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DEVELOPMENT OF JUTE FIBRE REINFORCED CEMENTITIOUS COMPOSITES USING LOCAL INGREDIENTS

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Approval

The paper titled "Development of jute fiber reinforced cementitious composites using local ingredients." Submitted by Redwan Elahe Rishad, Roedad Shabab Soran, Joynal Abedin, Kh. Asmaul Hossin Shaikat and Al Reyan Nirob have been accepted as partial attainment of the requisite for the degree, Bachelor of Science in Civil Engineering.

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Dedication

To our parents and teachers

for

their unwavering support and guidance.

Thank you for believing in us and shaping our journey.

Acknowledgement

All praise belongs to the All-Powerful Allah, by whose Acknowledgement.

All praise belongs to the All-Powerful Allah, by whose kindness we could finish our Research objective. We shall always give Allah our most sincere gratitude, the kindest and most compassionate.

We are expressing our sincere appreciation to Professor Dr. Md. Imran Kabir, Department of Civil and Environmental Engineering, IUT, who served as our thesis supervisor and with whose expert guidance we could finish our dissertation work. Sir, we appreciate your advice, constant support, and never-ending inspiration.

Finally, we want to thank our valued family members and everyone who helped us with our studies, openly or implicitly with kindness therefore, we could finish our Research objective. We shall always give Allah our most sincere gratitude, the kindest and most compassionate.

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Abstract

Jute fiber reinforced cementitious composites (JFRCCs) have gained significant attention as sustainable construction materials due to their eco-friendly nature, enhanced mechanical properties, and cost-effectiveness. This study focuses on developing JFRCCs using locally available ingredients to promote sustainable construction practices and efficiently utilize regional resources. The research methodology involved a systematic investigation of the mechanical, physical, and microstructural properties of the developed JFRCCs. Jute fibers were extracted from locally sourced jute plants, followed by a treatment process to enhance their compatibility with the cement matrix. The locally available cement, fine aggregates, and other additives were employed to ensure cost-effectiveness and reduce the environmental impact associated with long-distance transportation. Various tests were conducted to evaluate the performance of the JFRCCs, including compressive strength, flexural strength, tensile strength, and water absorption tests. The microstructure of the composites was analyzed using scanning electron microscopy (SEM) to assess the interfacial bonding between the jute fibers and the cementitious matrix. The experimental results indicated that the incorporation of jute fibers into the cementitious matrix significantly improved the mechanical properties of the composites. The JFRCCs exhibited enhanced tensile and flexural strengths compared to plain cementitious composites. Moreover, the water absorption resistance of the JFRCCs was improved, which is essential for durability in various environmental conditions. The utilization of locally available ingredients in JFRCCs offers several advantages, including reduced carbon emissions associated with transportation, promotion of local economy, and sustainable resource utilization. This research contributes to the development of eco-friendly construction materials, encouraging the adoption of jute fibers as a viable reinforcement option in cementitious composites.

Keywords: Jute fiber, cementitious composites, sustainable construction, local ingredients, mechanical properties, microstructure.

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Chapter 1 Introduction

The research on "Development of Jute Fiber Reinforced Cementitious Composites using Local Ingredients" aims to explore sustainable and cost-effective alternatives for construction materials. With the growing need for eco-friendly solutions in the building industry, this study focuses on harnessing the potential of jute fibers and locally available ingredients to enhance the properties of cementitious composites.

Cementitious composites have long been used in construction due to their durability and strength. However, conventional materials often rely on non-renewable resources and have a significant carbon footprint. This research proposes the integration of jute fibers, a natural and renewable resource, to develop composite materials that exhibit enhanced mechanical and environmental characteristics. Jute fibers are extracted from the bark of the jute plant, which is abundantly grown in many regions. These fibers possess unique properties such as high tensile strength, low weight, and biodegradability, making them suitable for reinforcement in cementitious composites. By incorporating jute fibers, the aim is to enhance the composite's crack resistance, flexural strength, and impact resistance while reducing its overall carbon footprint.

Additionally, the research focuses on utilizing locally available ingredients to formulate cementitious composites. This approach reduces the reliance on imported materials, supports the local economy, and promotes sustainability. By incorporating locally sourced ingredients, the research aims to create composite materials that are cost-effective and accessible for construction projects in various regions.

The study involves a comprehensive experimental investigation to evaluate the mechanical properties, durability, and sustainability aspects of the jute fiber-reinforced cementitious composites. Various tests, such as flexural strength tests, impact resistance tests, and water absorption tests, will be conducted to assess the performance of the developed materials. Furthermore, life cycle assessments will be carried out to quantify the environmental impacts and compare them with conventional cementitious materials.

The findings of this research hold great potential in advancing sustainable construction practices. Developing jute fiber-reinforced cementitious composites using locally available ingredients could provide a viable and eco-friendly alternative to traditional construction materials. The outcomes of this study may contribute to reducing carbon emissions, promoting the use of renewable resources, and enhancing the overall sustainability of the construction industry.

Chapter 2 Literature Review

2.1 Introduction

This chapter presents an audit of the later inquiry about and advancement of normal fiber-fortified cementitious composites. The later improvements in Characteristic fiber strengthened cementitious composites" strengthened with diverse sorts of characteristic strands, such as sisal fiber, jute fiber, coir fiber, banana fiber, and pinus transmit fiber are moreover surveyed. Characteristic filaments and their modification methodologies are first displayed, and the enhancement history of common fiber-braced concrete and the critical exploration of the mechanical conduct of NFRC in both short-term and long-term are abbreviated. The applications of NFRC are as well checked.

2.2 Previous research on natural fiber-reinforced cementitious composites:

Jute fiber could be a characteristic fiber gotten from the jute plant's stem. It has a few invaluable characteristics, counting tall ductile quality, reasonableness, and biodegradability. It has found utility in different businesses such as materials, paper, and bundling. In later times, jute fiber has been utilized as a fortifying component in concrete. Joining jute fiber into concrete can upgrade its mechanical properties, counting flexural and ductile quality, whereas decreasing brittleness. Moreover, these strands help in split control and move the toughness of concrete forward, which is especially profitable in challenging natural conditions. The expansion of jute fiber to concrete can be finished by either pre-mixing the fiber with the concrete or including it amid the blending handle. The amount of fiber included depends on the particular application and craved characteristics of the conclusion item.

The utilization of jute fiber in concrete holds an awesome guarantee as a practical substitute for engineered strands, advertising noteworthy financial and natural focal points. Be that as it may, advance investigate is required to comprehensively comprehend the impacts of jute fiber on concrete properties and to optimize its application in different scenarios. Common filaments are commonly joined in concrete to relieve breaks from drying and plastic shrinkage. Besides, they contribute to diminishing concrete porousness, subsequently minimizing water dying. Particular sorts of filaments, counting jute fiber, upgrade the affect resistance, scraped spot resistance, and break sturdiness of concrete. Jute fiber, as a common and plant-based fiber, has been effectively utilized in development and building materials.

Earlier to 1970, the advance within the improvement of building materials fortified with common strands was drowsy, in spite of the early utilization of crude normal strands such as roughage and branches as early as 3500 B.C. Normal strands had a few points of interest over-engineered strands, counting non-corrosiveness, a tall quality to weight proportion, and natural invitingness. In any case, with the development of businesses, recently made filaments like steel and manufactured filaments started to supplant common filaments in strengthening cementitious materials due to their prevalent capacity to upgrade the mechanical properties of composites. As a result, the utilization of characteristic filaments in development materials slacked behind, and the center moved towards utilizing steel and engineered filaments for made strides in solidness.

Since the development of the concept of natural supportability in 1970, there has been a recharged intrigue in common filaments as strengthening materials due to their one-of-a-kind qualities, recyclability, and eco-friendliness. The developing request for green and economical buildings and development materials has played a critical part in bringing normal filaments back into the highlight. In later a long time, there has been a fast advance in the improvement of natural fiber-reinforced concrete (NFRC), and inquiries in this field have picked up worldwide acknowledgment.

Most of the normal strands utilized in NFRC, such as wood or vegetable strands with moo versatile modulus, are inexhaustible normal squander materials found around the world. Interests, as distant back as the mid-1940s, analysts started investigating the utilization of cellulose fiber as a cost-effective substitute for asbestos. Within the 1970s, concerns approximately the well-being dangers related to asbestos were driven to its denial by the enactment in numerous nations, starting advanced examinations into making strides in the mechanical properties of characteristic fiber-strengthened cementitious composites.

As the development industry extends, there's a developing request for more grounded and more maintainable advancement. Common strands offer a promising arrangement as they can upgrade concrete quality whereas minimizing negative natural impacts and maximizing the utilization of promptly accessible normal assets.

The preferences for utilizing characteristic filaments in development materials are considerable. Firstly, the fabricating preparation of natural fiber-reinforced concrete (NFRC) depends on natural substitutes rather than conventional concrete components. This aligns well with the standards of maintainability within the building segment. The utilization of NFRC advances a low-carbon and naturally inviting way of developing buildings. Moreover, normal strands are impressively more cost-effective compared to steel or engineered filaments. They are inexhaustibly available over the globe, making them a reasonable and conservative choice for development ventures.

To accomplish this purpose, several researchers have successfully used fiber and yarn as a concrete reinforcing materials. For example M A Mansur and M A Aziz(1982)^([1]), Ramaswamy et.al.(1983)^([2]), ME et.al. (2015)^ ([3]), O. Onuaguluchi and N.Banthia (2016)([4]), Zakaria1 et.al (2016) ([5]),He Tian et.al.(2016)^([6]), L.Ferrara et.al. (2017)^([7]), Then Joaquin F et.al.(2020)^([8]).

A comprehensive investigation of common fiber-reinforced concrete (NFRC) improvements within the development industry has not been detailed in this way distant. In any case, past considerations by M.A. Mansur and M.A. Aziz in 1982 check on the inquiry about and improvement of NFRC sometime recently in 1980. These considerations centered on the utilization of characteristic strands such as coconut husk, sisal, bagasse, bamboo, jute, and wood strands in a concrete generation. In 1994, John et al. conducted a writing ponder that enveloped examinations on the utilization of vegetable filaments in development materials up until that year. This thinks about given experiences in the existing body of investigation on the subject.

Also, Pacheco-Torgal and Jalali carried out a more common ponder on fiber qualities, cementitious framework parameters, mechanical properties of fiber-reinforced composites, and solidness. Be that as it may, there remains a need for in-depth investigation with respect to current improvements in NFRC.

Ramaswamy et al. (1983) gave a think about the forecast and properties of utilizing steel fibers in cement concrete to realize alluring characteristics such as ductility, moved forward effect and break resistance, split hindrance, and wear resistance. Moreover, they investigated the potential of consolidating vegetable fibers, such as jute, coir, and bamboo, alongside manufactured filaments like nylon, polypropylene, and awkward f2, 3J. The paper presents the important properties of these three sorts of vegetable fibers when joined into cement concrete and highlights the preferences watched in terms of viable utilization and the behavior of the composite fabric gotten.

ME et al. (2015) conducted a think about to examine the flexural and ductile quality of jute texture strengthened by a polymeric framework fabric. The mechanical properties, particularly the twisting firmness, and breaking reaction, were compared to those of carbon material-strengthened polymers (CFRP) and glass material-fortified polymers (GFRP) composite frameworks.

The essential center of their think about was to assess the effect of pultrusion, which includes surface treatment of material texture to present extra work, as a preform for textile-reinforced mortar (TRM). They inspected the coordinate's execution and mechanical properties of crossover jute texture strengthened cementitious composites, especially in terms of bowing solidness and breaking behavior.

The ponder moreover highlighted that jute-based polymer composite frameworks were created and characterized, comparing their adaptable and flexural behavior to carbon material (CFRP) and glass material (GFRP) strengthened polymer composites. Jute, being inexhaustibly accessible in numerous creating nations, is considered a reasonable low-cost, solid, and strong building fabric. Jute filaments, as common fortification specialists, are around seven times lighter than steel whereas showing sensibly tall pliable quality values.

In spite of the fact that a few ponders have investigated the mechanical properties of jute fiber-reinforced cement composites, their down-to-earth applications have been constrained. Be that as it may, the consideration of jute filaments has appeared to essentially upgrade the physical and mechanical properties of cement composites. Exploratory tests illustrated a noteworthy increment in malleable, flexural, and affect quality of the composite materials.

In Jo et al.'s (2015) consideration, they inspected the impacts of alkali-treated jute fiber fortification on the physical characteristics and mechanical properties of cementitious composites. The utilization of alkali-treated jute fiber as a fortification in cement composites brought about progressed compressive quality and flexural properties compared to crude jute-fortified mortar and the control mortar.

In their ponder, the compressive quality of the control cement mortar (cured for 90 days) was found to be 34.5 M Pa, whereas the alkali-treated jute fiber strengthened cement mortar appeared a compressive quality of 36.2 M Pa. So also, the flexural quality of the control mortar was 7.4 M Pa, though the alkali-treated jute fiber strengthened mortar displayed a flexural quality of 10.4 M Pa.

Besides, the twisting properties of the alkali-treated jute fiber strengthened mortar appeared changes in break durability, sturdiness records, and post-cracking resistance vitality. These properties were upgraded by 1.5, 0.6, and 22.5 times, individually, compared to the control mortar. The crude jute fiber fortified mortar too appeared changes of 1.4, 0.5, and 20.4 times in these properties compared to the control mortar.

The analysts proposed an approach to clarify the in general execution of alkali-treated jute fiber fortified cement composites. They highlighted that concrete, being a crucial development fabric, has been broadly utilized for present day framework advancement due to its tall compressive quality. In any case, concrete has restrictions such as brittleness, moo ductility, destitute resistance to split opening and engendering, and restricted ductile quality. To address these issues and move forward the mechanical execution of concrete composites, the utilization of scattered fiber support has been noteworthy.

Customarily, steel filaments have been broadly utilized as support in cement composites due to their accessibility and tall load-bearing capacity. Steel filaments upgrade the strength of cementitious composites by controlling split engendering. In any case, there has been expanding intrigue in creating feasible and lightweight development materials. As a result, analysts have investigated elective sorts of fortification strands that can transmit stretch to the encompassing network and give sturdiness to concrete.

Common cellulose strands have picked up consideration due to their points of interest such as lower fetched, lower thickness, and natural invitingness. These strands are promptly accessible and display properties comparable to other customary fortification filaments utilized in cementitious composites. It has been detailed that characteristic filaments have the potential to overcome the characteristic brittleness of cementitious materials and can be utilized as support in cement composites.

Later inquire about has centered on creating high-strength, cost-effective, and energy-efficient concrete composites fortified with normal strands, especially jute, sisal, and coir strands.

The incorporation of common filaments in cement networks upgrades toughness, ductility, and vitality retention. These filaments act as split arrestors, restricting split engendering and driving to a slow disappointment of the composite.

The quality and ductility advancement in cement composites are fundamentally administered by the bridging activity of filaments, which exchange loads and avoid break proliferation. To guarantee compelling fiber-matrix compatibility, variables such as fiber cement compatibility, hydration behavior, antacid steadiness, and fiber-matrix bond have to be considered. Antacid treatment has been found to be exceedingly viable in improving the mechanical, physical, and warm properties of filaments and composites, as well as expanding the fiber-matrix interface interaction.

Soluble base treatment makes strides the mechanical properties of composites by expelling hemicelluloses and other dissolvable sugars and changing filaments into fibrils. It too increments the successful surface region of filaments, giving more holding destinations at the fiber-matrix interface. Whereas adequate inquiry has been conducted on the soluble base treatment of fiber surfaces.

In their consideration, Onuaguluchi and Banthia (2016) investigated the utilization of brief and mash strands in cement glue and mortar. The concept of supportability, as characterized by the World Commission on Environment and Improvement (WCED), includes assembling the show's needs without compromising the capacity of future eras to meet their claim needs. One of the major challenges confronting humankind is the expanding worldwide populace and the coming about weight on the built environment. The request for the framework has driven to critical squander era, vitality utilization, and fabric utilization within the development industry. Agreeing with Melchert, the development industry not as it devoured huge sums of vitality, and crude materials, and arrive but moreover contributes altogether to the natural contamination, especially nursery gas emanations.

To advance maintainability in the development of fabric utilization, the industry must grasp the reuse of mechanical by-products and renewable materials. As of now, the utilization of engineered filaments in cement composites is picking up notoriety due to their demonstrated execution. Existing cement inquiry about writing illustrates that the expansion of steel and polymeric filaments can altogether move forward the ductility, malleable quality, solidness, weariness quality, affect resistance, and vitality assimilation of cement-based materials.

There are three sorts of characteristic strands accessible for concrete support: animal-based, mineral-derived, and plant-based strands. Creature strands, which comprise of particular proteins, incorporate silk, fleece, and hair filaments. Mineral-derived filaments are gotten from normally happening minerals. At last, plant-based strands incorporate cotton, hemp, jute, flax, ramie, sisal, bagasse, and forte strands prepared from wood, among others.

In their order, Zakaria et al. (2016) conducted investigated the effect of fiber length and volume division to create jute fiber as a fortification fabric for concrete composites. The point of this investigation was to discover ways to improve the properties of concrete and decrease its negative natural effect by utilizing jute strands. Jute fiber has been examined as a potential fortification fabric in concrete due to its different benefits. By consolidating jute fiber into concrete, the mechanical properties of the fabric can be moved forward, counting its ductile quality, flexural quality, and durability. Furthermore, the utilization of jute fiber can upgrade the strength properties of concrete, such as its resistance to breaking, shrinkage, and water retention.

One advantage of utilizing jute fiber in concrete is the potential for fetched lessening compared to conventional support materials like steel. The ideal measurement of jute fiber in concrete depends on the particular application and the specified properties. It is imperative to discover the proper adjustment, as well much or as well small fiber can have negative impacts on the mechanical and strength properties of the concrete.

In any case, there are challenges related to handling and blending jute fiber with concrete. Jute filaments have the propensity to ball up and shape clumps, which can affect the homogeneity of the concrete blend. Appropriate blending methods ought to be utilized to overcome these challenges and guarantee uniform dissemination of the filaments all through the concrete framework.

Tian et al. (2016) talk about the developing intrigued in inquire about and advancement of eco-friendly, green, and feasible development materials that utilize reused or mechanical by-products and squanders. One zone of the center is the utilization of fiber-reinforced concrete (FRC), which includes consolidating discrete brief filaments arbitrarily into cementitious composites. This approach has appeared noteworthy advancements in different building properties such as pliable quality, flexural quality, break resistance, weariness resistance, and affect resistance.

To realize particular mechanical characteristics like multiple-cracking behavior and remarkable strain capacity, certain procedures have been utilized to bargain with the strands. In any case, customary FRC regularly requires a tall extent of cement, which comes about in a huge sum of CO2 emanations amid its generation, driving antagonistic natural impacts. Subsequently, it is alluring to in part supplant the cement with a few mechanical squanders or mechanical by-products.

Steel strands and manufactured strengthening filaments have been broadly utilized in FRCs. In any case, there has been developing intrigue in utilizing normal filaments, such as banana fiber, bagasse fiber, coir fiber, jute fiber, and sisal fiber, as a fortification in concrete. The utilization of common filaments, which are eco-friendly and cost-effective by-products of horticulture, presents a promising approach to upgrading the supportability of fiber-reinforced composites. Early considerations on normal fiber-reinforced cementitious composites were not given much consideration as normal filaments were delicate and vulnerable to corruption, particularly in antacid media. Be that as it may, through particular adjustments, common filaments have been demonstrated able of progressing the mechanical behavior of composites indeed beneath long-term weathering conditions.

The creators display their investigation on creating cutting-edge green cementitious composites fortified with bagasse fiber and steel fiber, at the side of an ultra-high volume of fly cinder. The mechanical behavior of the composites, counting compressive quality, Young's modulus, bowing behavior, and uniaxial ductile behavior, are tentatively examined. The impact of fly fiery remains substance on the mechanical properties is considered by changing the fly cinder to cement proportion, whereas keeping the bagasse fiber substance settled at 3% by volume. The impact of bagasse fiber substance is assessed by changing the fiber substance from 3% to 8% and 12% by volume division, with a settled fly cinder to cement proportion of 1.6. The mechanical properties of the refined bagasse strands, counting Young's modulus, malleable quality, and stress-strain relationship, are moreover considered and displayed. In conclusion, the investigative discoveries of the consideration are summarized, highlighting the potential of utilizing bagasse fiber and steel fiber in green cementitious composites with a tall volume of fly cinder.

L. Ferrara et al. (2017) examine the potential of utilizing normal strands as scattered support in cement-based materials. These filaments offer an elective to engineered filaments due to their amazing mechanical properties and characteristic maintainability. The paper centers on investigating the mechanical properties of Normal Fiber Strengthened Cementitious Composites (NFRCCs) and investigates two progressed points: the utilization of nano-sized cellulose-based constituents in cementitious composites and the self-healing capability that characteristic filaments may give.

The physical and mechanical properties of normal strands are exceedingly impacted by the natural conditions in which the plants are developed, as well as the generation, extraction, and assist preparing required to plan the strands for joining into a cementitious network. This may lead to a critical variety within the properties of the filaments, as well as the fiber-matrix bond, which may influence the unwavering quality of the mechanical execution of NFRCCs. Other variables, such as the casting strategy and the scattering and flow-induced arrangement of the strands, as well as the curing procedure, can moreover affect the mechanical and auxiliary execution of NFRCCs.

The permeable structure and hydrophilic behavior of normal filaments result in water assimilation from the lattice, influencing the workability of the fabric and the adequacy of the casting process. The early-age behavior, counting autogenous and drying shrinkage, is additionally likely to be impacted, possibly compromising the adequacy of the curing methodology.

The creators emphasize that the inquiries about exercises in this field have been built upon a solid establishment, especially with respect to the exploratory characterization of the mechanical execution, strength, and long-term soundness of NFRCCs. The audit points to addressing a critical crevice in current plan codes for Fiber Fortified Concrete (FRC) structures, which don't cover fiber materials with Young's modulus altogether impacted by time and natural varieties, as is the case with characteristic strands. Such an assessment is pivotal for the more extensive and well-founded utilization of NFRCCs in high-end building applications and for distinguishing modern patterns of advancement, such as the utilization of nano-sized characteristic constituents like nano-cellulose powder and precious stones.

Moreover, the paper analyzes the potential of characteristic filaments to transport water all through the cementitious lattice and actuate crack-sealing and recuperating forms. This examination points to improving the understanding of the supportability and multi-functional quality properties of progressed cement-based materials in this category.

In outline, the work gives bits of knowledge into the mechanical properties of NFRCCs, their compatibility with the cementitious lattice, and the potential for self-healing forms. The survey points to bolstering the broader utilization of NFRCCs in high-end development applications, addressing plan code restrictions, and investigating modern roads of improvement, counting the utilization of nano-sized characteristic constituents.

In Joaquin F et al.'s (2020) think about, the mechanical properties of plain foamed concrete (PFC) and fiber-fortified foamed concrete (FRFC) were explored. The FRFC was strengthened with henequen filaments at diverse volume divisions (0.5%, 1%, and 1.5%), and polypropylene filaments were utilized as a reference. Compression and weight tests were conducted to assess the compressive and pliable properties of the concrete tests. The inclusion of filaments within the FRFC moved forward its compressive and pliable quality and showed a more plastic behavior compared to the PFC. The improvement in mechanical properties was credited to the increment in test sturdiness due to the nearness of strands. The FRFC tests appeared no critical misfortune in quality after coming to their top quality, showing a plateau-like behavior beneath compressive stacking. Beneath malleable stacking, the strands altogether expanded the malleable quality of the FRFC, driving the sudden disappointment of the samples, which differentiated with the fragile behavior watched within the PFC. utilization of treated henequen filaments comes about in higher advancement in pliable behavior, credited to the improved fiber-matrix bond accomplished through antacid treatment.

Tiny characterization uncovered that the addition of strands did not altogether influence the air-void estimate and dissemination within the concrete. The FRFCs displayed higher vitality assimilation compared to the PFC, showing moved forward strength and ductility given by the filaments. These come about bolstering advance investigate on FRFC with henequen fibers for different development applications.

Foamed concrete, too known as cellular concrete, could be a lightweight cementitious fabric with air voids caught inside the mortar. It offers great workability and can be utilized in filling applications, warm separators, soundproofing, fire resistance, and impact energy retention. Be that as it may, foamed concrete is regularly not utilized as a basic fabric due to its moo compressive quality and destitute capacity to resist bendable loads. The flexural and pliable qualities of foamed concrete are by and large 15-35% of its compressive quality. The utilization of polymer strands as a fortification in concrete lattices has been found to decrease shrinkage splitting and make strides in mechanical properties, particularly ductility and flexural properties.

The centrality of this inquiry lies in progressing 15 the understanding of the mechanical behavior of common fiber-strengthened foamed concrete. There's as of now constrained information approximately the mechanical behavior of low-density foamed concrete fortified with treated henequen strands at distinctive volume divisions. The mechanical testing illustrated that treated henequen filaments can be utilized as an elective to engineered strands in feasible development applications, as they give comparable benefits in terms of compression properties and progressed pliable properties. The utilization of common strands, which are cost-effective and feasible materials, holds awesome esteem, particularly within the advancement of economical materials for the development industry.

In rundown, considers show that joining jute fiber in concrete presents a practical and eco-friendly arrangement for support, advertising cost-effective and maintainable benefits. Be that as it may, the extra investigation is required to maximize its viability and pick up a comprehensive understanding of its solidness and long-term behavior.

Chapter 3 Methodology

3.1 Introduction

Jute fiber reinforced cementitious composites are being studied for their characteristics and possible uses. Introducing this strategy requires numerous stages. Jute fibers are reinforced owing to their mechanical characteristics, inexpensive cost, and renewable nature. Because of its extensive usage in building and compatibility with jute fibers, cement is the matrix material. Jute plant fibers are mechanically removed. To guarantee consistency, fibers are washed, dried, and cut to length.

To improve the composite's workability and performance, a cement mixture is made by mixing cement, water, and any additional additives or admixtures, including sand. Fiber inclusion entails adding jute fibers to the cement mixture at various percentages and mixing them well to ensure that the fibers are evenly distributed and bonded to the cement matrix. Created by pouring the composite material into molds or casting it into desired forms, test specimens are made in the sample manufacturing stage. To learn how various characteristics affect the composite's qualities, the samples might range in size and fiber content. The manufacture and shape of samples of a composite material with the aim of performing different tests to assess its qualities constitutes specimen preparation.

After the constructed samples have been treated to a curing procedure, which normally involves conditions that are either wet or ambient, the cement is given time to hydrate and build strength. After the curing process is complete, the samples are conditioned by simulating real-world circumstances by carefully controlling the temperature and humidity. The jute fiber-reinforced cement composites are put through a battery of tests in order to characterize their mechanical, physical, and long-lasting qualities. The tests of compressive strength, flexural strength, and tensile strength, as well as impact resistance, water absorption, and durability against climatic conditions such as moisture and freeze-thaw cycles, are common.

3.2 Materials selection:

Sylhet Sand:

One of the types of sand that may be found in the Sylhet area of Bangladesh is referred to as Sylhet sand. This sand is highly regarded for its quality and is used in the construction industry, particularly in the production of concrete. The rocks in the area, which are mostly made up of granite and gneiss, erode over time, which results in the formation of sand. After going through sieve #300 micrometer, the sand that was used to make the mortar was allowed to dry out while it was held on sieve #150 micrometer. The Sand from Sylhet is well regarded for both its strength and its longevity, qualities that make it an excellent choice for use in building projects. In addition to this, it is famous for its resilience in the face of harsh climatic circumstances, including intense downpours and floods. Because of its superior quality, sand from Sylhet is in great demand not only inside Bangladesh but also around the globe.

Figure 1: Sylhet Sand

Jute:

In common usage, commercial jute fibers are referred to as "Tossa," and they were acquired from the region of Bangladesh where they were grown. They are cut into 12-15mm pieces and soaked with 5% w/w NaOH solution, then they were removed from the solution and dried in the sun for 24 hours.

Jute is a prominent natural fiber that is widely recognized for its long, soft, and lustrous vegetable fiber. It is considered one of the most significant natural fibers globally. Jute is classified as an environmentally sustainable fiber due to its biodegradable and renewable properties. The crop is sustainable due to its low dependence on pesticides and fertilizers and its ability to thrive in diverse soil conditions.

Figure 2: Jute fiber

Cement:

Ordinary Portland Cement (OPC) is a commonly utilized cement type that is manufactured through the process of grinding clinker, gypsum, and other mineral additives, including fly ash, slag, or silica fume. Ordinary Portland Cement (OPC) is a widely available and commonly used type of cement on the market. The term "ordinary" is used to denote its popularity and prevalence. Ordinary Portland Cement (OPC) is classified into various grades based on its minimum compressive strength after 28 days of curing. Ordinary Portland cement that complies with BS12 was selected.

Figure 3: Ordinary Portland Cement (OPC)

Admixture:

In the mortar, we utilized an additive that helped reduce the amount of water. In the production of concrete, a kind of chemical additive known as water-reducing admixtures (WRAs) is used to cut down on the quantity of water that is required in order to obtain the correct degree of workability. The admixture may increase the concrete's strength, durability, and workability by lowering the amount of water that is contained inside the concrete, which in turn lowers the likelihood that the concrete will crack, shrink, or have any other kind of fault.

Fly Ash:

The mortar was composed of oven-dried fly ash. Fly ash is a residual material generated from the thermal decomposition of coal during the energy production process in power plants. The fine powder is transported out of the power plant through the exhaust gases and subsequently gathered by electrostatic precipitators or other particulate control devices. Fly ash is a type of residue that contains inorganic components, including silicon, aluminum, iron, and calcium, along with trace amounts of other elements.

Figure 4: Fly Ash

3.3 Fiber extraction and preparation:

The process of jute fiber extraction and preparation comprises multiple stages that are necessary to obtain fibers from the jute plant and render them appropriate for diverse applications. Jute plants are commonly grown in warm and humid regions, including Bangladesh, India, and other parts of Southeast Asia, for the purpose of harvesting. Upon reaching maturity, which typically occurs between 120 and 150 days after planting, the plants are subjected to the process of harvesting. The process of harvesting usually entails the act of severing the plants near the soil surface.

Retting is a process that involves submerging small batches of harvested jute plants in water bodies, such as ponds or shallow streams, for a specific period of time. The procedure referred to as retting facilitates the separation of a plant's fibers from its woody core. The duration of the retting process is subject to variation based on several factors, including but not limited to temperature, water quality, and the desired quality of the fiber. The typical duration is between one or two weeks. After the retting process, the jute stalks are removed from the water and subjected to partial sun drying, a process known as stripping. The process of drying facilitates the separation of fibers from the husk. Subsequently, the desiccated stems undergo a process of stripping, which involves the elimination of non-fibrous components such as the bark and herds. This operation can be performed through mechanical or manual means.

The process of fiber extraction follows the stripping of jute stalks. The process entails the separation of long, soft, and fibrous strands from the residual woody material. Various methods can be employed for the extraction process, including mechanical decortication, which involves the use of machines to break the stalks and extract the fibers, and manual stripping, which involves the use of handheld tools by workers to extract the fibers. After the extraction of jute fibers, a meticulous cleaning process is carried out to eliminate any residual impurities, such as dust, bark particles, or other debris. The fibers undergo a drying process, which can be achieved through natural means such as exposure to sunlight or mechanical means, to decrease moisture levels and inhibit the development of mold or mildew. The jute fibers may undergo supplementary treatment processes based on their intended application and desired properties. This is known as fiber treatment.

The treatments that can be applied to the fibers include bleaching, dyeing, or chemical treatments. These treatments are intended to enhance the fibers' color, strength, or resistance to pests, moisture, or fire.

3.4 Cement mixture preparation:

The production of jute fiber-reinforced cementitious composites involves the blending of cement, water, and various additives or admixtures to achieve a consistent and functional mixture. The selection of cement is based on the specific application and requirements. There are several types of cement available, including ordinary Portland cement (OPC), mixed cement, and specialty cement. The selection of cement is contingent upon the requisite strength, durability, setting time, and cost. Proportioning is a crucial step in determining the appropriate amount of cement to be added to the mixture based on the desired characteristics of the composite. Weight and volume ratios are frequently utilized in order to determine the appropriate proportions. The exact ratios of the composite mix may vary based on factors such as desired strength, workability, and the inclusion of other components. Additives and admixtures can be utilized to modify the characteristics of the cement mixture. Examples of additives used in the construction industry include pozzolanic materials like fly ash and silica fume, water-reducing agents, superplasticizers, accelerators, and retarders. Additional components can be incorporated into the composite material to improve its strength, functionality, hydrophobicity, or other performance characteristics. The process of mixing involves the combination of cement, additives, and water in a mixing device that resembles a concrete mixer. This is done to achieve a consistent and uniform composition. The mixing process must ensure thorough dispersion of concrete particles and admixtures in the water to attain optimal hydration and material reactions. The process of integrating fiber involves the addition of jute fibers to the cement mixture after it has been uniformly mixed. Inclusion of fibers is commonly achieved by utilizing chopped fibers or fiber bundles.

During the mixing process, fibers are incrementally introduced to the slurry to ensure uniform dispersion within the cement matrix. Adequate mixing time is required to establish a robust bond between the fibers and the cement. The consistency of the cement mixture can be modified during the mixing process by adding more water or cement, depending on the desired workability. Consistency can be evaluated through the utilization of conventional tests such as the slump test and the flow table test. During the process of combining materials, quality assurance measures are implemented to ensure that the composite is uniform and consistent. These quality control techniques are crucial to maintaining the overall quality of the final product. The process entails assessing the characteristics and applicability of the blend and ensuring that the correct duration of mixing is employed.

Figure 5: Composite Mixture

Figure 6: Composite Paste

3.5 Fiber Incorporation:

Fiber incorporation is a technique that involves the addition of fibers, such as jute fibers, to a matrix material to produce a composite material. It is important to clean, dry, and prepare the fibers appropriately before incorporating them. The process may entail the elimination of contaminants, such as particulate matter or fragments, and the trimming of the fibers to the required dimensions. The mechanical properties of a composite can be affected by the length of its fibers. Integrate the pre-prepared fibers into the designated matrix material. The technique utilized for fiber integration is contingent upon the matrix substance and the intended fiber distribution and alignment. The fibers are uniformly distributed within the matrix material by stirring or mixing, depending on the composite system. In certain scenarios, it may be necessary to align the fibers in a specific orientation to optimize certain mechanical characteristics of the composite, such as tensile strength or stiffness. The objective of the mixing procedure is to achieve uniform dispersion of fibers and effective bonding with the matrix material. Efficient load transfer between the fibers and the matrix is critical for enhancing the overall strength and performance of the composite. Following the addition of fibers, the composite blend is subsequently introduced into molds or cast into predetermined configurations, thereby producing composite specimens.

3.6 Preparation of Test specimen:

The size and shape of the test specimens must be determined based on the testing standards, requirements, and objectives. Rectangular or square bars, cylindrical specimens, and plates are among the frequently employed shapes for specimens. Fabricate molds or fixtures that correspond to the specified dimensions and configuration of the test specimens. Molds can be fabricated from a range of materials, including metal, plastic, or silicone, contingent upon the composite material and testing prerequisites. To create the composite material, it is necessary to mix the matrix material and incorporate the reinforcing fibers, as previously mentioned. Transfer the composite mixture into the molds that have been previously prepared, making sure that the fibers are evenly distributed and consolidated. In order to achieve uniform distribution of the composite material within the mold and eliminate any air voids, it may be necessary to employ consolidation techniques. Various techniques, such as vibration, pressure, or vacuum-assisted consolidation, can be utilized based on the composite material and the desired properties of the specimen.

To conduct the test we used three specimen. They are cylindrical, rectangular and cubical.

Cylindrical Mold (mm)		Rectangular Mold (mm)		Cubical Mold (mm)	
Diameter	100	Length	400	Length	50
Height	200	Width	100	Width	50
		Height	100	Height	50

Table 1: The Dimensions of the specimens.

Figure 7: Cylindrical Mold

Figure 8: Rectangular Mold.

3.7 Curing & Casting of Concrete:

Concrete casting is a procedure that involves the pouring of a fluid mixture consisting of cement, water, aggregates, and additives into a mold or formwork. The mixture then solidifies and undergoes a curing process, resulting in a solid mass. The process of casting is a crucial stage in the manufacturing of concrete structures such as bridges, buildings, and roads. The initial stage of concrete casting involves the preparation of the mold or formwork. The object in question can be constructed using a variety of materials, including but not limited to wood, steel, or plastic. Its primary function is to ensure that the final product is produced with the desired shape and dimensions. A release agent is commonly applied to the formwork to prevent the adhesion of concrete. The subsequent procedure involves blending the concrete constituents in accurate ratios. The process of achieving a uniform consistency of cement, water, Sylhet sand, and additives is commonly carried out in a mixer. The ingredients are combined and blended thoroughly to attain the desired outcome. After the concrete has been thoroughly mixed, it is conveyed to the designated casting location and deposited into the prearranged formwork. The process of compacting concrete involves the use of vibration or other methods to eliminate any voids and guarantee that it occupies the entire formwork. Concrete can be reinforced with materials like steel bars or mesh to enhance its strength and durability. Upon completion of the pouring process, the concrete is subjected to a hardening and curing phase. The duration of the curing process is dependent on the environmental conditions as well as the type and strength of the concrete. It can last for days or weeks. During the curing process, the concrete undergoes a chemical reaction that results in increased strength and the development of desired properties, including durability and resistance to cracking. Upon completion of the curing process, the formwork can be dismantled to reveal the final concrete structure. The concrete surface can be manipulated to attain the intended aesthetic and practical properties through finishing and texturing techniques.

To initiate the casting process, it is essential to prepare the mold or formwork beforehand. The material options for this item include wood or metal. It is recommended to design it according to the desired shape and dimensions of the final product.

To mix the cement, use a clean container and gradually add water until a consistent texture is achieved. The quantity of water required for the final product's desired strength is contingent upon the type of cement utilized.

To incorporate Sylhet sand into the cement mixture, add it to the mixture. Sylhet sand is a type of sand that possesses a fine-grained texture and superior quality, which makes it a popular choice in the construction industry.

To incorporate jute fibers into the mixture, follow the appropriate procedure. Jute fibers are utilized to enhance the structural integrity of the mold and mitigate the likelihood of cracking or breaking while casting. To the mixture, add a minor quantity of admixture. An admixture is a type of chemical additive that has the potential to enhance the workability, strength, and durability of concrete.

To achieve a smooth and consistent mixture, thoroughly mix the ingredients together. To pour the mixture into the mold, ensure that the mold is prepared beforehand. Fill the mold to the desired level with the mixture. To ensure even distribution of the mixture and eliminate any air pockets, it is recommended to vibrate the mold. Utilize a trowel to even out the surface of the mixture. It is recommended to allow the mixture to cure and solidify for a few days, taking into account the type of cement utilized and the surrounding environmental conditions. To reveal the finished product, carefully remove the mold after the mixture has cured.

Figure 9: Casting of Jute fiber Cementitious Composites.

3.8 Test Procedure

Mechanical tests are frequently employed during the evaluation of jute fiber-reinforced cementitious composites to determine their properties. The Universal Testing Machine (UTM) is a commonly used tool in this testing process. The UTM must be configured in accordance with the specifications of the test standard. Proper orientation of the machine, calibration of load and displacement sensors, and connection of suitable grips or fixtures may be necessary. The jute fiber-reinforced cementitious composite specimens that were reported earlier must be finalized. Ensure that the samples conform to the appropriate size and shape requirements for the specific test being conducted. Cementitious composites that incorporate jute fiber reinforcement are commonly subjected to tensile, flexural, and compressive strength assessments.

To mount the prepped specimen, it is necessary to insert it into a grip or fixture on the Universal Testing Machine (UTM). It is imperative to confirm that the sample is firmly secured and positioned accurately with appropriate focus. The mounting technique may vary depending on the specific test being performed. Configure the UTM control panel to the designated test settings. The aforementioned parameters encompass limits such as the velocity of the test, the extent of the load's reach, and the range of dislodgement. The limitations are required to adhere to the specific testing standard. Initiate the User Test Module (UTM) and execute the test to perform the evaluation. The Universal Testing Machine (UTM) gauges the pertinent response, such as force or displacement, by exerting a regulated load or displacement on the sample. The test can be performed either in a controlled uprooting manner or in a load-controlled mode, depending on the test standard or investigative criteria.

Acquiring data: During the testing process, the Universal Testing Machine (UTM) acquires and displays data related to load displacement or load time. The presented data provides information on the stiffness, strength, and deformation properties of the specimen, as well as its mechanical behavior. The test has been administered. The testing process persists until the predetermined test limits are attained or until the sample expresses dissatisfaction. Disappointment is commonly characterized as a significant decrease in workload. The UTM may come to a conclusion or stop functioning near the end of the exam. The mechanical properties of jute fiber-reinforced cementitious composites are to be determined through data analysis. The test results can be utilized to identify properties such as ultimate strength, yield strength, elastic modulus, and strain capacity.

Test Report Generation: Utilize the results of the test to produce a comprehensive report that encompasses details regarding the specimen, the testing conditions, and any mechanical characteristics that were revealed. The report must contain any significant observations or insights regarding the testing procedure.

We also used Cylinder Testing Machine (CTM) to conduct the test. In order to determine the compressive failure load of the samples, we placed them through our cylinder testing machine and observed the results.

Figure 10: UTM Machine

Figure 11: Testing by UTM machine

Chapter 4 Data Analysis & Results

4.1 Presentation of Results:

We have tested the Jute Fiber Reinforced cementitious composite for three individual shapes. They are-

1. Cylinder mold (Column sample)

2. Rectangular mold (Beam Sample)

3. Cubical mold

We follow our test matrix and casted according to the given ratios:

Batch		1	2	3	4	5	6	7
Mix Ratio	Cement	1	1	1	1	1	1	1
	Fly-Ash	2	1.8	2	1.2	1.2	1.2	1.2
	Sand	1.5	1.6	1	0.6	1.1	0.6	1.1
	Water	0.65	0.8	0.8	0.8	0.5	0.5	0.8
	Admixture	0.0013	0.03	0.00625	0.00625	0.00625	0.00625	0.00625
	Jute Fiber content (%volume)	0.068	0.04	0.5	0.5	0.5	0.5	0.5
Jute fiber Length		10 mm	10mm	20mm	20mm	20mm	20mm	20mm
Curing type		Ambient air curing	Water Bath curing	Ambient air curing	Ambient air curing	Ambient air curing	Ambient air curing	Ambient air curing
Load on Cylinder(KN)		198	366.7					
Cube Load (KN)				32	23	39	13.6	30
load on beam (KN)		7.99	10.025					
Compressive Strength (MPa)		25.2101	46.6896	12.8	9.2	15.6	5.44	12
Fracture Strength (MPa)		3.5955	4.51125					

Table 2: Test matrix for Casting.

4.2 Analysis:

We casted 5 cylindrical and 6 rectangular mold from the 1st batch and 2nd batch. For the first batch we left the sample on cold and shaded place for ambient air curing and the second batch is left in water bath for water curing after demolding. We tested the samples under the Universal Testing Machine to observe the load and deformation of the samples. For the cylindrical sample we done the compression test and the rectangular samples are tested by one point loading test. Among these samples we tested the cylindrical sample in 28 days as we select all the test to be done by 28 days. On the 28th day the cylinder samples are placed for the compression test under the UTM machine. From all the cylindrical samples casted according to the mix design of batch 1, we got the height load of 198 KN. The data and graph of load vs deformation is shown below. Due to imprecation of the cement paste sealing on the top, the samples takes some load in low scale and shows a huge deformation. This part doesn't counted to measure the compression strength for the samples. By observing the curve we chose the useful data and shifted to zero to subtract the unnecessary load and deformation. We found the height compressive strength of 25.210084 MPa. In case of beam or rectangular shape samples we place the sample under the setup of single point loading test under the UTM machine. . From all the rectangular samples casted according to the mix design of batch 1, we got the height load of 7.99 KN. The data and graph of load vs deformation is shown below. We found the height fracture strength of 3.5995 MPa.

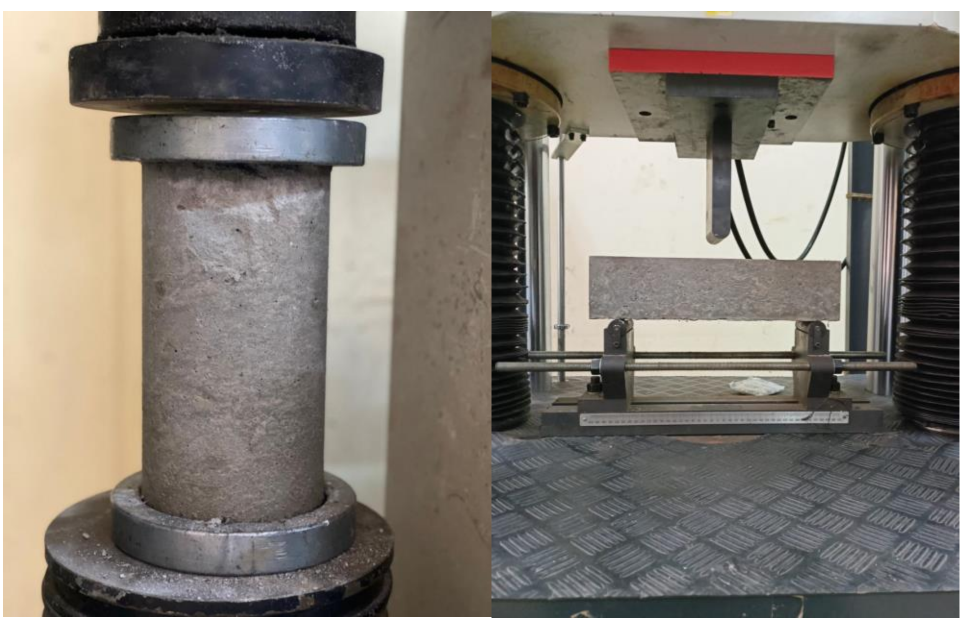

Figure 12: Samples of 1st batch under the UTM machine.

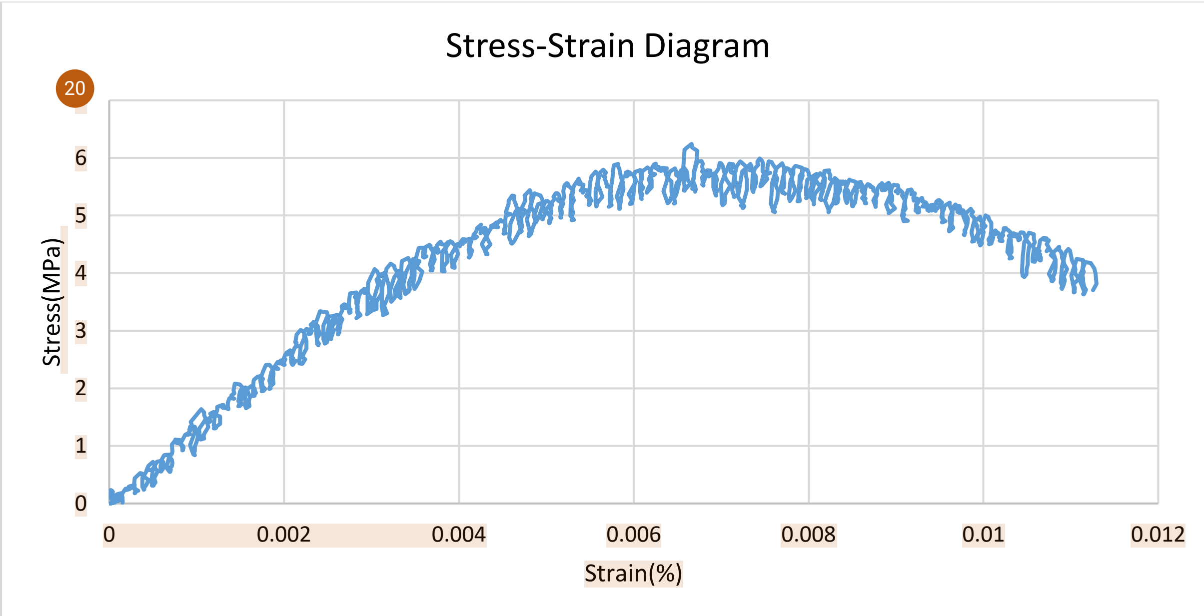

Figure 13: Stress vs Strain curve of cylinder from 1st batch.

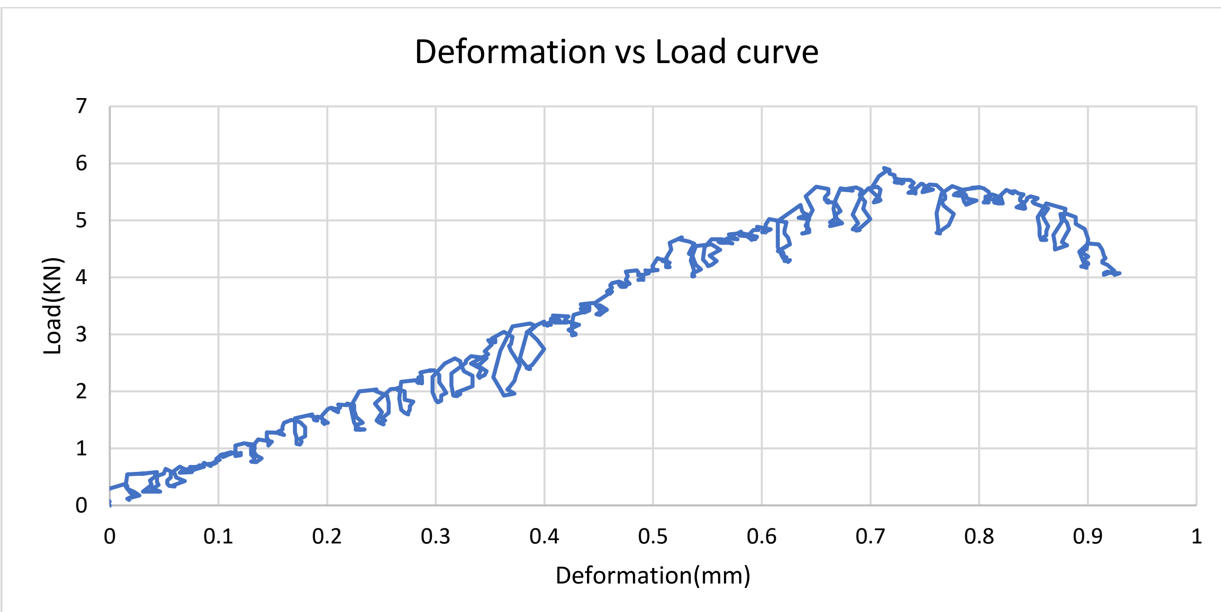

Figure 14: Load vs Deformation curve of beam from 1st batch.

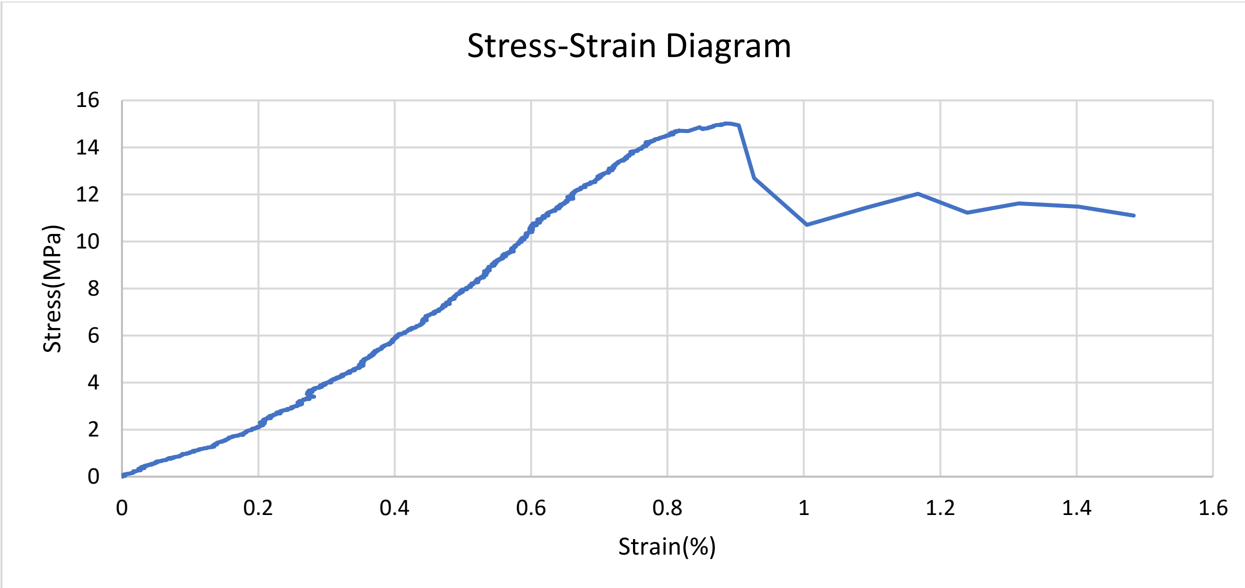

Figure 15: Stress vs Strain curve of cylinder from 2nd batch.

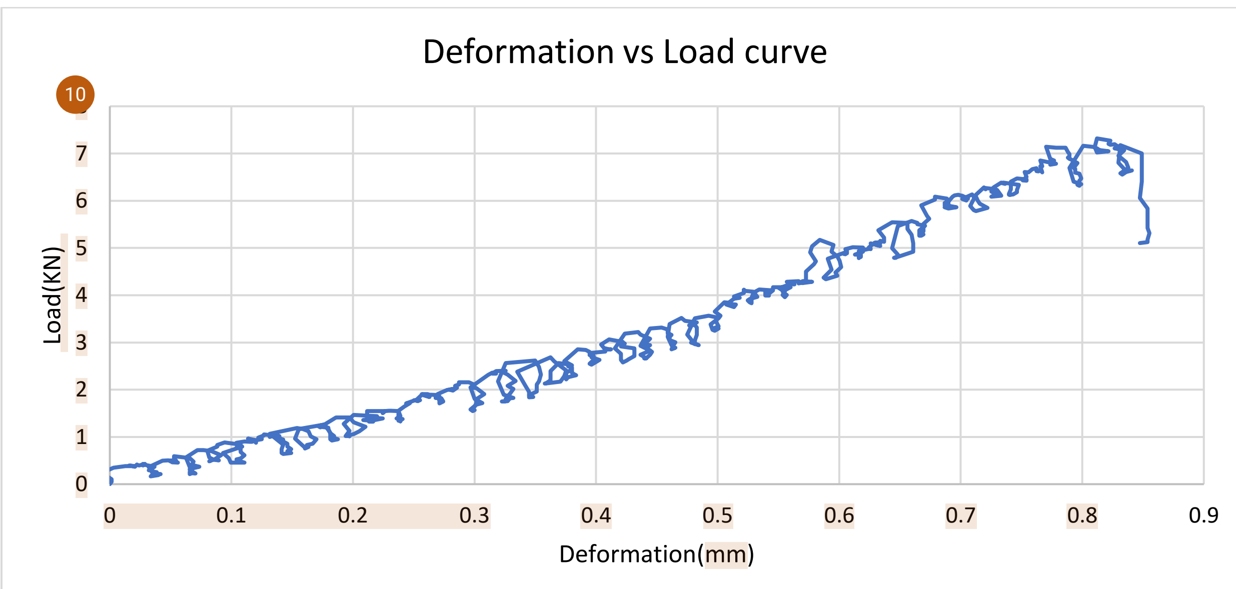

Figure 16: Load vs Deformation curve of Beam from 2nd batch.

Due to internal problem in the UTM machine we couldn't do more sample test under the previous setup. So we shifted our sample to cubical form and tested under the compression machine.

Figure 17: Failed cylinder Samples of 1st batch.

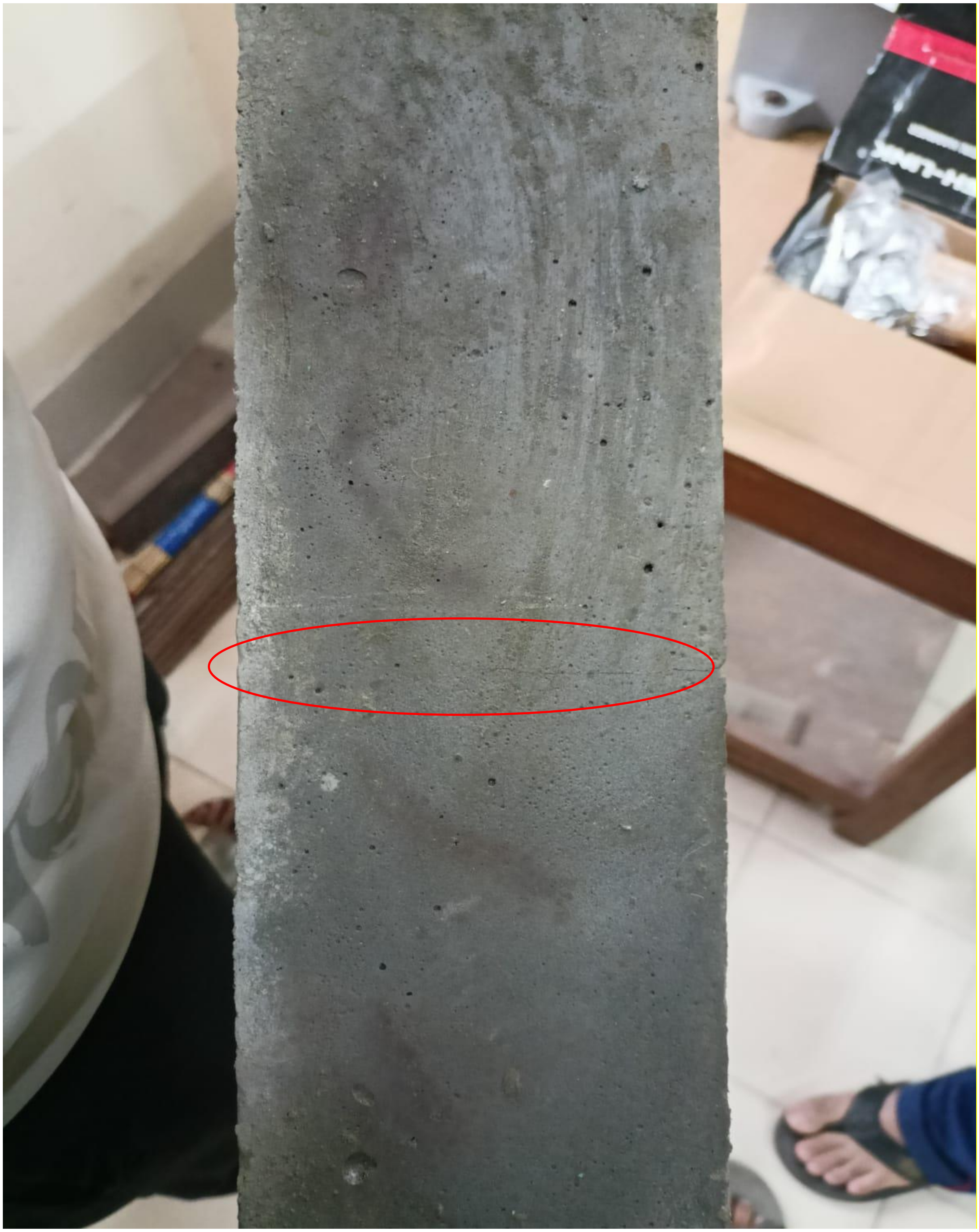

Figure 18: Failure of beam sample in 1st batch.

Figure 19: Failed cylinder samples from 2nd batch.

Figure 20: Failed beam sample from 2nd batch.

From the data we compared the effects of strength on changing the different parameters to find the optimal mix design ratio for the Jute Fiber Reinforced Cementitious Composite (JFRCC).

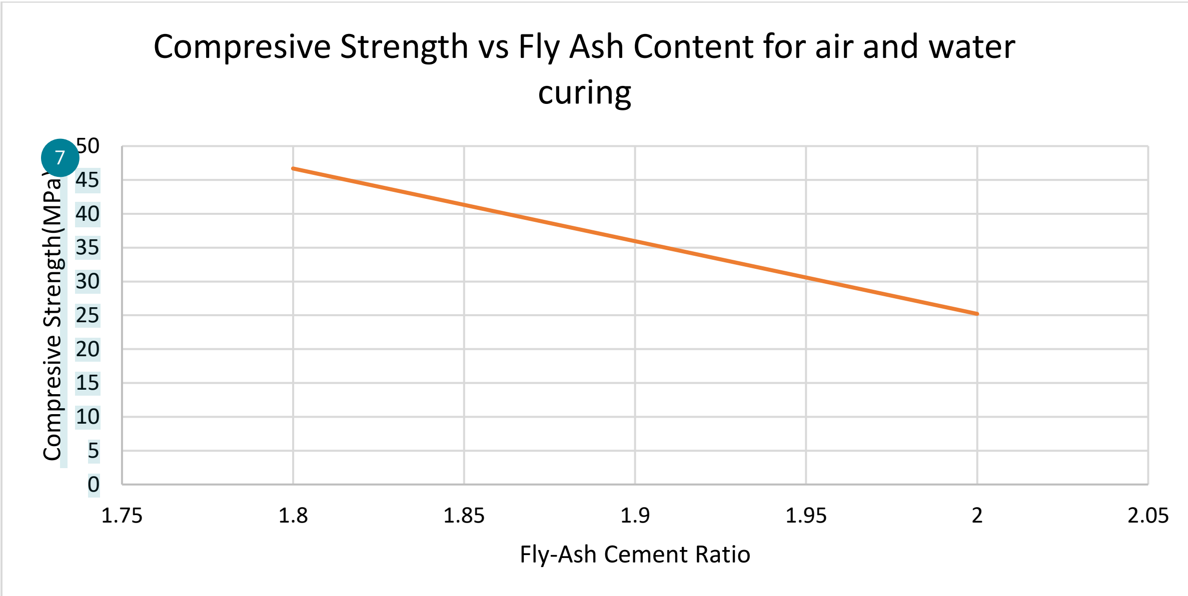

Figure 21: Compressive strength Vs Fly Ash content for Air & Water curing.

It is observed that water curing is beter than air curing as we get more strength in water curing which is 46.689585 MPa where the air curing gives 25.210084 MPa. As water hydrates the composite's binder materials and help to build heigher strong bond with the elements thus helps to increases the strength.

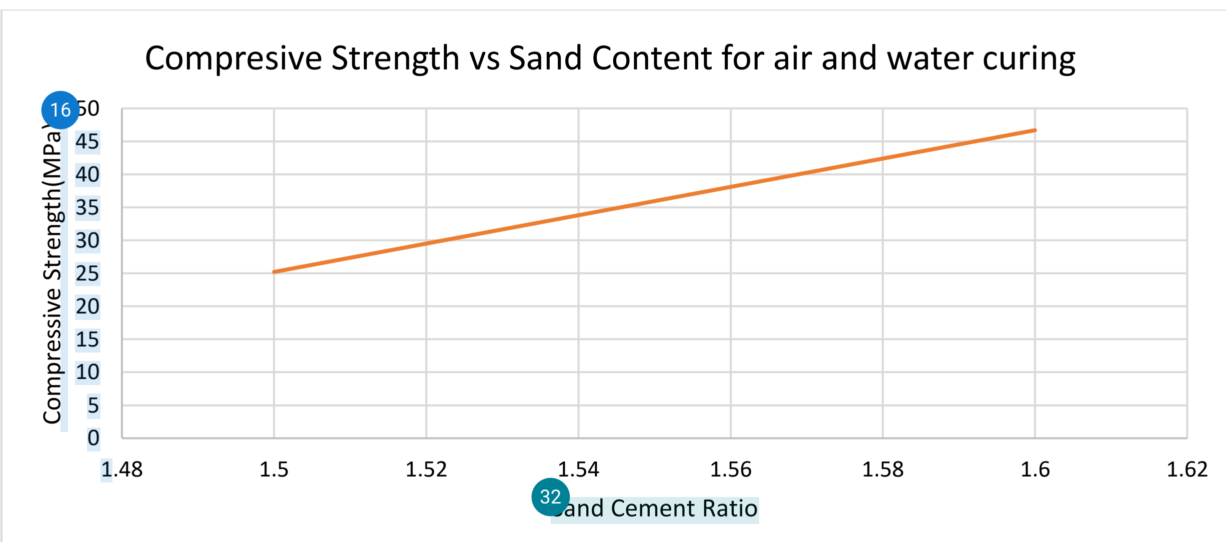

Figure 22: Compressive Strength vs Sand Content for Air and Water curing.

It is also observed that with the increases of cement quantity the strength also increases as cement is a binder element it helps to tight the bond between the elements.

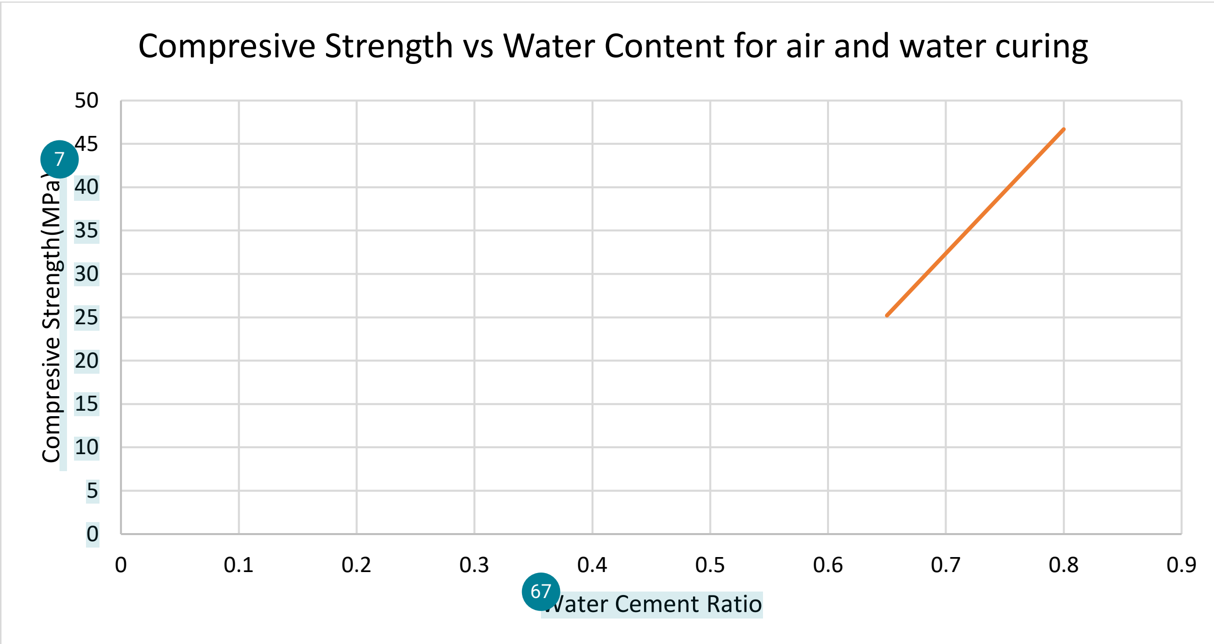

Figure 23: Compressive Strength vs Water Content for air and water curing.

It is observed that if the water content in the mix design increases the compressive strength also increases. As water helps in hydration of the binding elements the bond gets stronger. But if excessive water is used then the consistency of the mixture decreases and it needs a huge amount of time to settle down and also week the bond formation. It is wise to keep the water cement ratio less than 1.

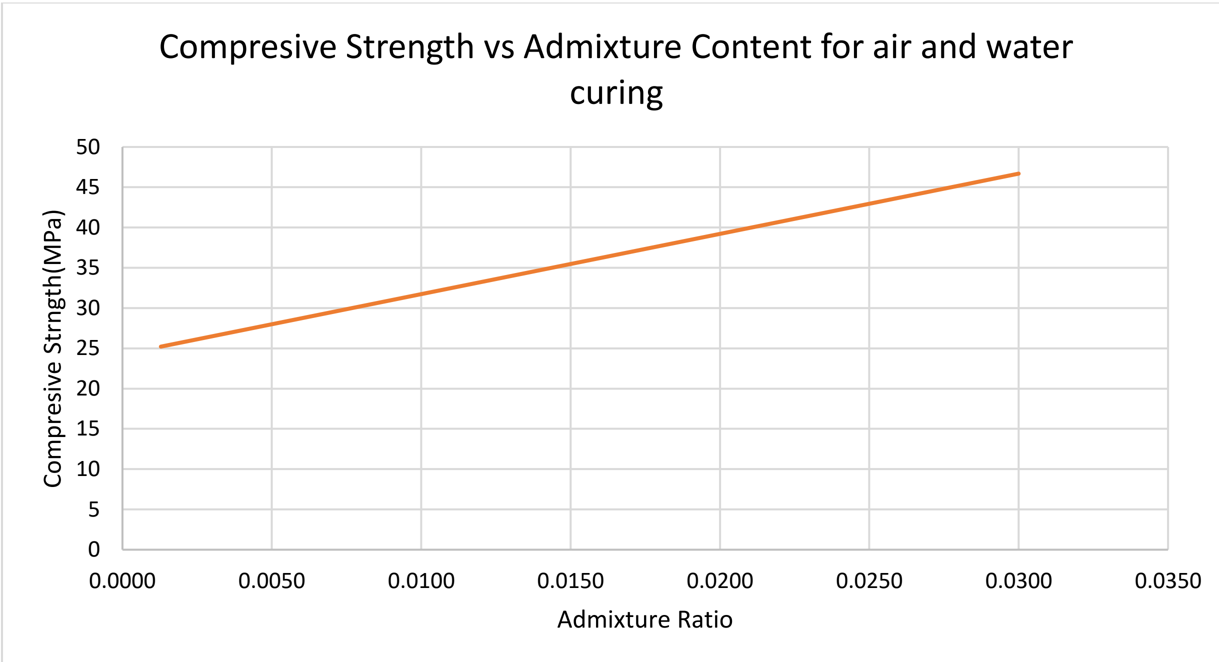

Figure 24: Compressive Strength vs Admixture Content for air and Water curing.

It is observed that by adding more admixture the strength increases. The admixture used is water reducing admixture. It helps to keep the water cement ratio low and also helps a lot to hydrates the mixture.

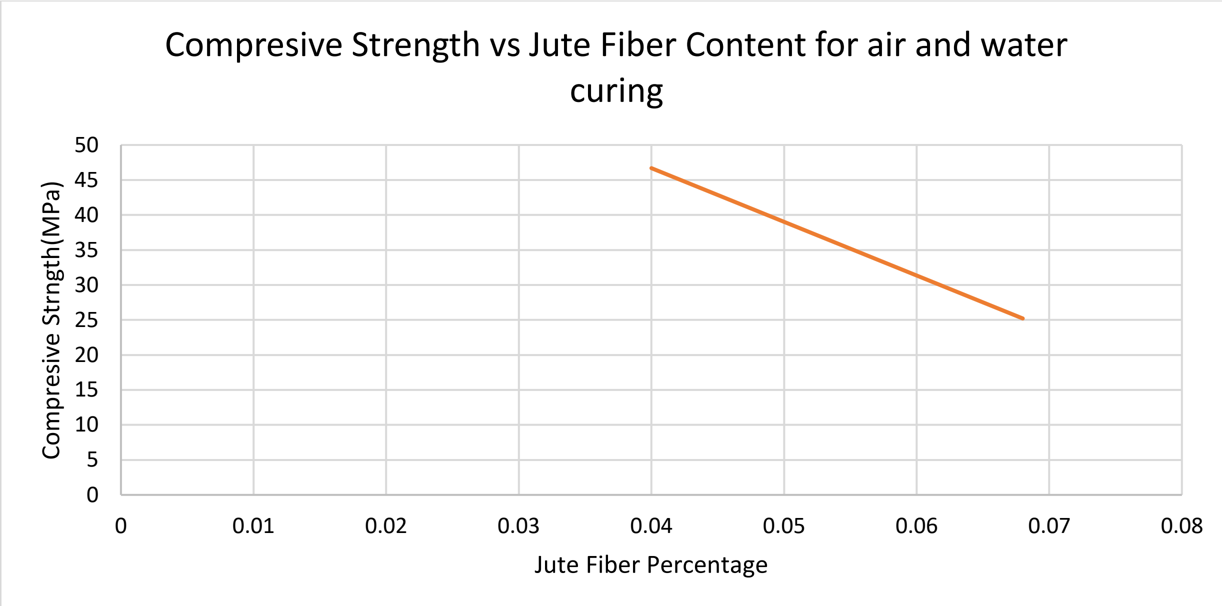

Figure 25: Compressive Strength vs Jute Fiber Content for air and water curing.

And finally, the ratio of jute fiber. It is observed from the experimental value that the jute fiber percentage decreases the compressive strength. Jute fiber is good in tension, but it also plays a good role in compression also. The strength decreases for the clustering of the fibers together. If the fibers are splits then the best result can be obtained. As cluster fibers occupies a space and in that part binder materials and sand doesn't enters so that part acts as a void in the sample and thus the load taken by the sample is low. But if they are not clustered then by increasing the fiber percentages the strength will be higher. Jute fiber make fiber bridging which helps to take more load and to hold the failed small parts attached with the sample. The circles in the load deformation graph of the beam shows the effect of fiber bridging of the jute fiber. The downward progression shows the breakdown of a single or a group of fibers and then the other fibers helps to take the load and thus the load bearing capacity increases. This is the basic principle of fiber bridging. So scattered fiber will give the best result for this composite.

Figure 26: Jute Fiber bridging in cylinder samples.

Figure 27: Breakdown of fiber bridging in beam samples.

We casted 3 cubes from each batch for 3^{rd} batch to 7^{th} batch. For this batches we left the sample on cold and shaded place for ambient air curing after demolding. We tested the samples under the "Cylinder Testing Machine" to observe the compressive failure load of the samples after 28 days from the casting. For 3^{rd} batch we got 32KN load where the compressive strength is 12.8 MPa. For 4^{th} batch we got 23KN load where the compressive strength is 9.2 MPa. For 5^{th} batch we got 39 KN load where the compressive strength is 15.6 MPa. For 6^{th} batch we got 13.6 KN load where the compressive strength is 5.44 MPa. For 7^{th} batch we got 30 KN load where the compressive strength is 12 MPa.

Figure 28: Cylinder Testing Machine (CTM).

Figure 29: Cubical Sample under CTM for testing.

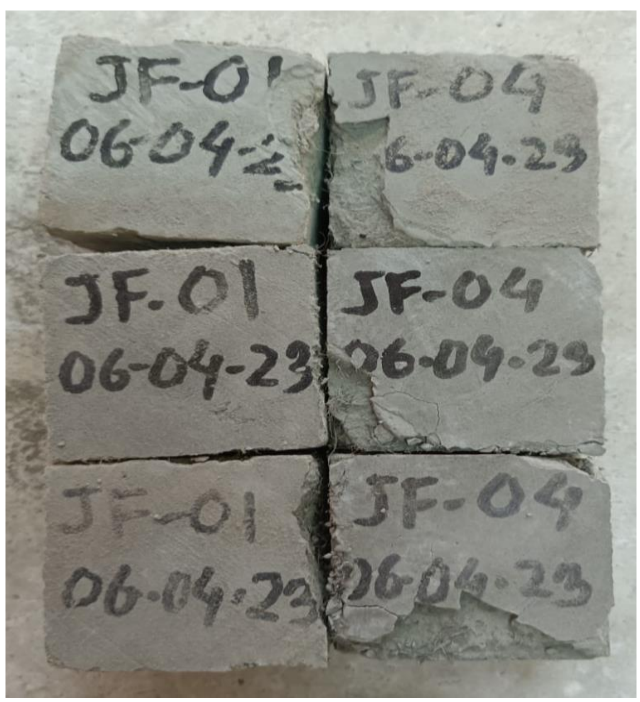

Figure 30: Samples before testing.

Figure 31: Failed Cubical samples of 3 to 7 batch.

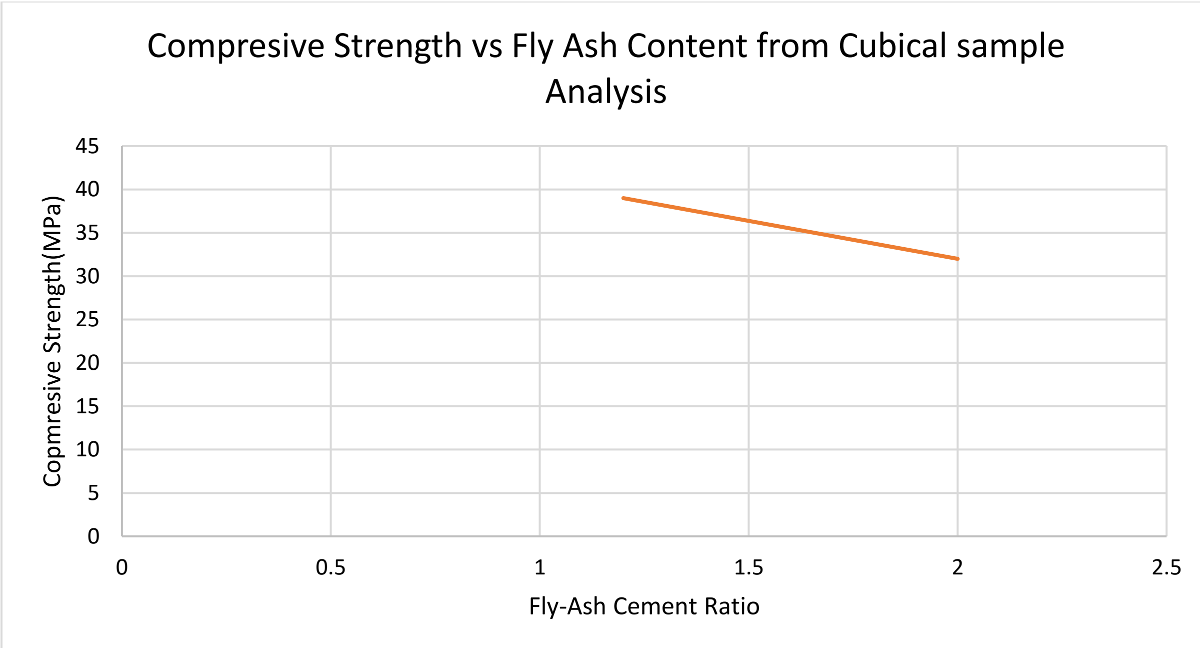

Figure 32: Compressive Strength vs Fly Ash content from Cubical sample Analysis.

From the graph we see that with the increment of fly ash content affects in the compressive strength of the cubical sample. The fly ash is a binder material which acts like cement but it is not strong binder as cement. So, it is wise to use less in amount then the amount of cement in the mix design.

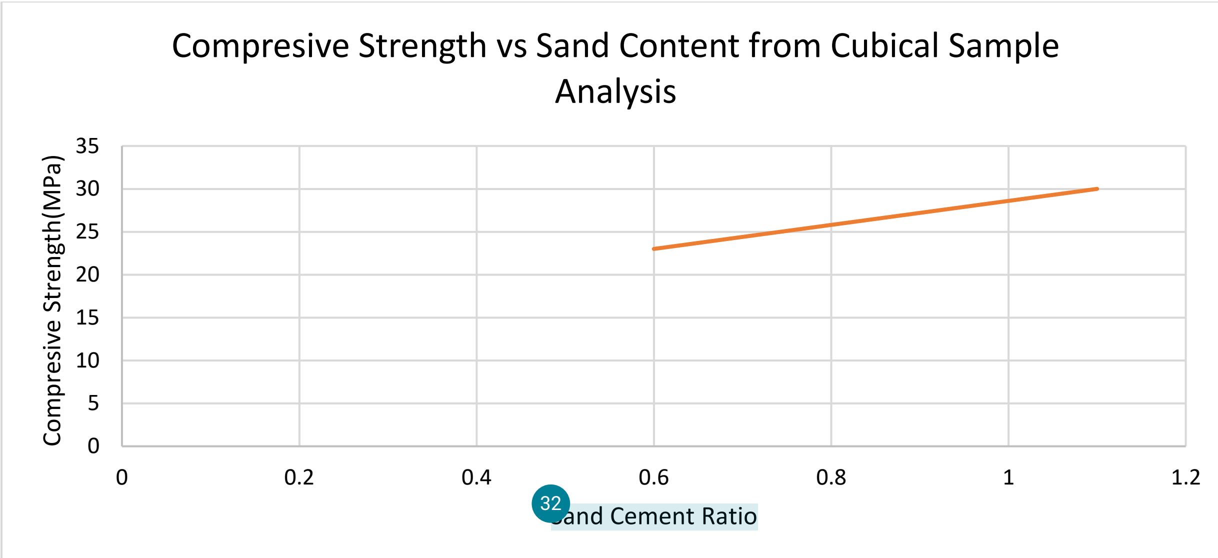

Figure 33: Compressive Strength vs Sand Content from Cubical sample Analysis.

The increment of sand helps to increase the compressive strength of the sample. As a filler material it helps to resist the compressive load and gives the economic support for the composite.

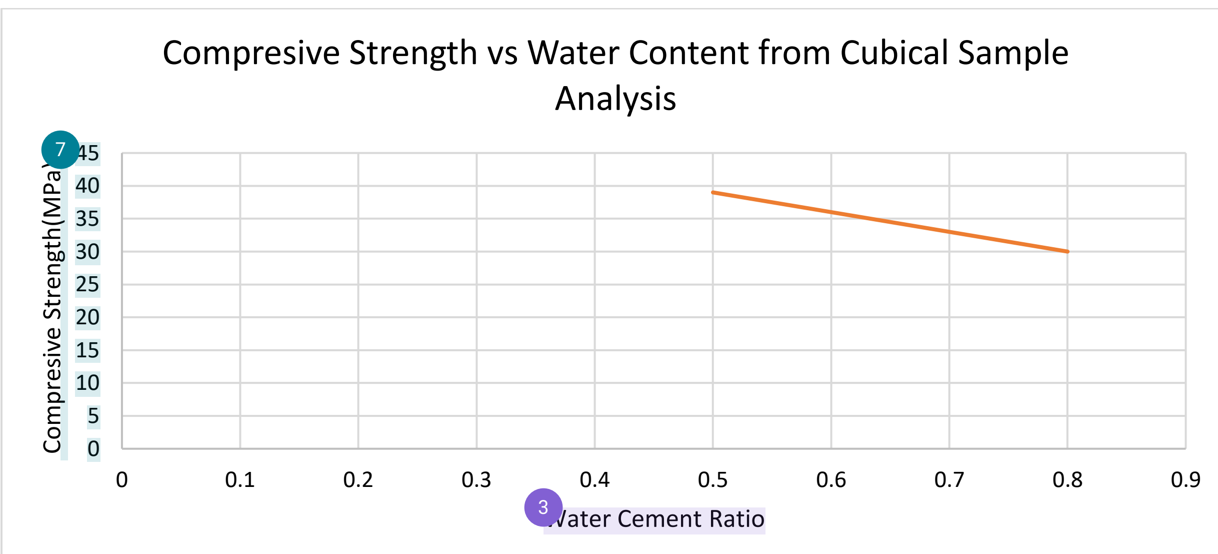

Figure 34: Compressive Strength vs Water Content from Cubical Sample Analysis.

As like we talk before about the water content, it is also observed same here. With the increment in amount of water the compressive strength falls.

Chapter 5 Conclusions and Recommendations

5.1 Future work

We have casted some more samples according to the batch 1 and batch 2 which are dipped into water bath to observe the condition after a year from casting date. We will also cast some other batches according to other mix design where the ratio of the elements will be changed to find the optimal mix design ratio where we will get the best result. Our plan is also to observe the nature and properties if jute fiber is added to the normal concrete and normal reinforced concrete.

5.2 Conclusion

Ultimately, the implementation of jute fiber as a strengthening agent in cement-based compounds presents numerous benefits and exhibits considerable promise across diverse engineering contexts. This scholarly research has examined and assessed the characteristics, efficiency, and suitability of utilizing jute fiber to reinforce cementitious composites.

Through substantial empirical examinations, it has been ascertained that the inclusion of jute fibers augments the mechanical characteristics of cement-based materials, encompassing tensile robustness, flexural durability, and impact resilience. The innate and sustainable properties of jute fibers render them a viable and ecologically sound substitute for synthetic fibers, thereby fostering eco-friendliness in construction methodologies.

Moreover, the coherence between jute filaments and cement-based formulations has been examined, emphasizing the crucial significance of appropriate bonding between the fibers and matrices. Several methodologies such as surface modification of fibers, alkali processing, and fiber coating have been analyzed in order to ameliorate the interfacial adhesion existing between fibers and cementitious matrix. This, in turn, leads to augmented mechanical characteristics and better longevity.

Regarding toughness, the resilience of cementitious composites fortified with jute fibers to various ecological influences, such as dampness, chemical corrosion, and fluctuations in temperature, has been assessed. The dissertation showcases that jute filaments can aptly alleviate the adverse impacts of these elements, thereby resulting in enhanced robustness and longevity of the amalgamations.

The economic feasibility of incorporating jute fibers as reinforcement in cement-based composites has also been examined. The cost-effectiveness of jute fibers in comparison to their artificial counterparts renders them a highly appealing proposition for construction ventures that operate within fiscal limitations. Moreover, the application of jute filaments fosters the expansion of the jute sector and confers financial advantages to jute-manufacturing locales.

To encapsulate, this scholarly dissertation has showcased an extensive evaluation of cementitious composites reinforced with jute fibers, highlighting their mechanical traits, longevity, eco-friendliness, and cost-effectiveness. The results imply that jute fiber strengthened cementitious composites exhibit capability as a hopeful substitute for construction materials, presenting an eco-friendly, financially practical, and enduring resolution. It is recommended that further investigation and innovation be undertaken within this domain to delve into supplementary utilizations, perfect the manufacturing techniques, and augment the comprehensive capabilities of these composites.

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