COMPARATIVE ANALYSIS OF CONCRETE WITH ADMIXTURE AND WITHOUT ADMIXTURE

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A Thesis Submitted to the Department of Civil Engineering, Daffodil International University in partial fulfillment of the requirements for the award of Degree of
Bachelor of Science in Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING
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Certification

This is to certify that this project and thesis entitled "Comparative Analysis of Concrete with Admixture and Without Admixture" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the department of Civil engineering under the faculty of engineering of a daffodil international university in partial fulfillment of the requirements for the degree of bachelor of science in civil engineering. The presentation of the work was held on 12th March 2022.

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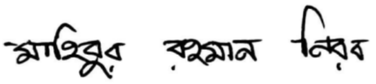

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DEDICATION

Dedicated to

OUR PARENTS

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LIST OF ABBREVIALITIONS

ASTM	American Society for Testing and Materials
PCC	Portland Composite Cement
FM	Fine Aggregate
CA	Coarse Aggregate
FA	Fine Aggregate
PSI	Pound per square inch.
W/C	Water Cement ratio.

ACKNOWLEDGEMENT

First of all, we give thanks to Allah. Then we would like to take this opportunity to express our appreciation and gratitude to our project and thesis supervisor Mr. Md. Imran Hasan Bappy, Lecturer of the Department of Civil Engineering for being dedicated to supporting, motivating, and guiding us through this project. This thesis can't be done without his useful advice and helps. Also thank you very much for allowing us to choose this thesis topic. He guided our courses and research and encouraged us with her enthusiasm to complete the research. He is the kind of advisor that inspired us for our future career plans with her work ethic and excellent expertise in research areas. His patience, support, and guidance were very precious for us, and feel very fortunate to conduct our research under her supervision.

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ABSTRACT

Compressive strength is an important topic for concrete. This paper discusses the use of admixture on concrete to increase compressive strength and also the economical effect of using admixture on concrete. In our project, normal concrete and concrete with admixture cylinders are prepared and tested for compressive strength at the end of 7, 14, and 28 days of curing. The results are compared for both types of concrete.

The main purpose of this research is to investigate the compressive strength of normal concrete and concrete with admixture. In this thesis project, we prepared a total of 36 cylindrical samples in four different sets, and in each set, there are nine samples. Doing this project work we maintained as per ASTM standards guideline. We are following the standard grade of concrete M20 and the mix ratio was 1:1.5:3. In all of the samples, we used the same amount of cement, coarse aggregate, fine aggregate, and as well as water/cement ratio. Among this one set we prepare without admixture and rest of the three we used admixture in three different percentages these are 4.5 ml, 6.7 ml, and 8.9 ml per sample. After three periods of curing 7, 14, and 28 days we tested compressive strength. After 28 days the results was 3218 psi (without admixture), 3356 psi (using 4.5 ml admixture), 3559 psi (using 6.7 ml admixture), and 3786 psi (using 8.9 ml admixture) and additionally cost increase 1.20 tk. (using 4.5 ml admixture), 1.70 tk. (using 6.7 ml admixture), and 2.30 tk. (using 8.9 ml admixture) per sample. Comparing all of results we can say that using 6.7 ml admixture is suitable percentages comparing to economical effect and strength.

All the Codes and conducts has been maintained according to ASTM standard specifications during the thesis work..

Keywords

Concrete, Concrete grade M20, PCC, Compressive strength, Admixture, Water Reducing Admixture, Plasticizer Admixture.

CHAPTER 1

INTRODUCTION

1.1 General

Concrete is a versatile engineering material consisting of cementing substances, aggregates, water, chemical admixtures, and an often controlled amount of entrained air. Concrete is very much used in the construction industry because of its durability and resistance to compressive stress. Concrete defend weathering action, chemical attack, and abrasion. the reaction between cement and water especially, it is effective to slum, workability, air content, and finish ability for the fresh state of concrete. Concrete is said to be a man-made rock. Because of its popularity are its high strength, fire resistance, durability, and workability. We can say concrete is almost the heart of construction. Concrete is the most useful. It is initially a plastic, workable mixture that constructs strength from hydration due to and commonly used man-made material on earth. We are using the concrete for many purposes, like foundations, superstructures, wastewater treatment facilities, water treatment facilities, parking structures, floor construction, exterior surfaces, and also many other uses.

The compressive strength of concrete is one of the most significant valuables of concrete. This test gives an overall idea about all the characteristics of concrete. The compressive strength depends on various factors like forming material properties and their proportion, method of preparation, curing, test condition also depends on assorted factors. Test for compressive strength is practiced either on cube or cylinder. Various standard codes are available to consult a perfect concrete cylinder or concrete cube as the standard specimen for the test. The standard test Method is (ASTM) American society for testing Materials C39/C39M. By this single test, we know whether concreting has been done properly or not.

Aggregates are the most fundamental material that we are used in construction work. The aggregate gives the volume, resistance, stability to wear or erosion, and other desired physical characteristics to the finished product. Aggregates contribute to the mechanical strength of the concrete also diminution the expenditure of cement and water. Aggregates maintenance of rigid structures and makes them an inevitable ingredient in the construction work. Coarse and fine aggregate make up the bulk of a concrete mixture, for this purpose mainly we use Sand natural, gravel crushed stone. The particles size distribution of the aggregate is also important because it indicates how considerably binder is needed. Aggregate with an exceedingly even size distribution has the largest gaps, contrariwise adding aggregate with smaller particles tends to fill these gaps. The binder helps to fill the gaps between the aggregate and adeptly a paste of the surface with aggregate together. The shape and texture of aggregate influence the properties of fresh concrete. We can also use recycled aggregate concrete in non-bearing structures. Such as Rural road construction, ground floor C.C, casting, sewerage pipe casting, etc.

Concrete is the most popular in Bangladesh and these are used in construction material. In fact, the most popular used artificial material on Earth is concrete it is not steel, not plastic, or not aluminum. Thousands of years ago concrete was only used to build civilization and overtime duration, the knowledge of concrete technology has advanced. Some supplementary cementing materials that are used in concrete to improve its durability and workability properties for example fly ash, slag, Rice Husk Ash, admixture, etc. Sometimes admixtures are also used in concrete because, in modern days, chemical admixtures are used in concrete when required because of the need for optimum and rapid construction.

In the present the most useful ingredients in concrete are chemical admixtures other than cement, water, or aggregate. Admixtures are added to the mix immediately before or during the concrete mixing. Admixture's primary target is to reduce the cost of concrete construction, also ensure the quality of concrete during mixing, also modify the properties of hardened concrete, placing, transporting, curing, and overcome certain emergencies during the concrete operations. Today's one of the most important ingredients is concrete admixtures because of high-performance, long-lasting, durable, and beautiful concrete produced. Concrete admixtures are actually natural chemicals or manufactured chemicals or additives chemicals. These are added during concrete mixing to enhance specific properties of the fresh or hardened concrete, such as workability, durability, or early and final strength.

1.2 Objective of the Study

The objectives of this research are as follows-

1. To observe the effect on compressive strength of concrete using admixture.

2. To observe the dissimilarity of compressive strength of concrete without admixture and concrete with an admixture in different curing duration.

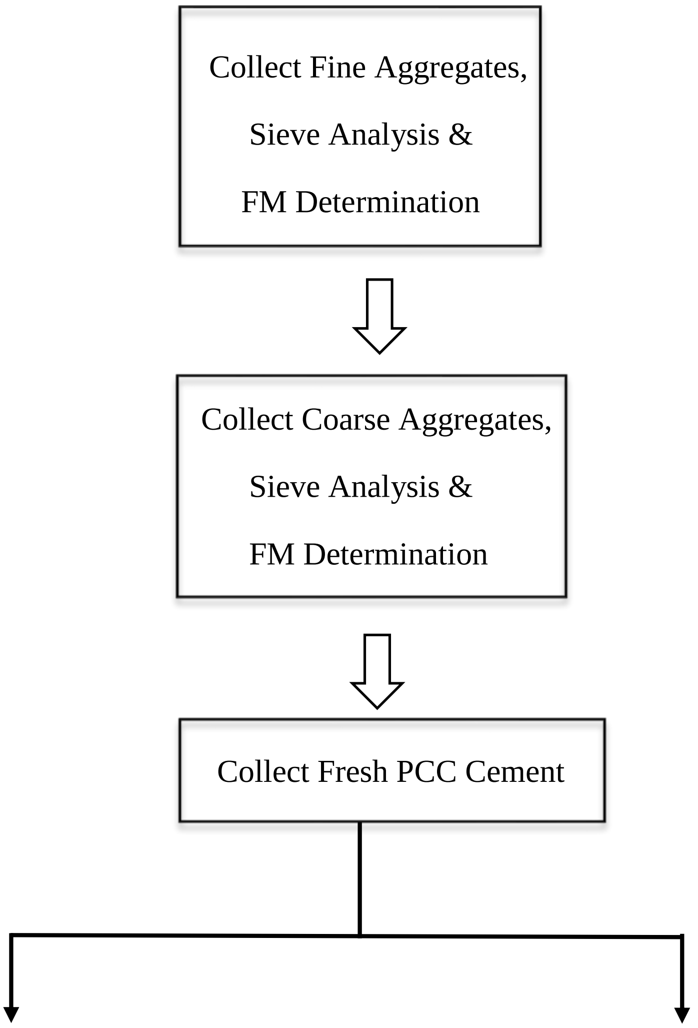
3. To observe the variation of using admixture in different types of percentages and find a suitable percentage.

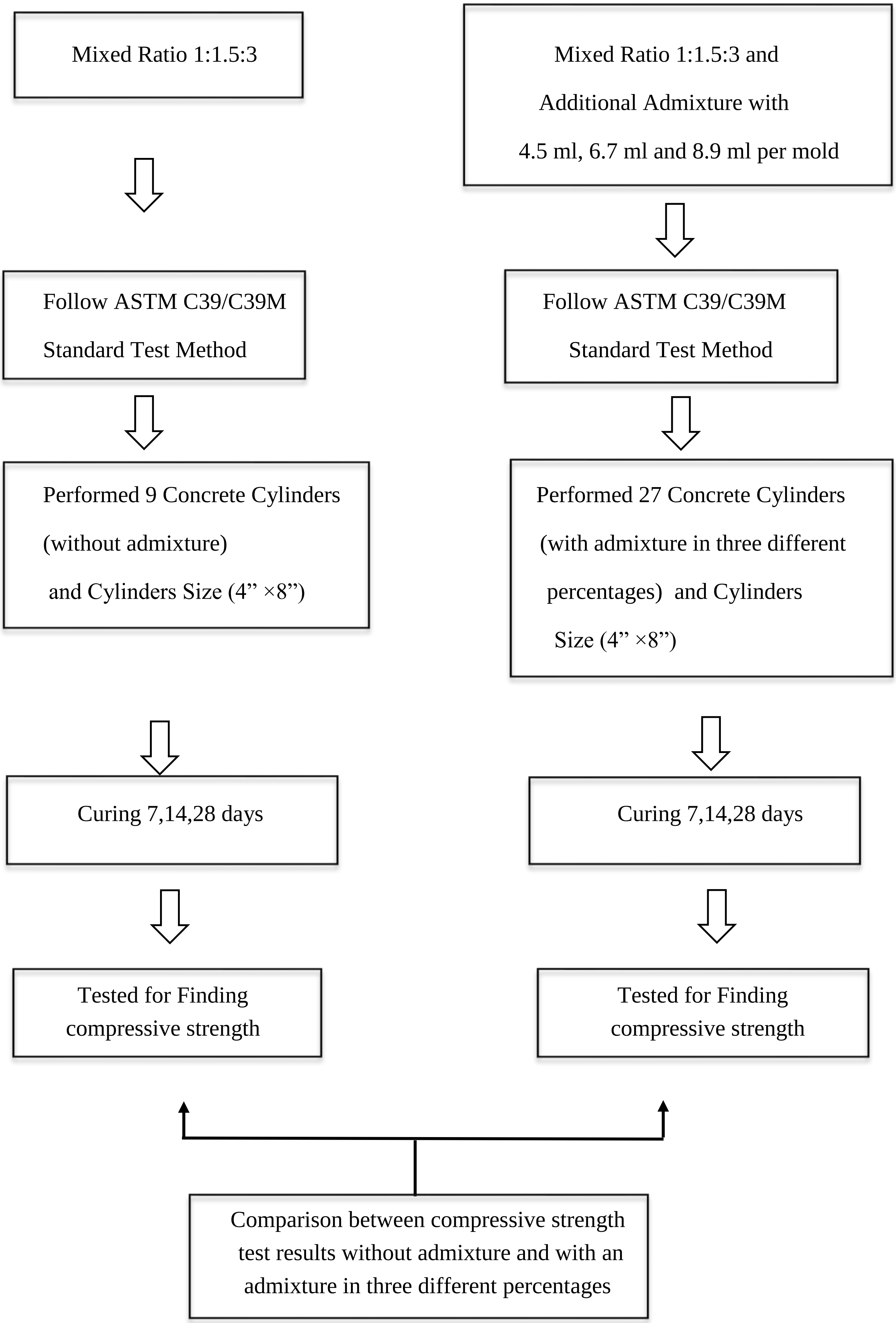
4. To determine the economical effect of using admixture in concrete for compressive strength.

1.3 Scope of the Study

- After completing our compressive strength test we know the overall strength and the above factors.
- By producing this test, we can easily determine the strength psi of the concrete and the quality of the concrete being produced.
- The Concrete Cube Test will give compressive strength of concrete which will help give an idea of all the properties of concrete.
- In this project work we are determining compressive strength using admixture or without using admixture. By this unique test, we can decide which is comfortable for construction and also decide whether the concreting was done correctly or not.

1.4 Methodology of the Study




Mixed Ratio 1:1.5:3
Mixed Ratio 1:1.5:3 and Additional Admixture with 4.5 ml, 6.7 ml and 8.9 ml per mold
Follow ASTM C39/C39M Standard Test Method
Follow ASTM C39/C39M Standard Test Method
Performed 9 Concrete Cylinders (without admixture) and Cylinders Size (4” ×8”)
Performed 27 Concrete Cylinders (with admixture in three different percentages) and Cylinders Size (4” ×8”)
Curing 7,14,28 days
Curing 7,14,28 days
Tested for Finding compressive strength
Tested for Finding compressive strength
Comparison between compressive strength test results without admixture and with an admixture in three different percentages

1.5 Outline of Thesis

Our thesis project consists of five chapters, references, and appendices.

Chapter 1 (Introduction)
This chapter contains the importance of concrete, compressive strength, aggregates, and admixture. Also, objectives of the research, scope, and the methodology of the study.

Chapter 2 (Literature Review)
Details of admixture. And a general review of previous research papers, journal papers, and thesisbooksk related to using of admixture in concrete and its effects on the properties of fresh and concrete with admixture are included.

Chapter 3 (Experimental Work)
This chapter describes the methodology followed to achieve the objectives of the study. Discuss the types of laboratory tests, standards, adopted procedures, material properties, and curing conditions.

Chapter 4 (Results and Discussion)
This chapter talks about the test results that we get from this experiment, analysis those results, and discusses the results.

Chapter 5 (Conclusion and Recommendations)
This chapter discusses the major findings of the experiment & recommendations for future work about it.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the available former studies which contract with admixture in concrete. The consequences of those admixtures on the mechanical properties of concrete were also reviewed.

2.2 Description of Admixture

Admixtures are mainly chemicals, these are added to the concrete, mortar, or grout at the time of blinding, to switch the properties, either in the wet state immediately after mixing. These may well be one chemical or a mix of several chemicals and could be supplied as powders but most are aqueous solutions because during this form they're easier to dispense into accurately, and so disperse through the concrete (Newman and Choo, 2003).

The major reasons for using admixtures are written below,

1. Target to abate the price of concrete construction.
2. Target to attain certain properties in concrete more successfully than by other means.
3. Target to take care of the standard quality of concrete during the stages of mixing, transporting, placing, and curing in adverse climate.
4. Target to beat certain extremities during concreting operations.

2.2.1 Performance of Admixtures

Admixtures work by one or more of the following activities (Newman and Choo, 2003):

1. Chemical interaction with the cement hydration process, typically causing acceleration or retardation of the rate of reaction of one or more of the cement phases.
2. Adsorption causing onto cement surfaces and also typically causes better particle dispersion (plasticizing or super-plasticizing action).

3. Affecting the surface tension of the water, typically resulting in increased air entrainment.
4. Affecting the theology of the water, and also usually resulting in an increased plastic viscosity or mixed cohesion.
5. Introducing special chemicals into the body of the hardened concrete that can affect specific properties such as corrosion susceptibility of embedded steel or water repellence.

2.2.2 Advantages of Admixtures

The advantages of using admixture are-

1. Exalted workability, as an example, Easier, quicker placing and compaction.
2. Increased strength, higher water reduction ability as an example, Provides high early strength for precast concrete.
3. Prosperous quality, as an example, Denser, close textured concrete with reduced porosity and hence more durable.
4. Advanced cohesion, as an example, Risk of segregation and bleeding minimized; thus aids pumping of concrete.

2.2.3 List of concrete Admixtures

In Design and Control of Concrete Mixtures (13th ed), Panarese and Kosmatka classify the admixtures by function and an extensive report. It can be seen below in the table.

Table 6-1. Concrete Admixtures by Classification

Type of admixture	Desired effect	Material
Accelerators (ASTM C494 and AASHTO M 194, Type C)	Accelerate setting and early-strength development	Calcium chloride (ASTM D98 and AASHTO M 144) Triethanolamine, sodium thiocyanate, calcium formate, calcium nitrite, calcium nitrate
Air detrainers	Decrease air content	Tributyl phosphate, dibutyl phthalate, octyl alcohol, water-insoluble esters of carbonic and boric acid, silicones
Air-entraining admixtures (ASTM C260 and AASHTO M 154)	Improve durability in freeze-thaw, deicer, sulfate, and alkali-reactive environments Improve workability	Salts of wood resins (Vinsol resin), some synthetic detergents, salts of sulfonated lignin, salts of petroleum acids, salts of proteinaceous material, fatty and resinous acids and their salts, alkylbenzene sulfonates, salts of sulfonated hydrocarbons
Alkali-aggregate reactivity inhibitors	Reduce alkali-aggregate reactivity expansion	Barium salts, lithium nitrate, lithium carbonate, lithium hydroxide
Antiwashout admixtures	Cohesive concrete for underwater placements	Cellulose, acrylic polymer
Bonding admixtures	Increase bond strength	Polyvinyl chloride, polyvinyl acetate, acrylics, butadiene-styrene copolymers
Coloring admixtures (ASTM C979)	Colored concrete	Modified carbon black, iron oxide, phthalocyanine, umber, chromium oxide, titanium oxide, cobalt blue
Corrosion inhibitors (ASTM C1582)	Reduce steel corrosion activity in a chloride-laden environment	Calcium nitrite, sodium nitrite, sodium benzoate, certain phosphates or fluosilicates, fluoaluminates, ester amines
Dampproofing admixtures	Retard moisture penetration into dry concrete	Soaps of calcium or ammonium stearate or oleate Butyl stearate Petroleum products
Foaming agents	Produce lightweight, foamed concrete with low density	Cationic and anionic surfactants Hydrolized protein
Fungicides, germicides, and insecticides	Inhibit or control bacterial and fungal growth	Polyhalogenated phenols Dieldrin emulsions Copper compounds
Gas formers	Cause expansion before setting	Aluminum powder
Grouting admixtures	Adjust grout properties for specific applications	See Air-entraining admixtures, Accelerators, Retarders, and Water reducers
Hydration control admixtures	Suspend and reactivate cement hydration with stabilizer and activator	Carboxylic acids Phosphorus-containing organic acid salts
Permeability reducers	Decrease permeability	Latex Calcium stearate
Pumping aids	Improve pumpability	Organic and synthetic polymers Organic flocculents Organic emulsions of paraffin, coal tar, asphalt, acrylics Bentonite and pyrogenic silicas Hydrated lime (ASTM C141)
Retarding admixtures (ASTM C494 and AASHTO M 194, Type B)	Retard setting time	Lignin Borax Sugars Tartaric acid and salts
Shrinkage reducers	Reduce drying shrinkage	Polyoxyalkylene alkyl ether Propylene glycol
Superplasticizers* (ASTM C1017, Type 1)	Increase flowability of concrete Reduce water-cement ratio	Sulfonated melamine formaldehyde condensates Sulfonated naphthalene formaldehyde condensates Lignosulfonates Polycarboxylates

Table 6-1. Concrete Admixtures by Classification (Continued)

Type of admixture	Desired effect	Material
Superplasticizer* and retarder (ASTM C1017, Type 2)	Increase flowability with retarded set Reduce water–cement ratio	See superplasticizers and also water reducers
Water reducer (ASTM C494 and AASHTO M 194, Type A)	Reduce water content at least 5%	Lignosulfonates Hydroxylated carboxylic acids Carbohydrates (Also tend to retard set so accelerator is often added)
Water reducer and accelerator (ASTM C494 and AASHTO M 194, Type E)	Reduce water content (minimum 5%) and accelerate set	See water reducer, Type A (accelerator is added)
Water reducer and retarder (ASTM C494 and AASHTO M 194, Type D)	Reduce water content (minimum 5%) and retard set	See water reducer, Type A (retarder is added)
Water reducer—high range (ASTM C494 and AASHTO M 194, Type F)	Reduce water content (minimum 12%)	See superplasticizers
Water reducer—high range—and retarder (ASTM C494 and AASHTO M 194, Type G)	Reduce water content (minimum 12%) and retard set	See superplasticizers and also water reducers
Water reducer—mid range	Reduce water content (between 6 and 12%) without retarding	Lignosulfonates Polycarboxylates

Table 2.1 Classification of concrete admixtures

2.3 Aggregate

Aggregates are the most dominant associates in concrete. Aggregates have many advantages. They give the body to the concrete, reducing shrinkage, and most importantly they affect the economy. Formerly aggregates were contemplated as a chemically inert material but now it has been observed that some of these aggregates are chemically active and also that certain aggregates have stable chemical bonds at the interface of aggregate and paste. The smallest amount of that the aggregates standing 70-80 percent of the volume of concrete, their impact on various facets and properties of concrete is clearly appreciable.

Natural aggregates are classified as

- Coarse aggregate
- Fine aggregate

2.3.1 Coarse aggregate

Coarse aggregates are larger size filler materials that are utilized in construction work. Coarse aggregate comprehensively persuasions the strength of the hardened concrete, as they constitute the foremost important feature of the branch. The coarse aggregate to be made use of making concrete should be clean, well-graded, strong, and sturdy and can be will be free from contaminants and destructive materials such as salts, coal readies, etc. Coarse aggregates are those particles that are retained on a 4.75 mm sieve.

In maximum cases, Coarse is as may well be expected occurring and should be obtained by blasting quarries or crushing them by hand or crushers. it's imperative to wash them before using them for producing concrete. Their angularity and strength affect the concrete in several ways. Needless to say, the selection of these aggregates could be an important process.

2.3.2 Fine aggregate

Fine aggregates are effectively any natural sand particles obtained from the land via the mining process. Fine aggregates are smaller size filler materials in construction project. It is the combination most of which passes through a 4.75 mm sieve and contains only 0.075 mm sieve that much coarser material as is allowable by the specifications. fine aggregate in concrete used as Sand, surki, stone screenings, burnt clays, cinders, fly ash, etc. Fine aggregates are used many purpose like as mortar, plaster, concrete, filling of road pavement layers, etc.

2.4 Literature Review

Salim Rawther (2018): The author was investigated using mineral admixtures are the supplementary cementing materials used in the production of concrete. He used mineral admixtures silica fume, silica fume is an industrial byproduct he thoroughly used this admixture in normal concrete simultaneously ready-mixed concrete. He used M40 concrete grade and the amount of admixture silica fume percentages is added of 0%, 5%, 10%, 15%, and 20% to the mix at the rate of the cement content. In this study from the result, we can see the strength parameters of the concrete using the silica fume and normal concrete without using the silica fume results were not the same. From the findings, it is noticed that concrete with using 10-25% amalgamation of silica fume to the concrete mix has better strength features than normal concrete without using the silica fume content.

Amudhavalli and Jeena (2012): They have investigated the effect of using admixture silica fume and audited the compressive strength and durability parameters of concrete. In this practice, they replaced of silica fume at 7 and 28-days curing they find out the compressive strength and flexural strength that is attained in the limit of 10-15% level. They have also seen 10 % of silica fume replacement increase in tensile strength and up to the 15 % replacements, which is almost inconsequential whereas augmentations in flexural tensile strength have occurred even.

Kanchan Mala et al (2013): They have also studied mineral admixtures fly ash and silica fume on strength of concrete with a ternary cement blend and found the effect of comparative levels. From the research, they used in concrete with a combination of 10% silica fume and 10% fly ash found that using a ternary blend of they used fly ash and silica fume, using 20% replacement level of OPC it gives higher strength than control mix for all water to binder ratios and at all ages.

Ashfi and Harjinder (2015): They have practiced characteristics of high-strength concrete of mineral admixtures. They replaced materials like fly ash, blast furnace, slag, and silica fume and have been found that the maximal suitable for making high-strength concrete. they also noticed that the effect of addition silica fume to concrete pointers to improvement in compressive strength and split tensile strength of concrete at all ages. The result is progressing the workability up to a replacement level of 30 % as they are used fly ash and slag as the replacement for cement

Kim et al (2015): They have investigated mineral admixture on the concrete because of the development of compressive strength and the effect of using this. For this experiment purpose, they have used ground granulated blast furnace slag or silica fume mineral admixtures of concrete and detected the containing exhibited adequate compressive strengths at 91 days.

Salim et al (2018): They have conducted studies on the mineral admixture of concrete made with pulverized used foundry sand and they find the mechanical properties of this. It is indicated that the addition of pulverized used foundry sand raises the strength parameters when pulverized used foundry sand is added at 10-15% of the cement content. The result is shown improving strength of concrete.

EnesEkinci et.al. in (2019): They are studied various properties of volcanic tuff-based GPC (Geopolymer Concrete). An admixture containing Nano and micro-silica in different ratios was prepared. An alkaline solution of NaOH & Na2SiO3 with sole NaOH was added while mixing. After curing for 28 days various tests were conducted. Finally, it was concluded that compressive strength is more in the case of alkaline solution with sole NaOH. Doing this experiment alkaline solution with activated NAOH also gives better results for bulk density, water absorption tests.

FarhadAslani et.al. in (2019): They are studied heavy-weight GPC (Geopolymer Concrete) which possesses properties of both heavyweight concrete and GPC. Normal weighted coarse aggregates were replaced by heavy-weight magnetite aggregates of GPC (Geopolymer Concrete) and the ratio was 50%, 75%, and 100%. Ambient curing was provided and it was concluded that upon raising the temperature from 1000 c to 3000 c, the compressive strength increases, and at 6000 c to 9000 c there is the destruction of the cellular structure of GPC (Geopolymer Concrete), and that results in dehydration damage, dimensional instability, and sintering.

Yifeng Ling et.al. in (2019): They are investigated various properties of Fly Ash that are based on GPC (Geopolymer Concrete) with or without the addition of the shrinkage material. Two solutions were made and compared one of these is portable cement and another one is Fly Ash GPC (Geopolymer Concrete). A liquid to binder ratio of 0.33 was added to them before mixing. Doing this experiment Fly Ash Geopolymer paste shows low cracking tendency than Portable Cement paste. Drying shrinkage increased with a decrease in module and increase in concentration.

Mohammed Farooq et.al. (2019): They are studied the tensile properties of eco-friendly ductile GPC (Geopolymer Concrete) with microfibers. Microfibers like Poly Vinyl Alcohol (PVA), High Strength Steel (HSS), Poly Propylene (PP), and Chopped Steel Wool (CSW) in the volume fraction of 1%, 2%, and 3% were added and finally investigated. As an important activator alkaline solution of NaOH & Na2SiO3 was added before mixing. And the result was High Strength Steel (HSS) fiber affects compressive strength considerably but has the least effect on workability. In the case of Poly Propylene (PP) fiber, compressive strength remained as it is and Chopped Steel Wool (CSW) fiber also shows notable results for compressive strength. For tensile strength, Poly Vinyl Alcohol (PVA) and HSA fiber respond well in terms of pseudo strain hardening and Poly Propylene (PP) fiber shows low post-crack tensile strength, and CSW fiber did not give better results.

AissaBouaissi et.al. in (2019): They are studied the mechanical behavior of GGBS (Ground Granulated Blast Furnace Slag), FA, and HMNS (High-Magnesium Nickel Slag) composed GPC (Geopolymer Concrete). FA was replaced by 20% GGBS and 10% HMNS. As a result, after curing of 28 days there is a 100% increase in compressive strength and 58% increase in tensile strength.

RadhwanAlzeebaree et.al. in (2019): They are studied the properties of GPC (Geopolymer Concrete) under static loading and cyclic loadings of H_2SO_4. GPC was wrapped with a layer of Blast or Carbon fiber reinforced polymers. It was noticed that this layering enhances its deductibility, strength, and durability properties and three layers of wrapping give considerable results.

Sanghamitra Jena et.al. in (2019): They are studied the properties of GPC (Geopolymer Concrete) composed of Fly Ash affected by the adding of 14 molar silica fumes. According to the experiment results, the concluded compressive strength of GPC (Geopolymer Concrete) is raised to 20 to 38 Mpa and a maximum of 48 Mpa.

AslamHutagi& R. B. Khadiranaikar (2019): They are presented their work to study admixture of GPC (Geopolymer Concrete) contained 60-100% Fly Ash, 0-40% GGBFS (Ground granulated blast-furnace slag) cured under ambient conditions for 3,7, and 28 days. It was evaluated that increase in curing time results in an increase in compressive, split tensile, and also flexural strength.

JianheXie et.al. in (2019): They are presented their work by considering an admixture of alkali-activated GGBS (Ground Granulated Blast Furnace Slag) and Fly Ash with recycled aggregates composed of GPC. The authors conclude that the combination of GGBS & Fly Ash affects the workability of GPC, less than 25% content of GGBS shows the consistent effect on compressive strength with GRAC (Green Recycled Aggregate Concrete) and 50% GGBS and Fly Ash with GRAC produce excellent results for workability and also compressive strength.

Rashik Mustafa et.al. in (2019): They are investigated the properties of GPC composed of Fly Ash and collect mortar from natural sand as fine aggregates and various additives like GGBS (Ground Granulated Blast Furnace Slag), micro silica, and lime dust were added in the ratio of 5%, 10%, and 15% by weight of Fly Ash. 10M alkaline solution of 2.5:1 by weight was added while mixing. As a result, It was noticed that compressive strength is affected by the type of additive used.

ShimaPilehvar et.al. (**2018):** They are studied the effect on properties of Geopolymer Concrete (GPC) by adding Micro Encapsulated Phase Change Materials (MPCM) to its mixture. Class F Fly Ash, slag, and alkaline solution along with two types of MPCM were here used. The addition of MPCM increases initial setting time & also shortens final setting time. As a result, Compressive and slum strength was decreased by the addition of MPCM but higher than Portland cement.

Sandep L. Hake et.al. in (2018): They are Studied the properties of GPC composed of Fly Ash & lime powder. M30 grade geopolymer concrete was constructed. As lime powder gives the better results without any heat curing. According to the results, there is an increase in compressive strength upon an increase in lime powder content from 5% to 10%.

B. Sri Umniati et.al. (**2017):** They are investigated the workability of Geopolymer Concrete (GPC) the by addition of retarder as an admixture element. The mix design contained Class F fly ash, alkaline solution for activation, sand fine aggregates, and split stone coarse aggregates. As additive type D water-reducing pastorate admixture RT6 plus was used. Ratio of the retarder used was 05, 0,2%, 0.4%, and 0.6%. the results revealed that the addition of retarder admixture initially affect the initial setting time by increasing it. The use of retarder gives high workability and does not give a satisfying result in the case of compressive strength.

Muhammad N.S. Hadi et.al. in (2017): They are designed of Geopolymer Concrete (GPC) by taking Ground Granulated Blast Furnace Slag (GGBFS) as a specimen and using the Taguchi method under ambient curing. As a replacement material Fly Ash (FA), Metakaolin (MK), and Silica Fume (SF) were used in various proportions. As a result, polymerization reaction delays due to a decrease in calcium content of aluminosilicate taken as source material that causes a delay in the foundation of the amorphous structure of Ca-Al-Si gel. Also, the compressive strength decreased by the decrease in calcium content of the specimen.

Rasoulshadnia et.al. in (2017): They are performed an experimental study on the formation of GPC using class Fly Ash and slag with lesser calcium value added in different proportions. They are used 10M alkaline solution and varying its concentration from 7.5M to 15M. It is revealed that an increase in the percentage of slag increases the compressive strength.

S. Jaydeep et.al. in (2017): They are presented their work on Fly Ash-based of Geopolymer Concrete (GPC) with different admixtures. In this experiment prepared cubical blocks of 50*50*50 and used superplasticizer admixture, fine aggregates, coarse aggregates, and alkaline solution. Under different temperature conditions and molarity, a compressive strength test was conducted and revealed that they are directly proportional and oven air curing gives high compressive strength than that of direct sunlight.

V. Supraja et.al. in (2017): They are Studied the effect of molarity of alkaline solution on Geopolymer Concrete (GPC) and Ground granulated blast-furnace slag (GGBFS) taken as a specimen. The ratio was taken 0.30 of GGBFS. Alkaline solution molarity varied from 3M to 9M. Curing situations chosen were "one is heating at 60°C for 24 hr. and another one using sunlight". These different curing situations and molarities are taken for the compressive strength test and revealed that strength and molarity are directly proportional.

Pradeep kumar et.al (2017): They are presented their novel work on studying the strength properties of Geopolymer Concrete (GPC) constructed using M-Sand. For alumina silicate material Fly ash was chosen and an alkaline solution as an activator was used. It was revealed that compressive strength increases by 4.08% and 9.51% for 5M and 10M respectively and hydration also reduced upon replacing M-sand. There was also an increase in split tensile strength by 9.2% and 4.5% for 5M and 10M respectively.

K. Arulpriya in (2016): They are present her novel work by studying Geopolymer Concrete (GPC) constructed using M-Sand and Fly Ash. Strength & durability properties were concluded. The casting of specimens was done by taking an alkaline solution with molarities 10M & 20M. It was revealed that the workability of GPC constructed using M-Sand is more than constructed using river sand. As a result, compressive strength is also higher than normal concrete i.e. 23.78%. it was also concluded that MSand GPC is more resistant to sulfate attack than the normal one.

K.SuryaTeja et.al. in (2016): They are studied GGBFS properties used as a binder. For activation of a mixture, an alkaline solution is used having varying molarity 8M to 10M. It was revealed that molarity and compressive strength are directly proportional but not in the case of flexural strength.

A. Iftiqar Ahmed et.al. in (2016): They are presented their work on studying Geopolymer Concrete (GPC) properties by taking with Fly Ash with different admixtures as construction material. As Fly Ash is rich in alumina silicate and used for the GPC synthesis process. 65% of total volume was taken as aggregate volume. An alkaline solution having varying molarity as 8M, 12M, 16M was taken as an activator. For curing oven and sunlight were used. The results revealed that for both the curing temperature supposed compressive strength of GPC and molarity are directly proportional.

Prakash R. Vord et.al. in (2016): They propound their work by studying parametric studies of GPC. For the admixture class, F Fly Ash was used. Two solution mixtures were taken one having of fly ash to the alkaline solution is 0.35 and another having ratio of 0.4. 8M, 10M, 12M, 14M are different varying molarities of the alkaline solution was taken. After experimentation, it was concluded that compressive strength and molarity are directly proportional.

Rohan Badhane et.al. (**2016):** They are Presented their work on admixtures used for the construction of GPC. The authors used fine aggregates, Fly Ash, coarse aggregates, and different admixtures like plasticizers, retarders, accelerators, and superplasticizers as materials. M30 grade 150*150*150 square cubes were cast. Two types of curing one of the ovens for 18 hours and another of 7- days & 28-days curing was conducted. It was confined that compressive strength of GPC at 7- days & 28-days curing did not give results as compared to oven curing of 18 hours.

Lorenza Carabba et.al. in (2016): They are presented their work by studying the effect of the addition of superplasticizer activated at room temperature on Carbon Fly Ash constructed GPC. Plasticizers like SMF, PCE, ACRa, and ACRb were used in forming admixtures. The results at lasts conclude that there is the satisfying effect of these admixture superplasticizers for GPC and produce efficient workability.

Triwulan et.al. in (2016): They are studied the effect of the addition of superplasticizer to Geopolymer Concrete (GPC). A naphthalene-based superplasticizer was used and its ratio was varied concerning Fly Ash from 1.5 to 3. It was checked that when the ratio of alkaline solution to superplasticizer was 2: 1.5 then maximum compressive strength was achieved. found out. And highest tensile was achieved at a 2.5: 1.5 ratio and the average density concluded was 2400 kg/m3.

Gaurav Nagalia et.al. in (2016): They are proposed their work in investigating the properties of GPC composed of Fly Ash. The manufactured geopolymer was composed of a mixture of Class C & F Fly Ash having 9.42% & 1.29% of CaO respectively. According to revealed results, NaOH alkali solution produces high activation and upon varying its molarity to 8, 12, AND 14M resulted in the conclusion that molarity and compressive strength are directly proportional.

In Rashidah Mohamed Hamidi et.al. (2016): They are investigated GPC composed of Fly Ashaffectedd by the concentration of NaOH. As an activator mixture alkaline solution was used. 600C temperature was chosen for curing of one day. 4M to 18M molarity of NaOH was varied. Flexural strength was investigated and SEM and FTIR (Fourier transform infrared spectroscopy) tests for the investigation of microstructure properties were carried out. It was noticed NaOH solution having molarity of 12M gives good results.

T G Usha et.al. in (2015): They have studied the effect of different admixtures on the performance of self-sustaining GPC. Admixtures like slump, l-box, u-box &T50 were used. GGBS & silica fume was replaced by 10%, 20%, 30%, and 5%, 10%, 15% respectively for Fly Ash. It was confined that mechanical properties give significant results & 6% of plasticizers were required to attain the required fluidity.

Pattanapong et.al. in (2015): They have studied GPC constructed using Fly Ash. Setting time, bonding of high calcium Fly Ash, and its strength properties were carried out. 0.5 ratio of alkaline solution to Fly Ash was taken. Results showed that the setting time of GPC decreases with an increase in calcium content of Fly Ash. And it was also concluded that compressive strength and bond in between bar increases with an increase in calcium content.

Du Haiyan et.al. in (2015): They have considered GPC manufactured using Fly Ash produced by two manners of using wet and dry bottom boilers. An alkaline solution as an activator was used in this experiment. The authors conclude that both boilers tend to have the same compressive strength. But in the case of hardening properties mixture of wet bottom boiler hardened more quickly than of dry bottom boiler. Fly Ash specimens of wet bottom boiler have less shrinkage and high early-age strength than wet bottom boiler specimens.

CHAPTER 3

METHODOLOGY

3.1 General

This chapter was describing the details of the raw materials that we are used in our project purpose, the preparation of samples, and the standard experimental tests operated in this investigation.

3.2 Materials

All materials we are collecting on our university campus. Collecting all of this Mr. Azaz Ahmed helps a lot. He is an Assistant Director of Planning and Development at Daffodil International University.

3.2.1 Cement

One type of cement was used for the experiment for the whole experimental investigation which is Portland composite cement (PCC).

Figure 3.1: Portland Composite Cement (PCC).

3.2.2 Fine Aggregate

One type of sand that has been used for our project work, which is Sylhet Sand. This sample of fine aggregate has been collected from our university campus.

Figure 3.2: Fine Aggregate (Sylhet sand)

3.2.3 Coarse Aggregate

Only one type of Stone chips has been used as coarse aggregate. This sample of fine aggregate has been collected from our university campus.

Figure 3.3: Course Aggregates

3.2.4 Water

Water is very important in concrete mixing. In our experiment we use normal water.

3.2.5 Admixture

In this project our main aim is to observe the comparison of compressive strength between using admixture and without admixture. We used here Water Reducing & Plasticizer Admixture.

There are some advantages of using this admixture for example,

- Increase the workability and helps to freeze quickly.
- Reduce concrete bleeding and segregation.
- Reduce the void and porosity and help to gain strength quickly.
- Simplify the concrete finishing.
- Reduce the hit of hydration for casting high thickness concrete.

Figure 3.4: Water Reducing & Plasticizer Admixture.

3.3 Property Tests of Aggregate

The major tests have been done for both coarse aggregate and fine aggregate. The tests are following

3.3.1 Sieve analysis of fine aggregate

This test method conforms to the ASTM standard requirements of specification.

Apparatus

1. Balance: Sensitive to within 0.1% of the weight of the sample.

2. Sieves: ASTM method.

Sampling

Sieve analysis of fine aggregate has been performed according to ASTM C 136/C (2004) standard specification. The procedure is as follows:

Procedure: (Fine Aggregate)

Step 1: We are taken a 500gm sample of fine aggregate (as per ASTM standard specification, the combination of aggregate must be fully dry). This can be determined by importing the material on a digital scale. Also, we have noted the weight of each sieve of the mechanical sifter, also the pan, and recorded the weights.

Step 2: Place the combination of aggregate within the top sieve of the wall-gutted mechanical sifter (here sieves used are #4, #8, #16, #30, #50 & #100). This outfit is employed for shaking the aggregates (similar to the principle employed in a paint-mixing machine) & sieving them. The mechanical sifter incorporates a bottom pan (to receive the material passing #100 sieve) and a lid to shut the sifter during the test. After placing the lid it takes about 10-20 minutes on the sifter to agitate the sifter.

Step 3: Determine the total weight of aggregates that are retained in each of the sieves, by weighting individually the sieves (along with the retained aggregates) and subtracting the burden of every sieve. Also, we are recorded all the weights of aggregates retained in individually of the sieves. To make sure that each one materials are collected, clean each sieve precisely using the proper type brush for the coarse sieves. Also corroborate whether the summation of weights of all aggregates, retained in all the sieves, and also the bottom pan is equal to the original weight of the aggregates taken.

Step 4: Systemize the data & determine the percent retained in individually sieves. From these values calculate the (cumulative) percentage of material that might are retained within the sieve if the full volume of material was to be sifted in this sieve alone. Also add the proportion of material retained all told the sieves and divided by 100 to urge the fineness modulus. Also prepare a column to see the cumulative percentage passing through the sieve to plot the fineness modulus curve (as laid out in CSA 23.1).

Step 5: And finally calculated the fineness modulus, the sum of the cumulative percentages retained on a surely specified set of sieves must be determined, and also the results are divided by100. The sieves specified for the determination of fineness modulus are No. #100, #50, #30, #16, #8, #4.

3.3.2 Sieve Analysis of Coarse Aggregate

Sieve analysis of coarse aggregate has been performed according to ASTM C 136/C (2004) standard specification for gradation. The procedure is as follows:

Procedure (Coarse aggregate)

Step 1: We're taken a 1500gm material of coarse aggregates and weighing them on a digital scale. We're taken the weight of each of the clean sieves together with the bottom pan and recorded their weights.

Step 2: We're Placed the aggregates within the mechanical sifter (sieve sizes used are #3/4", #3/8", #4, #8 & #16). This outfit is employed for shaking the materials (similar to the principle of a paint-mixing machine and sieving it.

Step 3: Determine the aggregates that are retained in each individual sieve as mentioned earlier in Part-I, and record the data. To ensure that all materials ate collected use the steel brush to clean each sieve.

Step 4: Tabulate the data and determine the percent retained, and the percentage that would have been retained in each sieve, if that sieve alone was used to sieve the whole volume. The fineness modulus is obtained by adding the percentage of material retained in all the sieves and dividing it by 100. To calculate the fineness modulus, the sum of the cumulative percentages retained on a definitely specified set of sieves needs to be determined, and the result is then divided by100.

Figure-3.5: Sieve Analysis Testing Apparatus

3.4 Procedures of Making Concrete Cylinder

Type of Concrete	Mixing Ratio	No. of Specimen	Name of Specimen	W/C Ratio	Admixture (ml)	Water (lit.)	Cement (kg)	Coarse Aggr. (kg)	Fine Aggr. (kg)
Without admixture	**1:2:3**	**9**	**Cylinder**	0.48	0	4.32	9.9	27.9	14.94
With admixture	**1:2:3**	**9**	**Cylinder**	0.48	40	4.32	9.9	27.9	14.94
With admixture	**1:2:3**	**9**	**Cylinder**	0.48	60	4.32	9.9	27.9	14.94
With admixture	**1:2:3**	**9**	**Cylinder**	0.48	80	4.32	9.9	27.9	14.94

Table 3.3 Estimation of Materials

3.4.1 Mold Preparation

Standard concrete specimen mold ware prepared according to ASTM standard C470.

In this study cylindrical molds ($4'' \times 8''$) has been used. Number of testing period is nine and types of samples are four. Thus total number of cylinder is 36 Nos.

The cylinder molds were cleaned properly and a coat of lubrication oil was applied on the inner surface of mold. But no excess oil was visible on inner surface.

Figure-3.6: Preparation of Mold

3.5 Concrete mixing

We mixed the concrete by hand following the Steps of mixing concrete.

Step 1: Spread a plastic sheet on the ground

Step 2: The mix design has been conducted dry condition.

Step 3: The mix design has been prepared according to the ratio of 1:1.5:3.

Step 4: We used 3/4" down grade aggregate.

Step 5: According to the ratio amount of CA, FA, Cement and Water are measured in the weighting machine.

Step 6: Placed the stone and sand into a pile on the sheet.

Step 7: Placed the cement on top of the pile of sand and stone.

Step 8: Admixture has been used 200, 300 ml and 400 ml ml per bag (50kg) cement.

Figure 3.7: Mixing concrete (Mixing by hand)

3.6 Slump test:

Slump value of concrete (PCC) with different amount of Water Reducing & Plasticizer Admixture.

Slump	At 0 min
Normal concrete (Without admixture)	83 mm
Concrete with admixture (200 ml)	97.5 mm
Concrete with admixture (300 ml)	115.5 mm
Concrete with admixture (400 ml)	125 mm

Table 3.3: Slump value of concrete

3.7 Casting

Step 1: We used molds for casting concrete which is 4" in diameter and 8" in height.

Step 2: The mold carries this concrete except for any leakage.

Step 3: First prepared the mold and before placing the concrete mix within the mold, the interior of the mold is completely greased to simplify easy removal of the hardened cylinder.

Step 4: The mixed concrete is placed into the molds in 3 layers and compacted with tamping rod 30 in number.

Step 5: The top of the mold was leveled off with the steel float & cleaned if any concrete from around the mold & the mold were left undisturbed for 24 hours.

Step 6: Compaction surpassed the underlying layers allowing the bulk of the air voids to flee.

Figure 3.8: Molds for concrete casting

Figure 3.9: Casted Concrete in molds

3.9 Opening of Molds

After 24±1 hours the specimen was removed from the mold. The concrete cylinder was still weak at this stage so handled carefully and the specimen was removed from mold. Just after removal from mold the specimen was put straight into a tank of clean water. The specimen was fully submerged under water.

Figure-3.12: Opening Cylinder Specimen from Molds

3.8 Curing

- Removed the specimen was from the mold After 24 hours of casting.
- Kept all the samples submerged under the normal water at 27 degrees Celsius.
- The specimen was kept for 7days, 14days, and 28 days.
- Every 7 days the water was changed.
- Removed the specimen from the water 60 min before to the test.
- Before conducting the testing, the specimen was in dry condition.

Figure 3.10: Curing of cylinder molds

Figure 3.11: Replacing the water at Curing

3.10 Compressive strength test of concrete cylinder

Compressive strength is often used as the crucial index of concrete quality. It's the capacity of concrete to repel axially director pushing load. Compressive strength may be a measure of the rate of strength gained with the age of concrete. This test method conforms to ASTM standard requirements of specification C39.

The test has been made within a short time after the removal from the storage tank. Two bearings blocks were used at the top and bottom of the cylindrical concrete specimen to confirm uniform seating. Here, applying continuous load and determining the compressive strength of concrete cylinders by over the cylinder until failure occu**rs.**

Then compressive strength is calculated by dividing maximum load (P) by cross-sectional area (A) of the specimen.

Compressive strength of concrete = P/A

3.10.1 Apparatus

The apparatus required is mentioned below:

1. Universal testing machine.

2. Cylinder mold of 4 inch diameter and 8 inch height.

3. Weight balance.

Figure 3.13: Universal Testing

Figure 3.15: Cylinder mold of 4 in x 8 in

Figure 3.16: Weighing balance (kg)

Figure 3.17: Weighing balance

3.10.2 Procedure for Concrete Cylinder Test

1. Cast concrete cylinder for standard size 4’’/8’’ and allowed to cure for 7,14, and28 days. All specimens are casting the indentical dimension for testing.

2. Collected all the samples from the curing tank.

3. Done in the residual water from the surface of all samples.

4. Placed all the samples vertically on the compression testing machine (UTM).

5. Before applying the load, verified that the loading platforms touch the the highest top of cylinder.

6. Applied the load continuously and uniformly. And continued the loading until the instance fails.

7. Taken the maximum load.

8. Repeated for the remaining samples as well.

Figure 3.18: compressive strength test of cylinder mold

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

The result of the experiment and other tests done in this study are presented in this chapter along with the analysis of different findings.

4.2 Fineness Modules (FM)

4.2.1 Sieve Analysis for Coarse Aggregate (Stone Chips)

Sieve No.	**Sieve Size**	**Weight of Retained**	**Percentage Retained (%)**	**Cumulative Percentage Retained (%)**	**Percentage Finer (%)**
	(mm)	**(gm)**			
3/4"	19	381	25.4	25.4	74.6
3/8"	9.5	612	40.8	66.2	33.8
#4	4.75	331	22.07	88.27	11.73
#8	2.36	140	9.33	97.6	2.4
#16	1.19	29	1.93	99.53	0.47
#30	0.59	7	0.47	100	0
#50	0.3	0	0	100	0
#100	0.15	0	0	100	0
Pan					
Total		1500		677	

Table 4.1: Sieve Analysis for Coarse Aggregate (Stone Chips)

Fineness Modulus, F.M = $\frac{677}{100}$ = **6.77**

The standard value of Fineness Modulus for coarse aggregate is **6.75-8.0**

We found Fineness Modulus for coarse aggregate is **6.77**, which is maintain the standard limit.

4.2.2 Sieve Analysis for Fine Aggregate (Sylhet Sand)

Sieve No.	Sieve Size	Weight of Retained	Percentage Retained (%)	Cumulative Percentage Retained (%)	Percentage Finer (%)
	(mm)	**(gm)**			
#4	4.75	5.86	1.172	1.172	98.828
#8	2.36	9.69	1.938	3.11	96.89
#16	1.19	56.57	11.314	14.424	85.576
#30	0.59	196.26	39.252	53.676	46.324
#50	0.3	196.69	39.338	93.014	6.986
#100	0.15	29.97	5.994	99.008	0.992
Pan		4.96	0.992		
Total		500		264.404	

Table 4.2: Sieve Analysis for Fine Aggregate (Sylhet Sand)

Fineness Modulus, F.M = $\frac{264.404}{100}$ = **2.64**

The standard value of Fineness Modulus for fine aggregate is **2 - 4**

We found Fineness Modulus for coarse aggregate is **2.64**, which is under the standard limit.

And our sample type is medium sand (medium sand = 2.6 to 2.9)

4.3 Graphical Presentation of Sieve Analysis

4.3.1 Graphical Presentation of Sieve Analysis for Coarse Aggregate (Stone Chips)

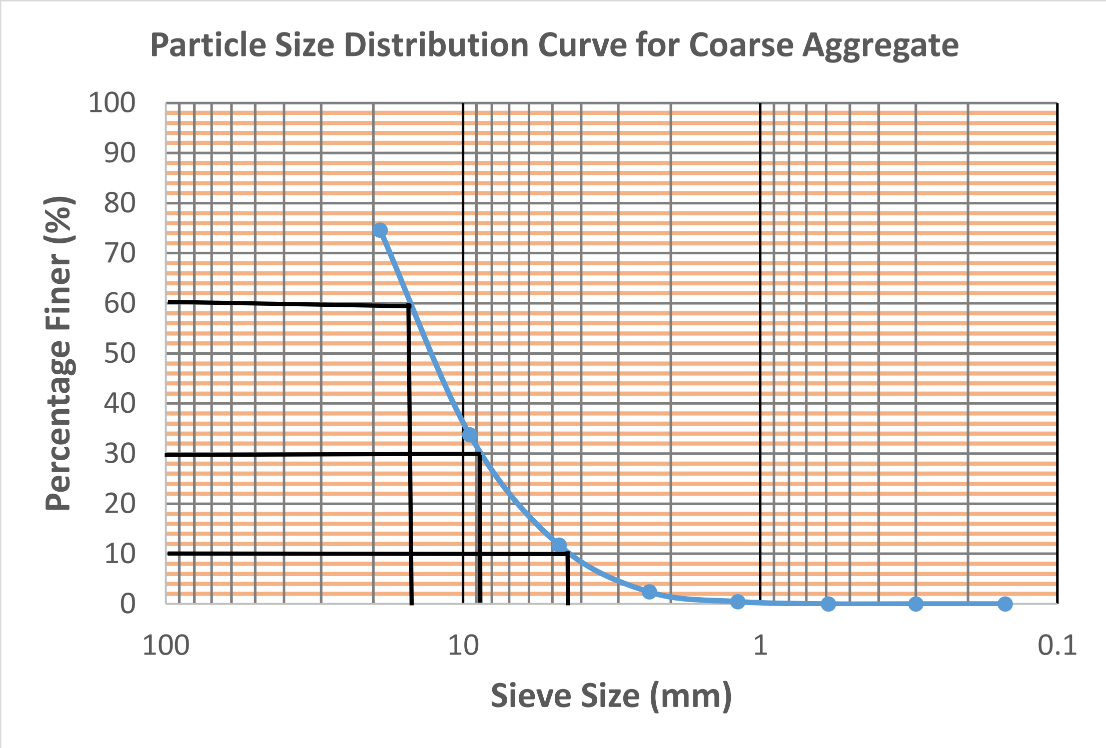


Figure-4.1: Particle Size Distribution Curve for Coarse Aggregate (Stone Chips)

D10 = 4.6 mm

D30 = 9.4 mm

D60 = 16.5 mm

$$\text{Cu} = \frac{D60}{D10} = \frac{16.5}{4.6} = 3.6 \text{ mm}$$

$$\text{Cc} = \frac{D30^2}{D60*D10} = \frac{9.4^2}{16.5*4.6} = 1.2 \text{ mm}$$

4.3.2 Graphical Presentation of Sieve Analysis for Fine Aggregate (Sylhet Sand)

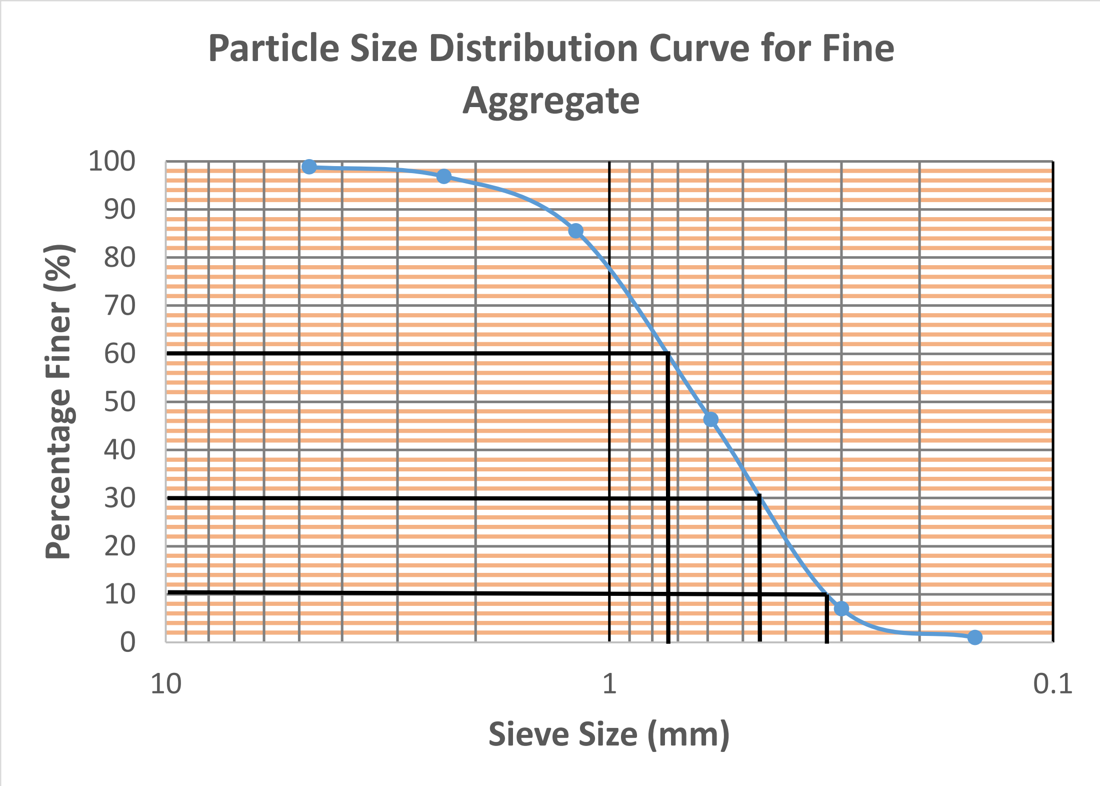


Figure-4.2: Particle Size Distribution Curve for Fine Aggregate (Sylhet Sand)

From graph,

#D10 = 0.32 mm

#D30 = 0.47 mm

#D60 = 0.72 mm

#Cu = $\frac{D60}{D10} = \frac{0.72}{0.32}$ = **2.25 mm**

#Cc = $\frac{D30^2}{D60*D10} = \frac{0.47^2}{0.72*0.32}$ = **0.96 mm**

4.4 Compressive Strength Test Result

4.4.1 Compressive Strength of Normal Concrete

Curing Duration days	Specimen No.	Crushing Strength			
		(kn)	Ib	Psi	Average
	1	120	26977	2146	2063
7	2	114	25628	2039	
	3	112	25179	2003	
	1	158	35520	2826	2748
14	2	148	33272	2647	
	3	155	34846	2772	
	1	180	40466	3219	3219
28	2	182	40915	3255	
	3	178	40016	3183	

Table 4.3: Compressive Strength of Normal Concrete

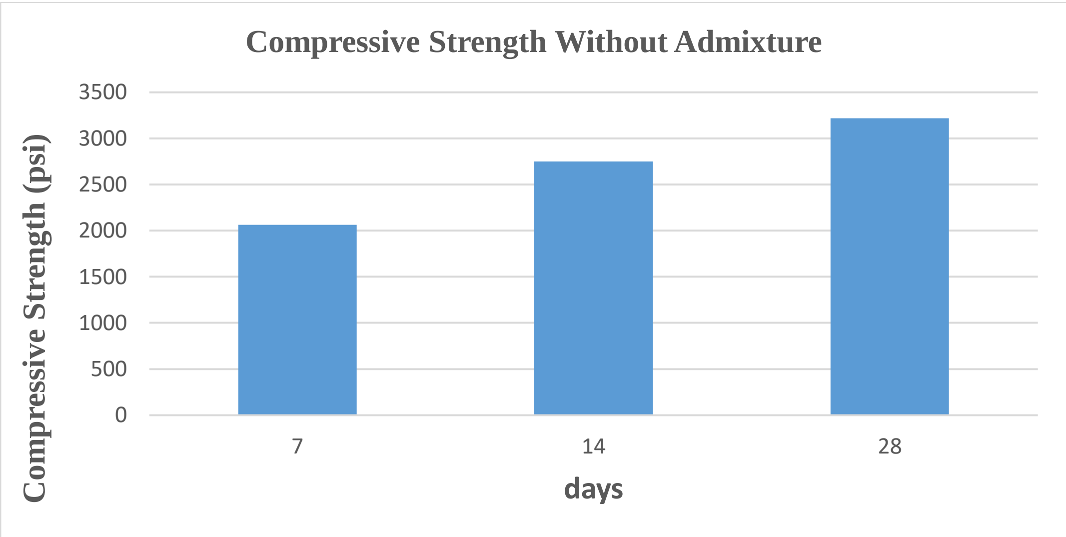


Figure-4.3: Graphical Representation of Normal Concrete

4.4.2 Compressive Strength of Concrete with 4.5 ml Admixture

Curing Duration days	Specimen No.	Crushing Strength (kn)	Ib	Psi	Average
	1	132	29675	2361	
7	2	132	29675	2361	2379
	3	135	30349	2414	
	1	168	37768	3005	
14	2	165	37094	2951	2969
	3	165	37094	2951	
	1	185	41590	3309	
28	2	188	42264	3362	3356
	3	190	42714	3398	

Table 4.4: Compressive Strength of Concrete with 4.5 ml Admixture

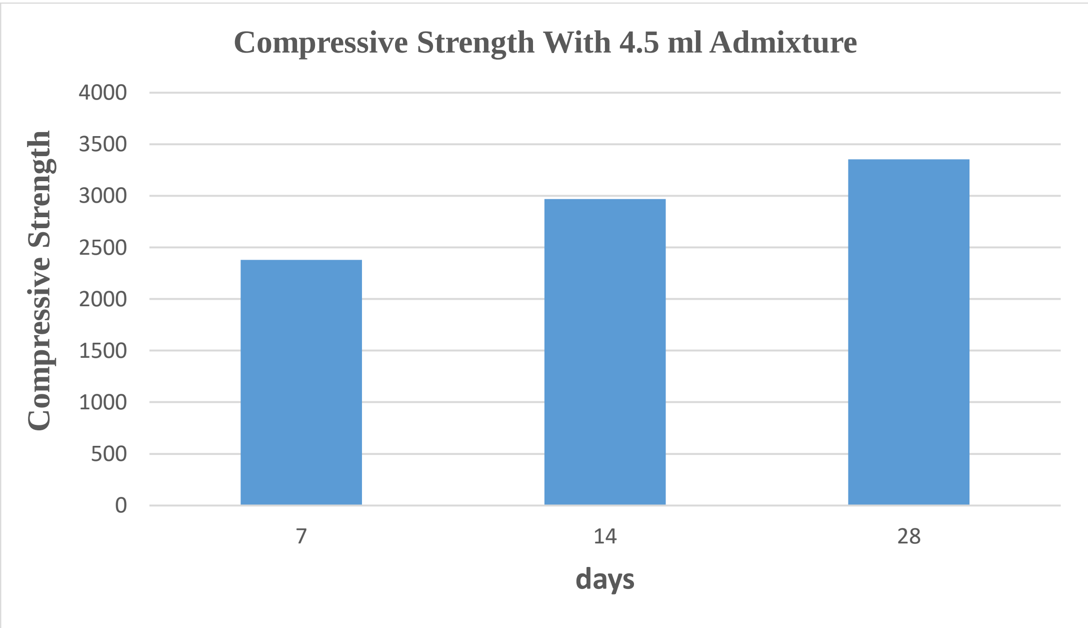


Figure-4.4: Graphical Representation of Concrete with 4.5 ml Admixture

4.4.3 Compressive Strength of Concrete with 6.7 ml Admixture

Curing Duration days	Specimen No.	Crushing Strength			
		(kn)	Ib	Psi	Average
	1	157	35295	2808	
7	2	146	32822	2611	2713
	3	152	34171	2718	
	1	180	40466	3219	
14	2	180	40466	3219	3195
	3	176	39567	3148	
	1	195	43838	3488	
28	2	200	44962	3577	3559
	3	202	45412	3613	

Table 4.5: Compressive Strength of Concrete with 6.7 ml Admixture

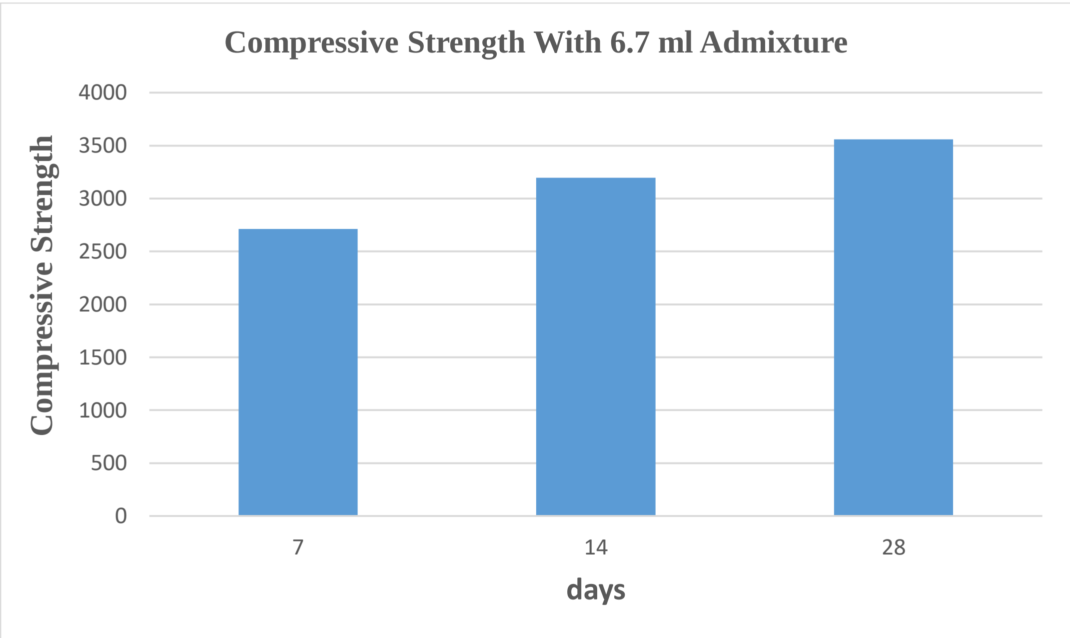


Figure-4.5: Graphical Representation of Concrete with 6.7 ml Admixture

4.4.4 Compressive Strength of Concrete with 8.9 ml Admixture

Curing Duration days	Specimen No.	Crushing Strength			
		(kn)	Ib	Psi	Average
	1	160	35970	2862	2897
7	2	160	35970	2862	
	3	166	37318	2969	
	1	196	44063	3505	3446
14	2	192	43164	3434	
	3	190	42714	3398	
	1	218	49009	3899	3786
28	2	205	46086	3666	
	3	212	47660	3792	

Table 4.6: Compressive Strength of Concrete with 8.9 ml Admixture

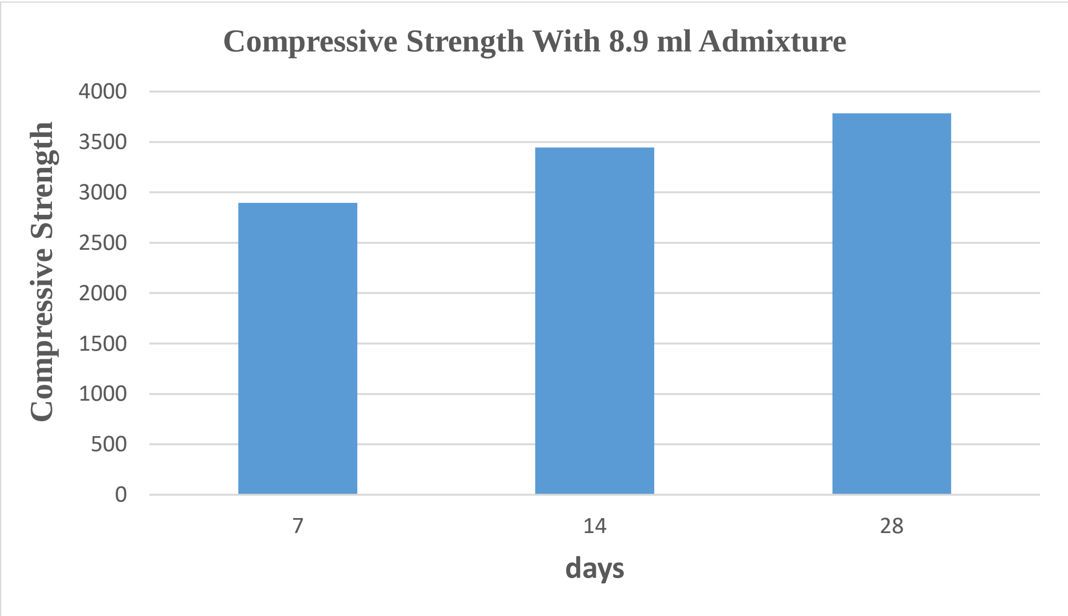


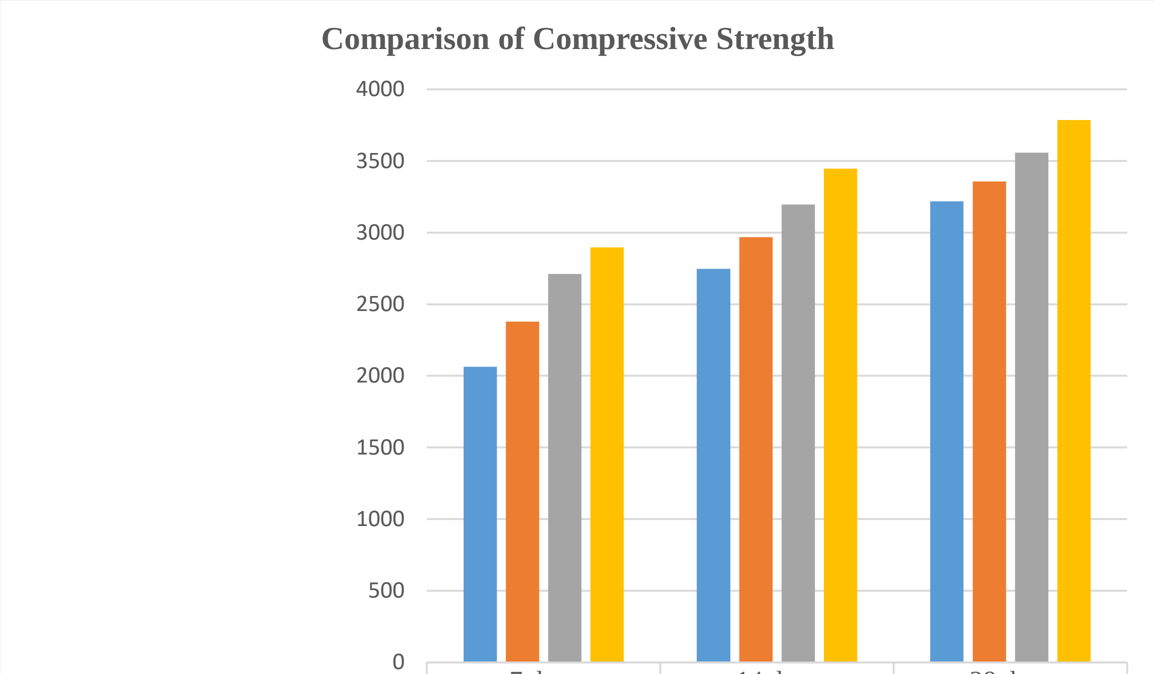
Figure-4.6: Graphical Representation of Concrete with 8.9 ml Admixture

4.4.5 Comparison Compressive Strength of Concrete Without Admixture and Concrete with an Admixture in Three Different types of percentage

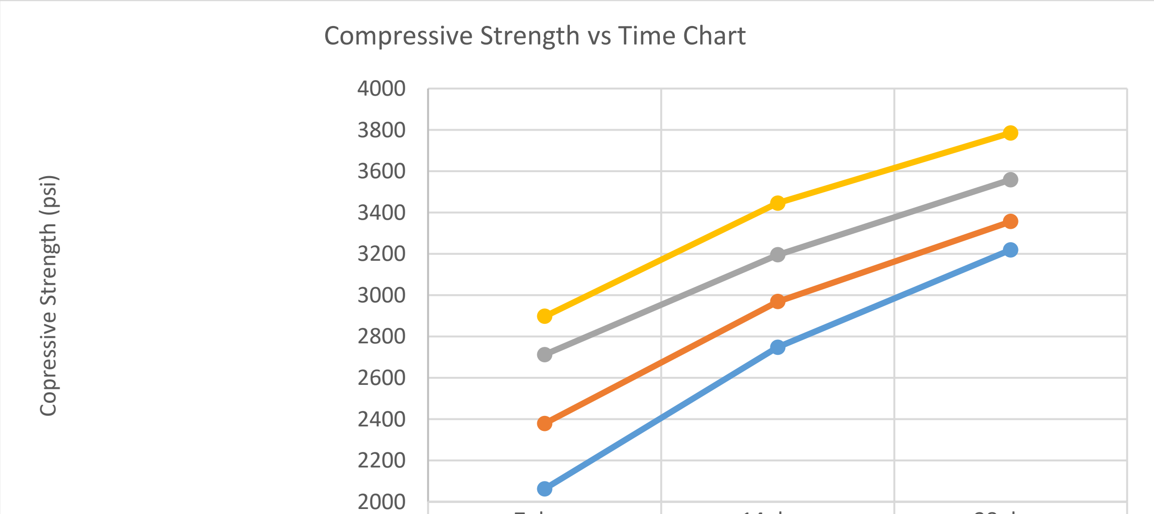
Specimen	W/C Ratio	Mix Ratio	Curing Time	Compressive strength			
				Average of Normal Concrete (psi)	Average of Concrete with Admixture 4.5 ml (psi)	Average of Concrete with Admixture 6.7 ml (psi)	Average of Concrete with Admixture 8.9 ml (psi)
Cylinder	0.48	1:1.5:3	7 days	2063	2379	2713	2897
			14 days	2748	2969	3195	3446
			28 days	3219	3356	3559	3786

Table 4.7: Comparison of Compressive Strength in psi Unit

4.4.6 Graphical Presentation Comparison of Compressive Strength



	7 days	14 days	28 days
Concrete without Admixture	2063	2748	3219
Concrete with 4.5 ml Admixture	2379	2969	3356
Concrete with 6.7 ml Admixture	2713	3195	3559
Concrete with 8.9 ml Admixture	2897	3446	3786



	7 days	14 days	28 days
Concrete without Admixture	2063	2748	3219
Concrete with 4.5 ml Admixture	2379	2969	3356
Concrete with 6.7 ml Admixture	2713	3195	3559
Concrete with 8.9 ml Admixture	2897	3446	3786

Axis Title

Figure-4.7: Comparison Compressive Strength VS Time Curve

From this graph, it is clearly seen that concrete with admixture has achieved higher compressive strength than normal concrete.

4.5 Calculation

4.5.1 Sample Calculation of Compressive Strength test

Sample calculation is given in the appendix

4.5.2 Calculate Quantities of Materials for Concrete

Sample calculation is given in the appendix. Here only shows the results

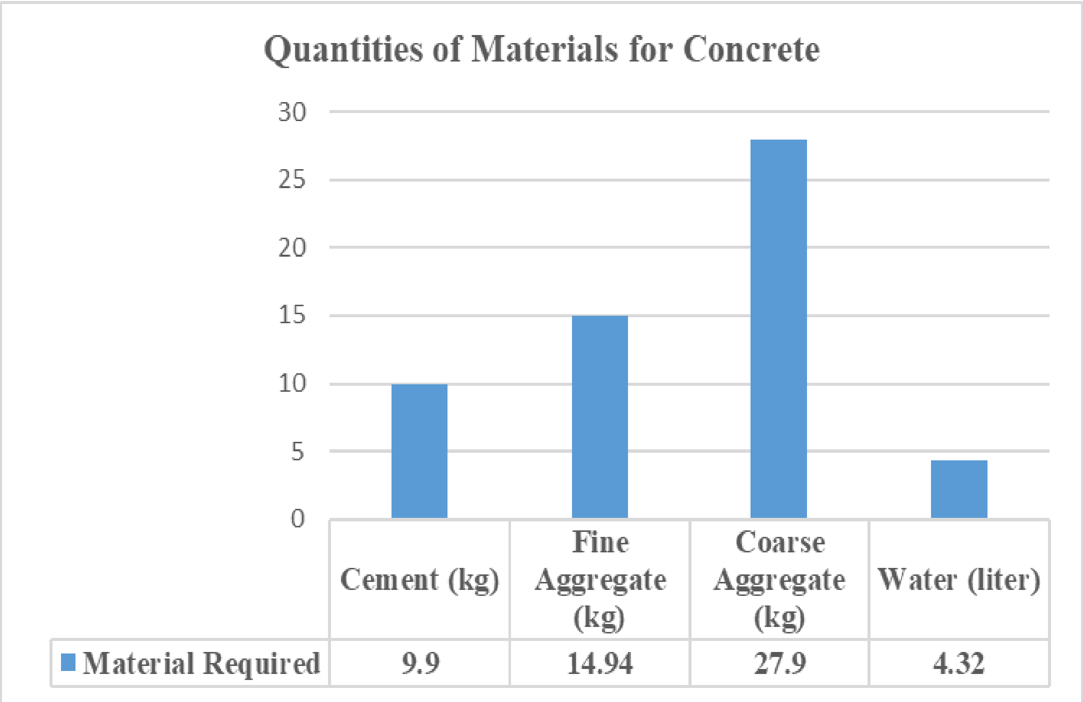


Figure-4.8: Quantities of Materials for Concrete

4.5.3 Calculate Amount of Admixture for Concrete

Sample calculation is given in the appendix. Here only shows the results.

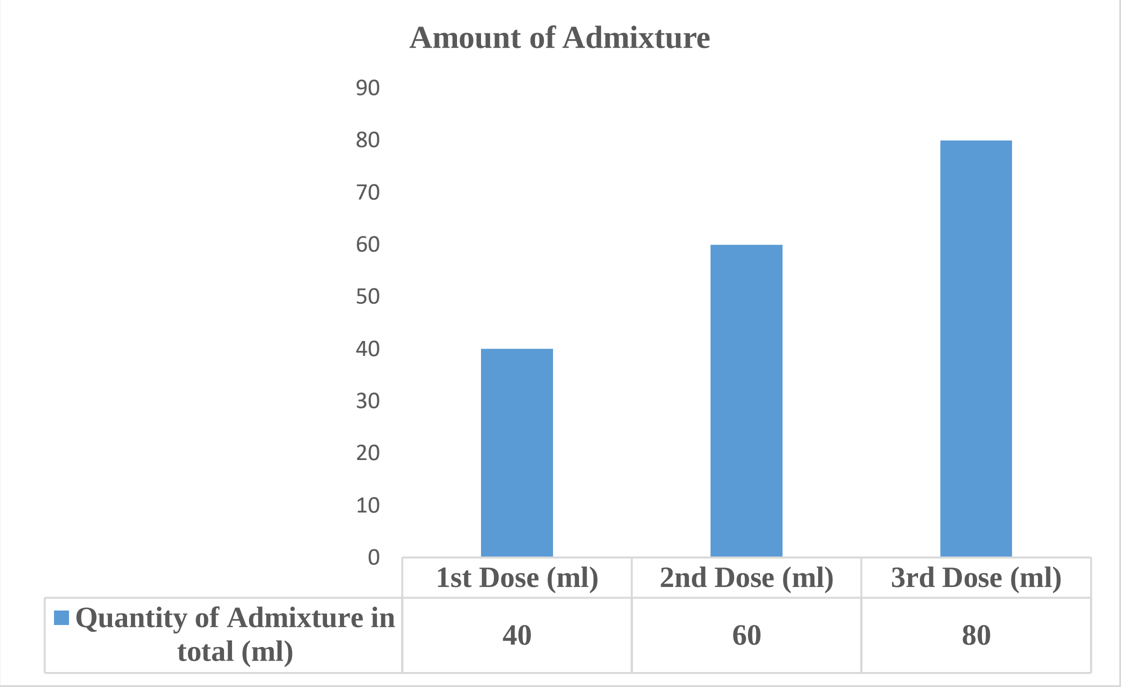


Figure-4.9: Amount of Admixture Using in Concrete

4.5.4 Calculation of Economical Effect

Sample calculation is given in the appendix. Here only shows the results.

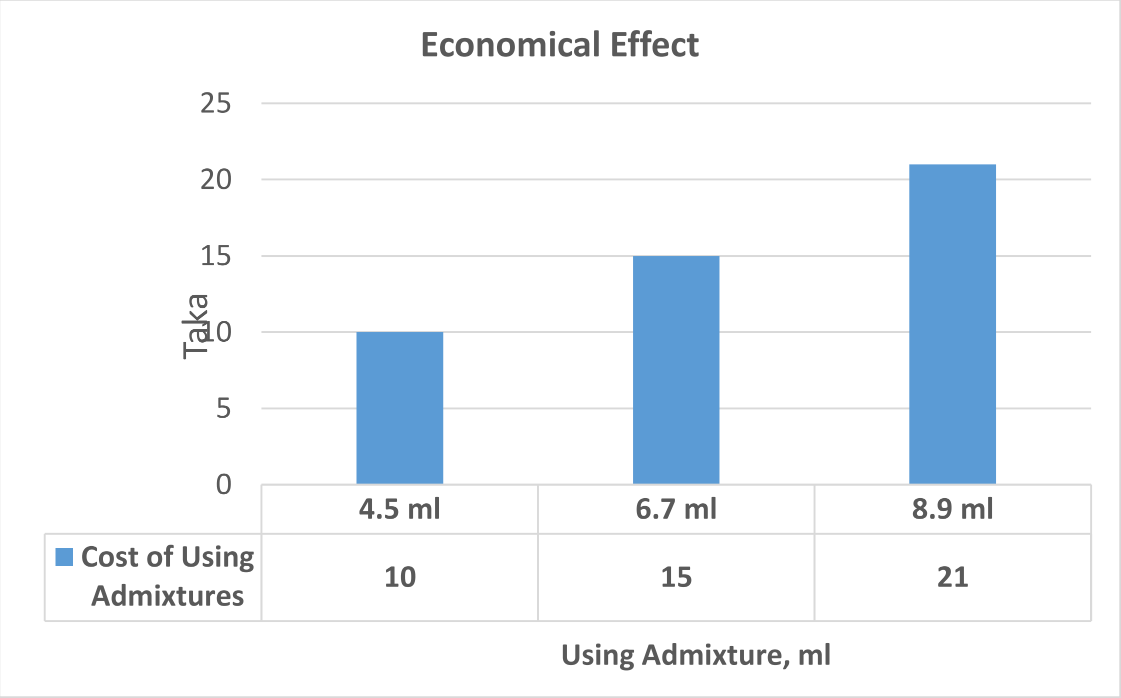


Figure-4.10: Economical Effect of Using Admixture

4.5.5 Comparison Compressive Strength Between Using Admixture and without Using Admixture After 28 days

	Without Admixture	4.5 ml Admixture	6.7 ml Admixture	8.9 ml Admixture
Compressive Strength After 28 days	2772	3088 psi	3559 psi	3786 psi
Difference of strength	0	3088-2772 = 316 psi	3559-2772 = 787 psi	3786-2772 = 1014 psi
Concrete with admixture increases strength	0	= 11.4%	= 28.4%	= 36.6%

Table 4.8: Comparison Compressive Strength

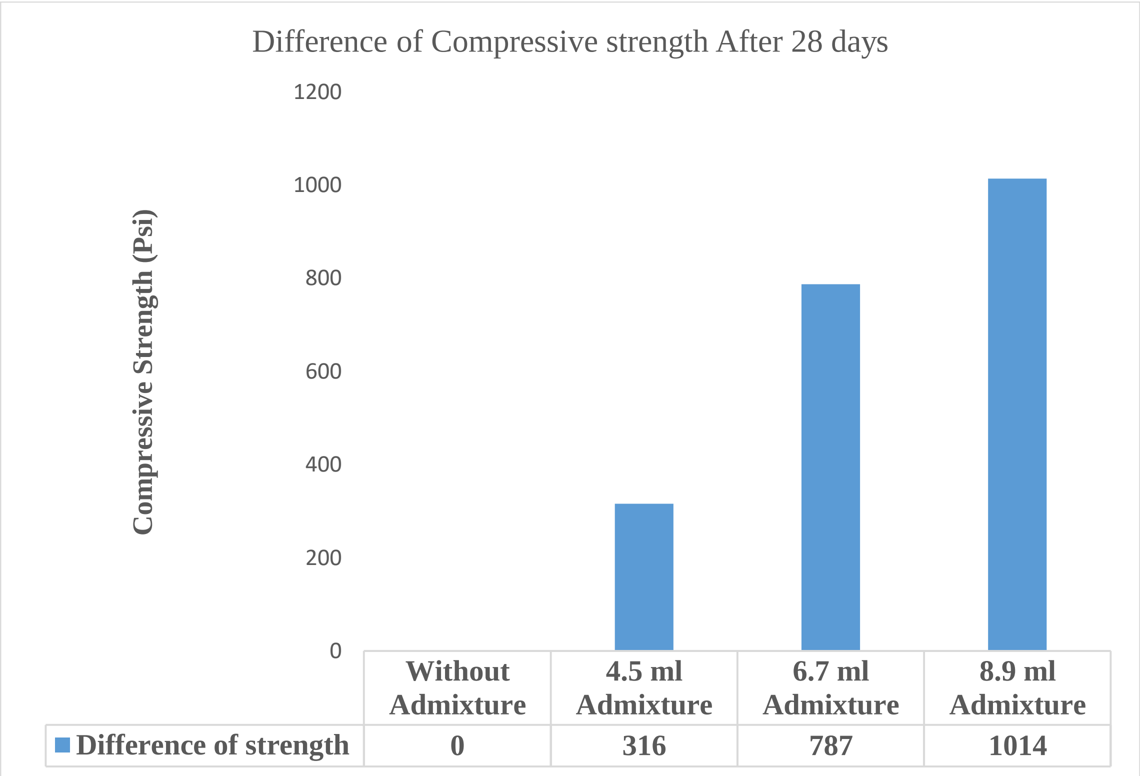


Figure-4.11: Difference of strength After 28 days

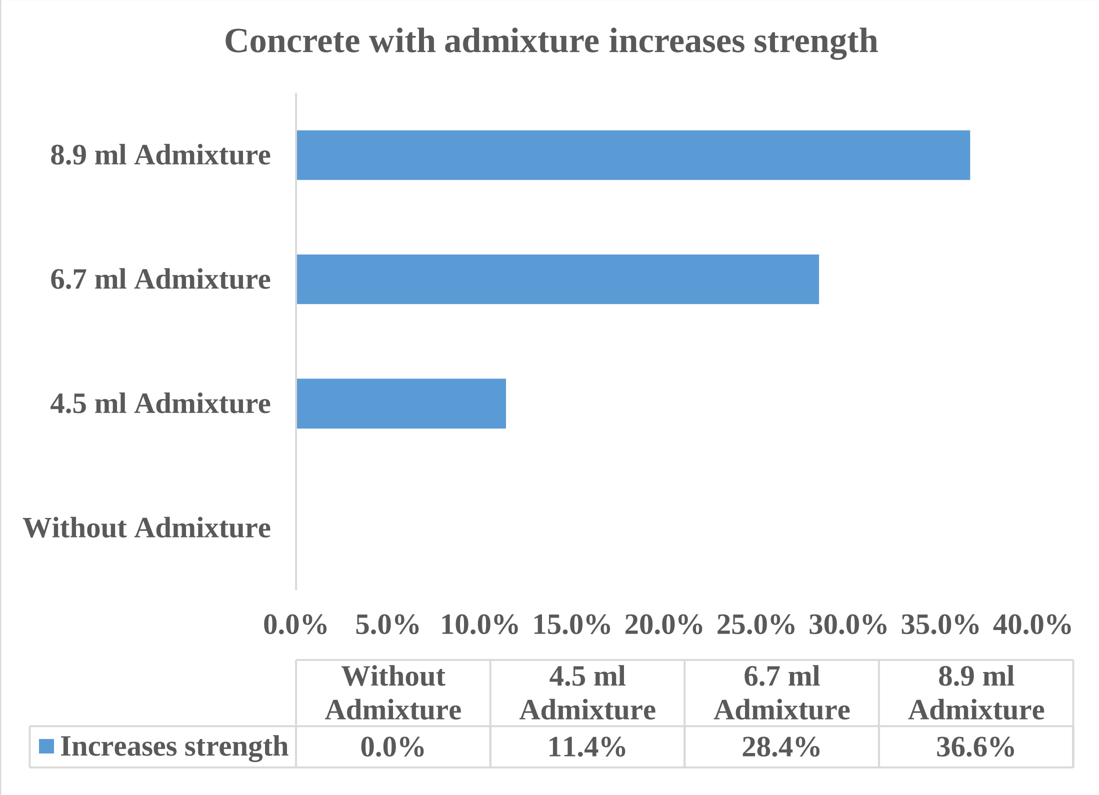


Figure-4.12: Increases The Strength After 28 days

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 General

This chapter gives a general outline of strength improvement characteristics of concrete without admixture and concrete with admixture. It can be expected that these findings will be useful for the construction of the concrete structure. A brief conclusion regarding the study is presented in this chapter. The chapter also includes a recommendation for further study.

5.2 Conclusion

In this study, the total number of cylindrical samples are 36. These are concrete without admixture and concrete with admixture in three different types of percentages. The motive of this chapter is to expressed a summary of the conclusions based on the observed test results also a comparison between these four types of sets. And then the comparison of the cost of concrete without admixture and concrete with an admixture in three different types of percentages and find a suitable percentage. The following conclusions can be drawn from the present study. It has been pointed out here that future investigations are necessary to confirm these findings:

5.2.1 Findings of the Study:

1. Compressive strength was found at 2063 psi, 2748 psi, and 3219 psi for concrete without admixture after 7days, 14 days, and finally, 28 days of curing.
2. Using an admixture quantity of 4.5 ml, we found the compressive strength that was 2379 psi, 2969 psi, and 3356 psi, after 7 days, 14 days, and finally, 28 days of curing.
3. Similarly using of admixture quantity of 6.7 ml, we found the compressive strength that was 2713 psi, 3195 psi, and 3559 psi, after 7 days, 14 days, and finally, 28 days of curing.
4. In the same process using of admixture quantity of 8.9 ml, we found the compressive strength that was 2897 psi, 3446 psi, and 3786 psi, after 7 days, 14 days, and finally, 28 days of curing.
5. Using an admixture quantity of 4.5 ml, 6.7 ml, and 8.9 ml admixture, compressive strength increases by almost 316 psi, 787 psi, and 1014 psi than normal concrete.

6. Expensing only 1.20 Taka, 1.70 Taka, and 2.30 Taka for using 4.5 ml, 6.7 ml, and 8.9 ml admixture (per sample), and strength increases almost 11.4%, 28.4%, 36.6%.
7. Comparing all of the results according to economical and strength we can say that concrete with using 6.7 ml admixture is a suitable percentage because using this percentage cost is moderate and strength is higher.

5.3 Recommendations

This is short-scale experimentation work due to time, scope, and resources limitations. And there were some limitations of the finding of this experiment. To acquire a more accurate result should conduct change various parameters. So, several number of guidelines were revealed below for future study on this topic.

1. The result analyzed in this experiment was obtained from a limited number of specimens. So, the further investigation, the mentioned limitation might be overcome.
2. The present study is performed with the same source of coarse aggregate & fine aggregate, so further investigation can be performed by changing the sources.
3. To improve the quality of concrete admixture can be adopted and it's economically effective.
4. Further studies may be conducted by considering different amounts of admixture.
5. More parameters like moisture condition of aggregates, flexural strength, split tensile strength, etc. can be considered for checking the strength of concrete.
6. Further studies may be conducted by considering different w/c ratios used to obtain quality concrete.

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APPENDIX

Test Result for Compressive Strength Test

Table for Compressive Strength of normal concrete cylinder (4” x 8”) after 7 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 18-12-2021

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	120	2146	2063
02					114	2039	
03					112	2003	

Table for Compressive Strength of using 40 ml admixture after 7 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 18-12-2021

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	132	2361	2379
02					132	2361	
03					135	2414	

Table for Compressive Strength of using 60 ml admixture after 7 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 18-12-2021

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	157	2808	2713
02					146	2611	
03					152	2718	

Table for Compressive Strength of using 80 ml admixture after 7 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 18-12-2021

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	160	2862	2897
02					160	2862	
03					166	2969	

Table for Compressive Strength of normal concrete cylinder (4” x 8”) after 14 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 23-12-2021

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	158	2826	2748
02					148	2647	
03					155	2772	

Table for Compressive Strength of using 40 ml admixture after 14 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 25-12-2021

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	168	3005	2969
02					165	2951	
03					165	2951	

Table for Compressive Strength of using 60 ml admixture after 14 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 25-12-2021

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	180	3219	3195
02					180	3219	
03					176	3148	

Table for Compressive Strength of using 80 ml admixture after 14 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 25-12-2021

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	196	3505	3446
02					192	3434	
03					190	3398	

Table for Compressive Strength of normal concrete cylinder (4” x 8”) after 28 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 08-01-2022

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	180	3219	3219
02					182	3255	
03					178	3183	

Table for Compressive Strength of using 40 ml admixture after 28 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 08-01-2022

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	185	3309	3356
02					188	3362	
03					190	3398	

Table for Compressive Strength of using 60 ml admixture after 28 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 08-01-2022

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	195	3488	3359
02					200	3577	
03					202	3613	

Table for Compressive Strength of using 80 ml admixture after 28 days at a mix ratio 1:1.5:3

Preparing Date: 09-12-2021

Crushing Date: 08-01-2022

Specimen No.	Specimen Name	Curing Duration	Mixing Ratio	W/C Ratio	Crushing Strength		Avg. Crushing Strength (Psi)
					KN	Psi	
01	Cylinder	7days	1:1.5:3	0.48	218	3899	3786
02					205	3666	
03					212	3792	

Calculation of Compressive Strength Test

Sample Calculation

We Know,

Compressive Strength of concrete,

= Maximum compressive load / Cross Sectional Area

Such as,

Maximum Compressive load,

= 120 KN

= 120 x 224.81

= 26977 lb [1KN=224.81lb]

And Cross Sectional Area of cylinder,

= $(\pi d^2)/4$

= $(\pi * 4^2)/4$

= 12.57 sq. inch

So, Compressive Strength of Concrete =

=Maximum compressive load / Cross Sectional Area

= 26977 /12.57

= 2146 psi

= 15 Mpa [1 psi=0.0068947573 MPa]

Calculate Quantities of Materials for Concrete

Here we are preparing 4 sets of cylinder mold and each set has a 9-cylinder mold.1st set was concrete without admixture and the last 3 sets were using admixture with three different percentages.

Volume of cylinder specimen:

$$= \frac{\pi d^2}{4} \times h$$

$$= \frac{\pi 4^2}{4} \times 8$$

$$= 100.531\ inch^3$$

$$= 0.058\ ft^3$$

Weight of cylinder specimen:

= Volume × Unit weight of concrete

= 0.058 × 150 × 1.54

= 13.398 lb × 0.4535

= 6.07 kg

M20 concrete proper mixing ratio is 1:1.5:3

and we assumed water/cement ratio = 0.48

According to the ratio of 1:1.5:3

Amount of Cement:

$$= \frac{1}{1+1.5+3} \times 6.07 \text{ kg}$$

= 1.1 kg (per sample)

= 1.1 × 9

= 9.9 kg

Amount of Sand:

$$= \frac{1.5}{1+1.5+3} \times 6.07 \text{ kg}$$

= 1.66 kg (per sample)

= 1.66 × 9

= 14.94 kg

Amount of Aggregate:

$$= \frac{3}{1+1.5+3} \times 6.07 \text{ kg}$$

= 3.3 kg (per sample)

= 3.3 × 9

= 27.9 kg

Amount of Water:

= 0.48 × 9.9

= 4.32 liter

Calculate Amount of Admixture for Concrete

Dosage of admixture: 200-400 ml per bag (50kg) cement

We use 200,300, and 400 ml admixture in 9.9 kg of cement

So, Amount of Admixture for 200 ml:

$$= \frac{200}{50} \times 9.9$$

= 39.6 ml

= 40 ml

= 4.5 ml (per sample)

Similarly, amount of Admixture for 300 ml:

$$= \frac{300}{50} \times 9.9$$

= 59.4 ml

= 60 ml

= 6.7 ml (per sample)

And, amount of Admixture for 400 ml:

$$= \frac{400}{50} \times 9.9$$

= 79.2 ml

= 80 ml

= 8.9 ml (per sample)

Calculation of Economical Effect

We are using Water Reducing & Plasticizer Admixture. The market price of this admixture is 260 Taka per liter.

1-liter bottle = 1000 ml

We are using 40, 60, and 80 ml admixture

Cost for using 40 ml admixture,

$$= \frac{40ml}{1000} \times 260$$

= 10.4 Taka

= 10 Taka

= 1.20 Taka (per sample)

Cost for using 60 ml admixture,

$$= \frac{60ml}{1000} \times 260$$

= 15.6 Taka

= 15 Taka

= 1.80 Taka (per sample)

Cost for using 80 ml admixture,

$$= \frac{80ml}{1000} \times 260$$

= 20.8 Taka

= 21 Taka

= 2.30 Taka (per sample)