Comparison of the Compressive Strength of Concrete Produced using Sand from Different Sources

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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: 14C

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DECLARATION

We hereby declare that this report is our own work and effort and that it has not been submitted anywhere for any award.

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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 after3, 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.

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.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1
INTRODUCTION

1.1 Background and Motivations

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 load standing 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[1]. 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 Research Objectives

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 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 [3].

2.3 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

2.4 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 [2].

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 [3].

2.5 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 [5].

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.

CHAPTER 3
METHODOLOGY

3.1 Materials

Sand:

1. ASTM standard graded sand/Ottawa sand.
2. Sylhet sand. (2.65)
3. Local sand. (3.41)

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 and Discussion

4.1 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=Total cumulative retained of sand
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=Total cumulative retained of sand
Total weigh to sand

$$=\frac{4.2+56.4+87.8+93.8}{10}$$
$$= 2.42$$

4.2 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

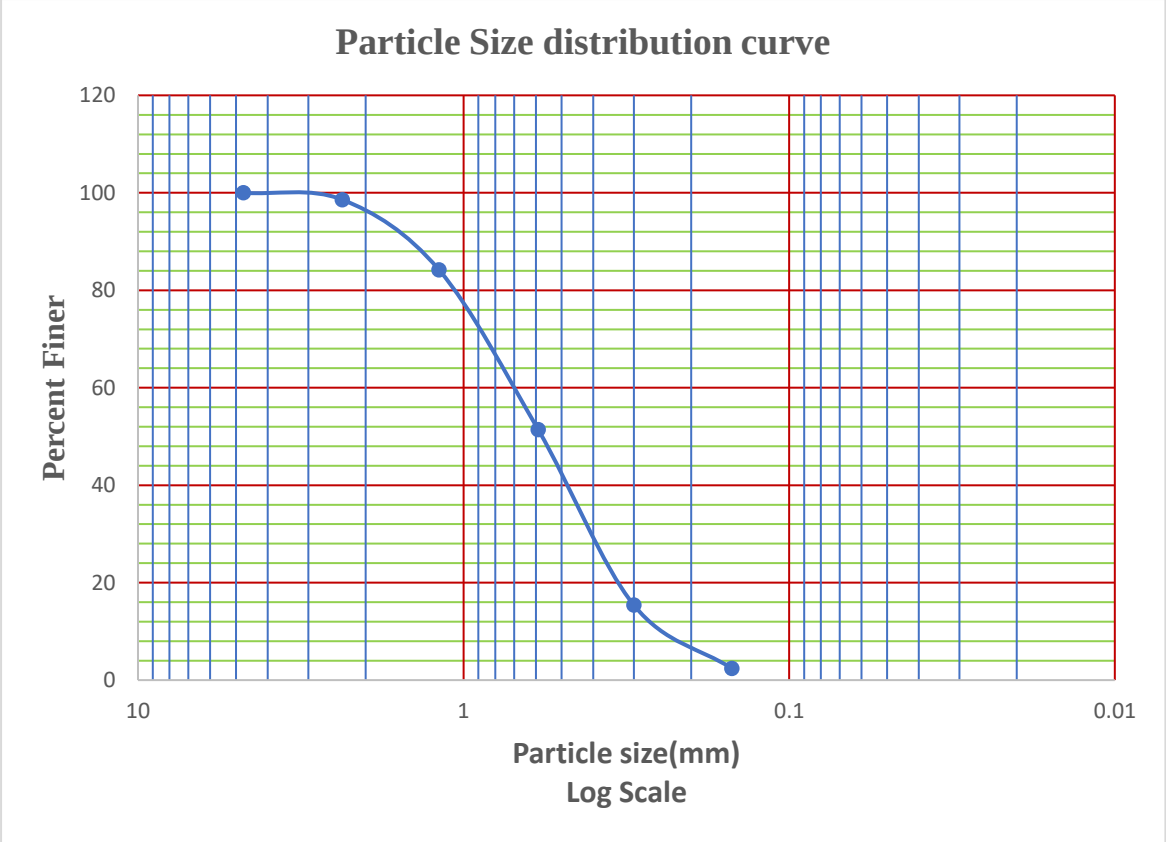


Figure. 4.1 Grain size distribution curve of Sylhet sand

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	_

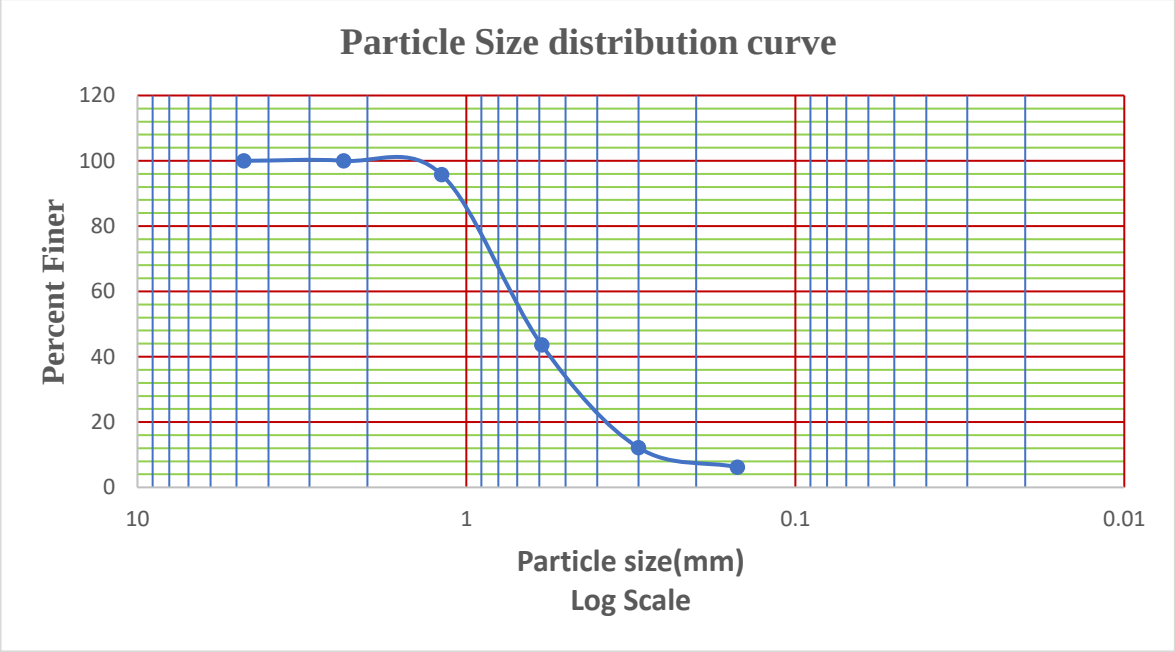


Figure. 4.2 Grain size distribution of Local sand

4.3 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

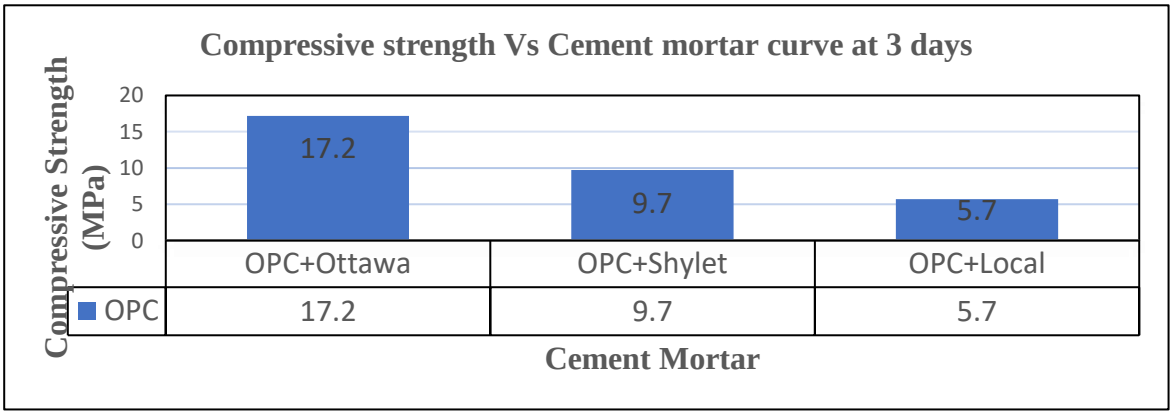
Water:

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.

4.4 Compressive Strength Test of Cement Mortar

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								

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



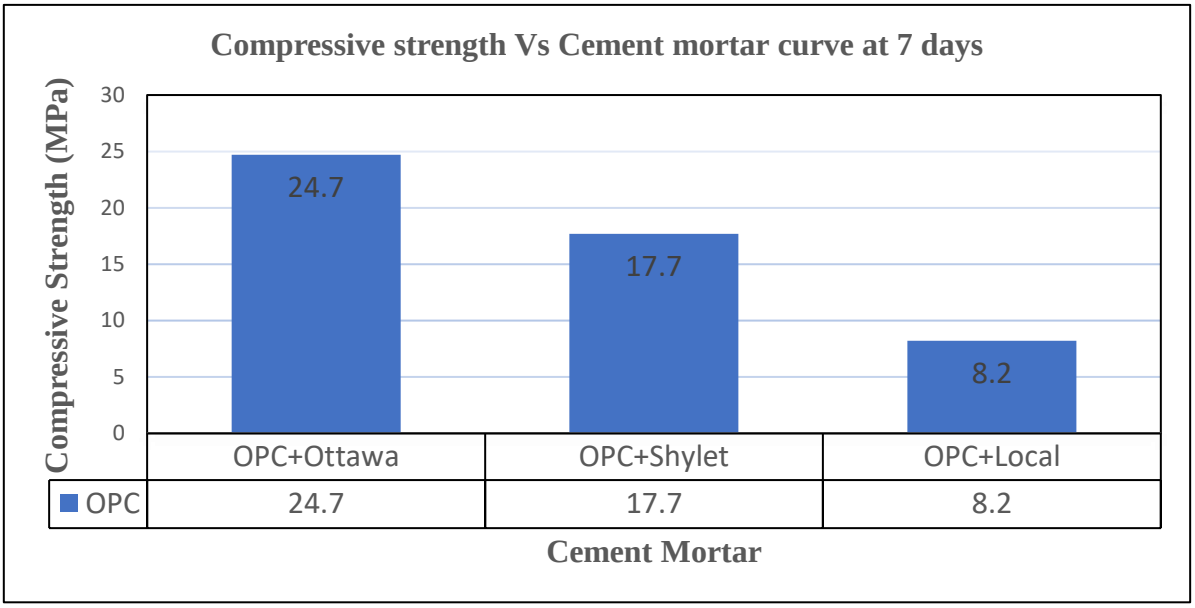


Figure. 4.4 Variation of compressive strength of cement mortar at 7 days

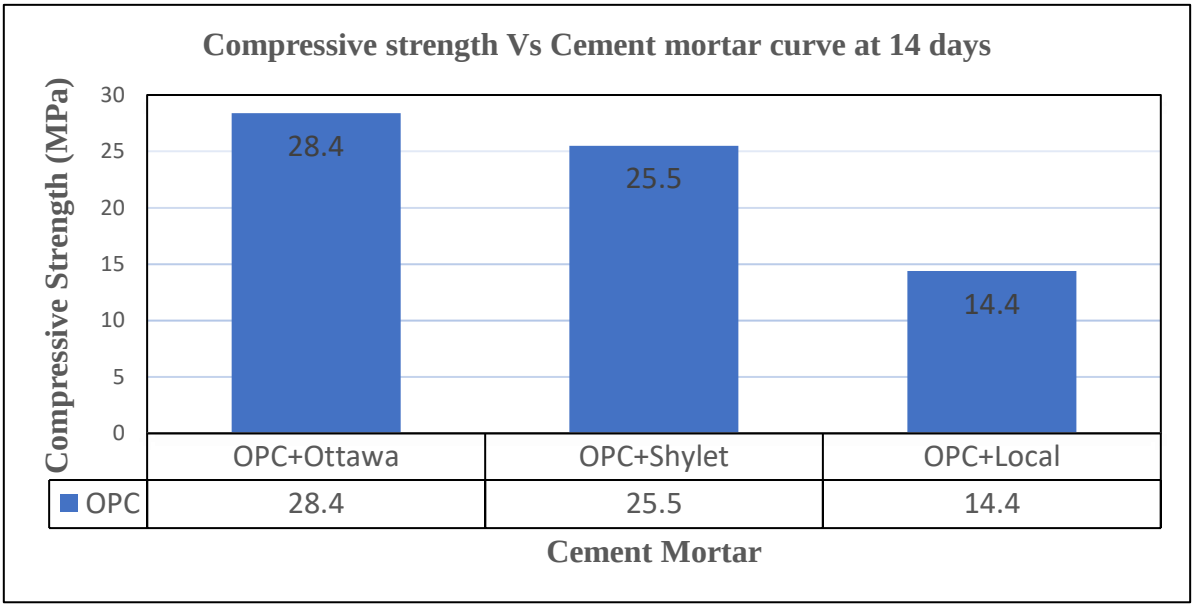


Figure. 4.5 Variation of compressive strength of cement mortar at 14 days

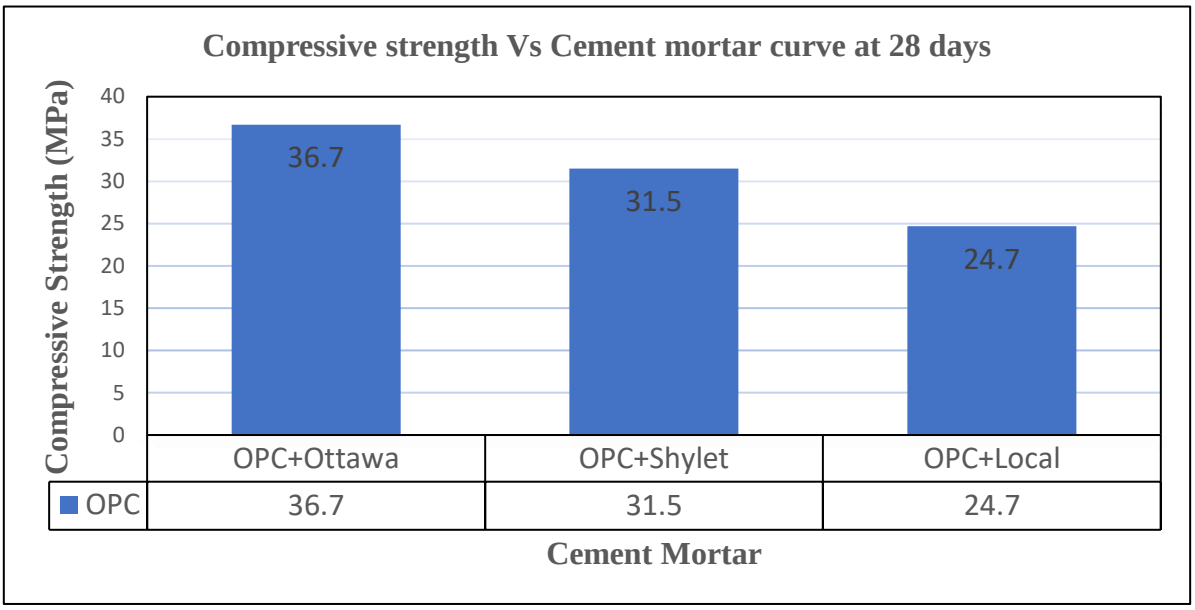


Figure. 4.6 Variation of compressive strength of cement mortar at 28 days

2.6 Graphical representation

Strength gaining

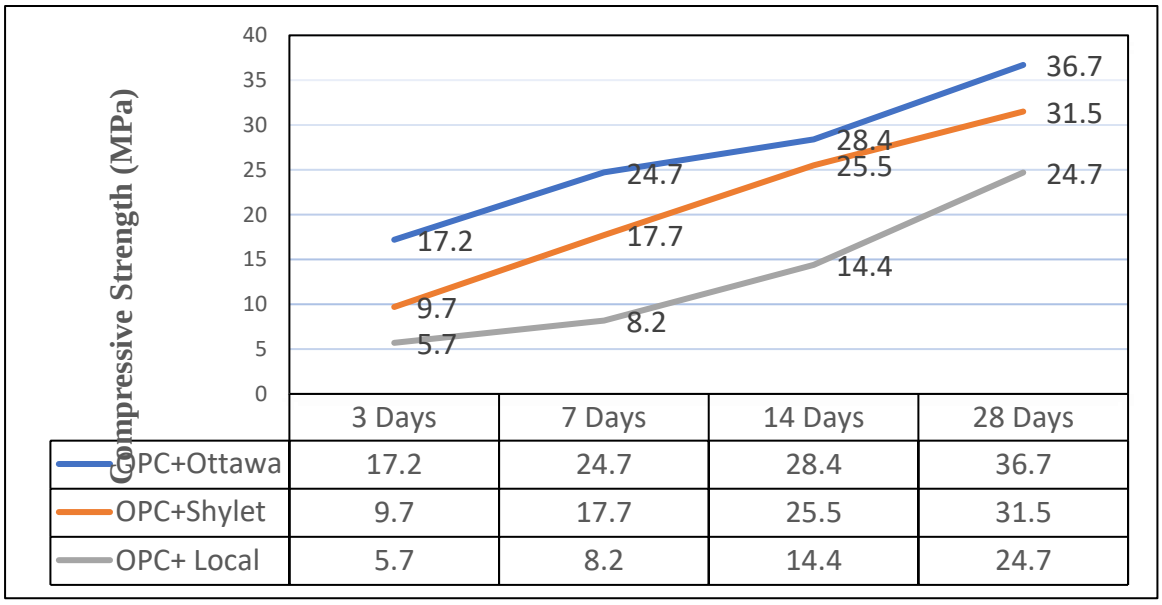


Figure. 4.7Graphical representation of all sand

CHAPTER 5
CONCLUSIONS

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.

Future studies

Sylhet sand contains a significant quantity of iron (29.4mg/g), which may play a vital role in removing arsenic through adsorption.

The iron-rich Sylhet sand bed may be a promising option for arsenic removal and proper design will ease the pavement to make the technology more effective.

As in however river sand is finer in gradation then Sylhet sand. There is a variation in compressive strength of cement concrete using river sand and Sylhet sand separately.

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