A STUDY TO ASSESS THE COMPRESSIVE STRENGTH OF CONCRETE BY INCLUDING JUTE FIBERS AND COMPARING THEM WITH ORDINARY CONCRETE.

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A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering



Department of Civil Engineering

Sonargaon University

147/I, Green Road, Dhaka-1215, Bangladesh

Section: 20C

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Dedicated

To

"Our Parents, Our Teachers and all the good people in the world"

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ABSTRACT

A proportionate combination of water, aggregate (gravel or sand), cement, and admixtures to impart desirable qualities make up concrete. Concrete has great compressive strength but is also brittle; its tensile strength is just 10% of its compressive strength, and it cracks easily, limiting how it may be used. One way around these restrictions is to use fiber-reinforced concrete, made of concrete mixed with fibrous material. Fiber-reinforced concrete (FRC) has become a novel and environmentally friendly material for various uses, such as runways, large industrial building floors, and building pavements. This study investigates using non-metallic fibers, such as jute fiber, in concrete. Natural fibers are employed in modern technologies. This article compares standard plain concrete specimens to study the strength qualities of non-metallic fibers in concrete. The fiber content of concrete increases when Jutes fiber is added, and the compressive strength rises to a particular point. Chopes jute fibers were used in this work to determine whether the 28-day strength might be increased to make an FRC material. High fiber concentrations led to fiber clumping, which caused problems with casting and mixing. Concrete is mixed with 10- and 15-mm long jute samples (0.1% and 0.2%) of volumetric weight in this experiment. The mix design complied with the guidelines provided by the American Concrete Institute (ACI). The proportions of cement to water were 0.45 and 0.55. Poor workability is another effect of the concrete's declining compressive strength. The 28-day compressive strength was 64.34% higher than that of regular concrete, and 0.1% was found to be the ideal jute content. The fiber's length impacted both its compressive and tensile strengths. As the fiber content rises, the FRC's ductile behavior gets better. Additionally, the analysis revealed that FRC's modulus of elasticity was higher than regular concrete.

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CHAPTER-1

INTRODUCTION

1.1 Background

The substance of concrete is extremely complex and varied. Three things make up this mixture: cement paste, fine aggregate, and coarse aggregate. The individual components' reactions and their interactions determine how concrete reacts to stress. With a strength greater than the concrete's, the coarse aggregate is a linearly elastic and brittle material. Concrete has a lower modulus of elasticity than cement paste, which has a higher compressive strength. Although small particles can weaken concrete, they can raise its modulus of elasticity. (Salih et al., 2019)

Concrete is a material that is known for its compressive strength, which is typically assessed by testing the strength of concrete cylinders or cubes. This property is important for designing structures made of concrete. However, it is important to note that concrete has lower tensile strength than compressive strength, which means that it is more prone to cracking when subjected to tensile stress. Although tensile strength is often ignored in design, it is a crucial characteristic because it is usually the cause of cracks that form under load or due to environmental changes. The collapse of concrete under tension is controlled by microcracking, which occurs in the area where the cement and aggregate particles meet. (Prakash Chandar & Balaji, 2015)

One of concrete's most crucial mechanical characteristics is its modulus of elasticity. The stiffer the material, the greater its modulus value. When comparing high-performance concrete to normal-strength concrete, it can be observed that the former has a greater elastic modulus, indicating that it is a stiffer type of concrete. One may describe concrete as a brittle material. (Jamil et al., 2023)

This is because the behavior of ductile materials, such as steel, under loading is quite different from that of concrete. Around the world, Fiber Reinforcement Cement Concrete (FRC) is commonly utilized to improve the overall performance of concrete. A technological problem in developing nations is the design of fiber-reinforced cement concrete that is both affordable and long-lasting for use in building construction. Currently, steel, glass, polymers, carbon, and natural fibers are among the types of fiber

employed(Prakash et al., 2021). Carbon fibers, despite their high performance, have not been used in cementitious composites on a commercial scale due to concerns about their ecological impact. They are not regarded as environmentally friendly because of their non-biodegradable nature and energy-intensive production process.(Zhou et al., 2013)

On the other hand, natural fibers are popular for their affordability and environmental friendliness. They may be used as reinforcement to overcome the inherent shortcomings in cementitious materials. Much study is being done on reinforcing fibers in cement composites, mostly for building materials such as jute, bamboo, sisal, coconut husk, and sugarcane bagasse. The use of natural fibers in a cement matrix that is comparatively brittle has greatly increased the composite's strength and toughness. (Chakraborty et al., 2013)

Bangladesh is the world's second-largest jute producer, ranking second overall in Asia as well. Bangladesh used to be the world's largest producer of jute, but due to a lack of technological breakthroughs in the crop's cultivation, production stagnated. India eventually overtook Bangladesh as the world's largest producer of jute, concrete's brittleness can be mitigated using these fibers (Shahbub & Lecturer, 2021). Jute is second to cotton in production volume and is among the least expensive natural fibers. This article reports on an effort to determine the ideal proportion of jute fibers to combine with concrete to attain the maximum compressive strength. Various fiber contents were employed as reinforcement, intended to produce uniformly dispersed reinforcement and randomly orientated inside the matrix. (Chakraborty et al., 2013)

1.2 Research Objective

This research was conducted to answer the flowing question:

- To evaluate the impact of varying proportions of jute fibers on the compressive strength of concrete.
- To compare the compressive strength of jute-reinforced concrete with that of ordinary concrete.
- To monitor the pattern of concrete failure, both with and without jute fiber.

1.3 Jute Fiber

1.3.1 Why should we use jute fiber?

Jute fibers have the following benefits over traditional reinforcing fibers: • Wide availability compared to synthetic (polypropylene, polyethylene, polyolefin, polyvinyl alcohol), glass, and steel, among others.

- Cheap.
- Decreased roughness.
- Capacity to withstand impact from machines.
- Environmental friendliness, ease of handling, and processing.
- Adaptable to various applications, including long-span roofing components, wall panels, pipes, permanent frames, reinforcement of already-existing structures, and structural building elements.

Because jute fibers (JF) are inexpensive and widely available due to their yearly plant origin, their use in concrete composites has been deemed a viable alternative. The fact that jute fibers are so widely available explains their abundance. These items have a pentagonal or hexagonal cross as their highlighted design, which makes them good for outdoor use because they block UV rays and act as shields. They also have antibacterial qualities. Jute textiles have remarkable mechanical qualities that make them perfect for reinforcing laminated and bionic composite materials. Jute textiles have several uses(Sultana et al., 2020). The jute fabric-reinforced composites are both economically feasible and demonstrate good structural qualities that meet the requirements for industrial materials. Because of its remarkable qualities, low cost, wide availability, and eco-friendliness, jute is a notable example of a biodegradable natural fiber. The intrinsic mechanical characteristics of jute and sisal fibers are significantly higher than those of coconut and sugarcane fibers. The phenomenon's manifestation is easily noticeable in the materials enhanced with these appropriate fibers. Jute fibers have been shown to have a tensile strength between 250 and 300 MPa based on the investigation's findings. This degree of power is considered sufficient for many different uses. Furthermore, these fibers have a density that is about seven times lower than that of steel fibers. The ability and impact properties of cementitious composites have been the subject of numerous experiments, focusing on the effects of short, isolated jute fibers and long, unbroken jute fibers. They claim that the durability,

resistance to cracking, and ability to endure external forces of the composite are all improved by adding jute fibers to concrete. According to several research, jute fibers can be used in concrete materials instead of traditional fibers.(Alomayri et al., 2023)

The kind and Amount of fibers utilized might have an impact on the characteristics of natural fiber-reinforced concrete (NFRC). Apart from the fiber's hydrophilic properties, the quantity of fiber and infill incorporated into the composite can also modify the properties of non-fibrous ceramic laminates. Composites usually need a lot of fiber content to attain high functionality and optimal performance. The ideal circumstances are essential to concrete's correct operation. As mentioned before, fiber content has a critical influence on NFRC properties. Several researchers focused on using jute fiber (JF) rather than steel fibers. The problems of corrosion and thermal expansion are also linked to steel fiber. It is difficult to assess the importance of coconut fiber because there is disagreement about using JF in concrete. Furthermore, various changes may occur over time because jute fiber is biodegradable. Jute filaments can deteriorate over time due to a number of causes, including exposure to alkalinity, moisture, and microbes that are frequently present in concrete surroundings. The deterioration process may compromise the fiber's mechanical characteristics, such as its stiffness and tensile strength. The presence of cement causes the alkalinity of concrete. Extended exposure to an alkaline environment might weaken jute fibers' structural integrity. Alkaline assault can weaken filaments' tensile strength and structural stability, eventually disintegrating filament. Regarding jute fiber's environmental assessment, several steps involve its cultivation and processing, such as preparing the ground, planting, harvesting, retting, and extracting the fiber. The manufacturing of jute fiber has a carbon footprint that varies depending on transportation, energy sources, agricultural practices, and processing techniques. Because it requires few pesticides and can grow in various regions without considerable irrigation, jute is often considered an environmentally benign fiber. The carbon footprint can be computed using the embodied carbon factor in the available literature.

CHAPTER-2

LITERATURE REVIEW

2.1 General

According to the earlier study by. Ahmad et al., 2022, the addition of JF increased the fibrous surface area of the concrete, decreasing its fluidity. Consequently, the concrete's abrasiveness increased. It has been established that adding 2% JF to concrete can increase the material's maximal mechanical strength. Their research revealed that the highest CS, STS, and FS increases when 2% JF is added. When jute fiber is added to concrete, the mechanical characteristics of the composite material deteriorate over a 2% threshold. It has been noted that adding JF to concrete improves its durability properties, particularly in terms of density, water absorption, drying shrinkage, and acidity tolerance. (Ahmad et al., 2022)

In another study on the usage of JF in concrete conducted by.(Islam & Ahmed, 2018), a favorable association was seen between the increase in JF content in concrete and the reduction in the slump of freshly mixed concrete. The results show that specimens containing JF with a larger length and aspect ratio—more specifically, JF with 20 mm of length and an aspect ratio of 200—showed a greater reduction in slump in concrete mixes than specimens containing JF with 10 mm of length and an aspect ratio of 100. This event happened due to the longer JF's noticeably higher surface area to volume ratio. The study's findings show a relationship between the amount of CS achieved and the length of the curing procedure. The study results show that, regardless of the length of the fiber, adding a tiny amount of 0.25% jute fiber to concrete significantly increased its compressive strength (Ahmad et al., 2022).

The results of this investigation show that the specimens tested for CS, STS, and FS showed failure patterns that indicate a decrease in the number and size of cracks due to the jute fibers' inclusion. The specimens used for the tests mentioned above were verified to have undergone CS, STS, and FS. The fibers worked as planned to keep the concrete sample from collapsing entirely. Concrete can reduce its embodied carbon natural fibers like jute and additional cementitious ingredients. (Serpieri & Monaco, 2023)

Plain concrete is fragile and disadvantageous because it is strong in compression but weak in tension. Much research has been done to examine how JF affects concrete in its fresh and hardened states. Since the late 1960s, there has been a rise in the use of

fiber-reinforced concrete (FRC) as a solution to these drawbacks(Dayananda et al., 2018).

This study aims to examine the effects of the JF particle ratio on the properties of freshly mixed and solidified concrete compositions that have been created using RSM, together with other prognostic factors. The application of this specific technology has the potential to accelerate the integration of fiber-reinforced concrete within a pragmatic setting. Using statistical equations, this work will support the actual application of JF in concrete and aid in predicting the strength of concrete containing different percentages of JF. Their primary goal is to improve the material's toughness and energy absorption capability while strengthening concrete.

2.2 Fiber Reinforced Concrete (FRC)

Fiber-reinforced concrete (FRC) consists of discontinuous discrete fibers, water, fine or coarse aggregate, and hydraulic cement.(Bheel et al., 2021) . It may also comprise common admixtures found in conventional concrete. Fibers made of steel, plastic, glass, and natural materials are utilized in a variety of shapes and sizes. However, out of all the fibers, steel fiber is the most frequently employed for both structural and nonstructural applications. The post-cracking behavior of fiber-containing concrete has significantly improved. Tensile strains at capture grow significantly despite the ultimate tensile strengths in fiber-reinforced concrete not increasing significantly. Fiber-reinforced concrete is significantly stronger and more impact-resistant than regular concrete. Fibers are typically added to concrete to regulate its cracking and alter the behavior of the components after the concrete matrix has fractured rather than to increase the strength of the concrete itself. This is accomplished by creating a bridge over the cracks as they open, and the fibers provide the FRC its post-cracking ductility. (Amartey et al., 2014)

2.3 Characteristics of FRC

The advantages of fiber reinforcement over traditional reinforcement are as follows:

- Steel bars are only positioned where necessary, while fibers are often dispersed across a cross-section.
- The steel bars are continuous and not as closely spaced as the fibers, which are quite short and closely spaced.

- Generally, fibers cannot provide the same reinforcement area as steel bars.
- Although the size of the cracks is smaller in FRC, the crack density is higher.
- Pull-out is the failure mechanism.
- Fibers stop cracks from spreading as quickly.
- Fiber-containing concrete compositions have extremely poor consistency, but the concrete's playability and compatibility outweigh the low consistency.
- The material's toughness can be raised by 15% to 30%.
- There is little change in the creep outcomes.
- There are variations in drying shrinkage.
- Their application lies in cavitation damage. (Chakraborty et al., 2013)

CHAPTER-3

MATERIALS AND METHODOLOGY

3.1 Introduction

This chapter includes the experiments needed to ascertain the characteristics of the concrete ingredient. Experimental research using a standard cylinder size of 4" by 8" was conducted. Five phases can be distinguished in an experimental programmed.

- ❖ The readying of the mixing of concrete.
- ❖ Casting of cylinders in a maritime environment for 28 days in a laboratory using coarse aggregate.
- ❖ Testing the crushing strength of these cylinders.
- ❖ Crushing strength was determined by casting cylinders in a laboratory using recycled or demolished coarse material and waiting 28 days for the results.

3.2 Materials & Properties

3.2.1 Cement

We use Ordinary Portland Cement (OPC) in our experiment. OPC cement is created by finely grinding clinker, gypsum, and other components like limestone, fly ash, or slag. This cement took 45 minutes to set. OPC has a specific gravity of 3.12 and is composed of 95-100 percent clinker and 0-5 percent gypsum. As a result, Shah Ordinary Portland Cement was utilized in the experiment because it was readily available.



Figure 3.1 Ordinary Portland Cement

Table 3.1: Physical Properties of Ordinary Portland cement (OPC 43 grade)

Physical property	Results	IS: 8112-1989 Specifications
Normal Consistency	31%	-
Initial setting time (minutes)	87	30 (minimum)
Final setting time (minutes)	201	600 (maximum)
Fineness (retained on 90-micron sieve)%	5.1	10 (maximum)
Soundness (mm)	2.2	10 (maximum)
Specific gravity	3.13	-
Compressive Strength (Mpa)		
14-Days	24.6	23 (minimum)
21-Days	35.3	33 (minimum)
28 Days	45.1	43 (minimum

3.2.2 Coarse Aggregate

In this investigation, Bhola Ganj stone chips were typically employed as a coarse aggregate for concrete preparation, as seen in the figure. In one instance, however, 20mm crushed stone chips that had been downgraded were used as coarse aggregate. The study's coarse aggregates came from crushed cylinders cast using coarse aggregate or crushed stone. As seen in the figure, most of the aggregate was recycled and washed thoroughly to remove dust and debris before preparing concrete.



Figure 3.2: (3/4” down grade) Coarse Aggregate.

Table 3.2: Physical properties of Coarse Aggregate

Properties	Observed values
Bulk Density (Loose), kg/m3	1440
Bulk Density (Compacted), kg/m3	1610
Specific Gravity	2.63
Water Absorption%	0.5

3.2.3 Jute Fiber

The experiment used raw jute fiber, as seen in the figure. This test required a certain percentage as well as a specific length. The jute fiber was cut into 10mm and 15mm length and combined with the concrete mixture.



Figure 3.3: 10mm & 15mm length jute fiber cutting

Table 3.3: Physical Properties of jute

Diameter (μm)	10-30
Tensile Strength (Mpa)	108
Youngs modulus (Gpa)	3.42
Specific Gravity	1.48-1.50
Stretch and Elasticity	Not good and 2% elongation at break
Resiliency	Not very good
Moisture Absorption	13.75%
Dimensional stability	Good



Figure 3.4: After cut of Jute fiber

3.3 Mix Design

No particular mix design is used in various nations, including Bangladesh, for low-rise buildings. People rely on masons without consulting a civil engineer, and the usual ratio-based mix (nominal mix) is employed. Therefore, such a design cannot yield precise strength. The parts or ratios of cement, fine and coarse aggregates are the most frequent ways to indicate the proportions of constituents in a concrete mix.

Either mass or volume is used to determine the proportions. Typically, the mass ratio of cement to water is stated. The local practice used mixed design because this research intends to employ fiber for diverse structures, including typical low-rise buildings. In addition to using a 1:2:4 ratio for mix design, we also employed a ratio of 1:1.5:3, meaning that 1 part cement, 1.5 parts fine aggregate, and three parts coarse aggregate were used based on their respective volumes.



Figure 3.5: Mixing Cement, Fine Aggregate, Coarse Aggregate.

3.4 Mixing Concrete for Casting

Before mixing, the cement was kept dry and in a moisture - proof container to avoid hydration and handling issues. The fine and coarse aggregate surfaces were wet and dry a full day before use. According to ASTM C 192-90a, all concrete products must be stored between 20 and 30 degrees at room temperature. A homogenous mass must be formed to guarantee that the materials are mixed properly and that the aggregate particles are covered in cement paste on all of their surfaces. This test used the drum mixer. Concrete slump tests were the workability tests used in this investigation. ASTM C143-90a was followed when conducting the slump test.

Given that the test concerned jute fiber reinforced concrete, jute was required in specific proportions and for a specific length of time. As a result, lengths of 10 and 15 mm were cut specifically for this investigation. Next, the necessary jute and cement aggregate were put in a concrete mixing machine. After the liquid is poured, there will be a consistent fiber dispersion. Three runs of the slump value test were conducted. Precise data regarding the slump value was obtained. Following that, the ASTM C31-recommended compaction for the cylindrical mold was completed. A cure took place for 14, 21, and 28 days to get the test result. The compression test machine provided the compressive load value.



Figure 3.6: Mixing JFRCC

3.5 Cylinders Preparing

Thirty sets of (4"*8") cylinders were cast in two steps. Regular Portland cement stone chips and coarse aggregates, Sylhet sand (1:1.5:3) and (1:2:4), were placed within the 60 cylinders. Mobile was used as lubricating oil to wipe the interior of the molds so that the concrete could be easily removed once the molds were closed. After being unloaded from the drum-type mixture machine, fresh concrete was prepared according to the designed mix and compacted using a 16 mm diameter and 600 mm length tool. The 2.5 tampering per layer allowed for uniform distribution of the temping strokes, which caused the compaction to be convicted over the mold's cross-section. After that, the specimen was kept in an undisturbed environment for 24 hours to minimize moisture loss and keep it at room temperature. The accurate way to measure the materials is through weight batching. In this investigation, batching has been employed for material measurement. A weight-batching technique should always be used for significant concrete.



Figure 3.7: prepare concrete cylinder

3.6 Tamping of Concrete cylinders

The concrete tamping rod is essential for concrete testing. It consolidates concrete specimens and removes air gaps to preserve the material's integrity. However, these instruments are essential for accurate workability evaluations like slump tests and unit weight measurements, so it's not simply about consolidation. However, utilising a tamping rod correctly and skillfully takes practice. Invalid test findings can be caused by using the wrong tamping technique. It could show up as leaks during testing or inadvertently disturbing the concrete when tamping. The Tamping Rod is composed of steel and is zinc/nickel plated to provide a long product life. 24" (60 cm) in length and 5/8" (16 mm) in diameter. Tamping rods remove air spaces from the concrete when creating slump tests, concrete cylinders, or concrete air entrainment tests. Both ends are rounded hemi spherically and are coated to prevent corrosion.



Figure 3.8: Tamping Concrete cylinder

3.7 Curing

Concrete must be thoroughly cured to acquire its maximum qualities. To keep water from evaporating from the un hydrated concrete, the specimens were immediately covered with a moist gunny bag after shaping. After 24 hours (ASTM C192, 1990), the specimens were removed from the molds and wet cured for 14, 21, and 28 days at normal room temperature. Following wet curing, the specimens were loaded for compressive strength testing.

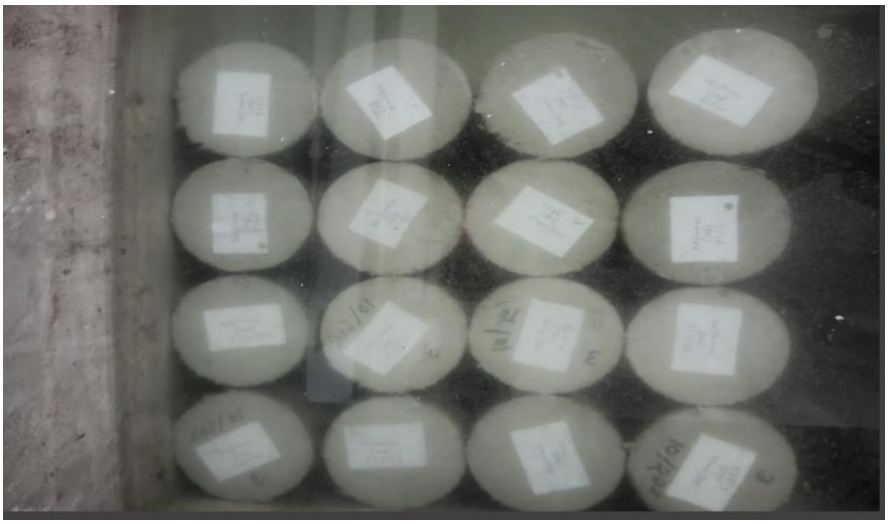


Figure 3.9: Curing Concrete Cylinder

3.8 Compressive Strength Test

After 14, 21 and 28 days of curing, the Universal Testing Machine (UTM) inspected the specimens. Bearing plates were positioned at the top and bottom to distribute the load equally. Without causing shock, a Universal Testing Machine (UTM) continuously applied compressive stress. Until the specimens failed, the load was progressively raised at 2 mm/min. The maximum load the compression test machine could support was noted during the test. They estimated the compressive strength of concrete involved dividing the load at failure by the specimen's area. In Figure below, the test setup is shown.

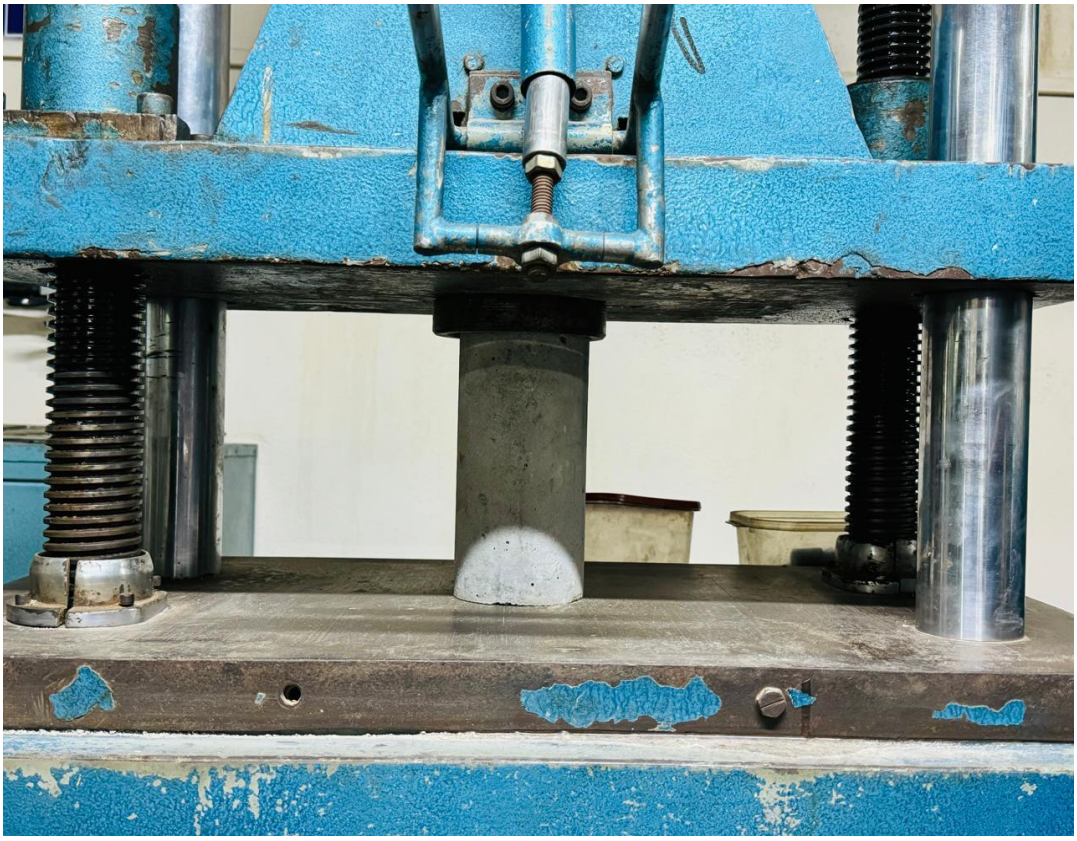


Figure 3.10: Concrete Cylinder setup on UTM for Compressive Strength Test

3.9 Crushing

Concrete is a composite material comprising cement paste and filler components, fine or coarse aggregate, and binding materials, such as filters. In the past, it was thought that aggregate and cement kept each other together chemically. However, current technology has demonstrated that aggregate exhibits a chemical bond at the interface between aggregate and paste. A significant component of concrete is aggregate, which determines the maximum properties and workability of the material. Specific aggregate characteristics include source, normal, light, or heavyweight, aggregate size, shape, crushing type, angularity index, surface texture, modulus of elasticity, bulk density, specific gravity, absorption and moisture content, bulking, cleanliness, soundness of aggregate thermal properties, and aggregate grading in addition to the interfacial transition zone (the surface where aggregate and cement paste come into contact).



Figure 3.11: Crushing Concrete Cylinder

Plays a significant part in the durability and strength of concrete. However, impurities that could interfere with the hydration process, impede an efficient link between the aggregate and matrix and shorten the lifespan of concrete should be avoided when using aggregates. Wall effects indicate that people should stay away from such areas. The shape of the aggregates plays a crucial role in maintaining workability and strength. If aggregate voids are minimized, less cement paste will fill them. It is challenging to accurately assess the irregular shape of a material such as concrete aggregate, which is made of rocks and has features of its parent rock and is shaped by the type of crusher used to crush the rock. Studies reveal a correlation between aggregate voids and particle shape, texture, and grade: rounded, cubical, and well-graded particles have lower aggregate void contents than flaky, elongated, and angular aggregates.

CHAPTER-4
RESULTS AND DISCUSSION

4.1 Introduction

"Effect of fiber percentage" and "Water-cement ratio" are two perspectives to discuss the experiment's results. Two water-to-cement ratios (0.45 and 0.55) were employed in this experiment. For every water-to-cement ratio, two fiber percentages were employed. The failure pattern may also point to a change in the properties of concrete that contains or lacks fiber.

4.2 Impact of the proportion of fiber

Fiber doesn't predictably change the various strengths of concrete, such as its compressive strength. Nonetheless, certain patterns can be observed in particular concrete strength requirements. For instance, different fiber percentages can be used to see changes in compressive strength, and the ideal dosage for greater compressive strength can be discovered.

4.3 Result Analysis

The results of an experimental investigation using various fiber amounts and lengths for a compressive strength test are shown in this section. Following 14, 21, and 28 days of water treatment, the following tests were carried out on the cast cylinders. There will be a table and a chart displaying the results. The results are shown diagrammatically, and the impact of jute fibers was evaluated. It was discovered that the slump value decreases as the fiber content rises. Therefore, at 0.2 percent fiber inclusion, the concrete slump is drastically reduced.

Tests of compressive strength were conducted on concrete cylinder specimens that had varying percentages of jute fiber added to them. For lengths of 10mm and 15mm, the compressive strength of the concrete was compared to two different concentrations of jute fiber (0.1% and 0.2%). The table below provides statistics about concrete's compressive strength. The compressive strength at high compressive stresses is displayed in the chart, as seen in the figures below. The results show that adding jute fiber to the mixture had a negligible effect on compressive strength.

The chart shows that for jute fibers measuring 15 mm in length and with a fiber content ratio of 1:2:4, the highest compressive strength reached 0.1%. Compared to regular concrete, the compression strength of 14, 21, and 28 days of 15 mm lengths was improved by 64.34% and 70.9%, respectively. Reducing the specific gravity of the composites and adding jute fiber to concrete can explain a downward trend in the fiber content. However, incorrect mixing, low specific gravity, and excessive porosity of the jute fiber concrete can also cause this decline. Reduced compressive strength has been discovered in ratios of 1:1.5:3, although different results are found in 1:2:4 when adding a bigger volume and longer fiber.

According to Chart, the Jute fiber raised stresses by 62.34 percent after 28 days, with the length of 15 mm having the maximum compressive stress at the peak (ratio of 1:2:4) compared to standard concrete with peak compressive stress. There was a diminishing tendency when the fiber content was raised by more than 0.1 percent.

Higher cement content results from using the proper concrete mixture and stronger enhancement, influenced by the composite strength. In the presence of more cement, fibers can be evenly distributed throughout the concrete mixture, resulting in a regular fiber arrangement that creates a more resilient composite material in opposition to functional forces. Regarding JFRC, the 10-mm fiber in the mixing ratio with 0.10% dosage represents the second-strongest improvement. An unexpected drop in pressure strength occurs by adding longer (15 mm) fibers and their contents.

The addition of yarns raises the percentage of coarse aggregate, which may result in significant porosity in the cement matrix since several studies used reinforcement materials, i.e., coarse aggregate-like fibers or yarns, despite the thin aggregate fraction. A decreasing trend in fiber can be explained by lowering the specific gravity of the composites by adding jute yarn to the concrete and by lowering low-specific gravity, insufficient mixing, and high JFC porosity. A lower compressive strength was added, particularly when there was a high volume and longer length of yarn.(Mahir et al., 2019) have obtained similar results. Last, but not least, the JFRC is the most promising combination of increased compression strength and less than 15mm fiber cut length with a fiber content of less than 0.1%.

Table 4.1: Compressive strength result after 14 days Ratio of concrete 1:1.5:3.

M20 Grade Concrete	% of coarse aggregate	% of jute fiber	Compressive Strength in (N/mm2)	Average Compressive strength (psi)
Ordinary Concrete	100%	0	18.41	2632
		0	17.89	
With jute fiber (10mm)	100%	10%	17.65	2572
		10%	17.825	
With jute fiber (10mm)	100%	20%	15.92	2305
		20%	15.86	
With jute fiber (15mm)	100%	10%	16.16	2300
		10%	15.56	
With jute fiber (15mm)	100%	20%	14.85	2213
		20%	15.67	

Table 4.2: Compressive strength result after 14 days Ratio of concrete 1:2:4.

M20 Grade Concrete	% of coarse aggregate	% of jute fiber	Compressive Strength in (N/mm2)	Average Compressive strength (psi)
Ordinary Concrete	100%	0	8.43	1273
		0	9.13	
With jute fiber (10mm)	100%	10%	11.89	1641
		10%	10.75	
With jute fiber (10mm)	100%	20%	10.51	1554
		20%	10.92	
With jute fiber (15mm)	100%	10%	11.78	1773
		10%	12.67	
With jute fiber (15mm)	100%	20%	9.51	1455
		20%	10.55	

Table 4.3: Compressive strength result after 21 days Ratio of concrete 1:1.5:3.

M20 Grade Concrete	% of coarse aggregate	% of jute fiber	Compression Strength in (N/mm2)	Average Compression strength (psi)
Ordinary Concrete	100%	0	20.83	2922
		0	19.47	
With jute fiber (10mm)	100%	10%	18.31	2641
		10%	18.11	
With jute fiber (10mm)	100%	20%	19.19	2750
		20%	18.72	
With jute fiber (15mm)	100%	10%	17.73	2453
		10%	16.1	
With jute fiber (15mm)	100%	20%	19.3	2690
		20%	17.80	

Table 4.4: Compressive strength result after 21 days Ratio of concrete 1:2:4.

M20 Grade Concrete	% of coarse aggregate	% of jute fiber	Compression Strength in (N/mm2)	Average Compression strength (psi)
Ordinary Concrete	100%	0	10.92	1465
		0	9.29	
With jute fiber (10mm)	100%	10%	12.06	1711
		10%	11.54	
With jute fiber (10mm)	100%	20%	12.72	1823
		20%	12.43	
With jute fiber (15mm)	100%	10%	13.97	2070
		10%	14.57	
With jute fiber (15mm)	100%	20%	12.18	1812
		20%	12.81	

Table 4.5: Compressive strength result after 28 days Ratio of concrete 1:1.5:3.

M20 Grade Concrete	% of coarse aggregate	% of jute fiber	Compression Strength in (N/mm2)	Average Compression strength (psi)
Ordinary Concrete	100%	0	22.34	3275
		0	22.81	
With jute fiber (10mm)	100%	10%	20.26	2985
		10%	20.87	
With jute fiber (10mm)	100%	20%	20.91	3075
		20%	21.48	
With jute fiber (15mm)	100%	10%	19.7	2835
		10%	19.4	
With jute fiber (15mm)	100%	20%	19.5	2799
		20%	19.1	

Table 4.6: Compressive strength result after 28 days Ratio of concrete 1:2:4.

M20 Grade Concrete	% of coarse aggregate	% of jute fiber	Compression Strength in (N/mm2)	Average Compression strength (psi)
Ordinary Concrete	100%	0	12.53	1895
		0	13.59	
With jute fiber (10mm)	100%	10%	14.16	2000
		10%	13.41	
With jute fiber (10mm)	100%	20%	14.55	2108
		20%	14.52	
With jute fiber (15mm)	100%	10%	17.12	2490
		10%	17.22	
With jute fiber (15mm)	100%	20%	14.96	2187
		20%	15.20	

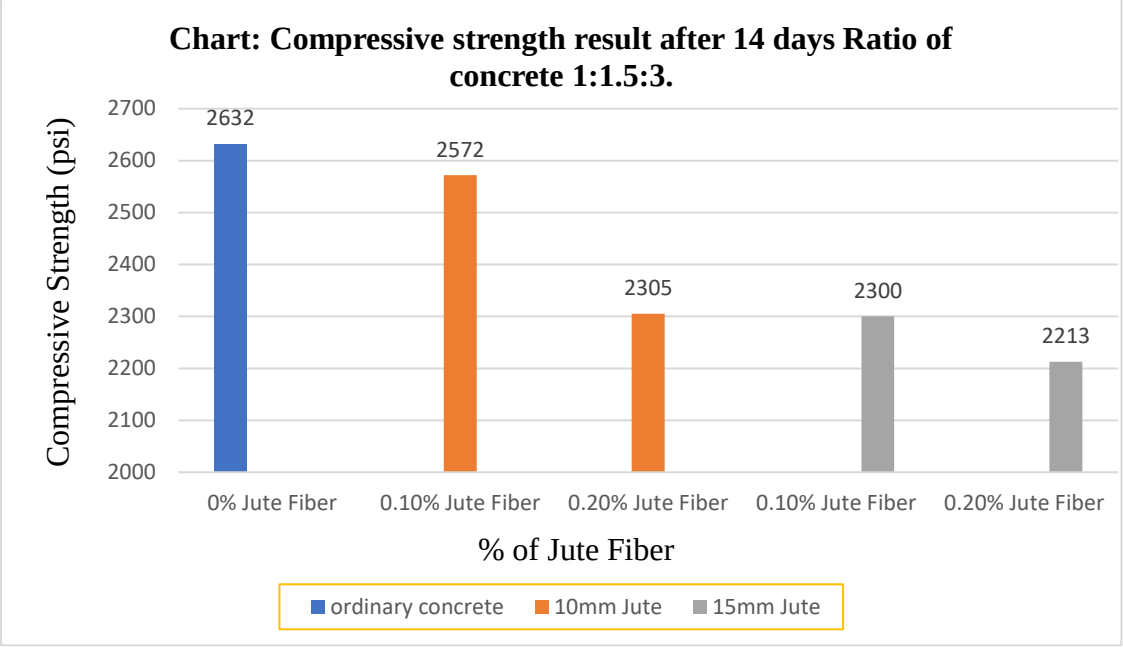


Figure 4.1: Compressive strength result after 14 days Ratio of concrete 1:1.5:3.

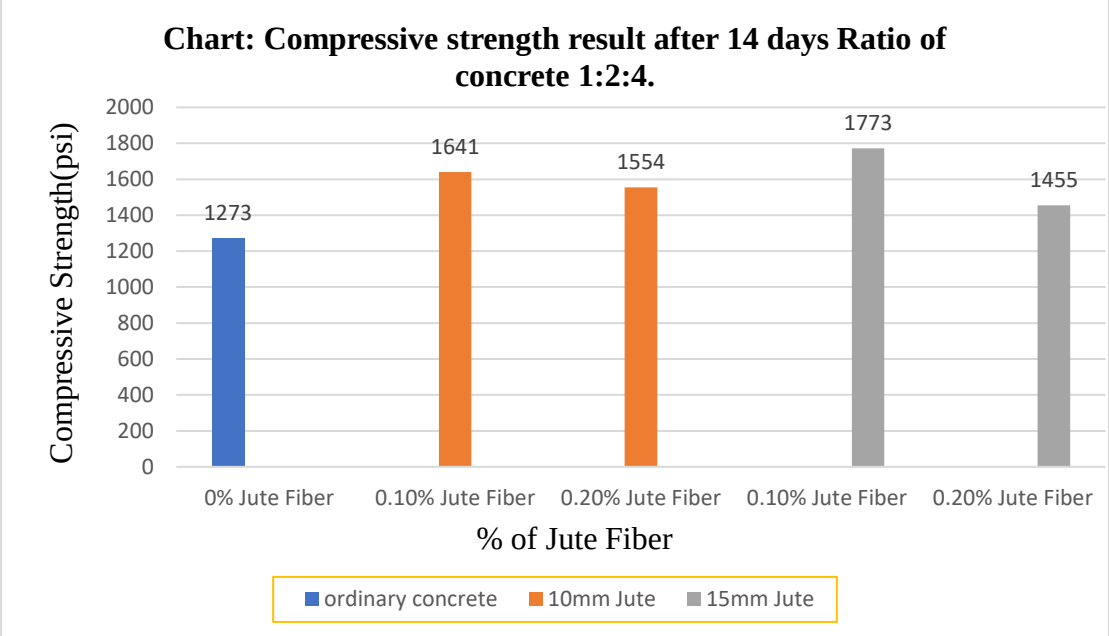


Figure 4.2: Compressive strength result after 14 days Ratio of concrete 1:2:4.

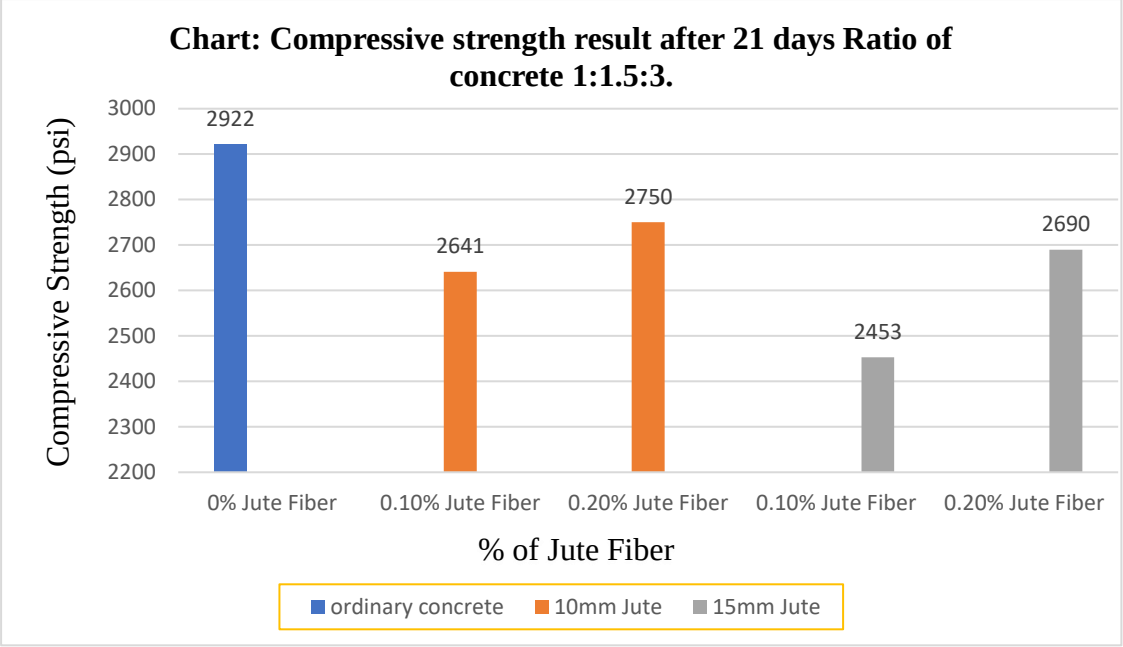


Figure 4.3: Compressive strength result after 21 days Ratio of concrete 1:1.5:3.

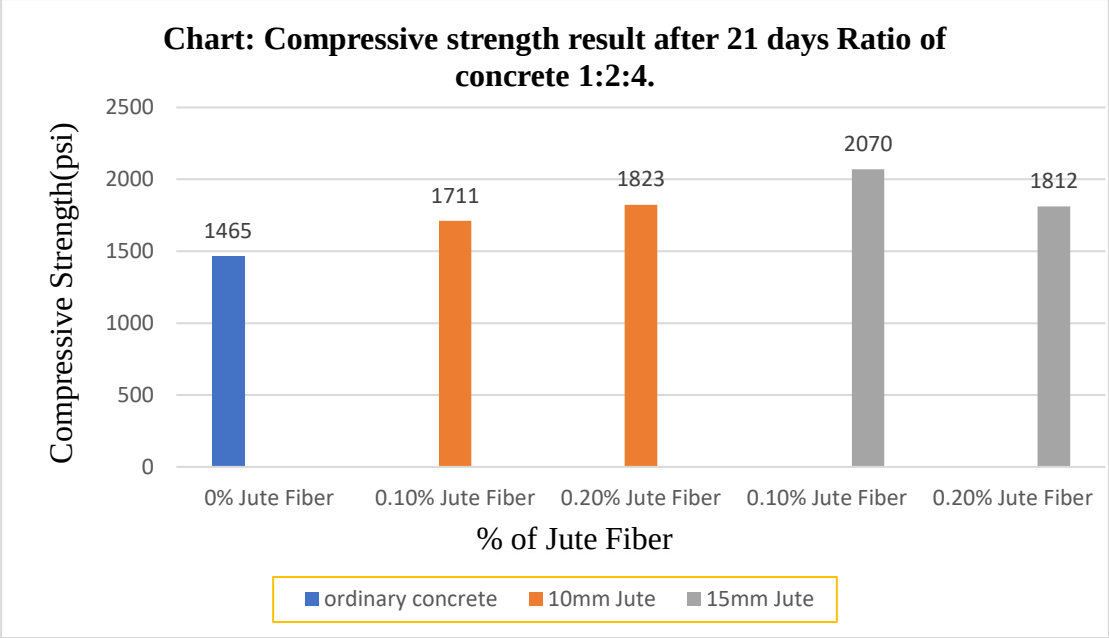


Figure 4.4: Compressive strength result after 21 days Ratio of concrete 1:2:4.

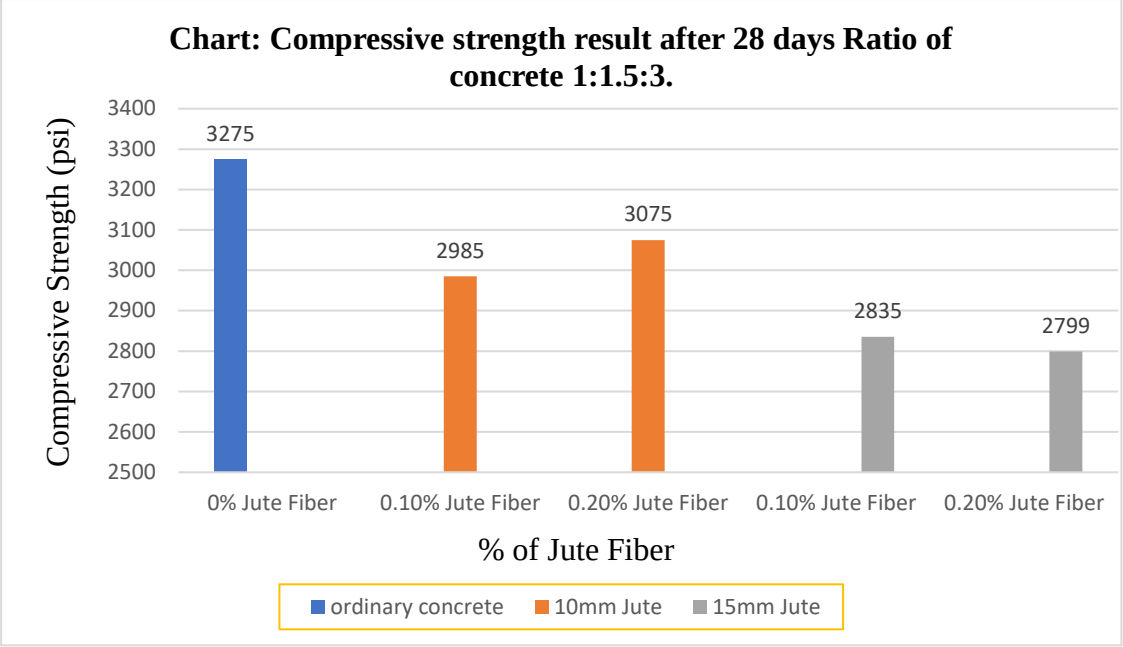


Figure 4.5: Compressive strength result after 28 days Ratio of concrete 1:1.5:3.

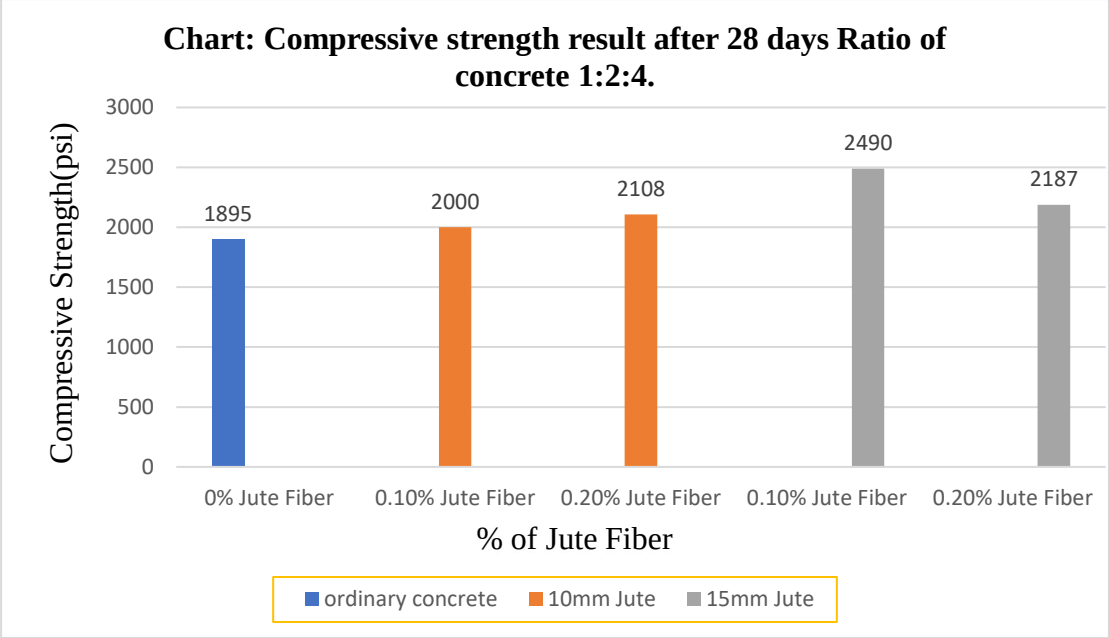


Figure 4.6: Compressive strength result after 28 days Ratio of concrete 1:2:4.

CHAPTER-5
CONCLUSION & FUTURE WORK

5.1 Conclusion

Concrete is a well-known material worldwide. Cement and aggregates, water quality, compaction type, mixing technique, cure time, temperature, and moisture content are only a few variables that affect it. One of the primary research topics is how well concrete complies with fibers. This study attempted to replace commercially available polyester fiber in Bangladeshi micro concrete with locally produced jute fiber. However, further research is needed to understand how reinforced concrete, like jute fiber, behaves and functions.

Therefore, this study aimed to discover many key characteristics of jute fiber reinforced concrete (JFRC), mostly related to strength . However, the primary focus of the study was the impact of fiber content on the previously listed properties of JFRC. It led to a low volume change in the fiber dosage. The study considers compressive loading and static compressive strength as strength parameters.

The following conclusions about the strength and flexibility of fiber-reinforced concrete may be made after testing and data analysis. The main findings and suggestions for additional study are outlined below:

- The concrete for this jute fiber is robust enough to maintain its shape and collapse quickly after the 0.2% jute fiber content, which decreases the slump.
- When a 1:2:4 ratio of concrete and a length of 15mm long fiber was used, the compressive strength of concrete reinforced with jute fibers increased by 64.34% and 70.94%, respectively, compared to ordinary concrete.
- The crucial fiber content, which is between 0.1% and 0.2% of the volumetric weight of the cement concrete, was optimized by producing it with different proportions of jute fiber. The maximal compressive strength of the cement compound is achieved at 0.1% fiber load.
- The traditional ratios of sand, cement, stone chips, and water were used in the concrete mixing process to produce adequate workability of concrete during casting.

- The ideal JFRC content, considering concrete strength, flexibility, and durability parameters, may be determined to be 0.1% fiber.
- Short jute fiber (optimal length: 10 mm) was designed for dispersion in wet and dry concrete and mortar.
- For a length of 10 mm, the ideal jute fiber content is 0.1%, yielding the highest compressive strength as overall.

5.2 Recommendation for Future work

Expanding the study's scope has always been necessary to gather more data and get more accurate results from testing and analysis. Further research has great potential because this is a relatively new topic in the nation's building industry. The following list suggests a few of these areas for further investigation-

- The ability of fibers and composites to absorb moisture should be assessed (along with other environmental conditions). Friction and sliding should be checked to determine the composite's durability and wear quality.
- The jute fiber integrated concrete mix did not work with the additive added. One more experiment using jute fiber and additives is possible.
- Research additional attributes, including creep, fatigue, shear strength, chemical resistance, and electric properties, is important.
- Since the composite system's performance will improve, hybrid composites incorporating fibers other than jute (such as okra fiber) can be explored.
- Structural jute-based composite materials with uniform densities, resilience in harsh environments, and high strengths can also be created using high-performance adhesives and fiber modification.
- Employing the hybrid approach of integrating the glass mat with a woven jute fabric in the epoxy matrix can improve the mechanical performance and dimensional stability of the composite jute epoxy.
- Experiments using raw or chemically modified jute-fiber-enhanced cement composites under various conditions, including different treatments, weight percentages of fiber contents, fiber lengths, and curing times, are possible.

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