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A STUDY ON FIBER REINFORCED CONCRETE USING DIFFERENT TYPES OF GEO-POLYMER FIBER IN PREPARATION OF CONCRETE SAMPLE

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Abstract : Portland cement is very malleable, but weak from stress and cracking. Weaknesses and stresses can be prevented by using standard steel reinforcements mixed to some extent with various special fibers. The addition of fiber increases the strength of the fiber matrix composite, which will change its behavior after failure. The purpose of this document is to provide information on the quality and compatibility of common fibers and their use in the production of concrete with specific properties. In this paper given and overview and related work details on fiber reinforced concrete using different types of geo-polymer fiber in preparation of concrete sample.

***IndexTerms* – Fiber, Concrete, Geo-Polymer, Cement, SRF.**

I. Introduction

Portland cement is very malleable, but weak from stress and cracking. Weaknesses and stresses can be prevented by using standard steel reinforcements mixed to some extent with various special fibers [1]. The addition of fiber increases the strength of the fiber matrix composite, which will change its behavior after failure. The purpose of this document is to provide information on the quality and compatibility of common fibers and their use in the production of concrete with specific properties. A new type of fibrous concrete is made from cellulose fibers. Fiber is a smart little power source made from a variety of materials, including steel, plastic, glass, carbon, and natural materials, and comes in a variety of shapes and sizes.

II. Fiber Reinforced Concrete (FRC)

Fiber-reinforced concrete is a cementitious mixture, aggregate or compact, mixed with suitable, discrete, well-defined and well-dispersed fibers. There are many types and levels of fiber, each with its own benefits. The various fibers do not include continuous nets, braids, cables or long bars. Fibers are little things that make them strong with special properties [2]. They can be round or flat and come in a variety of shapes and sizes. Aspect ratio is a useful parameter commonly used to characterize cables. The diameter of a fiber is the ratio of its length to its diameter. The proportions are generally between 30 and 150. FRC is a type of concrete with fibrous material to increase its strength properties. It is made up of small insulating fibers that continuously distribute and rotate randomly. Fibers include metallic fibers, glass fibers, synthetic fibers and natural fibers. The properties of fiber reinforced materials depend on the materials used, the fiber materials, the shape, distribution, orientation and density of these different fibers. Shotcrete supports multiple threads and can be used with a normal computer. Traditional concrete floors are often used for flooring and walkways, but can be used for a variety of other building materials. (Beams, fixtures, foundations, etc.) Alone or in combination with hand-bonded rebar, fiber concrete (usually steel, glass, or "plastic") is ten times cheaper than rebar. The shape, size and length of the fiber are important. Short fibers, such as short-hair glass fibers, are only effective in the first few hours after the concrete is poured (reducing shrinkage as the concrete hardens), but they do not increase the concrete's tensile strength.

Fibers are widely used in concrete to prevent shrinkage cracking due to resin shrinkage and drying shrinkage. It also prevents water seepage by reducing the permeability of the concrete. Concrete containing certain fibers is more resistant to impact, abrasion and spalling. Fiber generally does not increase the flexural strength of concrete, so it can also be used as a substitute for flexural or structural reinforcement. Certain fibers reduce the strength of concrete.

2.1. Advantages of Fiber Reinforced Concrete (FRC)

- Increase the tensile strength of the material.
- Reduces air and water pockets in the natural pores of the gel.
- Longevity is good.
- Most resins have low creep resistance, but graphite and glass have high creep resistance. Therefore, the orientation and number of fibers has a significant effect on strengthening / stretching muscle performance.
- Reinforcement material is a complex material that uses reinforcing steel as a reinforcing material and as a matrix. Both are important
- The material behaves similarly under thermal stress, reducing the different deformations between the material and the reinforcement.
- It is known that a fine, thick and smooth fiber with a material will make it anti-crack and improve the elastic properties and strength of the material.

2.2. Disadvantage of Fiber Reinforced Concrete (FRC)

- Rain exposes the fibers.
- One of the disadvantages of the fiber enhancer is that it interferes with the specific function of the fiber enhancer.
- The problem is one of the network servers on the computer. In addition, fiber balls are produced during the blending process.
- Another disadvantage is that fiber-reinforced concrete is heavier than non-fibrous concrete. There is also a risk of corrosion when using steel fibers.
- Finally, fiber-reinforced concrete is usually more expensive than regular concrete, but other factors can offset the cost.

2.3. Use of Fiber Reinforced Concrete (FRC)

- It was used for refractory lining, road overlays with explosive-resistant construction, and airport overlays.
- It is used to create precast items like pipelines, boats, beams, stairways, wall panels, roof panels, manhole covers, etc.
- Doors and door frames, pressure pipes, permanent and temporary formwork, bus shelters, and park benches are all constructed with glass fibre.

III. Literature Review

Le et. al. 2022 [3], Present the consequences of an examination study and recommends a hypothetical definition for the bond behavior of reinforced fly ash-based geopolymer concrete. Three grades (20 MPa, 30 MPa and 40 MPa) of a geopolymer concrete alongside three reinforcement breadths (12, 16, and 20 mm) were chosen for exploratory work. The bond behavior of the reinforced geopolymer concrete is resolved utilizing pullout test, limited component investigation, and hypothetical work. The test information showed that the bond strength of reinforced fly ash-based geopolymer concrete increments around 1.97 to 2.56 times with the increment of compressive strength from 20.33 MPa to 41.12 MPa. For grade 30 MPa and 40 MPa specimens, the concrete cover to breadth proportion expanded up to 4.19 brought about the increment of bond strength. Then, the bond strength diminishes with the increment of the c/db proportion from 4.19 to 5.75, while grade 20 MPa specimens is the other way around. The bond-slip relations between the reinforcement and not set in stone from FEA are in great agreement with exploratory outcomes. The coefficient of variety is just 0.01. Notwithstanding, this behavior is very not the same as the information determined by the fib model.

Chandrashekhar et. al. 2022 [4], The behavior of prestressed synthetic fiber beams (MSFRPC) was analyzed experimentally and numerically. To determine the effect of crude polyolefin synthetic fibers on shear strength and failure mechanism, MSFRPC beams were tested with an angle/depth (a / d) of 2.4. The parameters analyzed were 0.0%, 0.5%, 1.0% and 1.5% of fiber. Using the deformation plasticity model, a 3D finite element (FE) analysis was performed to determine the influence of the fibers on the shear behavior. The FRC tensile relationship was developed from the crack test results using reverse analysis and used as input for the FE model. A step-by-step analysis was performed to describe the effect of applying external pressure and stress. For different fiber treatments, the final analytical results are consistent with the experimental results. Using a finite element model, the effect of the degree of prestress on the elastic compressive strength was investigated. There is no significant increase in compressive strength due to the inclusion of strong synthetic fibers. A 0.5% increase in fiber content did not improve splicing behavior. However, the post-cracking behavior, ductility and ultimate strength of MSFRPC beams increased significantly through the experiment and the EF for reduced aspect ratio beams of 1.0% and 1.5%, respectively.

Karimipour et. al. 2022 [5], Study conducted by the Research Center for Reinforced Concrete (SFRC) and the Research Center for Reinforced Concrete (CRARC). 48 reinforcements were built and tested in two models. It was tested on sixteen reinforced concrete (RC) beams in the first generation, then tested again using the design method. In another group, 16 samples were analyzed after surgery. All samples were tested using the 4-down formula. There are two limit values (CRA), 0% and 100% (CJ), used in the RC system. There is a concrete cover. Steel fibers (SF) are introduced into the beam and CJ is also introduced at 0% and 2% by volume. The flexural capacity, maximum displacement at mid-span, and ductility of specimens were also measured during these tests. In addition, an unmodified model for predicting the flexural behavior of SF jacketed CRA and coarse natural aggregate (CNA) beams were developed.

Camille et. al. 2021 [6], investigates the carrying capacity of Macroscopic Synthetic Fiber Reinforced Concrete under vertical and shear loads. Compared to common materials, this new composite material has improved product quality (i.e., the innovation of this research is the characterization of the performance of different fiber materials as part and length of polypropylene), analyzed in terms of fibers. Reinforcement material is often used to increase durability and reduce damage caused by thermal cycling, test results show that fiber reinforcement improves various types of sagging and reduces hardness, fiber content greater than 1% has a great impact on the workability of both fibers. A mixture is made, reducing the average value by 40%. The testing results showed that the fibers have abridging effect, which reduces fracture propagation and leads to a more ductile failure mode. The addition of both types of fiber, however, had no discernible effect on the ultimate compressive strengths. Unfavorable impacts beyond 1.5 percent of fibers were shown to reduce compressive strength by 12.5 percent on average. The inclusion of fibers did not affect the notched specimens' ultimate flexural strength (i.e., pre-cracking). The fiber reinforcement, on the other hand, improved the fracture mechanisms, making them more ductile and, as a result, minimizing the loss of capacitance after the initial fractures. In term so residual flexural strength ductility, and toughness, greater fiber doses per formed better.

Jayasri et. al. 2021 [7], presents the after-effects of a test examination of the mechanical properties of underlying substantial utilizing steel filaments (SF), polypropylene strands (PF) and metakaolin (MK). The impacts of these strands and MK on different properties of grade M30 concrete are researched. . The substance of MK steel strands and the substance of polypropylene filaments were changed as a rate by weight of concrete. All examples were solidified with water and examined following 28 days. It very well may be seen that a huge improvement in the underlying presentation of cement is gotten by adding 15% of MK to typical cement. Cross breed Fiber Reinforced Concrete (HFRC) decreases the danger of fragility by halting miniature and full scale breaks. A 28.5% increment in compressive strength north of 28 days was noticed. A striking decrease in compressive strength was seen with an expansion in the level of MK past 15%.

Ramesh et. al. 2021 [8], Due to growing environmental concerns in recent years, researchers have focused on producing sustainable composites reinforced with natural fibers. In this regard, basalt fiber has recently attracted research attention for its high value and quality compared to other natural fibers. This study focuses on the functional properties of basalt fiber concrete with a volume fraction of 0% to 2%. Compression modulus, tensile modulus and damage modulus are the parameters studied. The inclusion of basalt fibers increases the modulus of rupture, but has little effect on the compressive strength. Compared to computer control, the performance of concrete with 1.5% basalt fiber increased by 4.45%, 22% and 57% respectively. In this study, fiber size and dimension influenced the modulus of rupture and tensile strength of the FRC basalt samples. At the above load, maximum strength is achieved with a small deformation of the fiber of 1.5%.

Mahmood et. al. 2021 [9], discussed about the impact of fiber reinforcement on the properties of geopolymer concrete composites, in light of fly ash, ground granulated impact heater slag and metakaolin. Customary concrete composites are fragile in nature because of low rigidity. The consideration of sinewy material changes fragile behavior of concrete alongside a huge improvement in mechanical properties i.e., sturdiness, strain and flexural strength. Ordinary Portland cement (OPC) is basically utilized as a limiting specialist in concrete composites. Notwithstanding, current ecological mindfulness advances the utilization of elective folios i.e., geopolymers, to supplant OPC in light of the fact that in OPC creation, critical amount of CO2 is delivered that makes natural contamination. Geopolymer concrete composites have been described utilizing many logical apparatuses including scanning electron microscopy (SEM) and basic identification X-beam spectroscopy (EDX). Understanding into the physicochemical behavior of geopolymers, their constituents and reinforcement with normal polymeric fibers for the creation of concrete composites has been acquired. Center has been given to the utilization of sisal, jute, basalt and glass fibers.

Yang et. al. 2021 [10], the bearing capacity of the fiber-reinforced composite (UHPC) is enhanced by its high mechanical strength and ductility under static and dynamic loads. In this study, we investigated the effectiveness of hybrid and UHPC composites in enhancing structural properties, especially fracture and flexural strength. This study is the first to investigate the effect of vertical hybrid cables on the vertical mechanical properties of UHPCs. We have developed four different hybrid monofilaments and hybrid fiber binding. It has fibers of three different lengths (6, 10 and 15 mm) but with the same diameter (0.2 mm) and ratio (2.5%). This composite has a quasi-static compression and flexural test. The results of this study show that longitudinal fibers increase compressive strength and modulus and UHPC with hybrid fibers is better in terms of flexural properties. Using the three bending results, the fracture threshold and fracture modulus of UHPC were obtained and discussed. The flexural strength and fracture toughness of composites reinforced with a combination of long and short fibers were respectively 21.84% and 20.13% higher than those reinforced with single long fibers. The dynamic behavior of the UHPC beam (2000 168 168 mm) with single and hybrid fiber reinforcement during low speed collisions was investigated.

Xiao et. al. 2021 [11], in this study, a four-dimensional bending test was used to evaluate the bending characteristics of a 3D sample made from recycled sand reinforced with polyethylene (PE) fiber. The negative effect of adding recycled sand can be reduced by adding PE fiber to the blend, which can increase the flexibility of the 3D printed pattern. Scanning electron microscopy studies show that old cement slurry combined with recycled sand increases the porosity of 3D printed samples with recycled sand compared to samples using only natural sand. The strong interfacial bond between the fiber and the matrix and the high strength of the fiber improve the mechanical properties of the 3D printed sample. If the deformation and hardness are not required to be strong, adding acceptable fiber content can increase the conversion value of the sand returned to useful applications.

Gupta et. al. 2020 [12], presented the utilization of steel fibre built up composites in framework applications is turning out to be progressively famous with the presentation of new elite execution materials. Composites supported with steel strands are acquainted with work on the general exhibition of constructions, for example, composite scaffold decks, radiates, load-bearing dividers, and so forth This survey of previous encounters presents the consequences of trial and logical examinations did on composite materials in fibre-supported cement superimposed on a customary support with concrete. The outcomes show that the composite designs have great compressive strength, elasticity, flexural strength, break opposition and most extreme limit..

IV. Conclusion

The purpose of this paper is to provide information on the quality and compatibility of common fibers and their use in the production of concrete with specific properties. In this paper given and overview and related work details on fiber reinforced concrete using different types of geo-polymer fiber in preparation of concrete sample.

References

[1] Mehtab Alam and Hemant Kumar Sain, “Partial Replacement of Cement with Kota Stone Slurry Powder and Coal Ash in High Performance Concrete”, Design Engineering, pp. 1094- 1102, 2021.

[2] Mehtab Alam and Hemant Kumar Sain, “An Experimental Study on Partial Replacement of Cement with Kota Stone Slurry Powder and Coal Ash in High Performance Concrete”, International Journal of Engineering Trends and Applications (IJETA), vol. 8, pp. 12-18, 2021.

[3] Tuan Anh Le, Thuy Ninh Nguyen and Khoa Tan Nguyen, "Experimental, Numerical, and Theoretical Studies of Bond Behavior of Reinforced Fly Ash-Based Geopolymer Concrete", MDPI Journal of Applied Sciences, 12(7812), pp. 1-19, 2022.

[4] Lakavath Chandrashekhar and Bhosale Aniket B. and Prakash, Suriya S, "Effectiveness of Hybrid Fibers on the Fracture and Shear Behavior of Prestressed Concrete Beams", Fibers, Vol. 10 (3). pp. 1-26, 2022.

[5] Arash Karimipour, Mehrollah Rakhshanimehr, Mansour Ghalehnovi and JorgeDe Brito, "Effect of different fibre types on the structural performance of recycled aggregate concrete beams with spliced bars", Journal of Building Engineering, Vol. 56, 2022.

[6] Christophe Camille, Dayani Kahagala Hewage, Olivia Mirza, Fidelis Mashiri, Brendan Kirkland and Todd Clarke, "Performance behaviour of macro-synthetic fibre reinforced concrete subjected to static and dynamic loadings for sleeper applications", Construction and Building Materials, Vol. 270 (8), 2021.

[7] M. Jayasri and H. Jane Helena, "Influence of Metakaolin on the Behaviour of Hybrid Fibre Reinforced Concrete", International Journal of Research in Engineering and Science, Volume-9, Issue-1, 2021.

[8] B. Ramesh and S. Eswari, "Mechanical behaviour of basalt fibre reinforced concrete: An experimental study", Materials Today Proceedings, Vol. 46, Part. 2, pp. 2317-2322, 2021.

[9] Aamir Mahmood, Muhammad Tayyab Noman, Miroslava Pechociakova, Nesrine Amor, Michal Petru, Mohamed Abdelkader, Jiri Militky, Sebnem Sozcu and Syed Zameer Ul Hassan, "Geopolymers and Fiber-Reinforced Concrete Composites in Civil Engineering", Polymers(Basel), Vol. 13(13), 2021.

[10] Yekai Yang, Chengqing Wu, Zhongxian Liu, Hai Zhang and Shenchun Xu, "Protective Effect of Unbonded Prestressed Ultra-High Performance Reinforced Concrete Slab against Gas Explosion in Buried Utility Tunnel", Process Safety and Environmental Protection, 2021.

[11] Jianzhuang Xiao, Shuai Zou, Tao Dinga, Zhenhua Duan and Qiong Liu, "Fiber-reinforced mortar with 100% recycled fine aggregates: A cleaner perspective on 3D printing", Journal of Cleaner Production, Vol. 319, 2021.

[12] Amit Gupta and Prof. Rahul Sharma, "Investigation on Properties of Steel Fibre Reinforced Concrete", International Journal of Engineering Research & Technology (IJERT), Vol. 9, Issue. 12, 2020.