COMPARATIVE STUDY ON COMPRESSIVE STRENGTH OF CONCRETE USING DIFFERENT TYPES OF SAND

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

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Section: 16A

Summer-2022

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Semester -Spring-2022

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It is hereby declared that this thesis/project or any part of it has not been submitted where for the award of any degree or diploma.

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Dedicated

to

“Our parents”

ACKNOWLEDGEMENTS

We are forever grateful to our Thesis Supervisor, Md Abu Saleh Sagor for his kind supervision and guidance throughout this important study and also with the continuous help from the beginning to the end of this study the work finally becomes positive to complete successfully.

We are grateful to our parents for their help & kind participation while preparing this Thesis book. This encouragement, helping hand, affection and sacrifice both directly and indirectly helped to reach on the today's position, without their love, appreciation and encouragement it was impossible to reach here. Acknowledgement of their contribution is too small as a reward.

The satisfaction and euphoria that accompany the successful completion of the task would be great but incomplete without the mention of the people who made it possible with their constant guidance and encouragement crowns all the efforts with success. In this context, we would like to thank all the other staff members, both teaching and non-teaching, which have extended their timely help and eased our task.

ABSTRACT

In Bangladesh and many other countries worldwide, concrete is the main ingredient and most commonly used building materials for the construction industries. Concrete is primarily composed of aggregate, cement and water. At present, it is currently thought that concrete properties are highly influenced on and its proportion in the concrete mix. Therefore, the identification of the level and nature of contamination in water and their subsequent influence on concrete properties is becoming increasingly important. The objective of this thesis is to determine the concrete strength behavior by using different types of sand. Three types of sands such as Local sand (FM = 1.95), Kustia sand (FM = 2.42) and Sylhet sand (FM = 2.48) are used as fine aggregates. In this investigation, fine aggregates samples are collected from available sources. Concrete Cylinder specimens (Dia 100mm and Hight 200mm) are made according to mixed proportion 1:1.5:3. After casting the specimens are cured for the curing period of 7, 14 and 28 days and tested for compressive strength by Universal Testing Machine (UTM) after the curing period. The workability of concrete is also measured by slump test. In this study, as per mix proportion 1:1.5:3 mixed concrete to form cylinder and conduct compressive strength test. The mixed proportion 1:1.5:3 concrete compressive strength Kustia sand usage concrete 1.48 times more than Local sand usage concrete and 1.16 times than Sylhet Sand usage concrete.

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CHAPTER 1

INTRODUCTION

1.1 General

Concrete is one of the most used materials in building and civil engineering construction works. Concrete is a mixture of water, cement or binder and aggregates and it is commonly used as material for construction. The strength of concrete depends on aggregate type, size, and source. In Bangladesh crushed bricks, crushed Stones are widely used as coarse aggregate in concrete. Sand is a major component of concrete and without the sand, concrete will not function as intended. The water to cement ratio largely determines the strength and durability of the concrete when it is cured properly. The w/c ratio refers to the ratio of the weights of water and cement used in the concrete mix. Out of many test applied to the concrete, this is the most important which gives an idea about all the characteristics of concrete. Concrete is brittle and weak in tension but its compressive strength is about ten to thirteen times greater than the tensile (Mahendrana et al 2006). However, Mosely and Bungey found the compressive strength to be about eight times greater than the tensile. The tensile strength of concrete is commonly neglected in the design of most ordinary structural elements. However, in the design of some structures that are required to contained liquids the tensile strength is taken into consideration. Ideal, standard and good concrete (whether plain, reinforced or pre stressed) should be strength enough to carry superimposed loads during its anticipated life. The cement concrete is a mixture of cement, sand, pebbles or crushed rock and water, which when placed in the skeleton of forms and allowed to cure, becomes hard like a stone. Aggregates are the important constituents in concrete (Mahendrana et al 2006). They give body to the concrete, reduce shrinkage and effect economy. Earlier, aggregates are considered as chemically inert materials but now it has been recognized that some of the aggregates are chemically active and also that certain aggregates exhibit chemical bond at the interface of aggregate and paste. The aggregate occupies 70 – 80% of the volume of concrete. Cement generally represents 12-14% of concrete weight. It plays an active part in the mixture. During the hardening process, it generates shrinkage and heat dissipation phenomena which lead to material cracking. Water is an important ingredient of concrete as inactively participates in the chemical reaction with cement (Mahendrana et al 2006).

1.2 Objectives of the Study

- To compare the compressive strength of concrete by using different types of sand such as Kustia sand, Local sand and Sylhet sand.

Organization of the thesis

The report of the analysis is organized in this paper to represent and discuss the results and findings that come out from the studies.
Chapter 1: introduces the topic, in which an overall idea is presented before entering into the main studies and discussion.
Chapter 2: is literature Review, which represents the work performed so far in connection with it and is collected from various references. It also represents the strategy for moving forward with the success current issue.
Chapter 3: is all about the methodology.
Chapter 4: is concerned with the results and discussions.
Chapter 5: is about the findings of this parametric study are demonstrated and discussed in detail with a recommendation of further study scope and a conclusion.

CHAPTER 2

Literature Review

2.1 Introduction

Sand is a major component in concrete mixes. Sand from natural gravel deposits or crushed rocks is a suitable material used as fine aggregate in concrete production. It is used with coarse aggregate to produce a structural concrete and can also be used alone with cement for mortals and plastering works.

2.2 Research Background

Previous studies indicate that pervious concrete has lower compressive strength capabilities than conventional concrete and will only support light traffic loadings. The authors of this work investigated prior studies on the compressive strength of pervious concrete as it relates to water-cement ratio aggregate-cement ratio, aggregate size, and compaction and compare those results with results obtained in laboratory experiments conducted on samples of pervious concrete cylinders created for this purpose (Mahendrana et al 2006).

The loadings and types of vehicles these systems can withstand will also be examined as well as the design of appropriate thickness levels for the pavement. Since voids are supposed to reduce the strength of concrete (Mahendrana et al 2006) the goal is to find a balance between water, aggregate and cement in order to increase strength and permeability, two characteristics which tend to counteract one another. In this study, also determined are appropriate traffic loads and volumes so that the pervious concrete is able to maintain its structural integrity (Mahendrana et al 2006). The end result of this research will be a recommendation as to the water-cement ratio, the aggregate-cement ratio, aggregate size, and compaction necessary to maximize compressive strength without having detrimental effects on the permeability of the pervious concrete system using the particular local materials available in central Florida (M. A. Aziz 1995).

2.3 Cement

Cement, one of the most important building materials, is a binding agent that sets and hardens to adhere to building units such as stones, bricks, tiles etc. Cement generally refers to a very fine powdery substance chiefly made up of limestone (calcium), sand or clay (silicon), bauxite (aluminum) and iron ore, and may include shells, chalk mart shale, clay, blast furnace slag, slate (M. A. Aziz 1995).

The raw ingredients are processed in cement production plants and heated to form a rock-hard substance, which is then ground into a fine powder to be sold. Cement mixed with water causes a chemical reaction and forms a paste that sets and hardens to bind individual structures of building materials (M. A. Aziz 1995).

Cement is an integral part of the urban infrastructure. It is used to make concrete as well as mortar, and to secure the infrastructure by binding the building blocks. Concrete is made of cement, water. sand and gravel mixed in definite proportions, whereas mortar consists of cement, water and lime aggregate. These are both used to bind rocks, stones, bricks and other building units, fill or seal any gaps, and to make decorative patterns. Cement mixed with water silicates and aluminates, making a water repellant hardened mass that is used for water-roofing (M. A. Aziz 1995).

A cement is a binder, a substance used in construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used solely, but is used to bind sand and gravel (aggregate) together. Cement is used with fine aggregate to produce mortar for masonry, or with sand and gravel aggregates to produce concrete. Cements used in construction are usually inorganic, often lime or calcium silicate based, and can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to set in the presence of water (Al Jabri and R. Taha 2008).

Non-hydraulic cement will not set in wet conditions or underwater; rather, it sets as it dries and reacts with carbon dioxide in the air. It is resistant to attack by chemicals after setting (Al Jabri and R. Taha 2008).

Hydraulic cements (e.g., Portland cement) set and become adhesive due toa chemical reaction between the dry ingredients and water. The chemical reaction results in mineral hydrates that are not very water-soluble and so are quite durable in water and safe from chemical attack. This allows setting in wet condition or underwater and further protects the hardened material from chemical attack (Al Jabri and R. Taha 2008).

In Britain particularly, good quality building stone became ever more expensive during a period of rapid growth, and it became a common practice to construct prestige buildings from the new industrial bricks, and to finish them with a stucco to imitate stone. Hydraulic limes were favored for this, but the need for a fast set time encouraged the development of new cements. Most famous was Parker's "Roman cement". This was developed by James Parker in the 1780s, and finally patented in 1796. It was, in fact, nothing like material used by the Romans, but was a "natural cement" made by burning sectarian nodules that are found in certain clay deposits, and that contain both clay minerals and calcium carbonate (F. Olutong and Amusan (2001). The burnt nodules were ground to a fine powder. This product, made into a mortar with sand, set in 5-15 minutes. The success of "Roman cement" led other manufacturers to develop rival products by burning artificial hydraulic lime cements of clay and chalk. Roman cement quickly became popular but was largely replaced by Portland cement in the 1850s, of making cement and concrete, as well as the benefits of cement the construction Apparently unaware of Seaton 's work the same principle was identified by Frenchman Louis vicar in the first decade of the nineteenth century. Vicar went, on to devise a method of combining chalk and clay into an intimate mixture and burning this. Produced an "artificial cement" in 1817 considered the "principal forerunner "of Portland cement and "Edgar Dobbs of Southward patented a cement of this kind in 1811" (F. Olutong and Amusan (2001).
In Russia'. Eger created a. new binder by mixing lime and clay. His results were published in 1822 in his book A Treatise on the Art to Prepare a Good Mortar published in St. Petersburg. A few years later in 1825, he published another book, which described the various methods of buildings and embankments (F. Olutong and Amusan (2001).
William Aspin is considered the inventor of "modem" Portland cement. Portland cement, the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and non-specialty grout, was developed in England in the mid 19th century, and usually originates from limestone. James Frost produced what he called "British cement" in a similar manner around the same time, but did not obtain a patent until 1822.In 1824, Joseph Aspin patented a similar material which he called Portland cement, because the render made from it was in color similar to the prestigious Portland stone which was quarried on the Isle of Portland, Dorset, England. However, Asp dins' cement was nothing like modem Portland cement but was a first step in its development, called a proto-Portland cement (M. S. Sheety 2002). Joseph Aspin's' son William Asp din had left his father's company and, in his cement, manufacturing apparently accidentally produced calcium silicates inthe1840s, middle step-in the development of Portland cement. William Aspin's innovation was counterintuitive for

manufacturers of "artificial cements", because they required more lime in the mix (a problem for his father), a much higher kiln temperature (and therefore more fuel),and the resulting clinker was very hard and rapidly wore down the millstones, which were the only available grinding technology of the time. Manufacturing costs were therefore considerably higher, but the product set reasonably slowly and developed strength quickly, thus opening up a market for use in concrete (M. S. Sheety 2002). The use of concrete in construction grew rapidly from 1850 onward, and was soon the dominant use for cements. Thus, Portland cement began its predominant role. Isaac Charles Johnson further refined the production of me so Portland cement (middle stage of development) and claimed to be the real father of Portland cement.
Setting time and "early strength" are important characteristics of cements. Hydraulic lines, “natural" cements, and "artificial" cement Sallrely upon their be lite content for strength development. Be lite develops strength slowly. Because they were burned at temperatures below 1,250 °C (2,280 °F), they contained no a lite, which is responsible for early strength in modem cements. The first cement to consistently contain a lite was made by William Asp din in the early 1840s: Ibis was what we call today "modem" Portland cement. Because of the air of mystery with which William Asp din surrounded his product, others (e.g.,Vicatand Johnson) have claimed precedence in this invention, but recent analysis of both his concrete and raw cement has shown that William Asp din's product made at North fleet, Kent was a true a lite - based cement. However, Asp din’s methods were "rule-of-thumb" Vicat is responsible for establishing the chemical basis of these cements, and Johnson established the importance of sintering the mix in the kiln (M. S. Sheety 2002).

It was not as durable, especially for highways, to the point that some states stopped building highways and roads with cement. Bertrand. wait, an engineer whose company had worked on the construction of the New York city's cats kill a queduct, was impressed with the durability of Rosendale cement and came up with a blend in the US the first large-scale use of cement was Rosendale cement, a natural cement mined from a massived posit of a large dolostone rock deposit discovered in the early 19th century near osendale, new York Rosendale cement was extremely popular for the foundation of buildings (e .g., statue of liberty capitol building, Brooklyn bridge) and lining water pipes sorel cement was patented in1867 by French man stand is Iassorel and was stronger than Portland cement but its poor water resistance and corrosive qualities limited its use in building construction. The next development with the manufacture of Portland cement was the introduction of the rotary kiln which allowed as Stronger, more homogeneous mixture and a continuous manufacturing process (M. S. Sheety 2002).

Table 2.1: Components of Physical & Chemical Characteristics.

Property	Portland Cement	Calcareous (ASTM C618 Class C) Fly Ash	Calcareous (ASTM C618 Class C) Fly Ash	Slag Cement	Silica Fume
SiO2 Content (%)	2.9	52	35	35	85-97
Al2O3 Content (%)	6.9	23	18	12	-
Fe2O3 Content (%)	3	11	6	1	-
CaO Content (%)	63	5	21	40	<1
MgO Content (%)	25	–	–	–	–
SO3 Content (%)	1.7	–	–	–	–
Specific Surface (m^2/kg)	370	420	420	400	15000-30,000
Specific Gravity	3.15	2.38	2.65	2.94	2.22
General use in concrete	Primary Binder	Cement Replacement	Cement Replacement	Cement Replacement	Property Enhancer

2.4 Properties of Cement

It is always desirable to use the best cement in constructions. Therefore, the properties of cement must be in best gated. Although desirable cement properties may vary depending on the type of construction, generally cement possesses following properties (which depend upon its chemical composition thoroughness of burning and fineness of grinding).

- Provides strength to masonry.
- Stiffens or hardens early.
- Possesses good plasticity.
- An excellent building material.
- Easily workable.
- Good moisture-resistant

2.5 Types of Cement are available in Bangladesh

Bangladesh Cement Manufacturers List

1.ALHAJ MOSTAFA-HAKIM CEMENT INDUSTRIES LIMITED

Chittagong based cement manufacturing company in Bangladesh, which is a manufacturer of ordinary port land cement (OPC).

2. PREMIER CEMENT MILLS LIMITED.

Brand Name: Premier Cement Type of cements are ordinary Portland cement (POC) & Portland composite cement (POC)

3. SHAHCEMENT INDUSTRIES LTD.

[A unit of Abul Khair group shah cement the largest and 100% local owner cement product teaching plan in Bangladesh] Product/ Brand name: Shah Cement special, Shah Cement popular, cement ready mix concrete.

4. MIR CEMENT LTD

[Mir cement ltd. is one of the leading cement companies in Bangladesh, which is a concern of Mir Akhter Hossain ltd - a renowned construction company in Bangladesh] Products: ordinary Portland cement (OPC) &Portland composite cement (PPC), Mir cement, also offers customized cement solutions. Brand name: Mir Cement

5. MADINA CEMENT INDUSTRIES LTD.

Products: Ordinary Portland Cement (OPC) &Portland composite cement (PCC)
Brand name: Tiger Cement.

6. MONGLA CEMENT FACTORY

[Mongla Cement Factory is a concern of Sena Kalyan Songstha (SKS) and it is producing one of the best quality cements in Bangladesh.] Products: Portland Grey Cement, Ordinary Portland and Composite Portland Cement Brand name: ELEPHANT BRAND.

M.I CEMENT FACTORY LTD.

[M.I cement factory ltd. is one of the leading manufacturers of cement in Bangladesh crown cement is a pioneer cement exporter in Bangladesh.] Products: Ordinary Portland cement (OPC) & Portland composite cement (PCC). Brand name: crown cement.

Other Companies' are-

7. Cemex Cement Bangladesh Ltd.

8. Holcim (Bangladesh) Ltd.

9. Aman Cement Mills Ltd.

10. Olympic Cement Ltd. (OCL).

11. Nowapara Cement Mills Ltd.

12. Dub Bangladesh Cement Mills Ltd.

13. Meghna Cement Mills Ltd. (Bashundhara Group).

14. Bashundhara Industrial Complex Ltd Bashundhara cement: (Bashundhara Group).

15. Confidence Cement Limited (CCL).

16. S. Alam Cement Limited.

17. NGS Cement Industries Limited.

18. Royal Cement Limited Etc.

2.6 Sand

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles it is defined by size, being finer than gravel and coarser than silt, sand can also refer to a textural class of soil or soil type; i.e., a soil containing more than85% sand-sized particles by mass.

The composition of sand varies, 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 sio_2), usually in the form of quartz, the second most

common type of sand is calcium carbonate, for example aragonite, which has mostly been created, over the past half billion years, by various forms of life, like coral and shellfish, for example, it is the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean (S. Kumar 2007).
Sand is a loose granular material blanketing the beaches, riverbeds and deserts of the World. Composed of different materials that vary depending on location, sand comes in an array of colors including white, black, green and even pink. the most common component of sand is silicon dioxide in the form of quartz the earth's land masses are made up of rocks and minerals, including quartz, feldspar and Mica (S. Kumar 2007).

2.7 Properties of Sand

Quartz is a very hard mineral, ranking a 7 on the most hardness scale, pure quartz is transparent to translucent and the crystals are often hexagonal.
A lot of sand especially that found on beaches is made of basalt, an igneous rock extruded from volcanoes. Much of the crust of earth's oceans is made out of basalt, is magic, which means that it's made of iron and magnesium minerals, such as plagioclase and pyroxene. Other types of sand are made up of tiny bits of coral and crushed snail and clam shells (S. Kumar 2007).
Sand can also come in many colors some beaches in Hawaii are famous for black sand, whereas beaches in the Caribbean are famous for pink sand because sand is composed of so many materials, it is possible to study grains of sand under a microscope and discover where they are from and what they are made of.

2.8 Types of Sand Available in Bangladesh

Chemical determined by x-ray analysis for local sands this test was conducted in atomic energy commission composition of graded sample for individual particle size was were used for Ottawa sand graph of x-ray analysis was given in figure 16 through figure typical values 21.

The sample that retained on sieve #30, #16. #50 and #100 are analyzed. The % presence of #30. #40, #50 and #100 are 2, 28, 45 and 25 respectively. The value of #40 can be divided between #30 and #50 equally. So weight age value of #30, #50 and #100 was 0.16, 0.59 and 0.25 respectively. Figure 22 Variation of quartz content in different sand Quartz content in sand is very important since it is chemically inert and strong enough to carry load. From X-ray analysis the values of quartz content were plotted in bar which shows that. Sand II W is best suited with Ottawa sand based on the consideration of quartz content. From X-ray analysis the values of quartz content with grain size were plotted in bar which shows that percentage of quartz content increases with the decrease in grain size.

This is because in larger particle there is a tendency to adhere foreign particles with its surface. On the other hand, in smaller particles there is low tendency to adhere foreign particles. So, there are lower impurities in smaller particles and for that quartz content is comparatively higher than that of larger particles Figure 23, Variation of quartz content with grain size in different sand from bur chart it is also seen that quartz content decreases after acid washing for both sands This is because disintegration of particles results from acid action i.e., relatively smaller particles get smaller.

Since in smaller particle the quantity of quartz is relatively high and after acid washing this smaller particle disintegrated and washed out. As a result, quartz content decreases another reason is that with the presence of acid. Fe reacts with SiO2 and form Fe3Si. As a result, decreases. On the other hand, Fe is very strong and is not disintegrated upon acid action rather than it reacts with SiO_2. So, for decreasing quartz content the relative proportion of Fe may increase or for reacting with SiO_2, Fe content may decrease The Fe content of acid washed sample is the resultant of above two actions In Sand 1 Fe content increases and for Sand II Fe content decreases after acid washing 18 6.3 Graph with correlation for strength for correlation any order of polynomial may be used.

2.9 ASTM Standard Graded sand

Sand is produced by processing silica rock particles obtained by hydraulic mining of the ortho-quartzite situated in open-pit deposits near Ottawa, Illinois.

a. Made of local (French Source) natural silica sand (silica content 99%).

b. Having a water content lower than 0.1%.

c. The constituent grains of this sand are uncrushed and of rounded form.

d. The sand is used for testing hydraulic cement in accordance with ASTM C 109.

Table 2.2: The average Grading of sand

Square mesh size in (mm)	Percent passing sieve (%)	
	Average grading	C778
16 (1.180)	100	100
30 (0.600)	97	96 to 100
40 (0.425)	69	65 to 75
50 (0.300)	26	20 to 30
100	1	0 to 4

CHAPTER 3
Methodology

3.1 Materials

Coarse aggregate and fine aggregate, such as Sylhet sand samples are collected from local supply center. Kustia sand is collected from Kustia and Local Sand are collected from Dhaka. The aggregates are tested for absorption capacity, specific gravity, moisture content, unit weight, and FM. The specific gravity and absorption capacity are determined. After investigation of fine aggregates, Concrete Cylinder specimens (Size Dia 100mm and Height 200mm) are made according to mixed proportion (1:1.5:3) The workability of concrete is also measured by slump test. The specimens are cured for the curing period of 7, 14 and 28 days and tested for compressive strength by Universal Testing Machine (UTM) after the curing period. In this study, as per mix proportion 1:1.5:3 mix concrete accordingly to per from Cylinder & conducted compressive strength test for 27 Cylinder with this mix ratios. This study is to evaluate concrete strength behavior of concrete with variation of sand by mixing proportion.

CHAPTER 4

Results and Discussion

4.1 Introduction

To used different types of sand in concrete. This paper reports the results of an experimental study on the mechanical properties of different types of sand, concrete as compared to natural aggregate concrete. To used different types of sand like as Kustia sand, Local sand and Sylhet sand but here coarse aggregate keep constant in concrete number [dia100mm & height 200mm] cylinder are cast with target compressive strength is 20 MPa curing period of 28 days.

4.2 Determination of fineness modulus of sand

The fineness modulus of sand is determined according to the test procedure described in ASTM Standard. The result of this test both for Sylhet sand and local sand is given below.

Table 4.1: Determination of fineness modulus of Sylhet sand

Sieve no	Sieve Opening (mm)	Materials Retained	%Materials Retained	Cumulative %Retained
#4	4.75	0	0	0
#8	2.36	7	1.4	1.4
#16	1.19	72	14.4	15.8
#30	0.59	164	32.8	48.6
#50	0.30	180	36	84.6
#100	0.15	13	13	97.6

$$FM = \frac{\text{Total cumulative retained of sand}}{100}$$

$$= \frac{1.4+15.8+48.6+84.6+97.6}{100} = 2.48$$

Table 4.2: Determination of fineness modulus of Kustia sand

Sieve no	Sieve Opening (mm)	Materials Retained	%Materials Retained	Cumulative %Retained
#4	4.75	0	0	0
#8	2.36	0	0	0
#16	1.19	21	4.2	4.2
#30	0.59	261	52.2	56.4
#50	0.30	157	31.4	87.8
#100	0.15	30	6.0	93.8
Pan		31	6.2	100

$$FM = \frac{\text{Total cumulative retained of sand}}{100}$$

$$= \frac{4.2+56.4+87.8+93.8}{100}$$

$$= 2.42$$

Table 4.3: Determination of fineness modulus of Local sand

Sieve no	Sieve Opening (mm)	Materials Retained	%Materials Retained	Cumulative %Retained
#4	4.75	0	0	0
#8	2.36	4	4	0.8
#16	1.19	51	55	11
#30	0.60	365	420	84
#50	0.30	74	494	98.8
#100	0.15	6	500	100
pan				

$$FM = \frac{\text{Total cumulative retained of sand}}{100}$$

$$= \frac{0.8+11+84+98.8}{100}$$

$$= 1.95$$

4.3 Gradation of Various Types of Sand

This test methods cover the determination of particle size distribution of different types of sand by sieving. The sieve analysis of sand is determined according to the test procedure described in ASTM standard. The result of this test for Sylhet sand Kustia and local sand is given below

Table 4.4: Grain size distribution of Sylhet sand

Sieve no	Sieve Opening (mm)	Materials Retained	%Materials Retained	Cumulative %Retained	%Finer
#4	4.75	0	0	0	100
#8	2.36	7	1.4	1.4	98.6
#16	1.19	72	14.4	15.8	84.2
#30	0.59	164	32.8	48.6	51.4
#50	0.30	180	36	84.6	15.4
#100	0.15	65	13	97.6	2.4
pan		12	2.4	100	0

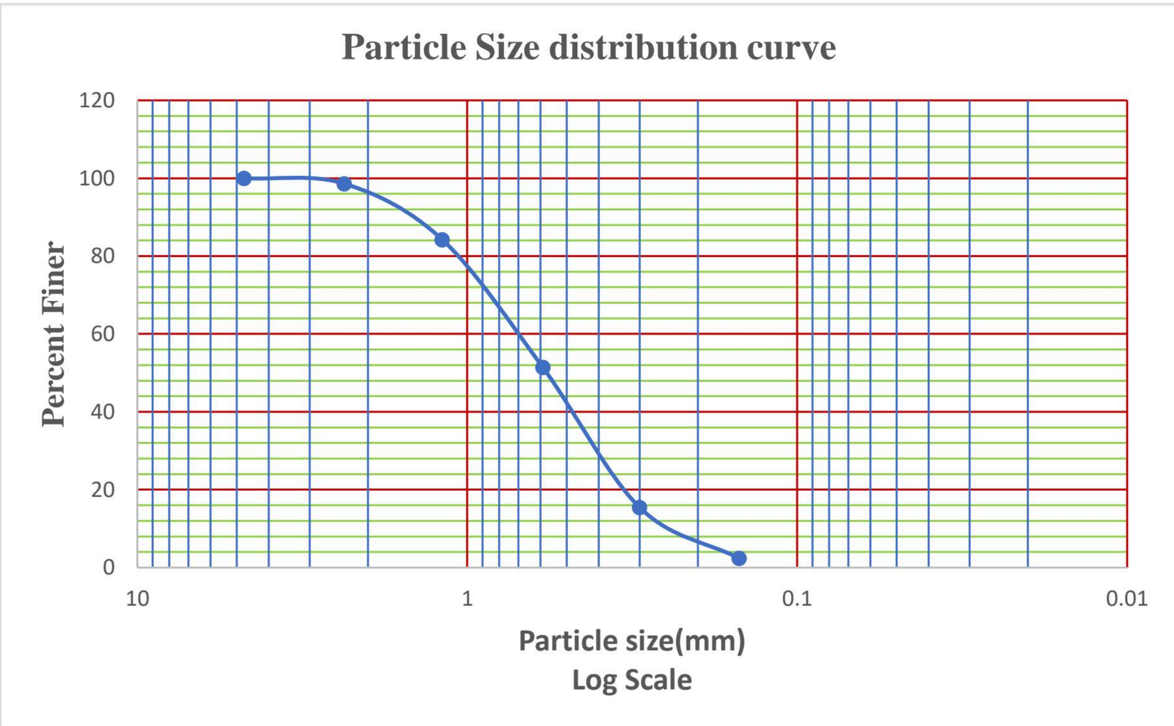

Figure 4.1: Grain size distribution curve of Sylhet sand

Table 4.5: Grain size distribution of Kustia sand

Sieve no	Sieve Opening (mm)	Materials Retained	%Materials Retained	Cumulative %Retained	%Finer
#4	4.75	0	0	0	100
#8	2.36	0	0	0	100
#16	1.19	21	4.2	4.2	95.8
#30	0.59	261	52.2	56.4	43.6
#50	0.30	157	31.4	87.8	12.2
#100	0.15	30	6.0	93.8	6.2
pan	_	31	6.2	100	_

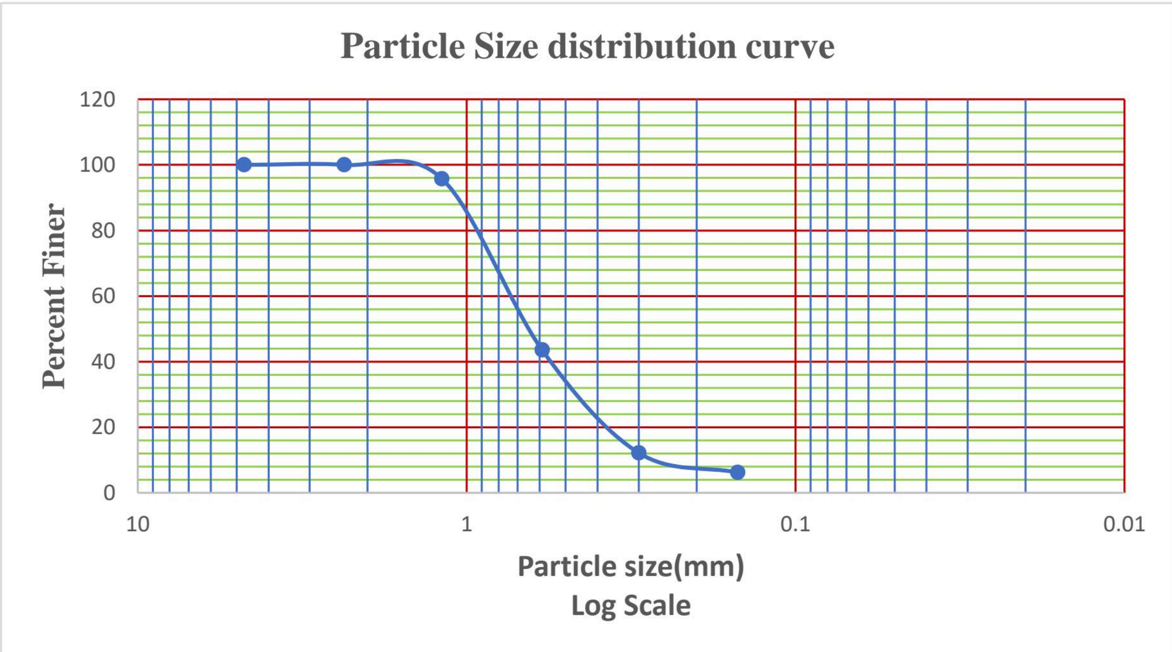

Figure 4.2: Grain size distribution of Kustia sand

Table 4.6: Grain size distribution of Local sand

Sieve no	Sieve Opening (mm)	Materials Retained	%Materials Retained	Cumulative %Retained	%Finer
#4	4.75	0	0	0	100
#8	2.36	4	4	0.8	99.2
#16	1.19	51	55	11	89
#30	0.59	365	420	84	16
#50	0.30	74	494	98.8	1.2
#100	0.15	6	500	100	0
pan					

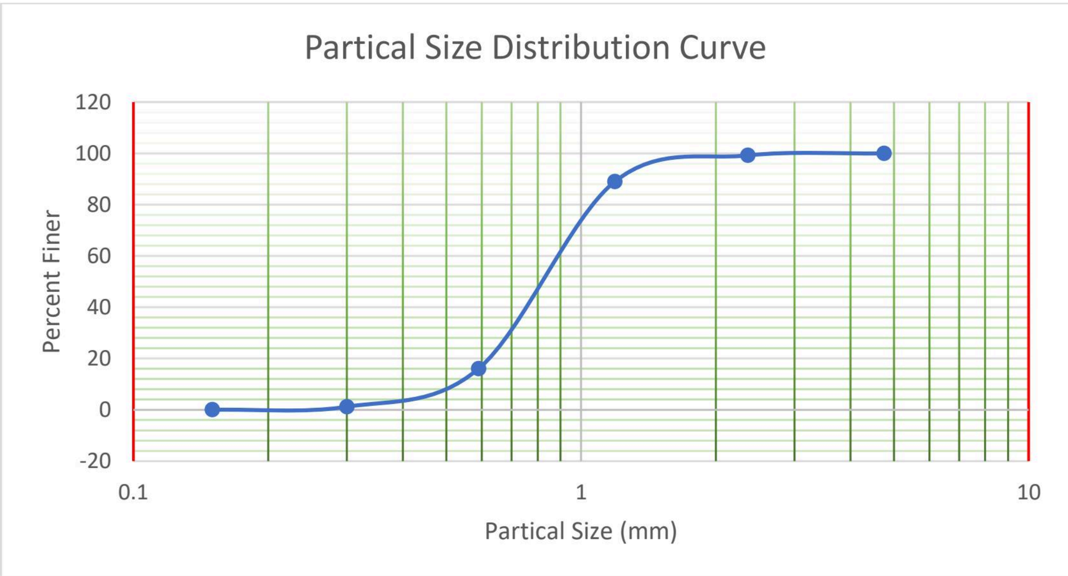

Figure 4.3: Grain size distribution of Local sand

4.4 Laboratory Test Result of Cement

Tests were performed to determine normal consistency of Cement according to ASTM standard procedure (ASTM C187-10) and setting time (ASTM C191-08).

Table 4.7: Physical properties of cement

Properties	Normal consistency (%)	Initial setting time	Final setting time
OPC	29%	25min	365min

Water:

Freshness of water was examined with naked eye. For this research we have used filtered water from Civil Engineering Department, SU. Other properties tests were not required for this study.

Table 4.8: Compressive Strength of Cement Mortar for Different Types of Sand

Mixing	Specimen No	Area (mm2)	Load (KN)			Average load (KN)			Average strength (MPa)		
			7 days	14 days	28 days	7 days	14 days	28 days	7 days	14 days	28 days
OPC+ Sylhet	1	7854	**122**	**142**	**208.5**	**120**	**144.3**	**210.16**	**15.37**	**18.37**	**26.75**
	2		**118**	**145**	**210**						
	3		**120**	**146**	**212**						
OPC+ Kustia	1	7854	**114**	**138**	**202**	**115**	**139**	**204.33**	**14.64**	**17.67**	**26.01**
	2		**115**	**140**	**206**						
	3		**116**	**139**	**205**						
OPC+ Local	1	7854	**78**	**115**	**181**	**76.67**	**113**	**182.83**	**9.76**	**14.38**	**23.27**
	2		**75**	**114**	**183.5**						
	3		**77**	**110**	**184**						

4.5 Compressive Strength of Cement Mortar

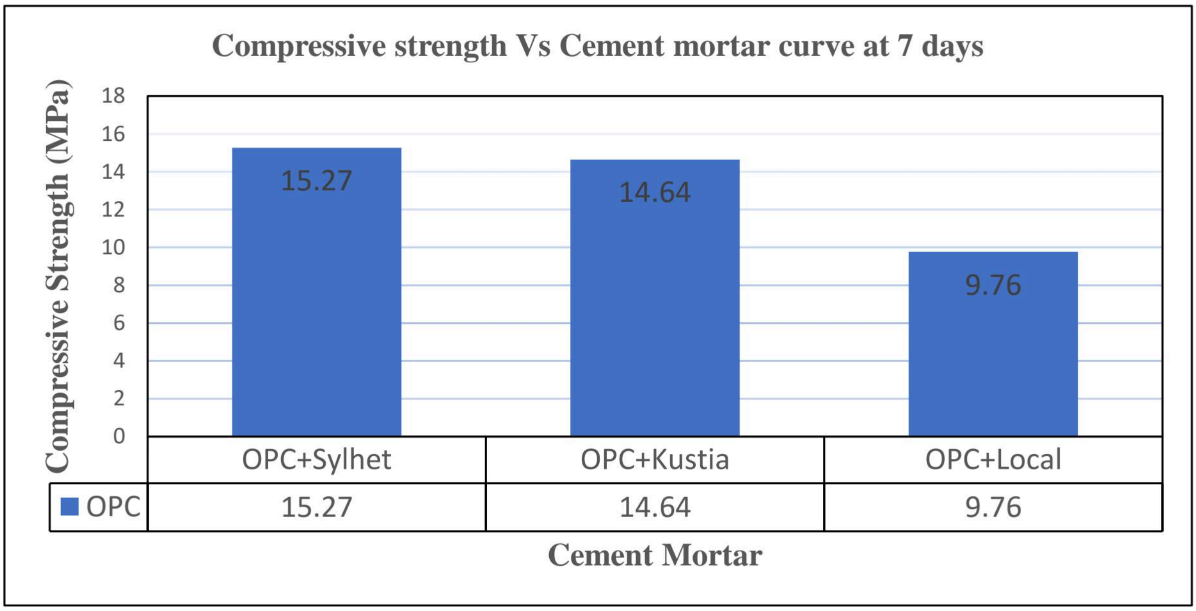

Figure 4.4: Variation of Compressive Strength of Cement mortar at 7 days

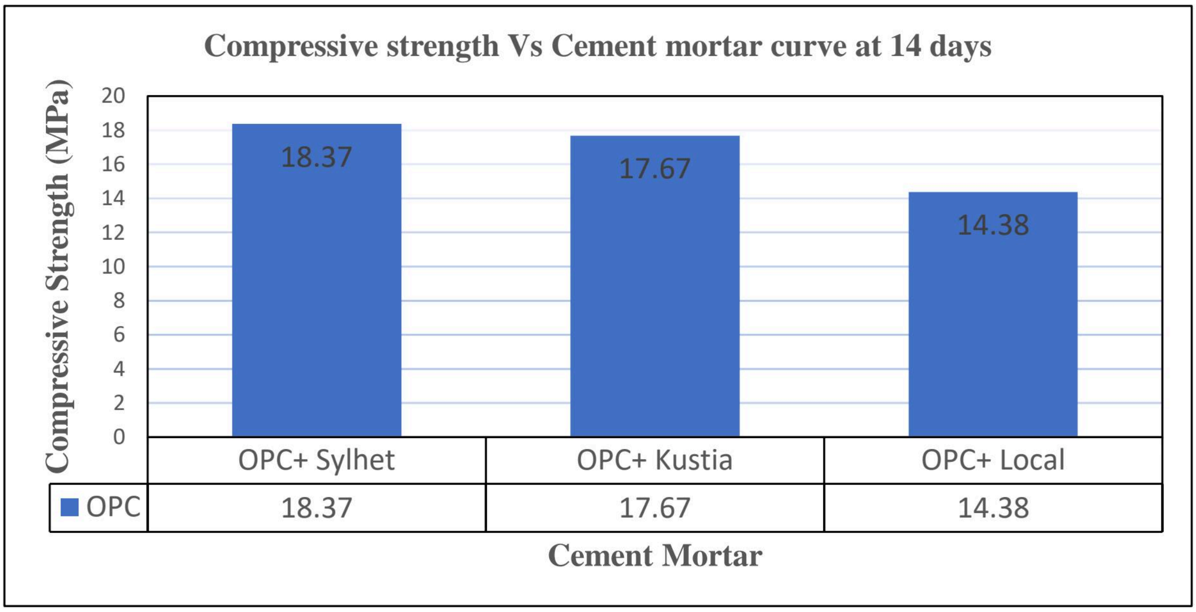

Figure. 4.5: Variation of Compressive Strength of Cement mortar at 14 days

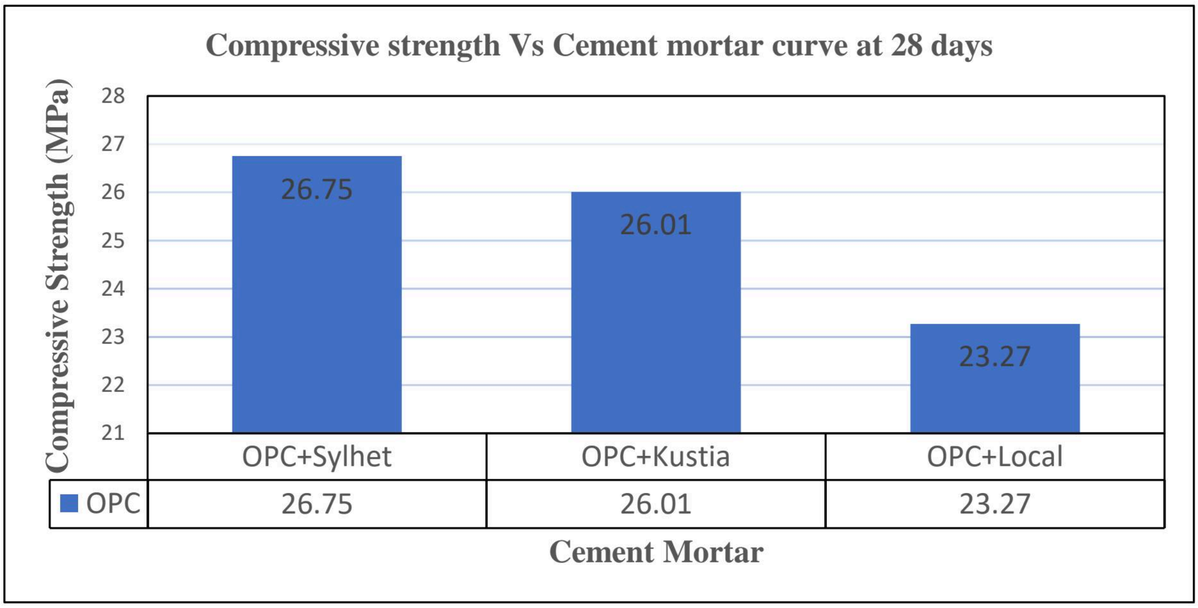

Figure. 4.6 Variation of Compressive Strength of Cement mortar at 28 days

4.6 Graphical Representation

Strength gaining

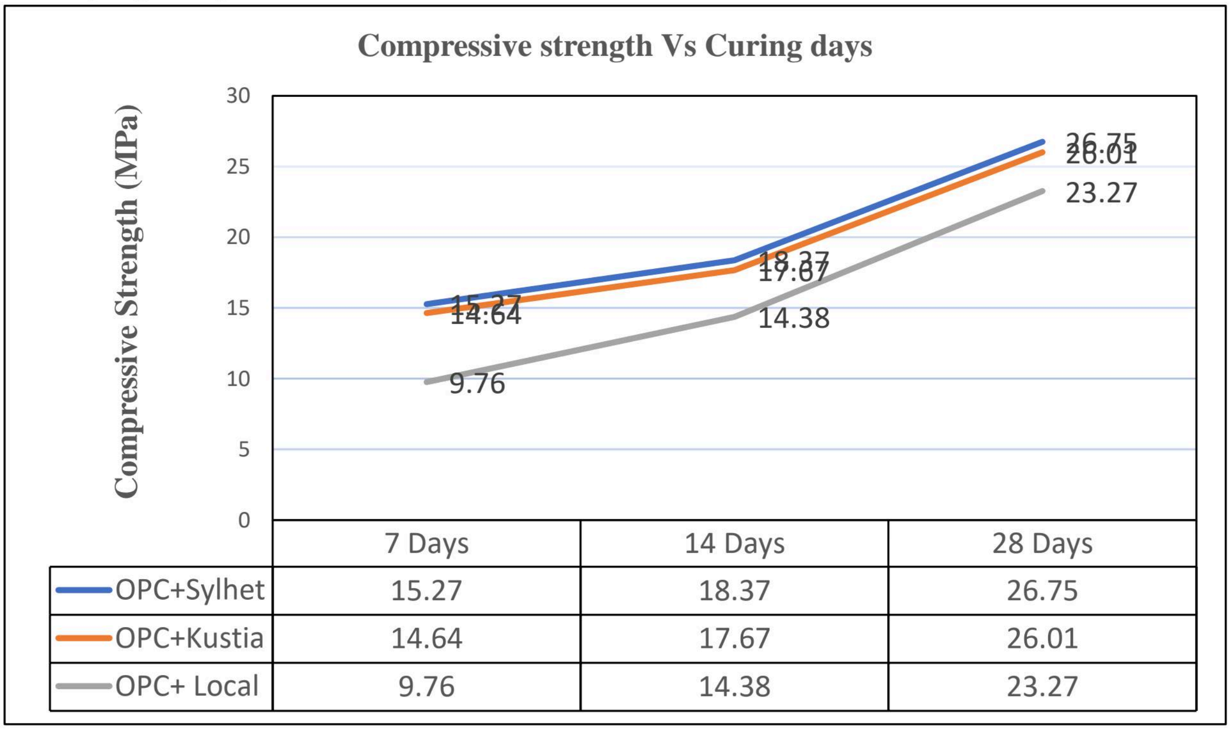

Figure. 4.7: Graphical Representation of all sand

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusions

Based on the results of this experimental study, the following conclusions are conducted where is different types of sand explanation.

1. Sylhet sand gives higher compressive strength of concrete and Kustia sand, Local sand gives lowest compressive strength of concrete respectively.
2. The mixed proportion concrete compressive strength of Kustia sand usage concrete 1.48 times more than local sand usage concrete and concrete 1.16 times more than Sylhet sand usage concrete.
3. Concrete compressive strength is gradually increases according to curing period.

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