Utilizing Marble and Granite as 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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Dedicated

to

"Our Parents & Honorable Teachers"

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ABSTRACT

Disposal of solid waste materials is a great concern in cities all around the world. Some of these waste materials are not biodegradable, which often leads to disposal crises and environmental pollution. Many efforts are being made for the recycling of different types of solid wastes to utilize them in the production of various construction materials. The granite & marble industries produce vast amounts of by-product rock waste and as a result, many residential and agricultural areas are settled over the landfills which are basically composed of these waste materials.

This paper reveals the use of polished granite and marble waste from discarded tiles as a partial replacement for coarse aggregates in cement concrete. It was observed that the incorporation of polished granite and marble waste in while better results were observed for water absorption, Unit weight, F.M, Compressive strength and water permeability. By comparing the compressive strength between granite and marble when 5% replacement of marble (by weight) gives maximum compressive strength than 0%, 10%, and 20% replacement (by weight) And also for 20% replacement of granite (by weight) gives maximum compressive strength than 0%, 5% and 10% replacement (by weight). Could be recommended for non-structural applications like pavement, footpaths, drainage line etc.

The main objective of this paper is to assess the potential of using marble and granite waste as a replacement of coarse aggregates of concrete mixes.

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CHAPTER ONE

INTRODUCTION

1.1 Background and Motivations

Because of the continual depletion of quarry aggregates, construction materials are more and more judged by their ecological characteristics. The lack of technology and unscientific methods of quarrying marble and granite in all over the world has generated a huge quantity of waste of this valuable mineral; leaving the waste materials to nature directly can cause serious environmental problems. In addition, the Marble & Granite cutting industry generates a high volume of waste. Recent studies showed that marble and granite waste can be used as aggregates for assorted construction materials. have studied some mechanical properties of concrete containing marble and granite waste; mixes were modified to 0%, 25%,50%, and 75% marble and granite instead of coarse aggregates (Stone Chips) and their compressive strengths were compared. [8]

In the specimens containing marble and granite, there is a much better bonding among the additives, cement, and aggregates. Because of the continual depletion of quarry aggregates, construction materials are more and more judged by their ecological characteristics. Furthermore, it may be said that marble and granite replacement rendered a good condensed matrix. The results of this study showed that marble and granite waste aggregates can be used to improve
the mechanical properties, workability, and chemical resistance of conventional concrete mixtures.

In this paper, we study the marble and granite waste of Bangladesh recycling in the process before use. The natural and recycled aggregates were characterized. Concrete mix designs with 0%, 5%, 10%, and 20% of aggregate substitutions are formulated. The performances of the ‘‘recycled aggregates” concrete is measured through tests of compressive strength.



Fig 1.1: Waste Marble and Granite (Jatrabari, Dhaka)

1.2 Research Objectives and Overview

- To study the strength behavior of cement concrete as the partial replacement of coarse aggregate by Marble and Granite waste.

- To compare the weight of concrete cylinders as the partial replacement of coarse aggregate by Marble and Granite waste.

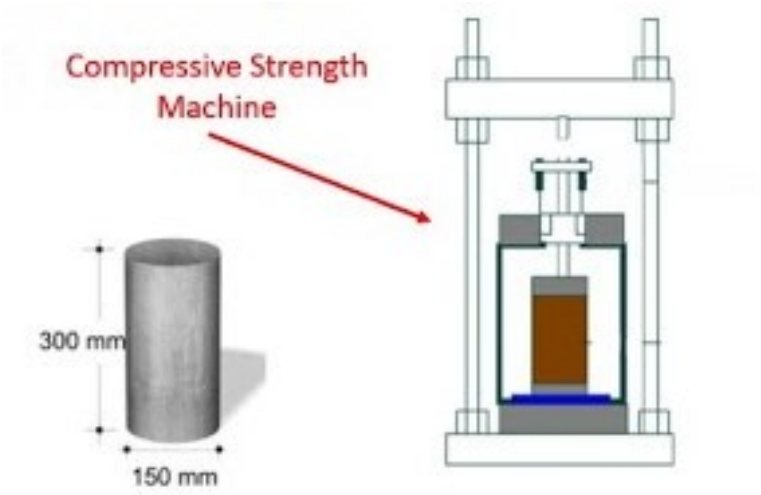


Fig 1.1.1: Compressive Strength Test Method

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Some of the significant research works that have been reported in the literature review in the context of the different waste materials cited in the afore-mentioned section are discussed in brief in the subsequent paragraphs. Besides, the marble and granite have a low density compared to the stone aggregate. As a result, Compressive strength decreases from 0% of Granite waste when using 40%, 60%, 80%, and 100% of Granite waste in concrete and compressive strength increases slightly when using 20% of granite waste use and after 14 days of curing. As a result, it is proposed that using wastes that may enhance concrete properties will lower the need for normal coarse and fine aggregates, enabling natural resource conservation.

2.2 Content

[1] MA Danish, D Budhlani in 2019 performed a study of Crushed waste mosaic tiles and crushed waste Granite powder are used as a replacement for coarse aggregates and fine aggregates. The waste-crushed tiles were partially replaced in place of coarse aggregates by 10%, 20%, 30%, 40% and 50%. Granite powder was replaced in place of fine aggregate by 10% along with the ceramic coarse tiles. M25 grade of concrete was designed and tested. The mix design for different types of mixes was prepared by replacing the coarse aggregates and fine aggregate at different percentages of crushed tiles and granite powder. Experimental investigations like workability, Compressive strength test, and Split tensile strength test for different concrete mixes with different percentages of waste crushed and granite powder after 7, 14, and 28 days of curing period has done. It has been observed that the workability increases with the increase in the percentage of replacement of granite powder and crushed tiles increases. The strength of the concrete also increases with the ceramic coarse tile aggregate up to 30% percentage.

[2] Athulya Sugathan, Visvesvara Technological University Bangalore, India in 2016 Broken marble is replaced by Coarse aggregates the project is carried out by using M20 grade concrete with replacement of 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50% broken marble pieces by coarse aggregates and is carried out to

determine the optimum percentage of replacement at which maximum compressive strength is achieved The concrete made with waste broken marble tiles as coarse aggregate produced similar strength in compression. The compressive strength of concrete cubes made with broken marble tiles as coarse aggregate in concrete were found to be 16% and 26.34% lesser respectively than that of conventional concrete. Hence, it can be seen that waste-broken marble tiles can be used as an alternate reconstruction material to coarse aggregate in concrete.

[3] K Ostrowski, D Stefaniuk in 2020 study the effect of granite waste on compressive strength and split tensile strength of concrete with partial replacement of coarse aggregates by 20%, 40%, 60%, 80% and 100% for 7, 14 and 28 days of water curing for M25 grade of concrete, B. Compare compressive strength of concrete with normal grade of concrete for 7, 14 and 28 days of water curing for M25 grade of concrete. (i.e. 0% of granite waste). Compressive strength decreases from 0% of Granite waste when using 40%, 60%, 80%, and 100% of granite waste in concrete. And compressive strength increases slightly when using 20% of granite waste use and after 14 days of curing. Split tensile strength is decreased from 0% of granite waste when using 20,40,60,80, and 100 percent of granite waste after 28 days of curing.

[4] S Singh, R Nagar, V Agrawal in 2016 a comparative study between granite cutting waste and marble slurry. The compressive strength at 7d and 28d exhibited similar trends. The 7d compressive strength of GCW concrete and MS concrete initially increased with an increasing percentage of replacement and ultimately exhibited a declining strength. The optimum percentage of replacement as
far as initial 7 days strength and final 28 days strength is concerned were observed at 25% and 15% for GCW and MS respectively. The enhanced strength of the GCW concrete and MS concrete may be due to a relatively rougher texture when compared with natural sand. However, once the optimum
replacement was achieved further addition of replacement had negative impacts on strength about the fact that now instead of acting as a filler material the increased GCW content and MS content would have led to the increased surface area thus demanding higher cement content. Since the cement content was kept constant for all the percentages of replacement it might be responsible for the decrease in the strength.

2.3 Summary

In this study, we know how many times research on waste marble and granite in concrete mixtures and use of waste marble and granite as Coarse Aggregate in concrete mixture. It helps to save and sustain natural resources that are not replenished, it decreases the pollution of the environment, and it also helps to save and recycle energy production processes. We study & research waste marble and granite as coarse aggregate in concrete. We replace coarse aggregate in concrete with waste marble and granite in varying proportions from 0%, 5%, 10%, and 20%. After 28 days of curing of the concrete cylinders we compared the Compressive strength of concrete cylinders.

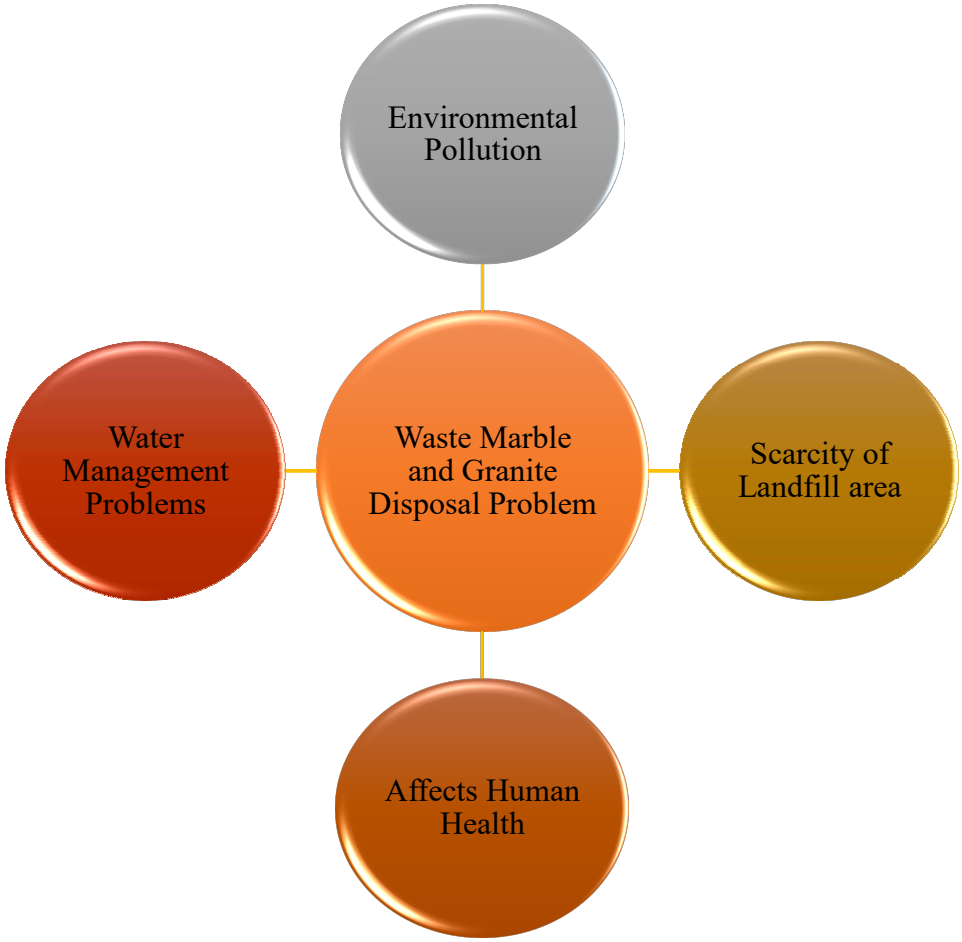


Fig 2.1: Problems for lack of proper use.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

Research of that project is to waste marble and granite as a coarse aggregate in the concrete mixture. Essential to know if the replacement of waste marble and granite in concrete is acceptable there are the making of concrete using coarse aggregate, selection sand, brick chips, and Portland cement used for making concrete, and waste marble and granite aggregate used in crushed concrete from the tested cylinders. Test carried out on these aggregate specific gravity and Bulk density, unit weight, water absorption, and sieve analysis. After testing, a mix design is produced by following the properties obtained from test results after testing: a mix design is produced by following the properties obtained from test results. Concrete is then produced with replacement of 0%, 5%, 10%, and 20% of waste marble and granite aggregate replacement of coarse aggregate by weight volume ratio. For the hardened concrete, compressive strength was determined. 28 days the results at each testing age are reported as an average. The engineering properties of the waste marble and granite were also compared to those of the reference concrete.

In the research materials:

Cement: Cement used for the test was Portland Composite Cement.
Fine Aggregate: Sylhet Sand F.M 3.5 was used as fine aggregate.
Coarse aggregate: Crushed brick chips obtained from local quarries were used as a course aggregate. The maximum size of coarse aggregate used was 20 mm.
Water: Portable water free from impurities and salt used for casting and curing the concrete blocks as per calculations.
Marble and Granite Aggregate: Waste marble and granite collected from the disposal area were sorted to get the superior one. Used as per requirement size.



Portland Composite Cement



Sylhet Sand F.M 3.5



Brick Chips



Waste Marble



Waste Granite

Fig: 3.1.1 Used Materials

Table 3.1: Percentage (%) of replacement:

SL	% Replacement	Number of Cylinders	
		Marble	Granite
1	0%	4 Nos	
2	5%	4 Nos	4 Nos
3	10%	4 Nos	4 Nos
4	20%	4 Nos	4 Nos
Total =		28 Nos	

Methodology Overview:

The methodology adopted for this study is given below:

1. Literature study was done on the available data on use of marble and granite waste partially replaced in concrete.
2. Marble and granite waste was collected from Construction waste materials dumping area which in Dhaka city, Bangladesh.
3. Marble and granite waste was broken into as per required size.
4. Proportion of marble and granite waste coarse aggregates in different mixes was selected on the basis of available literature.
5. Sieve Analysis, Specific Gravity, and Water Absorption and Unit weight test for mix design.
6. Mix design for different proportions of concrete was decided and tests were performed to obtain the mechanical properties of different mixes.
7. Based on the literature survey and mixed design of marble and granite waste, the following combinations were adopted.

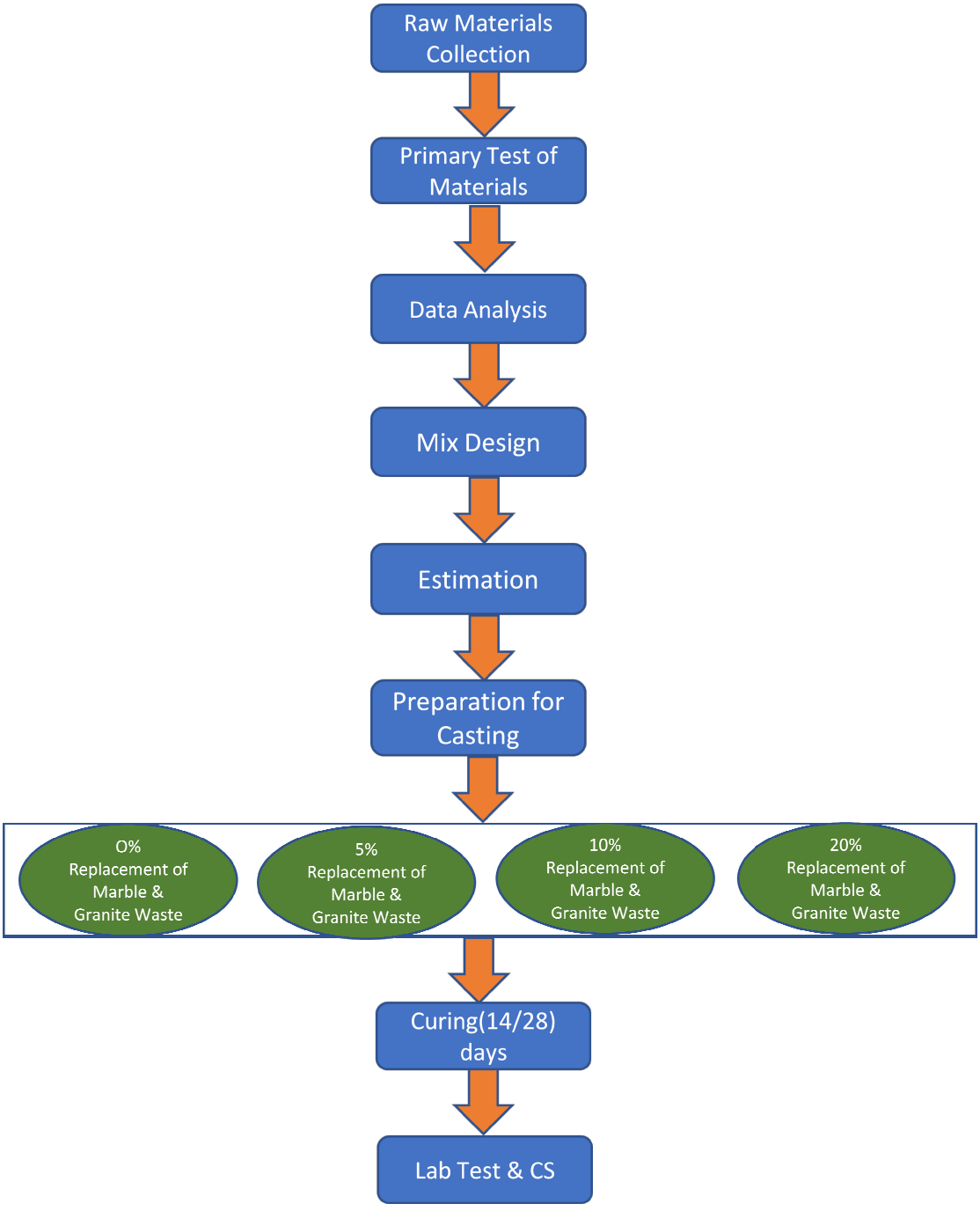


Fig: 3.1.2: Flowchart of Research

Below are some Materials tests for our research:

1. Sieve Analysis of Fine aggregate and Coarse aggregates.
2. Unit weight of Cement, Fine aggregate and Coarse aggregates.
3. Specific gravity of Cement, Fine aggregate and Coarse aggregates.
4. Water Absorption Capacity of Fine aggregate and Coarse aggregates.



Fig: 3.1.2.1: Sample of Materials for test

Table 3.2: Sieve Analysis of Fine Aggregate:

Sieve Analysis of Fine Aggregate -ASTM C 136 – 01		
Sample Weight Taken -	1000	gm

Sieve Number	Sieve size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative percentage weight retained (%)	F.M.
#4	4.75 mm	36	36	3.6	3.5
#8	2.36 mm	102	138	13.8	
#16	1.18 mm	390	528	52.8	
#30	0.6 mm	310	838	83.8	
#50	0.3 mm	130	968	96.8	
#100	0.15 mm	24	992	99.2	
Pan		8			
Total		1000		350	
		Weight OK			





Figure: 3.1.3: Sieve Analysis of Fine Aggregate

Table 3.3: Sieve Analysis of Marble Waste:

Sieve Analysis of Coarse Aggregate- Marble Waste				
Sample Weight Taken -		2000	gm	
Sieve size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative percentage weight retained (%)	F.M.
100 mm	0	1330	66.5	
90 mm	0	1330	66.5	
75 mm	0	1330	66.5	
63 mm	0	1330	66.5	
50 mm	0	1330	66.5	
37.5 mm	0	1330	66.5	
25 mm	0	1330	66.5	10.64
19 mm	1330	2660	133	
12.5 mm	0	2660	133	
9.5 mm	662	3322	166.1	
4.75 mm	8	3330	166.5	
Pan	0			
Total	2000		1064.1	
	Weight OK			



Figure: 3.1.4: Sieve Analysis of Coarse Aggregate (Marble)

Table 3.4: Sieve Analysis of Granite Waste:

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.
100 mm	0	1225	61.25	9.95
90 mm	0	1225	61.25	
75 mm	0	1225	61.25	
63 mm	0	1225	61.25	
50 mm	0	1225	61.25	
37.5 mm	0	1225	61.25	
25 mm	0	1225	61.25	
19 mm	1225	2450	122.50	
12.5 mm	0	2450	122.50	
9.5 mm	757	3207	160.35	
4.75 mm	15	3222	161.10	
Pan	3			
Total	2000		995.20	
	Weight OK			



Figure: 3.1.5: Sieve Analysis of Coarse Aggregate (Granite)

Table 3.5: Sieve Analysis of Brick Chips:

Sieve Analysis of Coarse Aggregate- Brick Chips				
Sample Weight Taken -	1500	gm		
Sieve size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative percentage weight retained (%)	F.M.
100 mm	0	656	43.73	7.48
90 mm	0	656	43.73	
75 mm	0	656	43.73	
63 mm	0	656	43.73	
50 mm	0	656	43.73	
37.5 mm	0	656	43.73	
25 mm	0	656	43.73	
19 mm	656	1312	87.47	
12.5 mm	0	1312	87.47	
9.5 mm	626	1938	129.20	
4.75 mm	124	2062	137.47	
Pan	94			
Total	1500		747.73	
	Weight OK			



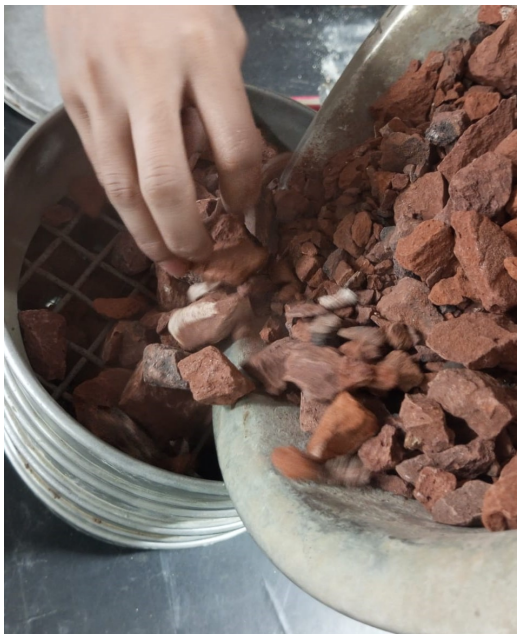


Figure: 3.1.6: Sieve Analysis of Coarse Aggregate (Brick Chips)

Table 3.6: Specific Gravity of Used Materials:

Specific Gravity Of Used Materials	
Materials Name	**Specific Gravity**
Portland Composite Cement	3.15
Sylhet Sand	2.54
Coarse Aggregate (Brick Chips)	2.27
Coarse Aggregate (Marble Waste)	2.82
Coarse Aggregate (Granite waste)	2.71



Fig: 3.1.7: Specific Gravity of Used Materials

Table 3.7: Unit Weight of Used Materials:

Unit Weight Of Used Materials	
Materials Name	**Unit Weight**
Portland Composite Cement	1440kg/m3
Sylhet Sand	1568kg/m3
Coarse Aggregate (Brick Chips)	904kg/m3
Coarse Aggregate (Marble Waste)	1531.43kg/m3
Coarse Aggregate (Granite waste)	1508kg/m3

Table 3.8: Water Absorption Capacity of Used Materials:

Water Absorption Capacity Of Used Materials	
Materials Name	**Water Absorption**
Sylhet Sand	3%
Coarse Aggregate (Brick Chips)	12.34%
Coarse Aggregate (Marble Waste)	1.90%
Coarse Aggregate (Granite waste)	1.64%



Fig 3.1.8: Water Absorption Capacity of Used Materials

Table 3.9: Materials requirement as per mixed design:

Materials Required for 1 cum of Concrete		
Cement	350	kg
Coarse	879.79	kg
Fine	773.49	kg
Water	175	kg
Shrinkage Factor	1.15	
Wastage Factor	1.25	

Table 3.10: Materials Estimation for Cylinder Casting:

1 set=4 nos Cylinder			Actual Volume (cft)	Volume with (Shrinkage factor & Wastage factor) - Cft	Volume-m^3
			0.229	0.330	0.009
Case-1	Cement (kg)	Fine Agg (kg)	Brick Chips (kg)	Marble (kg)	Water(kg)
0% Marble	3.266	7.217	8.209	0.000	1.633
5% Marble	3.266	7.217	7.798	0.410	1.633
10% Marble	3.266	7.217	7.388	0.821	1.633
20% Marble	3.266	7.217	6.567	1.642	1.633
Total Case-1	13.063	28.868	29.962	2.873	6.531
Case-2	Cement (kg)	Fine Agg (kg)	Brick Chips(kg)	Granite(kg)	Water(kg)
0% Granite	3.266	7.217	8.209	0.000	1.633
5% Granite	3.266	7.217	7.798	0.410	1.633
10% Granite	3.266	7.217	7.388	0.821	1.633
20% Granite	3.266	7.217	6.567	1.642	1.633
Total Case-2	13.063	28.868	29.962	2.873	6.531

Table 3.11: Total Materials for 32nos Cylinders:

Total Materials (Case1+Case2)		
Cement	26.125	kg
Sand	57.736	kg
Brick Chips	59.924	kg
Marble	2.873	kg
Granite	2.873	kg
Water	13.063	kg



Figure 3.1.9: Cylinders cleaning and oiling before casting



Figure 3.1.10: Materials mixing for casting



Figure 3.1.11: Materials mixing for casting

All the specimens were casted according to the mix proportions. For these mix proportions required quantities were measured and then mixed. Mixing of concrete was done with hand. Specimens for Compressive Strength to check the compressive strength of concrete mix, specimens of cylinder shape size Height-300mm & diameter 150mm were prepared. The required quantities of materials required were weighed according to the mix proportion. Aggregates and cement was firstly thoroughly mixed. Admixture was added to the water. Water was then added to the dry mix. Total 28 nos similar cylinders were casted, 14 nos cylinders for 14 days testing and rest 14 nos for 28 days testing.

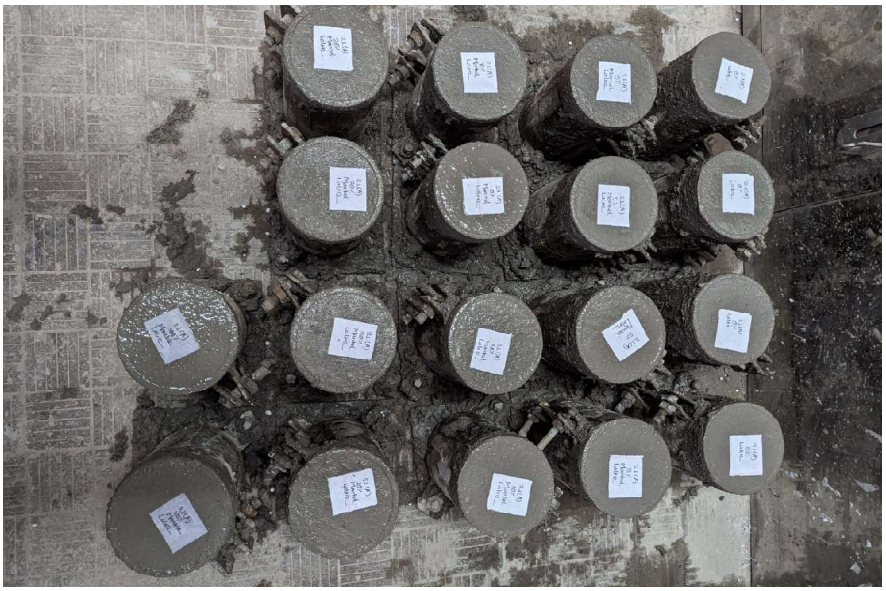


Fig 3.1.12: After casting of cylinders

After 24 hours of casting, the castings were removed from the cylinders and placed in the curing tank.



Figure 3.1.13: Molds placed in the water tank for curing.

Testing of Concrete: After casting specimens were tested after 14 days and 28 days of curing. Compressive Strength to evaluate the compressive strength of concrete, cube specimens was used. Specimens were then taken out of tank after 28 days of curing and surface dried.

Specimens were then placed in Universal Testing Machine. The load was applied and the peak load at which the specimen fails was noted.



Figure 3.1.14: Dry molds before compressive strength test



Figure 3.1.14.1: Compressive Strength Test

Compressive Strength = P/A

Where, P = Load in KN

A = Area of cross section



Figure 3.1.15: Compressive Strength Test

3.2 Summary

Before anything else, marble and granite waste needs to be gathered and separated from other trash. Then, we have broken the waste granites and marbles into tiny pieces. We have the ability to thoroughly mix and create a mixture. Concrete is then produced with replacement of 0%, 5%, 10%, and 20% of marble and granite aggregate replacement of coarse aggregate by weight volume method and curing for 28 days in the fresh distilled water. Tests conducted on these concretes include the slump of fresh concrete. For the hardened concrete, compressive strength, were determined.



Figure 3.1.15.1: Compressive Strength Test

CHAPTER FOUR
RESTULTS AND DISCUSSION

4.1 Introduction

This test was performed on freshly prepared concrete mixes to check the workability of concrete. Workability of concrete is defined as the case to do work with it. Workability of concrete is an important property of fresh concrete. Concrete materials used in this study included type Portland cement, sylhet sand, ¾ inch crushed brick chips, marble, granite and water.

Compressive Strength Test

The concrete cylinder is the most common sample type for tests of concrete compressive strength. There are other ways to determine concrete strength, and some methods may be more cost-effective and arguably better, but concrete cylinder testing remains the standard for acceptance.

Well-made concrete cylinders are easy and inexpensive to produce. Typically, one technician posted at the point of discharge or point of placement is sufficient to sample and test concrete batches for the slump, air content, unit weight, and cylinders. Technicians must follow standard practices and be certified in most regions, but training is neither extensive nor complex.

A compressive axial load is applied to molded cylinders or cores until failure occurs. The compressive strength of the specimen is calculated by dividing the maximum load achieved during the test by the cross-sectional area of the specimen. The results of this test method are used as a basis for quality control of concrete.

This test is performed on hardened concrete, to check the strength of concrete. The concrete specimens were put under the load per unit area of cross section in uniaxial compression under fixed rate of loading. The compressive strength of concrete is expressed in N/mm2. We performed this test on standard cylinder of size 150mm x 300mm. Concrete mix with different proportions was prepared and filled

into cylinder mound. It was then left for 24 hours for initial setting. For every mix proportion 28 specimens were prepared, for 28 days testing. After completion of curing period the 14 specimens were tested after 14days and rest 14 specimens were tested after 28days using Compression testing.

Table 4.1: Compressive strength after 14 days (Granite):

Compressive strength after 14 days (Granite)									
% of Granite	Sample	d1(mm)	d2(mm)	dAV(mm)	A (mm)^2	W(gm)	Load(KN)	CS(Mpa)	CSAV(Mpa)
0%	1	101.46	101.93	101.70	8122.51	3468.00	98	12.065	12.065
5%	1	103.26	102.30	102.78	8296.75	3549.00	75	9.040	9.190
	2	103.23	103.00	103.12	8350.93	3527.00	78	9.340	
10%	1	102.21	102.62	102.42	8237.93	3502.00	75	9.104	9.513
	2	103.30	103.11	103.21	8365.51	3630.00	83	9.922	
20%	1	102.69	103.25	102.97	8327.46	3673.00	91	10.928	11.508
	2	102.28	101.95	102.12	8189.74	3577.00	99	12.088	



Fig 4.1.1: Compressive strength after 14 days (Granite)

Table 4.2: 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	103.65	102.70	103.18	8360.65	3511.00	120	14.353	14.497
	2	101.91	102.40	102.16	8196.15	3443.00	120	14.641	
5%	1	102.63	103.98	103.31	8381.73	3561.00	100	11.931	12.751
	2	101.90	102.20	102.05	8179.31	3488.00	111	13.571	
10%	1	100.38	101.30	100.84	7986.50	3462.00	115	14.399	14.515
	2	102.05	102.33	102.19	8201.77	3542.00	120	14.631	
20%	1	101.41	102.96	102.19	8200.97	3580.00	120	14.632	14.543
	2	100.93	101.24	101.09	8025.36	3603.00	116	14.454	



Fig 4.1.2: Compressive strength after 28 days (Granite)

Table 4.3: Compressive strength after 14 days (Marble):

Compressive strength after 14 days (Marble)									
% of Marble	Sample	d1(mm)	d2(mm)	dAV(mm)	A (mm)^2	W(gm)	Load(KN)	CS(Mpa)	CSAV(Mpa)
0%	1	101.40	101.74	101.57	8102.55	3408.00	94	11.601	11.601
5%	1	101.29	101.92	101.61	8108.14	3468.00	84	10.360	10.468
	2	103.09	102.77	102.93	8320.99	3590.00	88	10.576	
10%	1	101.96	101.86	101.91	8156.89	3510.00	85	10.421	10.634
	2	103.16	102.40	102.78	8296.75	3567.00	90	10.848	
20%	1	103.35	102.20	102.78	8295.95	3620.00	95	11.451	11.570
	2	102.92	103.72	103.32	8384.16	3682.00	98	11.689	



Fig 4.1.3: Compressive strength after 14 days (Marble)

Table 4.4: Compressive strength after 28 days (Marble):

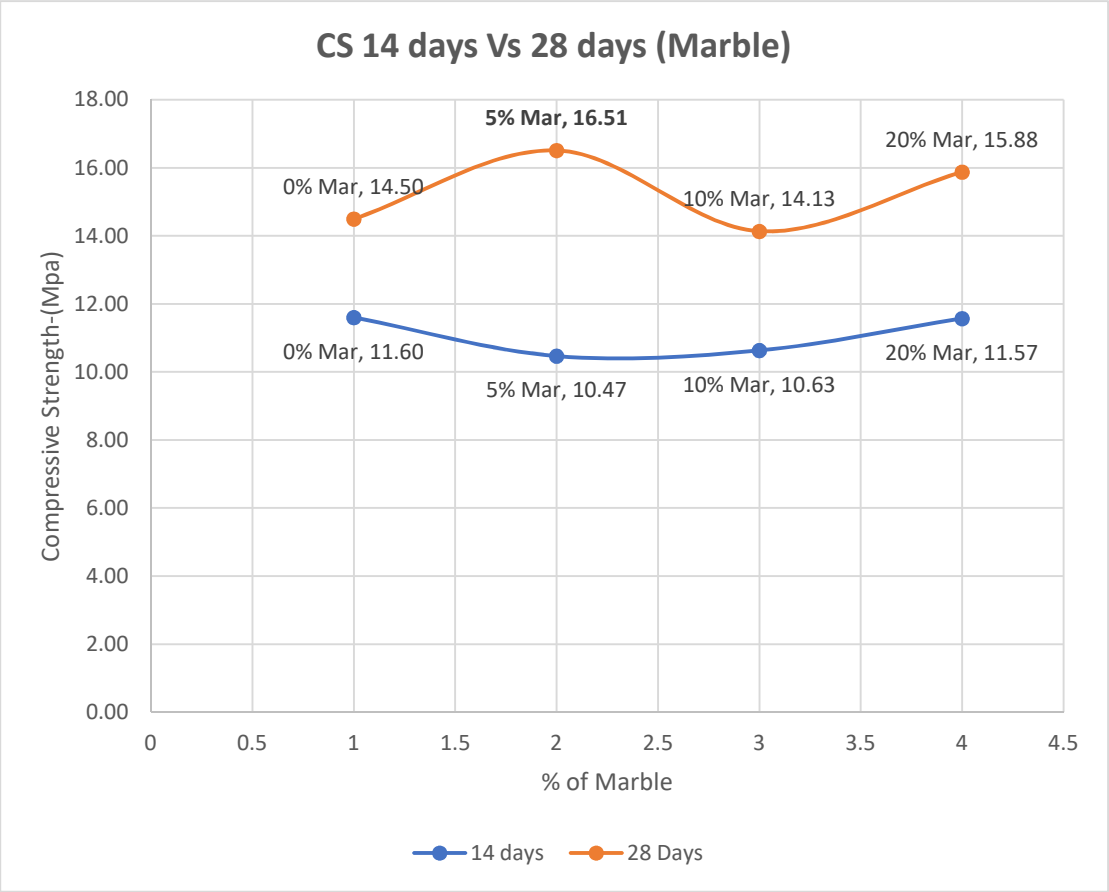
Compressive strength after 28 days (Marble)									
% of Marble	**Sample**	**d1(mm)**	**d2(mm)**	**dAV (mm)**	**A (mm)^2**	**W(gm)**	**Load (KN)**	**CS (Mpa)**	**CSAV (Mpa)**
0%	1	103.65	102.70	103.18	8360.65	3511.00	120	14.353	14.497
	2	101.91	102.40	102.16	8196.15	3443.00	120	14.641	
5%	1	102.60	103.53	103.07	8342.83	3605.00	140	16.781	16.512
	2	103.58	102.16	102.87	8311.29	3630.00	135	16.243	
10%	1	102.62	101.65	102.14	8192.95	3563.00	120	14.647	14.133
	2	103.80	103.58	103.69	8444.32	3579.00	115	13.619	
20%	1	102.50	101.46	101.98	8168.10	3551.00	126	15.426	15.876
	2	102.80	102.41	102.61	8268.52	3625.00	135	16.327	



Fig 4.1.3: Compressive strength after 28 days (Marble)

Table 4.5: Compressive strength 14 days vs 28 days (Marble):

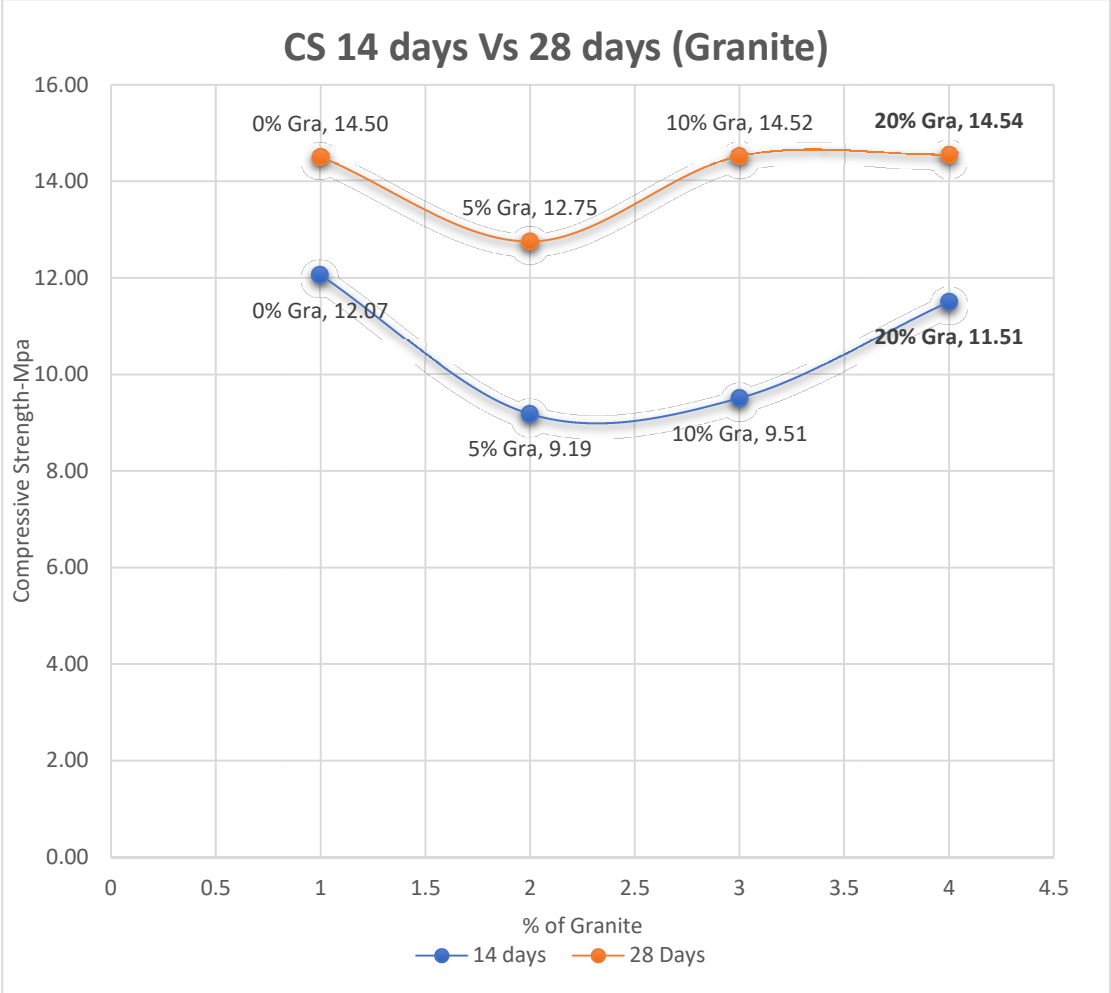
CS 14 days Vs 28 days (Marble)				
Days	0% Mar	5% Mar	10% Mar	20% Mar
14 days (Mpa)	11.60	10.47	10.63	11.57
28 Days (Mpa)	14.50	16.51	14.13	15.88



Compressive strength 14 days vs 28 days (Marble)

Table 4.6: Compressive strength 14 days vs 28 days (Granite):

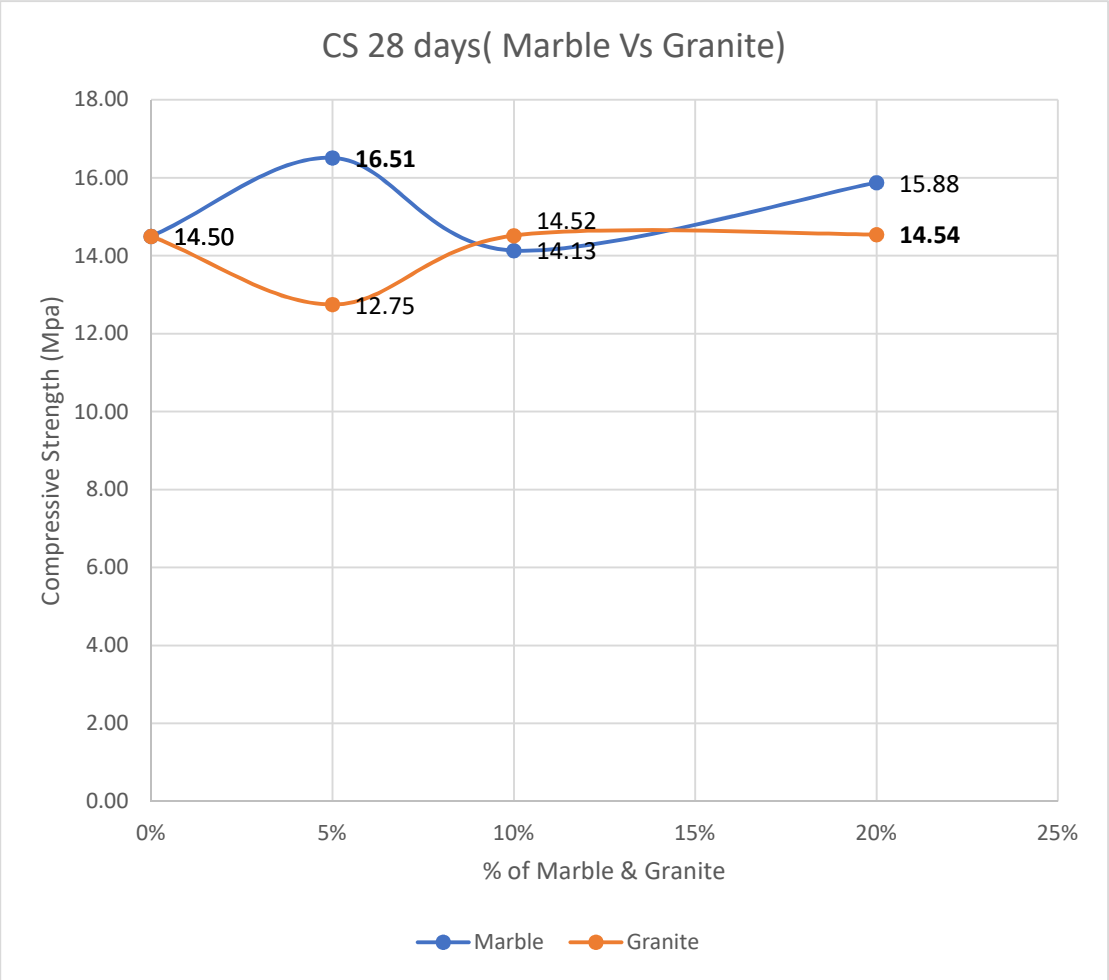
CS 14 days Vs 28 days (Granite)				
Days	0% Gra	5% Gra	10% Gra	20% Gra
14 days (Mpa)	12.07	9.19	9.51	11.51
28 Days (Mpa)	14.50	12.75	14.52	14.54



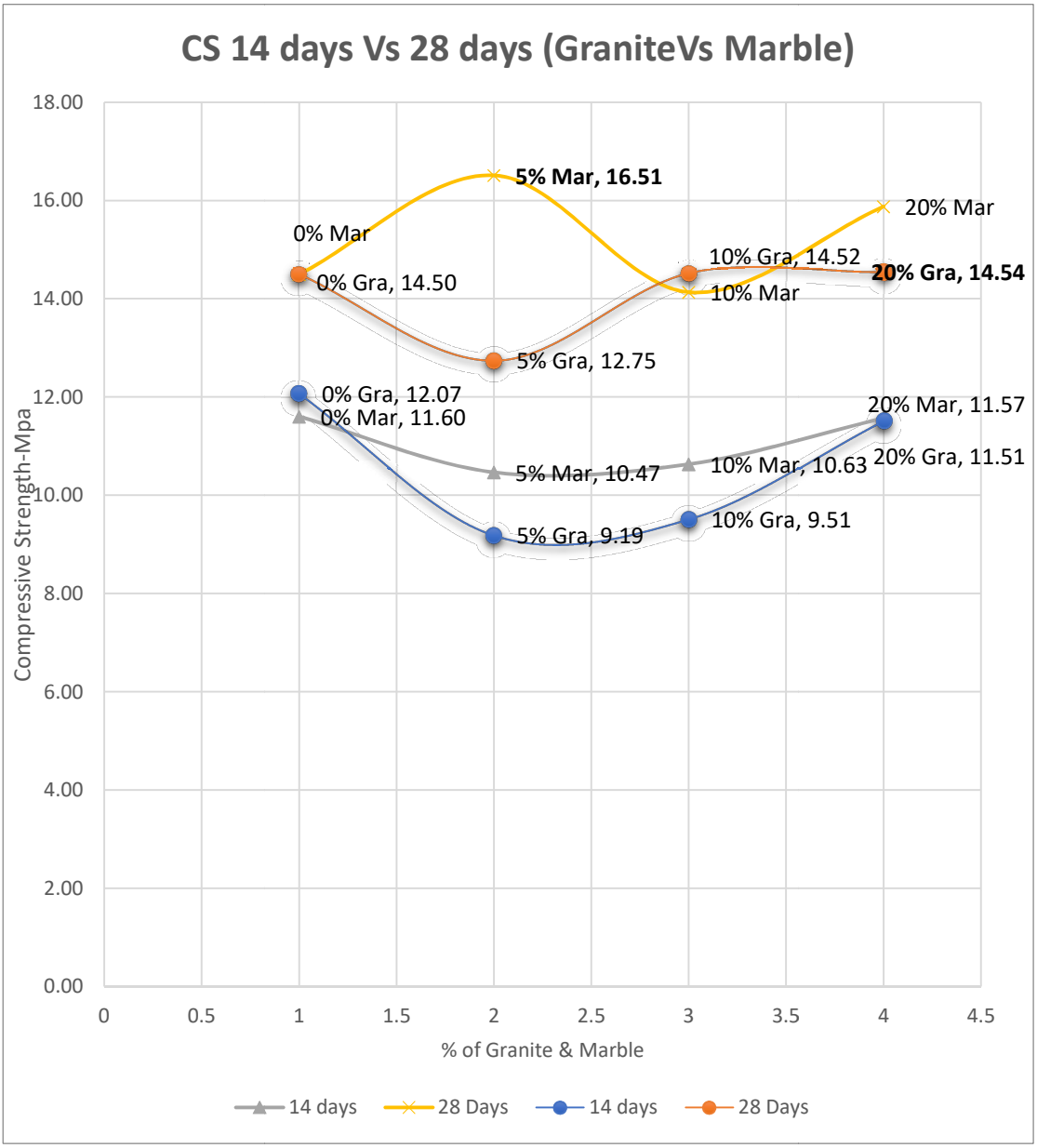
Compressive strength 14 days vs 28 days (Granite)

Table 4.7: Compressive strength 28 days (Marble vs granite):

CS 28 days(Marble Vs Granite)				
Aggregates	0%	5%	10%	20%
Marble (Mpa)	14.50	16.51	14.13	15.88
Granite (Mpa)	14.50	12.75	14.52	14.54



Compressive strength 28 days (Marble vs Granite)



Compressive strength 14 days vs 28 days (Marble vs Granite)

4.2 Summary

The compressive strength test is the most crucial of the several tests conducted on the concrete since it provides information about the properties of the concrete. Compressive strength can be defined as the capacity of concrete to withstand loads before failure. Partially replacing the coarse aggregates with waste marble and granite gives us a light weight concrete. By comparing the compressive strength between granite and marble when 5% replacement of marble (by weight) gives maximum compressive strength than 0%, 10% and 20% replacement (by weight) and also 5% replacement of marble increase cylinders weight than than 0%, 10% and 20% replacement. 20% replacement of granite (by weight) gives maximum compressive strength than 0%, 5% and 10% replacement (by weight) and also 20% replacement of granite increase cylinders weight than 0%, 5% and 10% replacement. It may be because of arrangement of aggregate particles, compaction and reduction in voids.

CHAPTER FIVE
CONCLUSIONS AND FUTURE WORKS

5.1 Conclusions

During the last decade, a lot of research works have studied the performance of cement composite with waste marble and granite aggregates. The main purpose of this paper, which was the development of a review of scientific research works in that field, was achieved. Ten papers were analyzed in-depth and remarkable results were found and discussed. Hereunder, conclusions and recommendations for future research works are presented.

The researchers have represented forms of marble and granite waste as coarse aggregate which can be use in production of concrete. The main focus of researchers was on the compressive strength of concrete containing waste marble and granite and very less attention was given to other properties of concrete. These proposals were based on results obtained from experimentation of various casted concrete samples. Waste Marble and granite was added to concrete in replacement of coarse aggregates by weight volume by proportion of 0%, 5%, 10%, and 20%. On the basis of the results from the present study, following conclusions were drawn

- Partially replacing the coarse aggregates with waste marble gives us a light weight concrete. By comparing the compressive strength of marble when 5% replacement of marble (by weight) gives maximum compressive strength than 0%, 10% and 20% replacement (by weight) also 5% replacement of marble increase cylinders weight than than 0%, 10% and 20% replacement.

- Partially replacing the coarse aggregates with waste granite gives us a light weight concrete. By comparing the compressive strength of granite when 20% replacement of granite (by weight) gives maximum compressive strength than 0%, 5% and 10% replacement (by weight) also 20%

replacement of granite increase cylinders weight than 0%, 5% and 10% replacement. It may be because of arrangement of aggregate particles, compaction and reduction in voids.

- Bangladesh is a developing country. So many buildings are built up here & there & also change their design. So, there in same place we can use waste marble and granite.

- Waste marble and granite can't be spoilt, so it would be long lasting or durable.

- Meanwhile in some cases where concrete is used there, we can use waste marble and granite & so that we can reduce the use of concrete.

- By using waste marble and granite at a time, we can reduce environment pollution & on the other hand we can reduce the use of stone & brick chips.

- We have so many wastage marble and granite while we can used in so many construction & it would be also helpful for our economic.

- We used (0%, 5%, 10% and 20%) percentage of mixing marble and granite waste; In future if someone would like to do a new research on this so that they can work on more than our percentage.

- In this test we used variation percentage. For that reason, the mechanical properties of the concrete are increased. By using so many variations we can get good quality of concrete.

- Most probably this concrete we can use in light structure and also we can use it footpath, garage, road side etc.

- By using this concrete, we can reduce the pressure of natural concrete.

5.2 Limitations

- As the UTM was not calibrated, we are not that confident about the results.
- As we collected the marble waste from the construction site and broken it by manually over the hand so that the shape of the particles was not angular.
- We could not manufacture enough concrete cylinders to test and get more strength data due to shortage of molds in our lab.
- Lack of safety equipments in our lab.

5.3 Recommendations for Future Works

- Comparatively better result was found with 5% replacement of marble and 20% replacement of granite (by weight). The reason behind this could be particle interlocking, compaction and reduction in voids, which could be further taken into study.
- Study on direct tensile strength or split tensile strength may be taken into consideration.
- In future if one might want to try admixture chemical with the concrete to see if there is any change in compressive strength.
- Better strength results could be found reducing water-cement ratio and utilizing water reducing admixture.

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