Study on use of Granite Wastage as a partial replacement of Coarse Aggregate in Concrete

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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: 23(B+D)

Semester – Fall 2024

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ACKNOWLEDGEMENTS

The report titled **"Study on the Use of Granite Wastage as a Partial Replacement of Coarse Aggregate in Concrete"** has been carefully prepared as part of our practicum requirements. We would like to extend our heartfelt gratitude to our distinguished thesis supervisor, Md. Zahid Husain Khan, Professor in the Department of Civil Engineering at Sonargaon University, for offering us the opportunity to delve into such a relevant and impactful topic. His consistent guidance, valuable suggestions, constant encouragement, and expertise have been essential throughout this research process. His genuine interest in the subject and unwavering support have been a constant source of motivation for us. Without his regular mentorship, thoughtful direction, and thorough feedback, this research would not have been completed successfully. We are truly fortunate to have had the privilege of working under his supervision.

We also express our deep appreciation for his steadfast cooperation, invaluable advice, and the encouragement he provided at each stage of our work. The data from prior surveys, as well as his ongoing feedback and guidance, greatly contributed to the successful completion of this thesis.

Lastly, we wish to thank every member of our team for their unwavering commitment, collaborative efforts, and selfless contributions throughout this research. Their dedication and support were crucial to the success of this project.

ABSTRACT

In our sub-continent, wastages of Granite production has generated a very 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 granite by-product for replacing of coarse aggregates in concrete partially. In this work, we have used waste granite in spite of stone in different percentages like 0%,5%,10%,20%,and 25% by weight and cement is used the same. Influence on replacement of wastage granite 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. 20% replacement of coarse aggregates with waste granite resulted in the best result in compressive strength at 28 days of curing. The results of the experimental study show that, mixture of wastage granite can 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 granite concrete offers a cost reduction of approximately 2% compared to normal concrete while providing additional strength benefits and contributing to sustainability.

Keywords:Waste Granite, Stone ; Partial replacement; Compressive strength.

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Chapter-1
Introduction:

1.1 Background:

Nowadays the 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 over-exploitation 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 granite waste is generated, primarily from, wastages of building materials and processing industries. Granite, a widely used igneous rock, is one of the most abundant resources, particularly in Dinajpur and Rangpur, but a large portion of it becomes waste in the form of dust, slurry, and other by-products during the cutting and polishing processes. This waste, 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 a partial replacement of conventional aggregates in concrete production, offering a viable solution to mitigate both waste accumulation and the overuse of natural resources.

1.2 Introduction:

This study explores the feasibility of utilizing waste granite as a partial replacement for coarse aggregates in concrete. By investigating the properties of concrete when granite waste is used, 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.

Now- a- days there are so many researches that has been done to improve

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 granite waste of Bangladesh recycling in the process before use. The natural and recycled aggregates were characterized. Concrete. Mix Designs with 0%, 5%, 10%, 20%, and 25% of aggregate substitutions are formulated.the performances of the concrete is measured through tests of compressive strength.



Fig 1.1: Waste Granite (64 free school street, Kathalbagan, Dhaka 1205)

1.3 Objectives:

1.To study the use of granite waste partially in place of stone concrete.

2. To determine the percentage of granite waste for best result.

3. To determine the cost comparison between stone and granite waste as waste aggregate

Chapter -2

Literature Review

2.1 Literature Review :

- **Properties of Granite Waste:**

  Granite is a hard, durable igneous rock primarily composed of quartz, feldspar, and mica. The waste granite generated during quarrying and processing is typically in the form of fine aggregates, slurry, and stone chips. Studies have shown that granite waste can be crushed 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 granite waste is also beneficial, as it often contains siliceous and aluminous materials that contribute positively to concrete's durability and strength.

- **Strength and Durability:**

  Many studies indicate that the incorporation of granite waste up to a certain percentage (typically 20%–30%) results in improved compressive strength, flexural strength, and durability of concrete. This can be attributed to the angular shape of granite particles, 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.

- **Workability:**

  The workability of concrete containing granite waste as course aggregate is typically lower compared to conventional concrete, due to the angular and rough texture of granite particles. The addition of superplasticizers or other additives has been suggested to mitigate this issue, improving the flow and cohesion of the concrete mix.

- **Strength Performance:**

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

- **Environmental Impact:**

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

- **Waste Reduction:**

  Waste granite is a byproduct of the granite 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 granite waste 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:**

  Utilizing granite waste in concrete not only helps in waste management but also provides economic advantages. Granite waste is 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 granite 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 granite waste, especially with regard to factors such as freeze-thaw resistance, shrinkage, and corrosion resistance.

- **Workability Issues:**

  As mentioned earlier, the angular nature of granite waste 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, river sand was selected as the fine aggregate due to its optimal characteristics. The river sand used had a density of 2.51, a specific gravity of approximately 2.67, and a fineness modulus (FM) of 2.48. These properties ensure that the sand is well-suited for high-quality concrete production. This sand was chosen for its reliable performance in concrete mix designs. Its water absorption rate is 0.3%, ensuring minimal moisture retention during the mixing process.

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.



Fig:3.2: Fine Aggregate Sand.

3.3 Sieve Analysis of Fine Aggregate (Sand):



Fig: 3.3: 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 testing of aggregate is of more direct application to the testing of stone aggregate for wearing. It has been found that the aggregate which shows a low loss in this test will general be hard, tough, resistant to abrasion and strong which are the desirable and necessary qualities for durability of concrete. The abrasion test on aggregate is found as per IS-2386 Part IV. The sieving operation should be conducted by mass of a lateral and vertical motion of the sieve, accompanied by the jarring action so as to keep the sample moving continuously over the surface of the sieve. In no case shall the fragments of the sample be turned or manipulated through the sieve by hand. Use a coarse sieve first in order to minimize wear of 1.7 mm IS sieve.

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 50 tones testing machine, which is expensive. The impact test on an aggregate is a useful guide to its behavior when subjected and brittleness must also be taken into account and is conducted as per the specifications of IS-2386 part IV. The sample should be subjected to 15 blows of the hammer at not less than one second interval. The fraction passing and retained on the 2.36 mm IS sieve should be weighed and sum should agree within one gram with the original mass of the sample taken. As the hammer is heavy,be cautions to keep away from falling mass, to avoid accidents.

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. Proper selection of aggregates is crucial to achieving a durable and high-performance concrete structure.

3.9 Coarse Aggregate (Waste Granite):

Granite wastage occurs during the extraction and processing of granite, resulting in scraps, chips. While these by-products are often discarded, they can be repurposed in construction and other industries, helping reduce environmental impact.

Larger granite pieces can be crushed and used as aggregates in concrete or for landscaping, while finer particles like dust can serve as fillers in road construction or other industrial applications.

For this study, granite waste was selected in smaller, uniform sizes to ensure it can be effectively used as a substitute for natural aggregates. Proper grading of the waste is essential to maintain the quality of concrete, ensuring good workability and strength.

Chapter -4

Experimention 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 Tejkunipara, Tejgaon, Dhaka and Sand from Chandrima Model Town, Mohammadpur, also Waste Granite from Kathalbagan, Dhaka 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 Waste Granite:

The specific gravity of waste granite is defined as the ratio of mass of a given volume of sample to the mass of an equal volume of water at the same temperature. The specific gravity of waste granite is generally required for calculations in connection with concrete mix design, for determination of moisture content and for the calculations of volume yield of concrete. The specific gravity also gives information on the quality and properties of waste granite. Departure of specific gravity from its standard value indicted change in shape and grading. It influences the behavior of waste granite in concrete in several important aspects. Highly absorptive waste granite, if used in dry condition, will reduce effective water-cement ratio to an appreciable extent and may even make the concrete unworkable unless a suitable allowance is made. Hence determination of absorption of waste granite is necessary to determine net water-cement ratio. The entire sample should be frequently stirred to secure uniform drying. The air trapped in the waste granite should be brought to surface by rolling the flask in inclined position.

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:**

  Normal or standard consistency of any given cement sample is that water content which will produce a cement paste of standard consistency. Consistence is determined by the Vacate apparatus, which measures the depth of penetration in paste of a 10 mm diameter plunger under its own weight. Normal or standard consistency is expressed as that percentage of water, by mass of dry cement, corresponding to which a specified depth of penetration in paste is achieved. Normal consistency varies from 26 to 33% for Portland cement. To determine the water to cement ratios of specimens to be used, normal consistency of cementused and also to determine the quality tests such as: compressive and tensile strengths, times of set, and soundness tests, on the same cement. For finding out initial and final setting time, soundness of cement and strength, a parameter known as standard consistency has to be used. The objective of conducting this test is to find out the amount of water to be added to the cement to get a percentage of normal consistency that is the paste of a certain standard solidity, which is used to fix the quality of water to be mixed in cement before performing tests for setting time, soundness and compressive strength. The test is required to be conducted in a constant temperature (270 °C ± 20 °C) and constant humidity (90%).

- **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 in the 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. For the construction like water filtration system, slope stabilization project, railway bedding, knowing the specific gravity of aggregates becomes critical.

4.5 Collected materials:



Fig:4.5: Collected materials.

4.6 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.

4.7 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.

4.8 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***

- **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 mould 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 mould 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 mould is lifted vertically upward and the change in height of the concrete is measured.

4.9 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.

4.10 Preparing Concrete:



Fig:4.10: Preparing Concrete.

4.11 Oiling and cleaning cylinder:



Fig:4.11: Oiling and cleaning cylinders.

4.12 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 moulded 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.

4.13 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 7,14 and 28 days after curing. For assessing the quality of concrete cast at site, compressive strength test is conducted during mix proportioning.

4.14 Curing 28 days:



Fig:4.14: After curing 28 days.

4.15 Checking Cylinders with our Supervisor:



Fig:4.15: Checking Cylinders with our Supervisor.

4.16 Taking measurement of Cylinder:



Fig:4.16: Taking measurement of Cylinder.

4.17 Compressive Strength test with Cylinder in presence of Supervisor:



Fig:4.17: Compressive Strength test with Cylinder in presence of Supervisor.

4.18 Compressive Strength:



Fig:4.18: Compressive Strength.

Chapter-5

Results and Analysis

5.1 Sieve Analysis of Fine Aggregate:

Sieve Analysis of Fine Aggregate -ASTM C 136 – 01	
Sample Weight Taken -	500gm

Sieve Number	Sieve size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative percentage weight retained (%)	F.M.
#4	4.75 mm	10	10	2	2.48
#8	2.36 mm	4	14	2.8	
#16	1.18 mm	21	35	7	
#30	0.6 mm	214	249	49.8	
#50	0.3 mm	190	439	87.8	
#100	0.15 mm	53	492	98.4	
Pan		8	500		
Total		500		247.8	

Weight OK

5.2 Sieve Analysis of Coarse Aggregate:

Sieve Analysis of **Coarse Aggregate (Stone)**	
Sample Weight Taken -	5000gm

Sieve size	Weight retained (kg)	Cumulative weight retained (kg)	Cumulative (%) retained	Cumulative (%) retained	F.M.
80 mm	0	0	0	100	7.26
40 mm	0	0	0	100	
20 mm	1.500	1.500	30	70	
10 mm	3.320	4.820	96.4	3.6	
4.75 mm	0.180	5.000	100	0	
2.36 mm	0.000	5.000	100	0	
1.18 mm	0.000	5.000	100	0	
600 µm	0.000	5.000	100	0	
300 µm	0.000	5.000	100	0	
150 µm	0.000	5.000	100	0	
Total	5 kg		726.4		

Weight OK

5.3 Sieve Analysis of Coarse Aggregate (Granite):



Fig:5.3: Sieve Analysis of Coarse Aggregate (Granite).

5.4 Sieve Analysis of Granite:

Sieve Analysis of Coarse Aggregate- Granite Waste				
Sample Weight Taken -		2000	gm	
Sieve size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative percentage weight retained (%)	F.M.
80 mm	0	0	0	6.72
40 mm	0	0	0	
20 mm	118	118	5.9	
10 mm	1432	1550	77.5	
4.75 mm	410	1960	98	
2.36 mm	30	1990	98	
1.18 mm	0	1990	98	
600µm	0	1990	98	
300µm	0	1990	98	
100µm	0	1990	98	
pan	10	2000		
Total	2000		671.4	

Weight OK

5.5 Physical Properties of Used Materials:

6 Physical properties of Granite Waste:

Properties	Test results
Specific gravity	2.73
Colour	Blackish Grey
Form	Granite Chips
Odour	Odourless
Fineness Modulus	6.72

6.1 Testing of Materials:

7 Spacific Gravity Test Result:

Specific Gravity Of Used Materials	
Materials Name	**Specific Gravity**
Ordinary Portland Cement	3.15
Sylhet Sand	2.71
Coarse Aggregate (Granite waste)	2.73
Coarse Aggregate (Chips Stone)	2.50

7.1 Unit Weight of Used Materials:

Unit Weight Of Used Materials	
Materials Name	**Unit Weight**
Ordinary Portland Cement	1440kg/m3
Sylhet Sand	1568kg/m3
Coarse Aggregate (Stone Chips)	1600kg/m3
Coarse Aggregate (Granite waste)	2460kg/m3

7.2 Percentage (%) of replacement:

SL	% Replacement by Granite	Number of Cylinders
1	0%	2 Nos
2	5%	2 Nos
3	10%	2 Nos
4	20%	2 Nos
5	25%	2 Nos
Total =		10 Nos

7.3 Compressive strength after 28 days (Granite):

Compressive strength after 28 days (Granite)									
% of Granite	Sample	d1(mm)	d2(mm)	dAV(mm)	A (mm)^2	W(gm)	Load(KN)	CS(Mpa)	CSAV(Mpa)
0%	1	102.20	103.56	102.88	8312.88	3512	175	21.05	21.58
	2	100.17	102.30	101.235	8049.18	3504	178	22.12	
5%	1	101.67	103.25	102.46	8245.16	3560	147	17.82	18.65
	2	99.56	101.80	100.68	7961.16	3488	155	19.47	
10%	1	103.51	102.20	102.85	8308.03	3464	190	22.86	22.63
	2	99.88	103.50	101.69	8121.68	3544	182	22.40	
20%	1	102.74	102.45	102.60	8267.70	3582	230	27.82	27.37
	2	101.67	103.28	102.48	8248.37	3606	222	26.92	
25%	1	101.27	102.87	102.07	8182.5	3540	205	25.06	24.28
	2	102.5	103.10	102.8	8299.97	3607	195	23.50	

7.4 Bar chart of Compressive strength:

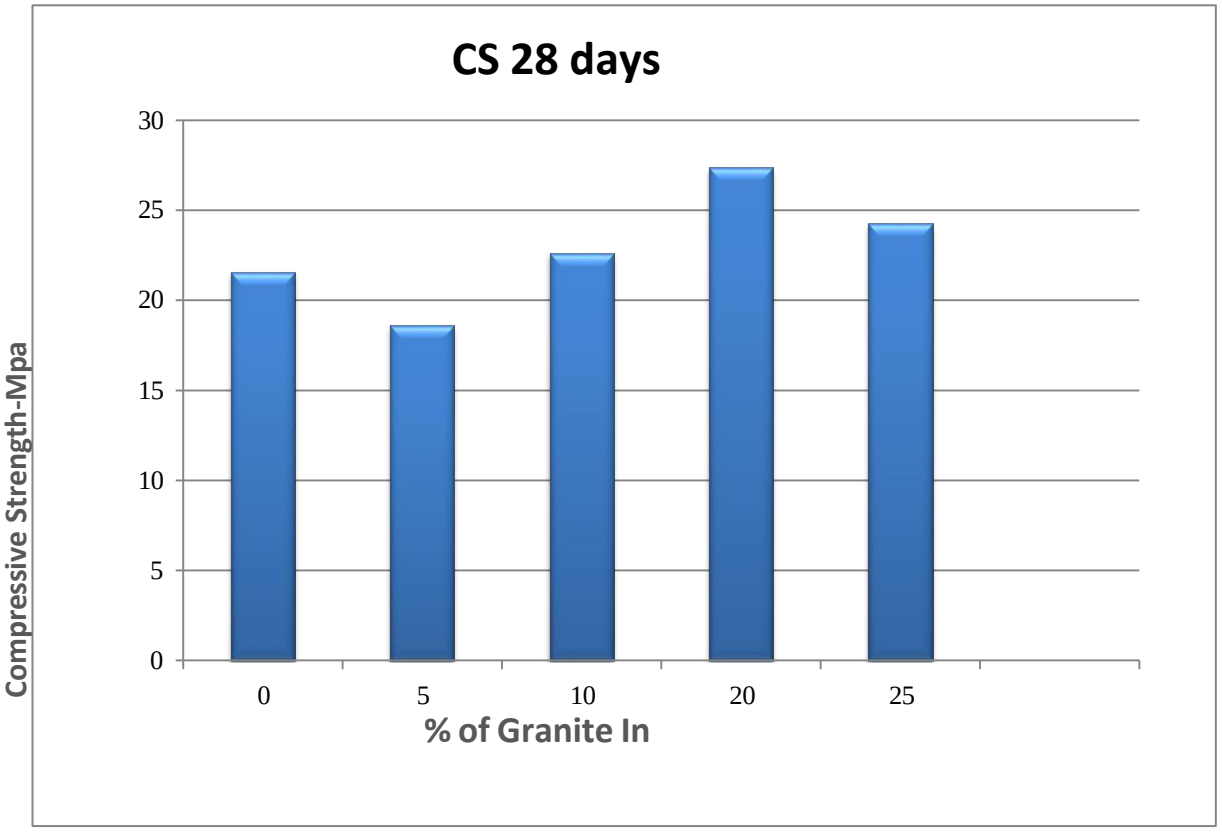


Fig:5.12: Bar chart of Compressive strength.

7.5 : Materials Estimation for Cylinder Casting:

1 set=2 nos Cylinder			Actual Volume (cft)	Volume with (Shrinkage factor & Wastage factor) - Cft	Volume-m^3
			0.229	0.330	0.009
Case	Cement (kg)	Fine Agg (kg)	Stone Chips(kg)	Granite(kg)	Water(kg)
0% Granite	3.267	7.217	8.310	0.000	1.623
5% Granite	3.267	7.217	7.894	0.416	1.623
10% Granite	3.267	7.217	7.479	0.831	1.623
20% Granite	3.267	7.217	6.648	1.662	1.623
25% Granite	3.267	7.217	6.233	2.077	1.623
Total Case	16.335	36.085	36.564	4.986	8.115

Chapter-6

Cost Analysis

6.1 Cost Analysis Between Normal Concrete and Wastage Granite Concrete in Taka:

8 **Introduction:** This analysis compares the cost of normal concrete and concrete made using granite waste as an aggregate, commonly referred to as wastage granite concrete. The aim is to evaluate material costs, production costs, and environmental benefits, all presented in Bangladeshi Taka (BDT).

9 Material Costs:

10 Normal Concrete:

Normal concrete consists of the following components:

- **Cement**: Approx. BDT 8,500 per ton.
- **Sand**: Approx. BDT 3,000 per ton.
- **Gravel (aggregates)**: Approx. BDT 4,000 per ton.
- **Water**: Approx. BDT 25 per cubic meter.

Total Material Costs (Normal Concrete):

For 1 cubic meter of normal concrete:

- Cement: 350 kg (0.35 tons) = 350 x 8,500 = **BDT 2,975**.
- Sand: 750 kg (0.75 tons) = 750 x 3,000 = **BDT 2,250**.
- Gravel: 1,200 kg (1.2 tons) = 1,200 x 4,000 = **BDT 4,800**.
- Water: 200 liters = 0.2 cubic meters = **BDT 5**.

Total material cost for normal concrete per cubic meter = **BDT 10,030**.

❖ *Wastage Granite Concrete:*

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

Total Material Costs (Wastage Granite Concrete):

For 1 cubic meter of wastage granite concrete:

- Cement: 350 kg (0.35 tons) = 350 x 8,500 = **BDT 2,975** (same as normal concrete).
- Sand: 750 kg (0.75 tons) = 750 x 3,000 = **BDT 2,250** (same as normal concrete).
- Granite Waste: 1,200 kg (1.2 tons) = 1,200 x 3,600 (granite waste cost) = **BDT 4,320**.
- Water: 200 liters = **BDT 5** (same as normal concrete).

Total material cost for wastage granite concrete per cubic meter = **BDT 9,550**.

6.2 Production Costs:

❖ *Normal 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 4,000 per cubic meter.
- **Transportation**: BDT 1,500 per cubic meter.

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

❖ *Wastage Granite Concrete Production:*

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

- **Labor & Machinery**: BDT 4,200 per cubic meter.
- **Transportation**: BDT 1,500 per cubic meter (same as normal concrete).

Total production cost for wastage granite concrete = **BDT 5,700**.

6.3 Total Costs Comparison:

- **Normal Concrete Total Cost**:
  - Material Cost: **BDT 10,030**
  - Production Cost: **BDT 5,500**
  - **Total Cost** = BDT 10,030 + BDT 5,500 = **BDT 15,530** per cubic meter.
- **Wastage Granite Concrete Total Cost**:
  - Material Cost: **BDT 9,550**
  - Production Cost: **BDT 5,700**

- **Total Cost** = BDT 9,550 + BDT 5,700 = **BDT 15,250** per cubic meter.

6.4 Environmental Impact:

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

6.5 Cost Comparison (BDT) Summary

Cost Component	Normal Concrete	Wastage Granite Concrete
Material Cost	10,030	9,550
Production Cost	5,500	5,700
Total Cost	15,530	15,250

The graph indicates that wastage granite concrete provides a marginal cost saving compared to normal concrete (BDT 15,250 vs. BDT 15,530). The savings stem mainly from using granite waste as a more affordable substitute for gravel. However, the slight increase in production costs due to the properties of granite waste slightly reduces the overall savings.

Chapter -7
Disscussion and Finding

Experimental data shows that adding granite waste improves the physical properties of construction materials. Granite 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 granite 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 granite 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 granite.
- Non availability of stone at reasonable cost as coarse aggregate in concrete for various reasons, search for alternative material waste granite qualifies itself as suitable substitute for stone at minimum cost.
- In specific gravity test of granite waste, we found the value is 2.73. This value indicates that it is preferable to use in construction works.
- We have so many wastages granite 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.
- We used (0%, 5%, 10%, 20% and 25% percentage of mixing granite waste; In future if someone would like to do new research on this so that they can work on more than our percentage.
- The compressive strength of cylinders at 28 days for replacement 20% is founded maximum.
- By using this type of concrete, we can reduce the pressure of natural concrete source.
- Reusing granite waste not only conserves natural resources but also contributes to sustainability by turning waste into valuable materials.
- By using waste granite 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.

- Waste granite is a recyclable material, which is more cost-effective compared to natural granite. Secondly, it can help increase the strength of concrete due to the high density and strength of granite, 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 granite 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 granite in concrete mixtures can make big step in pollution free world. Use of waste granite 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 granite wastage as a partial replacement of coarse aggregate in concrete". We replaced coarse aggregate in concrete with granite in varying proportions from 0%, 5%, 10%, 20% and 25% After 28 days of curing of the concrete cylinders we compared the Compressive strength of concrete cylinders.

8.1 Conclusion:

The study on the use of granite as a partial replacement for coarse aggregates in concrete has shown that waste granite can be an effective and sustainable alternative. The incorporation of granite 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 granite. Additionally, using waste granite 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 granite as a partial 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 granite 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 granite 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 granite 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 granite, making it more accessible and cost-effective for use in concrete production.

8.3 Limitations

❖ The UTM that we used wasn't calibrated that's why our confidence of the study is low.

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