COMPARITIVE STUDY ON THE USE OF COIR FIBRE, RECRON FIBRE AND STEEL SLAG IN THE CONCRETE

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Abstract: Fibre reinforced concrete (FRC) is Portland cement concrete reinforced with more or less randomly distributed fibres. In FRC, thousands of small fibres are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties in all directions. FRC is cement- based composite material that has been developed in recent years. It has been successfully used in construction with its excellent flexural-tensile strength, resistance to spitting, impact resistance and excellent permeability and frost resistance. It is an effective way to increase toughness, shock resistance and resistance to plastic shrinkage cracking of the mortar. Fibre is a small piece of reinforcing material possessing certain characteristics properties. They can be circular, triangular or flat in cross-section. The fire is often described by a convenient parameter called ―aspect ratio‖. The aspect ratio of the fibre is the ratio of its length to its diameter. The principle reason for incorporating fibres into a cement matrix is to increase the toughness and tensile strength and improve the cracking deformation characteristics of the resultant composite. For FRC to be a viable construction material, it must be able to compete economically with existing reinforcing system.

Keywords: Fibre reinforced concrete, Recron fibre, Compressive strength, workability, Mechanical properties.

1.1 INTRODUCTION

Concrete made with Portland cement has certain characteristics: it is strong in compression but weak in tension and tends to be brittle. The weakness in tension can be overcome by the use of conventional steel bar reinforcement and to some extent by the inclusion of a sufficient volume of certain fibres. The use of fibres also alters the behaviour of the fibre-matrix composite after it has cracked, thereby improving its toughness. The overall goal for this research is to investigate the potential of using waste and low energy materials for domestic construction, principally in Ghana. The objective of this research is to experiment on the use of coconut fibres as an enhancement of concrete. Coconut fibres are not commonly used in the construction industry but are often discarded as wastes. Coconut fibres obtained from coconut husk, belonging to the family of palm fibres, are agricultural waste products obtained in the processing of coconut oil, and are available in large quantities in the tropical regions of the world, most especially in Africa, Asia and southern America. In Ghana, they are available in large quantities in the southern part of the country. The specific objective of experimenting on coconut fibre as an enhancement of concrete is two fold. Firstly, to assess if the fibres of the species grown in Ghana would improve the mechanical properties of concrete like the species in Latin America and South East Asia. Secondly, once it was proven that vital mechanical properties of concrete and mortar could be enhanced by coconut fibre from species grown in Ghana, then further investigation would be carried out on improving the long term durability of concrete and mortar with coconut fibres as an enhancement. Ordinary concrete, when subjected to the rigorous test of time and extreme weather conditions, tends to crack and lose its strength. It can lead to seepage and corrosion of primary steel and spooling of concrete. Fiber reinforcement concrete is considered as a material of improved properties and not as reinforced cement concrete wherein reinforcement is provided for local strengthening of concrete in tension reason. Since in fiber reinforcement concrete, fibers are uniformly dispersed (Recron 3s) which has better properties to resist internal stress due to shrinkage. Also reduces segregation and bleeding and also results in a more homogeneous mix. This leads to better strength and reduced permeability which improves durability. During the present research, an attempt has been made to utilize the sludge and Recron 3s fibers for making concrete.

1.2 HISTORY OF STUDY

The utilization of admixtures to enhance some of the characteristics of materials used in construction is not a new procedure. It ranges more than 5000 years from the season of Egyptian pyramids to show day brightening concrete improvements. Around 3000 BC, Egyptians utilized mud blended with straw to give more quality. Later in 300 BC, the antiquated Romans utilized a material that is amazingly near present day bond to manufacture huge numbers of their compositional wonders. The Romans additionally utilized creature items in their concrete as an early type of admixtures. Later in 1939, the prologue to steel substituting asbestos was set aside a few minutes yet at that period it was not fruitful. In the year 1890, an expansion of gypsum when granulating clinker to go about in form of retardant to set the solid was presented in America. In 1985, the silica seethe and different superplasticizers were acquainted as an admixture with enhance the quality. After that different admixtures, for example, fly slag, Copper Slag, Egg shell powder, metakaolin and rice husk fiery debris, steel or optical filaments are acquainted with enhance the mechanical properties of cement.

1.3 RESEARCH OBJECTIVES

1. To calculate the Optimum content of coir fibre, Recron fibre and steel slag in concrete.
2. To find out the values of strength properties like flexural strength, Split tensile strength, and compressive strength of the concrete having coir fibre, Recron fibre and steel slag.
3. To find out some fresh characteristics of the concrete.

1.4 SCOPE OF THE STUDY

According to the accessibility of tools in the lab, the experimental procedure was carried out on cylinders and cubes by mixing coir fibre, Recron fibre and steel slag into the concrete so as to increase the split tensile strength, Flexural strength and compression strength test.

1.5 LITERATURE REVIEW ON COIR FIBRE, RECRON FIBRE AND STEEL SLAG

S. Satish Kumar et al did the study on the strength properties of concrete by using Recron Fibre, Coir Fibre and Steel slag in concrete. The principle goal of this trial study is to research the quality presentation of Recron fiber strengthened cement of M30 grade delivered by supplanting concrete with Egg Shell Powder in different rates like 5%, 10%, 15% and 20% both in OPC and PSC and furthermore expansion of Recron strands in various rates like 0.2%, 0.3%, 0.4% and 0.5%. The Ideal level of ESP in OPC and PSC can be resolved what's more, it very well may be utilized for deciding Compressive and Split Tensile quality tests by including various rates of Recron filaments. The quality attributes of Conventional OPC and Recron fiber strengthened cement and the Conventional PSC and Recron fiber strengthened cement are thought about. And furthermore the quality attributes of Recron Fiber fortified cement of OPC are contrasted and Recron Fiber strengthened cement of PSC at the age of 7 to 60 days. In this examination, Cube and Cylinder examples are ready for Compressive and Split Tensile quality tests furthermore, they were tried at the age of 7, 28 and 60 days.

H.S.Chore, et.al, determined the compressive strength of fibre reinforced fly-ash concrete using the regression model. The compressive strength of the fibre reinforced concrete containing flu-ash was predicted by creating a mathematical model using statistical analysis for the concrete data obtained from the experimental work.

Ashish Kumar Dash, et.al, used Recron 3s fibre and silica fume for making concrete. The compressive strength and the flexural strength of the concrete specimens were determined. The optimum strength was obtained at 0.2% fibre content.

Machine Hsie, et.al, used polypropylene hybrid fibre for making concrete. It was reported that the strength of concrete with polypropylene hybrid fibre was better than that of the single fibre reinforced concrete.

R.Srinivasan, et.al, determined the optimum percentage replacement of cement with hyposludge. The optimum replacement percentage was found to be 30%.[4]A Sivakumar and Manu Santhanam found that among hybrid fibre combinations, only the steel polypropylene combination performed better in all respects compared to the mono-steel fibre concrete.Qian and Stroeven studied the fracture properties of concrete reinforced with polypropylene fibre and three sizes of steel fibres with fibre content ranging from 0 to 0.95% by volume of concrete.

Wu, Li and Wu compared the mechanical properties of three different types of hybrid composite samples prepared by using the combinations of polypropylene- carbon, steel-carbon and polypropylene- steel fibres. Mechanical properties of hybride composites produced by using carbon and aluminum whiskers in addition to polypropylene fibres were studied.

Banthia and Sappakittipakron investigated three fibre hybride with carbon and polypropylene micro fibres added to macro steel fibres and showed that steel macro fibers with highly deformed geometry produce better hybrids than those with a less deformed geometry. Also composites with a lower volume fraction of fibre reinforcement were seen as having a better prospect for hybridization than composites with a high volume fraction of fibres.

Venkat Rao et al carried out an investigational study on durability of high strength self-compacting concrete (HSSCC). The sulphate attack effect on concrete and confrontation of concrete to the attack had been experienced in the laboratory, by immersing specimens of concrete cubes in the solution which encloses 5% sodium sulphate. The chemical attack effect had been estimated by taking adjustment of mass in to consideration. The sulphate attack effect on performance and properties of concrete were acknowledged. Even from the optical surveillance, the intensity of sulphate attack on cracking and the impact of breakdown were noticed.

Vijaya Sekhar Reddy et al The test specimens of 15 15 cm cubes were immersed in 5 % of sodium×15 cm×cm hydroxide solution over a period of 90 days. The effect of alkali attack on performance and properties of concrete were found out. Percentage decrease in weight after 28 days was found to be 10.32 %.

Desai et al. conducted a study on durability properties of fibre reinforced concrete on marine structures. In this study the properties of fibre reinforced concrete were compared with those of conventional concrete and also its environmental effects on durability of concrete. Results showed that the addition of polypropylene triangular fibres improved the durability of concrete. Compressive strength of concrete increases with increase in fibre dosage up to 0.3%, then it starts diminishing. So the best possible percentage fibre found from experiment was 0.3%.

Kokseng Chia et al. accomplished an investigational study on the water permeability and chloride permeability of high strength light weight concrete (LWC) in comparison to that of normal strength concrete with or without silica. Results were compared with LWC and NWC (Normal Weight Concrete) at a normal strength of about 30-40MPa. The water penetrability of the LWC with a w/c of 0.55 was lower than that of the equivalent NWC, when the concrete was subject to a pressure of 4MPa when the strength level reached 30-40MPa. The water penetrability of the high-strength LWC and NWC with a w/c of 0.35 was of the same order regardless whether silica fume was incorporated. The results point out that the resistance to the chloride dissemination does not seem to be concurrent to the water permeability of the concrete.

1.6 PREPARATION OF MIX SAMPLES

The M 25 concrete grade is utilized in this study for mix proportioning. It's composed according to IS 10262-1982 principles. A blend ratio received was cement sand: coarse aggregate: water/concrete quantitative connection severally. Blend extent utilized in this examination was 1:1.72:2.83 (M 25) complying with IS 10262-2009 with water-concrete proportion of 0.4 and Superplasticizer of 0.75%. The trial examination comprised by fluctuating level of eggshell powder as incompletely supplanted with customary Portland cement of 43 grade. The Cement is replaced by human hair with 0.5 %, 1 %, 1 %, 1.5 % replacement and cement is replaced with Recron fibre 0.5 %, 1 %, 1 %, 1.5 % and steel slag with 6 %, 12 %, 18 % and 24 % replacement. The solid cubes of 150mm×150mm×150mm blocks were tried. The compressive quality of 28 days strength was resolved.

1.7 COMPRESSIVE STRENGTH TEST

The concrete strength depends on various aspects like the cement type, quality or proportion of copper slag, recycled aggregates and curing temperature. The compressive strength results are given in Figure 1.Compressive strength test was performed confirming to IS 516-1959 to achieve the test results for concrete at the age of 7 and 28 days.

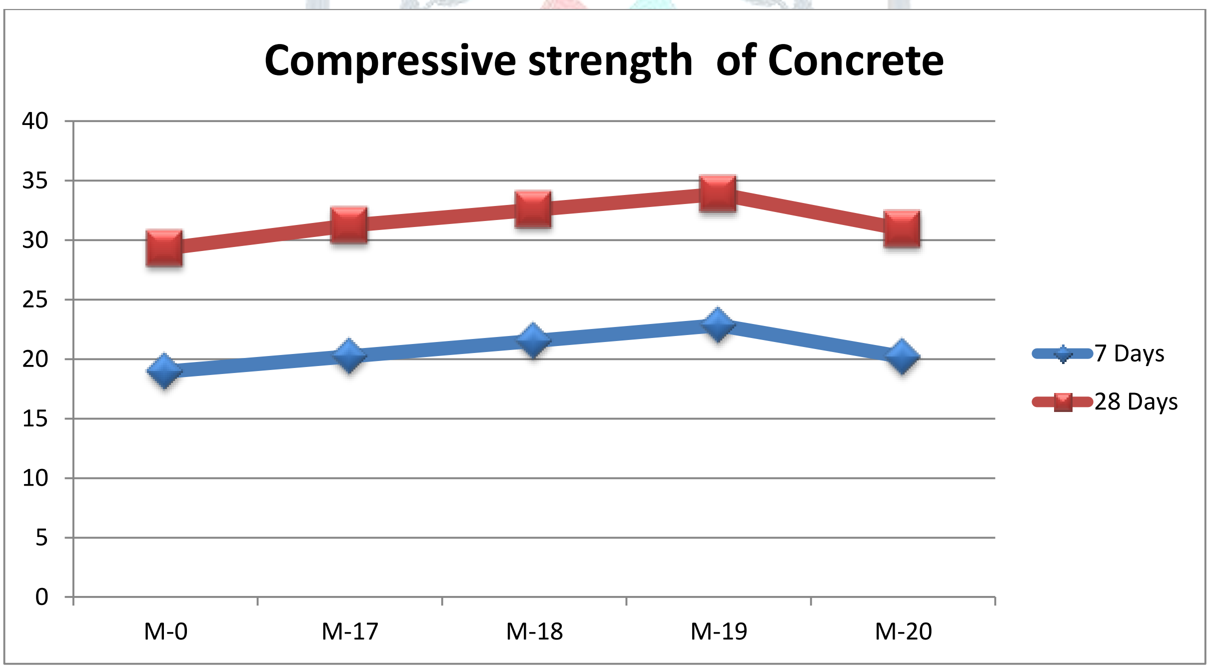

Figure 1: Compressive strength of Concrete by using coir fibre, Recron fibre and Steel Slag

1.8 SPLIT TENSILE STRENGTH TEST

The split tensile strength examination was performed to confirm to IS 516-1959 so as to achieve the value of concrete aged 7 days and 28 days. A Compression Testing Machine (CTM), of 1000Kn capacity was used to test the cylinders. The outcomes are displayed in figure 2.

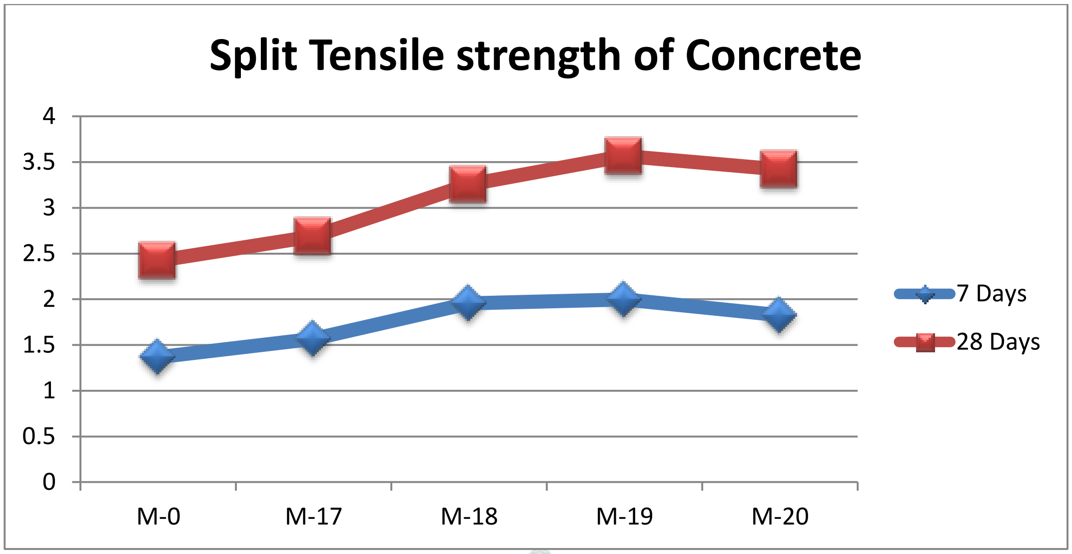

Figure 2: Split tensile strength of Concrete by using coir fibre, Recron fibre and Steel Slag

1.9 FLEXURAL STRENGTH TEST

The Flexural examination was performed to confirm to IS 516-1959 so as to achieve the value of concrete aged 7 days and 28 days. The outcomes are displayed in table 4.4. and results are shown in Figure 4.16 to 4.20.

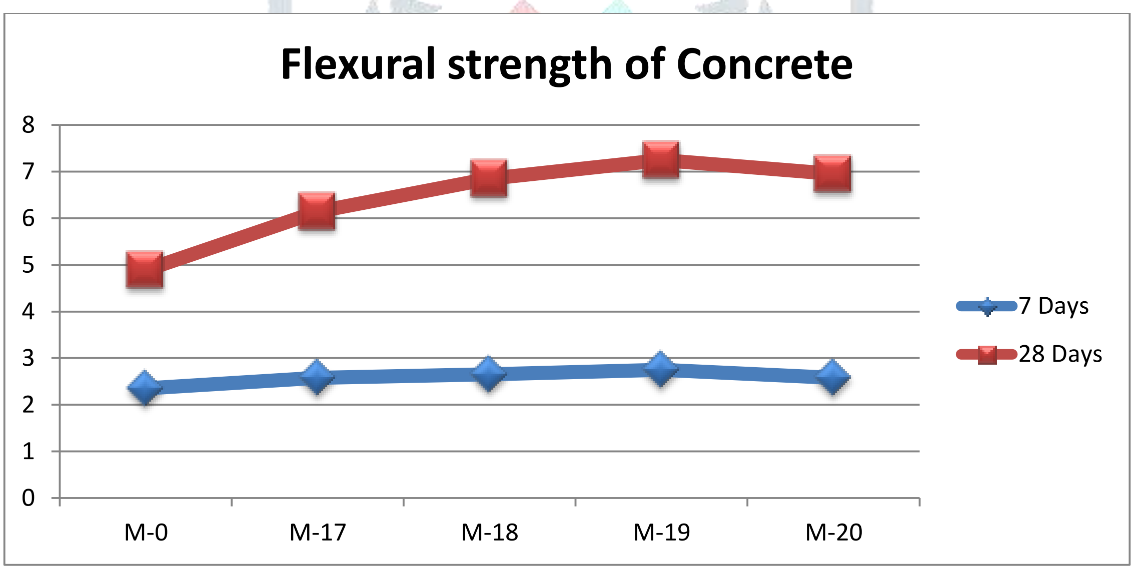

Figure 4.20: Flexural strength of Concrete by using coir fibre, Recron fibre and Steel Slag

CONCLUSION

Following are the various conclusions drawn after the test performance on cube samples of concrete by using coir fibre, Recron Fibre and Steel Slag:

1. The compressive strength1of concrete increases by the addition of coir fibre, Recron fibre and steel slag.
2. The maximum Compressive strength test is achieved 33.87 in the mix of 3 % CF+ 1.5 % RF +18 % Steel Slag.

3. The maximum Split tensile strength test is achieved 3.568 in the mix of 3 % CF+ 1.5 % RF +18 % Steel Slag.
4. The maximum Flexural strength test is achieved 7.25 in the mix of 3 % CF+ 1.5 % RF +18 % Steel Slag.
5. The overall optimum mix of all the test is M-19 having 3 % coir fibre + 1.5 % Recron Fibre +18 % Steel Slag.
6. The literature study concludes that the1flexural strength and compressive strength increases1with the coir fibre and Recron fibre in the concrete.
7. With the increase in coir fibre, recron fibre and steel slag in concrete, the workability of concrete also increases.
8. The cost of forming concrete can be reduced by using coir fibre, recron fibre and steel slag in it.
9. By using coir fibre, recron fibre and steel slag, we can make environment more sustainable.

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