STUDY ON USE OF WASTE CERAMICS AS COARSE AGGREGATE IN CONCRETE

By

MD. ABDUS SALAM CHOWDHURY
SIPON BISWAS
PROSANJIT KUMAR
MD.MAHABUBUR RAHMAN

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
147/I, Green Road, Dhaka-1215, Bangladesh
Section: (23B+23D)
Semester – Spring 2025

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By

MD. ABDUS SALAM CHOWDHURY	CE2102023071
SIPON BISWAS	CE2102023117
PROSANJIT KUMAR	CE2102023118
MD. MAHABUBUR RAHMAN	CE2102023073

Supervisor

Md. Zahid Husain Khan

Professor

Department of Civil Engineering

Sonargaon University (SU)

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

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

Section: (23B+23D)

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BOARD OF EXAMINERS

The thesis titled "**Study on the Use of Waste Ceramics of as course aggregate in concrete**" submitted by Md. Abdus Salam Chowdhury CE2102023071, Sipon Biswas. -CE2102023117, Prosanjit Kumar-CE2102023118, Md. Mahabubur Rahman-CE2102023073 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Science in Civil Engineering on **17 may 2025.**

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   Department of Civil Engineering
   Sonargaon University

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DECLARATION

It is hereby declared that, except for the contents where specific references are made, the work embodied in this thesis is the result of an investigation carried out by the authors under the supervision of **Md. Zahid Husain Khan, Professor** of Department of Civil Engineering of Sonargaon University.

Neither this thesis nor any part of it is concurrently submitted to any other institution in candidature

STUDENT NAME	STUDENT ID.	SIGNATURE
MD. ABDUS SALAM CHOWDHURY	CE2102023071	……..
SIPON BISWAS	CE2102023117	…….
PROSANJIT KUMAR	CE2102023118	…….
MD.MAHABUBUR RAHMAN	CE2102023073	……..

Dedicated

To

“ Our Beloved Parents ’’

&

“ Our Respected Teachers’’

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ABSTRACT

Wastages of Waste Ceramics production has generated a huge amount of by-products in the form of coarse aggregate which causes large scale of environmental pollution. This has led to a major concern in the environmental as well as construction industry due to the disposal of these million tons of coarse aggregate. The purpose of this study is to experimentally investigate the compatibility of wastage ceramics by-product for replacing of coarse aggregates in concrete partially. Influence on replacement of wastage Waste Ceramics with stone on the strength behavior on concrete was studied at curing age of 28 days and the results are found with conventional concrete cylinder. The results of the experimental study show that, mixture of wastage ceramics partially be used in place of coarse aggregate in concrete and it saves considerable amount of stone there by preserving the valuable natural resource. Wastage concrete offers a cost reduction of approximately 17.6% compared to normal concrete while providing additional strength benefits and contributing to sustainability.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS……V
ABSTRACT……VI
LIST OF FIGURES……VII
LIST OF TABLES……VIII

CHAPTER-1……1
INTRODUCTION……1
1.1 INTRODUCTION……..1
1.2 BACKGROUND……1
1.3 OBJECTIVES…….. 2

CHAPTER-2……..3
LITERATURE REVIEW……...3
2.1 LITERATURE REVIEW……..3-4

CHAPTER-3……
MATERIALS AND SPECIFICATION……
3.1.BINDING MATERIALS(CEMENT) ……5
3.2FINE AGGREGATE (SAND)……6
3.3 SIEVE ANALYSIS OF FINE AGGREGATE (SAND)……6
3.4 TASTE ON AGGREGATE……7
3.5 GRAIN SIZE DISTRIBUTION OF FINE AGGREGATE AND……7
COARSE AGGREGATE……7
3.6. AGGREGATE ABRASION VALUE……8

CHAPTER-4……..
EXPERIMENTION AND DATA ANALYSIS……..
4.1. BRIEF……..9
4.2 MATERIALS……9
4.3 SPECIFIC GRAVITY AND WATER ABSORBTION OF WASTE CERAMICS……9

4.4 TEST ON CEMENT……...9
4.5 COLLECTED MATERIALS……..11
4.6 CONCEPT OF MIX DESIGN……12
4.7 DESIGNED MIXES……13
4.8 TESTS ON CONCRETE……14
4.9 PREPARATION OF TEST SPECIMENS……14
10 PREPARING CONCRETE……13
4.11 OILING AND CLEANING CYLINDER……14
4.12 TRADITIONAL CURING……..15
4.13 TESTS ON HARDENED CONCRETE……15
4.14 CURING 28 DAYS……16
4.15 CHECKING CYLINDER……..16
4.16TAKING MEASUREMENT OF CYLINDER……16
4.17STRENGTH TEST WITH CYLINDER……17
4.18DETERMINING THE COMPRESSIVE STRENGTH TEST IN UTM……17

CHAPTER-5……...
RESULTS AND ANALYSIS……..
TABLE: FIG 5.1 SIEVE ANALYSIS OF FINE AGGREGATE……19
TABLE: FIG 5.2 SIEVE ANALYSIS OF COARSE AGGREGATE BRICKS…….20
TABLE: FIG 5.3 SIEVE ANALYSIS OF COARSE AGGREGATE (STONE)…….21
5.4 SIEVE ANALYSIS OF COARSE AGGR EGATE (TILES)……22
5.5 DATA SHEET OF SPECIFIC GRAVITY OF FINE AGGREGTE……..……23
5.6 DATA SHEET OF SPECIFIC GRAVITY OF STONE……24
5.7 DATA SHEET OF SPECIFIC GRAVITY OF BRICKS……...25
5.8 DATA SHEET OF SPECIFIC GRAVITY OF TILES……...26
5.9 COMPRESSIVE STRENGTH AFTER 28 DAYS (CYLINDER TEST RESULT)
5.10 BAR CHART OF COMPRESSIVE STRENGTH……..28

CHAPTER-6……
COST ANALYSIS……..
6.1 COST ANALYSIS BETWEEN WASTAGE CERAMIC
CONCRETE IN TAKA…… ……29-30
6.2 PRODUCTION COSTS……..30

6.3 TOTAL COSTS COMPARISON……..….31
6.5 ENVIRONMENTAL IMPACT……..……31

CHAPTER-7……
DISSCUSSION……..
7.1 DISCUSSION AND FINDING…….……32

CHAPTER 8……
CONCLUSION……....33
RECOMMENDATIONREFERENCES……..34
FIGURE :1.1: WASTE CERAMICS…….2
FIGURE: 3.1: BINDING MATERIALS (CEMENT…….5
FIGURE: 3.2: FINE AGGREGATE (SAND)……...6
FIGURE: 3.3: SIEVE ANALYSIS OF FINE AGGREGATE (SAND…… 6
FIGURE:4.5: COLLECTED MATERIALS: TILES, BRICK,…….6
STONE, FINE AGGREGATE CEMENT……11
FIGURE:4.5: PREPARING CONCRETE……14
FIGURE:4.10: OILING AND CLEANING CYLINDERS……..15
FIGURE: 4.11: CURING 28 DAYS…….16
FIGURE: 4.14: CHECKING CYLINDERS…….17
FIGURE:4.15: TAKING MEASUREMENT OF CYLINDER……17
FIGURE:4.16: COMPRESSIV ESTRENGTH TESTWITH CYLINDER……17
FIGURE: 4.17. COMPRESSIVE STRENGTH……18
FIGURE: 4.18: SIEVE ANALYSIS OF COARSE AGGREGATE (CERAMIC……19-22

LIST OF TABLES

Table: fig: 5.1: Sieve Analysis of fine Aggregate ……19
Table:fig:5.2:SieveAnalysis of Coarse Aggregate (Brick)…….20
Table: fig: 5.3 Sieve Analysis of Coarse Aggregate (Stone)……21
Table:fig:5.5Data Sheet of Specific Gravity of Tiles, Stone, Bricks, Fine Aggregate…….23-25
Table: fig: 5.6 Physical Proprieties of waste ……..21
Ceramics (Result&Findings)……..…… 27
Table: Compressive Strength After ……27
28 Days(Ceramic)…… 27
Table: Bar Chart of Compressive Strength ……..28
Table: Cost……31
Chapter 7
Discussion and Finding…… 32
Chapter-8
Conclusion & Recommendation ……33-34
References……..…….……35

LIST OF FIGURES

Figure:1.1 Waste Ceramic ……2
Figure:3.1 Binding Materials Cement…… 5
Figure:3.3.1 Fine Aggregate Sand…… 6
Figure:3.3.2 Sieve Analysis of Fine Aggregate…… 7
Figure:4.5.1 Tiles ……11
Figure:4.5.2 Bricks……..11
Figure:4.5.3 Stone……11
Figure:4.5.4 Fine Aggregate……11
Figure:4.5.5 Cement……11
Figure:4.9 Preparing Concrete……..……14
Figure:4.10 Oiling and Cleaning Cylinder……..14
Figure:4.12 Curing 28 Days ……16
Figure:4.13 Checking Cylinder……17
Figure:4.14 Taking Measurement of Cylinder…… 17
Figure:4.15 Compressive Strength Test with Cylinder…… 18
Figure:4.16 Test of Compressive Strength in UTM……18

CHAPTER-1

INTRODUCTION

1.1 Introduction:

Waste Ceramics as replacement for coarse aggregates in concrete. By investigating the properties of concrete when of waste Ceramics, it aims to provide an environmentally friendly and sustainable alternative that conserves natural aggregates without compromising the strength and durability of the material. The focus is on developing a concrete mix that is not only eco-friendly but also cost-effective, contributing to the development of green construction practices while reducing the ecological footprint of the industry. And upgrading the materials for concrete properties to be enhanced. The utilization of waste materials as a replacement or additional in materials for producing the concrete can give a lot of benefits to the humans and Environment.In this paper, we study the Ceramics waste Bangladesh recycling in the process before use. The natural and recycled aggregates were characterized.

1.2 Background:

Development of building construction is increasing rapidly which is continuously reducing the amount of aggregate in our country. Environment must be sustained and protected not only by law but with our realization for next generation. The construction industry is one of the largest consumers of natural resources, with concrete being the most widely used material globally due to its strength, durability, and versatility. Concrete is made from basic ingredients like cement, water, and aggregates, the latter of which are naturally occurring materials. However, the demand for aggregates, especially coarse aggregates, has been steadily rising, leading to overexploitation and scarcity of these resources.Furthermore, the excessive use of natural stone has several environmental implications, including ecological damage and the depletion of precious natural reserves. Consequently, there is an increasing need to find sustainable alternatives and substitute materials to conserve these resources.In Bangladesh, a significant amount of waste Ceramics is generated, primarily from, wastages of building materials and processing industries. Ceramic is one of the most abundant resources, waste in the form of dust, slurry, waste Ceramics,if not managed effectively, poses serious environmental challenges, contributing to pollution and occupying large areas of landfills. However, instead of discarding this waste, research has shown that it can be repurposed as replacement of conventional

aggregates in concrete production, offering a viable solution to mitigate both waste accumulation and the overuse of natural resources.



Fig 1.1: Waste Ceramic

1.3 Objectives:

i. To study the use of Waste Ceramics in place of stone in concrete.

ii. To determine the cost comparison between stone and Ceramics Waste

CHAPTER -2

LITERATURE REVIEW

2.1 properties of waste ceramics:

Waste Ceramics is a hard The ceramics Waste generated during quarrying and processing is typically in the form of fine aggregates, slurry, and stone chips. Studies have shown that Ceramics Waste can and processed to create a material with similar properties to traditional natural aggregates, including good particle shape, size distribution, and strength. The chemical composition of ceramics waste is also beneficial, that contribute positively to concrete's durability and strength.

Strength and durability:

Many studies indicate that the incorporation of waste ceramics, This can be attributed to the angular shape of waste ceramics, which improves the interlocking between aggregates and cement paste, enhancing the mechanical properties of concrete. However, beyond a certain replacement percentage, the compressive strength tends to decrease due to the increased brittleness of the material.

- **STRENGTH PERFORMANCE:**

Concrete mixes containing as coarse aggregate have shown comparable, if not superior, compressive and tensile strength to conventional concrete, especially when the waste ceramics is combined with appropriate mix designs.

- **ENVIRONMENTAL IMPACT:**

Using waste ceramics as coarse aggregate reduces the demand for natural aggregates, which are often extracted through environmentally damaging. This can significantly lower the carbon footprint of concrete production, making it a more sustainable option.

- **WASTE REDUCTION:**

Waste ceramics is a byproduct of the ceramics industry and is often disposed of in landfills or left unused. By recycling this material, the volume of construction and demolition waste is reduced, leading to a decrease in environmental pollution and landfill space consumption.

ENERGY SAVINGS AND REDUCED CO_2 EMISSIONS:

The energy required to process waste ceramics into usable aggregate is lower compared to the energy required to mine and process natural aggregates. This reduction in energy consumption translates into a lower carbon footprint for concrete production, contributing to overall sustainability.

Economic benefits:

waste ceramics in concrete not only helps in waste management but also provides economic advantages. waste ceramics typically abundant and, in many cases, is available at a lower cost than natural aggregates. The use of waste materials can also reduce the cost of transportation and quarrying operations, contributing to the overall cost-effectiveness of concrete production.

Variation in material quality:

The properties of waste ceramics waste can vary depending on the source and processing methods, which may lead to inconsistencies in concrete performance. Standardization and quality control measures need to be in place to ensure uniformity in the waste material.

Limited research on long-term durability:

While short-term studies have shown promising results, further research is required to assess the long-term performance and durability of concrete containing waste ceramics, especially with regard to factors such as freeze-thaw resistance, shrinkage, and corrosion resistance.

- **WORKABILITY ISSUES:**

As mentioned earlier, the angular nature of waste ceramics particles can affect the workability of concrete. Research into mix design optimization and the use of additives or admixtures is necessary to overcome these issues.

CHAPTER -3

MATERIALS AND SPECIFICATIONS

3.1 Binding materials (Cement):

The precise proportions of limestone and clay play a critical role in the production of cement, as they determine the quality and performance of the final product. These raw materials are carefully crushed and sieved before being fed into a rotary drum, where they undergo a controlled process. The drum rotates at a speed of 2 rpm, while fuel is injected in a counter-current manner, and the temperature inside the drum reaches approximately 500°C. This high-temperature process results in the formation of clinker, which is then ground into fine cement powder. Among the various types of cement available, Ordinary Portland Cement (OPC) is the most widely used in construction due to its versatility and reliability. Conforming to the IS 12269-1987 standard, OPC grade 53 is typically chosen for high-strength concrete applications. For this study, grade 53 OPC was used to prepare the concrete mix. The cement selected was fresh, with a uniform color, and free from lumps or foreign impurities, ensuring optimal performance. Ordinary Portland Cement is the go-to choice for general concrete construction, particularly in environments where there is no exposure to sulfates in the soil or groundwater. Its durability makes it ideal for withstanding a variety of environmental conditions, ensuring the long-term stability and strength of concrete structures.



Fig:3.1: Binding Materials (Cement)

3.2 Fine aggregate (Sand):

The quality and texture of sand play a crucial role in achieving a well- bonded and cohesive concrete mix. Finer sand requires a smaller proportion to achieve the desired consistency, while coarser sand demands a greater ratio relative to coarse aggregates. In this study Panchagrah sand was selected as the fine aggregate due to its optimal characteristics. The Panchagrah sand used had a specific gravity of approximately 2.65, and a fineness modulus (FM) of 2.47. These properties ensure that the sand is well-suited for highquality concrete production. This sand was chosen for its reliable performance in concrete mix designs.

The sand particles, which pass through a 4.75 mm IS sieve, were found to be hard, chemically inert, and durable. The sand was thoroughly cleaned and free from any organic matter, harmful coatings, or impurities such as clay balls, salts, or coal. Such contaminants could otherwise cause corrosion of reinforcing metals or negatively impact the strength, durability, and overall appearance of the concrete. By ensuring the sand was of high quality and free from impurities, the study aimed to produce a concrete mix with superior structural integrity and long-lasting performance.

3.3 SIEVE ANALYSIS OF FINE AGGREGATE (SAND):



Fig:3.3.1: Fine Aggregate Sand



Fig: 3.3.2 : Sieve Analysis of Fine Aggregate (Sand)

3.4 TESTS ON AGGREGATE:

The tests conducted to check the quality of aggregates are very important because of the presence of higher percentage of use in the production of concrete. So when it comes to aggregates, the quality really matters. Various tests which were done on aggregates are listed below.

* Sieve analysis for fine and coarse aggregate
* Aggregate impact value
* Aggregate crushing value
* Specific gravity and water absorption of Coarse and fine Aggregate

3.5 GRAIN SIZE DISTRIBUTION OF FINE AGGREGATE AND COARSE AGGREGATE:

The gradation of fine and coarse aggregate samples must be tested to determine compliance with the specifications for these materials. The set of sieves consist the sizes of 4.75 mm, 2.36 mm, 1.18 mm, 600, 300 µ, 150µ and pan were used for the present study. Sample should be taken for which the sample is thoroughly mixed and spread over a clean surface. If any further reduction of quantity is required, the process may be repeated. Weight retained on each sieve shall not exceed the limits specifies IS code.

3.6 AGGREGATE ABRASION VALUE:

Abrasion Angeles abrasion values of aggregate measures its resistance to abrasion, or wear and tear. This value represents the percentage of aggregate that breaks down and passes through a 1.7 mm sieve after being subjected to a standardized abrasion test in a rotating drum.

3.7 AGGREGATE IMPACT VALUE:

This test may be considered as an alternative to the aggregate crushing test, the special apparatus needed for aggregate impact test is simple and relatively cheap and is portable while the crushing test requires a 50tones testing machine, which is expensive. The impact test on an aggregate is a useful guide to The Aggregate Impact Value (AIV) test is a method used to assess the resistance of aggregate to sudden impact or shock. It measures the toughness of aggregate by determining the percentage of fines (small particles) produced when a sample is subjected to a standard number of blows from a hammer.

3.8 COARSE AGGREGATE (STONE):

The size and shape of coarse aggregates significantly influence the proportions of fine aggregates required in a concrete mix. Larger coarse aggregates have a smaller surface area, which means less fine aggregate is needed to achieve a cohesive mix. On the other hand, finer aggregates or flaky aggregates require a higher proportion of fine aggregate due to their larger surface area. Rounded aggregates, with their smoother surfaces, needed lesser fine aggregate to achieve the same cohesive mix as compared to angular or flaky aggregates. For this study, aggregates up to 20 mm in size were selected, ensuring they were well-graded, cubical, or rounded in shape. These characteristics are ideal for producing high-quality concrete with optimal workability and strength. Additionally, the aggregates were of uniform quality in terms of grading and shape, which is essential for maintaining consistency and reliability in the final concrete mix

Coarse Aggregate (ceramics Waste): Ceramic waste can be used as a coarse aggregate in concrete, offering a sustainable alternative to traditional aggregates and potential benefits in terms of material properties and environmental impact. This approach helps reduce reliance on natural resources and minimizes waste from the ceramic industry, contributing to a circular economy.

CHAPTER -4

EXPERIMENTATION AND DATA ANALYSIS

4.1 BRIEF:

Firstly we collected all the materials needed for our experiment from various places. Such, We've collected Ordinary Portland cement from a store situated in Te Farmgate, Manipuripara, Dhaka and Sand from Nabinagar housing, Mohammadpur, Ceramic waste also from, Dhakauddn and so on. After that we take it to our lab for scaling. Then we mixed the materials properly to make cylinder and gave it a time to set. After 28 days of curing we determined the weight of those cylinders and measured the cylinder. Then after drying it we crush it through UTM machine and determined the Compressive Strength.

4.2 MATERIALS:

All materials (coarse aggregate, fine aggregate, water, and cement) used for the production of concrete were randomly sourced. The aggregates were air-dried in the laboratory to remove moisture.

4.3 SPECIFIC GRAVITY AND WATER ABSORPTION OF CERAMIC WASTE:

The specific gravity of ceramic waste typically falls in the range of 2.22 to 2.68, while the water absorption rate can vary significantly, ranging from 0.10% to 16.04%. The specific gravity and water absorption of ceramic waste are influenced by factors such as the type of ceramic, the manufacturing process, and the presence of voids or pores within the material.

4.4 TASTE ON CEMENT:

* Fineness
* Normal consistency
* Initial and Final setting time
* Specific Gravity

FINENESS OF CEMENT BY SIEVE ANALYSIS:

The measure of size of particle of cement depends on fineness of cement which is expressed as specific surface of cement (in sq. cm /gm.).The fineness of cement is an important factor in determining the rate of gain of strength and uniformity of quality. It is measured in terms of specific surface of the cement and can be calculated from the

particle size distributions are determined by one of the air permeability. We have used IS sieve No.9 (90 microns), as for Indian standards as per IS-4031-1(1996), the percentage of residue left after sieving a good Portland cement through IS sieve number 9, should not exceed 10 %.

STANDARD CONSISTENCY OF CEMENT:

The standard consistency of cement refers to the amount of water needed to produce a cement paste that has a specific degree of plasticity, typically between 26% and 33% of the cement's weight. This consistency is determined using the Vicat apparatus, which measures the penetration depth of a plunger into the cement paste. The paste should allow the Vicat plunger to penetrate 5-7 mm from the bottom of the Vicat mold.

INITIAL SETTING AND FINAL SETTING: In order that the concrete may be placed in position conveniently, it is necessary that the initial setting time is not too quick and after it has been laid, hardening should be rapid that the structure can be made use of as quick as possible. The initial set is a stage in the process of hardening where the cracks that may appear will not be possible to re-unite. When the concrete obtains sufficient strength and hardness, it is said to be finally set. For Portland cement, the initial setting time should not be less than 30 minutes and final setting time should not be more than 600 minutes. For quick cement, Initial setting time should not be less than 5 minutes and final setting time should not exceed 30 minutes. The setting time is influenced by temperature, humidity fair and quantity of gypsum inthe cement.

IS REQUIREMENTS

According to IS4031-5-(1988) the setting time of ordinary Portland cement when tested by the Vicate apparatus method shall confirm to the following requirements;

* Initial setting time- not less than 30 minutes.
* Final setting time -not more than 600 minutes.

All concreting operations viz. mixing, transportation, placing and compaction of concrete should be completed before initial setting time of cement.

SPECIFIC GRAVITY OF CEMENT:

Specific gravity is normally defined as the ratio between the mass of volume of material to the mass of an equal volume of water. One of the methods used to determine the

specific gravity of cement is by the use of a liquid such as water free kerosene which does not react with cement. A specific gravity bottle may be employed or a standard Le-Chatelier flask may be used. Water, at a temperature of 73.4°F (23 °C).Specific Gravity is important for several reasons. Some deleterious particles are lighter than the normal aggregates. Change of material or possible contamination can sometimes indicated through tracking specific gravity. Differences in specific gravity may be used to separate the deleterious particles from the normal aggregates using heavy media liquid. The aggregate with high absorptive nature may result in a low durability. In Portland Cement Concrete the specific gravity of the aggregate is utilized to calculate the Percentage of voids and the solid volume of aggregates in computations of yield. The absorption plays a major role in determining the net water-cement ratio in the concrete mix.

4.5 COLLECTED MATERIALS:



Fig: 4.5.1Tiles



Fig:4.5.2 Bricks



Fig:4.5.3: Stone



Fig4.5.4: Fine Aggregate



Table:4.5.5: Cement

CONCEPT OF MIX DESIGN:

The process of selecting suitable material of concrete and determining their relative propositions is termed as mix design with the object of producing concrete of certain minimum strength and durability as economically as possible. Aggregate and paste are the essential ingredients of concrete with an important relationship. Workability of the mass is provided by the lubricating effect of paste and influenced by the amount of dilution of paste. The strength of concrete is limited by the strength of paste, since mineral aggregate with rare exception, are stronger than the paste compound. Essentially the permeability of concrete is governed by the quality and continuity of the paste, since little water flows through aggregate either under pressure or by capillarity. Further, the pre dominate contribution to drying shrinkage of concrete is that of paste. The properties of concrete are governed to a considerable extent by the paste which is helpful to consider more closely the structure of the paste. The fresh paste is a suspension, not a solution of cement in water. The more dilute the paste, the greater the spacing between cement particles, and thus the weaker will be the ultimate paste structure. Since the quantity of water that as little paste as possible should be used and hence the importance of grading.

Types of mixes:

(a) Nominal mixes:

In the past the specifications for concrete recommended the proportions of cement, fine and coarse aggregates. This blend of fixed cement-aggregate ratio that ensures sufficient strength is termed as nominal mix. These offer simplicity and under ordinary circumstances, have a margin of strength above that predetermined. The nominal concrete for a given workability varies widely in strength due to the variability of mix ingredients.

(b) STANDARD MIXES:

The nominal mix of cement-aggregate ratio by volume vary widely in strength and result may vary as under or over compared to rich mixes. Due to this reason, minimum compressive strength has been included in most of the specifications which termed as standard mixes. A number of grades as M10, M15, M20, M25, M30, M35 and M40 has been designated by IS 456-2000 where M refers to the mix and the number is the specified 28th day cube strength.

4.6 DESIGNED MIXES:

With specific materials of more or less unique characteristics, it is most rational approach to the selection of mix proportions which results in the production of concrete with most economical appropriate properties. However, the designed mix may not serve as a guide since this does not guarantee the correct mix proportions for the recommended performance. If the 28-day strength of concrete is within the range of 30 N/mm2, that type of concrete is known as less prescribed performance and may be used only for very small jobs

4.7 Tests on Concrete:

Testing of concrete plays an important role in knowing the quality of concrete. Raw materials, fresh and hardened concrete are inseparable part of any quality control program that testes in a sequential manner to know whether the materials accomplished higher efficiency and performance with respect to both strength and durability. The tests methods should be simple, direct and convenient to apply. Main purposes of testing fresh and hardened concrete is to confirm that the concrete used at site has gained the required strength. The basic tests to be conducted in the field as well as in the lab based on its state of concrete are given below;

1. Tests on fresh concrete
2. tests on hardened concrete
3. Tests on fresh concrete

(I) SLUMP TEST

To characterize the workability of fresh concrete, slump test is widely used. It is the most well-known and inexpensive test, which measures consistency of material used on job sites to determine whether a concrete batch is acceptable or not. It is a standardized test method used widely throughout the world. The apparatus consists of a mold in the shape of a frustum of a cone with a base diameter of 8 inches, a top diameter of 4 inches, and a height of 12 inches. The mold is filled with concrete in three layers of equal volume. Compaction of each layer is performed with 25 strokes of a tamping rod. The slump cone mold is lifted vertically upward and the change in height of the concrete is measured.

4.8 Preparation of Test Specimens:

The procedure for the preparation of test specimen like sampling of raw materials, preparation of materials, proportioning, weighing, mixing, testing for workability of fresh concrete, choice of the size of test specimens, compacting, and capping of specimen shall be done in a sequential manner and if tests are intended to draw correlation curve between the results of compressive strength tests on specimens cured by normal curing method and accelerated curing method, that should be tested in accordance with code IS: 516-1959, if If the tests are intended for control purposes, sampling shall be done in Accordance with permissible under ASTM C143

4.9 PREPARING CONCRETE:



Fig:4.9: Preparing Concrete.

4.10 OILING AND CLEANING CYLINDER:



Fig:4.10: Oiling and cleaning cylinders

4.11 TRADITIONAL CURING:

All specimens will be moist cured for one day and after moist curing the specimens will be water cured for required days. Testing will be done after required days. In the Traditional curing the cubes are molded with the cement concrete is subjected to curing in the water Tank and then check the strengths achieved by the cubes and beams for 28 days from this we can get the compressive strength from cubes and Flexural strength from Beams, split tensile strength for cylinders. Traditional curing, primarily involving salting, is a long-standing food preservation method used for meat, fish, and vegetables. The process draws moisture from the food, creating an inhospitable environment for spoilage-causing microbes. It enhances flavor and texture while extending the shelf life of food before the advent of modern refrigeration.

4.11 TESTS ON HARDENED CONCRETE

The most important parameter and represent tentative of almost overall quality of concrete is compressive strength of hardened concrete that mainly depends on the water/cement ratio of the mix and curing and age after it is cast. Compressive strength of hardened concrete is determined by testing the cubical or cylindrical dried specimens using a compression testing machine or universal testing machine, at various ages such 28 days after curing. For assessing the quality of concrete cast at site, compressive strength test is conducted during mix proportioning

4.12 Curing 28 days:

Initial setting of concrete occurs within hours, where it gains early strength. Yet, achieving the desired strength requires a longer duration. Therefore, a 28-day curing period is considered as a standard benchmark for evaluating the concrete's strength.

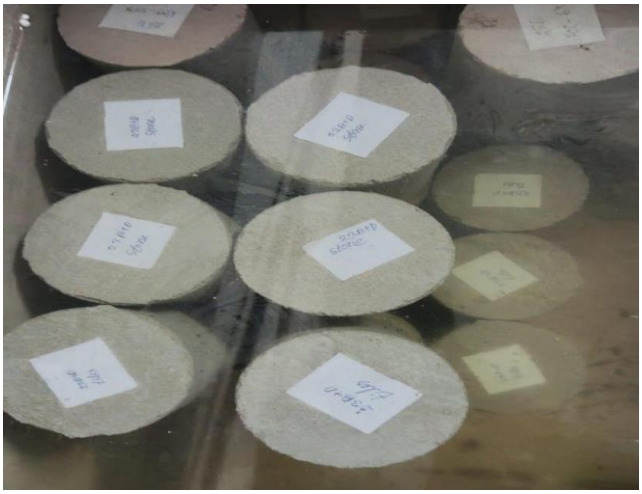


Fig:4.12: After curing 28 days.



Fig: 4.13: Checking Cylinders

4.13 Taking measurement of cylinder:



Fig:4.14: Taking measurement of Cylinder.

4.14 Compressive strength test with cylinder:



Fig:4.15: Compressive Strength test with Cylinder:



Fig 4.16:Test of compressive strength in (UTM)

CHAPTER-5

SIEVE ANALYSIS OF FINE AGGREGATE

Table 5.1: Sieve analysis of sand

Sieve No.	Sieve No. Retained (gm)	Cumulative Materials Retained (gm)	Cumulative% Retained	% of Passing	FM
4#	8	0.8	0.8	99.2%	2.47
8#	41	4.1	4.9	95.1%	
16#	132	13.2	18.1	81.9%	
30#	227	22.7	40.8	59.2%	
50#	440	44	84.8	15.2%	
100#	133	13.3	98.1	1.9%	
pan	19				
Total	1000		247.5		

Sieve analysis of coarse aggregate:

Table 5-2. Sieve analysis of brick

Sieve No.	Sieve No. Retained (gm)	Cumulative Materials Retained (gm)	Cumulative% Retained	% of Passing	FM
3/4	324	32.4	32.4	67.6%	**7.2**
3/8	627	62.7	95.1	4.9%	
4	49	4.9	100	0%	
8	0	0	100	0%	
16	0	0	100	0%	
30	0	0	100	0%	
50	0	-	-		
100	0	0	100	0%	
	Total=1000		Total=727.5		

Sieve analysis of coarse aggregate:

Table 5-3. Sieve analysis of stone

Sieve No.	Sieve No. Retained (gm)	Cumulative Materials Retained (gm)	Cumulative% Retained	% of Passing	FM
3/4	395	39.5	39.5	60.5%	
3/8	577	57.7	97.2	2.8%	
4	28	2.8	100	0%	
8	0	0	100	0%	
16	0	0	100	0%	**7.3**
30	0	0	100	0%	
50	0	-	-		
100	0	0	100	0%	
	Total=1000		Total=736.7		

Sieve Analysis of Coarse Aggregate:

Table 5.4: Sieve Analysis of Tiles

Sieve No.	Sieve No. Retained (gm)	Cumulative Materials Retained (gm)	Cumulative % Retained	% of Passing	FM
3/4	395	39.5	39.5	60.5%	
3/8	577	57.7	97.1	2.8%	
4	28	2.8	100	0%	
8	0	0	100	0%	
16	0	0	100	0%	**7.3**
30	0	0	100	0%	
50	0	-	100		
100	0	0	100	0%	
	Total=1000		Total=730.6		

Table 5.5 : Specific gravity of Panchagarh sand

Test	Result
Apparent Specific Gravity	2.65
Bulk Specific Gravity (Oven Dry Basic)	2.37
Bulk Specific Gravity (S.S.D. Basic), G	2.81
Absorption Capacity, D %	2.47

Table 5.6: Specific gravity of Stone

Test	Result
Apparent Specific Gravity	3.12
Bulk Specific Gravity (Oven Dry Basic)	2.91
Bulk Specific Gravity (S.S.D. Basic), G	281
Absorption Capacity, D %	3.81

Table 5.7: Specific gravity of Bricks

Test	Result
Apparent Specific Gravity	2.84
Bulk Specific Gravity (Oven Dry Basic)	2.58
Bulk Specific Gravity (S.S.D. Basic), G	2.44
Absorption Capacity, D %	5.65

Table-5.8: Specific Gravity of tiles

Test	Result
Apparent Specific Gravity	2.28
Bulk Specific Gravity(Oven Dry Basic)	2.25
Bulk Specific Gravity (S.S.D. Basic), G	2.22
Absorption Capacity, D %	1.12

CYLINDER TEST RESULTS

MIX PROPORTION 1:1.5:3

Table-8: Test result of cylinders for 28 days curing

Types of case	Dia of Cylinder (mm)	Height of Cylinder (mm)	Weight of Cylinder (kg)	Crushing Value (KN)	Compressive Strength (MPa or N/mm2)	Average Compressive Strength (MPa)
Stone Aggregate	103.7	206	4216	185	22.39	18.72
	102.8	206	4260	140	16.94	
	103.3	205	4233	145	17.37	
	101.1	206	4105	155	19.31	
	102.6	207	42261	145	17.63	
Tiles Aggregate	102.2	205	3762	182	21.01	17.47
	102.4	206	3757	140	17.02	
	102.8	205	3702	125	15.13	
	103.8	2057		148	17.55	
	102.5	205	3802	137	16.66	
Brick Aggregate	102.6	206	3375	133	16.17	15.89
	103.1	206	3403	138	16.61	
	102.0	206	3401	130	15.97	
	102.0	207	3285	120	14.74	
	102.1	205	3324	130	15.97	

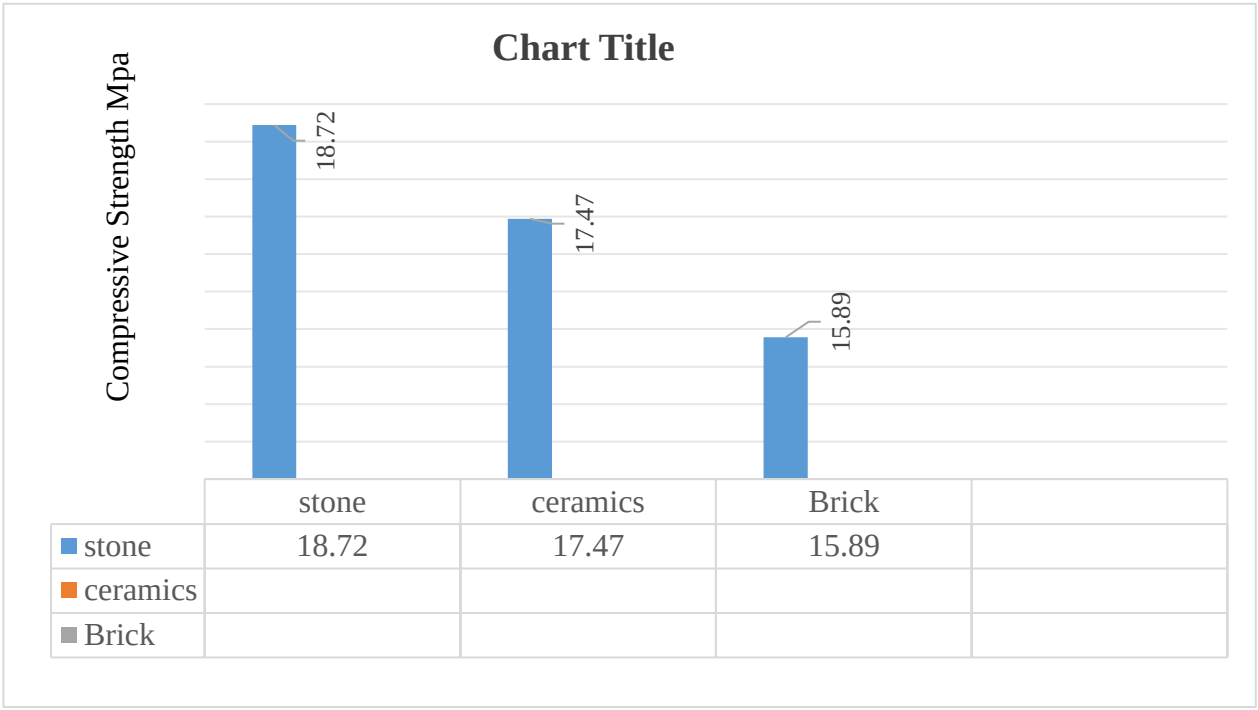


Figure 6.1: Bar Chart of Compressive Strength

CHAPTER 6

COST ANALYSIS

6.1 Cost Analysis Stone Concrete In Taka:

Introduction: This analysis compares the cost of stone concrete and concrete made using Ceramic waste as an aggregate, commonly referred to as wastage ceramics concrete. Theaim is to evaluate material costs, production costs, and environmental benefits, all presented in Bangladeshi Taka (BDT).

Material costs:

Stone Concrete Consists Of The Following Components:

Cement: Approx. BDT 10,400 per ton.

Sand: Approx. BDT 2,530 per ton.

Stone (aggregates): Approx. BDT 4,800 per ton.

Water: Approx. BDT 31.25 per cubic meter.

Total Material Costs (Stone Concrete):

For 1 cubic meter of stone concrete:

Cement: 350 kg (0.35 tons) = 350 x 10,400 = **BDT 3640**.

Sand: 750 kg (0.75 tons) = 750 x 2,530 = **BDT 1897.5**.

Stone: 1,200 kg (1.2 tons) = 1,200 x 4,800 = **BDT 5,760**.

Water: 200 liters = 0.2 cubic meters = **BDT** 6. 25

Total material cost for stone concrete per cubic meter = **BDT 11,304**.

Wastage Ceramic Concrete:

Ceramic waste is a by-product from the ceramic mining and stone industry, which can be used as a partial substitute for ceramic in concrete. It generally costs less than virgin ceramic, but the use of ceramic waste may need minor adjustments in mix design due to its angularity.

Total Material Costs (Wastage Ceramic Concrete):

For 1 cubic meter of wastage Ceramic Waste concrete:

a) Cement: 350 kg (0.35 tons) = 350 x 10400 = **BDT 36,40** (same as stone concrete).

b) Sand: 750 kg (0.75 tons) = 750 x 2,530 = **BDT 18,97.5** (same as stone concrete).

c) Ceramic Waste: 1,200 kg (1.2 tons) = 1,200 x 2,000 (ceramics waste cost) = **BDT 24,00**.

d) Water: 200 liters = **BDT 6.25** (same as stone concrete).

e) Total material cost for wastage ceramic concrete per cubic meter = **BDT 7,944**

Total Material Costs (Brick Concrete): For 1 Cubic meter of Brick chips concrete:

i) Cement: 350 kg (0.35 tons) = 350 x 10400 = **BDT 36,40** (same as stone concrete).

ii) Sand: 750 kg (0.75 tons) = 750 x 2,530 = **BDT 18,97.5** (same as stone concrete).

iii) Brick chips: 1,200 kg (1.2 tons) = 1,200 x 2,900 (ceramics waste cost) = **BDT 3480**.

iv) Water: 200 liters = **BDT 9,027** (same as stone concrete).

v) Total material cost for Brick chips concrete per cubic meter = **BDT 9,027**

6.2 PRODUCTION COSTS:

S**tone Concrete Production:**

Normal concrete is produced using conventional mixing techniques and batching. The labor cost, machinery, and transportation are considered in the production cost.

Labor & Machinery: BDT 3,500 per cubic meter.

Transportation: BDT 1,500 per cubic meter.

Total production cost for stone concrete = **BDT 5,000**.

Wastage Ceramic Concrete Production:

Wastage ceramic concrete follows similar production methods, but due to the angular nature of ceramic waste, there may be minor adjustments in the mixing process, slightly increasing the cost of production.

- **Labor & Machinery**: BDT 4000 per cubic meter.
- **Transportation**: BDT 1,500 per cubic meter (same as stone concrete).

Total production cost for wastage ceramic concrete = **BDT 5,500**.

Brick Chips Concrete Production:

Wastage ceramic concrete follows similar production methods, but due to the angular nature of ceramic waste, there may be minor adjustments in the mixing process, slightly increasing the cost of production.

Labor & Machinery: BDT 4,000 per cubic meter.

Transportation: BDT 1,500 per cubic meter (same as stone concrete).

Total production cost for Brick concrete = **BDT 5,500**.

6.3 Total Costs Comparison:

Stone Concrete Total Cost:

- Material Cost: BDT 11,304 Production Cost: BDT 5,000
- Total Cost = BDT 11,304 + BDT 5,000= BDT 16,304 per cubic meter.

- Wastage Ceramic Concrete Total Cost:
  - Material Cost: BDT 7,944 Production Cost: BDT 5,500
  - Total Cost = BDT 7,944 + BDT 5,500= BDT 13,444per cubic meter.
- Brick chips Concrete Total Cost:
  - Material Cost: BDT 9,027 Production Cost: BDT 4,500
  - Total Cost = BDT 9,027+ BDT 4,500 = BDT 13,527per cubic meter.

6.4 ENVIRONMENTAL IMPACT:

- **Stone Concrete**: Uses natural gravel aggregates, which are often mined from rivers, leading to environmental degradation.
- **Wastage Ceramic Concrete**: Reduces the environmental impact by recycling ceramic waste, helping to reduce the amount of ceramic disposed of in landfills, and minimizing the need for new ceramic extraction.

6.5 cost comparison (bdt) summary

Cost Component	Concrete (Stone)	Concrete (Crushed Ceramics)	Concrete (Brick)
Material Cost	11,304	7, 944	9,027
Production Cost	5,000	5,500	4,500
Total Cost	16,304	13,444	13,527

The graph indicates that wastage ceramic concrete provides a marginal cost saving compared to normal concrete (BDT 16,304, vs. BDT 13,444 vs.BDT 13,527). The savings stem mainly from using ceramic waste as a more affordable substitute for ceramic. However, the slight increase in production costs due to the properties of ceramic waste slightly reduces the overall savings

CHAPTER 7

DISCUSSION AND FINDING

Experimental data shows that adding ceramic waste improves the physical properties of construction materials. Ceramic waste, in particular, can be used as a replacement for coarse aggregate. It is already employed in various construction activities, such as road construction, surface area construction, driveways making, fire pits, and for leveling and setting pavers and stones. By incorporating ceramic waste into coarse aggregate, we can enhance material performance while promoting sustainable construction through the recycling of industrial waste. Based on our conducted studies and various laboratory investigations on the characteristics of ceramic waste concrete, the following findings be drawn Bangladesh is a developing country. So many buildings are being built up almost everywhere & there are also many changes in their design. So, in some places we can use waste ceramic.

1. Non availability of stone at reasonable cost as coarse aggregate in concrete for various reasons, search for alternative material waste ceramic qualifies itself as suitable substitute for stone at minimum cost.

2. In specific gravity test of ceramic waste, we found the value is 2.73. This value indicates that it is preferable to use in construction works.

3. We have so many wastages ceramic produce in our country because of that we can use it in so many constructions and it would be also very helpful for our economy.

4. The compressive strength of cylinders at 28 days for replacement 20% is founded

5. By using this type of concrete, we can reduce the pressure of natural concrete source.

6. Reusing ceramic waste not only conserves natural resources but also contributes to sustainability by turning waste into valuable materials.

7. By using waste ceramic in concrete, a 2% cost saving can be achieved. This method does not negatively impact the strength and durability of the concrete; rather, it helps in the conservation of natural resources. Through this approach, environmental impact in the construction sector can be reduced, and it becomes economically beneficial.

8. Waste ceramic is a recyclable material, which is more cost-effective compared to natural ceramic. Secondly, it can help increase the strength of concrete due to the high density and strength of ceramics, which can contribute to the durability of the concrete. Additionally, it helps in conserving natural resources and reduces waste in the environment. Therefore, despite having a higher unit weight, using waste ceramics provides both economic and environmental benefits.

CHAPTER 8

CONCLUSION AND RECOMMENDATION

After making this study, we came to know about how this type of concrete made with waste ceramic in concrete mixtures can make big step in pollution free world. Use of waste ceramic as Coarse Aggregate in concrete mixture can reduce the pressure of natural concrete source. It helps to save and sustain natural resources that are not replenished and it also helps us to save as well as recycle energy production processes. Our study was all about, “Study on use of ceramic wastage as a eplacement of coarse aggregate in concrete”. We replaced coarse aggregate in concrete with ceramic in the concrete cylinders we compared the Compressive strength of concrete cylinders.

8.1 CONCLUSION:

The study on the use of ceramic as a replacement for coarse aggregates in concrete has shown that waste ceramic can be an effective and sustainable alternative. The incorporation of ceramic as a partial substitute does not negatively affect the strength or durability of the concrete. In some cases, it may even improve the compressive strength due to the high density and hardness of ceramic. Additionally, using waste ceramic helps reduce environmental impact by promoting recycling and conserving natural resources. The study demonstrates that this approach can offer both economic and ecological benefits, particularly by reducing waste and lowering material costs in construction projects.

8.2 RECOMMENDATIONS:

- Further Research: It is recommended to conduct more comprehensive studies on the long-term effects of using waste ceramic as a replacement in different concrete mixes, especially in terms of durability under various environmental conditions.
- Optimal Replacement Levels: Further research should aim to identify the optimal percentage of ceramic replacement that maximizes both strength and cost-effectiveness without compromising the workability of the concrete mix.

Standardization: Standard guidelines should be developed for the use of waste ceramic in concrete to ensure consistency and quality in its application, especially in large-scale construction projects.

- Industry Adoption: Construction industry stakeholders should be encouraged to adopt the use of waste ceramic as a sustainable alternative to natural aggregates, promoting environmental conservation and reducing waste disposal challenges.

Recycling Infrastructure: It is recommended to improve recycling infrastructure to better process and utilize waste ceramics, making it more accessible and cost-effective for use in concrete production.

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