting tensile strength enhancement being increased with increasing MK and steel fiber in the mix. There is a continuous permeability reduction with increasing combined MK and steel fiber addition reaching 77.9% as maximum value for the mix of 20% metakaolin and 60 kg of steel fiber.

Also, there is a reduction of weight and compressive strength losses of RCC subjected to freezing and thawing cycles up to 300 due to MK and steel fiber addition. It is concluded that using a combination of MK and steel fiber has a promised future to be used in more durable RCC for road construction.

III. CONCLUSION

A lot of review study had been conducted to see the effect of mixing steel fiber as reinforced materialwith concrete as parent material. A large number of minor and major investigating tests were conducted like Compressive, flexure and tensile strength test with steel fiber mixed with concrete at various percentages ofsteel fiber.

Most of the review studies demonstrated that various mechanical, chemical and engineeringproperties like split tensile strength, compressive strength, impact strength and flexure strength of concretemixed with different percentages of steel fiber have been improved. From the above discussions it can be said that steel fiber proved to be a good reinforcing material andeconomically viable for improving the strength and durability characteristics of concrete.

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