COMPARATIVE STUDY ON COMPRESSIVE STRENGTH OF 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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Sonargaon University

147/I, Green Road, Dhaka-1215, Bangladesh

Section: 14B (Bangshi)

Semester: (Fall-2021)

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Dedicated

to

"Our Beloved Parent's"

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ABSTRACT

Mortar is a mixture of cement and sand in some specified proportion which is generally used for brick masonry and plastering. In first case of the mortar compressive loads such as the load of the wall above it, therefore it is very much necessary to test the mortar for its compressive strength. This paper discusses the variation of cement mortar compressive strength after 3, 7, 14, 28 days with different types of sand (Local sand, Sylhet sand, ASTM Standard Graded sand). In the experiment, 48 cubical specimens of 2 inch by 2 inch were tested to identify the compressive strength of cement mortar using Universal Testing Machine (UTM).

In this experiment we also used some process to increase the strength of mortar cylinder, there is curing process. Curing process must be followed to achieve desired concrete properties. Curing is necessary to ensure that the concrete will have sufficient moisture available to develop required properties. The results show that the compressive strength of cement mortar of ASTM Standard Graded sand is higher than that of the Sylhet or local sand. The difference in compressive strength of cement mortar tends to be greater as the difference in sand fineness increases.

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CHAPTER 1
INTRODUCTION

1.1 General

Compressive strength or compression strength is the capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstands loads tending to elongate. In other words, compressive strength resists compression (being pushed together), whereas tensile strength resists tension (being pulled apart). In the study of strength of materials, tensile strength, compressive strength, and shear strength can be analyzed independently. Some materials fracture at their compressive strength limit; others deform inversely, so a given amount of deformation may be considered as the limit for compressive load. Compressive strength is a key value for design of structures. Compressive strength is often measured on a Universal Testing Machine, these range from very small table-top systems to ones with over 53 KN capacity. Measurements of compressive strength are affected by the specific Test Method and conditions of measurement. Compressive strengths are usually reported in relationship to a specific technical standard. Compressive strength is measured on materials, components, and structures. By definition, the ultimate compressive strength of a material is that value of non-axial compressive stress reached when the material fails completely. The compressive strength is usually obtained experimentally by means of a compressive test. The apparatus used for this experiment is the same as that used in a tensile test.

1.2 Objectives of Compressive Strength Test

A. To determine the compressive strength of cement mortar with different type of sand after 3,7,14,28 days.
B. To compare the compressive strength of locally available sand with the standard graded sand.
C. To determine the actual sand type which give the best compressive strength.

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 (C. H. Huang, h, J. Chen and K. H. Fan (2012)).

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 (C. H. Huang, h, J. Chen and K. H. Fan (2012)), 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 (Ms. Shalini Mishra Ms. Nikita Jain (2019)).

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.

This research confirms that pervious concrete does in fact provide a lower compressive strength than that of conventional concrete; compressive strengths in acceptable mixtures only reached an average of around 1700 psi. Extremely high permeability rates were achieved in most all mixtures regardless of the compressive strength.

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, marl, shale, clay, blast furnace slag, slate (M.L. Gambhir (2010)).

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.

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 (Praveen Kumar K, Radhakrishna (2014)).

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.

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 (Praveen Kumar K, Radhakrishna (2014)).

Hydraulic cements (e.g., Portland cement) set and become adhesive due to a 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 (Shetty, M.S. (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 (Shetty, M.S. (2008)). 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".

In Russia'. Eger created a. new binder by mixing lime and clay. His results were published in 1822 in his book A Treatiseonthe Artto Preparea 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.

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 mid19th 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 (C. H. Huang, h, J. Chen and K. H. Fan (2012)). Joseph Aspdins' son William Aspdin had left his father's company and, in his cement, manufacturing apparently accidentally produced calcium silicates in the 1840s, a 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 (Ms. Shalini Mishra Ms. Nikita Jain (2019)). 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 meso-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 limes, "natural" cements, and "artificial" cements all rely upon their belite content for strength development. Belite develops strength slowly. Because they were burned at temperatures below 1,250 °C (2,280 °F), they contained no alite, which is responsible for early strength in modem cements. The first cement to consistently contain alite was made by William Aspdin in the early 1840s: lbis was what we call today "modem" Portland cement. Because of the air of mystery with which William Aspdin surrounded his product, others (e.g., Vicat and Johnson) have claimed precedence in this invention, but recent analysis of both his concrete and raw cement has shown that William Aspdin's product made at Northfleet, Kent was a truealite - based cement. However, Aspdin'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.

It was not as durable, especially for highways, to the point that some states stopped building highways and roads with cement. Bertrainh. wait, an engineer whose company had worked on the construction of the New York city's catskill aqueduct, 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 massive deposit of a large dolostone rock deposit discovered in the early 19th century near rosendale, 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 in 1867 by frenchman stanislassorel 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 a stronger, more homogeneous mixture and a continuous manufacturing process.

Modern cements

Modern hydraulic cements began to be developed from the start of the Industrial Revolution (around 1800), driven by three main needs

- Hydraulic cement render (stucco) for finishing brick buildings in wet climates.
- Hydraulic mortars for masonry construction of harbor works, etc., in contact with sea water
- Development of strong concretes.

Modern cements are often Portland cement or Portland cement blends, but other cements are used in industry.

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
SiO_2 content (%)	2.9	52	35	35	85-97
Al_2O_3 content (%)	6.9	23	18	12	-
Fe_2O_3 content (%)	3	11	6	1	-
CaO content (%)	63	5	21	40	<1
MgO content (%)	25	–	–	–	–
SO_3 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

[a] Values shown are approximate: those of a specific material may vary.

[b] Specific surface measurements for silica fume by nitrogen adsorption (BET) method, others by air permeability method (Blaine).

2.4 Properties of Cement

It is always desirable to use the best cement in constructions. Therefore, the properties of a cement must be investigated. Although desirable cement properties may vary depending on the type of construction, generally a 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) and having capacity 1,70,00 M.T

2. PREMIER CEMENT MILLS LIMITED.

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

3. SHAH CEMENT INDUSTRIES LTD.

[A unit of Abul Khair group shah cement ind.ltd is 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 Hossian ltd - a renowned construction company in Bangladesh]
Products: ordinary Portland cement (opc) & Portland composite cement (pcc), 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 Sangstha (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. Noapara 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. (cel)

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 than 85% 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 (Ms. Shalini Mishra Ms. Nikita Jain (2019)).

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 landmasses are made up of rocks and minerals, including quartz, feldspar and mica (M.L. Gambhir (2010)).

2.7 Properties of Sand

Quartz is a very hard mineral, ranking a 7 on the mohs 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 (Shetty, M.S. (2008)).

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 SiO_2 and form Fe_3Si.

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

Sand:

1. ASTM standard graded sand/Ottawa sand.
2. Sylhet sand.
3. Local sand.

Cement:

1. Ultratech OPC cement

3.2 Laboratory investigation of sand

1. Determination of fineness modulus.
2 Gradation of sand.

3.3 Laboratory investigation of Cement

1. Determination of normal consistency of cement.
2. Determination of setting of cement.

3.4 Compressive strength of cement mortar cube

1. OPC+ Ottawa sand.
2. OPC+ Sylhet sand.
3. OPC+ Local sand.

3.5 Methods

The mortar was prepared in nominal mix ratio with water/cement ratio of 0.50. It was thoroughly mixed before casting inside molds. The cubes were initially cleaned and light coat of oil was applied on the inner surface of the cubes. The cubes were later placed on smooth horizontal rigid surface. Thereafter, each cube was then cast in three layers with freshly mixed mortar and each layer was tamped with rounded end rod. Curing commences the following day after casting. 3, 7, 14 and 28days hydration period was adopted. Three sets of cubes were cast for each hydration period. That is, three for Ottawa sand, three for Sylhet sand and three for local sand. At the last day of hydration period, the samples were removed from the curing tank and crushed. The compressive strength of each sample was then noted.

CHAPTER 4

RESULTS ANALYSIS

4.1 Introduction

In this chapter, the experimental test results are presented. Different Laboratory test result of sand and cement are given below:

4.2 Determination of fineness modulus of sand

The fineness modulus of sand is determined according to the test procedure described in ASTM Standard (as per ASTM C 136-01). 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

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

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

Table 4.2 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	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

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

$$= \frac{4.2+56.4+87.8+93.8}{10}$$

$$= 2.42$$

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 (ASTM C 136-01). The result of this test both for sylhet sand and local sand is given below:

Table 4.3 Grain size distribution of Sylhet sand

Sieve no	Sieve Opening (mm)	Materials Retained	%Materials Retained	Cumulative %Retained	%Finer
#4	4.75	0	0	0	10
#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

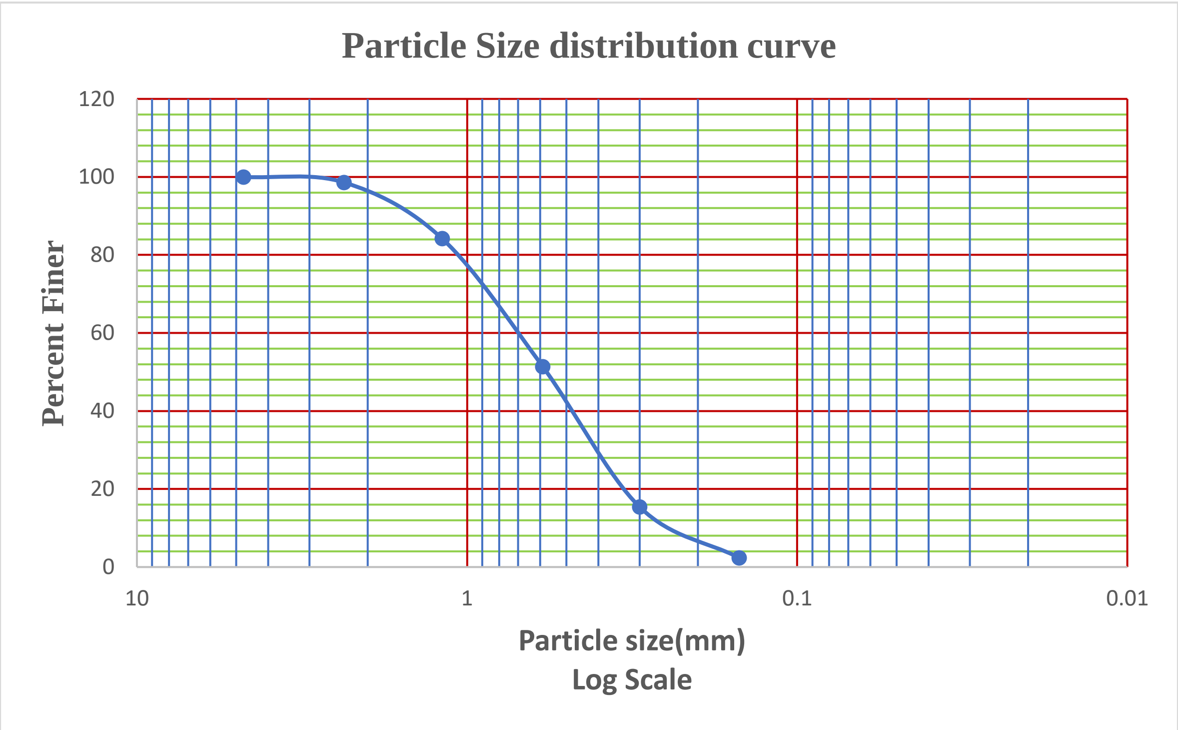

Figure. 4.1 Grain size distribution curve of Sylhet sand

Table 4.4 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	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	_

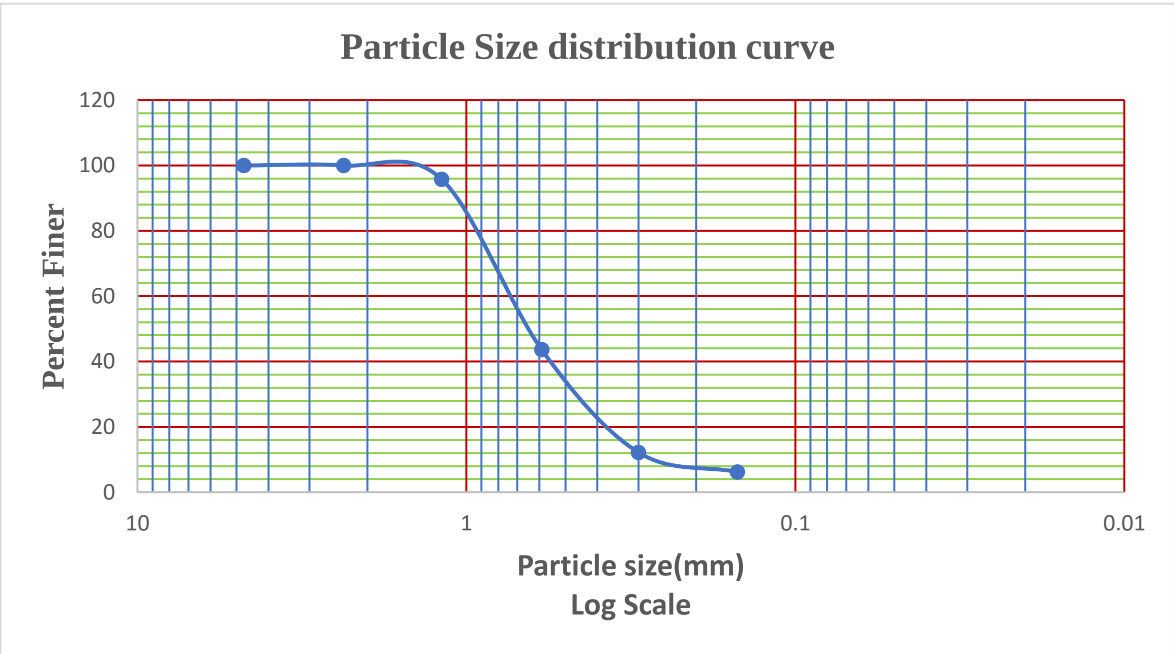

Figure. 4.2 Grain size distribution of Local sand

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 4.5 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.

4.5 Compressive Strength Test of Cement Mortar

Table 4.6 Compressive Strength of Cement Mortar for Different Types of Sand

Mixing composition	Specimen No.	Area (mm^2)	Load (KN)				Average load (KN)				Average strength (MPa)			
			3 days	7 days	14 days	28 days	3 days	7 days	14 days	28 days	3 days	7 days	14 days	28 days
POC+ Ottawa sand	1	2500	45	60	70	90	43	61.75	71	91.75	17.2	24.7	28.4	36.7
	2		42	62	68	95								
	3		40	65	72	92								
	4		45	60	74	90								
OPC+ Sylhet sand	1	2500	25	45	65	75	24.25	44.25	63.75	78.75	9.7	17.7	25.5	31.5
	2		25	43	60	78								
	3		22	45	62	82								
	4		25	44	68	80								
OPC+ Local sand	1	2500	13	20	35	60	14.25	20.5	36.0	61.75	5.7	8.2	14.4	24.7
	2		15	20	38	65								
	3		16	22	35	62								
	4		13	20	36	60								

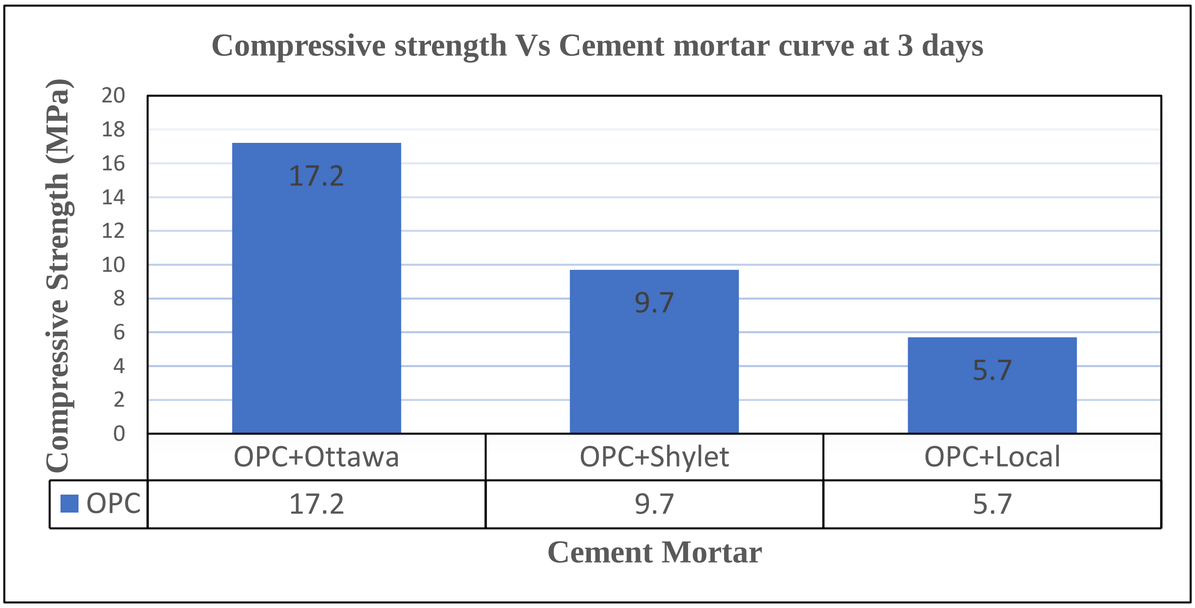

Figure.4.3 Variation of compressive strength of cement mortar at 3 days

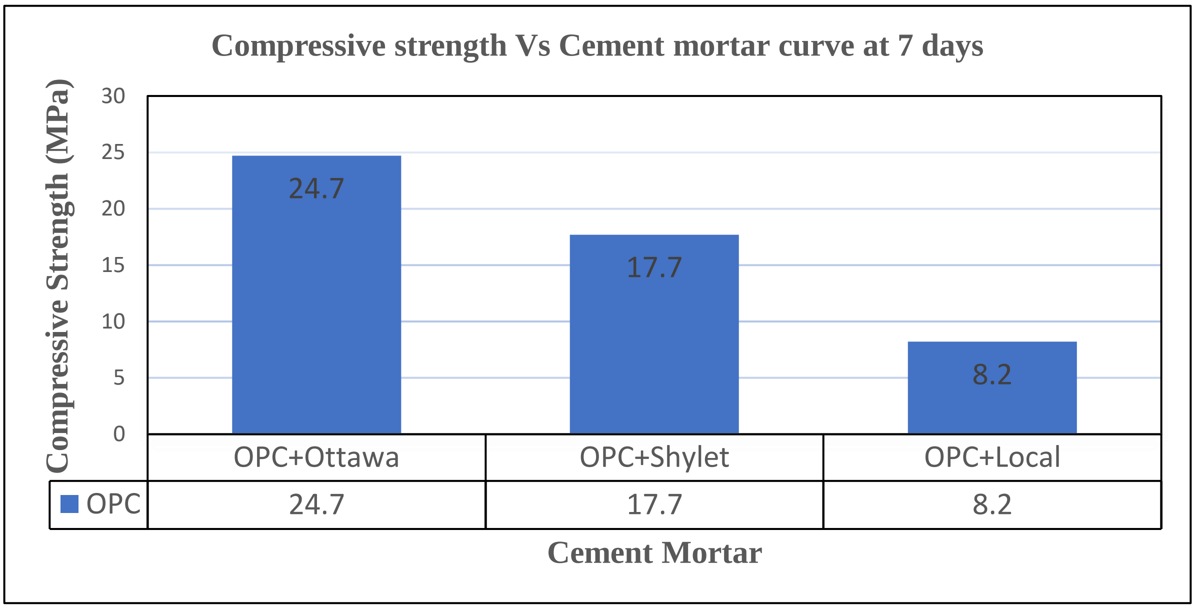

Figure. 4.4 Variation of compressive strength of cement mortar at 7 days

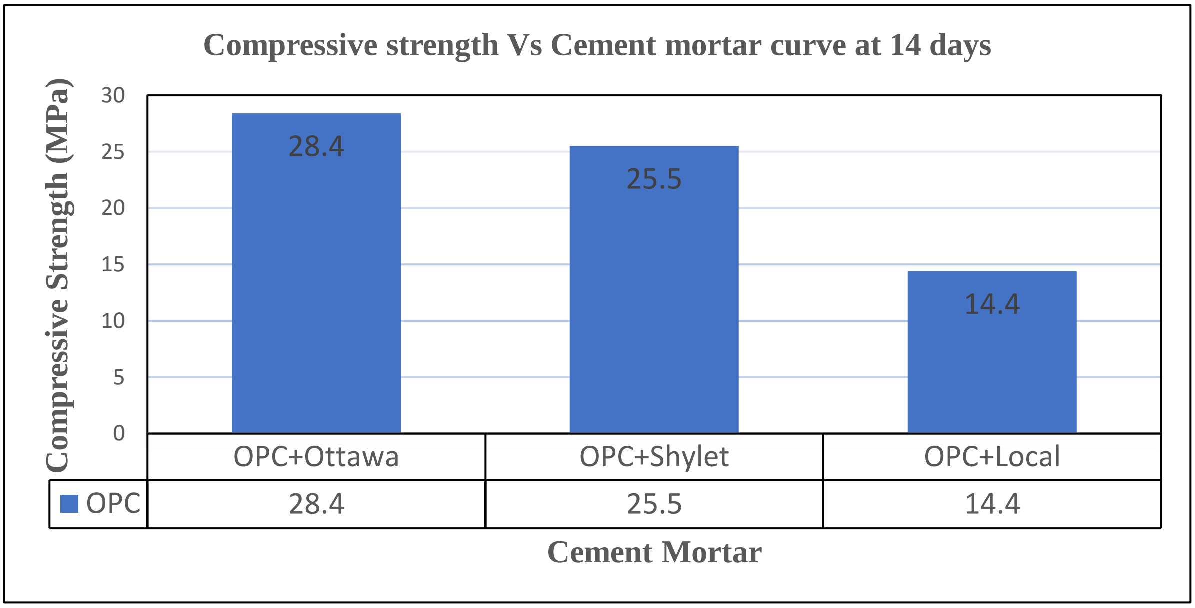

Figure. 4.5 Variation of compressive strength of cement mortar at 14 days

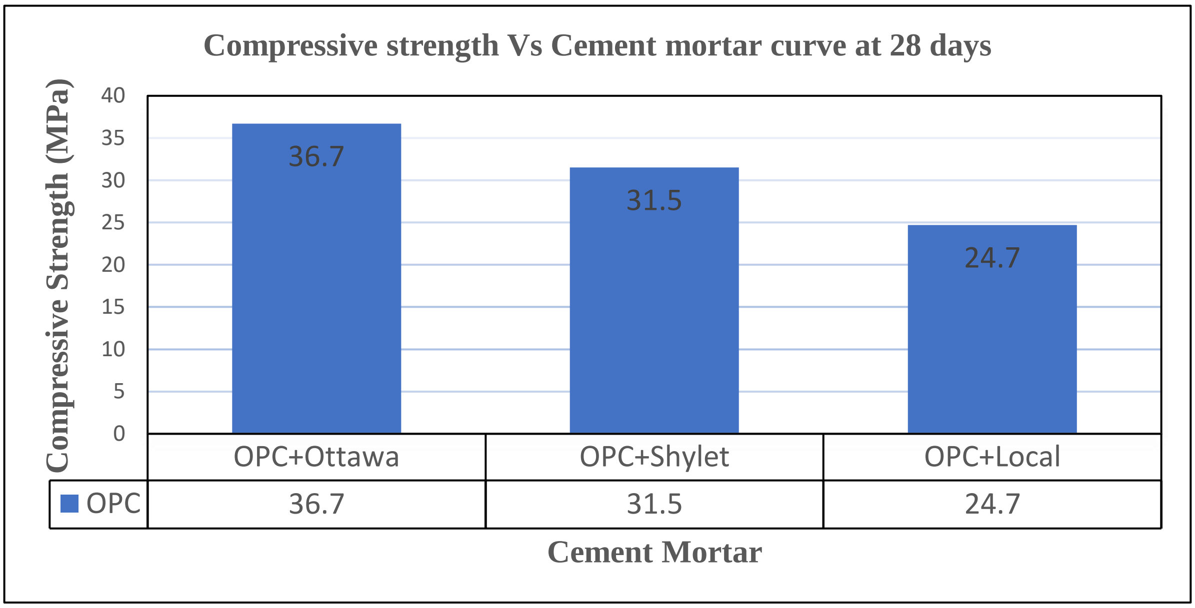

Figure. 4.6 Variation of compressive strength of cement mortar at 28 days

4.6 Graphical representation

Strength gaining

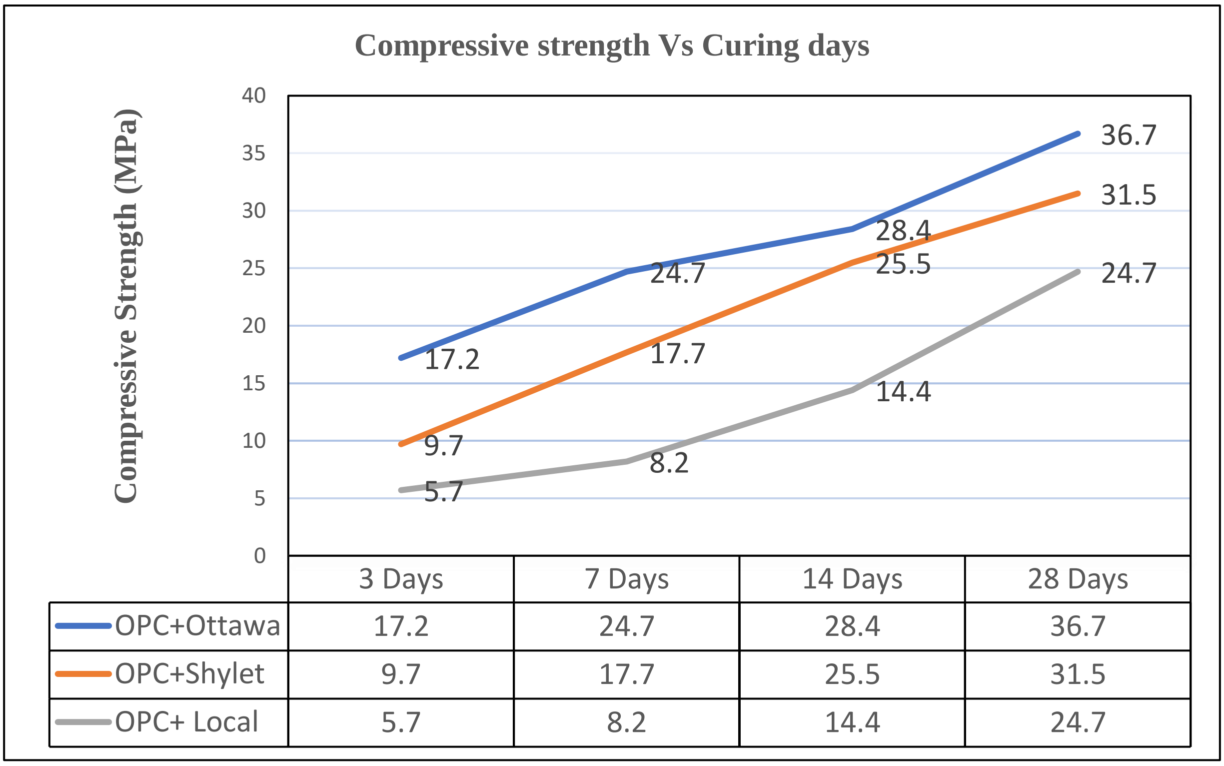

Figure. 4.7 Graphical representation of all sand

CHAPTER 5

CONCLUSIONS

5.1 Conclusions

The results show that the compressive strength of cement mortar of ASTM standard graded sand is higher than that of the sylhet or local sand. The strength of Ottawa cement mortar in 3 days is about 55% higher than local sand, in 7 days it is about 48%, in 14 days it is about 30% and in 28 days it is about 23% higher than local sand.

REFERENCES

(C. H. Huang, h, J. Chen and K. H. Fan (2012)) *Effects of mortar on the properties of lightweight aggregate concrete blocks.*

(Ms. Shalini Mishra Ms. Nikita Jain (2019)) *Comparative Study of Compressive Strength of Cement Concrete with Conventional and Supplementary Materials.*

(M.L. Gambhir (2010)) *"Concrete Technology "fourth edition 2012, Tata Mc Grew Hil Education Private Limited (New Delhi).*

(Praveen Kumar K, Radhakrishna (2014)) *"Strength and Workability of Cement Mortar with Manuflyashtured Sand" International Journal of Research in Engineering and Technology EISSN: 2319-1163 plSSN:2321-7308.*

(Shetty, M.S. (2008)). *Book "concrete Technology, "S. chand and company Ltd., New Delhi.*