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Experimental Study on the Strengthening Properties of Rubber Concrete with Hook End Steel Fibers

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***Abstract:** The fast development of automobile sector, removal of discarded waste elastic is turning into a broad ecological problem. In the current work, exertion has been made to limit this problem By using scrap elastic as the scrap (morsel) concrete rubber in various percentages, as a partial replacement for the fine aggregates. In this paper, the mechanical properties of rubberized concrete with steel fibre (RSFC) are studied experimentally. This article discussed the effect by volume of concrete (5, 7.5 and 10 per cent rubber) and (0.8.0.1 and 1.2 per cent steel fibre) on the reinforcement of the properties of rubberized concrete with steel fibres (RSFC) of scrap crumb rubber (SCR) and steel fibre (SF) with different steel substances. The literature survey suggests that there is a substantial decline in strengths of the single morsel rubber used in traditional concrete. like compressive, tensile and flexural strength therefore to overcome this problem by using steel fibers in present investigation and from the results it can be finalized that the all the strengthening properties (compressive, tensile strength and flexural strength) are increased contrasted with rubberized concrete but still test values are inferior than conventional concrete due to fineness of crumb rubber and irregular shape of hook end steel fiber.*

***Keywords**: Crumb rubber (CR), Hook-end steel fibers (SF), Rubberized steel fiber concrete (RSFC), Conventional concrete (CC).*

I. INTRODUCTION

The removal of waste piece tires has transformed into a significant ecological Issue. Every year huge amount of scrap rubber was produced from discarded vehicles so from this scrap rubber increases the ground pollution and environmental pollution. Tear scrap rubber tires cast as aggregates in concrete have gained popularity. Eldin and Senouciet al.[1] experimentally studied the strength compression and impact resistance of concrete in which the fine aggregation used various ratios of bite elastic particles of different sizes. Tests on rubber-concrete efficiency using rubber-plated rubber crumb and chips as aggregate substitute for the sizes of 38, 25 mm and 19 mm demonstrated an 85% reduction in compressive consistency, while the strength of the tensile fractures falls 50 percent.

Kunal Bisht et al.[2] have investigated on using of wasted rubber as a crumb rubber in the Portland pozzolona cement concrete in form of a partially substitute of the fine aggregates in various ratios. They examine the different proportion (Pure Concrete with 4% to 5.5% at every 0.5% adding) of crumb formed rubber add in concrete. They presumed that the consequence of compressive quality of concrete and flexural strength show slightly diminishes with four percentage substitution of fine totals (aggregates) by morsel rubber substance.

Ahmed Tareq Noamanet al.[3] tentatively explored to assess the impact of blend between the scrap-crumb rubber and the steel-fiber at low-speed sway vitality of solid shafts. They utilized Crumb rubber in concrete; sizes are various from 1–2 mm were reused from squander tyres. The waste crumb rubber was assimilated into the standard, CC (conventional concrete) and SFC, mixing in two proportions (of 17.5 percent and then adding 2,5 percent more of the volume, partially replaced with a fine aggregate. Of concrete. of concrete The findings were that the compressive st of both ordinary traditional concrete and concrete mixtures of Steel Fibers decreased by the part-allocation of fine aggregates with scraping crumb rubber; rubber and steel strands increased their vitality. The mechanical characteristics and impact blocking of cement with varying proportions of the crumb-rubber and steel Fiber were later combined with scrap rubber in the stainless steel. The use of rubber concrete steel fibre increases concrete strength. The main aim of this paper is to demonstrate the effect on different percentages of crumb-rubber and steel-fibers (0%, 5%, 7.5% and 10%) and (0.8%, 1.0% & 1%) through the use of the Portland cement in concrete. Different strength tests were carried out conducted, such as slump test, strength of compressive test, split tensile st. test and flexural st. test for equal water cement (w/c) ratio.

II. METHODOLOGY

A.Materials

The Portland pozzolona cement (RAMCO) confirming to IS 269: 1989 was used in this study. Fine aggregates confirming zone II according to asper IS: 383-1970 is utilized. In the present work, the coarse aggregates are 20mm and 10mm have been used with G= 2.70. The crumb-rubber having a dimension of 0.597 mm with G= 1.18 is utilised in present investigation. Crushed crumb rubber from the local industry was borrowed. The BS 5075, part 3, used to achieve the necessary slump is verified with a conplast SP430 superplasticizer. The characteristics of OPC, fine, coarse and scrap crumb rubber, and table are shown in Table.1. The 2 indicate chemical characteristics and morsel rubber composition.

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The concrete mixture was used as a component substitute for fine aggregates with scrap crumb rubber. The hook end steel filaments (fibers) were utilized and their tensile properties are shown in table 3. Aspect ratio (l/d) of fibers was 60 and volume of fractions (Vf) of steel filaments were 0.8%, 1.0% and 1.2%. Crumb rubber was blended to concrete directly as the percentages of 0%, 5%, 7.5% and 10% by volume of total fine aggregate.

Table-1: Physical properties of (PPC) cement, fine, coarse aggregates and crumb-rubber.

Analysis	Result
Specific gravity of PPC cement	2.90
Specific gravity of Fine aggregate	2.70
Specific gravity of Coarse aggregate	2.70
Specific gravity of Crumb rubber	1.18
Setting time of PPC cement	
Initial setting time	105 minutes
Final setting time	228 minutes
Water absorption:	
Coarse aggregate	0.48%
Fine aggregate	0.50%
Crumb rubber	0.30%

Table-2: Hook-end steel fiber properties

Type	Length(L) Mm of steel fiber	Diameter(d) mm of steel fiber	Aspect ratio (l/d) of steel fiber	Density g/cm3 steel fiber	Tensile strength N/mm 2
duraflex™	30	0.5	60	7.85	1100

Fig.1. Hooked end steel filaments and 30 mesh crumb rubber

B. Mixture Proportions

Concrete mix of strength M40 has been designed. The partial replacement by total amount of concrete for the finishing aggregates with the crumble and steel-fibres is used in preparing concrete mixtures at various ratios, 0%, 5% 7.5% and 10% and 0.8%, 1.0% and 1.2%. There is a continuous water cement ratio of 0.43. The superplasticizer dose was used for slumping 2 percent. Mixed, casted and cured specimens (materials) according to appropriate requirements.

III. EXPERIMENTAL PROGRAMME

The slump test was conducted by IS: 1199-1959 to assess the operation of the fresh concrete. A compassionate testing machinery was used in three 150 mm (IS 516:1959) cube samples of each beta mix, after 7, 28 and 90 days of treatment, to perform the strength of the compressive test. On the cubes the load rate was 140 kg/cm2/min. In order to evaluate the bending strength test on UTM, three 100x100x500 mm of every solid blend after 7, 28 and 90 days of curing and the charging rate on the strap was 18000 gm/cm2/min in accordance with BIS 514:59, the charging of the three point action was utilised. For each concrete mix after 7, 28 & 90 days of cure, the standard cylinder test specimen 300 x 150 mm (IS 5816:1999) was applied in opposite directions to the compression load along cylinder lengths at a stacking rate of 1.2N/mm2/min to 2.4N/mm2/min.

A. Preparation of specimens

The present work, the total number of mixes are 10 and specimens (molds) prepared was 270. Each mix 27 samples: 9 cubes, 9 cylinders and 9 prisms. From above nine cubes three cubes with 150 mm side were utilized for compressive strength test at a period of 7, 28 and 90 days of curing. From nine cylinders, three cylinders with 150X300 mm size were used for tensile strength test with same period of 7, 28 and 90 days of curing. And also For bending strength test during the same curing period of 7, 28 and 90 days three prisms with 100x100x500 mm were used. The steel fibres in the snare end have spread evenly into the concrete mix and blend for 5 minutes. Following mould fitting, the solid filling mixture is iron-shaped and then 24 hours at normal room temperature with a plastic thin sheet. After 24 hours the samples were removed and submerged in the water (pond) for a treatment of 23±1 degrees Celsius. The restoration was performed for seven, two and ninety days to assess the ready examples. The restoration continued on the research specimens until 7, 28 and 90 days.

Fig.2 Blending of rubber treated concrete with hook end steel filaments

Fig.3. Casting of specimens

Fig.4. Tests setup: (a) compressive st., (b) splitting tensile st., (c) flexural st., and (d) Slump test.

(a) (b) (c)

Fig.5. Failure of the concrete cylinders: (a) conventional concrete, (b) 5% rubber, (c) 10% rubber

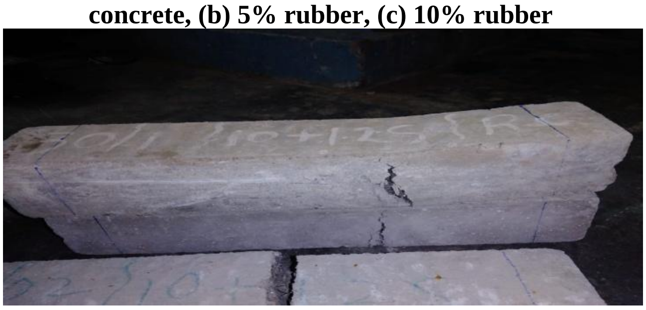

Fig.6. Failure of the concrete prisms (a) 10% Rubber with 1.2% of steel fiber

IV. RESULTS AND DISCUSSIONS

A. Workability

The present work, an appropriate amount of super plasticizer was considered to achieve a slump for different mixes with different percentage of morsel rubber with steel fiber content. Concerning slump at a ten percentage of crumb rubber, slump was not affected beyond that proportion the slump will reduces if we added more. The steel fiber increases the unit weight of concrete but decreases the slump value due to shape of the fiber and dosage of fiber. The results are recorded that the Crumb rubber with steel fiber content increments in the concrete mix it diminishes the slump due to smoothness of rubber. Slump is totally depends on water-cement ratio (w/c), Homogeneity of materials and grading of aggregates and also super plasticizer (SP).

Fig. 7. Slump values of varying proportions of crumb rubber with steel fibers

B. Compressive Strength

Fig. (8) Presents 7, 28 and 90-day the concrete strength for the cases, with and without morsel rubber with steel filament at different extents. We can see that from Fig. 8 that the st. of solid abatements with the increase in level morsel rubber with steel filaments. The reduction in strength is common Since the smooth rubber particles and concrete paste are not attached. During the stacking process, the cracks quickly develop around the particles of the crumb rubber that causes fast concrete cracks. The compressive force of the crumb rubber and the shape of the steel fibres is decreased due to the creation of voids that may have caused them. Consolidation of crumb rubber, hook end steel and cement matrix strengthen concrete integrity and affect rubber-coated steel fibre (RSFC) compressive concrete. Crumb rubber reduces strength in this phenomenon but steel fibre improves the strength of concrete as well as the unit weight. Fig.8 indicates a decreases in the content of rubber-coated steel fibre concrete, but the introduction of steel fibre into concrete increases compressive resistance. From the results, 5% rubber with 1.2% of steel compressive strength is more compared to 10% rubber with 1.2% steel fiber. And also from results, conventional (control) concrete strength is more compared to rubberized steel fiber concrete (RSFC). Steel fiber is little bit action on concrete to improve concrete compressive strength.

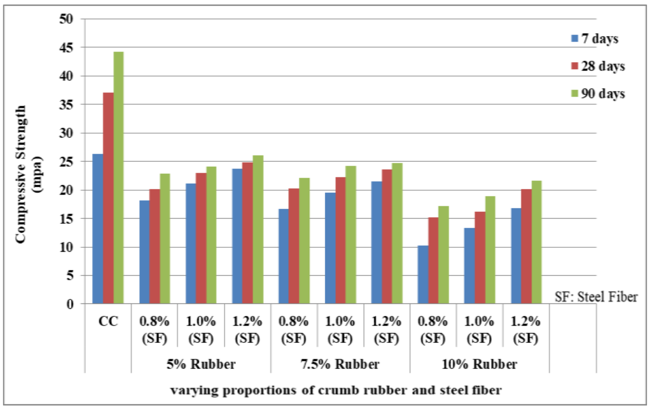

Fig. 8. Compressive strength of RSFC

C. Splitting Tensile Strength

The results of split tensile st of concrete with and without combination of morsel rubber with hook end steel fiber are appeared in Fig. (9). the figure shows impact of fractional supplanting of fine aggregates with crumb rubber and steel fibers on concrete's tensile strength. Incorporation of steel filaments in rubberized concrete increases the strength is due to integrity of concrete mixture. Steel filaments having tensile property in concrete and mix of crumb rubber with steel strands build up the tensile property in concrete contrasted with normal rubberized concrete. Steel strands can develop the bond among the mixture of concrete, the decreases in the strength is expected to non-polar action of the crumb rubber and shape steel fibers particles which attracts air and spurns water. Steel fiber and crumb rubber both improve over all tensile st of concrete. Most extreme split tensile strength achieved at the level of less rubber with high level of steel fiber content in concrete. From the Fig.9 can be noticed that the inclusion of rubber with hook end steel fiber in concrete mixture it leads to decreases the tensile strength concrete. It has been seen from Fig.9 split tensile strength of conventional concrete is more contrasted to rubberized steel fiber concrete (RSFC). Steel fiber is essentially increases the tensile property in rubberized concrete compared to compressive strength concrete.

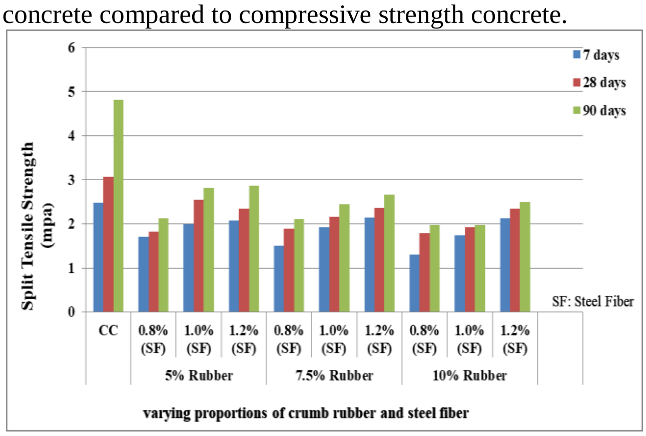

Fig. 9. Splitting tensile strength of RSFC

D. Flexural Strength

The results of 7, 28 and 90-day strength flexural with and without morsel rubber with hook end steel fiber at various fluctuating extents are appeared in Fig. (10). It has been seen that the flexural quality of concrete abatements with builds the scrap rubber. When Steel fiber are mixed in concrete with wit optimum proportion then results shows Improved flexure st also increases the bond between cement matrix and rubber particles. Consolidation of scrap crumb rubber and steel fiber in solid blend builds the structural integrity of concrete and also diminishes the cracks. Gupta et al. [1] announced that decline in flexural strength for the most part relies upon the shape and size of scrap elastic. Rubber treated steel fiber concrete flexural quality is high contrasted with rubber treated concrete however flexural quality of control blend is more contrasted with rubber treated steel fiber concrete. Crumbrubber declines the flexural quality yet rubber with steel fiber builds the flexural strength. It has been seen from fig.10 flexural st. of conventional concrete is more compared to rubberized steel fiber concrete.

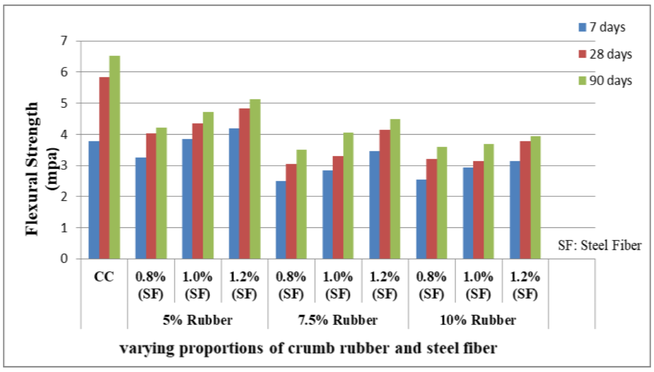

Fig. 10. Flexural strength of RSFC

V.CONCLUSION

In the current work analyzed the mechanical properties of elastic treated steel-fiber concrete. The going with ends depend on the outcomes acquired through the exploratory work.

1. The fresh concrete's workability decreased when added to the morsel rubber and steel strands to the concrete but conventional concrete workability is more compared to rubber treated steel fiber concrete, and super plasticizer its help to reduce the unwanted effects of rubber which improve the properties of concrete.
2. The conventional concrete compressive strength is more contrasted with rubberized steel fiber concrete compressive strength by level of 5% and 10% rubber with 0.8% steel diminished by 48% and 52%.
3. The tensile strength of conventional concrete is high compared to rubber treated steel fiber concrete split tensile strength by level of 5% and 10% rubber with 0.8% steel diminished by 40% and 41%.
4. The conventional concrete Flexural strength is more contrasted with rubberized steel fiber concrete flexural strength by level of 5% and 10% rubber with 0.8% steel decreased by 31% and 39%.
5. From the previous research the decrement in strength mostly its due to weak bond strength but when Steel fiber we add then bond strength also improve.

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