POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

INVESTIGATION OF WASTEPAPER SLUDGE AS A PARTIAL REPLACEMENT FOR SAND IN CONCRETE

JABATAN KEJURUTERAAN AWAM

NAVINESWARAN A/L YOGESHWARAN

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SESI 2:2023/2024

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This report was submitted to the Civil Engineering Department as part of the requirements for the award of the Civil Engineering

Jabatan Kejuruteraan Awam Diploma Kejuruteraan Awam

JABATAN KEJURUTERAAN AWAM

SESI 2:2023/2024

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(801026-02-5864)

as the project supervisor on the date: 08/12/2023

APPRECIATION

The effective completion of this last semester extension seems not to have been accomplished without the back, direction, and commitments of various people and organizations. It is with profound appreciation that we recognize their priceless help.

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In conclusion, we recognize and appreciate the collaborative endeavors of all those who have contributed to the effective completion of this extent. It is through their back and commitment that we have been able to realize our objectives and breakthroughs.

ABSTRAK

Industri pembangunan adalah salah satu punca berlakunya rasuah semulajadi. Isu ini timbul disebabkan oleh penggunaan meluas aset biasa, seperti pasir, yang merupakan komponen terpenting dalam penjanaan konkrit. Konkrit ialah fabrik bangunan yang paling utama digunakan secara meluas, dan permintaan untuk pasir untuk menghantar konkrit telah mendorong kebimbangan mengenai penggunaan aset biasa serta mempengaruhi alam sekitar. Dalam pengembangan, era pembaziran, mengira enapcemar kertas buangan, menimbulkan satu lagi cabaran semula jadi. Siasatan ini menunjukkan kepada meneroka kemungkinan dan faedah menggantikan kebanyakan pasir dalam konkrit dengan enap cemar kertas buangan. Objektif perenungan ini adalah untuk membandingkan kualiti mampatan dan kadar asimilasi air konkrit konvensional dengan konkrit yang mengandungi enap cemar kertas buangan. Menggunakan perkadaran adunan 1:2:4 (simen: pasir: jumlah kasar) untuk konkrit semakan M15, enapcemar kertas buangan dihantar dalam jumlah 3%, 6%, dan 9% mengikut berat untuk menggantikan pasir dalam konkrit dengan kualiti sasaran sebanyak 15 N/mm^2 pada 28 hari. Dalam pertimbangan ini, beberapa ujian telah dijalankan seperti ujian kualiti mampatan dan ujian pengekalan air. Kualiti mampatan konkrit 28 hari yang paling ketara ialah 0% dengan 26.7 N/mm^2 diambil selepas 6% dengan 18.7 N/mm^2, 3% dengan 17.4 N/mm^2, dan 9% dengan 15.1 N/mm^2. Selain itu, untuk ujian penyerapan air, semua contoh konkrit kelihatan mempunyai kadar penyerapan air, yang tidak melebihi 3%. Ini berlaku menunjukkan kebolehtembusan air yang boleh diabaikan untuk semua contoh konkrit. Kesimpulannya, pemikiran ini menunjukkan kebolehcapaian dan daya maju enap cemar kertas buangan dalam mencipta konkrit, dan pada masa yang sama dapat melindungi aset berciri dengan mengurangkan pergantungan kepada pasir dalam segmen pembangunan.

Frasa tangkapan: enap cemar kertas buangan, pasir, konkrit, kekuatan mampatan dan penyerapan air.

ABSTRACT

The development industry is one of the causes of natural corruption. This issue emerges due to the broad utilization of normal assets, such as sand, which is the most important component within the generation of concrete. Concrete is the foremost broadly utilized building fabric, and the request for sand to deliver concrete has driven concerns approximately the consumption of normal assets as well as influencing the environment. In expansion, squander era, counting wastepaper sludge, postures another natural challenge. This inquiry points to exploring the possibility and benefits of supplanting mostly sand in concrete with wastepaper sludge. The objective of this ponder is to compare the compressive quality and water assimilation rate of conventional concrete with concrete containing wastepaper sludge. Employing a blend proportion of 1:2:4 (cement: sand: coarse total) for M15 review concrete, wastepaper sludge was conveyed in sums of 3%, 6%, and 9% by weight to supplant sand in concrete with a target quality of 15 N/mm^2 at 28 days. In this consideration, a few tests were performed such as compressive quality test and water retention test. The comes about appear the most noteworthy compressive quality of 28-day concrete is 0% with 26.7 N/mm^2 taken after by 6% with 18.7 N/mm^2, 3% with 17.4 N/mm^2, and 9% with 15.1 N/mm^2. Other than that, for the water absorption test, all the concrete examples appeared to have a water absorption rate, which did not surpass 3%. These come about show negligible water penetrability for all concrete examples. In conclusion, this think about appears the achievability and viability of wastepaper sludge in creating concrete, while at the same time being able to protect characteristic assets by decreasing the reliance on sand within the development segment.

Catchphrases: wastepaper sludge, sand, concrete , compression test and water absorption test

TABLE OF CONTENT

LIST OF TABLES

NO. CONFERENCE TITLE TABLE

LIST OF ABBREVIATIONS

PSA	**Politeknik Sultan Salahuddin Abdul Aziz Shah**
OPC	**Ordinary Portland Cement**

LIST OF FIGURES

NO. FIGURE TITLE

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The construction industry is one of the biggest contributors to waste and environmental degradation around the world. One of the reasons for this is the massive use of natural resources like sand, which is one of the main ingredients in concrete construction. Concrete is by far the most used construction material and the demand for it has raised concerns about the depletion of sand and its environmental impact. Waste generation, including waste sludge, is also a major environmental concern. Proper disposal of waste is not only expensive but also unsustainable. Researchers and engineers have been looking for alternatives to replace or supplement the traditional ingredients in concrete to address these issues. This research aims to explore the feasibility and advantages of substituting sand in concrete with waste sludge. By addressing both environmental and waste challenges at the same time, this research can help promote sustainable construction practices and help conserve resources. By understanding the potential benefits and limitations of the substitution of waste sludge for sand in concrete, we can help promote an environmentally friendly approach to the building and mitigate the environmental and waste issues associated with the waste sludge. The results of this study can be of use to the construction industry as we strive for a greener, more sustainable future.

1.2 PROJECT BACKGROUND

One of the biggest challenges in the construction industry is the use of sand to create concrete. We are running out of sand and the digging up of sand is bad for the environment. The paper industry also produces a large amount of waste known as wastepaper or sludge. This waste is difficult and costly to dispose of. Some smart people are exploring the use of waste sludge in concrete instead of sand. The purpose of this project is to find out if this idea is a good one and how it will help the construction industry. The main objectives of this project include reducing resources, managing waste, and promoting green construction. To do this, we will test how it impacts the strength and the permeability of the concrete. The goal of this research is to gather information that can be used by decision-makers and builders to make better decisions. The goal of the project is to make the construction industry more sustainable and to find a better solution for disposing of waste paper.

1.3 PROBLEM STATEMENT

1.3.1 Environmental Concern

Sludge from wastepaper is becoming a global issue, which means that sludge output will keep rising and environmental quality regulations will tighten. By 2020, it is anticipated that the pulp and paper sectors will produce 77% more globally, with over 66% of the paper produced being recycled at the same time (Rosazlin Abdullah et al., 2016). In the past few decades, river sand mining has increased significantly in response to the building industry's requirement for concrete. The environmental balance of a river is maintained by the sand in its bed. Riverbed deterioration, which results in several issues like the loss of water-holding soil strata and the slide of riverbanks, is caused by excessive river-sand mining for use as fine aggregate in concrete (Hong Lich Dinh et al., 2022).

1.4 OBJECTIVES

i. To produce traditional concrete and wastepaper sludge concrete
ii. To test the compressive strength and water absorption rate of traditional concrete and wastepaper sludge concrete.
iii. To compare the compressive strength and water absorption rate between traditional concrete and wastepaper sludge concrete.

1.5 SCOPE STUDY

Partial fine aggregate will be replaced by wastepaper sludge using the ratio of 1:2:4 using grade M15 concrete which is suitable for making curbs. Next, wastepaper sludge will be collected at UPP Pulp & Paper (M) Sdn Bhd. The concrete will be prepared with wastepaper sludge as a partial replacement for fine aggregate, with ratios of 3%, 6%, and 9%. Three samples will be prepared for each ratio, and the results will be evaluated after 7 days and 28 days of curing. Concrete will be cast using cube size which is 150mm x 150mm x 150mm. Lastly, The tests will include the assessment of compressive strength and water absorption. The objective is to evaluate the ability of wastepaper sludge to maintain the strength, durability, quality, and behavior of concrete under weathering conditions.

1.6 DEFINITION

1.6.1 Definition Of Concrete

Sand, water, fine and coarse aggregates, and cement are the ingredients of concrete. When producing high-quality concrete, the velocity at which the concrete is mixed is crucial. A building project can benefit from high-quality concrete. One material with a varied composition is concrete. The maximal properties and workability of concrete are determined by the aggregate. The shape, size, source, crushing type, normal or lightweight aggregate, angularity index, modulus of elasticity, surface texture, specific gravity, bulk density, adsorption and moisture content, cleanliness, soundness of aggregate, bulking of aggregate, thermal properties, and aggregate grading are some of the aggregate properties that affect the mechanical properties of concrete (Varsha Rathore and Aruna Rawat, 2019). Since it is inexpensive, readily available, long-lasting, and resistant to weather, concrete is one of the most popular and oldest building materials in the world. According to Hasan M.Y. Tantawi (2015), concrete is a brittle material with good compressive but low tensile strength. The performance criteria should serve as the foundation for developing the new generational mix design technique. It is not appropriate to think of the design concrete mix's concrete strength and ideal cement content as the only factors determining the stability of the concrete mix. Wani, Shoib Bashir (2021).

1.6.2 Definition Of Wastepaper Sludge

The residue left over after paper and cardboard goods are recycled is referred to as wastepaper sludge. It is mostly made up of remnants from the pulp and paper industries, which might comprise different materials including fibers, dyes, chemicals, and pollutants. Since these remnants can't be used to create new paper goods, they are usually eliminated during the recycling process. Depending on the particular recycling method and the source of the recycled paper, wastepaper sludge might have a different composition. It is often regarded as a waste product as it contains elements that are ineffectively repurposed in the creation of new paper. Sludge made from waste paper might need to be disposed of or treated further to lessen its influence on the environment.

1.7 CONCLUSION

The concrete is put through a compression test after the study to ascertain its strength. This study also shows how to recycle the wastepaper sludge that is being used more and more these days.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The construction industry stands on the cusp of a transformative journey towards sustainability and resource efficiency. With environmental concerns at the forefront of contemporary building practices, the search for innovative construction materials that not only fulfill structural requirements but also reduce the ecological footprint has gained momentum. In this context, the study on the utilization of wastepaper sludge as a substitute for sand in concrete emerges as a compelling exploration of sustainable construction practices.

Concrete, a principal building fabric, intensely depends on the utilize of common sand as a key fixing. Be that as it may, the extraction of sand from waterways and quarries has come beneath examination due to its unfavorable natural affect, counting living space devastation and asset consumption. To address this issue, analysts and engineers have been looking for options that keep up or upgrade the execution of concrete whereas diminishing its biological impression. Wastepaper sludge, a byproduct of the paper reusing industry, offers a promising road in this interest.

Wastepaper sludge, already considered a transfer challenge, has advanced into a asset with the potential to revolutionize concrete generation. This consider points to investigate the possibility of coordination wastepaper slime into concrete blends, supplanting routine sand, and saddling its maintainable and basic points of interest. As we dive into the conceivable outcomes and challenges of this endeavor, it gets to be clear that maintainable development isn't fair a vision for long haul but a substantial reality, with each clump of concrete speaking to a greener, more ecologically capable choice.

This research embarks on a journey of discovery, evaluating the impact of wastepaper sludge on the mechanical and environmental properties of concrete. It seeks to assess the potential benefits, such as reduced waste, cost savings, and a diminished ecological footprint, while also acknowledging the need for stringent quality control to ensure structural integrity. As we venture into this study, the transformation of wastepaper sludge from an environmental concern to a sustainable building resource stands as a testament to the ever-evolving landscape of construction materials. In the pages that follow, we uncover the promise and potential pitfalls of wastepaper sludge as an alternative to sand in concrete, offering a glimpse into a more sustainable future for the construction industry.

2.1.1 Previous Studies Of Concrete With Additional Material

2.1.2 Real Type Projects

I. Use of paper waste industry [Hypo Sludge] in design mix concrete. (Ahmad S. , 2017)

II. Study of concrete involving the use of wastepaper sludge ash as a partial replacement of cement (Sajad, 2013)

III. Study on the use of soya bean as a substitute for sand in concrete (Shahkur, 2013)

IV. Study of the Incorporation of Waste from the Paper Industry in Ceramic Tiles (Azevedo,2019)

V. Study Of Concrete Involving Use Of Waste Glass As Partial Replacement Of Fine Aggregates (Iqbal Malik,2019)

2.2 CONCRETE

Concrete, a vital construction material, comprises aggregate, typically sand and gravel, bonded by cement and water. Ancient civilizations used clay, and later lime, as binders. Portland cement, a mixture of limestone and clay, dominated since 1824. Aggregates vary in size, designated as fine or coarse. Cleanliness is crucial for aggregate quality. Concrete strength relies on the water-to-cement ratio, lower water content enhances strength. Environmental factors and curing influence strength and reinforced and prestressed concrete innovations enhance structural capabilities. Its versatility, fire resistance, and widespread use make concrete a fundamental global building material. (encylcopedia, 2023)

2.3 WASTEPAPER SLUDGE AS AN ADDITIONAL MATERIAL IN CONCRETE

WPS (wastepaper sludge) is produced during the recycling of paper and is an industrial byproduct that can pollute the environment. Because of its pollution-related effects, a general examination of its application is necessary. Despite the efforts of many researchers across the world to address the use of WPS as a sustainable material, the consequences of WPS as a cementitious material in its application are still being evaluated. As a result, this study provides a broad overview of the impact of WPS as a cementitious material. WPS was given a general evaluation in terms of its physical qualities, chemical properties, reactive properties, and industrial applications. According to the assessment of WPS characteristics, the WPS has a high potential as a material in the construction sector, particularly in the manufacture of concrete, brick, mortar, soil stabilizing additives, rigid pavement, and co-wastepaper sludge (WPS) as a substitute for sand in concrete is according to [Katsina Christopher BALA1 et.al, 2013.] driven by its distinctive characteristics and the chemical compounds it contains, which collectively address environmental, material, and economic considerations. Natural sand, a conventional component in concrete, is associated with environmental challenges, including habitat disruption due to extensive mining. WPS, on the other hand, is an eco-friendly alternative, as it is a byproduct of paper recycling, repurposing what would otherwise be waste. (M F Azrizal1*, 2019)

WPS contains valuable chemical compounds, notably silica and alumina. These compounds give it pozzolanic properties, which means it can react with calcium hydroxide produced during cement hydration. This chemical interaction results in the formation of additional binding compounds within the concrete, enhancing its strength, durability, and resistance to various forms of deterioration. These properties make WPS a promising material in construction.

Additionally, WPS's lightweight aggregates are advantageous for applications where reducing concrete density and improving thermal insulation is crucial. The environmental benefits, enhanced performance, and cost-efficiency make the adoption of WPS in concrete a responsible choice. By addressing the environmental impact of sand mining, conserving natural resources, and offering a viable and eco-friendly building solution, WPS contributes to sustainable construction practices, aligning with the principles of environmental responsibility and circular economy. Table 2.1 and table 2.2 show the constituent of hypo sludge and the structural performance of concrete with paper sludge as a partial replacement of fine aggregate in concrete.

Table 2. 1 Constituent of Hypo Sludge according to (Ahmad S., 2017)

No.	CONSTITUENT	PERCENTAGE (%)
1	ACID INSOLUBLE	11.1
2	SILICA (Sio2)	9.0
3	MAGNESIUM	3.3
4	CALCIUM SULPHATE	46.2
5	MOISTURE	56.8

Table 2.2: structural performance of concrete with paper sludge as a partial replacement of fine aggregate in concrete according to (Adajar, 2006)

MATERIAL	FINE AGGREGATE (%)
SILICA	18.91
CALCIUM	1.66
MAGNESIUM	2.055
IRON	0.93
SODIUM	3.68
ALUMINIUM	6.33

2.4 PREVIOUS STUDY

We discovered that wastepaper sludge has a chemical substance that interacts with cement, resulting in a process known as "Pozzolanic Activity" in prior investigations. The subsequent chemical reaction can be beneficial to a structure. The silica content is one of the chemical components of wastepaper sludge that interacts well with cement. This allows wastepaper sludge to substitute sand, which also contains silica. In a prior investigation, we discovered that wastepaper sludge contains 9.0% silica.

2.4.1 Use of Paper Waste Industry [Hypo Sludge] In Design Mix Concrete

The study explores the application of hypo sludge in construction, emphasizing its economic viability for government-funded temporary shelters post-natural disasters. It notes a decrease in compressive strength with increased hypo sludge replacement, identifying the optimal level at 7.5%. The material's lower cost makes it suitable for structures prioritizing cost over strength. Additionally, hypo sludge usage in concrete is seen as environmentally friendly, reducing disposal costs and environmental effects. The research suggests judicious engineering decisions for effective use, including potential silica addition for increased strength in rural road construction, contributing to innovative and environmentally conscious construction practices while addressing hypo sludge disposal challenges. (Ahmad S. , 2017)

2.4.2 Study Of Concrete Involving The Use Of Wastepaper Sludge Ash As Partial Replacement Of Cement

The study explores the use of wastepaper sludge ash as a partial replacement for cement in concrete. A 5% replacement showed a 10% increase in compressive strength at 7 days and 15% at 28 days. Up to 5% replacement resulted in a 15% strength increase. As wastepaper sludge ash content rises, water absorption and concrete weight decrease, making it lightweight. Workability decreases with higher ash content while splitting tensile strength decreases but remains above reference concrete at 5% replacement. Economically, environmentally, and sustainably, using wastepaper sludge ash in concrete proves beneficial, solving disposal issues and reducing harmful emissions from the cement industry. (Sajad, 2013).

2.4.3 Study On The Use Of Soya Beans As A Substitute For Sand In Concrete

The study aimed to substitute soybean dregs for sand in concrete. The cube compression test yielded disappointing results, attributing low compressive strength to high water absorption. A cost analysis favored soybean dregs due to their waste status, but the research fell short in promoting environmental awareness. Overall, the study concludes that replacing sand with soybean dregs is unsuitable as the resulting concrete fails to meet JKR standards for compressive strength. (Shahkur, 2013)

2.4.4 Study of The Incorporation Of Waste From The Paper Industry In Ceramic Tiles

According to study by Azevedo in 2019, Red wall tile formulas can substitute up to 5 weight percent of typical limestone material with waste from paper sludge.Red wall tiles made from waste paper sludge were created by uniaxial dry pressing and burned using a fast-firing cycle at 1170 °C.The burned wall tile pieces showed an apparent density of 1.76 to 1.81 g/cm3, a linear shrinkage of 2.88 to 3.22%, a flexural strength of 15.77 to 16.17 MPa, and a water absorption of 17.15 to 18.31%.The waste paper sludge, up to 5 weight percent, may be used to make red wall tiles that fit within ISO 13006 group-BIII.Red wall tile manufacturing uses paper sludge waste, which reduces the environmental damage the paper sector does

.

2.4.5 Study of Concrete Involving Use Of Waste Glass As Partial Replacement Of Fine Aggregate

According to study by Mohamaad Iqbal Malik in 2013, Waste glass powder can be used as a partial replacement of fine aggregates in concrete up to 30% by weight for particle size of range 0-1.18mm. The percentage of water absorption decreased with an increase in waste glass content, with the lowest value found for concrete mix with 40% waste glass content.The workability of concrete mixtures improved with an increase in waste glass content, as waste glass particles absorbed less water compared to sand.Waste glass concrete is lightweight in nature, with a 5% reduction in dry weight of concrete cube specimens for concrete mix with 40% waste glass content compared to the reference mix. 20% replacement of fine aggregates by waste glass showed a 15% increase in compressive strength at 7 days and a 25% increase at 28 days. Fine aggregates can be replaced by waste glass up to 30% by weight, showing a 9.8% increase in compressive strength at 28 days.

2.5 CHAPTER SUMMARY

The literature review for the study on using wastepaper sludge (WPS) as a replacement for sand in concrete highlights several key findings. Researchers have extensively explored the benefits of incorporating WPS, including its pozzolanic properties, which enhance concrete strength and durability. This sustainable approach reduces the environmental impact of sand mining, aligning with eco-friendly construction practices This is because the study is based on recycled material that will be generated every year due to the increasing paper usage. The study aims to address this research gap by investigating the specific effects of WPS in concrete mixes, further advancing sustainable construction methods. This section concludes the literature assessment by identifying issues and gaps in existing research. It identifies opportunities for additional research, such as standardization of testing methodologies, long-term performance studies, and mix design optimization. The chapter establishes the context for upcoming research by emphasizing the need to fill these gaps.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter will clarify and grow on a few imperative focuses related to the approach and arrange utilized to wrap up the inquiry. Utilizing an investigative strategy makes the investigator prepare more deliberateness and the investigation performed more orderly to meet the study's targets. The strategies and investigative approach have been carefully created to get information and data utilizing certain procedures.

This research will investigate the compressive strength and water absorption of wastepaper sludge concrete by partially substituting the fine aggregate in the concrete mixture with various combinations, including water, coarse aggregate, cement, fine aggregate, and wastepaper sludge. These tests will take place on days seven and twenty-eight of the concrete curing process. This process will represent the combination of components, tests, plans, and results required to produce concrete made from waste.

3.2 METHODOLOGY FLOW CHART

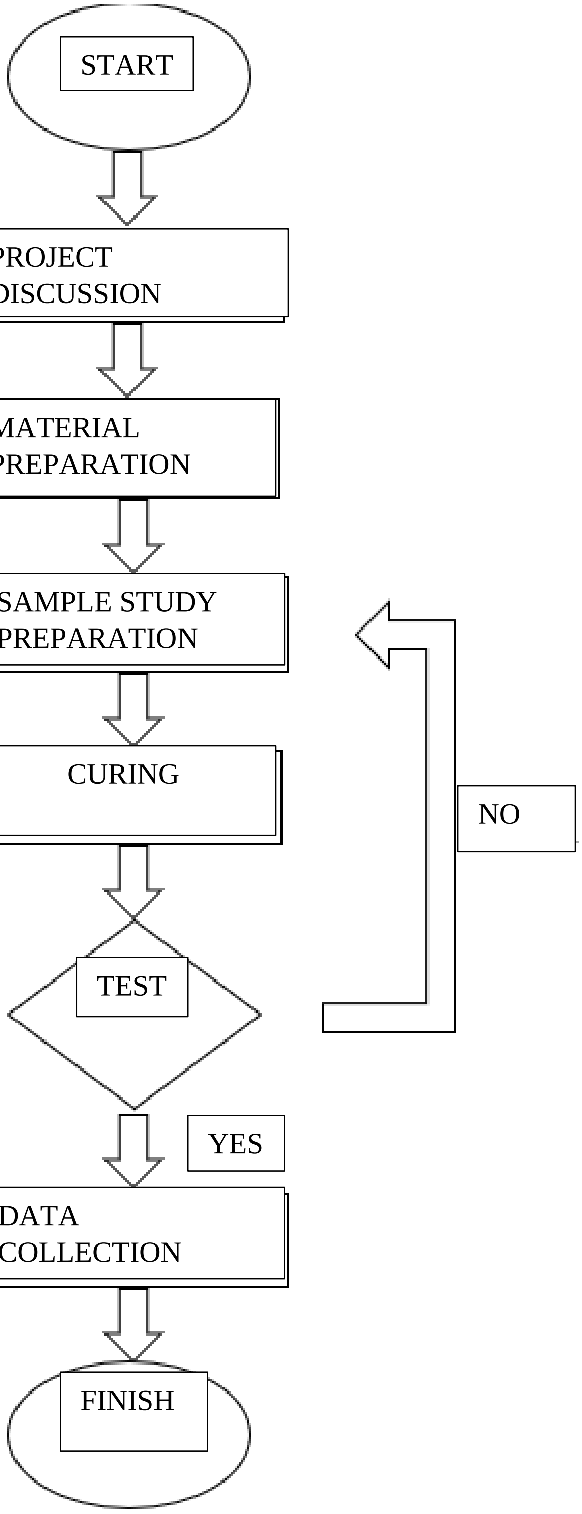

Figure 3.1 shows the flow chart of the project

3.3 MATERIAL

3.3.1 Waste Paper Sludge

The leftover leftover from the paper-making process is called wastepaper sludge, often known as pulp and paper mill sludge. Wastepaper sludge is a valuable resource for environmentally friendly matrices used in concrete production since it contains organic matter, talc, kaolin, calcium carbonate, and other mineral loading (Friedel, Moises et al., 2011). For this experiment, a sample of wastepaper sludge was obtained from UPP Pulp & Paper (M) Sdn.Bhd. We will add wastepaper sludge to concrete in three different amounts: 3%, 6%, and 9%. This will allow us to assess the concrete's water absorption and compression strength. Figure 3.2 shows the Waste paper sludge.

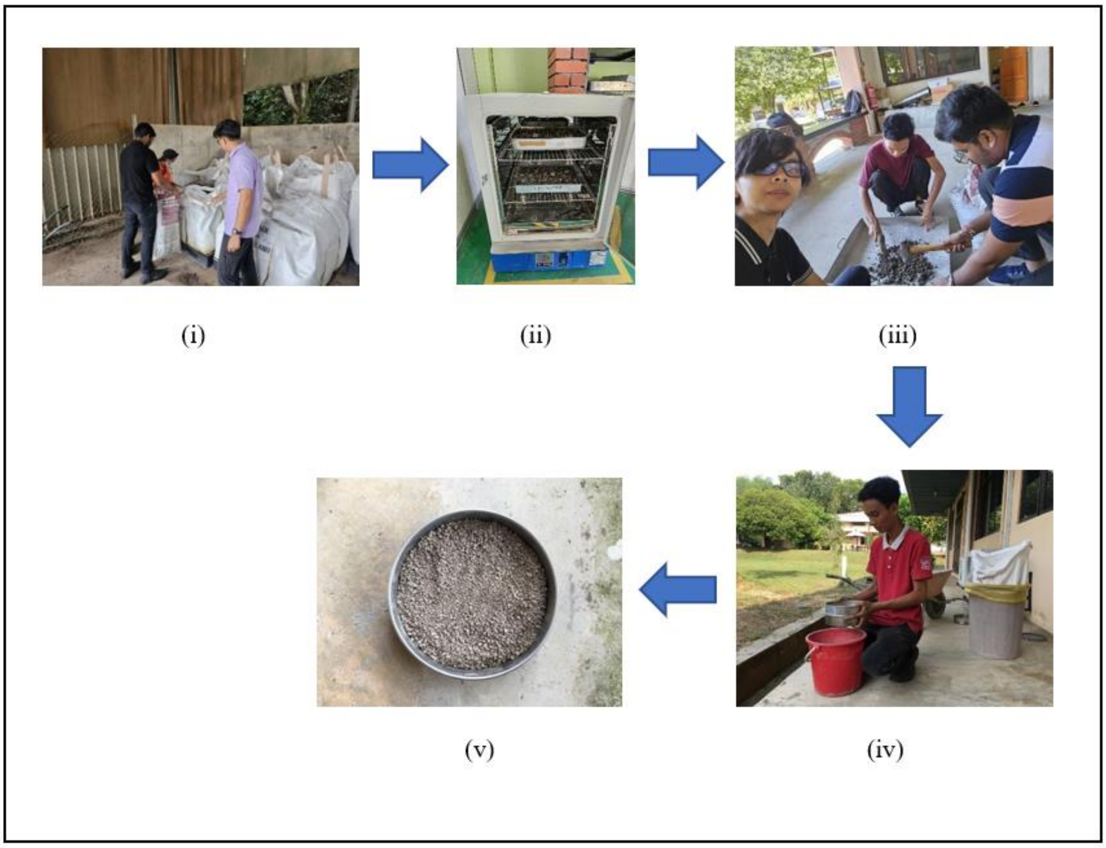

Figure 3.2 shows waste paper sludge

3.3.2 Coarse Aggregate

Coarse aggregate plays a significant part within the construction of concrete, because it contributes significantly to the quality and strength of the ultimate item. It is regularly comprised of geographical substances such as rock, sand, and pulverized shake. The selection of high-quality coarse total is basic to create concrete that meets the specified measures of quality and solidness. A perfect ideal Synonyms development total ought to have a rough surface surface, as well as show cleanliness, quality, and flexibility from any frame of coating or unessential particulate matter. For this examination, a 20mm coarse total estimate will be utilized, by the established dimensions of concrete. Coarse totals allude to particles that are held by a 4.75mm sifter. We are going to collect the coarse total and decide its characteristics utilizing the strainer examination method, permitting us to select the proper mix for the concrete blend. We'll collect the coarse total and decide its characteristics utilizing the strainer examination method, permitting us to select the correct mix for the concrete blend. Figure 3.3 shows coarse aggregate.

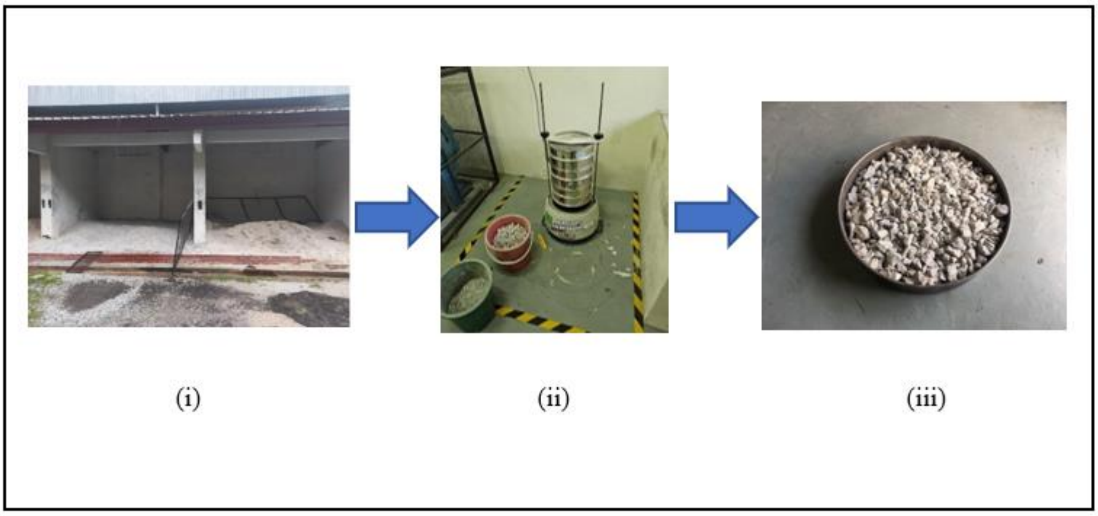

Figure 3.3: coarse aggregate

3.3.3 Fine Aggregate

The natural sand particles that are extracted during mining are referred to as fine aggregates (Pitroda et al., 2013). The fractions that fall between 4.75 mm and 150 microns are designated as fine aggregate. However, naturally existing stones (crushed or uncrushed), gravel, sand, or a mix of these components must make up an aggregate. These ingredients need to be strong, hard, dense, and long-lasting; they also need to be free of veins, stickiness, broken pieces, alkali, vegetable matter, and other potentially dangerous materials. Flaky, elongated parts should be avoided if feasible. For this study, we choose to replace some of the fine aggregates with wastepaper sludge. Figure 3.4 shows fine aggregate.

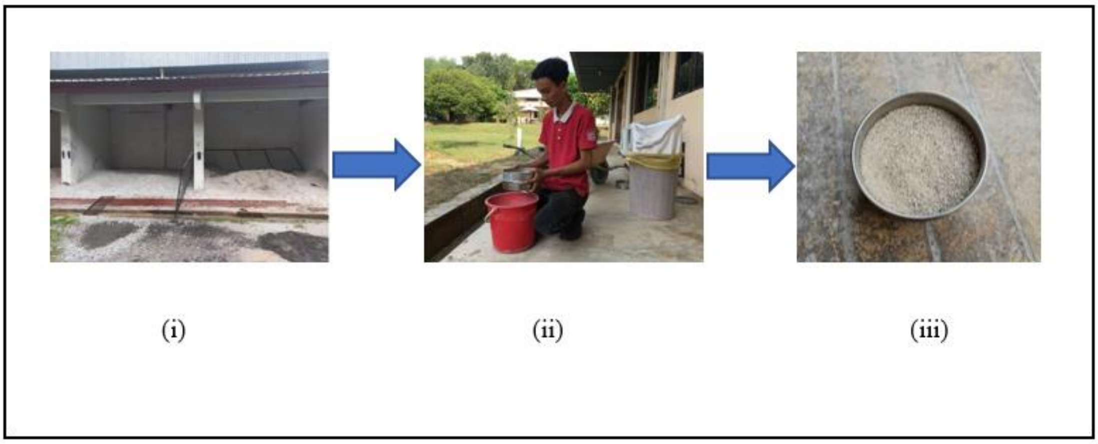

Figure 3.4: fine aggregate

3.3.4 ORDINARY PORTLAND CEMENT (OPC)

Cement is a cohesive material that possesses both solid and adhesive capabilities. As such, it makes it easier to combine various building materials and create a strong bond. Ordinary Portland Cement is one of the most often used varieties of Portland Cement among those used in the construction industry. The estimated amount of cement used in this specific research is one bag. Pitroda's thorough investigation indicates that the physical properties of cement meet the requirements specified in IS:8112-1989, where the minimum starting setting time is 30 units and the maximum final setting time is 600. Figure 3.5 shows Ordinary Portland Cement (OPC).

Figure 3.5: Ordinary Portland Cement (OPC)

3.3.5 Water

While not necessary on other celestial worlds, water as shown in figure 3.6 is a basic material or component for all known life forms on Earth. Water covers a large portion of the Earth's surface—roughly 71%. Water has no flavor or color. It is a powerful solvent that can dissolve a wide range of other chemicals, such as sugar, salt, acid, and other gases as well as different types of organic molecules. When it comes to building, water plays a part in the concrete mixing process. It makes the cement and active ingredients react more easily, which makes it possible for the cement and sand to bind together in the way that is intended.

Figure 3.6: water

3.4 RESEARCH DESIGN

This waste paper sludge-containing concrete will be made to grade M15 standard dimensions, or 150 mm by 150 mm by 150 mm. For cube concrete, tests for water absorption and compression will be conducted. Three specimens, including 3%, 6%, and 9% waste paper sludge as a partial substitute for fine aggregate, will be used in this investigation. The concrete cube, measuring 150 mm by 150 mm by 150 mm, will be placed in the mold. The ratio of water to cement utilized is 0.55, and the mixing ratio for concrete grade M15 is 1:2:4. Figure 3.7 shows cube concrete mould.

Figure 3.7: cube concrete mould

Table 3.1: specification of the mix value of concrete with the addition of waste paper sludge.

MATERIAL	0%	3%	6%	9%
CEMENT	6.87 kg	6.87 kg	6.87 kg	6.87 kg
WASTE PAPER SLUDGE	0 kg	0.32 kg	0.64 kg	0.96 kg
FINE AGGREGATE	15.65kg	15.17	14.71kg	14.24kg
COARSE AGGREGATE	26.55kg	26.55kg	26.55kg	26.55kg

Water cement ratio:0.55

3.4.1 CURING

The improvement of concrete strength is largely dependent on the installation of suitable curing conditions. The sample must begin the curing process as soon as it has sufficiently hardened at room temperature for twenty-four hours. For this study, the concrete samples were cured in a water tank for seven and twenty-eight days, respectively, until the testing ages were achieved. Figure 3.8 shows the curing of concrete cubes

Figure 3.8 shows the curing of concrete cubes

Table 3.2: Total cube specimen for every ratio

TEST	QUANTITY / DAYS	TOTAL SAMPLE			
		0 %	**3 %**	**6 %**	**9 %**
COMPRESSION TEST	7	3	3	3	3
	28	3	3	3	3
WATER ABSORPTION TEST	28	3	3	3	3
TOTAL		9	9	9	9

3.4.2 Concrete 3d shape fixed.

A 3d shape frame may be a bit of hardware utilized to make concrete either inside the shape of a barrel or a 3d shape where the concrete mix is poured into it and cleared out to set. The concrete frame must be strong and keep up its shape when the concrete is poured into it. In this consideration, press sort molds are utilized to form test concrete 3d shapes. The taking after is the strategy for presenting the concrete 3d shape as Figure 3.9 shows.

i. Each side of the form begins with joined in conjunction with the base of the shape.

i. Screws are introduced on each side of the shape to secure the form.

iii. Oil is connected to the shape's inward surface to prevent the concrete from staying in its form.

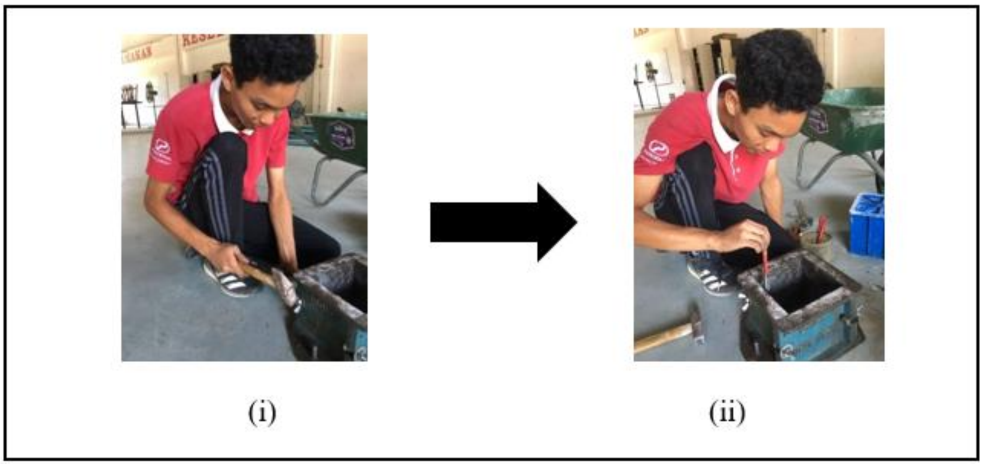

Figure 3.9: Concrete 3d shape Establishment Handle

3.4.3 Concrete Mixing Planning Prepare

Concrete 3D shapes are a vital component in assessing the compressive quality of concrete, a vital parameter in development. The method includes planning, pouring, and curing concrete 3d shapes, which are at that point. This strategy guarantees the basic judgment and quality of the concrete utilized in different development ventures. Let's dig into the nitty gritty steps included in planning the concrete blend.

i. All materials such as cement, sand, stone, paper slime squander, and water are blended into the concrete blending machine agreeing to the rate proportion set.

i. After the blend is altogether blended, a droop test is performed to test the workability of the concrete blend.

iii. The drop in esteem for the slump test is recorded.

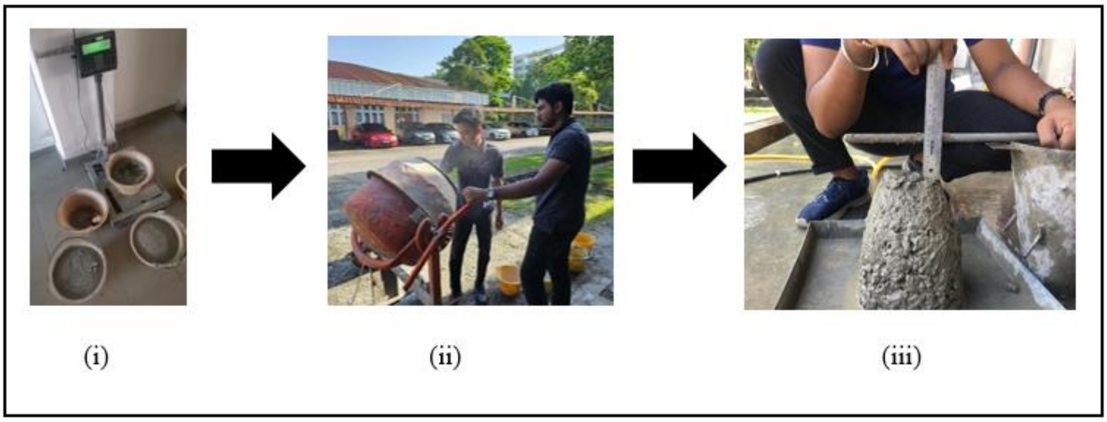

Figure 3.10: Concrete Mixing Planning Prepare

3.4.4 Concrete Casting Prepare

Pouring a concrete 3d shape into a frame of degree 150mmx150mmx150mm is the fundamental handle a few time as of late the test on the 3d shape was carried out. This 3d shape serves as a test standard speaking to the concrete utilized inside the advancement wander. Figure 4.0 appear Concrete Casting Plan.

i. Concrete is poured into the concrete form in 3 layers.

ii. Compacting poles are utilized to compress the concrete blend by 25. affect to diminish discuss voids.

iii. A trowel is utilized to level the surface of the concrete 3d shape.

Iv. Names for each test are joined with paper.

(I) (ii) (iii)

Figure 3.11: Concrete Casting Prepare

3.5 TESTING METHOD

3.5.1 Water Absorbtion Test

This study will use a water absorption test to determine the concrete samples' water absorption capability using BS 1881-122. The process by which water is absorbed is shown in Figure 3.1.

1. Label the concrete sample with the sampling number and the proportion of waste paper sludge.
2. The concrete is weighed while it is dry using an electronic weighing device.
3. Every sample that is weighed shall be noted.
4. A container with water in it is filled to a height of 150 mm above the tank's surface. As soon as the concrete is submerged in water and left for a full day, the time is recorded.
5. The concrete is removed after 24 hours, cleaned with a cloth, and left for a short while.
6. The concrete will be weighed after being left, and its weight will be noted to calculate an average weight and use equation 3.1 to ascertain the concrete's percentage of water absorption.

$$absorbate = \frac{100\ (mw - md)}{md}$$

Where,

mw: mass wet concrete, g

md: mass dry concrete, g

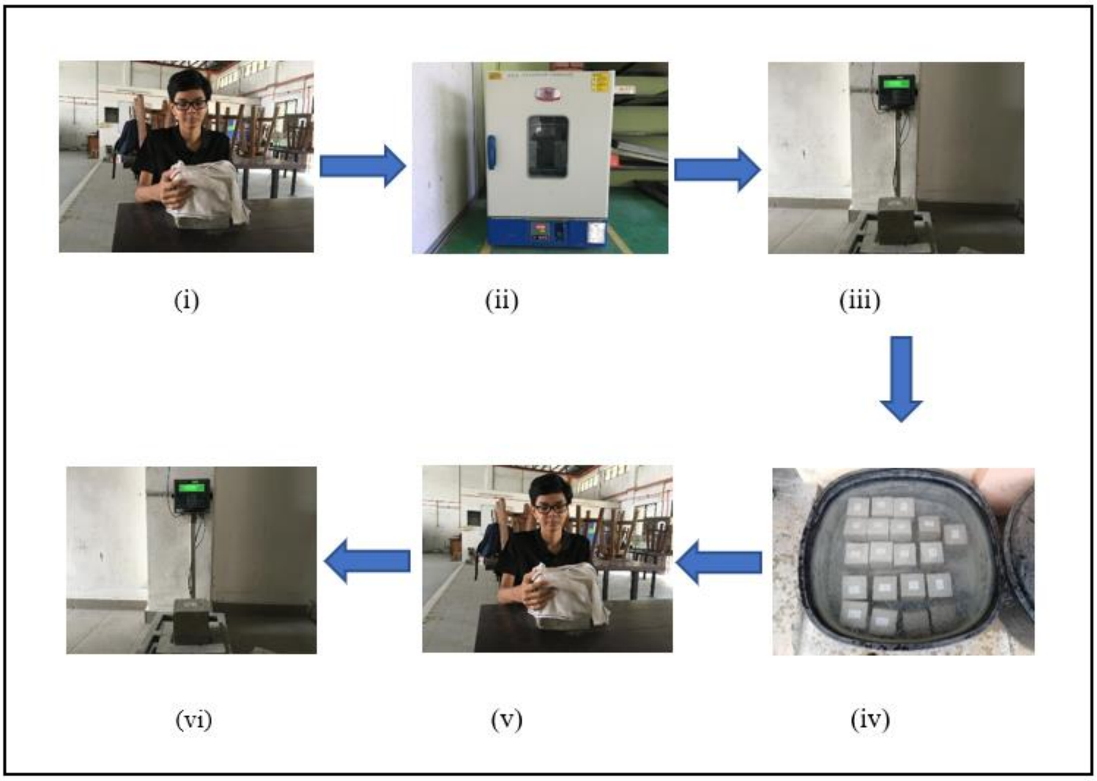

Figure 3.12: Water Absorption Test

3.5.2 Compressive Strength Test

The compressive strength test will be performed by the research using the EN 12390-3:2012 compaction testing apparatus. Three cubic specimens, each measuring 150 x 150 x 150 mm, will be tested, and average values for each batch of combination will be determined. Figure 4.0 shows Compressive strength testing.

The cubic specimens were dried in an oven for twenty-four hours before testing started. Before testing, the specimen's dimensions were measured to determine its cross-sectional area. The test was then started at the specified loading rate and continued until the test specimen failed and surface fractures appeared. To determine the test specimen's compressive strength, the greatest force it underwent was recorded.

$$fc = \frac{P}{A}$$

Where

fc= compressive strength, MPa

P= maximum load sustained by the specimen, N

A=cross sectional area of the specimen to which load applied, mm2

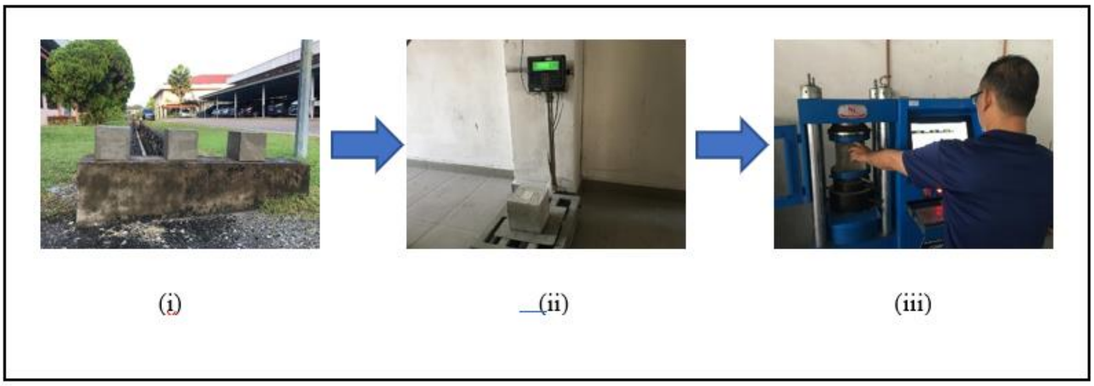

Figure 4.0: Compressive strength testing

3.6 CONCLUSION

In summary, on days 7 and 28, a compressive strength test will be conducted using concrete grade M15 with a ratio of 1:2:4 and containing 0%, 6%, and 9% wastepaper sludge. After the concrete has cured, a water absorption test will be conducted on day 28.

CHAPTER 4

EXPECTED OUTCOMES

4.1 RESULT TESTING EXPECTATION

The information and discoveries made after the concrete has cured for seven and twenty-eight days will be the most important points of this chapter. After compression and water retention tests, this information was accumulated. The show think about will utilize a tabular and graphical representation to demonstrate the varieties in surrender coming about from the 1:2:4 proportion of squandered paper slime to concrete. Three percent, six percent, and nine percent of the squander slime is substituted with fine total. This consideration points to find out the concrete's quality when squandered paper slime is substituted for a few of the fine totals. The reason for this ponder is additionally to find out the comes about of the water retention test once the concrete has cured for 28 days. As seen in Chapter 3, 36 concrete 3d shapes were made, each measuring 150 mm by 150 mm by 150 mm. Sultan Salahuddin Abdul Aziz Shah Polytechnic's Concrete Research facility conducts testing on compressive quality.

4.2 COMPRESSIVE STRENGTH TEST RESULTS AFTER 7 DAYS

Table 4.1: Compression test for 7 days of curing

WasteSludge ContaminatedPaper (%)	**Result(N/mm2) Avg**			**Average(N/mm2)**
	1	2	3	
0	22.2	22.1	23.0	22.4
3	14.7	14.3	14.9	14.6
6	13.4	13.0	14.9	13.8
9	10.2	10.7	10.9	10.6

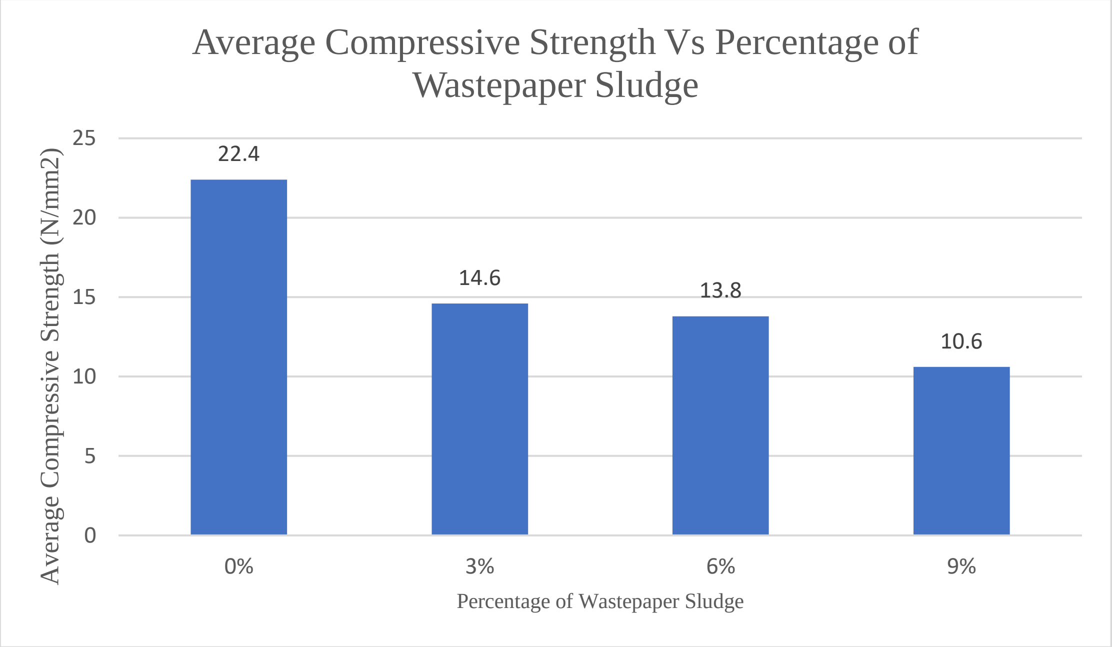

Figure 4.1: Compression test for 7 days of curing

The purpose of a compression test is to evaluate the strength of concrete under stress on a specimen. A compression test is performed on three concrete cubes to determine the strength's average value. The data for the concrete compression test, broken down by the proportion of sand substituted for sludge waste paper in cases where preservation is difficult for seven days, are displayed in Table 4.1. The average compressive strength measured for 0% waste paper sludge is 22.4 N/mm2. The average compressive strength measured for the 3% paper sludge residue was 14.6 N/mm2. Next, it is 13.8 N/mm2 for 6% paper sludge waste. In the end, 10.6 N/mm2 of compressive strength was obtained for 9% paper sludge waste. The research indicates that when waste paper sludge is put into concrete, the proportion of concrete that has compressive strength decreases. The table shows that the highest compressive strength for concrete that has been left for seven days is achieved when paper sludge waste is not substituted as fine aggregate. Chart 4.1 indicates that there is a statically declining concrete strength. In conclusion, after seven days of curing, every specimen met the minimal criteria for compressive strength, which is 10N/mm2.

4.3 COMPRESSIVE STRENGTH TEST RESULTS AFTER 28 DAYS

Table 4.2 : Compression test for 28 days of curing

Wastepaper Sludge (%)	Reading (N/mm2)			Average (N/mm2)
	1	2	3	
0	26.8	25.4	27.9	26.7
3	17.7	15.7	18.7	17.4
6	18.4	17.8	19.8	18.7
9	16.3	14.0	15.1	15.1

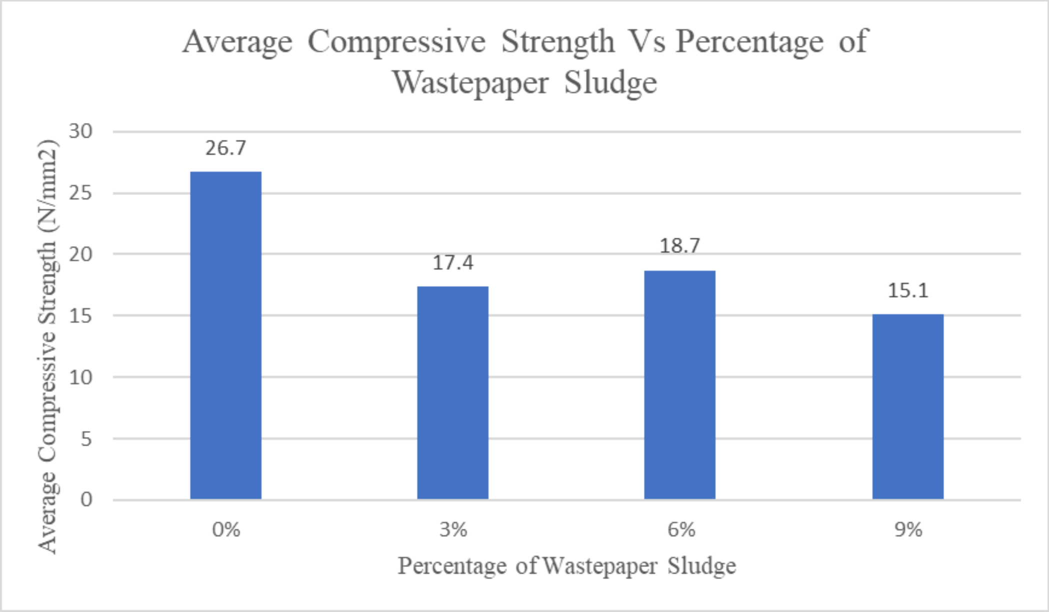

Figure 4.2: Compression test for 28 days of curing

The purpose of the compression test is to evaluate the strength of the concrete under applied loads. Three cubes are usually used to calculate the average strength. Data from a concrete compression test measuring the proportion of wastepaper sludge replacing sand and analyzing its effect on concrete strength over 28 days are shown in Table 4.3.1. Notably, at 0% wastepaper sludge, the average compressive strength is 26.7 N/mm^3; at 3% sludge, it drops to 17.4 N/mm^2; at 6%, it rises to 18.7 N/mm^2; and at 9% sludge, it drops to 10.6 N/mm^2. This data shows a tendency of varying concrete strength as the amount of wastepaper sludge increases. The data shows that 0% wastepaper sludge yields the highest 28-day compressive strength. The average compressive strength test results' wavy trend is graphically represented by the graph in Chart 4.3.1. All of the specimens ultimately demonstrated how wastepaper sludge affects concrete strength by meeting the minimum 28-day compressive strength criterion of 10 N/mm^2.

4.4 RESULTS OF THE WATER ABSORPTION TEST AFTER A 28-DAY CURE

Table 4.3: Water absorption test for 28 days of curing

Wastepaper Sludge (%)	Mass (kg)		Water Absorption Rate (%)
	Wet	Dry	
0	6.97	6.87	1.46
3	7.04	6.92	1.73
6	6.73	6.63	1.51
9	6.74	6.62	1.81

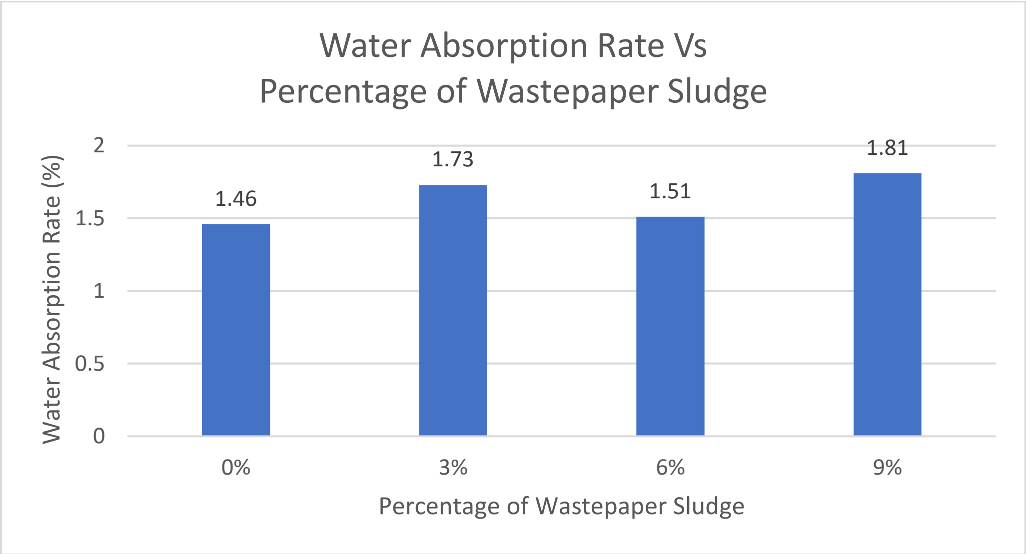

Figure 4.3: Water absorption test for 28 days of curing

The purpose of the Water Absorption Rate test is to measure the quantity of water absorbed under certain circumstances. Three cubes are usually used to get the average percentage rate. To determine the quantity of water absorbed for 28 days, Table 4.3.1 displays results from a water absorption test based on the proportion of wastepaper sludge replacing sand. The water absorption rate at zero percent wastepaper sludge is remarkably low at 1.46%. It rises to 1.73% at 3%, falls to 1.51% at 6%, and then rises again to 1.81% at 9%. The data shows that when the amount of wastepaper sludge grows, the rate at which water is absorbed varies. The chart shows that the maximum 28-day water absorption rate may be achieved by replacing 9% of the wastepaper sludge. Additionally, Chart 4.2.1 graphically illustrates the fluctuating pattern of a greater water absorption rate with a larger sludge content.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This subject will overview the request that has been done and the information that has been shown in Chapter 4. This examination centers on the utilization of wastepaper sludge as a fragmentary substitute for sand in concrete. In extension, this chapter will look at the around of the wander and choose whether wastepaper sludge is fitting for utilization inside the improvement fragment. After the examination and conversation around in Chapter 4, this portion will look at the proposals that can be highlighted in association with this consideration.

5.2 CONCLUSION

In conclusion, based on this study, the objective of comparing the compressive strength and water absorption rate of traditional concrete and concrete with wastepaper sludge residue has been achieved. The highest compressive strength for concrete containing wastepaper sludge residue is the 6% specimen with a strength of 18.7 N/mm2. As for the water absorption rate, the 6% specimen has the lowest water absorption rate which is 1.51%. However, traditional concrete is better than concrete containing paper sludge waste where the compressive strength is 26.7N/mm2 and the water absorption rate is 1.46%. In this study, the advantage obtained is to be able to produce building materials based on green technology because of the reuse of waste materials from the factory, which is wastepaper sludge. This can reduce waste disposal activities thus maintaining the sustainability of the environment.

5.3 RECOMMENDATION

After completing this ponder, a few proposals can be highlighted on the off chance that they think about wastepaper sludge proceeds in the future. First, utilize added substances within the generation of wastepaper sludge concrete to get the maximum compressive quality comes about. In expansion, it is additionally anticipated that analysts will be encouraged to ponder the effect on the environment on the off chance that concrete based on wastepaper sludge is created.

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ATTACHMENT 1

RAW TEST DATA

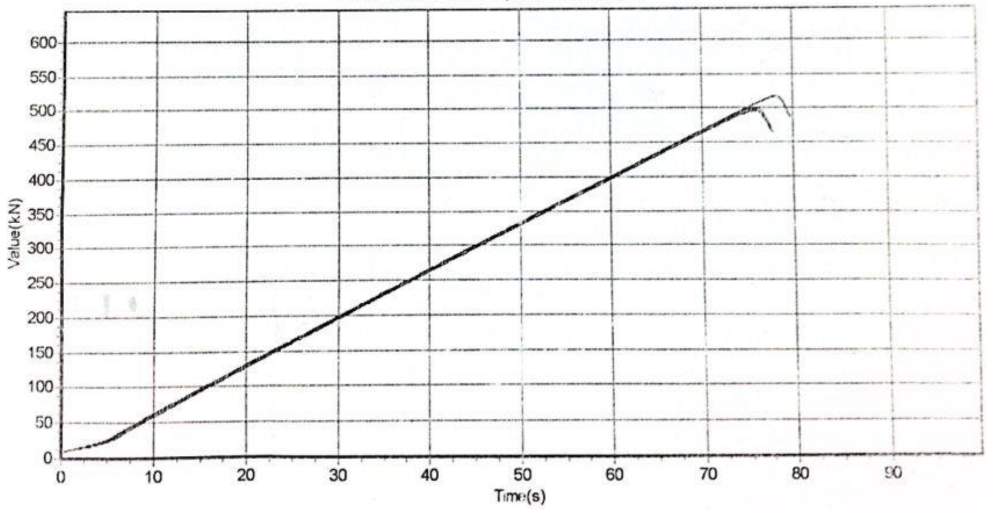
Concrete Compress Report

Test Num : 91 Test Date : 2024-03-05

sufi	FYP 2	AVG WGT	6.93kg
day	7	CONTROL	0%
		K1	6.86KG
		K2	6.97KG
		K3	6.95KG
Specification(mm*mm*mm)	150.0*150.0*150.0	Strength level	C15

Area(mm*mm)	Days	1		2		3		Value(kN)	Strength(MPa)
		Press	Strength	Press	Strength	Press	Strength		
150.0*150.0	7	500.29	22.2	496.39	22.1	516.61	23.0	504.43	22.4

Concrete CompressGraph



Remark	
Principal	Auditing
Tester : Admin	Print Date : 2024-03-05

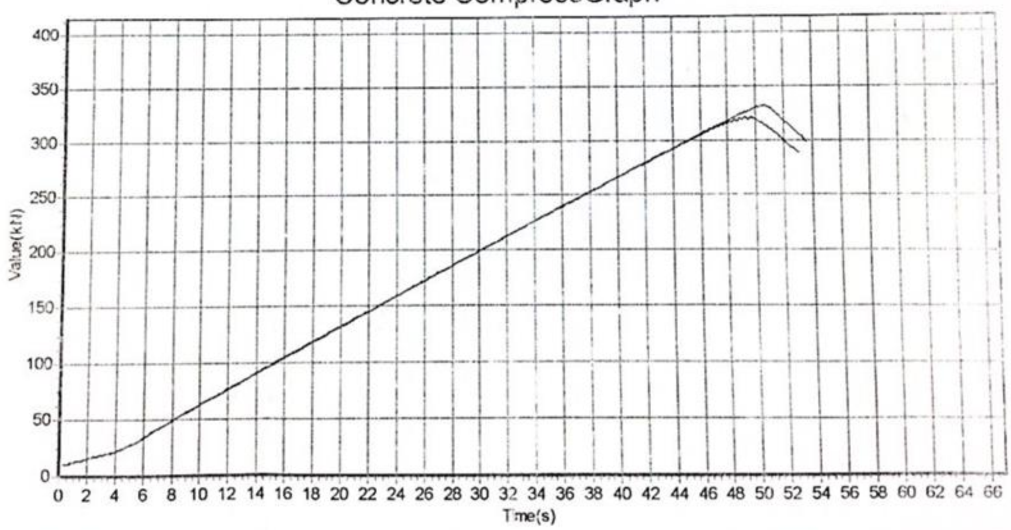
Concrete Compress Report

Test Num : 94 Test Date : 2024-03-11

sufi	FYP 2	AVG WGT	6.79KG
day	7	WPS	3%
		K1	6.71KG
		K2	6.77KG
		K3	6.89KG
Specification(mm*mm*mm)	150.0*150.0*150.0	Strength level	C15

Area(mm*mm)	Days	1		2		3		Value(kN)	Strength(MPa)
		Press	Strength	Press	Strength	Press	Strength		
150.0*150.0	7	331.78	14.7	321.04	14.3	335.98	14.9	326.41 329.6	14.5 14.6

Concrete CompressGraph



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Tester : Admin	Print Date : 2024-03-11

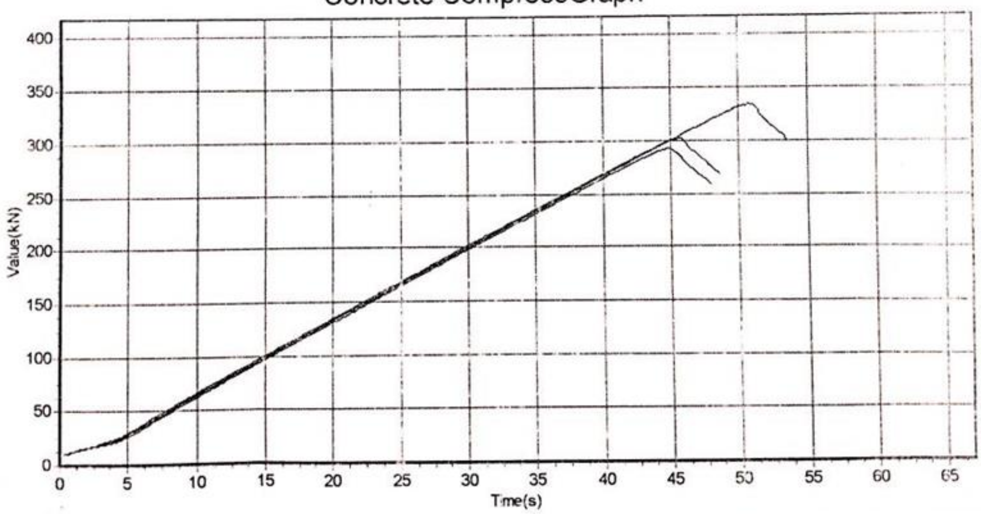
Concrete Compress Report

Test Num : 95　　　　Test Date : 2024-03-11

SUFI	FYP 2	AVG WGT	6.86KG
day	7	WPS	6%
		K1	6.84KG
		K2	6.81KG
		K3	6,94KG
Specification(mm*mm*mm)	150.0*150.0*150.0	Strength level	C15

Area(mm*mm)	Days	1		2		3		Value(kN)	Strength(MPa)
		Press	Strength	Press	Strength	Press	Strength		
150.0*150.0	7	302.33	13.4	292.67	13.0	334.68	14.9	309.89	13.8

Concrete CompressGraph



Remark			
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Tester :	Admin	Print Date :	2024-03-11

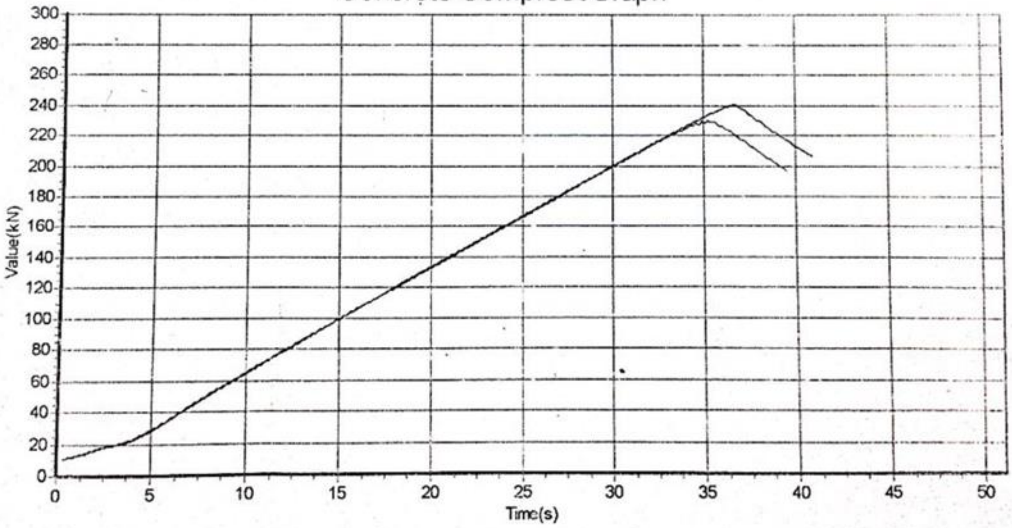
Concrete Compress Report

Test Num : 98　　　　Test Date : 2024-03-15

SUFI	FYP 2	AVG WGT	6.73KG
day	7	WPS	9%
		K1	6.79KG
		K2	6.69KG
		K3	6.72KG
Specification(mm*mm*mm)	150.0*150.0*150.0	Strength level	C15

Area(mm*mm)	Days	1		2		3		Value(kN)	Strength(MPa)
		Press	Strength	Press	Strength	Press	Strength		
150.0*150.0	7	229.98	10.2	240.21	10.7	245.32	10.9	238.50 ~~235.09~~	10.6 ~~10.4~~

Concrete CompressGraph



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Principal	Auditing
Tester : Admin	Print Date : 2024-03-15

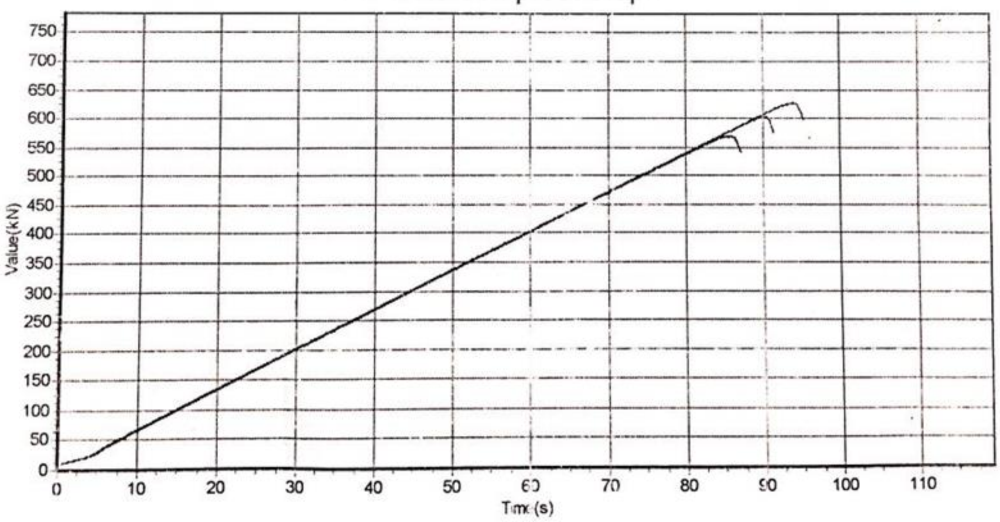
Concrete Compress Report

Test Num : 101 Test Date : 2024-03-25

MEGAT	FYP 2	AVG WGT	7.04KG
day	28	CONTROL	0%
		CUBE 1	6.98KG
		CUBE 2	6.98KG
		CUBE 3	7.15KG
Specification(mm*mm*mm)	150.0*150.0*150.0	Strength level	C15

Area(mm*mm)	Days	1		2		3		Value(kN)	Strength(MPa)
		Press	Strength	Press	Strength	Press	Strength		
150.0*150.0	28	603.54	26.8	570.46	25.4	627.56	27.9	600.52	26.7

Concrete CompressGraph



Remark	
Principal	Auditing
Tester : Admin	Print Date : 2024-03-25

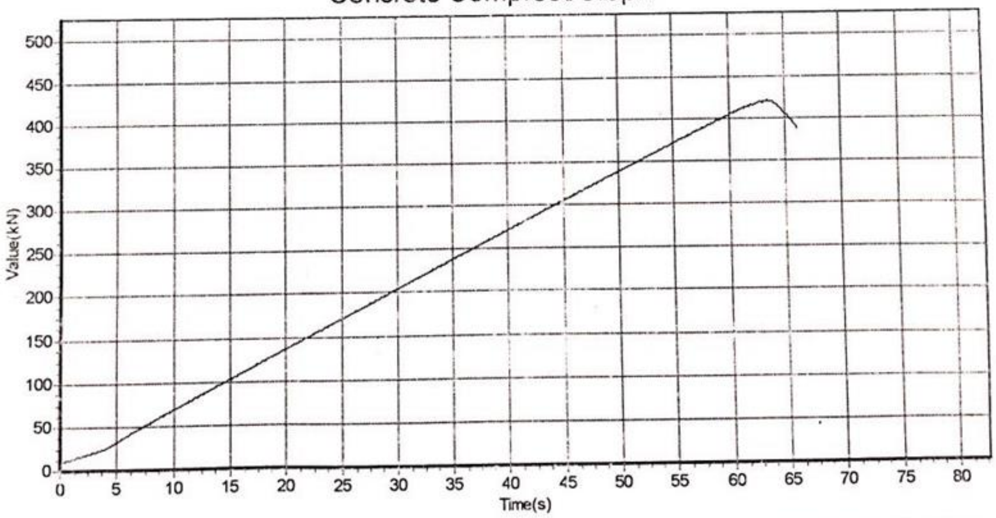
Concrete Compress Report

Test Num : 102 Test Date : 2024-03-29

MEGAT	FYP 2	AVG WGT	6.84KG
day	28	WPS	3%
		CUBE 1	6.84KG
		CUBE 2	6.72KG
		CUBE 3	6.95KG
Specification(mm*mm*mm)	150.0*150.0*150.0	Strength level	C15

Area(mm*mm)	Days	1		2		3		Value(kN)	Strength(MPa)
		Press	Strength	Press	Strength	Press	Strength		
150.0*150.0	28	~~421.03~~ 398.46	~~18.7~~ 17.7	- 352.76	- 15.7	- 421.03	- 18.7	~~421.03~~ 390.75	~~18.7~~ 17.4

Concrete CompressGraph



Remark	
Principal	Auditing
Tester : Admin	Print Date : 2024-03-29

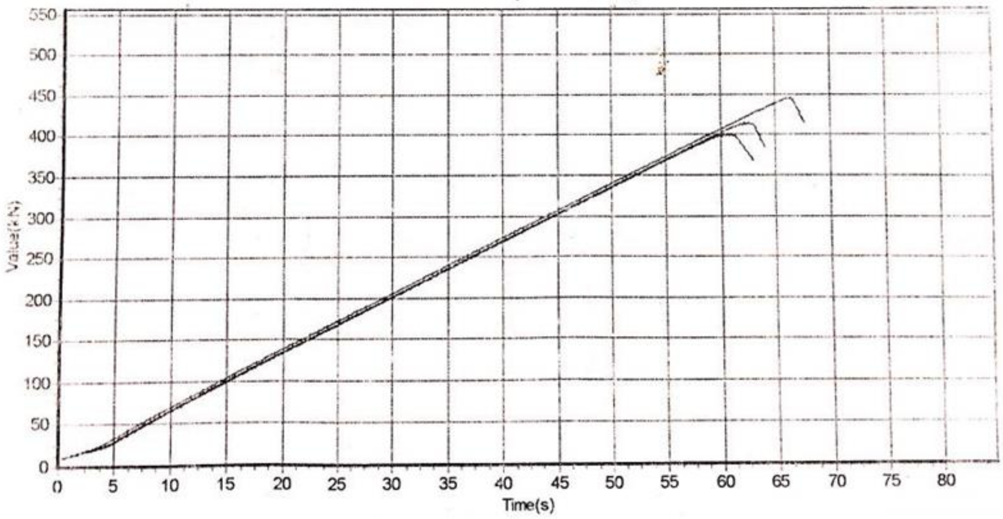
Concrete Compress Report

Test Num : 103 Test Date : 2024-04-01

MEGAT	FYP 2	AVG WGT	7.04KG
day	28	WPS	6%
		CUBE 1	6.98KG
		CUBE 2	6.98KG
		CUBE 3	7.15KG
Specification(mm*mm*mm)	150.0*150.0*150.0	Strength level	C15

Area(mm*mm)	Days	1		2		3		Value(kN)	Strength(MPa)
		Press	Strength	Press	Strength	Press	Strength		
150.0*150.0	28	414.73	18.4	401.50	17.8	445.23	19.8	420.49	18.7

Concrete CompressGraph



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Principal	Auditing
Tester : Admin	Print Date : 2024-04-01

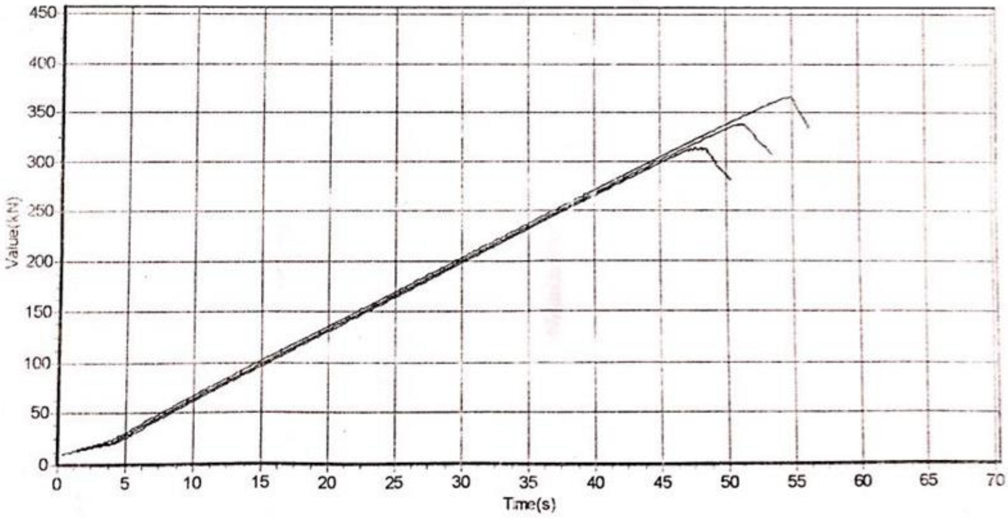
Concrete Compress Report

Test Num : 104 Test Date : 2024-04-05

MEGAT	FYP 2	AVG WGT	6.73KG
day	28	WPS	9%
		CUBE 1	6.73KG
		CUBE 2	6.60KG
		CUBE 3	6.87KG
Specification(mm*mm*mm)	150.0*150.0*150.0	Strength level	C15

Area(mm*mm)	Days	1		2		3		Value(kN)	Strength(MPa)
		Press	Strength	Press	Strength	Press	Strength		
150.0*150.0	28	365.96	16.3	314.23	14.0	338.77	15.1	339.65	15.1

Concrete CompressGraph



Remark	
Principal	Auditing
Tester : Admin	Print Date : 2024-04-05