Effects of Modified Organic Solid Waste on the Strength Properties of Concrete.

A project submitted to the department of civil engineering, Sonargaon University of Bangladesh, for the partial fulfillment of the requirement for the degree of **Bachelor of Science in Civil Engineering.**

Submitted by

MD. SHORIFUL ISLAM	BCE- 1602008175
FEROZ MAHMUD	BCE-1602008185
MD. NAZRUL ISLAM	BCE-1602008186
ABUL KALAM AZAD	BCE-1602008036
SHIMUL CHANDRA DAS	BCE-1602008192
MUJAMMAL HAQUE	BCE-1602008060

Supervisor

Md. Ferdous Wahid

Lecturer & Assistant Co-ordinator

Department of Civil Engineering

Sonargaon University

Fall 2019

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LETTER OF TRANSMITTAL

January 28, 2020
To
Md. Ferdous Wahid
Lecturer
Department of Civil Engineering
Sonargaon University, Bangladesh

Subject: Submission of Project Report

Dear Sir,
We are hereby pleased to submit the project paper on **"Effects of Modified Organic Solid Waste on the Strength Properties of Concrete.** We believe this project paper will certainly help you in evaluating our project work. We would be happy to provide any assistance in interpreting any part of the report whenever necessary.

Signatures:

Name	ID	Signature
MD. SHORIFUL ISLAM	BCE- 1602008175	-----------------------
FEROZ MAHMUD	BCE-1602008185	-----------------------
MD. NAZRUL ISLAM	BCE-1602008186	-----------------------
ABUL KALAM AZAD	BCE-1602008036	-----------------------
SHIMUL CHANDRA DAS	BCE-1602008192	----------------------
MUJAMMAL HAQUE	BCE-1602008060	----------------------

DECLARATION

We do hereby declare that the presented in the project paper has been carried out by us and has not been previously submitted to any University/ College/ Organization for any academic qualification or for any professional qualification. We hereby ensure that the project paper that has been presented here does not breach any existing copyright rule. We are further giving undertaking to the University against any loss or damage arising from breach of the forgoing obligations.

Name	ID	Signature
MD. SHORIFUL ISLAM	BCE- 1602008175	----------------------
FEROZ MAHMUD	BCE-1602008185	----------------------
MD. NAZRUL ISLAM	BCE-1602008186	----------------------
ABUL KALAM AZAD	BCE-1602008036	----------------------
SHIMUL CHANDRA DAS	BCE-1602008192	----------------------
MUJAMMAL HAQUE	BCE-1602008060	----------------------

Sonargaon University (SU)

CERTIFICATE

This is to certify that the project on**"Effects of Modified Organic Solid Waste on the Strength Properties of Concrete.** Is the eventual record of project done by Md. Shoriful Islam, Feroz Mahmud, Abul kalam Azad, Md.Nazrul Islam, Mujammal Hauqe, Shimul Chandra Das for partial fulfillment of the requirement for the degree of Bachelor of Science in Civil Engineering from The Sonargaon University (SU).

The project work has been carried out under my guidance and is a record of successful work.

Md. Ferdous Wahid
Lecturer & Assistant Coordinator
Department of Civil Engineering
Sonargaon University, Bangladesh

ACKNOWLEDGEMENT

All praise be to Allah, Lord of the Worlds, and may the peace and blessings be on the most noble of, Prophets and Messengers, our Prophet Muhammad, and on his family and all of his Companions. We offer to Him all praise and gratitude, and seek His assistance and forgiveness. We seek refuge in Allah from the evils of our souls and the wickedness of our deeds. Whomsoever Allah guides, none can misguide and whomsoever Allah misguides, none can guide. We thank Allah, the Exalted, for the completion of this thesis. Alhamdulillah, Allah gave me the enough strengths and patience to tackle every problem with calm and ease. This thesis has been kept on track and been seen through to completion with the support and encouragement of numerous people including our supervisor, our teachers and classmates. We would like to express gratitude to all those people who made this thesis possible and an unforgettable experience for us. We ask Allah to bountifully reward all these peoples. Allah!! Mercy, Love and Guidance is what we seek from Him. May He the Elevated bless us with them, like He blessed those before us; those who loved Him and He loved them in turn. Amin

We would like to express our deepest gratitude to our supervisor **MD. FERDOUS WAHID** for his guidance and invaluable advice. His constructive comments and suggestions throughout the experimental and thesis work have contributed to the success of this research. His timely and efficient contribution helped us shape this thesis into its final form and we express our sincerest appreciation for his assistance in any way that we may have asked. We consider it our privilege to have accomplished this thesis under his right guidance.

We are extremely indebted to Assistant Professor **MD. LUTFOR RAHMAN**, Head, Department of Civil Engineering, Sonargaon University (SU) for providing necessary infrastructure and resources to accomplish our research work. Sincere appreciation and gratitude are also expressed to **S. M. YASHIN**, Coordinator, Department of Civil Engineering, (SU), for his encouragement and co-operation in the research.

Finally, the authors would like to convey their thanks to all faculty members of the Department of Civil Engineering, (SU), for providing continuous inspiration in every step of the research.

ABSTRACT

Discarded Jute Fiber & Bamboo chips constitute one important part of solid waste which had historically been disposed of into landfills. Recent EU policies on the Landfilling of Waste (Council Directive 1999/31/EC) have however put a ban on the landfilling Jute Fiber & Bamboo chips of whole or shredded, creating an imminent need to investigate any possible viable uses of this cheap product. An emerging use is the production of concrete, in which Jute Fiber & Bamboo chips particles partially replace natural aggregates. This has the additional advantage of saving in natural aggregates used in the production of concrete which are becoming increasingly scarce. This research investigated a wide range of physical and mechanical properties of concrete containing Jute Fiber & Bamboo chips aggregates to assess its suitability as a construction material. The influence of percentage of Jute Fiber aggregate content was considered. The results showed a great loss in strength and so it needs further investigation with lower percentage of replacement. The quantities of concrete produced worldwide for such applications could ensure the viability of this product. Therefore, this type of concrete shows promise for becoming an additional sustainable solution for Jute Fiber & Bamboo chips management. Our sincere gratitude and love to Noman Soikat sir,for helping us with this information about chemical selection in our study and where to find it.

Chapter One
Introduction

1.1 INTRODUCTION

Concrete is an artificial building material that is obtained by mixing together cement, water and some other inert materials. The mixture in a plastic condition when allowed to set becomes as hard as stone. By suitably adjusting the proportions of various ingredients, concrete with sufficient compressive strength for various uses can be developed. The strength of concrete depends mainly on its ingredients, their relative quantities and the manner in which they are mixed and placed. Portland cement is the commonly used Jute Fiber & Bamboo chips mixed with rajin & hardener of cement for production of concrete. Concrete technology deals with study of properties of concrete and its practical applications. In a building construction, concrete is used for the construction of foundations, columns, beams, slabs and other load bearing elements. As we know concrete is very much weak in tension and strong in compression.

In Bangladesh, the most commonly used coarse aggregate is stone aggregate which is made by Crushing stones into stone chips. stones are often broken into pieces without considering the aggregate size that may influence the properties of concrete. Though coarse aggregate is used to occupy volume in concrete, use of larger size aggregate can reduce the cement content in concrete, which is largely responsible for shrinkage and creep (Ioannidis and Jeff, 2006). On the other hand, larger size coarse aggregates lower the water demand resulting a decrease in the water/cement ratio (W/C), which gives strength to concrete (Neville, 2011). This is because as aggregate size increases, the surface area to be wetted decreases. Though several studies with contradictory conclusions have been conducted to find the optimum of coarse aggregate to make concrete, no such study has been done on stone chips as coarse aggregate. In old days hair of horse was using as reinforcement in the mortar and some of them are using straw as a reinforced material in the mud stones. Now a days with the introduction of fibers in plain or reinforced concrete gives better solution for reinforcement in the concrete. The development of Fiber-Reinforced Concrete (FRC) helps to achieve sustainable development. Now a day's FRC is widely used because of its effectiveness and durability. It is much stable, tough and resistant as compared to plain concrete and hence problem of cracks is minimized by using FRC. A concrete mix with fiber can provide environmental and economic benefits. Fiber reinforced concrete enhances the compressive strength, flexural strength and also increases durability and concrete finishing. It also decreases permeability, workability and bleeding in concrete. It is difficult to maintain strength of concrete and increase its durability, so addition of natural fibers is economical way to increase strength of concrete. The type of fibers currently been used include steel, bamboo and jute fibers. Use of the fibers in a relatively brittle cement matrix has achieved considerable strength, and toughness of the composite. Jute Fiber is such materials which have toughness value, the brittleness value and the plastic and elastic energy capacities. It is an important fact that, this material cannot be destroyed without its harmful effect. In this sense if we use it would be saved our environment as usual reduce environmental waste. Bamboo chips are natural equipment. Bamboo is a multipurpose reserve categorized by large ratio of strength to weight and its ease of work with simple tools. Bamboo had been using for construction even from early times in housing purposes. Bamboos have better modulus of elasticity than any other natural material. It gives the compressive strength and tensile strength. It has low specific weight. These are biodegradable and eco-friendly also.

1.2 Background of the study

Thorough investigation on the effect of waste materials recycle based on hardened properties of low-strength, high strength and traditional concrete were done by researchers; and their findings indicate that it is important that we know how influences the structural and durability performances of concrete. In Bangladesh, Stone Chips aggregate is the most widely used coarse aggregate in construction. Construction sites are often found to use coarse aggregates without proper gradation, and thus the concrete strength often can't be predicted, which drives design engineers to go for over-design.Topçu (1995) determined the toughness value and the plastic and elastic energy capacities. He indicated that plastic energy capacity increases when the high elastic energy capacity of normal concrete decreases by adding jute fiber. The results showed that the impact resistance of jurist concrete was higher than conventional rein-forced concrete .Beamy and Khatib (1999) examined the behavior of Jut able concrete and concluded that it could be suitable for nonstructural purposes such as light-weight concrete walls, building facades, and architectural units. Fed off et al. (1997) concluded that the addition of Jute the concrete performance under freeze-thaw conditions. Taoukil, El-bouardi, Ezbakhe, and Ajzoul (2011) have conducted experiments to find thermal properties of concrete lightened by Jute aggregates.

Bamboo waste in some form or other was used earlier in the manufacturing of concrete to establish its feasibility (Mageswari & Vidivelli, 2009; Saeed, 2013). Economical disposal of this Bamboo waste is a problem of growing concern to the Bamboo industries (Cooper, 1994, 1999). Today environmental studies discussing the recycling and reuse of waste materials are gaining great importance. Using waste material which was obtained from razed buildings that was cleaned and later reduced to aggregate form is considered an appropriate solution to environmental pollution. In a study, various mechanical properties of concretes were examined. These concretes were obtained with the addition of C 16 (28-day compressive strength of 16 MPa) pieces as aggregate in weight percentages of (referred to total aggregate) 0, 30, 50, 70 and 100 %. From σ - ε diagrams modulus of elasticity, toughness, plastic and elastic energy capacities were calculated. In those concretes, it was observed that as the amount of WCA increases, density, and compressive strength, modulus of elasticity and value of toughness decrease.(Topçu and Günçan 1995)

Use of milled waste bamboo, as partial replacement of cement, is estimated to produce significant gains in strength and durability of recycled aggregate concrete. Milled waste bamboo was also found. The encouraging test results are viewed to facilitate broad-based use of recycled aggregate and diversion of large quantities of landfill-bound mixed-color waste bamboo for a value-added use to produce recycled aggregate concrete incorporating paper milled waste bamboo.(Nassar and Soroushian 2012)

The disposal of waste bamboo in landfills is an important environmental challenge that many countries face around the world. The repurposing of waste bamboo into a construction material reduces the consumption of natural resources, minimizes greenhouse emissions and alleviates landfill scarcity. Over the last sixty years, numerous investigators have studied reusing waste bamboo (WB) as a construction material. However, WB has not been widely used in concrete or asphalt construction applications across the globe. Additionally, barriers still exist that prevent WB from being used as a fine aggregate in concrete, such as the severity of Alkali-silica reaction (ASR) expansions within concrete consisting of WB, and the lack of understanding of these reactions.(Mohajerani et al. 2017)

Construction and demolition waste corresponds to 50% of all urban solid waste, usually it is dumped in improper places. In a work reuses this waste as substitute of natural aggregate to produce bricks. Lime and cement were used as binding agents and were pressed using a uniaxial hydraulic press. After 21 days curing were submitted to compression tests, the probes presented an average resistance greater than 4 MPa, which is higher than standards. Water absorption, apparent porosity and density were also determined. The results show that it is possible to produce low-cost bricks with excellent physical properties using CDW as aggregate and lime or cement as additive.(Contreras et al. 2016)

The use of construction waste materials as aggregates for concrete production is highly attractive compared to the use of non-renewable natural resources, promoting environmental protection and allowing the development of a new raw material. Several countries have recommendations for the use of recycled coarse aggregate in structural concrete, whereas the use of the fine fraction is limited because it may produce significant changes in some properties of concrete. However, during the last decade the use of recycled fine aggregates (RFA) has achieved a great international interest, mainly because of economic implications related to the shortage of natural sands suitable for the production of concrete, besides to allow an integral use of this type of waste. In a study of the durable behavior of structural concretes made with different percentage of RFA (0%, 20%, and 30%) is evaluated. Different properties related to the durability of concretes such as absorption, absorptivity, water penetration under pressure, and carbonation are determined. The results of that study of compressive strength, static modulus of elasticity and drying shrinkage are presented. The obtained results indicate that the recycled concretes have a suitable resistant and durable behavior, according to the limits indicated by different international codes for structural concrete.(Zega and Di Maio 2011)

Sanitary ceramic ware waste is classified as belonging to group of non-biodegradable industrial waste. A paper presented the studies on possible reuse jute Fiber wastes as the aggregate (both fine and coarse) in concrete. The procedure of aggregate production (crushing, dividing particles into two groups - fine and coarse particles and establishing their proportion) and designing the concrete mix were described. Studies on properties of this aggregate and properties of concrete containing this aggregate were presented. Tested concrete displayed high strength and high abrasion resistance. That paper presents also results of examination of concrete with alumina cement and Jute Fiber ware wastes as aggregate. For comparison purposes, specimens with traditional natural aggregate and alumina cement were heated as well. As opposed to specimens of concrete with traditional aggregate, specimens with ceramic aggregate preserved their shape and cohesion and showed no cracks and defects. Despite some decrease in strength, these specimens after heating continued to display high compressive and tensile strength. On the basis of described studies, Organic materials aggregate may be recommended for preparing special types of concrete: abrasion resistant concrete and concrete dedicated for members working in high temperatures.(Halicka, Ogrodnik, and Zegardlo 2013)

The importance of sustainability and recycling has become increasingly recognized and understood in academia and industry over the last several decades. Recycling construction and debris waste is one of many avenues that provide a great opportunity to prevent waste material from entering landfills and reduce the construction industry reliance on decreasing natural resource supplies. A coarse aggregate replacement scheme in concrete is investigated with three different waste jute fiber & bamboo chips materials in replacement ratios including 5%, 10%, 15%, 20%, Results show jute fiber & bamboo chips as a possible non practicable natural coarse aggregate replacement material with minimal changes in mechanical properties.(Anderson, Smith, and Au 2016)

Environment friendly and sustainable construction practice with competitiveness is essential for the balanced development of a country. Being and part of that, proper management of construction wastes is an important issue nowadays. Being a developing country, Bangladeshis in the face of massive construction development work considering its current socioeconomic condition. However, construction waste management practice is very poor in most cases. It is high time to think about some timely steps in order to implement different strategies for overall management. For successful waste management strategies, reliable and examined case studies are necessary.(Chowdhury and Islam 2006)

This study considered reviews on construction wastes, their generation, and available management strategies.

1.3 Objectives of the Study

The objectives of this study are as follows:

1. To understand the variation of hardened properties of concrete with the varieties Component.
2. To evaluate the effect of different percentage of Jute waste.
3. To evaluate the effect of different percentage of Bamboo.

4. To compare the compressive strength response at different percentage of Jute & Bamboo waste used.

5. To compare the split tensile strength response at different percentage of Jute & Bamboo used.

6. To evaluate a clear difference with convenience concrete & choose a better option.

7. Compare unit weight & workability between them.

1.4 Methodology

This study investigated the Effect of Jute & Bamboo as a Partial Replacement of Traditional Coarse Aggregates. For investigation, Malaysian stone chips were collected from market and into size of 20.0 mm downgraded and 10 mm retained. Jute are collected from Kawran-bazar & cutting them by manually in 20mm Long & 10mm Dia size by Cloth Cutting Kits. .Bamboo are collected from Van garage cutting them into 20mm down size by Knife. The mixture proportion was prepared with W/C ratio of 0.60; s/a ratio of 0.44; and cement content of 340 kg/mo. 85 nos concrete cylinders for seventeen cases having each of them 100 mm diameter and 200 mm height were made for aggregate size of 20 mm downgraded and 10 mm retained stone chips . Compressive strength and Split tensile strength were measure after 28 days of curing.

After some physical tests of aggregates, the molds were prepared for the destructive test in "Universal Testing Machine". Strains were measured by the strain gauge. Finally, with all the data found from the destructive test, the stress-strain curve drawn. Crashing patterns and crack surface pictures were taken for the specimens. Strains were measured by the strain gauge. Then test results tabulated and converted in a graph.

1.5 Scope

The Jute Fiber and glass wastes can be reused as coarse and fine aggregate respectively in new construction, such as

- The sidewalk of a road,
- Low priorities low-rise ` buildings,
- Yard of rural area's house.

Chapter Two
Literature Review

2.1 Introduction

Compressive strength analysis is most important to select the coarse aggregate. Most importantly cement, sand and aggregate properties with mixing procedure discussed in this chapter. Water, admixture details, curing, compressive strength calculation also performed.

2.2 Cement

Cement is a cementing of bonding materials and water-resistant products used in engineering construction. Portland cement was developed from natural cement made in Britain in the early part of the nineteenth century, and its name is derived from its similarity to Portland stone, a type of building stone that was quarried on the Isle of Portland in Dorset, England(Gillberg et al. 1999).

The Portland cement is considered to originate from Joseph Aspdin, a British bricklayer from Leeds. It was one of his employees (Isaac Johnson), however, who developed the production technique, which resulted in a more fast-hardening cement with a higher compressive strength. (Courland 2011). Portland cement (often referred to as OPC, from Ordinary Portland Cement) is the most common type of cement in general use around the world because it is a basic ingredient of concrete, mortar, stucco and most non-specialty grout. It is a fine powder produced by grinding Portland cement clinker (more than 90%), a limited amount of calcium sulfate (which controls the set time) and up to 5% minor constituents as allowed by various standards such as the European Standard EN197.1.Portland cement clinker is a hydraulic material which shall consist of at least two-thirds by mass of calcium silicates (3CaO.Si02 and 2CaO.Si02), the remainder consisting of aluminum- and iron-containing clinker phases and other compounds.

The ratio of Ca0 to Si02 shall not be less than 2.0. The magnesium oxide content (MgO) shall not exceed 5.0% by mass. ASTM C 150 defines Portland cement as "hydraulic cement (cement that not only hardens by reacting with water but also forms a water-resistant product) produced by pulverizing clinkers consisting essentially of hydraulic calcium silicates, usually containing one or more of the forms of calcium sulfate as an inter ground addition."(ASTM n.d.) Clinkers are nodules (diameters, 0.2-1.0 inch [5-25 mm]) of a sintered material that is produced when a raw mixture of predetermined composition is heated to high temperature. The low cost and widespread availability of the limestone, and other naturally occurring materials make Portland cement one of the lowest-cost materials widely used over the last century throughout the world. Concrete becomes one of the most versatile construction materials available in the world.

Figure 1: Cement

Portland cement clinker is made by heating, in a kiln, a homogeneous mixture of raw materials to a sintering temperature, which is about 1450 °C for modern cement. The aluminum oxide and iron oxide are present as a flux and contribute little to the strength. For special types of cement, such as Low Heat (LH) and Sulfate Resistant (SR) types, it is necessary to limit the amount of tricalcium aluminates (3CaO.Al203) formed. The major raw material for the clinker making is usually limestone (CaCO3) mixed with a second material containing clay as a source of alumina-silicate. Normally, an impure limestone, which contains clay or Si02, is used. The CaCO3 content of this limestone's can be as low as 80%. Second raw materials (materials in the raw mix other than limestone) depend on the purity of the limestone. Some of the second raw materials used are: clay, shale, sand, iron ore, bauxite, fly ash and slag. When a cement kiln is fired by coal, the ash of the coal acts as a secondary raw material.

2.3 Aggregate:

Construction aggregate, or simply "aggregate", is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete. Aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material. The American Society for Testing and Materials publishes an exhaustive listing of specifications for various construction aggregate products, which, by their individual design, are suitable for specific construction purposes. These products include specific types of coarse and fine aggregate designed for such uses as additives to asphalt and concrete mixes, as well as other construction uses. State transportation departments further refine aggregate material specifications in order to tailor aggregate use to the needs and available supply in their particular locations(Nelson and Bolen 2008).

2.3.1 Physical Properties of Aggregate

1. Unit weight and voids
2. Specific gravity
3. Particle shape and surface texture
4. Absorption capacity and surface moisture

2.3.2 Coarse Aggregate

Coarse aggregates are larger size filler materials in construction. Coarse aggregates are the particles that retain on 4.75 mm sieve. Brick chips (broken bricks), stone chips (broken stones), gravels, pebbles, clinkers, cinders etc. are used as coarse aggregate in concrete. Coarse aggregate acts as inert filler material for concrete. Coarse aggregates are mainly used in concrete, railway track ballast, etc.(Mahmud n.d.)

Figure 2: Stone Chips

2.3.3 Fine Aggregate

Fine aggregates are small size filler materials in construction. Fine aggregates are the particles that pass through 4.75 mm sieve and retain on 0.075 mm sieve. Sand, surki, stone screenings, burnt clays, cinders, fly ash, etc. are used as fine aggregate in concrete. The voids between the coarse aggregate are filled up by fine aggregate. Fine aggregates are used in mortar, plaster, concrete, filling of road pavement layers, etc.(Mahmud n.d.)2.3.1 Sand

Sand is an engineering material in concrete work. It is usually termed as fine aggregate. Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. The composition of sand is highly variable, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or Si02), usually in the form of quartz.

Figure 3: Sylhet Sand

General conditions of aggregate:

- More or less 75% volume of concrete is aggregate. So good quality of aggregate should be used.
- Aggregate act as filler materials on concrete.
- Good quality of aggregate needed to make good quality of concrete.
- Sand should be free from dust (Clay & silt).
- Sand should be free from related silica or carbonate and organic matter.
- Sand should be well graded.
- Washing of sand is necessary to remove dust.
- Dust: This passes through the #100 sieve. (Dust= clay & silt).

2.3.3.1.1 Classification of sand

According to the source

- Pit sand
- River sand
- Sea sand

According to the shape

- Angular
- Round
- Flaky

According to the size

- Coarse sand (3/8"), F.M-2.6
- Medium sand (1/8"), F.M-2.2
- Fine sand (1/16"), F.M- 1.8-2.0

2.3.3.1.2 Bulking of sand:

In the increase in the volume of a given weight of sand due to the presence of moisture, for up to about 5-8% of moisture of sand, there is a steady increase in volume to about 20-30%.The bulking of sand for small moisture content is due to the formation of the film of water around the sand grains and interlocking the air in between the sand grains and the film of water.

2.3.4 Jute Fiber:

Jute is a best fiber used for sacking, burlap, and twine as a backing material for long, soft, shiny fiber that can be spun into coarse, strong threads. It is one of the cheapest natural fibers, and is second only to cotton in amount produced and variety of uses. Jute fibers are composed primarily of the plant materials cellulose, lignin, and pectin. Both the fiber and the plant from which it comes are commonly called jute.

Figure 4: Jute Fiber ¾" Size

2.3.4.1 Properties of Jute Fiber:

Jute is one of the strongest natural fibers. The long staple fiber has high tensile strength and low extensibility. Its luster determines quality; the more it shines, the better the quality. It also has some heat and fire resistance. Jute is a biodegradable features.

Figure 5: Jute

Jute includes good insulating and antistatic properties, as well as having low thermal conductivity and moderate moisture regain. It includes acoustic insulating properties and manufacture with no skin irritations. Jute has the ability to be blended with other fibers, both synthetic and natural, and accepts cellulosic dye classes such as natural, basic, vat, sulfur, reactive, and pigment dyes. Jute can also be blended with wool. By treating jute with caustic soda, crimp, softness, pliability, and appearance is improved, aiding in its ability to be spun with wool. Liquid ammonia has a similar effect on jute, as well as the added characteristic of improving flame resistance when treated with flame proofing agents.

2.3.5 Bamboo Chips:

Any of various woody or arbore scent grasses (as of the genera Barbosa, Arundinaria, and Dendrocalamus of the subfamily Bambusoideae) of tropical and temperate regions having hollow stems, thick rhizomes, and shoots that are used for food.

Figure 6: Bamboo Chips

2.3.6 Characteristics of bamboo:

Bamboo Stalks There are approximately 1200 different species of bamboo and both the species and the growing conditions will affect the characteristics of each individual bamboo stalk. In general bamboo is very durable. The outer layer of the stem is quite dense and strong. Bamboo is both flexible and elastic. As a result items made from bamboo tend to be very resilient and resist breaking when placed under stress. Bamboo does not have rays or knots the way Bamboo Chips does; this means that stress applied to the bamboo is evenly distributed over

2.3.7 Advantages of Building with Bamboo:

One of the main advantages of building with bamboo is that it is a wonderful, natural and renewable resource, capable of rapid growth that can avoid future deforestation of our precious tropical rainforests.

In case of Guadua bamboo, fibers are up to 1 cm long, while those of Bamboo Chips are approximately 2 mm long. With a tensile strength up to 40 kN/cm2, Guadua easily surpasses timber fibers (approximately 5 kN/cm2), or even mild steel (36 kN/cm2).

Its capacity to absorb energy and the higher bending strength makes this bamboo an ideal material for seismic-resistant constructions.

Bamboo possesses only a small proportion of lignin. Its main component is silicic acid, which gives the shoot its durability and hardness. The tissues composition of guadua is 40% fiber, 51% parenchyma and 9% conductive tissue, which explains its astonishing strength and flexibility.

2.4 Water

Potable water (That which is fit for human consumption) can be used without testing. This information summarized requirements for mixing water for use in ready mixed concrete. In October 2004 ASTM approved two new standards that address mixing water for use in concrete. While the requirements for water were addressed in ASTM C 94, increased pressure on concrete producers to use process water from concrete production operations and other recycled sources created a need for a more comprehensive coverage on the standard of water.

2.5 Admixture

It is defined as a material other than water, aggregate and cement that is used as an ingredient of concrete to modify the properties of fresh or hardened concrete. Chemical admixtures are the ingredients in concrete other than Portland cement, water, and aggregate that is added to the mix immediately before or during mixing. Producers use admixtures primarily to reduce the cost of concrete construction; to modify the properties of hardened concrete; to ensure the quality of concrete during mixing, transporting, placing, and curing; and to overcome certain emergencies during concrete operations. The successful use of admixtures depends on the use of appropriate methods of batching and concreting. Most admixtures are supplied in ready-to-use liquid form and are added to the concrete at the plant or at the job site. Certain admixtures such as pigments, expansive agents, and pumping aids are used only in extremely small amounts and are usually batched by hand from pre-measured containers.

Fig 7: Resin & Hardener

The effectiveness of an admixture depends on several factors including type and amount of cement, water content, mixing time, slump, and temperatures of the concrete and air. Sometimes, effects similar to those achieved through the addition of admixtures can be achieved by altering the concrete mixture-reducing the water-cement ratio, adding additional cement, using a different type of cement, or changing the aggregate and aggregate gradation.
We have used Virat WP admixture. It is a waterproofing admixture and it increases concretes bonding strength and increases its compressive strength.

2.5.1 Use of Admixture

- Placing and finishing qualities
- Workability increasing
- Appearance improving
- Protect Against Freeze Thaw Cycles Improve Durability
- Water Reduction in the Mix
- Mid-Range water reducers
- High-Range water reducers
- High Strength Concrete
- Corrosion Protection
- Set Acceleration
- Strength Enhancement
- Set Retardation
- Crack Control (shrinkage reduction)
- Flow ability

2.5.2 Category of Admixture

Water reducing Admixture

1. Retarding Admixture
2. Air-entrained Admixture
3. Accelerating Admixture
4. Pozzolanic Admixture
5. Damp proofing Admixture
6. Grouting Admixture
7. Bonding Admixture
8. Coloring Admixture
9. Gas forming Admixture
10. Anti-washout Admixture

2.6 Curing of concrete

Adding water to Portland cement to form the water-cement paste that holds concrete together starts. A chemical reaction that makes the paste into a bonding agent. This reaction, called hydration, produces a stone-like substance the hardened cement paste. Both the rate and degree of hydration and the resulting strength of the final concrete, depending on the curing process that follows placing and consolidating the plastic concrete. Hydration continues indefinitely at a decreasing rate as long as the mixture contains water and the temperature conditions are favorable. Once the water is removed, hydration ceases and cannot be restarted.

Curing is the period of time from consolidation to the point where the concrete reaches its design strength. During this period, you must take certain steps to keep the concrete moist and as near 73°F as practical. The properties of concrete, such as freeze and thaw resistance, strength, water tightness, wear resistance, and volume stability, cure or improve with age as long as you maintain the moisture and temperature conditions favorable to continued hydration. The length of time that you must protect concrete against moisture loss depends on the type of cement used, mix proportions, required strength, size and shape of the concrete mass, weather, and future exposure conditions. The period can vary from a few days to a month or longer. For most structural use, the curing period for cast-in-place concrete is usually 3 days to 2 weeks. This period depends on such conditions as temperature, cement type, mix proportions, and so forth.

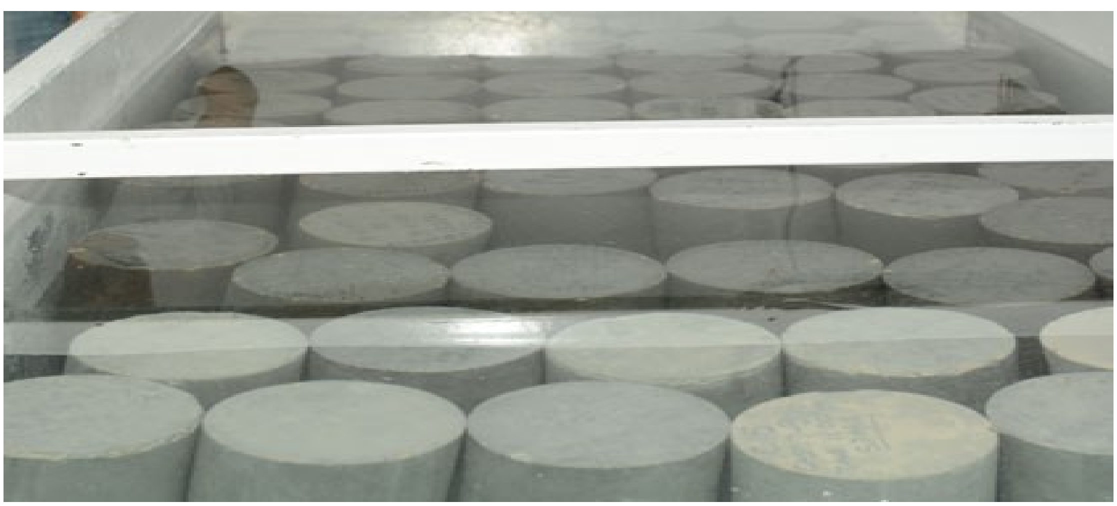


Figure 8: Curing

2.6.1 Curing Methods

Methods that supply additional moisture include sprinkling and wet covers. All of these methods add moisture to the concrete surface during the early hardening or curing period. They also provide some cooling through evaporation.

Table 1: Curing Methods and their advantages and disadvantages

Methods	Advantages	Disadvantages
Sprinkling with water or covering with Burlap	Excellent results if kept constantly wet	Likelihood of drying between sprinklings; difficult on vertical walls
Straw	Insulator in water	Can dry out, blow away, or burn
Moist earth	Cheap but messy	Stains concrete; can dry out; removal problem
Pending on flat surfaces	Excellent results; maintains uniform temperature	Requires considerable labor
Curing compounds	Easy to apply and inexpensive	Sprayer needed; inadequate coverage allows drying out; unless pigmented, can allow concrete to get too hot.
Waterproof paper	Excellent protection, prevents drying	Heavy cost can be excessive; must be kept in rolls; storage and handling problems.
Plastic film	Absolutely watertight, excellent protection, light and easy to handle	Should be pigmented for heat protection; requires reasonable care and tears must be patched;

2.7 Physical tests

2.7.1 Setting of concrete

Setting of concrete is defined as the onset of rigidity in fresh concrete. It is destined from hardening, while it describes the development of useful and measurable strength. Settings precede hardening, but it should be emphasized that both are gradual changes, which are controlled by the continuing hydration of the cement. Setting is a transitional period between states of the true fluidity and true rigidity. The penetration test according to ASTM C 403 is used to determine the initial and final setting of concrete. This test method covers the determination of the time of setting of concrete with a slump greater than zero, by means of penetration resistance measurements on mortar sieved from the concrete mix. The penetration tests do not correspond to any specific change in concrete properties, although it is useful to consider that the initial set represents approximately the time at which fresh concrete can no longer be properly handled and placed, while the final set approximates the time at which the hardening begins. Fresh concrete will have lost measurable slump prior to the initial set, while measurable strength will be achieved sometime after the final set. As per ASTM 0403, the time of initial setting is the elapsed time, after initial contact of cement and water, required for the mortar sieved from the concrete to reach a penetration resistance of 3.5 Mpa (500 psi). Time of final setting is defined, in ASTM C 403, as the elapsed time, after initial contact of cement and water, required for the mortar sieved from the concrete to reach a penetration resistance of 27.6 Mpa (4000 psi).

2.7.2 Slump Test

The concrete slump test is used for the measurement of a property of fresh concrete. The test is an empirical test that measures the workability of fresh concrete. More specifically, it measures consistency between batches. The test is popular due to the simplicity of the apparatus used and simple procedure. The slump test is used to ensure uniformity for different batches of similar concrete under field conditions, and to ascertain the effects of plasticizers on their introduction. The slump test result is a measure of the behavior of a compacted inverted cone of concrete under the action of gravity. It measures the consistency or the wetness of concrete. The slumped concrete takes various shapes, and according to the profile of slumped concrete, the slump is termed as a true slump. Shear slump or collapse slump. If a shear or collapse slump is achieved, a fresh sample should be taken and the test repeated. A collapse slump is an indication of too wet a mix. Only a true slump is of any use in the test. A collapse slump will generally mean that the mix is too wet or that it is a high workability mix, for which slump test is not appropriate. Very dry mixes; having slump 0 - 25 mm are used in road making, low workability mixes; having slump 10 - 40 mm are used for foundations with light reinforcement, medium workability mixes having slump 50 - 90 for normal reinforced concrete placed with vibration, high workability concrete, slump > 100 mm.

Figure 9: Slump Test

The slump test is suitable for slumps of medium to high workability, the slump in the range of 25 - 125 mm; the test fails to determine the difference in workability in stiff mixes which have zero slumps, or for wet mixes that give a collapse slump. It is limited to concrete formed of aggregates of less than 38 mm.

2.7.3 Sieve Analysis

A sieve analysis (or gradation test) is a practice or procedure used (commonly used in civil engineering) to assess the particle size distribution (also called gradation) of a granular material by allowing the material to pass through a series of sieves of progressively smaller mesh size and weighing the amount of material that is stopped by each sieve as a fraction of the whole mass.

The size distribution is often of critical importance to the way the material performs in use. A sieve analysis can be performed on any type of non-organic or organic granular materials including sands, crushed rock, clays, granite, feldspars, coal, soil, a wide range of manufactured powders, grain and seeds, down to a minimum size depending on the exact method. Being such a simple technique of particle sizing, it is probably the most common(McGlinchey 2009)

Figure 10: Sieve analysis

The results are presented in a graph of percent passing versus the sieve size. On the graph the sieve size scale is logarithmic. To find the percent of aggregate passing through each sieve, first, find the percent retained in each sieve. To do so, the following equation is used,

$\%Retained = (W_{Sieve} / W_{Total})*100\%$

Where W_{Sieve} is the mass of aggregate in the sieve and W_{Total} is the total mass of the aggregate.

The next step is to find the cumulative percent of aggregate retained in each sieve. To do so, add up the total amount of aggregate that is retained in each sieve and the amount in the previous sieves. The cumulative percent passing of the aggregate is found by subtracting the percent retained from 100%.

%Cumulative Passing = 100% - %Cumulative Retained.

The values are then plotted on a graph with cumulative percent passing on the y-axis and logarithmic sieve size on the x-axis.

2.7.4 Types of gradation

A Dense gradation

A dense gradation refers to a sample that is approximate of equal amounts of various sizes of aggregate. By having a dense gradation, most of the air voids between the materials are filled with particles. A dense gradation will result in an even curve on the gradation graph.

Narrow gradation

Also known as uniform gradation, a narrow gradation is a sample that has aggregate of approximately the same size. The curve on the gradation graph is very steep and occupies a small range of the aggregate. Gap gradation a gap gradation refers to a sample with very little aggregate in the medium size range. This results in only coarse and fine aggregate. The curve is horizontal in the medium size range on the gradation graph.

Open gradation

An open gradation refers to an aggregate sample with very little fine aggregate particles. This results in many air voids, because there are no fine particles to fill them. On the gradation graph, it appears as a curve that is horizontal in the small size range.

Rich gradation

A rich gradation refers to a sample of aggregate with a high proportion of particles of small sizes. (Mamlouk and Zaniewski n.d.)

2.7.4.1Compressive strength test

Compressive strength of concrete is the Strength of hardened concrete measured by the compression test. The compression strength of concrete is a measure of the concrete's ability to resist loads which tend to compress it. It is measured by crushing cylindrical concrete specimens in the compression testing machine.

The compressive strength of concrete can be calculated by the failure load divided with the cross-sectional area resisting the load and reported in pounds per square inch in US customary units and mega Pascal (MPa) in SI units. Concrete's compressive strength requirements can vary from 2500 psi (17 MPa) for residential concrete to 4000psi (28 MPa) and higher in commercial structures. Higher strengths up to and exceeding 10,000 psi (70 MPa) are specified for certain applications. (Jamal 2017)

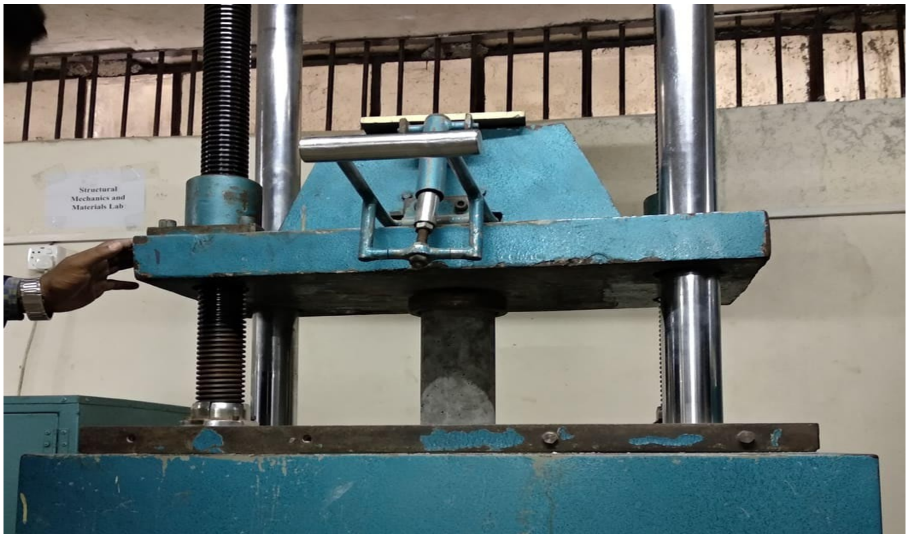


Figure 11: Universal Testing Machine

2.7.4.2: Importance of Determining the Compressive Strength:

Compressive strength results are primarily used to determine that the concrete mixture as delivered on-site meets the requirements of the specified strength, fc', in the job specification. Cylinders tested for acceptance and quality control are made and cured in accordance with procedures described for standard-cured specimens in ASTM C-31 (which is the Standard Practice for Making and Curing Concrete Test Specimens in the Field). For estimating the in-place concrete strength, ASTM C-31 provides procedures for field-cured specimens. Cylindrical specimens are tested in accordance with ASTM C-39 (which is the Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens).

A test result is the average of at least two standard-cured strength specimens made from the same concrete batch and tested at the same age. In most cases, strength requirements for concrete are at 28 days.

2.7.5 Data Acquirement from Compression Strength:

Design engineers use the specified strength to design structural elements. This specified strength is incorporated in the job contract documents and is called design strength of concrete. The concrete mixture is designed to produce an average strength fc' higher than the specified strength such that the risk of not complying with the strength specification is minimized. To comply with the strength requirements of a job specification, the following acceptance criteria apply:

- The average of three consecutive tests should equal or exceed the specified strength fc'.
- No single strength test should fall below fc' by more than 500 psi (3.45MPa) or by more than 0.10fc' when fc' is more than 5000 psi (35 MPa).

It is important to understand that an individual test falling below fc' does not necessarily mean that the test has failed and specifications were not as per requirement. When the average of strength tests is as per the required average strength fc', the probability that individual strength tests will be less than the specified strength is about 10% and this is accounted for in the acceptance criteria.

When strength test results indicate that the concrete fails to meet the requirements of the specification, it is important to recognize that the failure of concrete may also be due to the testing procedure. This is especially true if the fabrication, handling, curing and testing of the cylinders are not conducted in accordance with standard procedures.(Jamal 2017)

2.7.6 Strain

A strain is a normalized measure of deformation representing the displacement between particles in the body relative to a reference length. Strain is related to change in dimensions and shape of a material. The most elementary definition of strain is when the deformation is along one axis:

Strain = Change in length / Original length.

It is found experimentally that an axial tensile loading induces a lateral strain corresponding to a reduction in a material specimen's cross-sectional area. Similarly, an axial compressive load causes a lateral strain associated with an increase in the cross-sectional area. When the axial stress is removed, the lateral strain disappears along with the axial strain. Strain is thus, a measure of the deformation of the material and is a non-dimensional quantity i.e. it has no units. It is simply a ratio of two quantities with the same unit.

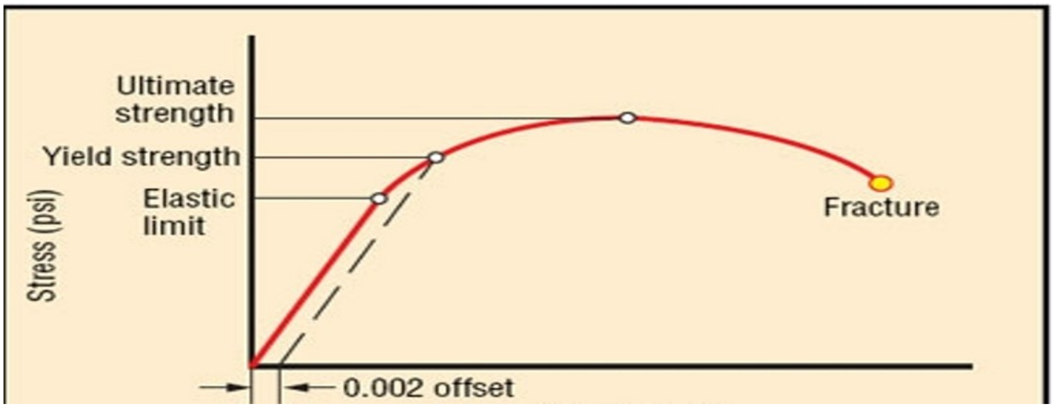


Figure 12: Typical Stress-Strain Diagram

2.7.6.1 Normal strain

The amount of stretch or compression along a material line elements or fibers is the normal strain. If there is an increase in length of the material line, the normal strain is called tensile strain; otherwise, if there is reduction or compression in the length of the material line, it is called compressive strain. Normal strain is expressed as the ratio of total deformation to the initial dimension of the material body in which the forces are being applied. The engineering normal strain or engineering extensional strain or nominal strain e of a material line element or fiber axially loaded is expressed as the change in length AL per unit of the original length L of the line element or fibers. The normal strain is positive if the material fibers are stretched or negative if they are compressed.

2.7.7 Shear strain

Strains which involve no length changes but which do change angles are known as shear strains.

$\varepsilon = \Delta L / L$

$= FL / AEL$ $[\because \Delta L = FL / AE]$

= F/AE

Where, ε = Strain,

E = Modulus of elasticity of Concrete,

A = Cross Sectional Area,

F = Applied Force / load.

ε_a= Allowable strain in concrete

Chapter Three
Experimental Data

3.1 Introduction

The compressive strength analysis will give the clear concept about the selection of aggregate before construction. Before the compressive strength test the below mentioned physical test have to perform.

3.2 The scope of work of Jute Fiber and Bamboo Chips:

The work presented in this paper reports an investigation on the behavior of concrete produced from using Jute Fiber & Bamboo Chips as aggregate. The physical properties of these materials were investigated first then compared it to ordinary aggregate. In this investigation Jute Fiber & Bamboo Chips are used in percentage of 0, 5, 10, 15 and 20, in place of crushed stone and sand respectively, and was developed with a characteristic compressive strength of 25MPa, with a mixing proportion of 1:2:3 and with W/C ratio of 60%. A total of eighty eight specimens were casted and tested to evaluate the strength and durability properties of concrete.

3.3 Physical Tests

3.3.1 Physical tests for coarse aggregate

- Sieve analysis
- Abrasion test
- Specific gravity and absorption capacity
- Unit weight and void calculation

3.3.2 Physical tests for fine aggregate

- Sieve analysis
- Specific gravity
- Unit weight and void calculation

3.4 Coarse aggregate investigation and preparation

Stone chips were collected from local market. Waste broken Jute Fiber were collected from a construction site. Then the Jute Fiber were crashed manually. All the aggregates were washed properly to avoid dust and other impurities. Coarse aggregates sieved by the ASTM C 33-39 standards for the aggregate size of 20 mm to 4.75 mm. Three sieves were used and they are 20 mm, 9.5 mm and 4.75 mm. Aggregates had been taken in different sieved sizes. Saturated surface dried condition broken Jute Fiber were used for concrete casting with crushed stone.

3.4.1 Sieve Analysis

This experiment was done to find the fineness modulus of coarse aggregate, sieve grading is given in the below table:

Table 2: Sieve analysis of Stone Chips

Stone chips					
Sieve no	Sieve opening (mm)	Retained (gm)	% Retained	Cumulative % retained	% Finer
¾”	19.05	116	7.73	7.73	92.27
3/8”	9.5	1285	85.67	93.4	6.6
#4	4.75	86	5.73	99.13	.87
Pan		13	.87	100	0
Total		1500	100		99.74

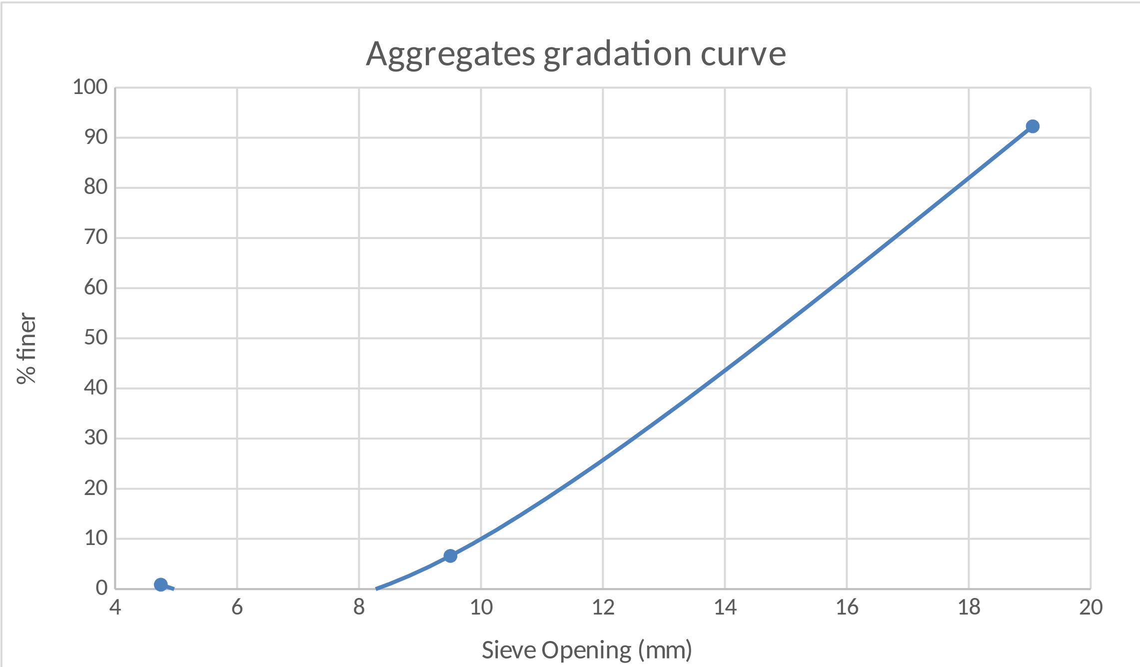


Figure 13: % Finer VS Sieve Opening graph for Stone Chips

Table 3: Sieve analysis of Jute Fiber

Broken Jute Fiber					
Sieve no	Sieve opening (mm)	Retained (gm)	% Retained	Cumulative % retained	% Finer
¾”	20.05	58	3.73	3.74	99.30
3/8”	9.5	1421	94.73	98.46	1.54
#4	4.75	23	1.54	100	0
Pan		0	0	-	-
Total		1500	100		97.81

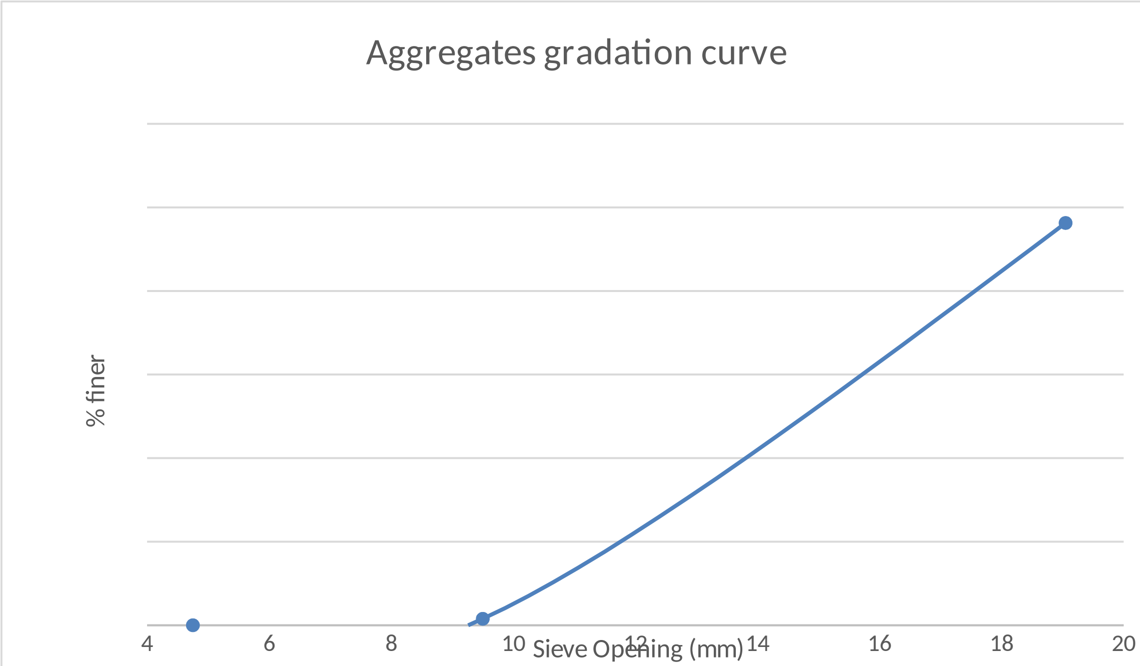


Figure 14: % Finer VS Sieve Opening graph for Jute Fiber

3.4.2 Abrasion Test

Abrasion test is very important for coarse aggregate. There are four grading in abrasion test:

Grade-A for > ¾" Aggregate – Used in road construction

Grade-B for < ¾" Aggregate – Used in building, bridge etc construction

Grade-C for < ½" Aggregate

Grade-D for > ½" Aggregate

For our test it required group-B category aggregate.

3.4.3 Specific Gravity and Absorption Capacity

This experiment was done to find the Bulk Specific Gravity and Absorption Capacity of coarse aggregate, values are given in the below table:

Table 4: Specific Gravity and Absorption Capacity of coarse aggregate

Sample	Wt. of Busket (gm)	Wt. of SSD sample (gm), B	Wt. of SSD sample in water (gm), C	Wt. of oven dry sample (gm), A
Stone	779	2000	1326	1955
Jute Fiber	779	1950	1060	1919

Results:

For Stone Chips:

Bulk Specific Gravity (SSD Basis) = B/ (B-C) = 2000/ (2000-1326) = 2.97

Absorption Capacity, D% = {(B-A)*100}/A = {(2000-1955)*100}/1955 = 2.30

For Broken Jute Fiber:

Bulk Specific Gravity (SSD Basis) = B/ (B-C) = 1950/ (1950-1060) = 2.19

Absorption Capacity, D% = {(B-A)*100}/A = {(1950-1919)*100}/1919 = 1.62

3.4.4 Unit weight and void calculation

This experiment was done to find the Unit weight and void calculation of coarse aggregate, values are given in the below table:

Volume of the mold, $V = (\pi d^2/4)*h$

Here, Dia, d = 6”, Height, h = 6”

$\therefore$ Volume, $V = (\pi*6^2/4)*6 = 169.65\ in^3 = 0.1 ft^3$

Table 5: Unit weight of coarse aggregate

Sample	Wt. of the mold (gm)	Wt. of the specimen with mold (gm)	Wt. of the specimen (gm), W	Volume of the mold (ft^3), V	Unit weight (W/V) gm/ft^3	Unit weight kg/ft^3
Stone chips	4000	8489	4489	0.1	44890	44.89
Broken Jute Fiber	4000	7577	3577	0.1	35770	35.77

3.5 Fine aggregate investigation and preparation

Sand was collected from the local market, and Sylhet sand was used. Waste broken glasses were collected from a construction site. Then the glasses were powdered manually in the laboratory. Before using these sand, it had been washed properly to avoid mud and other organic materials. After washing the sand, it had been dried in the laboratory and then SSD (Saturated Surface Dry) was prepared. All the fine aggregates was sieved through No 4 ASTM standard sieve to ensure that no big particle or no rubbish were present into it.

3.5.1 Sieve Analysis

This experiment was done to find the fineness modulus of fine aggregate, sieve grading is given in the below table:

Table 5 Sieve analysis of Sand

Sand					
Sieve no	Sieve opening (mm)	Retained (gm.)	% Retained	Cumulative % retained	% Finer
#4	4.75	0	0	0	100
#8	2.36	58	6.44	6.44	93.56
#16	1.19	299	33.22	39.66	60.34
#30	0.59	293	32.56	72.22	27.78
#50	0.30	202	22.44	94.66	5.34
#100	0.15	39	4.33	98.99	1.01
Pan		9	1.01	100	-
Total		900	100		288.03

Table 5 Sieve analysis of Sand

Fineness Modulus (F.M.) = (sum of Cumulative % Retain/100) = 288.03/100 = 2.88

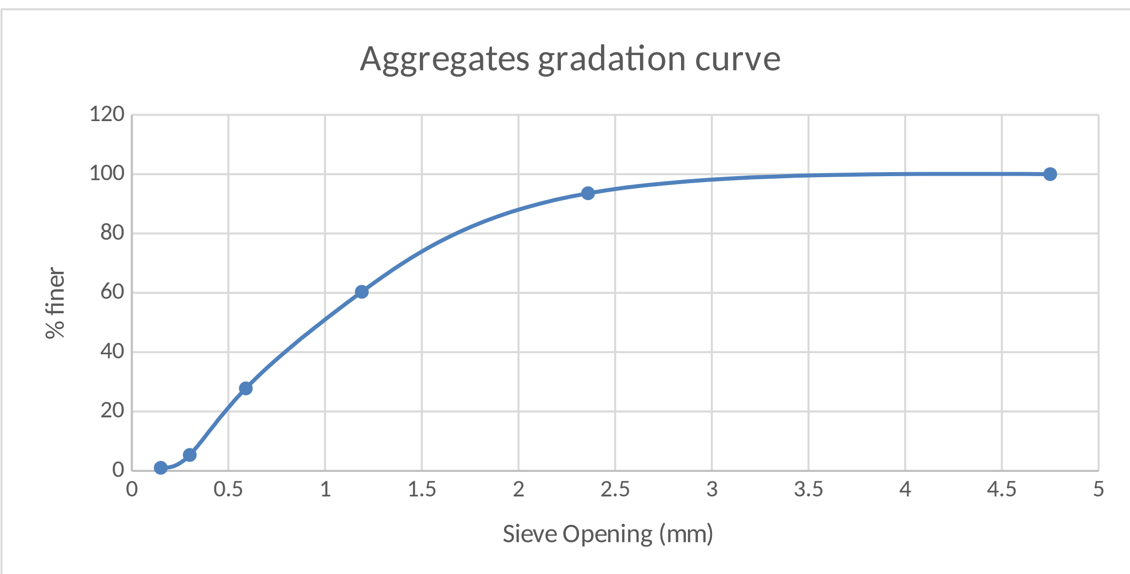


Figure 15: % Finer VS Sieve Opening graph for Sand

Table 6: Sieve analysis of Bamboo Chips

Glass Powder					
Sieve no	Sieve opening (mm)	Retained (gm)	% Retained	Cumulative % retained	% Finer
#4	4.75	0	0	0	100
#8	2.36	17	1.7	1.7	98.3
#16	1.19	555	55.5	57.2	42.8
#30	0.59	170	17	74.2	25.8
#50	0.30	183	18.3	92.5	7.5
#100	0.15	57	5.7	98.2	1.8
Pan		18	1.8	100	-
Total		1000	100		276.2

Fineness Modulus (F.M.) = (sum of Cumulative % Retain/100) = 276.2/100 = 2.762

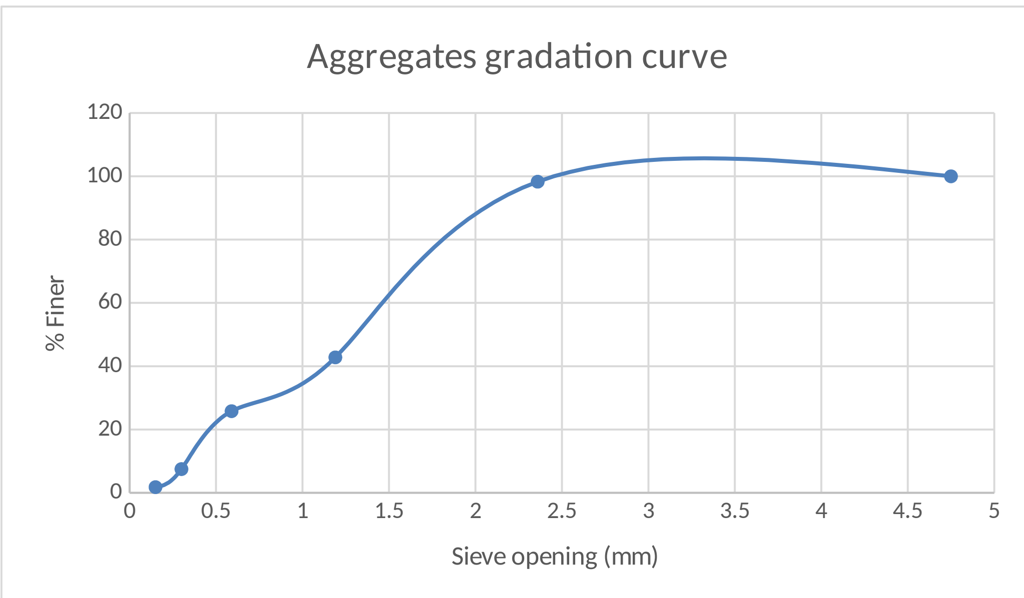


Figure 16: % Finer VS Sieve Opening graph for Bamboo Chips

3.5.2 Specific Gravity and Absorption Capacity

This experiment was done to find the Bulk Specific Gravity and Absorption Capacity of fine aggregates, values are given in the below table:

Table 7: Specific Gravity and Absorption Capacity of fine aggregates

Sample	Wt. of Pycnometer	Wt. of Pycnometer	Wt. of SSD sample in air,	Wt. of oven dry sample,

	filled with water to calib mark, B (gm)	with water and sample to calib mark, C (gm)	S (gm.)	A (gm)
Sand	1236	1586	600	570
Bamboo chips	1236	1532	502	489

Results:

For Sand:

Bulk Specific Gravity (SSD Basis), G = S/ (B+S-C) = 600/ (1236+600-1586) = 2.4

Absorption Capacity, D% = {(S-A)*100}/A = {(600-570)*100}/570 = 5.26

For Bamboo Chips:

Bulk Specific Gravity (SSD Basis), G = S/ (B+S-C) = 502/ (1236+502-1532) = 2.44

Absorption Capacity, D% = {(S-A)*100}/A = {(502-489)*100}/489 = 2.66

3.5.3 Unit weight and void calculation

This experiment was done to find the Unit weight and void calculation of fine aggregates, values are given in the below table:

Volume of the mold, $V = (\pi d^2/4)*h$

Here, Dia, d = 6”, Height, h = 6”

∴ Volume, $V = (\pi*6^2/4)*6 = 169.65\ in^3 = 0.1 ft^3$

Table 8 Unit weight of fine aggregate

Sample	Wt. of the mold (gm)	Wt. of the specimen with mold	Wt. of the specimen (gm), W	Volume of the mold (ft^3), V	Unit weight (W/V)	Unit weight kg/ft^3

		(gm)			gm/ft^3	
Sand	4000	8100	4100	0.1	41000	41.00
Glass Powder	4000	8126	4126	0.1	41260	41.26

3.6 Cement

Cement is collected from the local market and its initial setting time and final setting time were 30 and 600 minutes respectively. The unit weight of the cement was approximately 1350 kg/m^3.

3.7 Water

Water that was used in the concrete mixing and the curing of the specimens was normal tap water, which has a Unit weight of 1000kg/m^3. (Approximately)

In general, the air percent of the mix design was assumed 2%. The cement content of the ratio was for the workability of the concrete.

3.8 Mix Design

Mix design can be defined as "the process of choosing the ingredient of concrete and determining their quantities with the object of producing as economically as possible of certain concrete of certain minimum properties such as consistence, strength, and durability".(Neville, 1995). (Ghasemi n.d.)

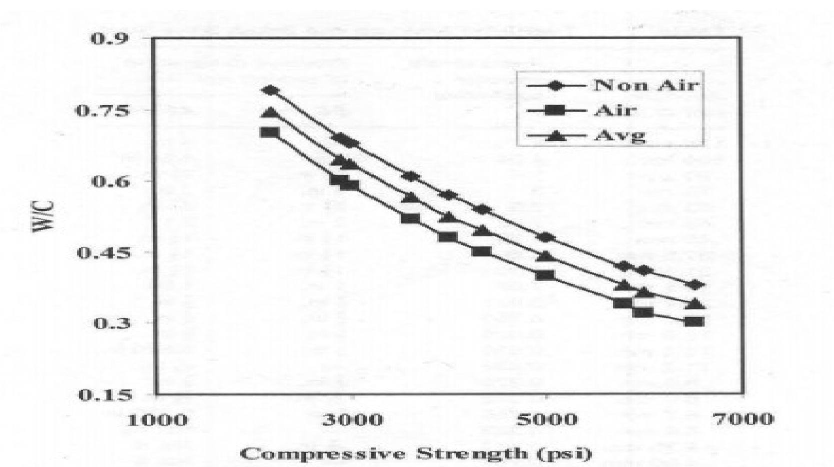


Figure 17: W/C versus Compressive Strength (for stone chips)

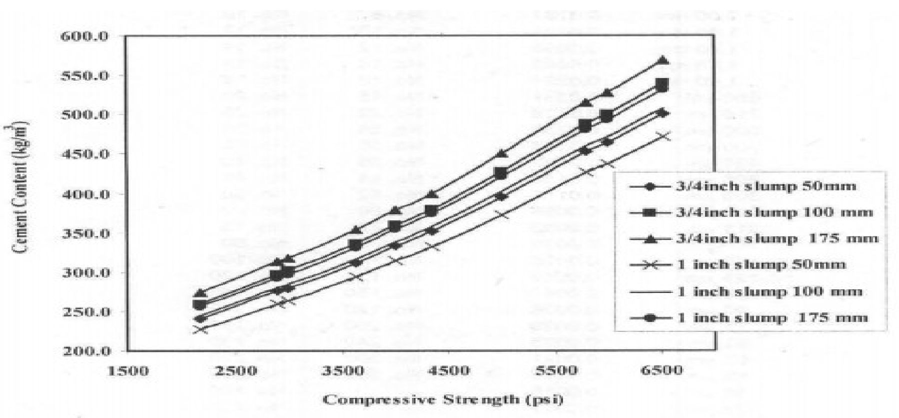


Figure 18: Cement content versus Compressive strength (for stone chips)

From the above graph and our calculation we get the ratio of water- cement is 0.60 and the

Derivation					
When strength f'c= 3000 psi	**Note, W/c=0.60,wc=320 Kg/m^3**				
Vc+	Vca+	Vfa+	Vw+	Vv+=	1
Wc/Gc*γw +	Wca/Gca*γw+	Wfa/Gfa*γw+	Ww/Gw*γw+	2%=	
320/(3.1*1000)+	Wca/(2.6*1000)+	Wfa/(2.6*1000)+	192/(1*1000)+	0.02	
Wca/(2.6*1000)+	Wfa/(2.6*1000)+	0.103	0.192	0.02	0.69
Wca/(2.6*1000)+	Wfa/(2.6*1000)+	0.685			
Wca+Wfa/(2.6*1000)=		0.685			
Wca+Wfa=	.685*(2.6*1000)				
Wca+Wfa=	1781.000	…............(1)			
Again,	Vs/Va=0.40				
(Wfa/Gfa*γw)/((Wca/Gca*γw)+(Wfa/Gfa*γw))=			0.4		
(Wfa/2.6*1000)/((Wca/2.6*1000)+(Wfa/2.6*1000))=			0.4		
(Wfa/2.6*1000)/((Wca+Wfa)/(2.6*1000))=			0.4		
(Wfa/2600)=	0.4*((Wca+Wfa)/2600))				
Wfa=	0.40*(Wca+Wfa)				
Wfa=	0.40*Wca+0.40*Wfa				
Wfa*(1-0.40)=	0.40*Wca				
Wfa=	0.67*Wca……..(2)				
From equation (1) &(2) We get,					
Wca+0.67*Wca=	1781.000				
Wca(1+0.67)=	1781.000				
Wca=	1066 kg/m^3				
Putting the value of Wca in eq-2 ,					
Wfa=	0.67*1066				
Wfa=	714 Kg/m^3				

So, Materials required for 1m^3 of concrete is as follows ,					
Name of materials	Unit	Weight			
Cement	kg	320			
Coarse aggregate	kg	1066			
Fine aggregate	kg	714			
Water	kg	192	water=0.60 *320	192	
Trial Mix-	Name of materials	Weight			
Cement	kg	320			
Coarse aggregate	kg	1066			
Fine aggregate	kg	714			
Water	kg	192			
Unit weight of Concrete in kg =		2292			
Volume ratio :					
If					
Unit weight of Cement in kg =		1440			
Unit weight of Sand in kg =		1540			
Unit weight of Coarse Aggregate in kg =		1560			
Volume of Cement ,	Vc= 320/1440	0.22	m^3		
Volume of Sand ,	Vs=714/1540	0.46	m^3		
Volume of Coarse Aggregate ,	Vca=1066/1560	0.68	m^3		
	Vc:Vs:Vca	1:2.1:3.10	Cement : Sand: Agregate		
Vc=	320	3.1	1000	0.103225806	
Vca=	1066	2.6	1000	0.41	
Vfa=	714	2.6	1000	0.274615385	
Vw	162	1	1000	0.162	
Vv	2%			0.02	
			Total	0.969841191	
			Assume	1.00 m^3	

3.9 Mold preparation

Our mold cylinder size was 4in on diameter and 8in in height. The molds were prepared and cleaned properly before putting the concrete mix into these molds. All the molds were properly lubricated inside before casting of concrete specimens.

3.10 Casting

Concrete mixture was prepared by hand. Trial mix was done for every case before the final mix. At construction sites all the element, such as cement, sand, stone and water put together in the mixture machine to produce concrete mix. But in fact, it is not a good way to gain the good strength of concrete. To ensure the quality strength in the matrix, the following procedure was followed for mixing concrete.

At first, all the coarse aggregate sand and cement putted together and mixed properly with the help of Kurni. After that one third of the water was mixed with the mixed aggregate. Then after mixing that properly, the rest of the water was putted into the mixture and mixed properly. After that casting was done of the specimens. For water-cement ratio we have used 0.55, this is found from the mix design calculation.

3.11 Compaction of the concrete

The concrete mixture was compacted properly before completing the mold. Every cylinder specimen was compacted by three layers. In each layer, there were total 25 blows. After the proper compaction of these mixtures, hammering and scaling were done to get a void free surface and cylinder of the specimen.

3.12 Curing of Concrete

After all the casting was done, curing was ensured properly. Normal tape water was used for curing. We have used a water drum for the curing procedure. All the specimen are putted into the water in the drum. Before crashing these cylinder, all of them were putted under water in the drum for 28 days.

3.13 Destructive Test by Universal Testing Machine (UTM)

The universal testing machine had used to do destructive tests for all the concrete specimens. Before the destructive tests of the cylinder, all the cylinder specimen was carried out of the curing drum and left for drying. Before the test all the specimen were capped properly to get a smooth and uniform surface for concentrated load. Loading was 4kN/sec applied by the Universal Testing Machine to the specimen. Stresses were measured for each case.

Crashing patterns and all the crack surface picture were taken for every specimen. Generally speaking, concrete used for residential purposes is around 2500 psi, for commercial uses is 4000psi, and as high as 10000psi for other specified application.

Our mold cylinder size was 4in on diameter and 8in in height. The molds were prepared and cleaned properly before putting the concrete mix into these molds. All the molds were properly lubricated inside before casting of concrete specimens.

Chapter Four

Results and Discussion

4.1Introduction: Our natural resources are limited, but the rapidity of our infrastructure development is very fast. Our recent development scenario indicates that we need to utilize our land by replacing the old low rise building with new and high rise building. Recycling these old building make huge mass of demolished concrete, and that can harm our environment in many ways. By using these waste demolished material as recycled aggregate we can save both our environment and our construction cost at a time.

4.2 Results

We got compressive and tensile cylinder test result from crashing the specimen concrete cylinder by Universal Testing Machine (UTM). We got the result in kN from the test and converted that to Psi format. [Cylinder size (4” * 8”) & Ratio 1: 2: 3.5]

Table 10: Compressive strength of concrete with Jute Fiber as coarse aggregate (with admixer) By Volume

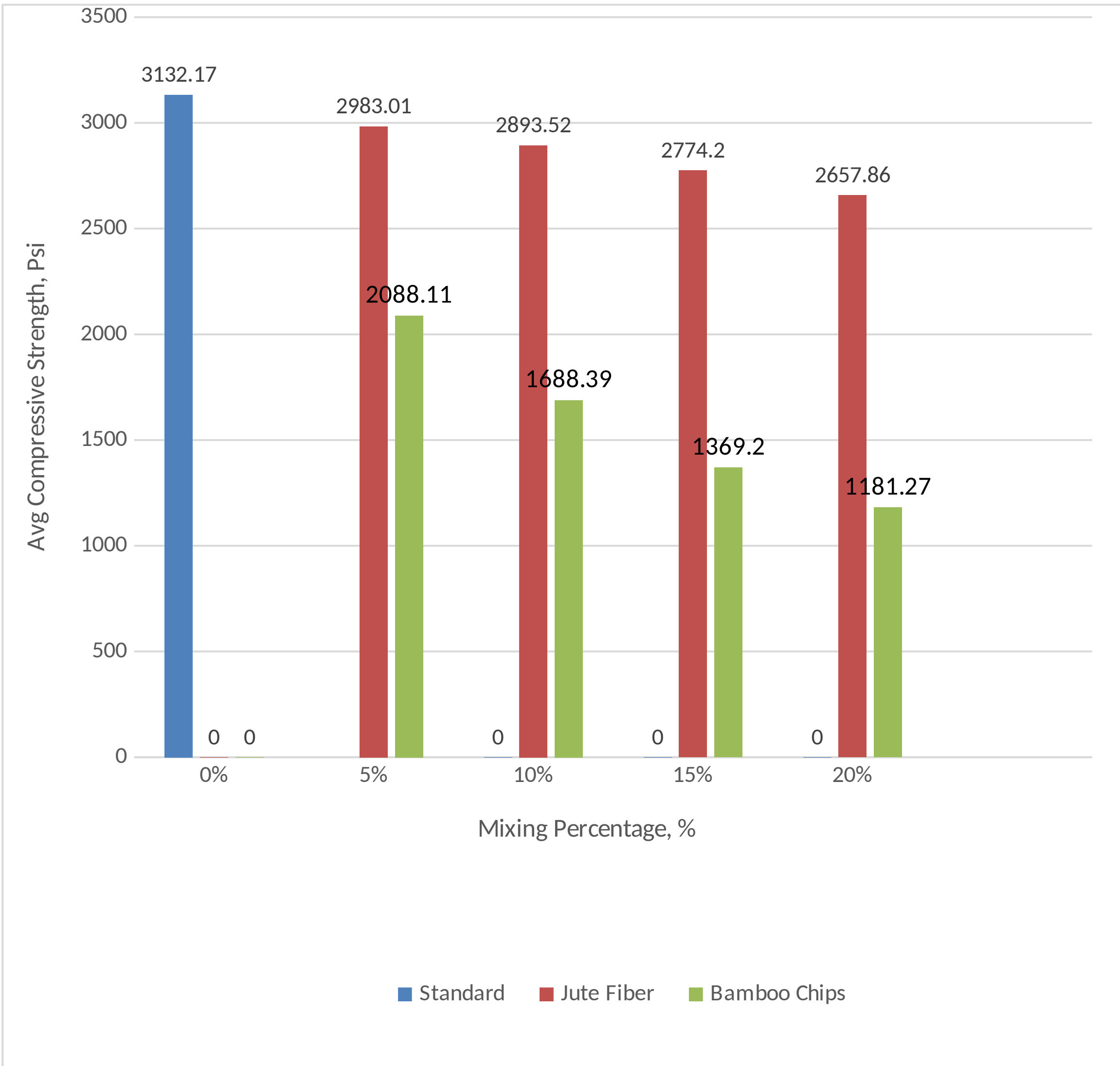
Load Calculation By Volume

Water Cement Ratio .60

Case No	% of Parcentage	Types of Replacement	Amount of Replacment Metarials		Others Components									
				Cement	Water	Fine Aggregate	Stone Chips	Load in(KN) Cylinder 01	Load in(KN) Cylinder 02	Load in(KN) Cylinder 03	Average Load (KN)	Average Compressive Strength f'c (PSI)	Average Tensile Strength ft=6.5√f'c	Percent (%) decreases of compressive strength respect to fresh
1	0%	Normal		2.85	1.71	6.11	9.282	175	178	172	175	3132.166	363.78	0
2	5%	Jute Fiber	0.464	2.85	1.71	6.11	8.818	165	175	160	166.67	2983.015	355.01	4.761904762
3	10%		0.928	2.85	1.71	6.11	8.354	155	170	160	161.67	2893.524	349.65	3
4	15%		1.392	2.85	1.71	6.11	7.89	160	165	140	155	2774.204	342.36	4.12371134
5	20%		1.856	2.85	1.71	6.11	7.426	152	145	0	148.5	2657.866		4.193548387

Case No	% of Percentage	Types of Replacement	Amount of Replacement Materials		Others Components									
				Cement	Water	Fine Aggregate	Stone Chips	Load in(KN) Cylinder 01	Load in(KN) Cylinder 02	Load in(KN) Cylinder 03	Average Load (KN)	Average Compressive Strength f'c (PSI)	Average Tensile Strength ft=6.5√f'c	Percent (%) decreases of compressive strength respect to fresh
1	5%	Bamboo Chips	0.464	2.85	1.71	6.11	8.818	120	120	110	116.7	2088.11	297.02	33.33333333
2	10%		0.928	2.85	1.71	6.11	8.354	90	95	98	94.33	1688.386	267.08	43.4
3	15%		1.392	2.85	1.71	6.11	7.89	75	78	0	76.5	1369.204	240.52	52.68041237
4	20%		1.856	2.85	1.71	6.11	7.426	65	67	0	66	1181.274	223.4	57.41935484

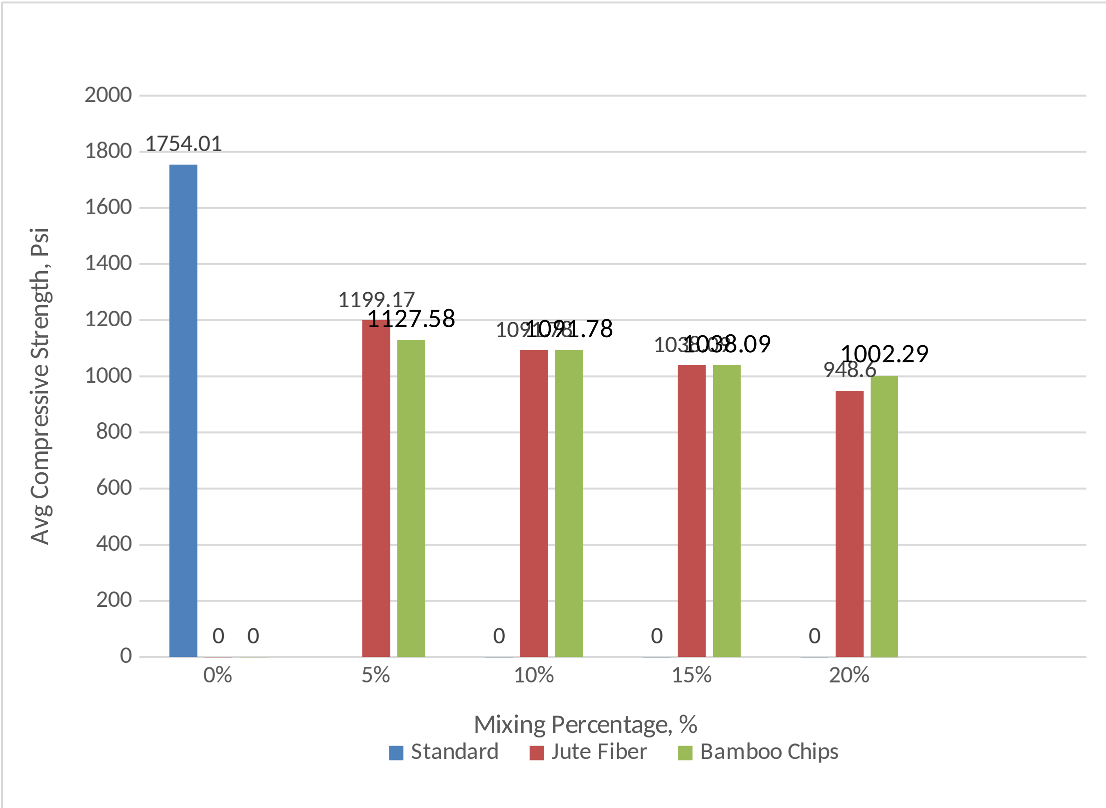
Table 11: Compressive strength of concrete with Bamboo Chips as coarse aggregate (with admixer) By Unit Weight .



Graph1: Compressive strength of concrete with Jute Fiber &Bamboo Chips as coarse aggregate (with admixer)

Table 12:Tensile strength By Volume

Case No	Name	% of Percentage	Weight gm	Load (KN)	Average Load KN	Load (PSI))	Average (Psi)	Remarks
1	No Organic Metal	0%	4755	110	110	**1968.79**	**1968.79**	
2	Jute Fiber	5%	3848	78		**1396.051**		Tension
3	Jute Fiber	10%	3851	70	**67**	**1252.866**	**1199.172**	Tension
4	Jute Fiber	15%	3875	62		**1109.682**		Tension
5	Jute Fiber	20%	3851	58		**1038.089**		
		Bamboo Chips						
1	Bamboo Chips	5%	3851	73		**1306.561**		Tension
2	Bamboo Chips	10%	3875	64.5	**46.375**	**1154.427**	**11.59375**	Tension
3	Bamboo Chips	15%	3851	62		**1109.682**		Tension
4	Bamboo Chips	20%	3875	59		**1055.987**		Tension

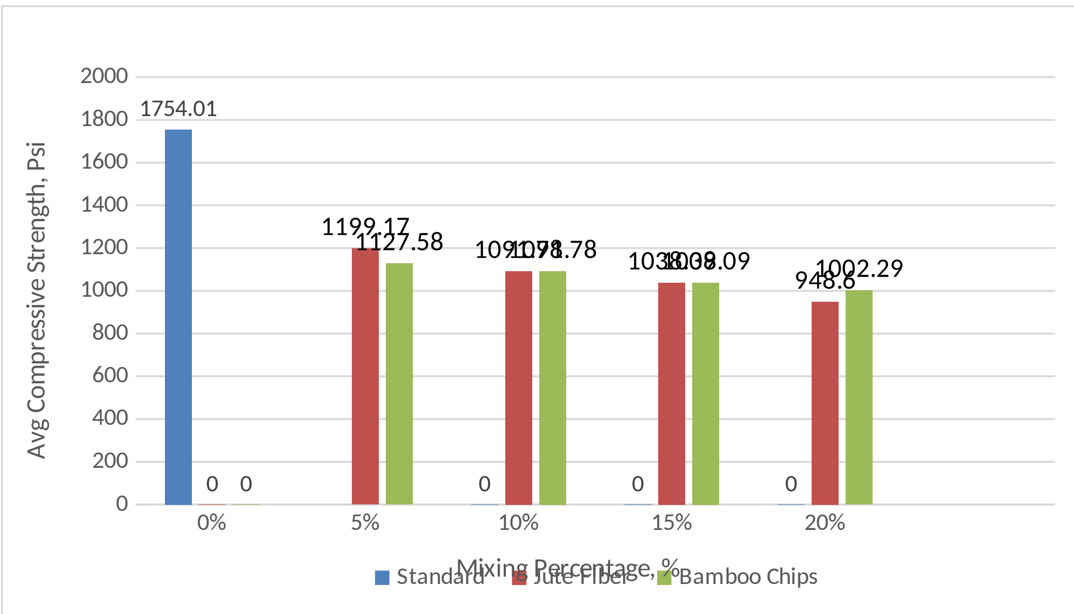


Graph2 : Tensile strength By Volume

Case No	Name	% of Percentage	Weight gm	Load (KN)	Average Load KN	Load (PSI))	Average (Psi)	Remarks
1	No Organic Metal	0%	4755	98	98	**1754.013**	**1754.013**	
2	Jute Fiber	5%	3848	67		**1199.172**		Tension
3	Jute Fiber	10%	3851	61	**59.75**	**1091.783**	**1069.411**	Tension
4	Jute Fiber	15%	3875	58		**1038.089**		Tension
5	Jute Fiber	20%	3851	53		**948.5987**		
		Bamboo						

	Chips						
1	Bamboo Chips	5%	3851	63		**1127.58**		Tension
2	Bamboo Chips	10%	3875	61	**43.75**	**1091.783**	**10.9375**	Tension
3	Bamboo Chips	15%	3851	58		**1038.089**		Tension
4	Bamboo Chips	20%	3875	56		**1002.293**		Tension

Table 13:Tensile strength By Volume



Graph 3: Tensile strength By Volume

4.3 Discussion

This paper investigate the chances of making high strength concrete by using waste broken Jute Fiber as coarse aggregate and waste glass powder as fine aggregate. For this experiment, at first we collected broken waste Jute Fiber and broken glass panel from two different construction site around the Dhaka city. Then we crashed the Jute Fiber as coarse aggregate size and the glasses into fine powder. About 42 concrete cylinder were made using broken Jute Fiber as coarse aggregate and 36 concrete cylinder were made using glass powder as fine aggregate. A total 88 cylinder were made to test the standard concrete and the waste materials concrete strength with the water content ratio 0.55. For all the materials tests like sieve analysis, unit weight test, specific gravity and absorption capacity were done. Final tests include the compressive and tensile strength test of the concrete cylinder. We have tested some of our cylinder from the Digital Universal Testing Machine of metro rail project, for more accurate results. The average compressive strength of the specimen with broken Jute Fiber are between 3898.88psi to 5593.16psi. The average compressive strength of the specimen with glass powder are between 3687.01psi to 4820.55psi. The average tensile strength of the specimens are between 3898.88psi to 5593.16psi. The results of the specimens test from metro rail projects UTM are between 3454psi to 4555psi. This result indicates that these concrete with glass powder and broken Jute Fiber can be used for low rise and low priority building and some other construction work. Destructive tests were performed by the Universal Testing Machine. Loading was 4 kilo Newton per second applied by the Universal Testing Machine over the specimens. Stress was measured for each case.

From the above discussion, it can be said that maybe this kind of concrete having that kind of compressive and tensile strength can be used in low priority building and construction work which needs lower compressive strength then other construction work. By doing this, the waste material can be used as aggregate and can be used in new construction work which helps reducing the cost budget and also helping the waste dumping situation.

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Chapter Five
Conclusion and Recommendation

5.1 Introduction

The research was aimed to study compressive and tensile strength analysis of concrete made using by waste broken Jute Fiber and glasses. Another aim was to find the results of compressive strength; if it is within the allowable limit then it can be used in new construction. From the results we get that it cannot be used in high rise and high priority buildings, bridges and other important construction work. But it can be easily used in low priority constructions and low rise buildings, and less important construction work like sidewalk of road, road of rural areas, benches of park, drainage etc. It is found satisfactory results from the strength test which indicates waste materials like broken Jute Fiber glasses can be used in concrete as aggregate. After some physical test we can find the quality of these aggregates. By compressive strength analysis the final condition of concrete produced by these waste material aggregates was found. By using these waste material as aggregate, we can reduce the construction waste, and it will help us from environmental pollution and landfill by this type of wastes. And finally it can reduce our construction cost of new construction requiring nominal strength of concrete.

5.2 Specific Conclusion

Based on the investigation of experimental analytical data, we can say

I. By using waste broken Jute Fiber compressive strength was found as high as 5593psi. This strength was much higher than the standard 0% mixing sample which has strength

3132.psi (max avg). The lowest average strength was 3908psi for 10% Jute Fiber replacement and with admixture.

II. By using waste glass powder compressive strength was found as high as 4821psi. The lowest one was found 3687psi for 20% glass replacement and with admixture.

III. Maximum tensile strength was found from the cylinder test was 1521psi for 15% Jute Fiber and 10% glass replacement. While the standard 0% mixing sample had strength of 1280psi.

IV. The lowest tensile strength was 1065psi for 15% Bamboo Chips replacement concrete cylinder.

V. Compressive strength test results from the Digital UTM was as high as 5155psi for 25% Jute Fiber replacement with admixer. And the lowest one was 2774psi for 15% glass replacement without admixer.

5.3 Recommendation for future study

In every stage of tests, it may happen some human error, machine calibration error and environmental error and that can influence the result making some variation of results.

I. In every stage of work it needs to take special care like sample (Broken glass, Jute Fiber) collection, sample sorting, sieving, taking weight, mold preparation, curing etc.

II. It needs more care in time of taking values of strain data and applied load data from Universal Testing Machine.

III. This type of concrete can be used in low priorities construction work and low rise building, sidewalks, more importantly when less strength is sufficient.

IV. May not be suitable for high rise building and construction that withstand high compressive load.

V. More tests can be performed for more accurate and effective results.

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https://www.emachineshop.com/types-of

https://www.emachineshop.com/types-of-Jutefiber

Appendix-I

Pictures of our lab work

Compression Strength Test By Universal Testing Machine (According to Unit Weight)

Fig: Bamboo 5 %

Fig: Bamboo 10%

Fig: Bamboo 15%

Fig: Bamboo 20%

Jute Fiber 5%

Jute Fiber 10%

Jute Fiber 15% Jute Fiber 20%

Compression Strength Test By Universal Testing Machine (According to Volume)

Fig: Bamboo 5% Fig: Bamboo 10%

Fig: Bamboo 15%

Fig: Bamboo 20%

Jute Fiber 5%

Jute Fiber 10%

Jute Fiber 15% Jute Fiber 20%

Tensile Strength Test By Universal Testing Machine (According to Volume)

Tensile Strength Test by Universal Testing Machine (According to Unite Weight)

All Group Members

Sir Noman Soikat with Us

Supervises Sir with Us