COMPARISON OF COMPRESSIVE STRENGTH OF COARSE AGGREGATE & RECYCLED AGGREGATE BASED CONCRETE BY USING DIFFERENT BRANDS OF PORTLAND CEMENT

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A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering

Department of Civil Engineering

Sonargaon University

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

Section: 16C

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Dedicated

to

"Our Parents"

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ABSTRACT

Construction using concrete is getting more and more complicated, therefore it's critical to create structures that are both affordable and long-lasting. To compare the compressive strengths of different brands of Portland composite cement, numerous experimental studies have been conducted. The goal of the study is to one distinct grades of Portland Composite Cement (PCC) M15 a in order to assess the compressive strength of concrete. Three brands of cement were used for the experiment. They are A cement, B cement, C cement. Three types of materials were used for the experiment They are water, Sylhet sand, brick chips and recycle aggregate. The specimens were mix the ratio of (1:2:3.3).

The objectives of the study are to determine the impressive strength of concrete by using differently types of Portland Composite Cement (PCC) grades M15. The Materials used for the experiment are 3 types. They are brick chips, Recycle Aggregates and combined Recycles and brick chips. The mass of the specimens was recorded carefully for 7 and 28 days the values of compressive strength of concrete for Scan Cement, Shah special Cement and Fresh Cement. in this we have prepared different mix of cement and coarse aggregate. There are 9 different types of mixing in this experiment, such as- A1 cement with Coarse aggregates, A2 cement with Combined aggregates, A3 cement with Recycle aggregates, B1 cement with Coarse aggregates, B2 cement with Combined aggregates, B3 cement with Recycle aggregates, C1 cement with Coarse aggregates, C2 cement with Combined aggregates, C3 cement with Recycle aggregates, 13.5 Mpa,13.7 Mpa, 20.9 Mpa, 12.3 Mpa , 17.5 Mpa, 21.5 Mpa, 8.48 Mpa, 13 Mpa and 14.5 Mpa for 7 days. Respectively for 28 days, 15.64 Mpa,19.57 Mpa,25.52 Mpa,12.42 Mpa, 19.03 Mpa , 24.67 Mpa, 12.11 Mpa, 13.93 Mpa, and 20.61 Mpa For 7 days, the highest compressive strength of the concrete found 21.5 Mpa For B cement with Recycle aggregates M15 and the lowest compressive strength is 8.48 Mpa for C Cement with Coarse aggregates grade M15. For 28 days, the highest compressive strength of the concrete found 25.52 Mpa for A Cement with Recycle aggregates, grades M15 and the lowest compressive strength is 12.11 Mpa for C Cement with Coarse aggregates, grades M15. The compressive strength of A Cement with Recycle aggregates was better than the other variants of the mixing.

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CHAPTER 1

INTRODUCTION

1.1 General

Strength, accessibility, long-lastingness, adaptability, and affordability are all advantages of concrete. The compressive strength of concrete is a crucial factor when developing a concrete construction.

The concrete cube test's compressive strength gives an understanding of all the properties of concrete. The water-cement ratio, cement quality, concrete material quality, quality control procedures used in concrete production, etc. all affect the compressive strength of concrete.

A quick and accurate forecast of concrete strength would therefore be very important. One can determine whether concrete pouring was done correctly or not by using this one test. For general construction, the concrete's compressive strength ranges from 15 MPa to 30 MPa and greater in commercial and industrial constructions. There is a compressive strength test. (Abrams, 1924)

When necessary, stronger concrete is employed, but its main drawback is the cost. For less crucial applications, like sidewalks or residential slabs, low-strength concrete, which has a strength of roughly 2500 psi, is employed. We often employ 3000–4000 psi strength concrete for mid-rise structures. (Mohammed Tarek Uddin1, December 8, 2014) The preservation of the environment is one of the main issues facing our civilization today. The reduction of energy and natural raw material use as well as waste material usage are some of the key factors in this regard. In the context of sustainable development, these subjects are currently receiving a lot of attention. The use of recycled aggregates made from construction and demolition wastes is showing promise as a replacement for primary (natural) materials in building. It preserves natural resources and minimizes the amount of land needed for the landfill disposal.

1.2 Compressive Strength

Concrete mix design is a procedure that combines the expertise of the involved engineer with code recommendations. The load applied at the point of failure to the cross-section area of the face on which load was applied is the formula for compressive strength for any material. To accomplish this, apply cement paste evenly throughout the whole surface of the specimen. Depending on the size of the aggregate, either a 10.16 cm x 20.32 cm or larger cylinder is employed for the cylinder test of specimens. This concrete is properly tempered after being put into the mold to prevent voids. Molds are eliminated within 24 hours, and one felt to be necessary. Therefore, a quick and accurate estimate of concrete strength would be crucial. According to "Akinkurolera et. Al. (2007)," salt or ocean salt in the mixing and curing water has been demonstrated to boost the compressive strength of concrete. Concrete's compressive strength is a crucial factor to consider while developing a concrete construction. A procedure called "concrete mix design" combines the expertise of the involved engineer with code recommendations. A simple and accurate method for determining the final strength of concrete at a young age has long been deemed vital because it is required to wait at least 28 days for each failure. Therefore, an accurate and timely prediction of concrete strength would be of great significance. In 28 days compressive strength of concrete is usually considered as the design strength. To ensure this strength it is necessary to wait a considerable time i.e., 28 days. Both of these criteria have been studied to some extend in this work.

1.3 Background and Motivation

Recycle materials are being used more frequently these days. Additionally, it is becoming more typical to use CEM 11 cement, which contains supplemental cementing ingredients. Supplemental cementing ingredients utilized properly can greatly improve the characteristics of concrete. A pozzolanic substance is fly ash. The American Society for Testing and Materials (ASTM) defines a pozzolan as "a siliceous or siliceous and aluminous material which, in itself, possesses little or no cementations value but which, in finely divided form, in the presence of moisture, and at ordinary temperature, chemically reacts with calcium hydroxide to form compounds having cementations properties" (ASTM, 1975). Fly ash's alumina-silicates react with calcium ions to create calcium silicate hydrates when moisture is present (Malhotra and Ramezanianpour, 2004). Concrete will use ash in place of Portland cement in part. Although fly ash is frequently less expensive than Portland cement, adding fly ash to concrete also improves the characteristics of both freshly mixed concrete and cured concrete (Mindless et al., 2003). Despite the financial and environmental advantages of using CEM II cements in concrete, very little is known about how such concrete behaves, and there is hardly any advice on how to produce or utilize it. In 2003, Donald Burden released a report on the resilience of concrete made with a lot of fly ash. By adding varying amounts of fly ash to concrete, he conducted the quick chloride permeaity test, as well as additional durability tests and compressive strength tests. ash and contrasted the outcomes. The durability test results of Ordinary Portland Cement, CEM II, and Portland Composite Cement, CEM II cement with an unknown composition are compared in this thesis paper.

It is quite difficult to find different types of Portland (PCC) cement in the open market. PPC (Portland Pozzolan Cement) and PCC are the varieties that are now in demand (Portland composite cement). This particular brand of cement is being utilized in a concrete mix as an adhesive. There is fierce competition in the ready-mix industry as well, thus cement is used as a stand-in. Problems occurred during the testing of concrete samples at varied ages for cube and cylinder test objects. The test results are frequently obtained at ages 7 and 28 days, showing that the concrete's compressive strength is even higher than the planned compressive strength. The 28-day sample test, however often yields less value than the standard of the strategy. to calculate the compressive strength value in the test at less than 28 days.

1.4 Costs

According to the government, the cost of building up and running facilities to create RA as a method of getting rid of C&D wastes compares favorably to the cost of supplying and maintaining the conventional landfill facilities for getting rid of the wastes. For instance, the three key landfills in Hong Kong, which together occupy 270 hectares of land, cost about HK$6 billion to build and HK$400 million annually to maintain. Additionally, there is no fee for disposal. As these strategic landfills fill up in 10 to 15 years and there are now no additional suitable locations available, the situation will get worse quickly. Without these outlets, the cost for the government to absorb the C&D wastes is very expensive and will definitely propel the government to look for alternate outlet for C&D waste disposal, including the use of RA and RAC. A developer or building contractor may decide against using RAC because of the anticipated increased cost and the current unstable supply of RA. Despite the fact that RA is provided without charge, there are additional expenses associated with storage, shipping, processing, and quality control.

But things will soon start to change for the better. The SAR Government is affecting the landfill levy of the pricing plan for processing C&D materials. With the scheme's implementation, developers and construction companies will have an incentive to decrease the production of C&D trash and to sort it to make reuse and recycling easier. C&D waste can be decreased with improved cost incentives and RAC usage may eventually become more prevalent.

1.5 Research Objectives and Overview

The objectives of this thesis are:

1. To evaluate the durability of concrete constructed from recycled aggregates.
2. To compare the strength of normal aggregates and recycled aggregates.
3. To determine the compressive strength of concrete by using different brands of Portland composite cement.

1.6 Public Perception of RAC

In the opinion of the general public RA (Recycle Aggregate) is of lower quality because they were made from C&D waste. Home purchasers who lack faith in the product are unlikely to be won over by the use of RAC (Recycle and Normal Coarse Aggregate). The public is discouraged from accepting RAC because of a lack of confidence, but on the other hand, confidence can only be increased by demonstrating RAC's effectiveness in the past.

In that it does not construct apartments for sale, HA is a distinctive developer. With the study and perhaps a later pilot test, HA will be able to show through hard evidence that RAC's performance can be engineered to be on par with regular concrete.

1.7 Outline of the Study

It can undoubtedly aid construction workers in the construction of sewage pipes, retaining walls, dams, and dykes through mass concreting. It is also appropriate for usage in typical contexts like plastering and masonry mortars. Suitable for residential building construction, retaining concrete productions, canal, channel, and edging productions, as well as plastering and mortar applications. Where high compressive strength is required, it is also appropriate for ready-mixed concrete.

CHAPTER 2

LITERATURE REVIEW

2.1 History

For any type of building activity, compressive strength is crucial. Use a variety of cement brands for construction projects to increase compressive strength. A material or structural element's capacity to endure loads that, when applied, cause them to shrink in size is referred to as their compressive strength. A test sample is subjected to a force at its top and bottom until it breaks or deforms. Despite the wide variety of cement brands available today, many of us are unable to identify the optimum cement strength. Another one of them is compressive strength. Numerous experiments had been conducted by various cement brand names. Different varieties of Portland composite cement's compressive strength, the compressive strength in the experiment, Scan cement, Shah Special cement, and Fresh cement were used, and it was discovered that utilizing Scan cement gave concrete the maximum compressive strength. Therefore, investigations were crucial to determining the sort of cement to employ in projects in order to ensure long-term durability.

Concrete cube test gives information on all the properties of concrete. One can determine whether concrete pouring was done correctly or not by using this one test. One of the most crucial characteristics of concrete and mortar is its compressive strength. Therefore, the performance characteristics of the combination and the overall quality of the completed product are greatly influenced by the strength of the binder (cement). Tests on new concrete take into account characteristics including temperature, air content, unit weight, and strength. We can identify changes in concrete that may have an impact on its long-term performance by consistently carrying out these tests.

They employ A cement, B cement, and C cement in the experiment. For a cement, they discovered the highest compressive strength. Essentially, the major objective of this study is to identify which Bangladeshi local cement brand has the strongest compressive strength. Concrete is a man-made composite building material made by mixing pre-measured amounts of fine and coarse filler aggregates with cement, water, and air under specific conditions that make it simple to move, transport, place, cure, compact, and harden into a sturdy, long-lasting, and compression-resistant final product. Concrete essentially exists in any of these three stages: the plastic (fresh) state, the setting state, and the hardened state. As an engineering material, concrete is technically assessed on the basis of these three states.

Consisting of the five key deciding factors of stiffness, workability, durability, cohesion, and strength. The compressive strength of the concrete is often the stated attribute while carrying out the design of any proposed concrete structure and taking into account its quality control (QC) Jones and Kaplan, Aug. (1957). This is due to the fact that evaluating concrete's compressive strength is simpler than other concrete parameters. Additionally, a number of other characteristics of concrete, including its resistance to weathering, its impermeability, and its elastic modulus, can be inferred from the values of the three routinely evaluated strengths for concrete's compressive strength of the concrete cube test provides an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not. Compressive strength is one of the most important properties of concrete and mortar. The strength of the binder (cement) therefore has a significant effect on the performance characteristics of the mixture and ensures the overall quality of the finished product. Fresh concrete tests measure factors such as strength, consistency, unit weight, air content, and temperature. By performing such tests consistently, we can detect to changes in concrete that may affect its long-term performance. The compressive strength of a material or structure, is the capacity of that material or structure to overcome (resist) loads which tend to reduce its size. It is usually determined using a Universal Testing Machine (UTM), and reported with respect to a specified technical standard. noted that there are three broad determining factors that primarily affect the compressive strength of concrete, Nemati, K. M. (2015). which are:

The impact of the mix proportions (water/cement ratio, air entrainment, cement brands, maximum aggregate size, mixing water, etc.) and the component elements (ingredients).

Curing conditions (time/age, temperature & relative humidity)

Testing parameters:

A concrete mix's "workability of fresh (plastic) concrete" essentially relates to how easily it can be poured, moved around, compacted, and completed. As a result, the durability of concrete decreases with increasing permeability and vice versa. Menon, D., and Sengupta, A. K. defined concrete durability as the material's capacity to survive weathering/environmental action, abrasion, chemical attack, or other processes that could cause deterioration (2008)

2.2 International Research of RAC

Scotland- About 63% material has been recycled in 2000, remaining 37% material being disposed in fill and exempt sites. The Government is working out on specifications of recycling and code of practice. Attempts are being made for establishing links with the planning system, computerizing fer note system to facilitate data analysis and facilitating dialogue between agencies for adoption secondary aggregates by consultants and contractors.

Denmark- According to the Danish Environmental Protection Agency (DEPA), in 2003, 30% of the pal waste generated was Construction & Demolition waste. According to DEPA around 70-75% waste is generated from demolition activity, 20-25% from renovation and the remaining 5-10% from w building developments. Because of constraints of landfill site, recycling is a key issue for the country. Statutory orders, action plan and voluntary agreements have been carried out, e.g., reuse of asphalt (1985), sorting of Construction & Demolition waste (1995) etc.

Netherland- More than 40 million Construction & Demolition waste is being generated out of which 80% is brick and concrete. A number of initiatives taken about recycling material since 1993. such as prevention of waste, stimulate recycling, promoting building materials which have a longer life, products which can be easily disassembled, separation at source and prohibition of Construction & Demolition waste at landfills.

USA- Construction & Demolition waste accounts for about 22% of the total waste generated in the USA. Reuse and recycling of Construction & Demolition waste is one component of larger holistic practices green building construction practices may include salvaging dimensional number, wing reclaimed aggregates from crushed concrete, grinding drywall scraps, to use as soil amendment at the site. Promoting deconstruction in place of demolition. Deconstruction means planned breaking of s building with reuse being the main motive.

Japan- Much of the R&D in Japan is focused on materials which can withstand earthquake and prefabrication 85 million tons of Construction & Demolition waste has been generated in 2000, out of which 95% of concrete is crushed and reused as road bed and backfilling material, 98% of asphalt concrete and 35% sludge is recycled.

Singapore- Construction & Demolition waste is separately collected and recycled. A private company has built an automated facility with 3,00,000 ton per annum capacity.

India- Use for embankment purpose in bridges, roads etc, up to 3% to 4% of total production. (Akmal Abdelfatah,Sami W. Tabsh, 2011) insist that the available resources should be used appropriately & whenever recycled it should be done at the national level with the help of Gulf Cooperation Council (Gcc) & Environment Protection Industrial Co (EPIC). They observe that GCC countries produce more than 120 million tons of waste every year out of which 18.5% is related to solid construction waste. Results from Dubai municipality indicate that out of 75% of 10,000 tons of general waste produced, 70% is of concrete demolition waste.

CHAPTER 3

METHODOLOGY

3.1 General

Cement and aggregates (brick chips and recycled brick chips) were gathered from industrial suppliers and tested. Sand from Sylhet served as the fine aggregate. Portland Composite Cement (PCC) was utilized in the experiment as a binding substance. Concrete cylinders were cast and properly cured once the components were collected. Then, in accordance with the needs of the investigation, various tests were carried out on these samples.

3.2 Materials Used

Various types of tests were performed on recycled aggregate, brick chips, sand and cement. Sieve analysis was conducted to get the gradation of aggregate. Aggregate properties such as Bulk specific gravity (oven dry basis), Bulk Specific Gravity (S.S.D basis), Apparent Specific gravity. Absorption capacity.

Cement

Cement is a crucial component of concrete and a high-quality (Scan) affordable building material used in construction projects. It is a thin, grey powder that hardens over time due to a hydration reaction. In reality, it serves as the binding component of concrete. All sorts of tests were conducted using brand-new Portland composite cement (Scan,Shah Special ,Fresh) We use here as a type-A,type-B and type-C.

Water

Water is a key ingredient of concrete. The property of water that was used in the concrete work is being potable, free from oil and other organic impurities. Ordinary tap water was used as mixing water throughout the mixing procedure.

3.3 Collecting Materials

Coarse Aggregate (Brick Chips), Recycled Aggregate (Brick Chips) :

The brick aggregate was created by smashing brand-new bricks with a hammer on a solid concrete surface. Recycled brick concrete, which was gathered from the 59 East Raja bazar, Dhaka -15 site and broken down by hand, was utilized as an aggregate. Gradations of coarse aggregate were produced independently using the ASTM C136 technique for comparison purposes.

Figure 3.1 Recycle Aggregate

Figure 3.2 Normal Brick Aggregate

3.4 Procedure for Sieve Analysis of Fine Aggregate

At first, we collected the Sylhet Sand as a fine aggregate from local market. After collecting the Sylhet and we weighted sample 500 gm. Then we nest the sieve in order of decreasing size of opening from p to bottom and place the sample 500gm on the top sieve. Agitate the sieves by hand for an efficient period. We performed in a proper sequence (forward and backward motion, left and right motion, clockwise (CW) and counter-clockwise (CCW) motion and frequent jolting). Then we carefully remove the sieves one at a time and weight each sieve with its retained fine aggregate. Then we calculate the mass of material retained on each sieve deducting the weight of corresponding sieve and determine the weight of each size increment by weighting on a balance to the nearest 0.1% of the total original dry sample weight. The total weight of the material after sieving we checked closely with original weight of sample placed on the sieves.

3.5 Procedure for Sieve Analysis of Coarse Aggregates

At first, we collected (brick chips) as a fine aggregate from local market also recycle brick aggregate were collected from east 59 rajabazar, Dhaka 15 sites. The collected recycle brick concrete samples were broken into pieces manually in particular sizes as 25 to 20 mm, demolished concrete blocks and recycled aggregates are shown in Fig. 3.1after collecting four samples we weighted every sample 1000 gm separately. Then we nest the sieve in order of decreasing size of opening from top to bottom and place every sample 1000gm separately on the top sieve. Agitate the sieves by hand for a sufficient period. We performed in a proper sequence (forward and backward motion, left and right motion, clockwise (CW) and counter-clockwise (CCW) motion and frequent jolting). Then we carefully remove the sieves one at a time and weight each sieve with its retained coarse aggregate. Then we calculate the mass of material retained on each sieve deducting the weight of corresponding sieve and determine the weight of each size increment by weighting on a balance to the nearest 0.1% of the total original dry sample weight. The total weight of the material after sieving we checked closely with original weight of sample placed on the sieves.

Figure 3.3 Sieve Analysis

3.6 Specific Gravity and Absorption Capacity of Coarse Aggregate

At first, we weighted the test sample at a suitable temperature cool in air at room temperature for 1 to 3 hr. for test samples of 20mm nominal maximum size. Subsequently immerse the aggregate in water at room temperature for a period of 15 to 19 hrs. Then we remove the test sample from the water and roll it in a large absorbent cloth until all visible films of water are removed. Wipe the larger particles individually. A moving stream of air used to assist in the drying operation. We take care to avoid evaporation of water from aggregate pores during the operation surface drying. Then we weighted the test sample in the test sample in saturated surface-dry condition. we recorded this and all subsequent weight to the nearest 0.5 g.or 0.05 of the sample weight ,whichever is greater. After weight we immediately place the saturated-surface-dry test sample container and determined it's weight in water at 23° 1.7°C (73.4°C 3°F). We take care to remove all entrapped air before weight by shaking the container while immersed.

Figure 3.4 Specific Gravity and Absorption Capacity of Coarse Aggregate

3.7 Mix Design

The five main components of a concrete mix are cement, water, coarse aggregates, fine aggregates (i.e., sand), and air. These components are combined in different ratios. To provide the mixture specific desired features, additional elements can be added, such as pozzolanic components and chemical admixtures.

Step-1

Calculation of target Strength:

Target Mean Strength of concrete is derived from the below formula –

$F_t = f_{ck} + 1.65\ s$

Where s = standard deviation which is taken as per below table;

Grade of Concrete	Standard deviation (N/mm^2)
M15	3.5

Characteristic Compressive strength after 28 days f_{ck}= 15 N/mm2

F_t=15+1.65+3.5

= 20.775 N/mm2

=3012.43 lb/in2

Step-2

Selection of water cement ratio:

Water cement ratio is selected from the graph plotted between 28 days compressive strength and water –cement ratio which is as per Is10262-2009

So w/c ratio =0.57

The final water-cement ratio will be taken as the minimum of the above two values,

Therefore, w/c ratio =0.57

Step-3

Air content calculation:

Nominal maximum size of aggregate taken is = 20 mm

So, from the table entrapped air in % of the volume of concrete = 2%

Step-4

Cement content calculation:

From step 2, water cement ratio =w/c=0.57

The Aggregate nominal maximum size is 20 mm and they belong to zone 2. So, the adjustment for compacting is to be applied

Therefore, the water content =186 +(186*3/100) =191.6 ft/m3 of concrete.

Water content W=191.6 liters=191.6 kg

191.6/c =0.57

Finally, c =336.14 kg /m3 of concrete.

Step-5

Aggregate Content calculation:

Volume of concrete (with encrypted air) =1m3

Encrypted air %=2%=0.02

Therefore, volume of concrete (without air content) =1-0.02=0.98 m3

Fine aggregate content determines from below formula;

V=[w+C/Gc+(1-p) *(F*A)/Gf] *1/1000

0.98= [191.6+336.14/3.15+(1/1-0.62) *(F*A)/2.6] *1/1000

Therefore, amount of fine aggregate F. A=673.52 kg

Similarly, Coarse aggregate content C.A is derived from,

V= [191.6+336.14 +(1 * C.A)] * 1

3.15 0.62 2.65 1000

Therefore, amount of course aggregate C. A= 1120 Kg

Step-6

Final Mix of ingredient:

w/c ratio =0.57

Cement quantity = 336.14 kg =337 kg

Fine Aggregate = 673.53 kg =674 kg

Coarse Aggregate Quantity =1120 kg

Mix proportion for M15 Concrete: (Cement:FA:CA) =1:2:3.3

3.8 Preparation of Cylinder

The cylinder specimens are cast in non-absorbent molds consisting of steel, cast iron, or another material. Testing cylindrical specimens need to be 4 x 8 inch (100 x 200 mm). Concrete must be held in the mold without any leaks. To make it simple to remove the hardened cylinder, the interior of the mold needs to be properly greased before adding the concrete mix to it. Layers of the mixed concrete that are at least 5 cm thick are added to the molds. When compacting, there must be a minimum of 30 strokes per layer. The majority of the air gaps must be allowed to escape for the compaction to reach the subsurface layers. The samples are kept undisturbed for 24 hours at a temperature of 27° 2°C and a relative humidity of at least 90%. The samples are taken after this window and immersed in freshwater until the testing age is attained.

Figure 3.5 Formwork Preparing

3.9 Concrete Mixing

Concrete of a proper grade is mixed together by the ingredients of concrete, such as cement, sand, aggregate water, and additives. To produce the various grades of concrete, at first, we mix the concrete components properly in accordance with the concrete's mix design in order to reach the concrete's design strength. A concrete mix with the following proportions will have a compressive strength of about 3000 per 1 part cement, 2 parts sands, and 3.3 parts aggregate. When we add water to cement, sand and stone, we get a paste created that binds the components together until the mixture reaches the desired hardness.

Concrete mixing is a fairly complicated operation. We simply need to combine the elements according to a specified procedure to produce concrete of high quality. Making concrete is just not enough, but producing high-quality concrete is crucial. The same materials are used in the production of high and low-quality concrete, but the percentage and mixing technique can make a difference. To produce high-quality Concrete, proper attention and knowledge are needed.

Figure 3.6 Concrete Mixing

3.10 Casting of Cylinder

Early on, the cylinder head casting technique should be chosen. It is advised to take casting and pattern-making knowledge into account while developing the fundamental form of the cylinder head. All casting techniques cannot achieve the specified geometries. The overall geometry of the cylinder head is specifically determined by the position and shape of the intake and exhaust ducts as well as the geometry of the combustion chamber. Additionally, the cylinder bore and the space between the cylinders are very important since the combustion of fuel results in high temperatures both in the cylinder head and the surrounding air.

Figure 3.7 Cast in Cylinder.

3.11 Curing

All test specimens must be stored under circumstances similar to the concrete in the structure or pavement for the first 24 to 48 hours after molding. The specimens may be sent to the laboratory for further curing and testing after the initial curing period.

Figure 3.8 Curing Process

3.12 Preparation to Crush of Cylinder

The cylinders were submerged for up to seven days. Then, three brands of Portland Composite Cement, 18 cylinders of M15 grade and three different variety of materials were withdrawn from the container. To determine the crushing of each cylinder, the cylinders were then placed one by one in the center of the Universal Testing Machine (UTM) in the Sonargaon University (SU) Lab. Then were submerged for up to 28 days. After that withdrew from the dram and crushing the cylinders and note down the value.

Figure 3.9 Preparation to Crush of Cylinder

3.13 UTM Machine

In addition to being known as a UTM machine, a UTM tester, a materials testing machine, or a material testing frame, manufacturers sometimes referred to this device as a "universal testing machine" because it was used to measure the compressive strength of materials. In order to play distinct roles in the construction of infrastructure, roads, and highways, UTM machines have different responsibilities that have had some of their capabilities stripped out or are marketed for particular industries & sectors.

3.14 Procedure to Compressive test with UTM Machine

Test the samples as soon as possible after removing them from the wet closet for 24-hour samples and from storage water for all other specimens. Within the permitted time tolerance specified as follows, all test specimens for a particular test age should break under compressive force:

Test age	Permissible Tolerance
7 days	± 3 h
28 days	± 12 h

In tests conducted over periods of 7 days and 28 days, the specimens were kept submerged in water that was kept at a temperature of 73.4 30 F (23 1.70 C) and had enough depth to completely submerge each specimen until the time of testing. Remove any loose sand or incrustations from the face of each specimen so that it is surface-dry and will not come into touch with the testing's bearing blocks. Use a straightedge to inspect these faces. Grind the face or faces if there is any appropriate curvature, or throw the specimen away. The cross-sectional area of the specimens should be periodically checked. Apply the load to the specimen faces that were in touch with the mold's true plane surface. Insert the specimen very carefully into the testing device beneath the upper bearing block's center. It is required to confirm that the spherically seated block is not restricted from tilting before each cube is tested. No bedding or cushions should be used. For specimens with predicted maximum loads of more than 3000lb (13.3KN), an initial loading of up to 50% of the projected minimum loads may be applied at any convenient rate. Apply initial loading without interruption to failure at a pace such that the maximum load is not attained in more than 80 seconds from the commencement of loading for specimens with estimated maximum loads of less than 3000 lb (13.3 KN).

3.15 Compressive Strength Test

The mechanical test known as the compressive strength test determines the maximum compressive load that a material can withstand before breaking. A gradually applied load compresses the test component, which is typically in the shape of a cylinder, between the platens of a compression testing machine. Despite having high compressive strengths, brittle materials including rock, brick, cast iron, and concrete eventually shatter. Concrete's crushing strength, often known as the cylinder strength, is measured by breaking a cylinder. Some ductile metals, like mild steel, have extremely high compressive strengths, although it can be challenging to measure the precise numbers When a load is given to a ductile metal, it first deforms elastically up to a specific point, after which plastic deformation takes place. In order to get values for the compressive strength for six different varieties of material for grade M15, increasing loads may even totally flatten a test piece without any discernible fracture taking place.

Figure 3.10 Compressive Strength Test

3.16 Compressive Fracture of Cylinder

The specimen was held in the center of the UTM machine during the 7-day and 28-day tests, and each piece was crushed one at a time while recording the value. Total crushed 24 specimen in Sonargaon university lab.

Figure 3.11 After Crushed Cylinder

3.17 Compressive Strength Importance

The effects should be discussed either under result and discussion chapter, or better in conclusion. Not in this chapter. Here you will only show how your research is done.

Effect of Cement:

1.The chemical makeup and fineness of Portland cement determine how it affects the strength of concrete. Concrete strength is also influenced by cement content.

2. Cements with a higher C3S concentration develop strength more quickly, although they may eventually age with slightly lower strengths.

3. As can be seen in the accompanying figure, the fineness of the cement controls both the pace of hydration and the strength of concrete.

4. The impact of cement content on concrete strength at a certain slump.

5. Effect of Aggregate/Cement ratio

7. It has been established that a leaner mix one with more aggregate and less cement produces a higher strength for a constant water/cement ratio.

8.The reason for this is that since the total porosity of the concrete is lower and its strength is better when the paste makes up a smaller fraction of the volume of concrete (as is the case with a leaner mix).

<u>Effect of Aggregate properties</u>

1.The impact of aggregate characteristics on strength is only of little significance.

2.The shape, texture, and maximum aggregate size are the factors that should be given the most consideration.

<u>Effect of Admixture</u>

1. The strength of concrete is increased by any admixture that can lower the w/c ratio or the porosity of the concrete.

<u>Effect of the specimen size</u>

1.The strength of concrete is increased by any admixture that can lower the w/c ratio or the porosity of the concrete.

<u>Effect of the rate of loading</u>

1. The measured strength of concrete increases with increasing loading rates.

<u>Effect of moisture content</u>

1.Concrete that is moist provides less measurable strength than concrete that is dried.

<u>Effect of the temperature of the testing</u>

1.Concrete strength is tested at higher testing temperatures.

3.18 Compressive Strength Formula

Compressive strength is the maximum compressive stress that, under a gradually applied given solid material can sustain without fracture. Compressive strength is calculated by dividing the maximum load by the original cross-sectional area of a specimen in a compressive test. The compressive strength is one of the most important and useful properties of concrete. The design strength of the concrete normally represents its 28th day. Compressive strength can be defined as the capacity of concrete to withstand loads before failure. Of the many tests applied to the concrete, the compressive strength test is the most important, as it gives an idea about the characteristics of the concrete.

The compressive strength was calculated by using the equation:

$F = P/A$

Where,

F is compressive strength of specimen in Pound per square inch (Psi).

P is the maximum applied load by Pound.

A is the cross-sectional area (inch square).

Compressive strength test, mechanical test measuring the maximum amount of compressive load a material can bear before fracturing. The test piece, usually in the form of a cube, prism, or cylinder, is compressed between the platens of a compressive-testing machine by a gradually applied load.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Result for Sieve Analysis of Fine Aggregate

The test sample of the aggregate (F.M=3.52) shall weigh, after drying, approximately the following requirement:

Aggregate with at least 100% passing No. 4 Sieve 500gm and more than 9.8% retained on a No. 8 Sieve. Aggregates with at least 91.2% passing No. 8 Sieve.

Table 4.1 Sieve Analysis (Fine Aggregates)

Sieve No.	**Retained (gm)**	**% Retain**	**Cumulative % Retain**	**FM**	**Finer (%)**
#4	0	0	0		100
#8	49	9.8	9.8		90.2
#16	240	48	57.8	352.2/100	42.2
#30	149	29.8	87.6	= 3.52	12.4
#50	51	10.2	97.8		2.2
#100	7	1.4	99.2		0.8
Pan	4	0.8	100		0
Total=	=500 gm				

4.2 Result for Sieve Analysis of Coarse Aggregates

The test sample of Aggregate (F.M) shall weight, after drying, approximately the following requirement: Aggregate at least 74% Passing No (3/8”) And 20% Passing in (3/4”) And 6% Passing in #4 no

Table 4.2 Result of coarse Aggregate

Sieve No.	Retain (gm)	% Retain	Cumulative % Retain	FM	Finer
3/4”	200	20	20	214/100 =2.14	80
3/8”	740	74	94		6
#4	60	6	100		0
Total	=1000gm				

Calculation:

1. Calculate percentages passing, total percentage retained, or percentages in various size fractions to the nearest 0.1gm on the basis of the total weight of the initial dry sample.

2. Calculate fineness modulus, when require, by adding the total percentage of material in the sample that is coarser than each of the flowing sieves (Cumulative percentage retained), and dividing the sum by 100. 150-tm (No. 100), 300pm (No. 50), 600-llm (No. 30), 1.18 mm (No. 16), 2.23 mm (No.8), 4075 mm (3/8 in), 37.5mm (1.5 in) and larger, increasing in the ratio of 2 to 1.

4.3 Results of Recycled Aggregates

Table 4.3 Sieve Analysis of Recycle Aggregate

Sieve No.	Retain(gm)	% Retain	Cumulative % Retain	FM	Finer
3/4”	240	24	24	=220/100 =2.2	76%
3/8”	720	72	96		4%
#4	40	4	100		0%
Total	=1000gm		=220		

4.4 Specific Gravity of Coarse Aggregate

Wt. of pycnometer Filled with water to Calibration, Bgm	Oven Dry Wt. in air, A gm	Wt. of pycnometer withSpecimen and water to Calibration mark, C gm
1230 gm	980 gm	580 gm

Table 4.4 Specific gravity of coarse Aggregate

Test	Formula	Calculation	Result
Apparent Specific Gravity	$A/(B + A - C)$	980/ (1230 + 980 -580)	0.60
Bulk Specific Gravity(Oven Dry Basic)	A/ $(B - C)$	980/ (1230 – 580)	0.83
Bulk Specific Gravity (S.S.D. Basic), G	$B/ (B - C)$	1230/ (1230– 580)	1.89
Absorption Capacity, D %	$\{(B - \text{A})\} *100\}/A$	(1230 − 980) *100/980	25.51

The specific gravity of the normal stone coarse aggregate after oven drying was found 0.83 Specific gravity for coarse aggregate. We found the specific gravity of the apparatus to be 0.60 and bulk specific gravity oven dry ac obtained from 0.83. Apparent capacity redaction received 25.51And bulk SSD received 1.89.

4.5 Specific Gravity of Recycle Aggregates

Wt. of pycnometer Filled with water to Calibration, Bgm	Oven Dry Wt. in air, A gm	Wt. of pycnometer with Specimen and water to Calibration mark, C gm
1245 gm	1070 gm	615 gm

Table 4.5 Specific Gravity of Recycle Aggregate

Test	Formula	Calculation	Result
Apparent Specific Gravity	$A/(B + A - C)$	1070/1245+1070 − 615	0.62
Bulk Specific Gravity (Oven Dry Basic)	$A/ (B - C)$	1070/ (1245 – 615)	1.698
Bulk Specific Gravity (S.S.D Basic), G	$B/ (B - C)$	1245/ (1245− 615)	1.967
Absorption Capacity, D %	$\{(B - A) * 100\}/A$	{(1245 −1070)} ∗100}/1070	16.35

The specific gravity of the normal stone coarse aggregate after oven drying was found 1.697 Specific gravity for coarse aggregate. We found the specific gravity of the apparatus to be 0.62 and bulk specific gravity oven dry ac obtained from 1.697. Apparent capacity redaction received 16.35 And bulk SSD received 1.967.

4.6 Materials Used

Table 4.6 Quantity of materials.

Mix No	Number of Cylinder required	Cement Name	Coarse Aggregate (kg)	Recycle Aggregate (kg)	Fine Aggregate (kg)	Cement (kg)	Mix Details
01	4	A cement	8.00	-	5.16	2.27	1:2:3.3
02	4	A cement	4.04	2.80	5.16	2.27	
03	4	A cement	-	5.60	5.16	2.27	
04	4	B cement	8.00	-	5.16	2.27	
05	4	B cement	4.04	2.80	5.16	2.27	
06	4	B cement	-	5.60	5.16	2.27	
07	4	C cement	8.00	-	5.16	2.27	
08	4	C cement	4.04	2.80	5.16	2.27	
09	4	C cement	-	5.60	5.16	2.27	
Total	36	-	36.12	25.20	46.44	20.43	-

Table 4.7 Result of 7 days compressive strength

No.	Name of Cement & Materials	Applying load (lb)	Average Applying load (lb)	Average Strength (PSI)	Average Strength (Mpa)
01	100%(CA)Type A Cement	25177.6	25177.6	1970	13.5
		25177.6			
02	50%(CA)+50% (RCA)Type A Cement	26301	25514.5	1996	13.7
		24728			
03	100% (RCA) Type A Cement	40466	38779	3034	20.9
		37092			
04	100% (CA) Type B Cement	22929.6	22929.6	1794	12.3
		22929.6			
05	50%(CA)+50% (RCA)Type B Cement	35968	32596	2550	17.5
		29224			
06	100% (RCA) Type B Cement	42936	40014	3130	21.5
		37092			
07	100% (CA)Type C Cement	15736	15736	1231	8.48
		15736			
08	50%(CA)+50%(RCA)Type C Cement	24952	24165.5	1890	13
		23379			
09	100%(RCA)Type C Cement	26976	26976	2110	14.5
		26976			

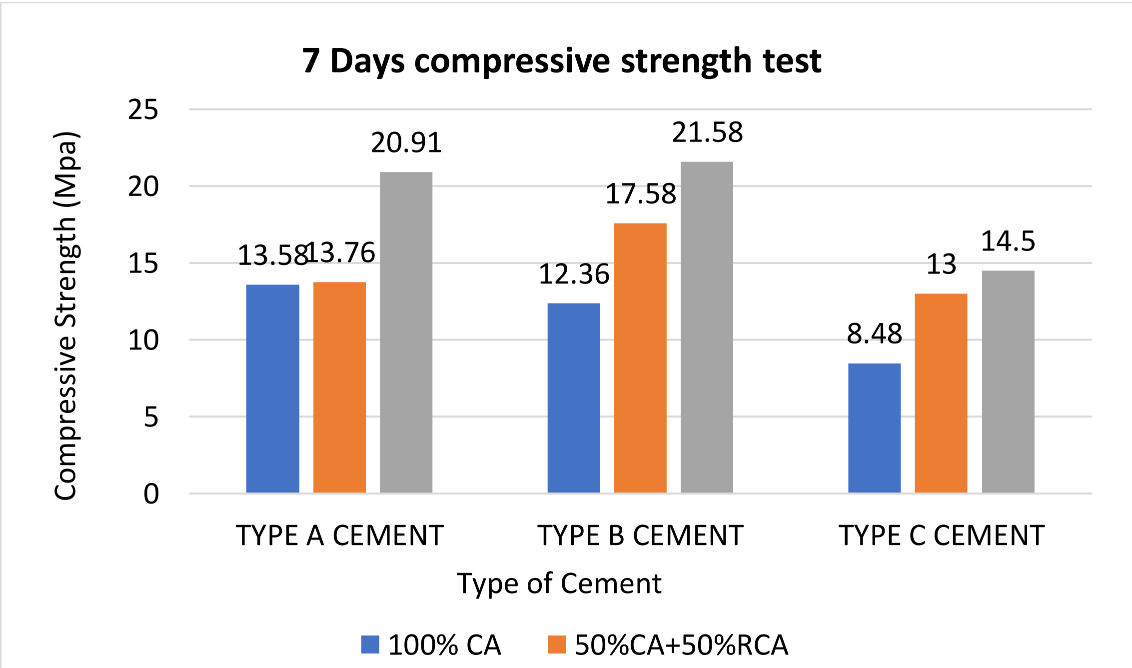


Figure 4.1 7Days compressive strength

4.7 After the Experiment of 7 days

1. After Crushing the cylinder, we found in Type –A(scan) cement and 100%RCA (Recycle coarse Aggregate) shows best compressive strength result 20.91Mpa and 100% CA (Normal Coarse Aggregate) shows the Lowest Result 13.58 Mpa, Mixed 50%CA and 50% RCA shows 13.76 Mpa.

2. Then we found in Type –B (shah special) cement and 100%RCA (Recycle coarse Aggregate) shows best compressive strength result 21.58 Mpa which is much better then type-A cement and 100% CA (Normal Coarse Aggregate) shows the Lowest Result 12.36 Mpa which is less then type –A cement, Mixed 50%CA and 50% RCA shows 17.58 Mpa.
3. After Crushing the cylinder we found in Type –C (Fresh) cement and 100%RCA (Recycle coarse Aggregate) shows best compressive strength result 14.5 Mpa which is so much less then type-A and type-B cement and 100% CA(Normal Coarse Aggregate) shows the Lowest Result 8.48 Mpa which is less then type –B cement , Mixed 50%CA and 50% RCA shows 13 Mpa.

Table 4.8 28 Days Compressive Strength test

No.	Name of Cement & Materials	Applying (lb)	Average Applying load (lb)	Average Strength (PSI)	Average Strength (Mpa)
01	100% (CA) Type A Cement	27425.6 30572.8	28999.2	2269	15.64
02	50%(CA)+50%(RC) Type A Cement	39340 33270.4	36305.2	2840	19.57
03	100%(RCA)TypeA Cement	46308.8 48332	47320.4	3702	25.52
04	100% (CA) Type B Cement	21356 24728	23042	1802	12.42
05	50%(CA)+50%(RCA) Type B Cement	34844 35743.2	35293.6	2761	19.03
06	100%(RCA)TypeB Cement	45409.6 46084	45746.8	3579	24.67
07	100% (CA)Type C Cement	23604 21356	22480	1758	12.11
08	50%(CA)+50%(RCA) Type C cement	23604 28100	25852	2022	13.93
09	100% (RCA) C Cement	42712 26976	38216	2990	20.61

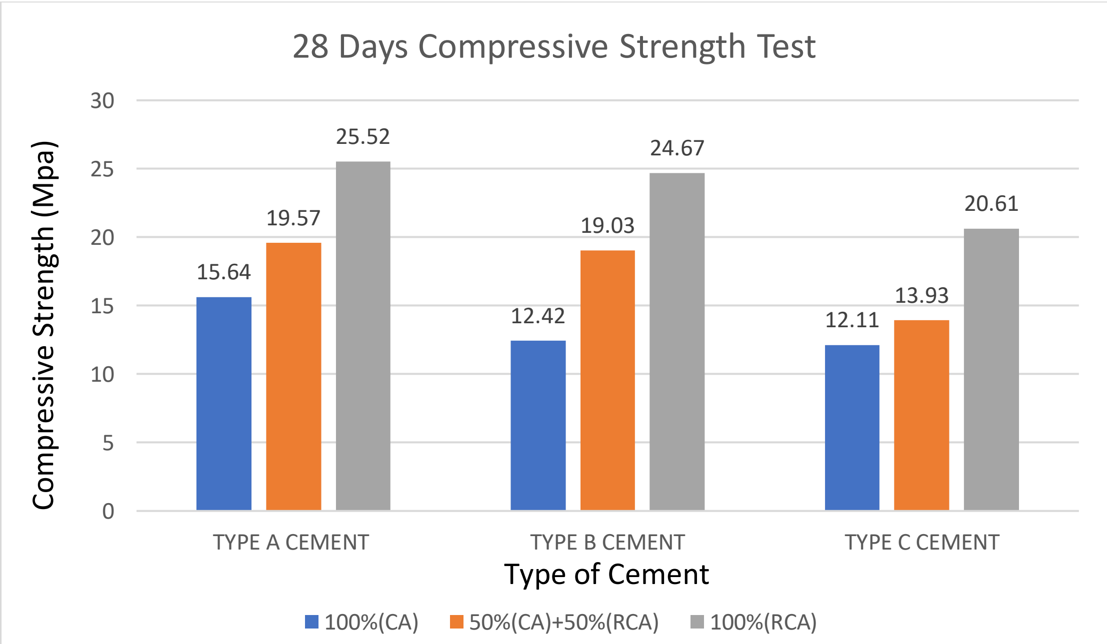


Figure 4.2 28 Days compressive strength test

4.8 After the Experiment of 28 days

1. After Crushing the cylinder, we found in Type –A(scan) cement and 100%RCA (Recycle coarse Aggregate) shows best compressive strength result 25.52 Mpa and 100% CA (Normal Coarse Aggregate) shows the Lowest Result 15.64 Mpa w, Mixed 50%CA and 50% RCA shows 19.57 Mpa. This all-compressive strength result increase from 7 days compressive strength.
2. Then we found in Type –B(shah special) cement and 100%RCA(Recycle coarse Aggregate) shows best compressive strength result 24.67 Mpa which is much less then type-A cement and 100% CA(Normal Coarse Aggregate) shows the Lowest Result 12.42 Mpa .which is less then type –B cement , Mixed 50%CA and 50% RCA shows 19.03 Mpa.
3. After Crushing the cylinder, we found in Type –C (Fresh) cement and 100%RCA (Recycle coarse Aggregate) shows best compressive strength result 20.61 Mpa which is so much less then type-A and type-B cement and 100% CA (Normal Coarse Aggregate) shows the Lowest Result 12.11 Mpa which is less then type –B cement, Mixed 50%CA and 50% RCA shows 13.93 Mpa.

This compressive result all are increase from 7 days compressive strength result and type-A(scan) cement and 100% RCA shows best result best result after 28 days.

Table 4.9 Compressive strength test for type A cement

No.	Materials Name	7 Days Strength	28 Days Strength
01	100% (CA)	13.58 Mpa	15.64 Mpa
02	50%(CA) +50%(RCA)	13.67 Mpa	19.57 Mpa
03	100%(RCA)	20.91 Mpa	25.52 Mpa

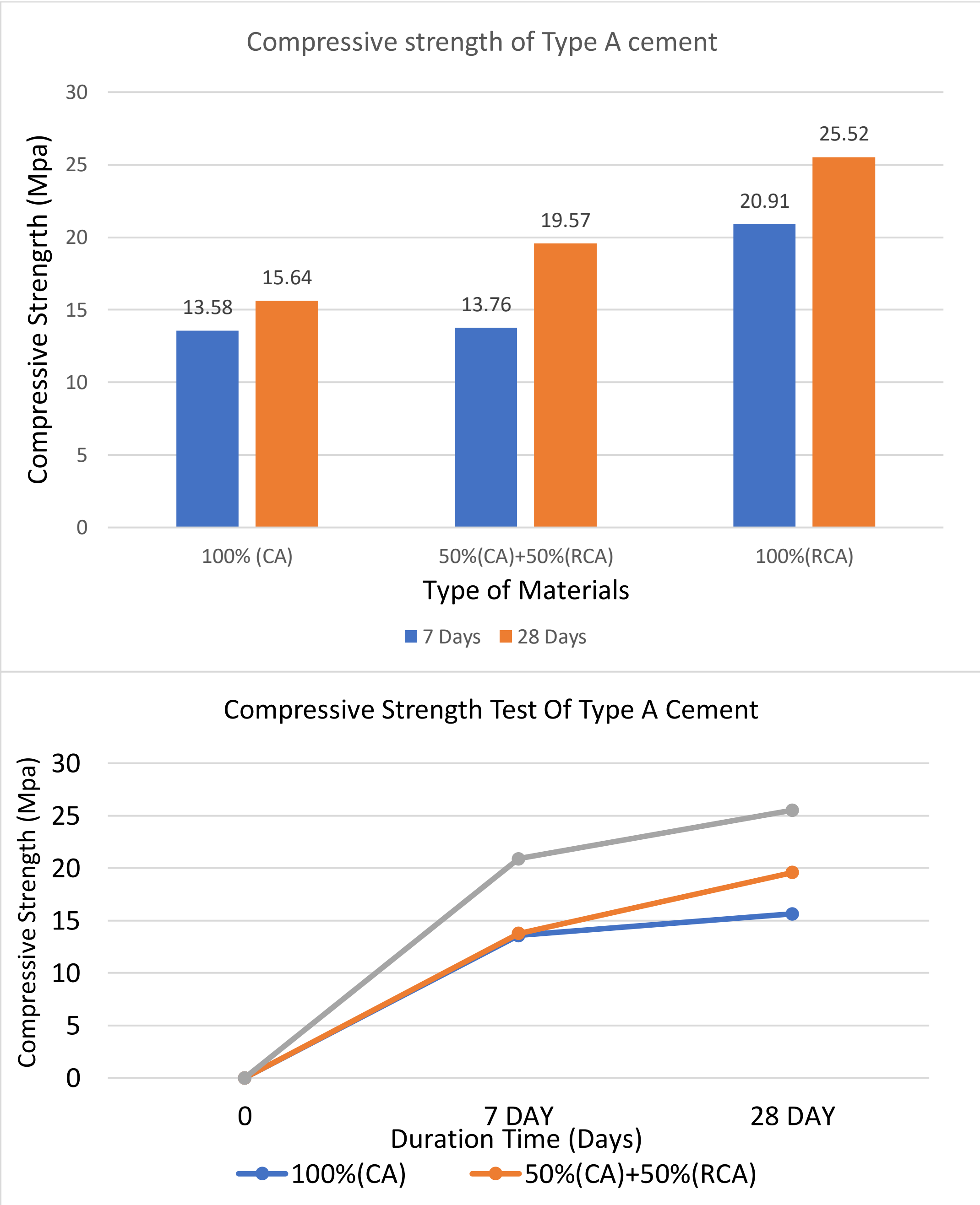
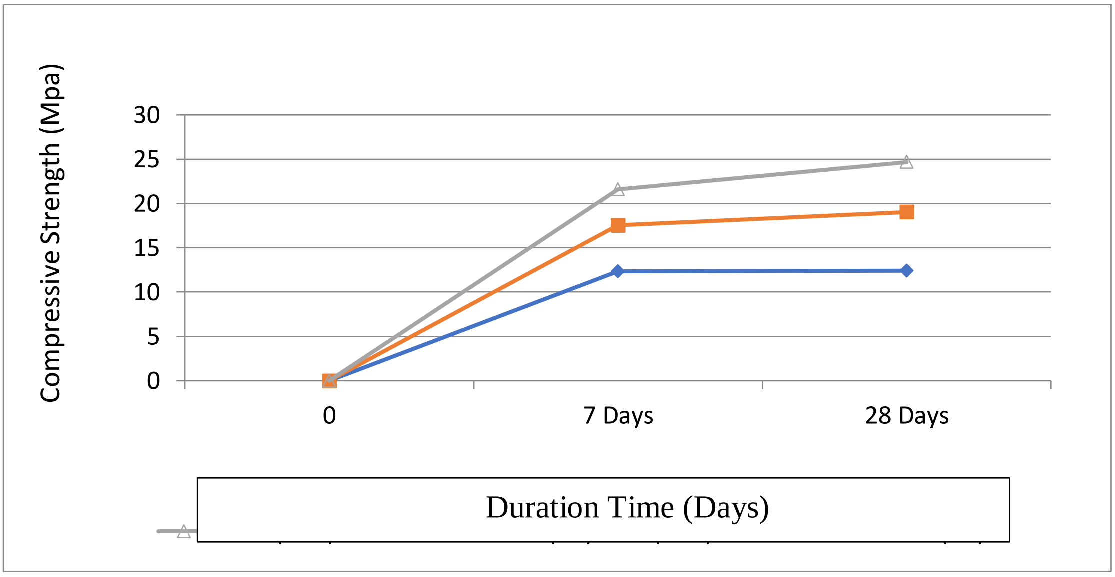


Figure 4.3 Compressive strength test of type A cement

Table 4.10 Compressive strength test of type B cement

No.	Material Name	7 Days Strength	28 Days Strength
01	100%(CA)	12.36 Mpa	12.42 Mpa
02	50%(CA)+50%(RCA)	17.58 Mpa	19.03 Mpa
03	100%(RCA)	21.58 Mpa	24.67 Mpa



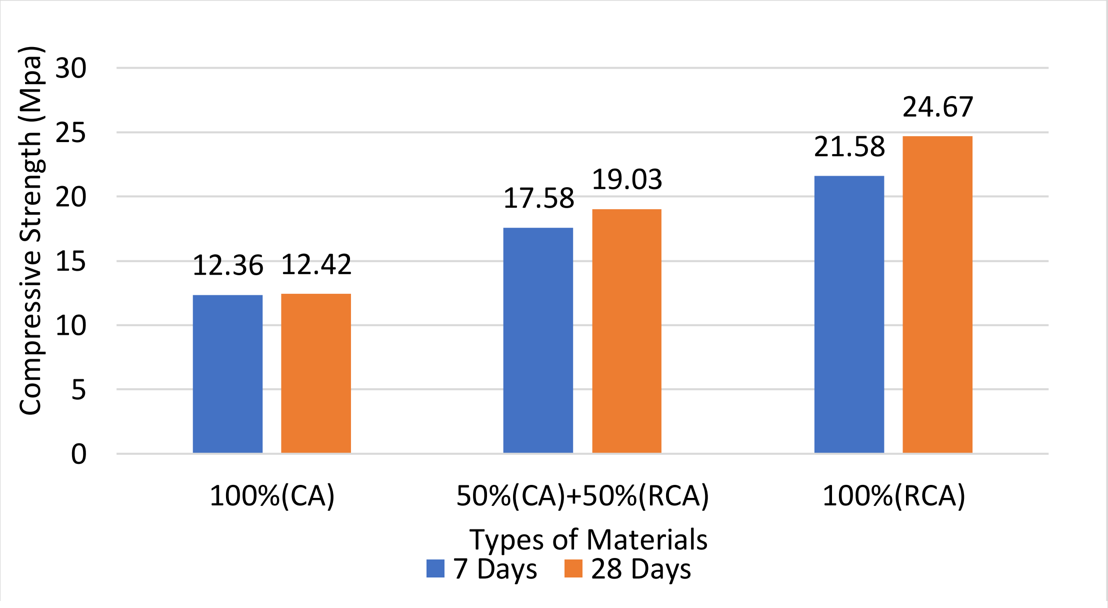
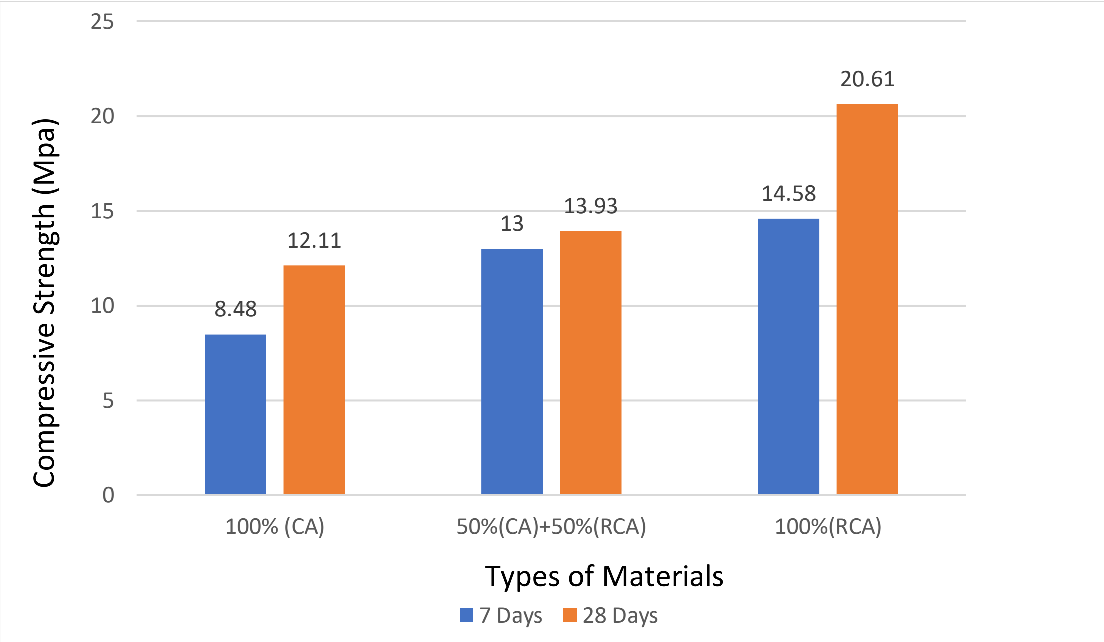


Figure 4.4 Compressive strength test of type C cement

Table 4.11 Compressive strength test of type B cement

No.	Material Name	7 Days Strength	28 Days Strength
01	100%(CA)	8.48 Mpa	12.11 Mpa
02	50%(CA)+50%(RCA)	13 Mpa	13.93 Mpa
03	100%(RCA)	14.58 Mpa	20.61 Mpa



Compressive Strength test for type C cement

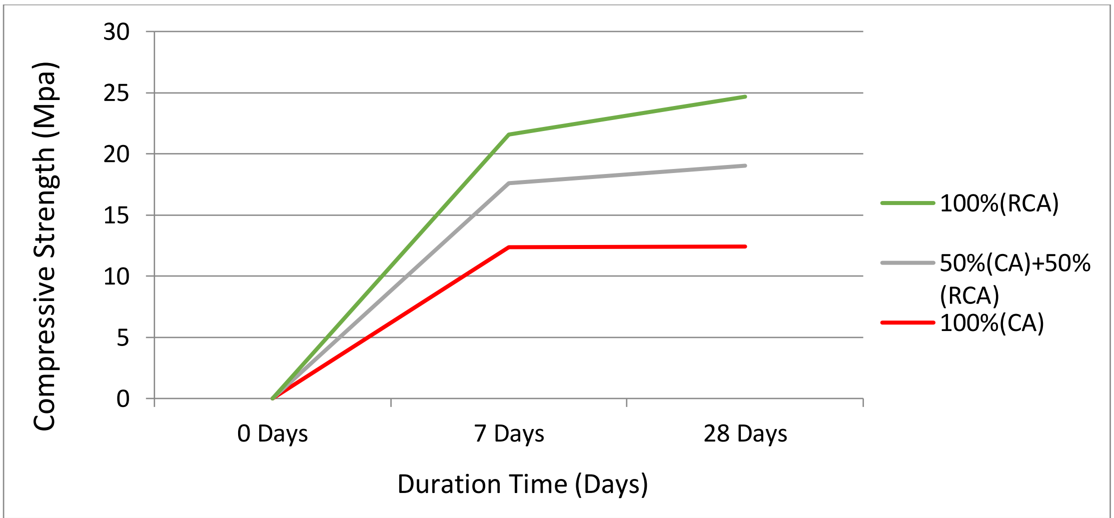


Figure 4.5 Compressive Strength test for type C ceme

4.9 After the Experiment Shows Below the Result

1. For 100%(CA) for Compressive strength of the concrete is to reach 13.58 Mpa in 7 days & 15.64 Mpa in 28 days of A Cement.
2. For 50%(CA)+%) %(RCA) Compressive strength of the concrete is to reach 23.67 Mpa in 7 day &19.57 Mpa in 28 days of A Cement.
3. For 100%(RCA) for Compressive strength of the concrete is to reach 20.91 Mpa in 7 day & 25.52 Mpa in 28 days of A Cement.
4. For 100%(CA) for Compressive strength of the concrete is to reach 12.36 Mpa in 7 day & 12.42 Mpa in 28 days of B Cement.
5. For 50%(CA)+%) %(RCA) Compressive strength of the concrete is to reach 17.58 Mpa in 7 day &19.03 Mpa in 28 days of B Cement.
6. For 100%(RCA) Compressive strength of the concrete is to reach 21.58 Mpa in 7 day &24.67 Mpa in 28 days of Bl Cement.
7. For 100%(CA) for Compressive strength of the concrete is to reach 8.48 Mpa in 7 day & 12.11 Mpa in 28 days of C Cement.
8. For 50%(CA)+50%(RCA) of Compressive strength of the concrete is to reach 13 Mpa in 7 day &13.93 Mpa in 28 days of Fresh C Cement.
9. For 100%(RCA) of Compressive strength of the concrete is to reach 14.58 Mpa in 7 day &20.61 Mpa in 28 days of C Cement.

Concrete's compressive strength will increase to 25.52 Mpa for 100% (RCA) in 28 days. Most cylinders meet this criterion for compressive strength in less than a week. The concrete's peak compressive strength was 21.58 MPa at 100%(RCA) for B Cement, and its lowest was 8.48 MPa at 100%(CA) for C of Grade M15 during the course of 7 days. And for a period of 28 days, C cement had a compressive strength of 12.11 Mpa 100% (CA) and A cement had a compressive strength of 25.52 Mpa 100% (RCA). A Cement and 100% RCA (Recycled Coarse Aggregate) had a higher compressive strength than other cement brands and brick chips.

CHAPTER 5

CONCLUSIONS AND FUTURE WORKS

5.1 Conclusions

After the experiment we get the below decision-

The comparison of grade three brand of Portland composite cement and 100% Coarse Aggregate and 50% Coarse Aggregate +50% Recycle Coarse Aggregate and 100% Recycle Coarse Aggregate.

In 7 days, compressive strength test result of A Cement, B Special Cement, C cement doesn’t show good compressive strength.

In 28 days, compressive strength test result of. A Cement, B Cement, C cement doesn’t show good compressive strength.

In 7 days, compressive strength test result 100%CA, 50%CA+50%RCA, 100%RCA here 100%RCA shows high compressive strength.

In 28 days, compressive strength test result of 100%CA, 50%CA+50%RCA, 100% RCA here 100% CA doesn’t show high Compressive strength.

Here.

We get highest compressive strength of concrete for used A Cement and 100% Recycle coarse Aggregate and get lowest compressive strength of concrete for used fresh cement and 100% Coarse Aggregate. Over all we get by all test A Cement and 100% Recycle Aggregate was better than the others cement And Coarse Aggregate.

5.2 Future Recommendations

The following are some recommendations provided considering the previous discussion:

We used M15 grade.

1. Additional research or work can be done in collaboration with other local cement brands.
2. Additionally, different water-to-cement ratios can be used.
3. The other brand of Portland composite cement like as, Premier, Crown, Seven Rings cement etc. And Others Coarse Aggregate like as stone, surki, timber, glass, crush tiles etc. may be worked in further.
4. Different water cement ratio can also be worked in further.

REFERENCES

Abrams. (1924). "Design of Concrete Mixtures", *SCRIBD.*

ABRAMS. (1924). "Design of Concrete Mixtures", Kimberley Holland"

Akmal Abdelfatah,Sami W. Tabsh. (2011). "Review of Research on and Implementation of Recycled Concrete Aggregate in the GCC", Advances in Civil Engineering, (1687-8086).

Clayton, N. (March 1978). "Testing of concrete cylinder", Magazine of Concrete Research,26-30.

Hdonza, O. F. (2002). "High-strength concrete with different fine aggregate Science Direct"

Hughes, b. P. (november 1960). "Rational concrete mix design. Proceedings", of the Institution of Civil Engineers, 315-332.

Jones, M. K. (August 1957). "The effect of coarse aggregate on the mode of failure of concrete in compression and flexure"

Mohammed Tarek Uddin1, I. M. (December 8, 2014). "Sustainable Development of Concrete Construction Materials in Bangladesh", 1st IUT International Seminar on Sustainability, Recycling and Durability of Concrete

P.H.daviesj.P.goettljr.J.R.sinleyn.F.Smith. (1975). "Acute and chronic toxicity of lead to rainbow trout salmo gairdneri", in hard and soft water. 2003.

R. Jones, B. P. (1957). "No accessthe effect of coarse aggregate on the mode of failure of concrete in compression and flexure", ICE Virtual Library.

S.B.Singh, P. M. (2015). "Role of water/cement ratio on strength development of cement mortar. Science Direct"

Skominas, r. (2019). "effect of aggregates impurity on concrete properties", rural development 2021.

Suraya Hani Adnan, L. Y. (2007). "Compressive strength of recycled aggregate concrete with various percentage of recycled aggregate", National Seminar on Civil Engineering Research, 1-12.

Calculations Questionnaire

Appendix A

Section A: Mix Design

The five main components of a concrete mix are cement, water, coarse aggregates, fine aggregates (i.e., sand), and air. These components are combined in different ratios. To provide the mixture specific desired features, additional elements can be added, such as pozzolanic components and chemical admixtures.

Step-1

Calculation of target Strength:

Target Mean Strength of concrete is derived from the below formula –

Ft= fck +1.65 s

Where s = standard deviation which is taken as per below table;

Grade of Concrete	Standard deviation (N/mm2)
M15	3.5

Characteristic Compressive strength after 28 days fck= 15 N/mm2

Ft=15+1.65+3.5

= 20.775 N/mm2

=3012.43 lb/in2

Step-2

Selection of water cement ratio:

Water cement ratio is selected from the graph plotted between 28 days compressive strength and water –cement ratio which is as per Is10262-2009

So w/c ratio =0.57

The final water-cement ratio will be taken as the minimum of the above two values,

Therefore, w/c ratio =0.57

Step-3

Air content calculation:

Nominal maximum size of aggregate taken is = 20 mm

So, from the table entrapped air in % of the volume of concrete = 2%

Step-4

Cement content calculation:

From step 2, water cement ratio =w/c=0.57

The Aggregate nominal maximum size is 20 mm and they belong to zone 2. So, the adjustment for compacting is to be applied

Therefore, the water content =186 +(186*3/100) =191.6 ft/m3 of concrete.

Water content W=191.6 liters=191.6 kg

191.6/c =0.57

Finally, c =336.14 kg /m3 of concrete.

Step-5

Aggregate Content calculation:

Volume of concrete (with encrypted air) =1m3

Encrypted air %=2%=0.02

Therefore, volume of concrete (without air content) =1-0.02=0.98 m3
Fine aggregate content determines from below formula;
V=[w+C/Gc+(1-p) *(F*A)/Gf] *1/1000
0.98= [191.6+336.14/3.15+(1/1-0.62) *(F*A)/2.6] *1/1000
Therefore, amount of fine aggregate F. A=673.52 kg
Similarly, Coarse aggregate content C.A is derived from,

$$V=\left[191.6+\frac{336.14}{3.15}+\left(\frac{1}{0.62}*\frac{C.A}{2.65}\right)\right]*\frac{1}{1000}$$

Therefore, amount of course aggregate C. A= 1120 Kg
Step-6
Final Mix of ingredient:
w/c ratio =0.57
Cement quantity = 336.14 kg =337 kg
Fine Aggregate = 673.53 kg =674 kg
Coarse Aggregate Quantity =1120 kg
Mix proportion for M15 Concrete:(Cement:FA:CA) =1:2:3.3

Section B: Quantity of materials.

Mix No	Number of Cylinder required	Cement Name	Coarse Aggregate (kg)	Recycle Aggregate (kg)	Fine Aggregate (kg)	Cement (kg)	Mix Details
01	4	A cement	8.00	-	5.16	2.27	1:2:3.3
02	4	A cement	4.04	2.80	5.16	2.27	
03	4	A cement	-	5.60	5.16	2.27	
04	4	B cement	8.00	-	5.16	2.27	
05	4	B cement	4.04	2.80	5.16	2.27	
06	4	B cement	-	5.60	5.16	2.27	
07	4	C cement	8.00	-	5.16	2.27	
08	4	C cement	4.04	2.80	5.16	2.27	
09	4	C cement	-	5.60	5.16	2.27	
Total	36	-	36.12	25.20	46.44	20.43	-

Section B: Result of 7 days compressive strength

No.	Name of Cement & Materials	Applying load (lb)	Average Applying load (lb)	Average Strength (PSI)	Average Strength (Mpa)
01	100%(CA)Type A Cement	25177.6	25177.6	1970	13.5
		25177.6			
02	50%(CA)+50% (RCA)Type A Cement	26301	25514.5	1996	13.7
		24728			
03	100% (RCA) Type A Cement	40466	38779	3034	20.9
		37092			
04	100% (CA) Type B Cement	22929.6	22929.6	1794	12.3
		22929.6			
05	50%(CA)+50% (RCA)Type B Cement	35968	32596	2550	17.5
		29224			
06	100% (RCA) Type B Cement	42936	40014	3130	21.5
		37092			
07	100% (CA)Type C Cement	15736	15736	1231	8.48
		15736			
08	50%(CA)+50%(RCA)Type C Cement	24952	24165.5	1890	13
		23379			
09	100%(RCA)Type C Cement	26976	26976	2110	14.5
		26976			

Section C: Result of 28 days compressive strength

No.	Name of Cement & Materials	Applying (lb)	Average Applying load (lb)	Average Strength (PSI)	Average Strength (Mpa)
01	100% (CA) Type A Cement	27425.6	28999.2	2269	15.64
		30572.8			
02	50%(CA)+50%(RC) Type A Cement	39340	36305.2	2840	19.57
		33270.4			
03	100%(RCA)TypeA Cement	46308.8	47320.4	3702	25.52
		48332			
04	100% (CA) Type B Cement	21356	23042	1802	12.42
		24728			
05	50%(CA)+50% (RCA)Type B Cement	34844	35293.6	2761	19.03
		35743.2			
06	100%(RCA)TypeB Cement	45409.6	45746.8	3579	24.67
		46084			
07	100% (CA)Type C Cement	23604	22480	1758	12.11
		21356			
08	50%(CA)+50%(RCA) Type C cement	23604	25852	2022	13.93
		28100			
09	100% (RCA) C Cement	42712	38216	2990	20.61