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Study the Strength Behaviour of M30 Grade Concrete Using Glass, Nylon and Natural Fibres

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Abstract: ***The project report entitled "study the strength of M30 grade concrete using Glass fibre, synthetic and Natural fibre". The main objective of the study is to analyse the strength of M30 grade concrete using glass. Synthetic and natural fibre. In this process of identifying the strength of the used concrete we can conclude the best material to be mixed with for better long-lasting strength. These details of concrete and fibre are collected by a few articles and through some experiments***

Glass, jute, nylon fibres are taken in the ratio of 0.5% ,1.5% ,2.5 %. Complast sp420 is used for water reducing. Mixing of fibres in concrete helps in increasing 50% of strength then conventional concrete with better increase of mechanical properties. We are casting cubes for compression and cylinders for tensile strength. Chairs and tables are used for better understanding.

This study focuses on evaluating the strength characteristics of M30 grade concrete incorporating three distinct types of fibres: glass, synthetic, and natural. The investigation includes a comprehensive analysis of the mechanical properties of these fibre-reinforced concrete mixes. Various tests such as compressive strength, and split tensile strength are conducted to assess the performance and effectiveness of each type of fibre.

The research methodology involves the preparation of M30 grade concrete specimens with varying fibre content for each type. The concrete mixes are cured and subjected to a series of standard tests to evaluate their strength and durability. The study aims to understand the influence of glass, synthetic, and natural fibres on the overall performance of M30 grade concrete and to identify the optimal fibre dosage for enhanced structural properties.

Results obtained from the experimental tests are analysed and compared to ascertain the impact of each fibre type on the concrete's strength characteristics. The findings aim to contribute valuable insights to the field of concrete technology, providing a basis for informed decision-making in the selection and application of fibres to improve the performance of M30 grade concrete in structural applications. Through experiments with considerable apparatus, process and ratios we can conclude the result

Keywords: Fibre reinforced concrete, jute fibre, nylon fibre, glass fibre, compression strength

I. INTRODUCTION

Fibre Reinforced Concrete (FRC) is a composite material made up of fibrous material that adds structural strength and integrity. The term FRC is defined by ACI as concrete, incorporated with dispersed randomly oriented fibres. Since concrete is a significantly brittle material and exhibits a very poor tensile strength, it cracks easily and results in freeze and thaw damage, scaling, discoloration, and also steel corrosion. Therefore, to sort out these issues, fibres are added to concrete to control the cracks and crack growth . Commonly, various synthetic and natural fibres are used in concrete to control cracking and its propagation caused by plastic and drying shrinkage. The papers published in the early 1960s brought FRC to the notice of academic and industry research scientists all around the world . At that time there was a significant sense of discovery and enthusiasm that FRC can promise a great future development for Portland cement-based composite material. Since then multiple investigations have been made by the researchers into the development of FRC by incorporating various fibres like glass, nylon and jute fibres. This paper intended to present the effects of adding various types of fibres in concrete.

II. METHODOLOGY

1) *Collection of Materials:* The process of creating moss concrete requires a careful blending of conventional concrete ingredients with the addition of moss. This section offers a succinct summary of the essential ingredients used to make moss concrete, taking into account both environmental and structural variables. The first step is the collection of materials for concrete mixes of M20, M25, and M30 grades, which includes:

2) *Cement:* Concrete is made with either regular Portland Cement (OPC) or alternative environmentally friendly cement formulas. Sustainability and its effect on the environment may be taken into account.
3) *Aggregates:* Sand and gravel are examples of fine and coarse aggregates that give the concrete its structural integrity. The strength and workability of the concrete are largely dependent on the size and gradation of the particles.
4) *Water:* Potable, clean water is essential to the cement hydration process. To get the right strength and longevity out of the concrete, the water-to-cement ratio must be carefully considered.
5) *Concrete Mix:* Concrete mix design is the process of selecting the proportions of the various ingredients—cement, aggregates (coarse and fine), water, and admixtures—to produce concrete with the desired properties for a specific application. It's a crucial step inensuring the quality, strength, durability, and workability of the final concrete product. For M30 grade the mix Ratio is 1:2.31:3.09.
6) *Curing of Cubes:* The curing of concrete cubes is a crucial step in determining their compressive strength, a fundamental property for ensuring the safety and reliability of structures. It involves providing the cubes with the right conditions for complete hydrationof the cement, which ultimately determines their strength.

III. TYPES OF FIBRES USED

1) *Jute Fibres:* Jute Fibres (JTF), which are derived from annual plants and are abundant, might be regarded as a potential material for concrete composites because of their low cost and availability. They feature a pentagonal or hexagonal cross shape, and their soundproofing, ultra-violent protection, and antibacterial qualities make them an excellent choice for outdoor use. The excellent mechanical qualities, jute textiles are appropriate for use as reinforcements in bionic and laminated composites. In terms of structural qualities, the jute fabric-reinforced composites fulfil the criteria of commercial materials while maintaining a relatively cheap cost. Jute is a particularly important degradable natural fibre because of its high specific characteristics, cheap cost, ease of supply, and environmental friendliness composite. The mechanical qualities of jute and sisal fibres are naturally superior to those of coconut and sugarcane, and this effect is mirrored in the concrete samples reinforced with the corresponding fibres.
2) *Nylon Fibres:* The nylon fibres are used in manufacture of various products like carpet, rope, clothes, tires and other durable materials. The reason for using nylon fibre is that it has good hardness, resilience and durability; is readily available in different colours, can be dyed, resistant to soil and dirt, good abrasion and wearing characteristic, availability in different cross-section. The Nylon fibre production, though, affects the environment and the disposal of these fibre pose more severe threat. In this regard, use of nylon fibre as ingredient in cement concrete is promising as it provided an alternative method of disposal and fibres, owing to their also improve strength and durability of concrete. The addition of nylon fibre has also been reported to improved durability of concrete, the fibres protect concrete cover from spalling due to bonding character [7], [8]. In present study, nylon fibres are added to normal strength cement concrete in various proportions and its effects on workability, compressive strength, and tensile strength is reported.
3) *Glass Fibres:* Glass fibres (GF) were first employed as a mortar and concrete reinforcement in 1931 They are made by drawing molten glass through spherical holes, stranding roughly 200–240 individual fibres, and then cutting them into smaller portions. Glass fibre isa waste product dumped in significant quantities by the glass producing industries. As a result, the application of such fibres may improve the mechanical capacity of concrete while also facilitating the disposal of industrial waste. Polyester resin is reinforced with glass fibre in glass fibre-reinforced plastic (GRP) composites. Construction, aerospace, automotive, and locomotive sectors produce waste, which is a discarded byproduct of production and is removed at the end of is service life. GRP waste is created in the United Kingdom (UK) at a rate of roughly 55,000 tons per year, with the amount predicted to rise by 10% every year. The physical properties of glass fibres are presented in Error! Reference source not found. Glass comes in a wide range of colours, chemical compositions, and properties. Glass fibres show excellent strength, thermal characteristics, durability and interfacial attachment to the matrix. Glass fibres are often utilized as reinforcement in resins and composites because of their incredible strength qualities

IV. COMPRESSIVE STRENGTH

Compressive strength refers to the maximum load per unit area that a material can withstand under compression before it fails or fractures. In the context of concrete, compressive strength is a critical parameter as it indicates the ability of the concrete to withstand applied loads or pressure without undergoing significant deformation or failure. It is typically measured in megapascals (MPa) or pounds per square inch (psi) and is determined by conducting standardized compression tests on concrete specimens.

The compressive strength of concrete is influenced by various factors including the mix proportions, curing conditions, age of the concrete, and presence of any additives or reinforcements like fibers.

V. SLUMP TEST

The slump test is a standard test in civil engineering and construction to measure the consistency of freshly mixed concrete before it sets. It involves filling a cone-shaped mold with concrete, compacting it, then removing the mold and measuring the settlement, or "slump," of the concrete. This test helps ensure the concrete has the desired workability and strength for its intended use.

VI. RESULTS AND DISCUSSION

A. *Slump Test*

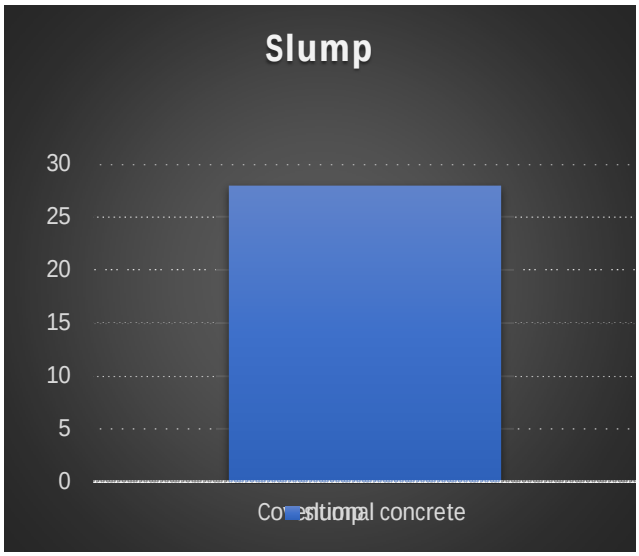

Fig 1

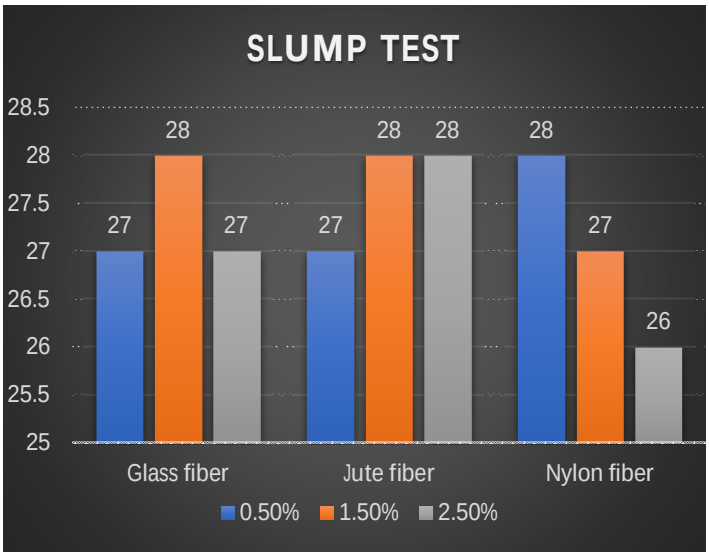

Fig 2

From the Fig 2 graph shows,

- In glass fiber it is observed that the slump result is good at 1.50%.
- In jute fiber it is observed that the slump result is good at 1.50%.
- In nylon fiber we can observe that the slump result is good at 0.50%.

B. *Cube Compressive Strength*

1) *For Cubes*

- From the fig 3
- The compressive strength of the concrete of mix proportion 1:2.31:3.09 with the water-cement ratio of 0.45

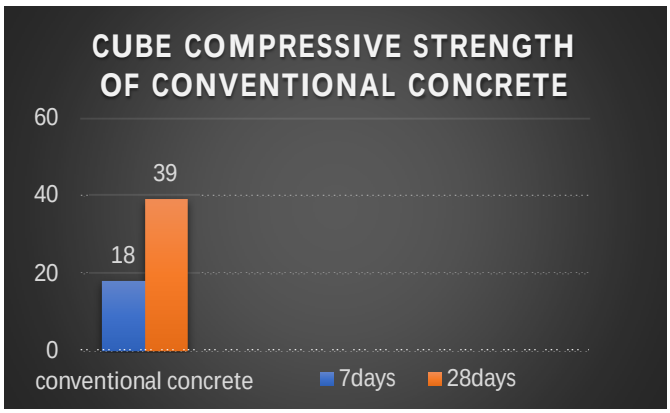

Fig 3

From the above fig 4,the compressive strength at 7 days

- In Glass fiber it is observed that the compressive strength of cube gives better outcome at 1.50% compared to 0.50% and 2.50%.
- In Jute fiber we can observe that the compressive strength of cube gives better outcome at 1.50% compared to 0.50% and 2.50%.
- In Nylon fiber we can observe that the compressive strength of cube gives better outcome at 2.50% compared to 0.50% and 1.50%.

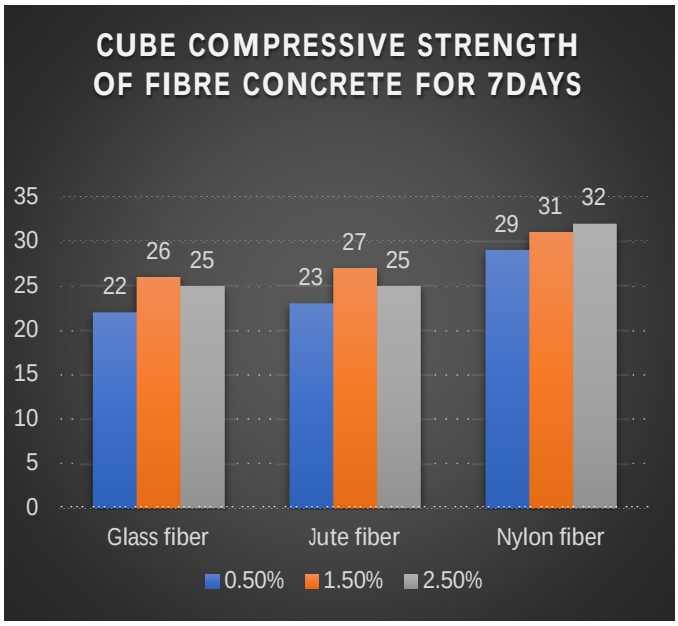

Fig 4

From the above fig 5, the compressive strength at 28 days

- In Glass fiber it is observed that the compressive strength of cube gives better outcome at 1.50% compared to 0.50% and 2.50%.
- In Jute fiber it is observed that the compressive strength of cube gives better outcome at 1.50% compared to 0.50% and 2.50%.
- In Nylon fiber we can observe that the compressive strength of cube gives better outcome at 2.50% compared to 0.50% and 1.50%.

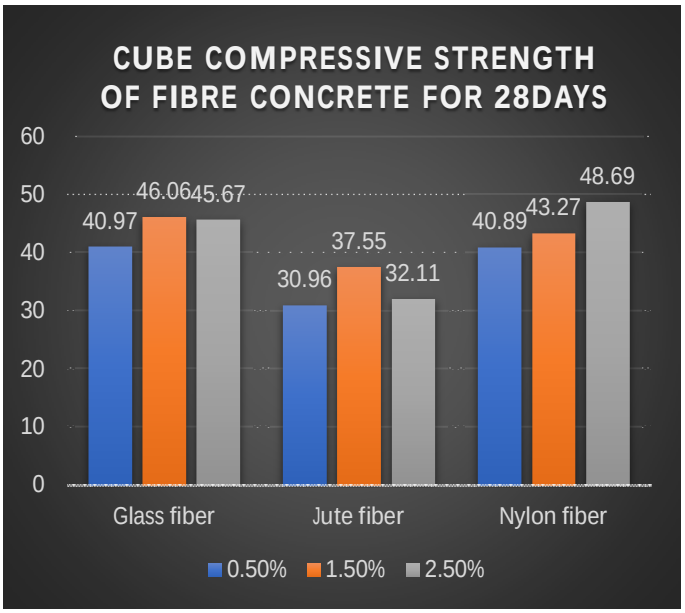

Fig 6

2) For Cylinders

The compressive strength of conventional concrete is observed from fig 7.

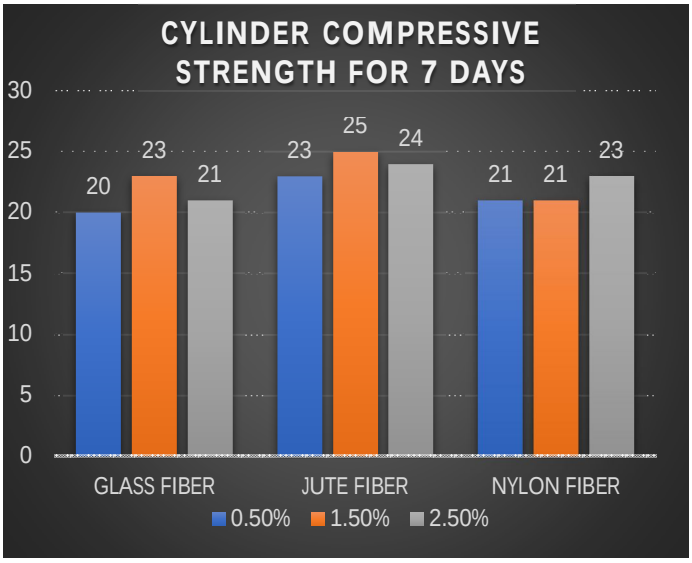

Fig7

From the above fig8

- In Glass fiber it is observed that the tensile strength of cube gives better outcome at 1.50% compared to 0.50% and 2.50%.
- In Jute fiber it is observed that the tensile strength of cube gives better outcome at 1.50% compared to 0.50% and 2.50%.
- In Nylon fiber it is observed that the tensile strength of cube gives better outcome at 2.50% compared to 0.50% and 1.50%.

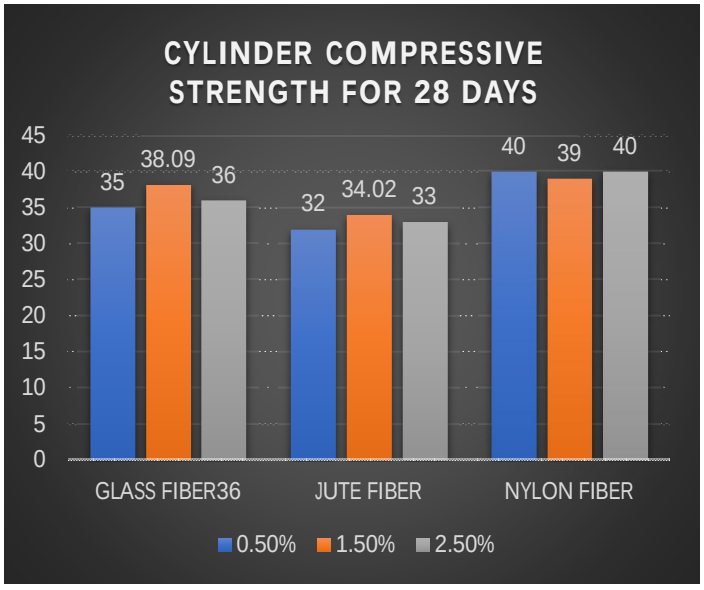

Fig 8

- From the fig 9

- In Glass fiber it is observed that the tensile strength of cube gives better outcome at 1.50% compared to 0.50% and 2.50%.
- In Jute fiber it is observed that the tensile strength of cube gives better outcome at 1.50% compared to 0.50% and 2.50%.
- In Nylon fiber it is observed that the tensile strength of cube gives better outcome at 2.50% compared to 0.50% and 1.50%.

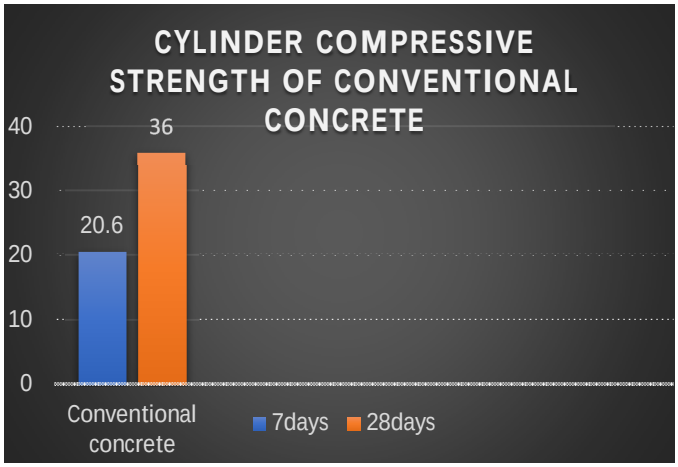

Fig9

Table showing the 28 days compressive strength of Glass, Jute and Nylon fibre concrete compared with conventional concrete

CUBES

percentage	0.5%	1.5%	2.5%
Glass	40.97 N/mm2	46.06 N/mm2	45.67 N/mm2
Jute	30.96 N/mm2	37.55 N/mm2	32.11 N/mm2
Nylon	40.89 N/mm2	43.27 N/mm2	48.69 N/mm2

CYLINDERS

percentage	0.5%	1.5%	2.5%
Glass	38.09 N/mm2	36 N/mm2	35 N/mm2
Jute	34.2 N/mm2	32 N/mm2	33 N/mm2
Nylon	40 N/mm2	39 N/mm2	37 N/mm2

CONVENTIONAL

Conventional cubes	Conventional cylinders
38N/mm2	36N/mm2

Table showing the 07 days compressive strength of Glass, Jute and Nylon fibre concrete compared with conventional concrete

CUBES

percentage	0.5%	1.5%	2.5%
Glass	22 N/mm2	25 N/mm2	26 N/mm2
Jute	23 N/mm2	25 N/mm2	27 N/mm2
Nylon	29 N/mm2	31 N/mm2	32 N/mm2

CYLINDERS

percentage	0.5%	1.5%	2.5%
Glass	20 N/mm2	21 N/mm2	23 N/mm2
Jute	23 N/mm2	25 N/mm2	24 N/mm2
Nylon	21 N/mm2	21 N/mm2	21 N/mm2

CONVENTIONAL

Conventional cubes	Conventional cylinders
18N/mm2	17.6N/mm2

VII. CONCLUSION

From the results and discussions, a few summaries can be drawn.
The workability decreased with the increasing percentage of fibers (glass,jute,nylon).
• The workability of FRC either with WHSF or SBF decreased with the
• The compressive strength of FRC with 0.2% addition of WHSF and 0.5%
The addition of raw Fibres shows an predominant increase in the compressive strength of the cube and cylinder when compared to conventional concrete.
It observed that the compressive strength of the conventional concrete is 18N/mm2 for 7days and 39N/mm2 for 28 days.

In Glass Fiber,
The addition of glass fiber at 0.5%,1.5%,2.5% for concrete.it has been observed that the workability of concrete increased at 2.5% with the addition of glass fiber.
The increase in compressive strength for M30 grade of concrete at 7and 28days are observed to be more at 2.5%.
As the fiber content was increased above 2.5% the compressive strength gets reduced. Excessive addition of fiber leads to poor workability.

In Jute Fiber,
The addition of jute fiber at 0.5%,1.5%,2.5% for concrete.it has been observed that the workability of concrete increased at 1.5% with the addition of glass fiber.
The increase in compressive strength for M30 grade of concrete at 7and 28days are observed to be more at 1.5%.
As the fiber content was increased above 2.5% the compressive strength gets reduced. Excessive addition of fiber leads to poor workability.

In Nylon Fiber,
The addition of nylon fiber at 0.5%,1.5%,2.5% for concrete.it has been observed that the workability of concrete increased at 1.5% with the addition of s fiber.
The increase in compressive strength for M30 grade of concrete at 7and 28days are observed to be more at 1.5%.
As the fiber content was increased above 2.5% the compressive strength gets reduced. Excessive addition of fiber leads to poor workability.

VIII. ACKNOWLEDGMENT

I am profoundly thankful to Mr. G. Tirupati Naidu Head of the Department of Civil Engineering, Dr.Lankapalli Bullayya College of Engineering, Visakhapatnam, India, who has served as my mentor and guide, advising me on how to accomplish my goals.

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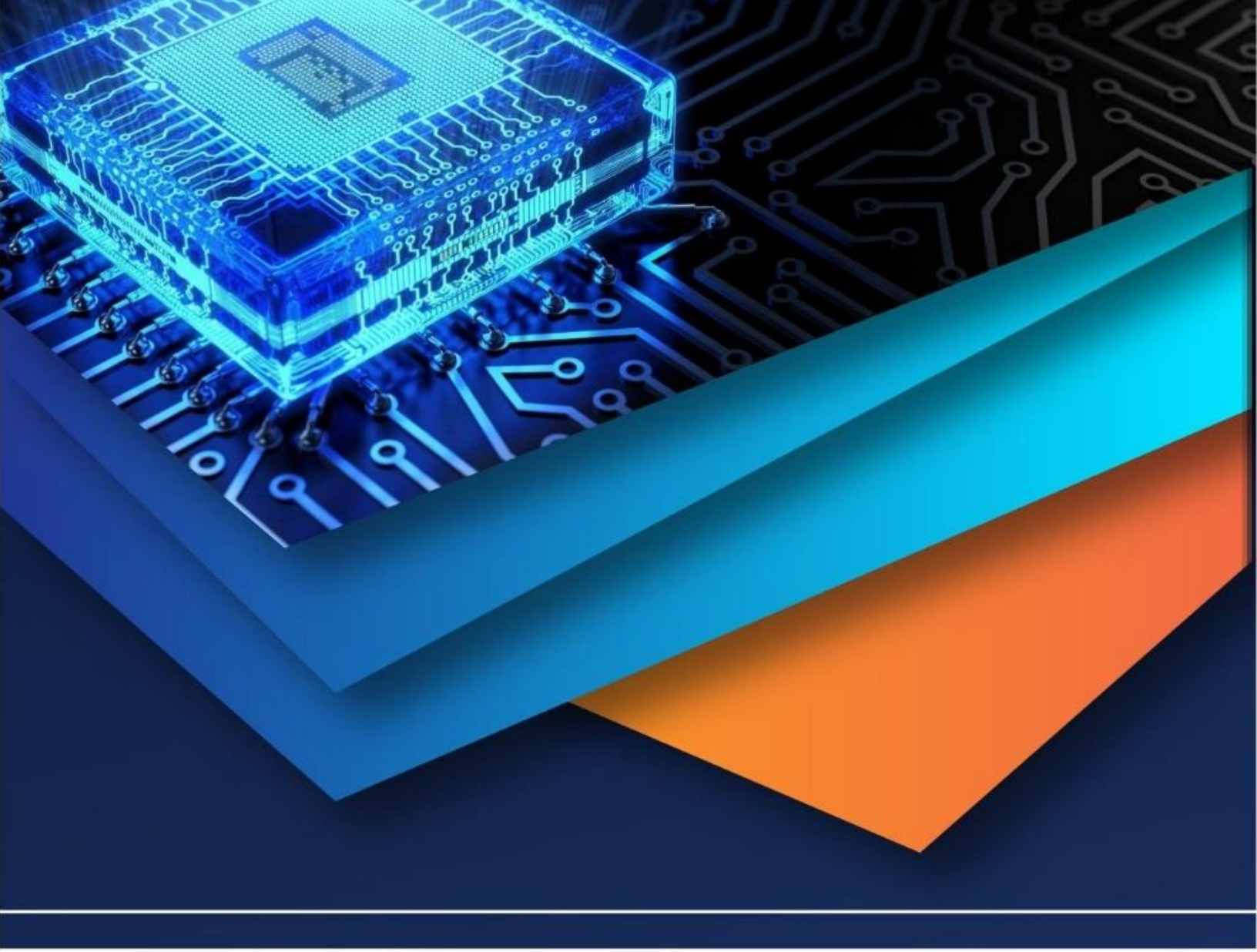
[8] The water absorption of the FRC is increased by increasing the percentage.
[9] From the comparative study between fibre mixed concrete and conventional concrete it is observed that fibre mixed concrete can give better value.



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