International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 12 | Dec 2020 www.irjet.net p-ISSN: 2395-0072

STUDY ON THE STRENGTH PERFORMANCE OF HYBRD FIBER REINFORCED CONCRETE

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Abstract - Hybrid Fibre Reinforced Concrete (HFRC) is formed from a combination of different types of fibres, which differ in material properties, remain bonded together when added in concrete and retain their identities and properties. In this project work an attempt has been made to investigate the possibility of using locally available coir fibre and Glass fibre as concrete composites. Based on the literature survey on past work fibres were added in concrete at 0.5%, 1.0% and 1.5% of the weight of cement. In that 0.5%, 1% and 1.5%, coir and glass fibres were added with the following proportion 0:100, 25:75 and 50:50 (i.e., 0% Coir fibers and 100% Glass fibers). The combining of fibres, often called hybridization, were used in concrete of grade **M20** and investigated.

Key Words: Hybrid Fibre, E-glass Fibre, Coir Glass, High Performance Concrete

INTRODUCTION

Concrete is the most widely used construction material. It is obtained by mixing cementitious materials, water, aggregate and sometimes admixtures in required proportions. Fresh concrete is freshly mixed material which can be moulded into any shape hardens into a rock-like mass known as concrete. The hardening is because of chemical reaction between water and cement, which continues for long period leading to stronger with age. The utility and elegance as well as the durability of concrete structures, built during the first half of the last century with ordinary Portland cement (OPC) and plain round bars of mild steel, the easy availability of the constituent materials of concrete and the knowledge that virtually any combination of the constituents leads to a mass of concrete have bred contempt. Strength was emphasized without a thought on the durability of structures.

Extensive research in the field of concrete technology has lead to the development of special types of concretes which are capable of eliminating, to a great degree these basic deficiencies. For many applications, it is becoming increasingly popular to reinforce to the concrete with small, randomly distributed fibers.

OBJECTIVES

1) To carryout detailed characterizations of Hybrid fibres based on the Literature review and theoretical studies.

2) To study the effects on workability due to the addition of natural fibres and artificial fibres in various proportions.

3) To fix the optimum fibre content based on the comparing results of three different volume fractions (0.5%, 1.0% & 1.5%).

4) To study the behaviour of Reinforced Concrete beams with Hybrid fibres of optimum percentage.

LITERATURE REVIEW

GENERAL

In this chapter, an elaborate discussion is made regarding works done so far in this area as literature review. Fibre reinforced concrete with different fibres and their behavior were studied. The review is about the Hybrid fibre reinforced concrete (HFRC).

HYBRID FIBER REINFORCED CONCRETE (HFRC)

Fibre Reinforced Concrete is concrete containing fibrous material which increases its structural integrity. Fibres having lower modulus of elasticity are expected to enhance strain performance whereas fibres having higher modulus of elasticity are expected to enhance the strength performance.

Study on Fiber synergy in Hybrid Fiber Reinforced Concrete (HFRC) in flexure and direct shear. Flexural and direct shear tests were performed and the results were analyzed to identify synergy, if any, associated with various fiber combinations. The paper highlights the influence of load configuration on fiber synergy [1].

Strength and flexural toughness of concrete reinforced with steel-polypropylene hybrid fibres that results obtained in this investigation indicate that in terms of flexural toughness, concrete with fibre combination of 75% of steel fibres +25% polypropylene fibres gives the best performance [11].

The investigation on the flexural fatigue strength of Hybrid Fibre Reinforced Concrete (HFRC) containing different proportions of steel and polypropylene fibres The experimental coefficients of the fatigue equation have also been obtained from the fatigue test data to represent the S-N-Pf curves analytically [12].

Tensile and flexural properties of Glass fiber-reinforced, Polyster hybrid composites. glass fiber reinforced high performance polyster resin composites have been developed and their tensile and flexural strength with different synthetic (glass) and natural (jute) fibers combinations have been studied[8].

Investigation of mechanical properties of hybrid fiber reinforced concrete samples and prediction of energy absorption capacity of beams. Significance of hybrid fiber addition was put forward for the increase in ductility of the concrete which displays a brittle behavior when forced to bending [6] [7].

The Workability of hybrid fiber reinforced self-compacting concrete. Compared to fiber reinforced concrete (FRC), self compacting concrete (SCC) is a relatively new type of concrete with high flow ability and good cohesiveness. It was concluded that in addition to the above mentioned quantifiable three properties, other properties of fibers such as shape and surface roughness are also found to be important but they cannot be quantified at this stage [14].

MATERIALS TO BE USED

INGREDIENTS OF CONCRETE

Concrete is a construction material composed of Portland cement and water combined with sand, gravel, crushed stone, or other inert material such as expanded slag or vermiculite. The cement and water form a paste which hardens by chemical reaction into a strong, stone-like mass. The inert materials are called aggregate, and for economy no more cement paste is used than in necessary to coat all the aggregate surfaces and fill all the voids. The concrete paste is plastic and easily moulded into any form or trowel to produce a smooth surface. Hardening begins immediately, but precautions are taken, usually by covering, to avoid rapid loss of moisture since the presence of water is necessary to continue the chemical reaction and increases the strength. Too much water, however, produces a concrete that is more porous and weaker.

CEMENT

Cement is the most important ingredient in concrete. Some of the important factor that play a vital role in selection of cement are compressive strengthat various ages, fineness, heat of hydration alkali content, tricalcium aluminate (C_3A) content, tricalcium silicate (C_3S) content, dicalcium silicate (C_2S) content etc. Portland slag cement is obtained by mixing Portland cement clinker, gypsum and granulated blast furnace slag in suitable proportion and grinding the mixture to get a thorough and intimate mixture between the constituents. It has lower heat of evolution and is more durable and can be used in mass concrete production.

FINE AGGREGATE

Fine aggregate are material passing through an IS sieve that is less than 4.75mm gauge beyond which they are known as coarse aggregate. Coarse aggregate form the main matrix of the concrete, where as fine aggregate form the miller matrix between the coarse aggregate. The most important function of the fine aggregate is to provide workability and uniformity in the mixture. The fine aggregate also helps the cement paste to hold the coarse aggregate particle in suspension.

COARSE AGGREGATE

The coarse aggregate is the strongest and the least porous component in concrete. It is also chemically stable material. Presence of coarse aggregate reduces drying shrinkage and other dimensional changes occurring on account of movement of moisture. Coarse aggregate contributes to impermeability concrete provided that graded and the mix is suitably designed. Ordinary blue granite crushed stone aggregate confirming IS-383:1970 was used as a coarse aggregate in concrete. Optimum size of the coarse aggregate in most situations was about 20mm was adopted. They generally possess all the essential qualities of a good building stone showing very high crushing strength, low absorption value and least porosity.

WATER

Water is an important ingredient of concrete as it actively participates in chemical reactions with cement to form the hydration product, calcium-silicate- hydrate (C-S-H) gel. The strength of the cement concrete depends mainly from the binding action of the hydrate cement paste gel. A higher water binder (w/b) ratio will decrease the strength, durability, water tightness and other related properties of concrete. The water used for making concrete should be from desirable salts that may react with cement. Silts and suspended particles are undesirable as they interfere with setting, hardening and bond characteristics. Algae in mixing water may cause marked reduction in strength of concrete either by combining with cement to reduce the bond or by causing large amount of air entrainment in concrete.

E-GLASS FIBRE

E-Glass or electrical grade glass was originally developed for stand off insulators for electrical wiring. It was later found to have excellent fibre forming capabilities and is now used almost exclusively as the reinforcing phase

in the material commonly known as fiberglass. Glass fibres are generally produced using melt spinning techniques. These involve melting the glass composition into a platinum crown which has small holes for the molten glass to flow. Continuous fibres can be drawn out through the holes and wound onto spindles, while short fibres may be produced by spinning the crown, which forces molten glass out through the holes centrifugally.

COIR FIBRE

Coir is a versatile natural fibre extracted from mesocarp tissue, or husk of the coconut fruit Generally fibre is of golden color when cleaned after removing from coconut husk; and hence the name " The Golden Fibre". Coir is the fibrous husk of the coconut shell. Being tough and naturally resistant to seawater, the coir protects the fruit enough to survive months floating on ocean currents to be washed up on a sandy shore where it may sprout and grow into a tree, if it has enough fresh water, because all the other nutrients it needs have been carried along with the seed.

EFFECT OF FIBRES IN CONCRETE

Fibres are usually used in concrete to control plastic shrinkage cracking and drying shrinkage cracking. They also lower the permeability of concrete and thus reduce bleeding of water. Some types of fibres produce greater impact, abrasion and shatter resistance in concrete. Generally fibres do not increase the flexural strength of concrete, so it cannot replace moment resisting or structural steel reinforcement. Some fibres reduce the strength of concrete.

WORK TO BE CONTINUED

- The basic properties of cement, fine aggregate, coarse aggregate and fibre should be found out.
- The workability test for concrete such as Slump test, Flow test, Vee Bee apparatus test, Compaction factor test should be found out with and without adding of fibres.
- Further, the results of mechanical properties of concrete should be done and compared with conventional concrete.

CONCLUSION

The E-glass fibre reduces the cracks in the surface, during and after the finishing. The ultimate load carrying capacity of Hybrid fibre reinforced concrete beam is higher than that of controlled concrete beams. Addition of fibres expected to be reduces the crack widths at service load in the HFRCs as compared to Controlled reinforced concrete beams. HFRCs exhibit fine cracks at ultimate load. The presence of two fibres in reinforced concrete may improve the ductility performance of concrete because of higher bond and anchorage.

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