# COMPARISON OF THE PROPERTIES OF ALTERNATIVE BUILDING BLOCK WITH BURNT CLAY BLOCK

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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


Department Of Civil Engineering

Sonargaon University (SU)

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

Section- 14B

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## DECLARATION

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

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## Dedicated

To

“Our Honorable Teachers”

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# ABSTRACT

Environment pollution is the most concerned issue in today's world. Construction Industries is one of the largest sectors to pollute the environment. In Bangladesh, burnt clay block is the most commonly used building material which produces a significant amount of greenhouse gasses. For a better environment alternative sustainable building material is a must. This study appraises alternative building materials and technologies as a walling material. Burnt clay block have been used for long in building construction and its demand is increasing rapidly with the passage of time. In the burning process of clay block air is polluted and necessary clay is collected from agricultural land. As a result, agricultural land is being diminished. So alternative building block can be the possible solution of the disadvantages of burnt clay block. In this thesis, we use three types of blocks. These are burnt clay block (BCB), Block from Gazipur (GP), Block from Gaptoli (GT). The bulk density of burnt clay block, block from Gazipur, block from Gabtoli were 1740, 1310 and 1400 kg/m3 respectively. The absorption of burnt clay block, block from Gazipur, block from Gabtoli were 13.1, 11.9 and 9.6% respectively. The 28 days compressive strength of these blocks were 3300, 2040 and 1740 psi respectively. So for use in construction block from Gazipur is better than other types.

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CHAPTER 1

# INTRODUCTION

## 1.1.1 General

Burnt clay block have been used for long in building construction and its demand is increasing rapidly with the passage of time. In the burning process of clay brick air is polluted and necessary clay is collected from agricultural land. As a result, agricultural land is being diminished. Using light weight block in building construction foundation cost can be reduced as foundation treatment is directly related to the load of the structures. At present, energy use has become a burning question word wide, in which building consume between 20 and 40% of the total energy consumption in developed countries (Camila Barreneneche, 2013).

### 1.1.2 Objective of Study

The objectives of this study are as follows:

i. To investigate the physical and mechanical properties of the block.

ii. To reduce environment pollution and encourage people to use alternative building block.

### 1.1.3 Burnt Clay block (BCB) :


Figure 1.1.3 : Burnt Clay block

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1.1.4 Gazipur block (GP) :

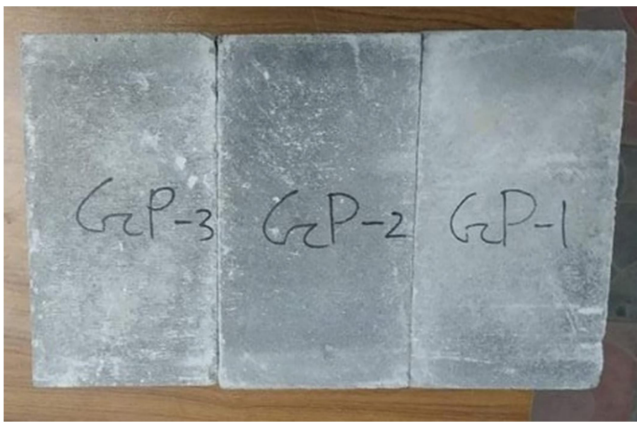


Figure 1.1.4: Gazipur block

1.1.5 Gabtoli block (GT) :

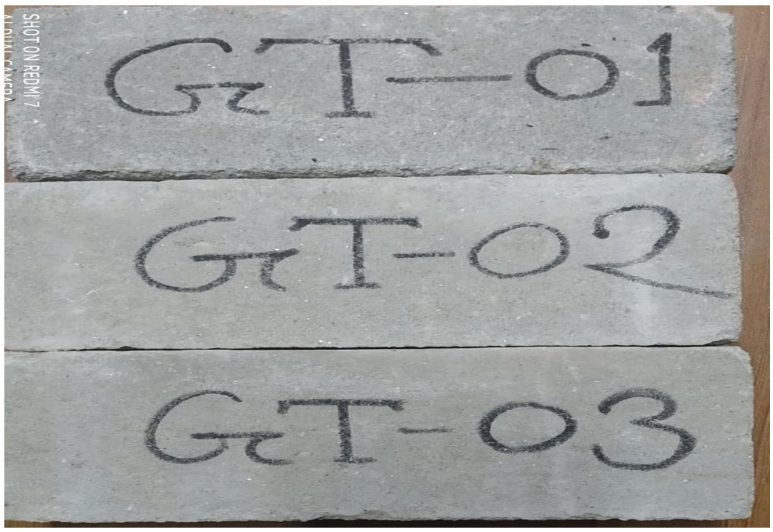


Figure1.1.5: Gaptoli block

### 1.1.6 Brick kilns top polluter in Bangladesh:

Brick kilns are the top air polluter in seven major cities in the country, particularly during dry season when most bricks are made, turning the air quality of these metropolises “Severely unhealthy”.

Also to blame are construction work that kicks u dust, poorly-maintained vehicles that emit excessive harmful particles and toxic gases, and industrial air pollution, according to the department of Environment (DOE).

A five-year survey by the department found Narayanganj has the most polluted air, followed by Dhaka. Third is Gazipur, which is followed by Rajshahi, Chattogram, Khoulna, and Barisal.

Figure1.1.6: **Brick kilns top polluter in Bangladesh**

### 1.1.7 Agricultural land is cut by cutting soil and brick kiln:

The soil of the crop land is being cut and taken to the kiln. The soil is losing its fertility as the upper part of the land i.e. the top soil brick goes down. As a result, hundreds of acres of land have become uncultivated and there is a danger of food shortage. In the aman season, as soon as the paddy is harvested, the process of cutting the soil from the of cutting the soil from the crop land and taking it to the brick kiln begins. The owner off the brick kiln and some unscrupulous soil traders are showing greed for money to the farmers by cutting the soil with the help of workers or machines.

Figure1.1.7: **Agricultural land is cut by cutting soil and brick kiln**

### 1.1.8 APPLICATION OF ALTERNATIVE BUILDING MATERIAL

The customary building construction trend in Bangladesh usually focuses on the use of burnt clay bricks for the infill and Reinforced Cement Concrete frame structures. Under the study project the researcher try to establish CSEB, Hollow Block, Thermal Block and others material as an infill wall material.

Figure 1.1.8 : Model House-II using Compressed Stabilized Earth Block and Thermal Block at HBRI campus

### 1.1.9 Use of Interlocking, Compressed Stabilized Earth Block (CSEB)

To find out the performance of interlocking block, HBRI has taken initiatives to complete a one storied building within an area of about 320sft. The successful implication of interlocking bricks can be proved to be an exceptional substitute to burnt clay bricks.

Figure 1.1.8 : Model house-I with interlocking blocks

### 1.1.10 Use of Hollow Block

HBRI has Constructed a two stories Building using alternative building material at HBRI campus. Sand Cement Hollow blocks are used in the Model House. The Total area of the building is about 1300 square ft.

### 1.1.11 Use of Thermal Block

Two Model House has been constructed at HBRI campus under the study project. Thermal block are used in the second story of the Building. The Performance of the Block is pretty well. Another advantage of using thermal block is the properties of thermal and sound in solution

CHAPTER 2

# LITERATURE REVIEW

## 2.1.1 General

Alternative building block is necessary because traditional burnt clay brick having much weight produce smoke in construction process which pollutes the environment and necessary clay is collected from agricultural top soil. This practice is diminishing the agricultural land. .Heat Insulation is very important factor for the comfort of people living in residential building. Wall made from these blocks can reduce room temperature. As a whole, these blocks are economical, less energy intensive, fire resistant, environment-friendly and recommended for earthquake resilient buildings.

## Some Types of Existing Alternate Building Blocks

### 2.1.2 Sand Cement Hollow Block

A Sand Cement block is one of several precast concrete products used in construction. Hollow block helps in saving construction materials and therefore use of hollow block reduces construction cost. Use of larger size concrete block reduces number of joints in work and hence helps in saving mortar. Sand Cement Hollow block masonry can safely with stand the atmospheric action and it requires no protective covering. Hollow block have good insulating properties against sound, heat and dampness. Presence of rough surface on blocks provides good bonding of mortar and plaster.

Figure 2.1.2. Hollow Concrete Block (Md. Akhter Hossain Sarker, 2018)

### 2.1.3 Autoclaved Aerated Concrete

Autoclaved Aerated Concrete is a lightweight, precast, foam concrete building material suitable for producing concrete masonry unit (CMU) like blocks. Composed of quartz sand, calcined gypsum, lime, cement, water and aluminum powder, AAC products are cured under heat and pressure in an autoclave.

Figure 2.1.3 Autoclaved Aerated Concrete Block (Md. Akhter Hossain Sarker, 2018)

### 2.1.4 Compressed Stabilized Earth Block (CSEB)

Housing and Building Research Institute has produced CSEB from the dredged soil of river mixing with proportion of cement. The production cost of CSEB is near about half of the conventional burnt clay brick.

Figure 2.1.4 Compressed Stabilized Earth Block (CSEB) (Md. Akhter Hossain Sarker, 2018)

### 2.1.5 Interlocking CSEB

These types of blocks are prepared with proportionate mixing of dredged soil from river with cement and sand. It is possible to prepare wall without any mortar due to its' interlocking mechanism.

Figure 2.1.5 Interlocking Compressed Stabilized Earth Block (Md. Akhter Hossain Sarker, 2018

### 2.1.6 Thermal Block

Thermal Block is produced using Sheet with both side mortar. The advantage of thermal Block is that it has good thermal and sound insulation properties. Moreover, the weight of the block is almost half of the traditional or fire brick

Figure 2.1.6 Thermal Block (Md. Akhter Hossain Sarker, 2018)

Bjørn Petter Jelle concluded that nowadays there exist no single thermal insulation material which can satisfy thermal conductivity, perforation vulnerability, building site adaptability

Expanded polystyrene) is one of the industrial solid waste that having serious problem for disposal. The world today has concern in environmental issue, the problem to accumulate of unmanaged solid waste. The is not a biodegradable type; it will not provide an environmental friendly solution to landfills. In increase concern for environmental issues, the sustainable development and energy conservation concept has become paramount importance

It is one of many light weight, low strength materials with density between (16-27) kg/m3 and good energy absorbing characteristics. It is well known for its good thermal and acoustic insulation properties leading mainly to non-structural applications including precast roof and wall panels and lightweight infill blocks. It also in the way to reduce the density of the bricks, as well in improving thermal insulation properties, there forms the light weight brick innovate.

CHAPTER 3

# METHODOLOGY AND EXPERIMENTAL PROGRAM

### 3.1.1 Collection of building block

We collected three types of blocks from the market, one from Gazipur and one from Gaptali and another type was burnt clay block. The components of these blocks were cement sand, stone chips and water. Pictures of these blocks are given below.

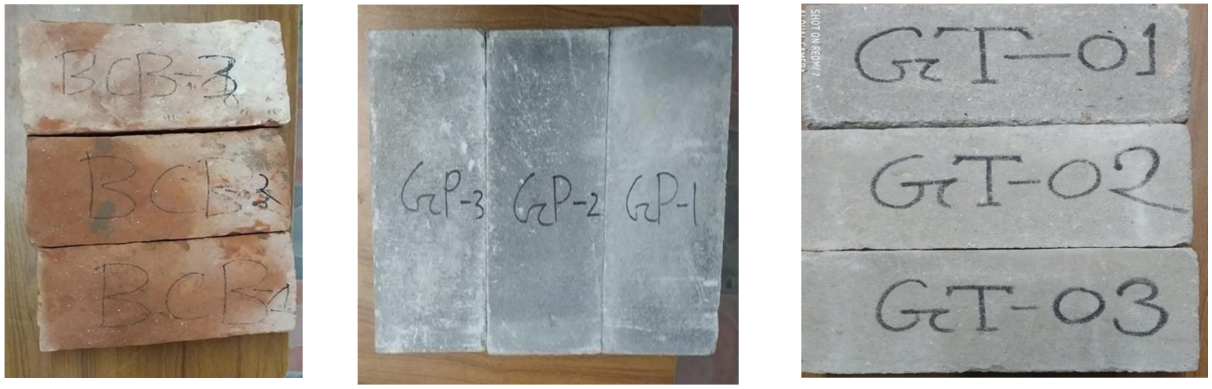


Figure 3.1.1 ( Burnt Clay block , Gazipur block and Gaptoli block )

### 3.1.2 Determination of Compressive Strength

Compressive strength test of bricks are performed according to ASTM C67-03 to determine the load carrying capacity of bricks under compression with the help of compression testing machine. This is one of the most important and significant properties of building block. In this report the compressive strength of different types of building block including burnt clay brick were determined at the age of 7, 14 and 28 days. The typical setup for compressive strength of building block is shown in the Figure 3.2.

Figure 3.1.2: Typical setup for compressive strength determination

The compressive strength was determined by using equation (1)

C=P/A..... (1)

Where,

C = Compressive strength

P = Failure load A = Contact area.

### 3.1.3 Determination of Water Absorption

Water absorption test on bricks are conducted according to ASTM C-67-80 to determine durability property of bricks such as degree of burning, quality and behavior of bricks in weathering. A brick having water absorption of less than 7% provides better resistance to damage by freezing. The water absorption by bricks increase with increase in pores. So, the bricks, which have water absorption less than 3 percent can be called as vitrified. This test provides the percentage of water absorption of bricks and procedure of the same is discussed below. Dry the specimen in a ventilated oven a temperature of 105°C to115°C till it attains substantially constant mass. Immerse completely dried specimen in clean water for 24 hours.

Figure 3.1.3: Water Absorption

### 3.1.4 Determination of density of building block

Density is a measurement that compares the amount of matter an object has to its volume. An object with much matter in a certain volume has high density. An object with little matter in the same amount of volume has a low density. Density is found by dividing the mass of an object by its volume. We have collected data on the length, width and height of the block then we determine with of the block by dividing the weight of the block density of the block by the  volume of the block.

# CHAPTER 4

# RESULTS AND DISCUSSIONS

In this chapter, the result obtained from the experimental investigations are reported using necessary graphs and tables. All the values reported are the average in this study.

### 4.1.1 Bulk Density

The bulk density of 3 types of block were determined. Among these, 2 types of block were prepared. Other one types of block were burnt clay brick and commercial solid block collect of cement, sand and crushed stone. These densities are shown in figure 4.1. It was observed that the density of block with GP market and GT is less than other types which indicates that the block collect of GP and GT is lighter than other types of block.

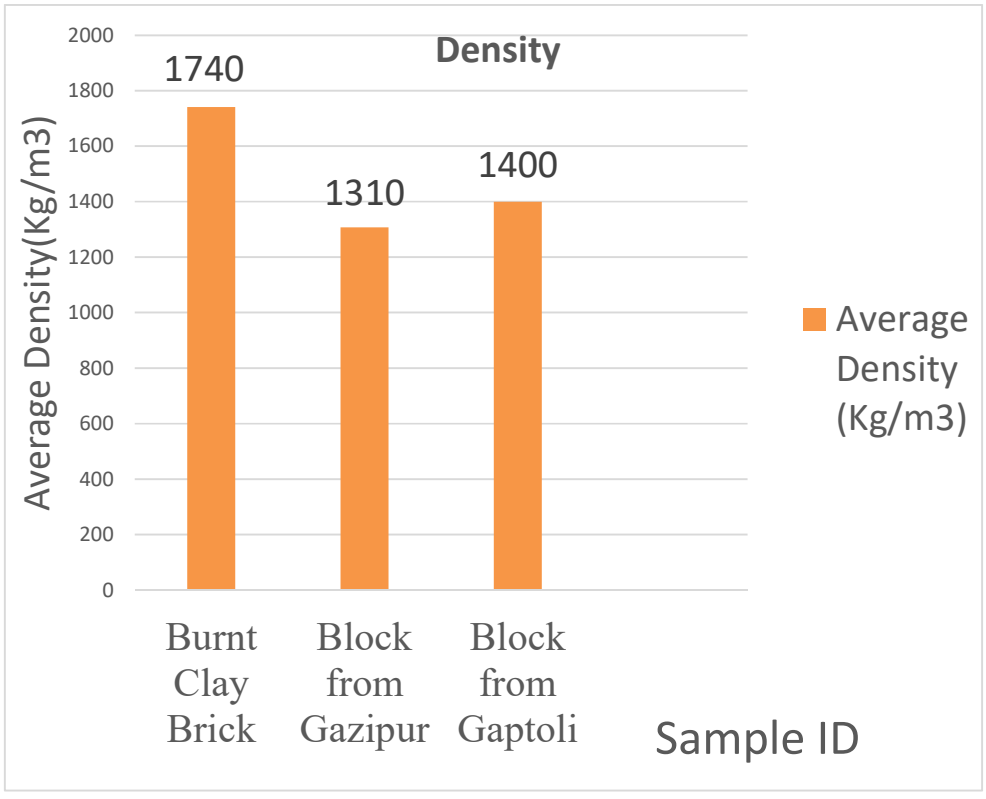


Figure 4.1.1 Comparison of Density of Different Types of Building

### 4.1.2 Absorption of Different Types of Building Block

Water absorption test on bricks is conducted to determine the compactness of bricks as water is absorbed by pores of the bricks. The water absorption increase in bricks with the increase of pores. This test is done to measure the physical property of bricks. A brick having water absorption of less than 7% provides better resistance to damage by freezing. The water absorption of 3 types of building block are shown in figure 4.2. The water absorption of GP block and GT block are, 11.91 and 9.6.% respectively. These values are less than the absorption of clay brick. These values are very close to the absorption of commercial solid block.

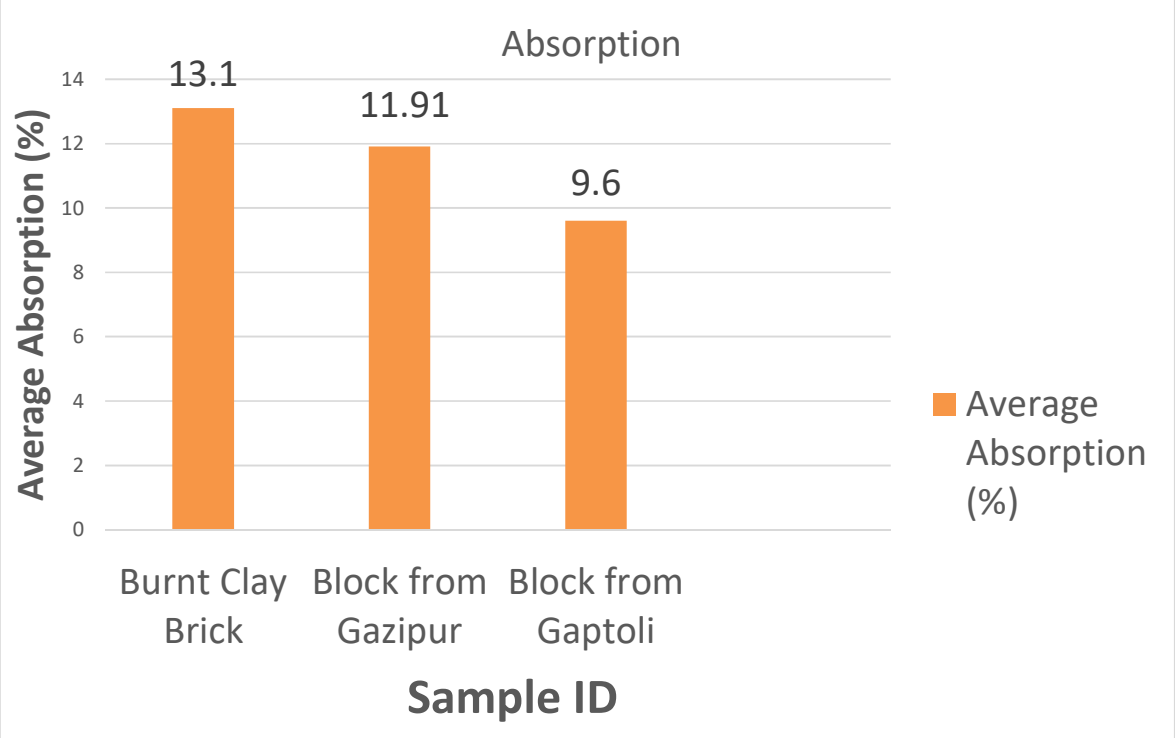


Figure 4.1. 2 Absorption of Different Types of Building Block

### 4.1.3 Compressive Strength of Building Block

Compressive strength of block was determined for 7, 14 and 28 days of curing. In a previous study, comparison of compressive strength reveals that concrete with 82.22% EPS volume reached a strength of 0.08 MPa after 28 days, while the strength of 0.067, 0.24, 0.29 and 0.85 MPa was obtained for specimens containing 73.10, 67.40 and 45.0% polystyrene beads, respectively (AliA.Sayadi,2016). This test was conducted for 3 types of blocks.

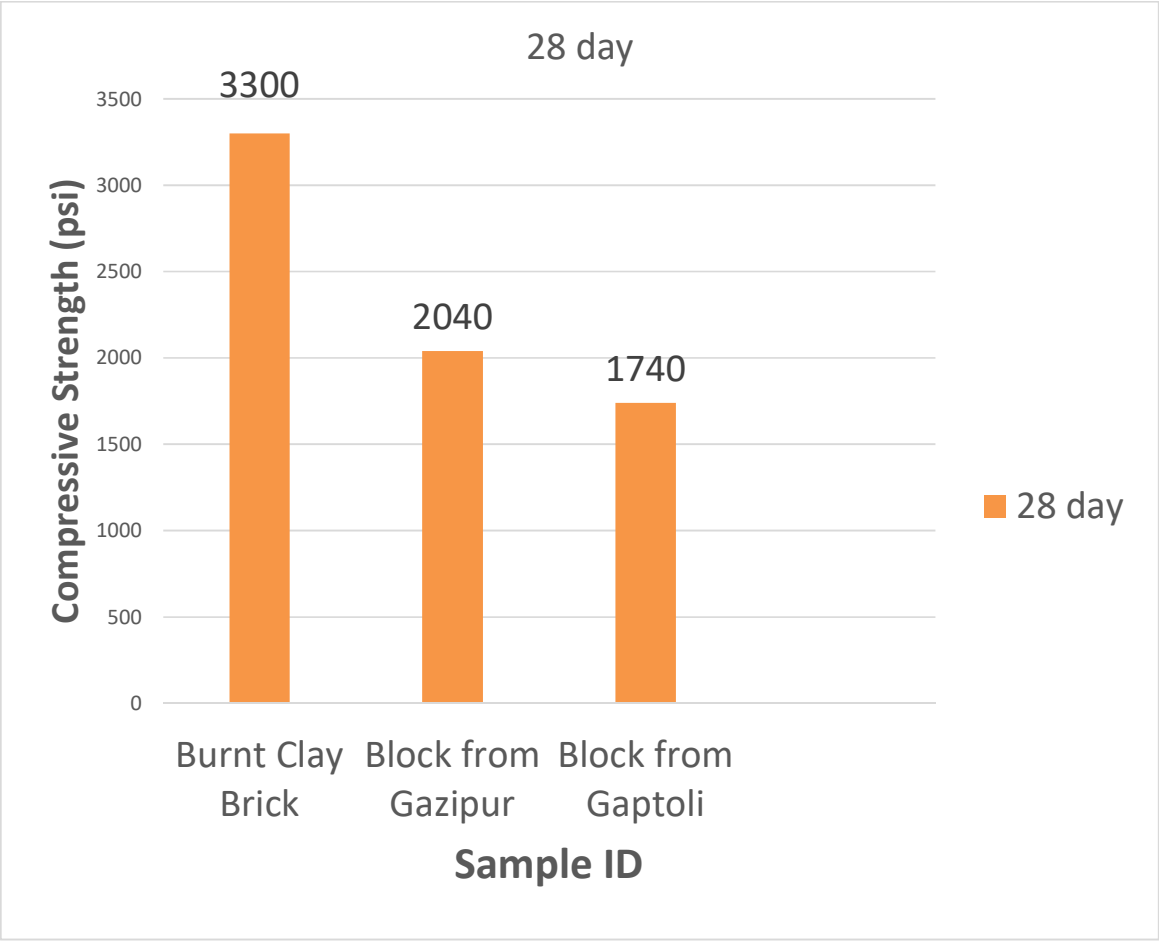


Figure 4.1.3 Comparison of Compressive strength of Different Types of Building Block

In this study, the 28 days compressive strength found for the block with GP and block and GB block are 2040 and 1740 psi respectively. The minimum compressive strength of brick is 1500 psi.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATIONS

### 5.1.1 Conclusion

The main objective of this project is to study the compare of light weight building block collect of burnt clay block , GP block and GT block. In this study, It was observed that the density of block with GP market and GT I less than other types which indicates that the block collect of GP block and GT block is lighter than other types of block. It was observed that the compressive strength of block with GP and GT block is slightly less than other type of block but the density of this type of block is lower than other type of blocks which proves it lighter. The water absorption of GP block and GT block are,11.9 and 9.6% respectively. These values are less than the absorption of clay brick 13.1%. These values are very close to the absorption of commercial solid block. In this study, the 28 days compressive strength found for the clay block GP block and GT block are 3300 , 2040 and 1740 psi respectively. GP and GT are less than the compressive strength of clay brick. Better clay block than Gazipur and Gabtali blocks Because the density of the block is low, the water absorption capacity is low and the compressive strength is low.

### 5.1.2 Recommendations

The following recommendation may be proposed for further study:

i. Before using this types of blocks commercially in building construction more extensive research is need to be done.

ii. Type of sample and number of sample for each test should be increased for each test.

# REFERENCES


Ali A. Sayadi, J. V. (2016). Effects of expanded polystyrene (EPS) particles on fire resistance, thermal conductivity and compressive strength of foamed concrete. *Construction and Building Materials*, Volume 112, Pages 716-724.

Camila Barreneneche, V. J. (2013). Improvement of the thermal inertia of the building materials incorporating PCM. *Applied Energy* , Pages 428-432.

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# APPENDIX

Table 1: Density of Different Types of Building Blocks

| Types of Block | Serial No | Sample ID | Density (Kg/m3) | Average Density (Kg/m3) |
|---|---|---|---|---|
| Burnt Clay Brick | 1 | BCB -1 | 1780 | 1740 |
| | 2 | BCB -2 | 1729 | |
| | 3 | BCB -3 | 1714 | |
| Block From Gazipur | 1 | GP-1 | 1362 | 1310 |
| | 2 | GP-2 | 1208 | |
| | 3 | GP-3 | 1352 | |
| Block From Gabtoli | 1 | GT-1 | 1400 | 1400 |
| | 2 | GT-2 | 1348 | |
| | 3 | GT-3 | 1450 | |

Table 2: Absorption of Different Types of Building Blocks

| Types of Block | Serial No | Sample ID | Absorption (%) | Average Absorption (%) |
|---|---|---|---|---|
| Burnt Clay Brick | 1 | BCB -1 | 12.58 | 13.1 |
| | 2 | BCB -2 | 12.47 | |
| | 3 | BCB -3 | 14.42 | |
| Block From Gazipur | 1 | GP-1 | 12.9 | 11.9 |
| | 2 | GP-2 | 11.32 | |
| | 3 | GP-3 | 11.5 | |
| Block From Gabtoli | 1 | GT-1 | 6.9 | 9.6 |
| | 2 | GT-2 | 11.14 | |
| | 3 | GT-3 | 10.85 | |

Table 3: Compressive Strength of Different Types of Building Blocks

| Types of Block | Serial No | Sample ID | Compressive Strength (psi) | Avg. Compressive Strength (psi) |
|---|---|---|---|---|
| Burnt Clay Brick | 1 | BCB -1 | 3685 | 3300 |
| | 2 | BCB -2 | 2950 | |
| | 3 | BCB -3 | 3260 | |
| Block From Gazipur | 1 | GP-1 | 2475 | 2040 |
| | 2 | GP-2 | 2000 | |
| | 3 | GP-3 | 1630 | |
| Block From Gabtoli | 1 | GT-1 | 2105 | 1740 |
| | 2 | GT-2 | 1735 | |
| | 3 | GT-3 | 1370 | |

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