EFFECT OF USING NATURAL JUTE FIBER ADDITION ON CONCRETE PERFORMANCE

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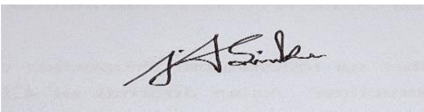
The thesis titled **“EFFECT OF USING NATURAL JUTE FIBER ADDITION ON CONCRETE PERFORMANCE.”** Submitted by Joynal Abdin Sarker and Imran Hossain Siam have been accepted as satisfactory in partial fulfillment of the requirements for the degree of Bachelor of Science in Civil Engineering on January 2023.

The thesis titled **“EFFECT OF USING NATURAL JUTE FIBER ADDITION ON CONCRETE PERFORMANCE.”**



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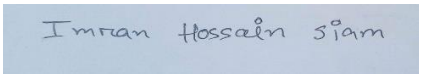

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Dedicated to

PARENTS, FAMILY AND TEACHERS

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RCC	Reinforced Cement Concrete.
FRC	Fiber Reinforced Concrete.
NJF	Natural Jute fiber.
OPC	Ordinary Portland cement.
PCC	Portland Composite Cement.
ACI	American Concrete Institute.
IS	Indian Standard.
ACMS	Advances in Construction Materials and Structures.
BNBC	Bangladesh National Building Code.
UTM	Universal Testing Machine.
GRP	Glass Reinforced Plastic.
MDF	Medium Density Fiber-board.

DECLARATION

The dissertation entitled **"EFFECT OF USING NATURAL JUTE FIBER ADDITION ON CONCRETE PERFORMANCE."** Has been performed under the supervision of J. M. Raisul Islam Shohag (Lecturer), Department of Civil Engineering, Daffodil International University, Dhaka, Bangladesh and the criterion for the Bachelor of Science in Civil Engineering was partially satisfied and accepted. Except where appropriate mention is made in the capstone itself, the capstone does not, to the highest of our understanding and belief, contain any previously published or authored works by other authors.

Name of the supervisor

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We would really like to start by thanking God, who made it possible for us to complete the practicum and write the laboratory report that allowed us to receive the Bachelor of Science in Civil Engineering degree. All of my family and friends, as well as those that support and inspire us, deserve our gratefulness for helping me reach this level of confidence. For enabling us to report on this, we are grateful to Prof. Dr. Md. Hannan Mahmud Khan, Head of the Department of Civil Engineering. **"EFFECT OF USING NATURAL JUTE FIBER ADDITION ON CONCRETE PERFORMANCE."** By Using Manual Calculation.
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ABSTRACT

Numerous studies have been focusing on raising the mechanical and physical qualities of concrete since the first industrial revolution. By utilizing the waste materials in concrete as Fiber reinforced concrete, many concrete professionals are working on new techniques and ideas for modification in the field of concrete technology. This study outlines sustainable development that is based on an original application of natural jute fiber as a concrete fiber. One of those innovations that provides a practical, cost-effective, and convenient solution for overcoming microcracks and similar types of inadequacies is fiber reinforced concrete. Concrete typically has a brittle quality and weak tension. As a result, fibers are added to improve the properties of construction materials and raise their tensile strength. The tensile strength of jute fiber ranges from 300 to 700 MPa. The treated jute fiber shows a noticeable improvement in tensile strength, which is up by roughly 45% (JochenGassan, 1997). Natural Jute Fiber is an alternative material available in local area and at cheap cost. It is normally cultivated in field as jute and fiber is extract from jute.

In this investigation, we employed readily accessible jute fiber as a concrete fiber. To boost strength and durability, we have attempted to employ Natural Jute Fiber as a fiber. Natural jute fiber was gathered, cut into smaller pieces, and added to cement concrete in this investigation at concentrations of 0%, 4%, 8%, 12%, and 16% by weight of cement. Compressive strength and split tensile strength have been evaluated for workability at three different curing ages, namely 7, 14, and 28 days. The strongest cylinder sets are seen when 1.5% jute fiber is utilized in concrete. By adding jute fiber concrete's brittle problem totally gone and act like a plastic.

Keywords: Natural Jute Fiber, Concrete, Fiber Reinforcement, Mixture.

CHAPTER-1
INTRODUCTION

1.1 General

The most popular synthetic substance utilized worldwide is concrete. It is a fundamental component of buildings and is frequently employed in the construction of dams, bridges, and other structures. The main binding substance used in the creation of concrete is cement. Lime, clay, shale, energy, and other naturally occurring materials are used primarily in the manufacturing of cement. The price of concrete is rising daily as a result of the utilization of naturally occurring materials. The cost of using it for structural applications is rising. In order to strengthen the tensile strength of concrete because it is weak in tension and upright in compression, several researchers have used a range of materials. Water fibers are generally utilized to lessen permeability and lessen bleeding. These actions control micro-cracks and pores in concrete caused by plastic and drying shrinkage. The quality of concrete is often controlled by fine, unbroken fibers that create microcracks during the curing and thermal expansion processes. Fibers like polypropylene, nylon, engineered, glass, and carbon fiber have been employed to overcome these obstacles and make concrete affordable. In this investigation, we employed readily accessible jute fiber as a concrete fiber. Natural jute fiber is a biodegradable and readily available material. We have attempted to employ natural jute fiber as a fiber to boost strength and durability while reducing cost and environmental problems When compared to other materials, natural jute fiber has a high tensile strength. It is inexpensive and widely accessible. Natural jute fiber is used as an additional material or secondary reinforcement to prevent concrete from spalling and to reduce concrete's plastic and drying shrinkage. From literature, it has been found that using jute fiber with a length of 20 to 30 mm and 14 to 18 mm effectively makes concrete sturdy and long-lasting. But if you use so small length than they will not mix properly. This investigation employed a 20 mm length to support it. Applying natural jute fiber as a fiber, this test examines the freshness, durability, and toughness characteristics of M15 grade concrete. The research on the effect of using natural jute fiber addition on concrete performance nearly essential. In order to investigate the efficacy of M15 grade concrete, we employed natural jute fiber in this experiment in various ratios, including 0%, 4%, 8%, 12%, and 16%. For this inquiry, fresh characteristics like compaction factor and slump are taken into account, as well as hardening properties like flexural, compressive, and split tensile strength at 7, 14, and 28 days of curing. The physical characteristics of the concrete production materials are also examined in this experiment.

1.2 Background of the study

We have studied and worked on reinforced concrete using natural jute fiber "**EFFECT OF USING NATURAL JUTE FIBER ADDITION ON CONCRETE PERFORMANCE.**"

1.3 Scope of the study

The primary goal of this study is to employ natural jute fiber as fiber reinforcement to increase concrete's strength to its maximum capacity and lessen its permeability.

1.4 Objective

The goals of this thesis and project:

a. To change the strength and properties of concrete.
b. To compare the strengths of fiber-reinforced concrete and plain concrete.

1.5 Research Outline

Six chapters and a connected annex make up the thesis work. The first chapter is an introduction, which provides background information, a summary of the issue, the study's aims and research boundaries, as well as the general thesis statement. The review of prior studies is covered in Chapter 2 along with the main associated facts from the references used in the study. The different studies that have been carried out in particular areas of the overall study area are adequately described and incorporated in the study. The third chapter covers the test plan and resources. This chapter serves mostly as an introduction to the materials and test program required for this thesis. A general summary of methodology is provided in Chapter 4. This covers the study methodology, data collection methods, and tools. The methodology that will be used to fulfill the study's objectives is also briefly described in this chapter. Results and debates are covered in chapter five. The sixth and last chapter addresses the conclusion and suggestions.

CHAPTER-2

LITERATURE REVIEW

2.1 Introduction

Concrete that contains fiber material that strengthens the structure is known as Fiber Reinforced Concrete (FRC), and it is becoming more and more popular. It is made up of tiny, fragmented fibers that are randomly orientated and distributed. Fiber as reinforcement is not a novel concept. Since ancient times, fiber has been utilized as a rejuvenator. In the past, straw, mortar, and clay bricks all contained jute fiber or hair. When the idea of composite materials was developed in the 1950s, fiber-reinforced concrete was one of the hotly debated topics (S. Ramakrishnan, 2020). Asbestos fibers were first utilized in concrete in the early 1900s. As a result of the additional health hazards, the use of asbestos for concrete reinforcement was later discouraged Asbestos has taken the role of more modern materials including steel, glass, and synthetic fibers as a reinforcement. Fiber is a tiny component that has the qualities of a reinforcing substance. The kind, length, and percentage of the fiber have a major impact on the mechanical properties of the concrete when added. Concrete tensions typically have a frail nature and are feeble. Therefore, fibers are included to enhance the tensile strength and other qualities of building materials.

2.2 Previous Stories Regarding F.R.C (Fiber Reinforced Concrete)

There has been earlier research on this topic by a number of scholars, and a number of models have also been used to calculate the bonding between cement matrix and fibers. Although the behaviors of concrete composites are greatly influenced by the cement matrix and fibers' bonding.

Asma Benkhelladi (2020), they published an article on “Cementitious composites made with natural fibers: Investigation of uncoated and coated sisal fibers”. where they carried out a study on the mechanical properties of natural fiber-based composite materials. They developed a hybrid composite by 80% of jute and 20% of flax by weight. Results indicate that the fiber weight fraction has the biggest impact on mechanical properties. When compared to NaOH-treated fibers, sodium bicarbonate-treated fibers ($NaHCO_3$) demonstrated a considerable improvement in mechanical characteristics. Additionally, the specimens in the flexural test exhibit greater values compared to the tensile characteristics and tend to behave similarly to the ones in the tensile test. Those experiment shows that jute fiber has high tensile strength compare to other natural materials.

Melvin Glenn Veigas (2022), they published an article titled “Cementitious composites made with natural fibers: Investigation of uncoated and coated sisal fibers”. They research about how natural sisal fibers can be used as an alternative to synthetic fibers to create high-performance cementitious composites, particularly in situations when access to synthetic fibers is restricted due to cost and availability constraints. Compressive strength, splitting tensile strength, flexural strength, and weathering resistance of the created mixes were also examined. Both coated and uncoated fibers were analyzed, and they were compared before and after being cast in the mixes. The inclusion of 1.4% sisal fibers was sufficient to completely prevent such cracks in mixes that had no fiber, which fully cracked due to plastic shrinkage in two hours. The sisal fiber dosages, ranging from 0.8% to 2.6% by combination volume, were used to create a number of different mixtures. Three different techniques were looked at to add the fibers to the mixtures: two dry methods (DM1 and DM2), as well as a wet method (hereafter referred to as WM). For the initial research, three 50-mm cubes of each mixture were cast and allowed to cure for seven days in a damp curing chamber. Additionally, three 100 mm 200 mm cylinders per mixture were cast and left in the moist curing room for cures of 7, 14, and 28 days. They casted total 9 cylinder and 1 beam. Compressive strength produced in the mixtures with fiber dosages ranging from 0.8% to 2.0% that was comparable to the control mixture. The mixture with 2.6% sisal fibers, however, showed a noticeably low compressive strength, indicating the loss of the necessary mechanical qualities. The findings suggested that sisal fibers are a practical substitute for synthetic fibers in a variety of applications.

Kyong Ku Yun (2022), they published an Article on “Rheological, mechanical properties, and statistical significance analysis of shotcrete with various natural fibers and mixing ratios” in 2022. 28 specimens, including and without natural fibers, were subjected to rheological study. Three natural fibers kenaf, flax, and jute three fiber lengths 5 mm, 10 mm, and 20 mm as well as three mixing weights 0.5 kg, 1.0 kg, and 1.5 kg were taken into consideration. Using an ICAR rheometer, the specimens' rheological characteristics, including flow resistance and torque viscosity, were assessed and linked with pumpability and shootability. According to the length and weight of the natural fiber, each physical attribute of the natural fiber combining with concrete they determined the yield stress. The amount of combined water absorbed by the specimen varies greatly depending on the type of natural fiber employed, and the fibers' adherence to the concrete also varies. With kenaf and jute fibers, flax fiber was far more likely to be significant. The best fiber is flax fiber, the best fiber length is 10 mm, and the best mixing weight is 1.0 kg. The findings of this investigation show that, while having high initial strengths, the specimens with 20 mm fibers did not possess adequate long-term strengths. The fibers with a diameter of 10 mm were best for long-term strength. The 5 mm jute fibers and the 20 mm kenaf and flax fibers exhibited good initial strength. Although natural fibers don't greatly increase flexural strength like steel fibers do, they nonetheless do so to some level.

N.Sultana (2020), article name "An experimental investigation and modeling approach of response surface methodology coupled with crow search algorithm for optimizing the properties of jute fiber reinforced concrete" about the impact of jute fiber on the tensile and compressive strengths of composites made of reinforced jute (JFRCC). Standard-sized cubes and cylinders have been created by adjusting three independent variables, such as the volume, length, and water-cement (W/C) ratio of the jute fiber. After 28 days of curing, the highest anticipated compressive and tensile strengths of 35.1 N/mm2 and 3.5 N/mm2, respectively, were discovered with the best set of fiber length, fiber volume, and water-cement (W/C) ratio. The findings imply that using natural jute fiber instead of more expensive, traditional methods to boost concrete strength may be a good alternative.

Dipa Ray (2001), title "Effect of alkali treated jute fibers on composite properties" about how alkali effect jute fiber. Jute fibers were treated with a 5% NaOH alkali solution for 0, 2, 4, 6, and 8 hours at 30°C. After 4, 6, and 8 hours of treatment, correspondingly, an enhancement in the crystallite size of the jute fibers raised its modulus by 12%, 68%, and 79%.However, 4 hours was the ideal amount of time for the vinylester composite materials with jute fibers and processed with a 5% NaOH solution at 30°C to achieve their maximal strength. Treating jute fiber is good because treated jute fiber gain more strength than untreated jute fiber.

N. Sultana (2020), published a paper by title "Soft computing approaches for comparative prediction of the mechanical properties of jute fiber reinforced concrete" about the progress of non - linear empirical studies that forecast the mechanical characteristics (compressive and tensile strengths) of Jute Fiber Reinforced Concrete Composites uses a variety of soft computing techniques, including RSM (Response Surface Methodology), ANN (Artificial Neural Networks), and SVR (Support Vector Regression) (JFRCC). For every set of trials, two cubic samples measuring 150 mm x150 mm x150 mm and two cylinder samples ranging 100 mm in diameter and 200 mm in length were created. All of the generated models have extremely high prediction accuracy. Additionally, comparing to both ANN and RSM models, the SVR model outperforms with greater predictive consistency. With some other natural fiber related concrete platforms, it may be used as an overclockability monitoring tool for executives and construction engineers.

Sumit Chakraborty (2013), published a paper by title “Improvement of the mechanical properties of jute fiber reinforced cement mortar: A statistical approach” about how the physical characteristics and mechanical properties of cement mortar are changed by adding jute fiber. They made a cubic and rectangular mould compressive and flexural strength test. To manufacture the mortar, the fiber was adjusted from 0.0 to 4.0 wt.% (with regard to cement) in the concrete mixture (cement: sand: water:1:3:0.6). They find the best result when water saturated jute added. If the jute fiber is used after water saturation than bonding in mortar will be good. Otherwise jute fiber will consume all the water.

A. Razmi (2017), published a paper by title “On the mixed mode I/II fracture properties of jute fiber-reinforced concrete” In this paper, a significant number of split semi-circular bend (SCB) materials are used to conduct an exploratory program into the mixed mode I/II fracture toughness of jute fiber-reinforced concrete. Jute fibers are added to ordinary concrete in proportions of 0.1%, 0.3%, and 0.5% by weight and 20 mm in length for such reason. Using higher percentage of jute fiber slow the pace of fracture expansion. Concrete that has been reinforced with fibers at mix proportions of 0.1%, 0.3%, and 0.5% saw an enhancement in its compressive, tensile, and flexural strengths. As the curing age grows, the gain in strength properties becomes much more noticeable.

Mohammad S. Islam (2018), published a paper by title “Influence of jute fiber on concrete properties” In this paper, they study about how jute fiber effect on fresh and hardened properties of concrete. They prepare concrete cylinders and beam using 0.00%, 0.25%, 0.50%, and 1.00% of jute fiber. They did cured about 7, 28 and 90 days for testing the compressive strength. And for the tensile strength test curing days was 28 and 90 days. The compressive strength of concrete was improved with the addition of 0.25% jute fiber. Jute fiber length and curing time effect the result. Thereby jute fiber help preventing total collapse of concrete specimens.

Tasaddaq Hussain (2019), published a paper by title "Improving the impact resistance and dynamic properties of jute fiber reinforced concrete for rebars design by considering tension zone of FRC". In this paper, they study about Improving the quality of fiber reinforced concrete for preventing the effect of natural loading. Flexural strength and damage tolerance of short slab structure made of plain concrete (PC) and JFRC, containing and without reinforcing steel, are tested. Inside the lab, the impacts resistance is determined using a streamlined drop-weight test. The crushing and split-tension capacities of 12 cylindrical are determined by testing. When comparing to PC, JFRC's toughness is approximately six times greater. Additionally increased by 68% and 100%, correspondingly, are the dynamic elastic modulus and the damping ratio. Values in the split-tension and flexural strengths are correspondingly improved by 8% and 20%. It is determined that the utilization of little jute fibers in concrete can decrease the amount of reinforcing steel in slabs by roughly 28%.

J. Kim (2012), published a paper by title "An Investigation of Mechanical Properties of Jute Fiber-Reinforced Concrete". They tested two type of JFRC, one is normal and another is high fluidity. When comparison to concrete lacking fiber, the compressive strength of high-fluidity concrete reinforced with jute fiber increased by 55%. Unfortunately, the compressive strength of such regular concrete strength supplemented with jute fibers does not significantly boost. Jute fiber absorb so much water so before using water must be added to jute fiber.

S. Ramakrishnan (2020), published a paper by title "Dynamic Mechanical Properties and Free Vibration Characteristics of Surface Modified Jute Fiber/Nano-Clay Reinforced Epoxy Composites". They examined the effects of different NaOH solutions and weight percent additions of nano-clay on the viscoelastic but also free vibration characteristics of JFREC. Due to improved mechanical interlocking, the composites containing 5% treated jute fibers had the greatest E′ and E″ values and the lightest tan values. But after processing and adding of the nano-clay, it was seen that the natural frequency values were better. Particularly, 5% NaOH treatment and 5% injection of nano-clay produced successful performances.

Mohammad Zakaria (2016), written a paper by title "Scope of using jute fiber for the reinforcement of concrete material". Jute Fiber Reinforced Concrete Composites (JFRCC)'s flexural, and ultimate tensile have been experimentally investigated. They made cube, prism, and cylinder for testing. The unfavorable propensity of whacking formation and high porosity of combinations caused by the large cut length and greater concentration of reinforcing elements (jute fiber) result in the degradation of the mechanical characteristics of JFRCC in comparison to plain concrete. But short and low fiber shows greater result. Most particularly, for volume contents of 0.1 and 0.25% and the fiber cutting length of 10 and 15 mm, it is discovered that compressive, flexural, and tensile significantly increases.

Tiezhi Zhang (2019), written a paper by title “Mechanical properties of jute fiber-reinforced high-strength concrete”. In this work, greater concrete was supplemented with jute fiber, and the appeal process, amount, and impact on the mechanical characteristics were investigated. The best water-cement ratio was 0.30, the ideal jute fiber length was 16 mm, and the ideal jute fiber content was 3.0 kg/m3, according to a thorough examination of the test data. The best possible balancing of these elements may enhance the overall mechanical concrete's performance. Adding jute fiber could effectively fill the micro cracks in concrete.

M.A.Mansur (1982), written a paper by title “A study of jute fiber reinforced cement composites”. In this paper they determine how volume fraction and fiber length affect the tensile, flexural, compressive, and impact strengths of cement paste and mortar reinforced with jute fiber. If small size jute fiber is used than a substantial increase of mechanical properties of concrete will be increased. To ascertain the outcome, four distinct types of specimens were cast. Tensile strength increased by a maximum of 97 percent, although flexural strength increased by a maximum of 60 percent. Impact strength increased by up to 400% in comparison to the similar plain examples. Jute fiber has also been discovered to greatly increase the composite's flexural resistance. Therefore, research should be done to see if jute fibers can be utilized to create a new, affordable construction material that may be used to replace asbestos sheets.

2.3 History of Jute Fiber as Fiber Reinforcement

The history of using reinforcement is not new. People using jute fiber with clay to making house from old days. Now jute fiber is being used to increase concrete strength because concrete is brittle in nature. Jute (Corchorus capsularis/Corchorus olitorius) is a staple fiber that is farmed primarily for its fiber. It is among the most affordable natural materials and ranks second in importance only to cotton fabrics in terms of importance. Jute of the Corchorus capsularis and Corchorus olitorius species are both found in Indo-Burma, including South China. The origin of jute dates from 206 BC to 221 AD. jute paper out from Western Han Dynasty was created in Dunhuang, Gansu Province, China. Jute fiber was reportedly employed in India beginning in the 16th century, under the rule of Mughal Emperor Akbar, according to historical records. Jute was supplied from India by the British East India Company. Following that, the jute fiber market expanded quickly all over the world, notably in Dundee, Scotland around 1800. Jute is cultivated in a number of nations, including Bangladesh, India, Myanmar, Nepal, China, Taiwan, Thailand, Vietnam, Cambodia, and Brazil. Bangladesh, India, and China are among them where jute may develop best. Jute fiber offers excellent thermo - mechanical performance, a high strength-to-weight ratio, a high aspect ratio, and outstanding insulating qualities. A door, window, piece of furniture, an automobile, an airplane, water pipes, fake roofing, floor tiles, etc. have all been made from jute fiber-based hybrid. T. Subash et al. talked about biocomposites with bast fiber reinforcement that are applied to aircraft inside structures. The aerospace and vehicle industries employ excellent materials made from natural fibers including jute, kenaf, bamboo, bagasse, coir, and sisal. Natural fiber may be used to create lightest, low-density goods that can significantly lower the quantity of energy used in the aerospace sector. Jute fiber is utilized in a variety of products, including bags for packing, carpet backing, roping, doors, furniture, flooring, yarns, and wall art. Jute fiber is a natural fabric with various benefits, including high tensile strength, superior water resistance, biodegradability, and environmental friendliness (Kamrun N. Keya, 2019).

Its application in composite materials has become more significant due to its wide availability and low cost. Jute fiber is made from bark of the jute plant and contains three main types of organic chemicals: cellulose (58–63 weight percent), hemicellulose (20–24 weight percent), and lignin (12–15 weight percent), along with additional minor components such lipids, pectins, and water extracts (Asma Benkhelladi, 2020).

Asbestos fibers were first included into concrete as a reinforcing component in the early nineteenth century. Following the discovery that asbestos posed a serious threat to human health, a variety of different chemical and synthetic materials including steel, glass, and synthetic fiber were developed as asbestos' superior replacements. The use of concrete with fibers has significantly increased during the past twenty years. Approximately 100 million cubic meters of fiber-reinforced concrete are reportedly manufactured each year, of which 60%, 25%, 5%, and 10% are used in precast structural components, slabs on grades, fiber shotcrete, and other construction applications, respectively. Recent years have seen a rise in the use of biological fibers in concrete as opposed to synthetic fibers because natural fiber is environment friendly.

2.4 Treatment of Jute Fiber

The Natural Jute Fiber we used to make mould that we collected from market. We treated the jute fiber before mixing with concrete. The following steps should be taken

a. Separation: We need to remove the hard part of jute like the bottom part. Because that won't mixed with concrete.
b. Cutting: Before using we cut jute fiber into small pieces because it small pieces mix with mortar easily.
c. Drying: Jute fiber must be dried under the sun. Jute fiber may be kept after drying without having to worry about odor or rust..
d. Watering: At least 10 minute before using we need to saturated the jute fiber or jute fiber will consume most of the water and mortar will dry firstly.

2.5 Advantages and Disadvantages of jute fiber reinforced concrete

2.5.1 Advantages

- In comparison to unreinforced concrete, fiber-reinforced concrete has greater tensile strength.
- When components subjected to high frequency flows, it is best suitable to reduce enhanced corrosion effects.

- The number of fatalities will undoubtedly go down if fiber reinforcing concrete is used in seismically locations.
- Fiber lowers inner capabilities by preventing the formation of tiny fractures in concrete.
- According to studies, FRC increases the structural qualities of concrete, like its compressive strength, splitting rejection, hardness, tensile strength, and damage tolerance.
- Cheap and light in weight.
- There is no energy spent on the creation of fiber.
- Easy to make and widely available

2.5.2 Disadvantages

- The fibers that are mixed into the concrete must all be the same size. It takes even longer and is thought as a challenging procedure.

- Insufficient heating and physical durability.

- weaker than certain composites made of natural and synthetic fibers.

- A composite with a small fiber volume and uneven fiber dispersion.

- Matrix interaction is ineffective.

- Increased cost of production and fiber preparation.

CHAPTER 3

MATERIALS AND TEST

3.1 Materials

Different type of materials was used in this experiment. Like coarse aggregates, fine aggregates and cement etc. For better result we used Sylhet sand as fine aggregates and we used jute fiber as a fiber reinforcement.

3.1.1 Water

For the cement mortar, the water needs to be pure and devoid of contaminants. We may control the qualities of the cement, like the way the concrete flows, by increasing and reducing the water percentage in relation to the cement, but doing so will also alter the quality of the concrete. Concrete will flow smoothly when there is too much water present, but the toughness will be reduced. Therefore, you must adhere to the water-to-cement ratio based on the kind of concrete utilized in this experiment.

3.1.2 Portland Composite Cement (PCC)

In this experiment, Portland cement was utilized. The most popular type of cement is portland cement. Gypsum, silica, alumina, iron, lime, and other tiny amounts of materials make up Portland cement.

3.1.3 Aggregates

Concrete mixes contain both large and small particles to boost the toughness. Broken stone, glass, natural jute fiber, sand, and gravel are now utilized as aggregate the ingredients required to grind up mortar.

- **Fine Aggregate**: Choose a high-quality, graded sand. 2.3 to 3.0 adjustable fineness modulus. examined the fine aggregate results.

- **Coarse Aggregate:** Clay percentage less then 1% and particle sizes of 5mm to 20mm are also included in coarse aggregate test graded unbroken gravel, aggregate form, and choosing of related to standard. used a common test procedure to evaluate the performance of coarse aggregate.

3.1.4 Jute fiber

The proportion of jute fiber included in the cement mortar compared to the total volume of cement. The word for this is volume fraction (V_f). Volume fraction (V_f) typically falls between 0% and 16%. According to some latest study, adding fibers to concrete has no influence on the materials' ability to withstand impacts. Additionally, the outcome suggests that using microfibers provides greater structural stability than using longer fibers.

3.2 Test Programs

We performed several types of test like compression test, tensile strength test after making the mould ready. Before mixing concrete we did absorption test and after mixing we did slump test.

3.2.1 Compression test

This test determines the compressive strength of substances, goods, and parts, in this instance concrete. The concrete specimen in this test is subjected to opposing pressures that push downward against it from opposite sides. A global testing device will push the two plates together while the concrete cube is sandwiched between them. The load will be imposed, squeezed, and finally fail.

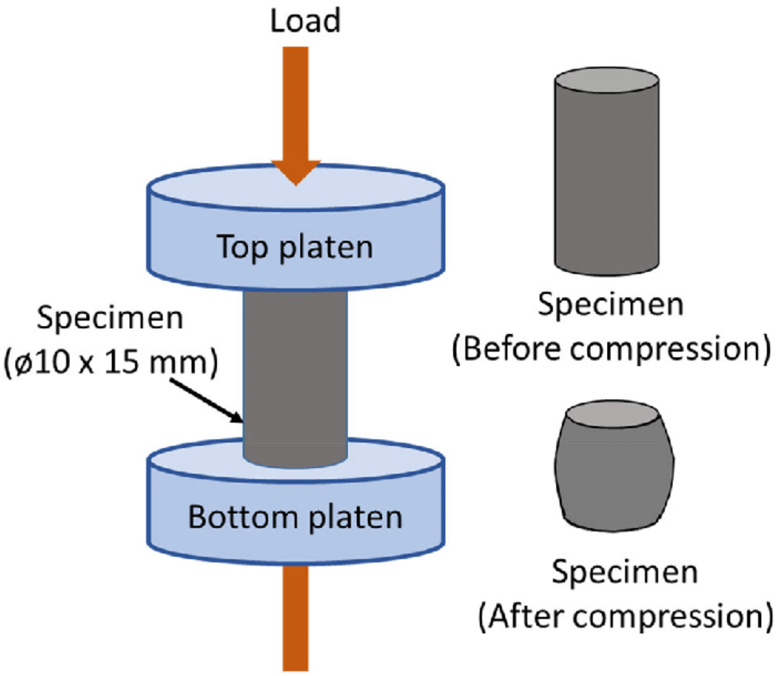

Figure 0-1: compression test

3.2.2 Tensions test

One such experiment is conducted to find the tensile strength of concrete. The tensile strength of concrete is determined utilizing split cylinder experiment of concrete technique.

- **Split cylinder test**

This technique detects the concrete's tensile strength. A straight concrete cylinder will be positioned in this test among the carrying surfaces of a general testing apparatus. The concrete cylinder will then continue to receive weight unless a crack form. The concrete cylinder will experience tensile stress from the loads and tension cracks throughout its diameter.

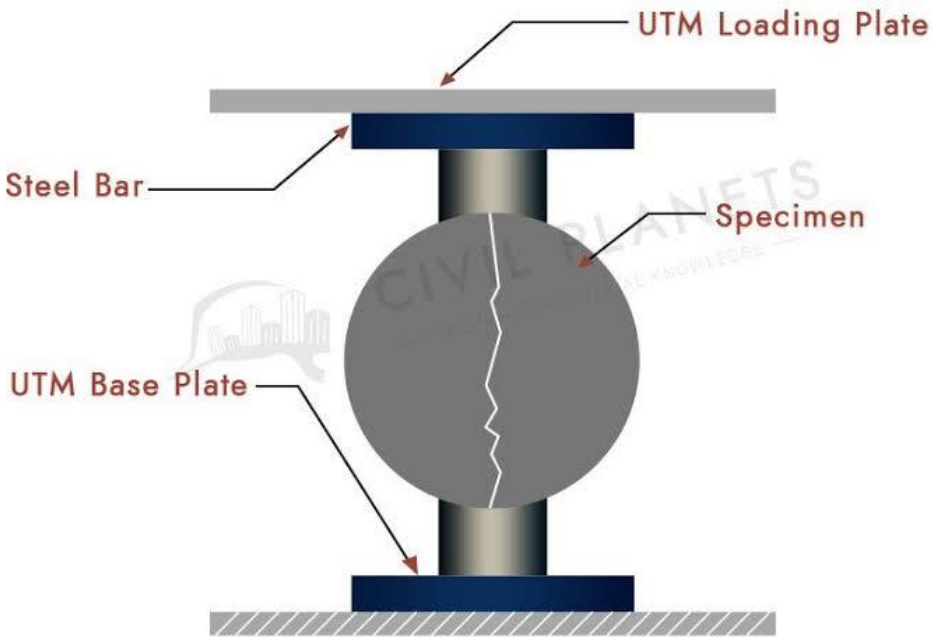

Figure 0-2: Split Cylinder test

3.2.3 Slump test

Concrete's cohesiveness just before setting is determined by the slump test. This is carried out to evaluate how easily freshly-poured concrete can be worked. That experiment demonstrated if the concrete was mixed correctly or otherwise. In this experiment, newly formed concrete will be put in a mold, which will then be gently elevated vertically. The concrete will sag as a result. The distance between the peak of the slumped concrete and the position of the slump cone head will then be used to determine the concrete slump.


Figure 0-3: Slump test

3.2.4 Absorption Test

Concrete's safety showers is determined by the moisture absorption. This test is carried out to determine how much water seeps into concrete while it is immersed. A dried concrete cube or beam will be weighed for this experiment. The concrete cube or beam will then be submerged in water for 24 hours before being weighed once more. The ability of the concrete to absorb water shall then be calculated by evaluating the two values.

CHAPTER 4

METHODOLOGY

4.1 Introduction

We want to add fiber to the mixture within that experiment at various ratios of 0%, 4%, 8%, 12%, and 16%. The control combination had no fiber at all.

4.2 Collection of Raw Materials

RAW materials were collected from different place. Like cement, sand and crushed stone was collected from local shop and jute fiber was collected from farmer house and village market.

4.2.1 Portland Composite Cement (PCC)

We utilized the Super Cement brand, that is accessible at any neighborhood market in Bangladesh, as Portland Composite Cement (PCC).

4.2.2 Aggregate

The type of operation will determine the size of the coarse and fine aggregate. The trial experiment's coarse aggregate has a nominal size of 20 mm. As course aggregate we used crushed stone and as a fine aggregate we used Sylhet sand.

Figure 0-4: Crushed stone

Figure 0-5: Sylhet sand

4.2.3 Water

Water must be gathered from the neighborhood's clean water sources. We must ensure that the water is free of any dust or other contaminants.

Figure 0-6: Clean water

4.2.4 Natural Jute Fiber

Natural jute fiber collected from the local market and farmer house which is located besides our area savar, Dhaka, Bangladesh.

Figure 0-7: Collected jute fiber

Figure 0-8: 1″ jute fiber

4.3 Procedure and Casting the specimens

Technology Laboratory at Daffodil International University in Dhaka, Bangladesh. The central point behind such a study is to examine the compressive and tensile strength test results of cubes of regular ordinary concrete and cylinders of concrete with jute fiber as fiber. This analysis is considered to be the most widely used test because it is simple to conduct and because all of the necessary characteristics of a concrete are somehow related to the compressive strength test. To conduct this test, a concrete cylinder of 101.6 mm x 203.2 mm was made using plain cement concrete of grade M15 and jute fiber for fiber-reinforced concrete. After curing for 7, 14, and 28 days in the Concrete technique for this study. Jute fiber was utilized as a fiber as reinforcement to create a cylinder, and it was employed in varied percentages by weight of cement. For the preparation of the samples cylinder of M15 grade concrete for evaluation, we employed jute fiber as 0%, 4%, 8%, 12%, and 16% by weight of cement.

jute fiber that was used to make the sample concrete cylinder was procured from markets and farmer's homes, separated from other debris, and then cleaned with water before being properly dried in the sun. In order to have a consistent distribution of jute fiber in concrete, the dried and clean jute fiber was then further separation was conducted by cutting depending on length and quality. To create an effective mix design, the dry components needed to be well mixed before any water was added during the whole investigation. This study has been done in the field of concrete technology. For every A sensitive weighing equipment was used to measure the weight of the jute fiber. After perfectly combining and mix with water, the molds were placed on a vibrating table to start vibrations and ensure that the concrete was properly poured into the mold, layer by layer, to prevent air gaps between the aggregates and the binder and to ensure proper placement of the concrete until it was fully filled to prevent air bubbles or voids from entering the concrete cubes. The mold were eventually removed out from vibration plate and placed in the lab undisturbed for the following 24 hours. The cylindrical molds were then placed in the water tank for varying curing times of 7, 14, and 28 days after the molds had been extracted. In order to determine the mix's compressive strength and tensile strength, the cylinder was lastly tested using a compression and tension testing equipment. The purpose of this test was to compare the strengths of two different types of specimen: normal cement concrete and fiber reinforced concrete made with jute fiber.

Figure 0-9: Plastic moulds prepared for casting concrete cylinder.

Figure 0-10: Mixing jute fiber fiber in concrete at dry condition

Figure 0-11: Casting the mould with conrete

Figure 0-12: Casted mould for 24 hr

Figure 0-13: Remove the mould after 24 hrs

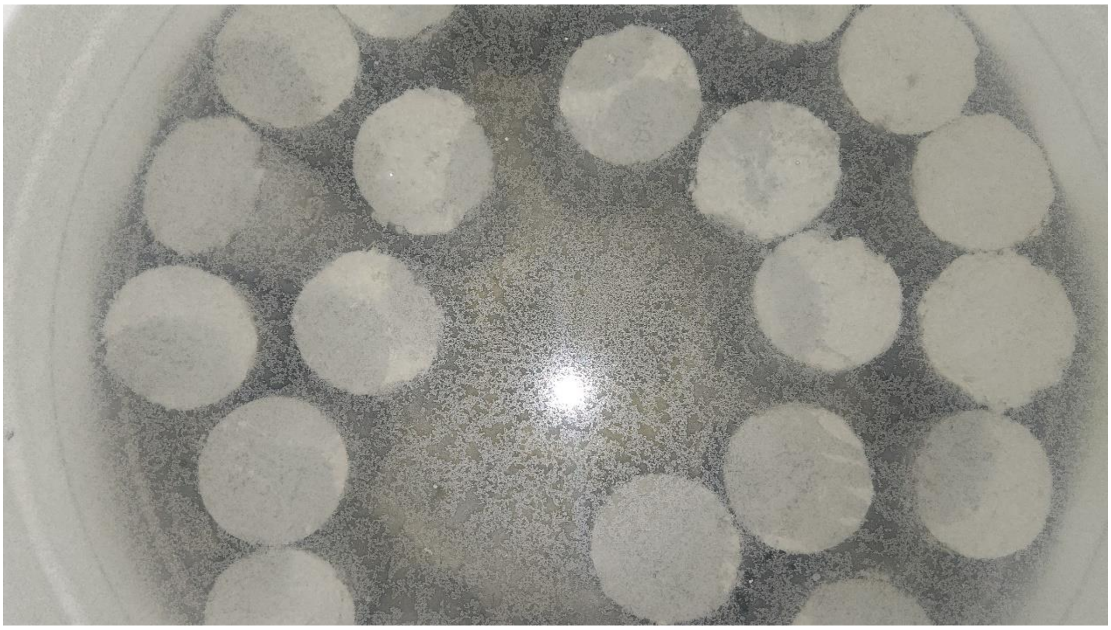

Figure 0-14: Cylinder are being submerged in the curing pond for curing period of 7, 14 & 28 days

Figure 0-15: 0% 18 cylinder

Figure 0-16: 4% 18 cylinder

Figure 0-17: 8% 18 cylinder

Figure 0-18: 12% 18 cylinder

Figure 0-19: 16% 18 cylinder

Cylinder for 0%, 4%, 8%, 12% & 16% jute fiber.

Figure 0-20: Compressive Strength Test

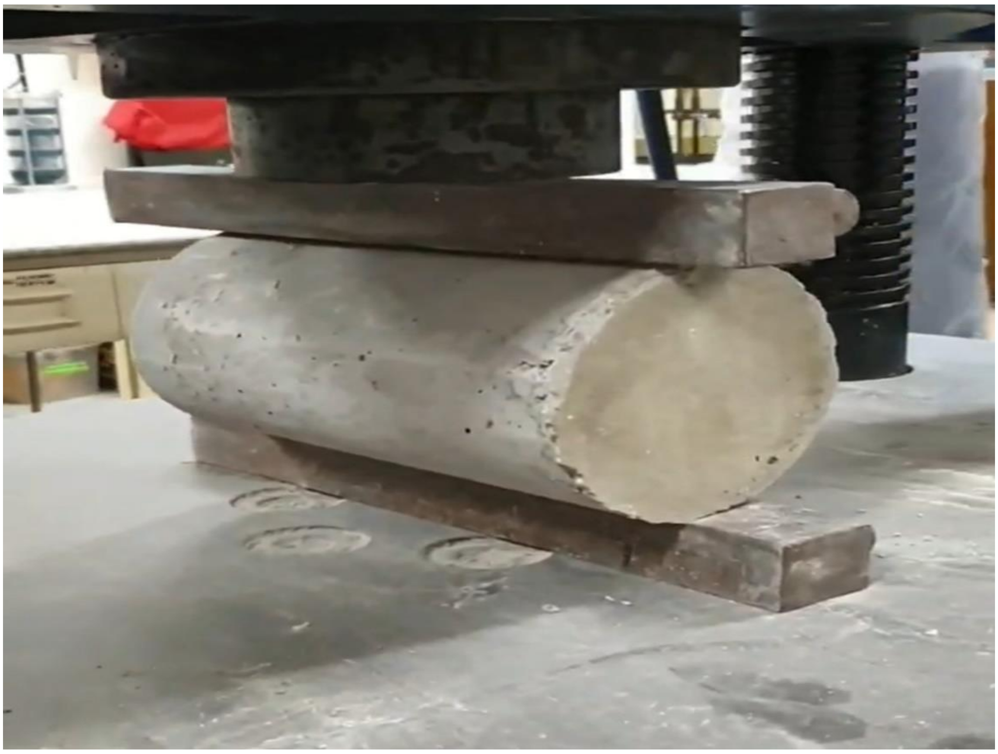

Figure 0-21: Split Tensile Strength Test

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Result Analysis

5.1.1 Workability

Because there is natural jute fiber present, the flowability of natural jute fiber reinforced concrete is higher than the control mix. The following Table-5.1 displays the flowability results.

Table 0-1: Results of Workability of concrete mix.

SL NO.	Concrete Mix	% Jute fiber	Slump Value (mm)	Workability
1	M15	0%	56	Medium
2	M15	4%	50	Low
3	M15	8%	42	Low
4	M15	12%	11	Very Low
5	M15	16%	0	Zero

5.1.2 Compressive Strength

The cylinder is tested using a Universal Testing Machine (UTM) to evaluate the compressive strength of concrete.

The results of compressive strength are shown in the Table-5.2 to Table-5.4:

Table 0-2: Compressive strength at 7 days curing period

SL NO.	Concrete Mix	% Jute Fiber	Maximum load recorded (KN)	Compressive Strength (N/mm2)
1	M15	0%	85	7.766761223
2	M15	4%	45	5.390004965
3	M15	8%	27.5	3.289159716
4	M15	12%	31	3.395347894
5	M15	16%	26	3.289159716

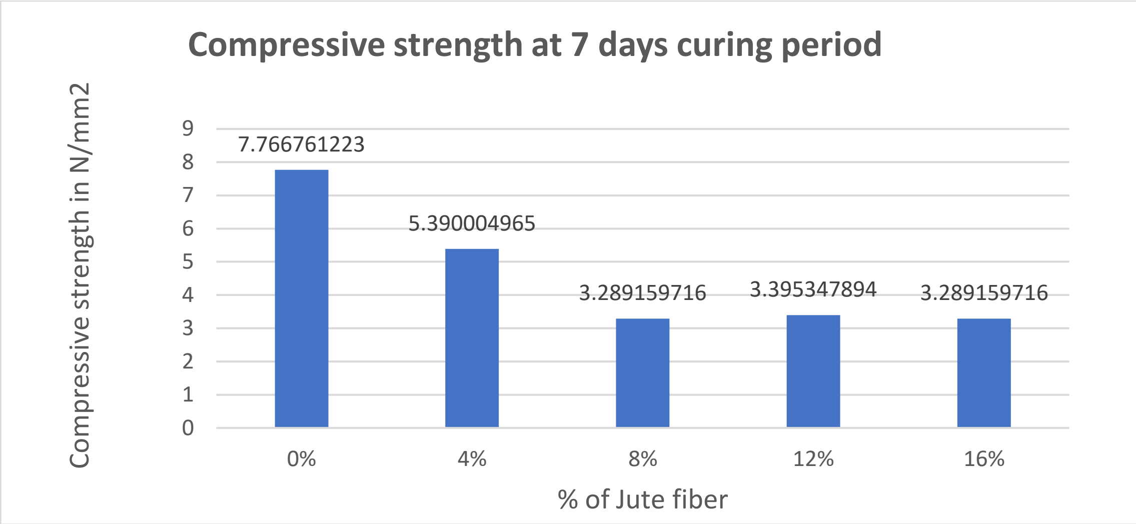

Figure 0-22: Compressive strength at 7 days curing period.

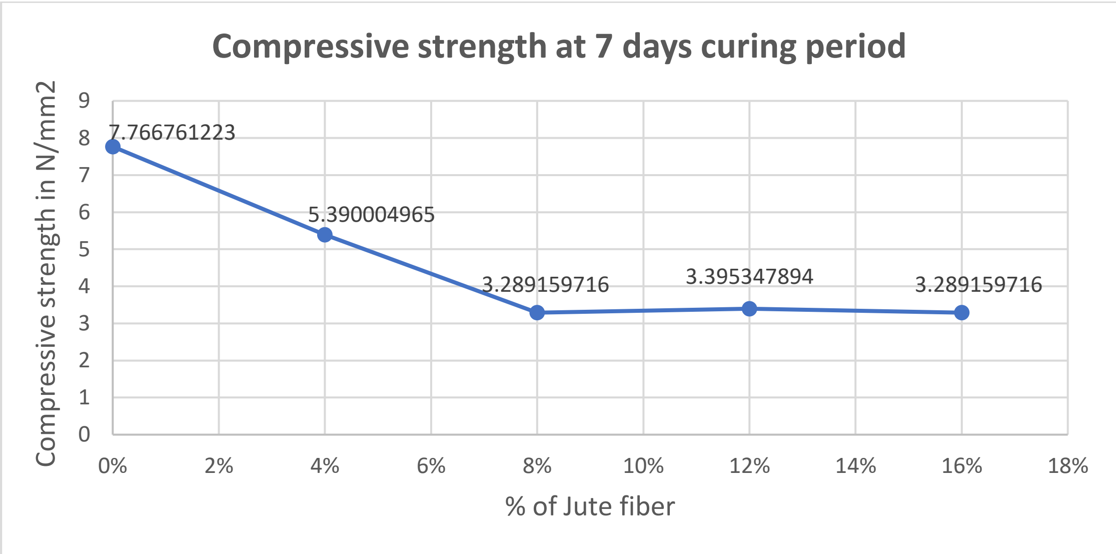

Figure 0-23: Compressive strength at 7 days curing period.

Table 0-3: Compressive strength at 14 days curing period

SL NO.	Concrete Mix	% Jute Fiber	Maximum load recorded (KN)	Compressive Strength (N/mm2)
1	M15	0%	82.5	9.018737667
2	M15	4%	59	7.002817496
3	M15	8%	35	4.074366543
4	M15	12%	29	3.352821693
5	M15	16%	33	3.862117511

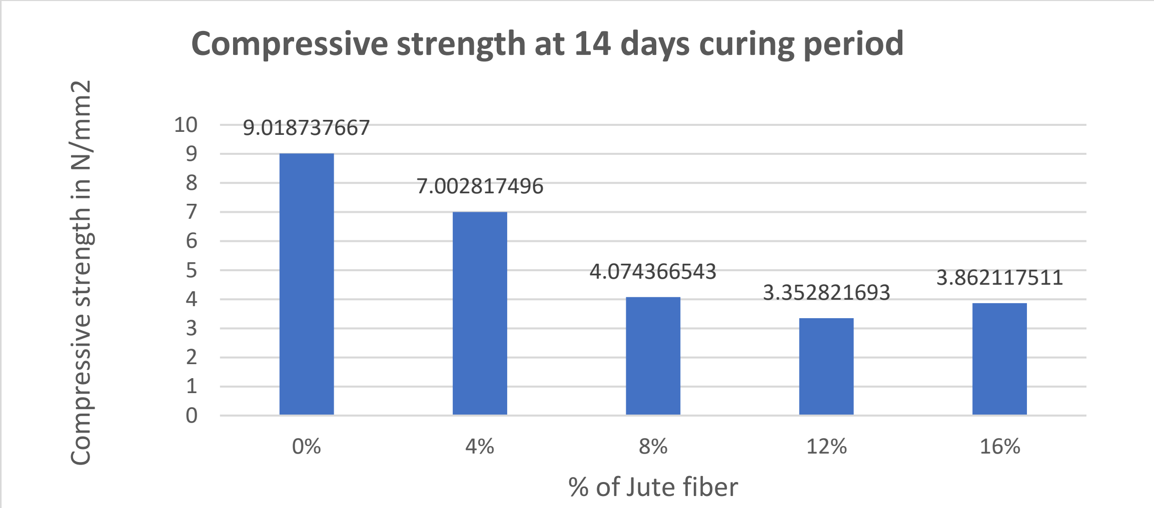

Figure 0-24: Compressive strength at 14 days curing period.

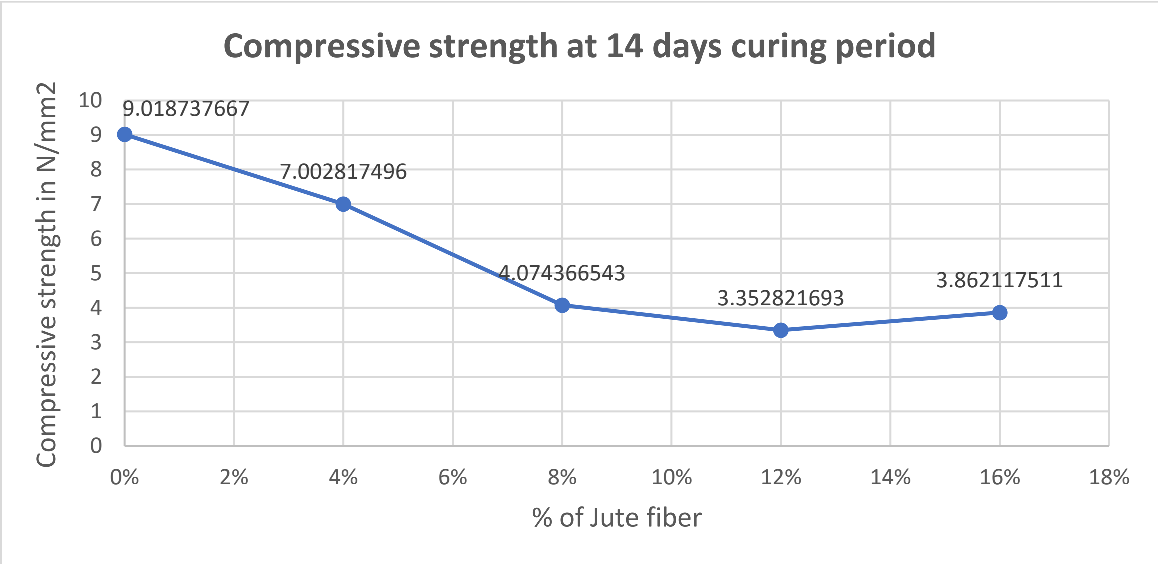

Figure 0-25: Compressive strength at 14 days curing period.

Table 0-4: Compressive strength at 28 days curing period

SL NO.	Concrete Mix	% Jute Fiber	Maximum load recorded (KN)	Compressive Strength (N/mm2)
1	M15	0%	103	10.86493501
2	M15	4%	50	5.814503029
3	M15	8%	43	4.710986316
4	M15	12%	41	4.880709147
5	M15	16%	45	5.092958179

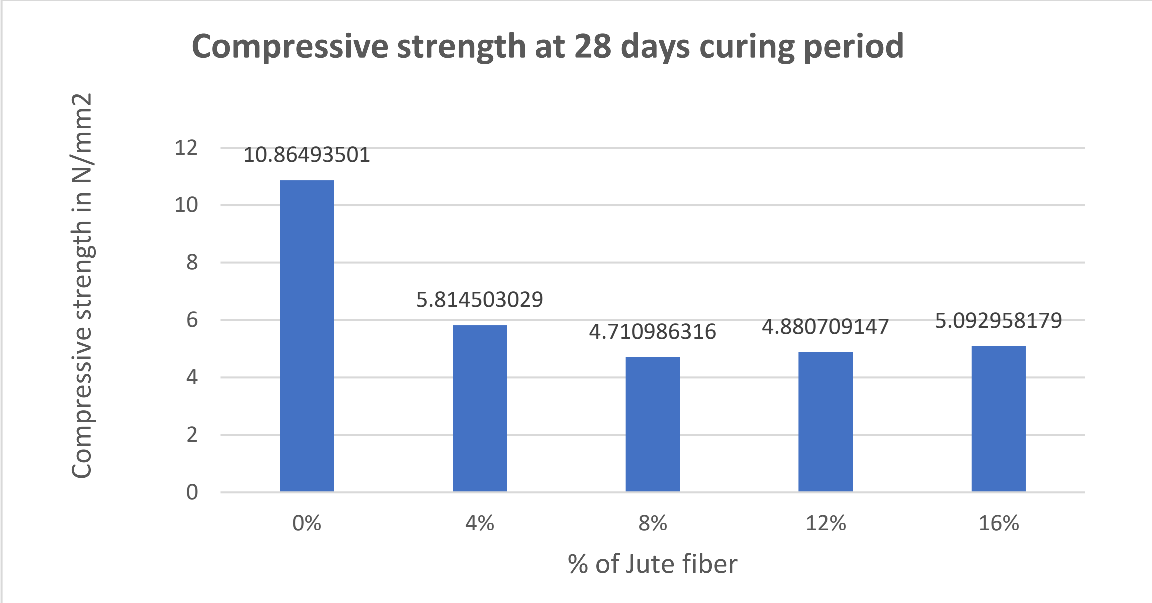

Figure 0-26: Compressive strength at 28 days curing period.

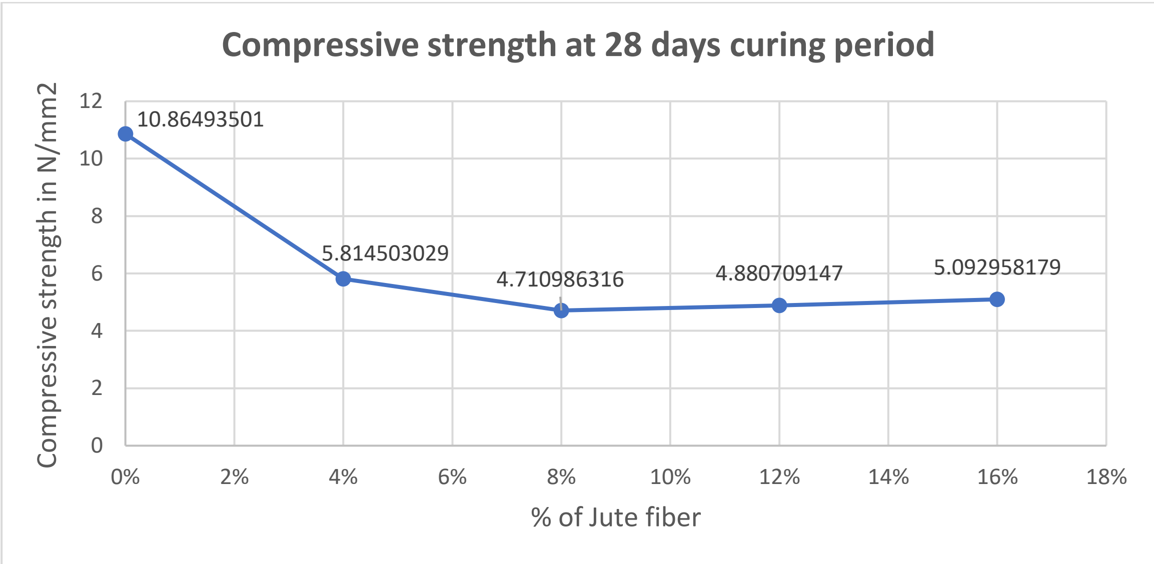

Figure 0-27: Compressive strength at 28 days curing period.

5.1.3 Split Tensile Strength

Evaluating the cylinder underneath a universal testing machine (UTM) yields information on the split tensile strength of concrete.

The results of split tensile strength are shown in the Table-5.5 to Table-5.7:

Table 0-5: Split tensile strength at 7 days curing period

SL NO.	Concrete Mix	% Jute fiber	Maximum load recorded (KN)	Split tensile strength (N/mm2)
1	M15	0%	64	1.655207538
2	M15	4%	40	1.029188948
3	M15	8%	35	0.954927426
4	M15	12%	35	0.939011968
5	M15	16%	31	0.891265597

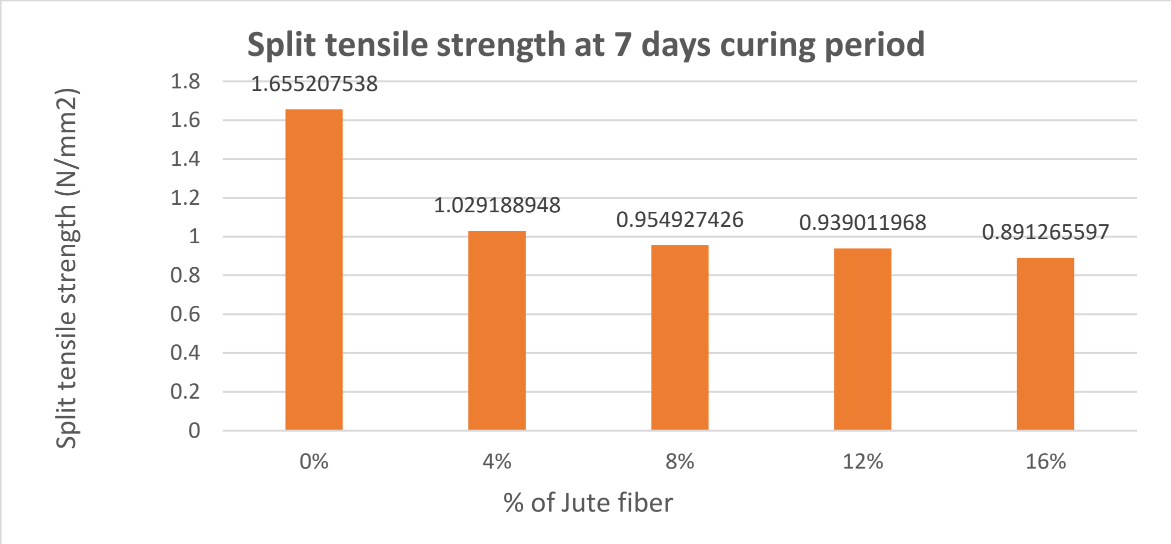

Figure 0-28: Split tensile strength at 7 days curing period.

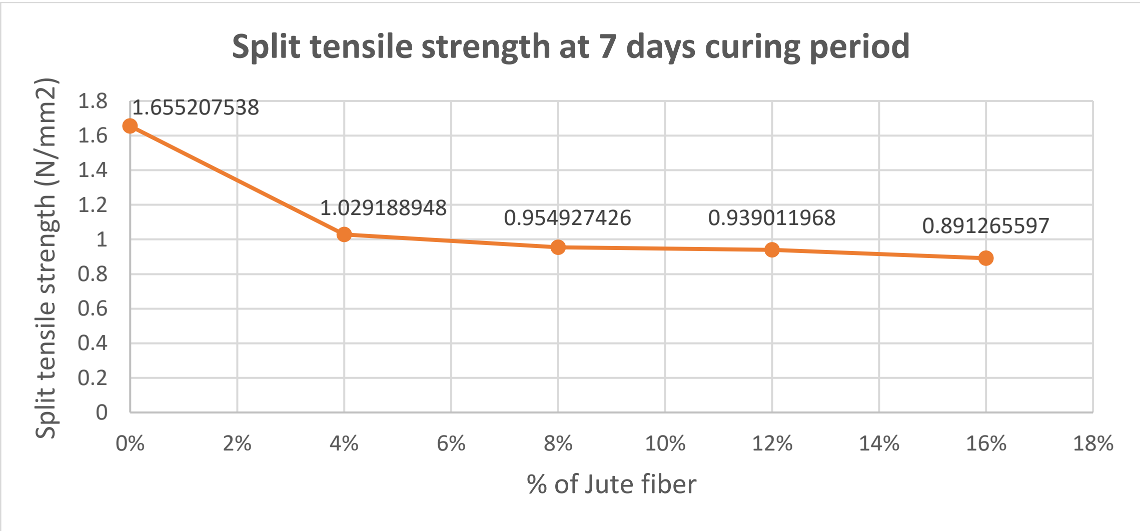

Figure 0-29: Split tensile strength at 7 days curing period.

Table 0-6: Split tensile strength at 14 days curing period.

SL NO.	Concrete Mix	% Jute fiber	Maximum load recorded (KN)	Split tensile strength (N/mm2)
1	M15	0%	100	2.785204991
2	M15	4%	53	1.633976318
3	M15	8%	31	0.901865292
4	M15	12%	41	1.061019862
5	M15	16%	43	1.018589254

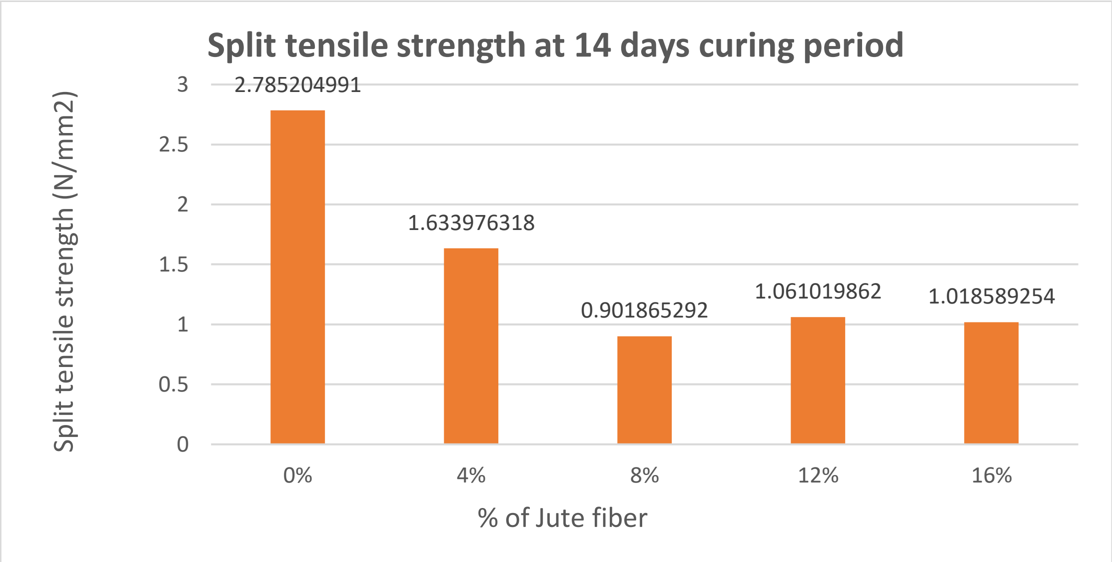

Figure 0-30: Split tensile strength at 14 days curing period.

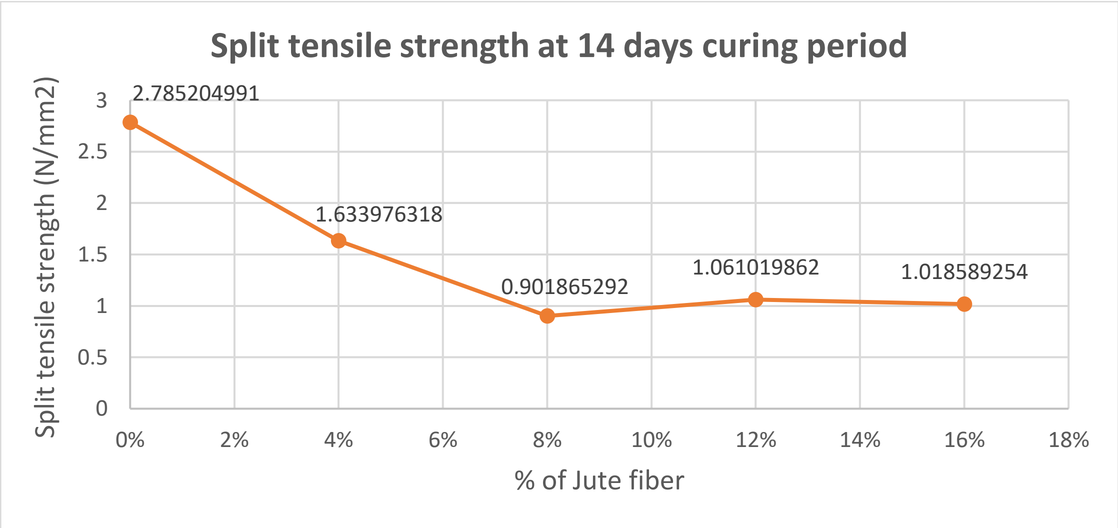

Figure 0-31: Split tensile strength at 14 days curing period.

Table 0-7: Split tensile strength at 28 days curing period

SL NO.	Concrete Mix	% Jute fiber	Maximum load recorded (KN)	Split tensile strength (N/mm2)
1	M15	0%	81	2.079609116
2	M15	4%	70	1.856792717
3	M15	8%	52	1.432391138
4	M15	12%	44	1.188343519
5	M15	16%	45	1.246721416

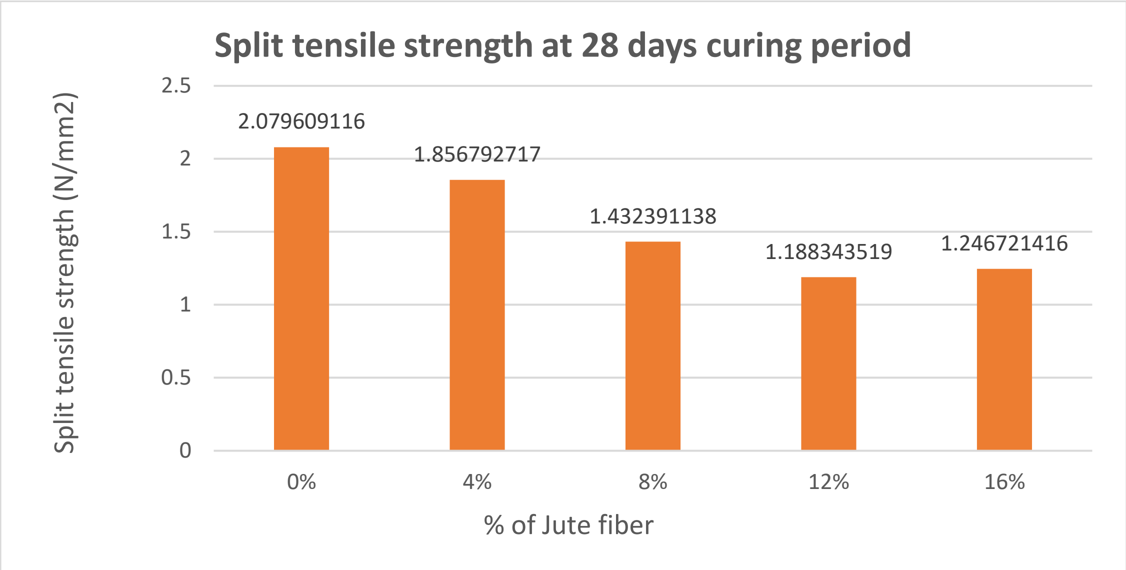

Figure 0-32: Split tensile strength at 28 days curing period.

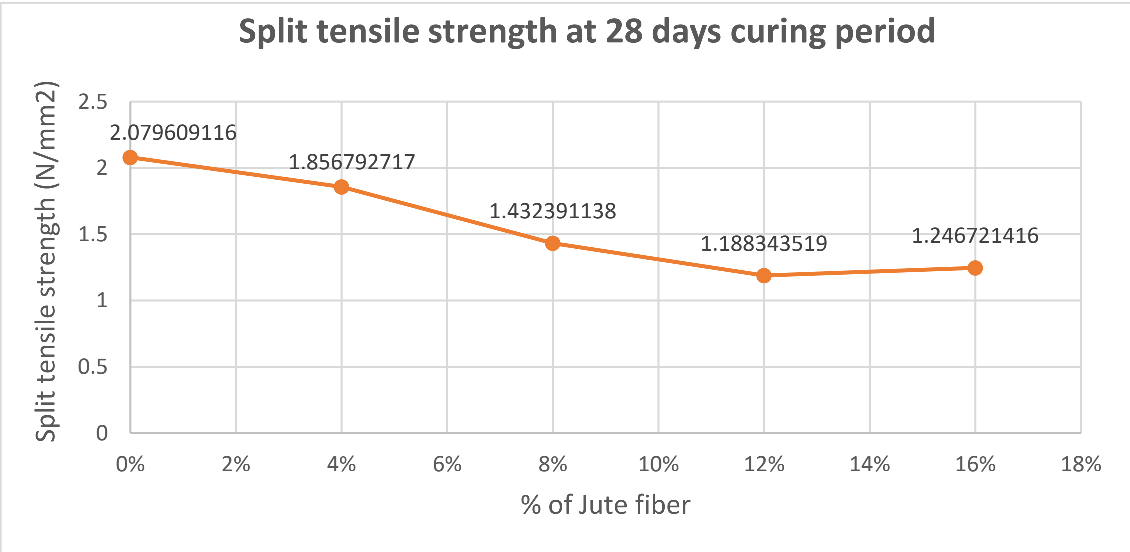

Figure 0-33: Split tensile strength at 28 days curing period.

5.2 Comparison between compressive and split tensile strength

Comparing between compressive and split tensile strength at 7,14 and 28 days. The results are shown in graph.

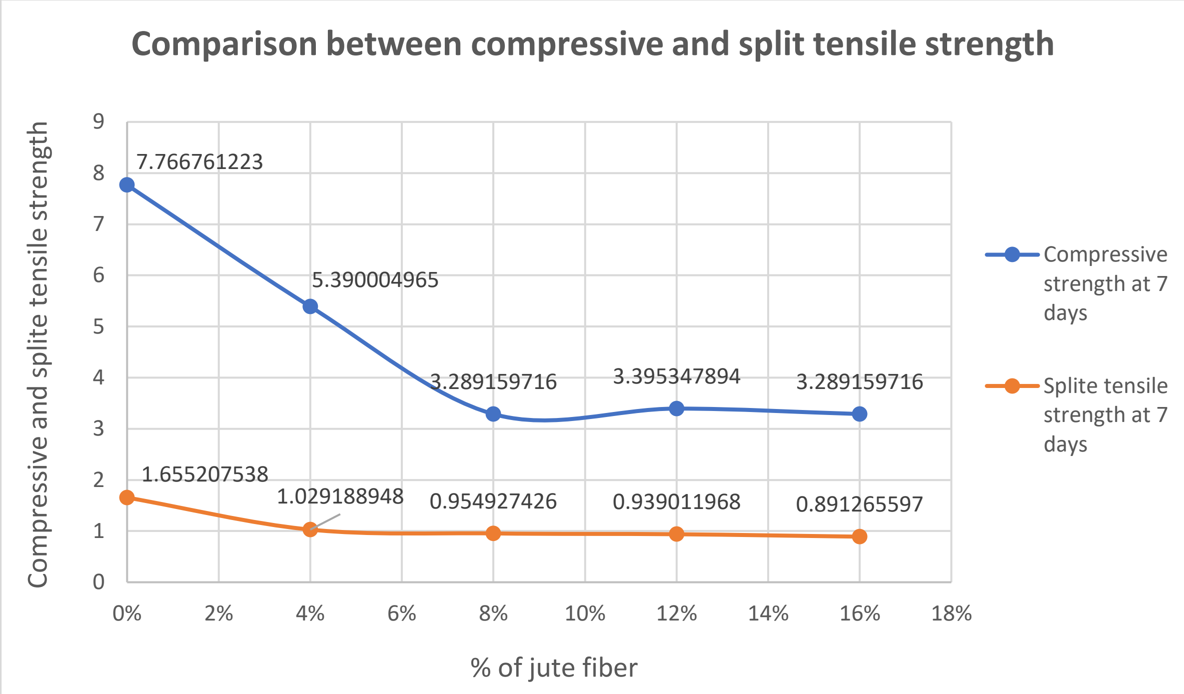

Figure 0-34: Comparison between compressive and split tensile strength 7 days curing period.

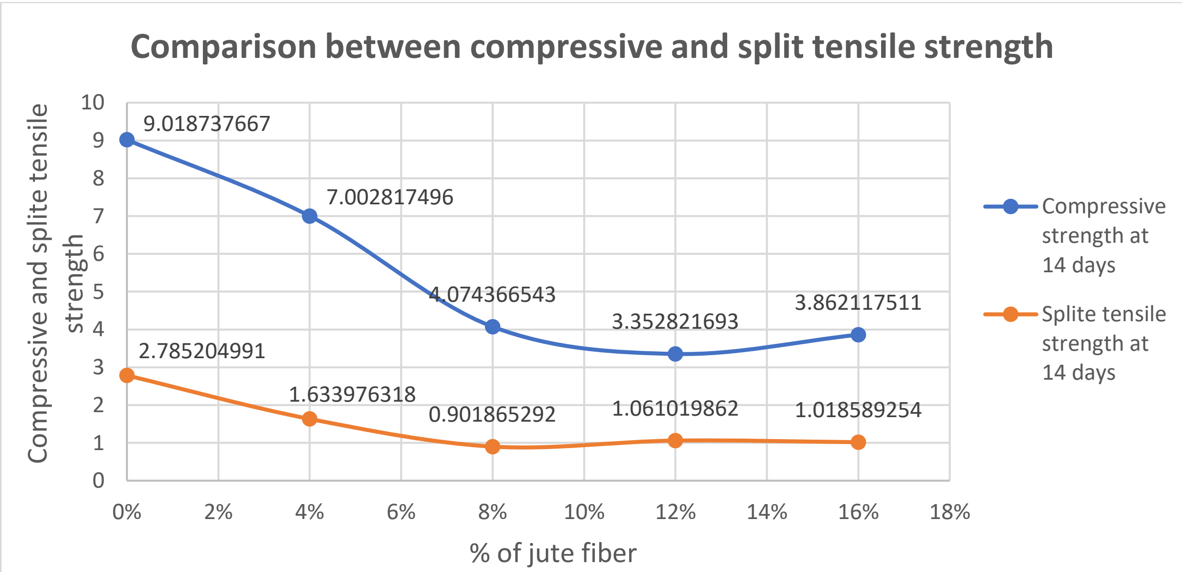

Figure 0-35: Comparison between compressive and split tensile strength 14 days curing period.

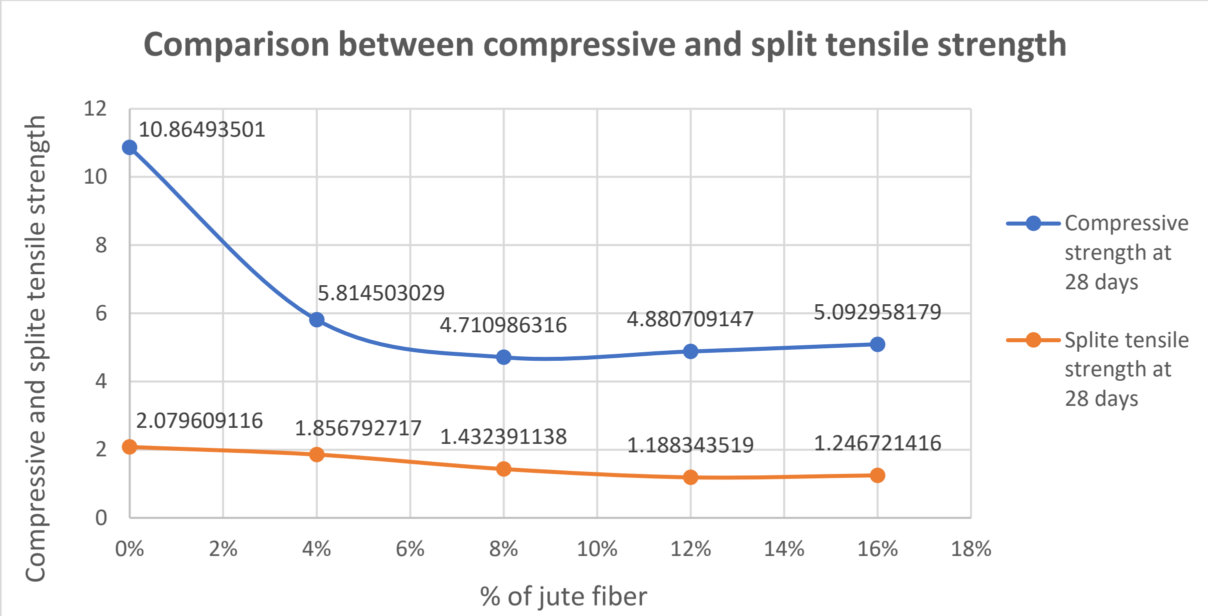

Figure 0-36: Comparison between compressive and split tensile strength 28 days curing period.

5.3 Discussion

- When M15 concrete with 0% jute fiber is especially in comparison to concrete with 4% jute fiber for a 7-day curing period, it is discovered that there is a reduction of 30.60% in compressive strength; with 8%, there is a reduction of 57.65%; with 12%, there is a reduction of 56.28%; and with 16%, there is a reduction of 57.65% in compressive strength (Table 0-8).

- When M15 concrete with 0% jute fiber is especially in comparison to concrete with 4% jute fiber for a 14-day curing period, it is discovered that there is a reduction of 22.35% in compressive strength; with 8%, there is a dramatic reduction of 54.82%; with 12% jute fiber, there is a significant drop of 62.82%; and with 16% jute fiber, there is a significant drop of 57.18% (Table 0-9).

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- When M15 concrete with 0% jute fiber is especially in comparison to concrete with 4% jute fiber for the 28-day curing period, it is discovered that there is a significant drop of 46.48% in compressive strength, and with 8%, there is a reduction of 56.64%, with 12% jute fiber, there is a decrement of 55.08%, and with 16% jute fiber, there is a dramatic reduction of 53.12% (Table 0-10).

- When M15 concrete with 0% jute fiber is especially in comparison to 4% jute fiber concrete for a 7-day curing period, it is discovered that there is a significant drop in tensile strength of 37.82%; with 8% jute fiber, there is a decrement of 42.31%; with 12% jute fiber, it shows a reduction of 43.27%; and with 16% jute fiber, there is a drop in tensile strength of 46.15% (Table 0-11).

- When M15 concrete with 0% jute fiber is especially in comparison to concrete with 4% jute fiber for a 14-day curing period, it's also discovered that there is a significant drop of 41.33% in tensile strength; with 8%, there is a decrement of 67.62%; with 12% jute fiber, it shows a steady decline of 61.91%; and with 16% jute fiber, there is a drop of 63.43% (Table 0-12).

- When M15 concrete with 0% jute fiber is especially in comparison to 4% jute fiber concrete for something like the 28-day curing period, it is discovered that there is a reduction of 10.71% in tensile strength. With 8%, there is a significant drop of 31.12%, with 12% jute fiber, it shows a significant drop of 42.86%, and with 16% jute fiber, there is a steady decline of 40.05% (Table 0-13).

- In M15 concrete for 0%, 4%, 8%, 12% and 16% of jute fiber concrete strength increased by increasing curing period.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

It is now important to provide alternative concrete technology as a source of natural protection material. This project illustrates sustainable development through the creative use of natural jute fiber as a concrete fiber.

- According to the test performed it is observed that there is remarkable decrement in properties of concrete according to the percentages of jute fiber by weight of cement in concrete.
- The jute fiber concrete has the high compressive strength compared to the normal Concrete.
- Our experiment shows that mixing with 4% or more jute fiber by percentage of cement decrease the compressive and split tensile strength in a significant amount.
- It is well observed that using less than 4% of jute fiber could increase the strength of fiber reinforcement.
- Using jute fiber also decrease the brittle characteristics of concrete as well as formation of micro cracks is reduced.
- Jute cultivated as a crop and using jute fiber by percentage of cement could reduce environmental problem which we do producing cement.
- Using jute fiber in fiber reinforcement concrete reduce cost which a big concern in construction work.
- When we tried using 8%, 12% and 16% of jute fiber by weight of cement, it was hard to mixing up but while mixing it was observed that the materials were not binding properly and were falling under segregation further making it impossible to cast the cylinder with 8% or more percentage of jute fiber so we had mix extra water or before using jute fiber we had to soaked with water.
- It may also be inferred that using a higher proportion of jute fiber is not practical.
- An alternate method for using natural fiber not only sustainable but also has economical in civil construction.

6.2 Recommendation

It has been noted that adding 16% jute fiber to cement causes the greatest strength loss, whereas adding 4% jute fiber to cement causes a smaller loss. Therefore, less than 4% of the specified jute fiber proportion should be used to obtain optimal strength.

Others some recommendations are made for improving concrete strength:

❖ Strength will increase further if 2:3:4 or 1:1:1.5 ratios is used.

❖ Using Sylhet sand will boost your strength.

❖ For this experiment, don't use jute fiber that has been finely cut. Because it has been found that using jute fiber with a length of 20 to 30 mm and 14 to 18 mm effectively makes concrete sturdy and long-lasting. But if you use so small length than they will not mix properly.

❖ Utilizing distilling water will boost strength.

❖ Concrete can reach its maximal compressive strength by using aggregate that is 18 mm downgraded.

❖ To obtain concrete with a high strength, utilize ready-mix.

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