

PARTIAL REPLACEMENT OF FINE AGGREGATES WITH RECYCLED MATERIALS IN CONCRETE BLOCKS

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in
Civil Engineering
By

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**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of ABISHEK D (Reg No. 39200001) and AMARJEET YADAV (Reg No. 39200005) who carried out the project entitled **"PARTIAL REPLACEMENT OF FINE AGGREGATES WITH RECYCLED MATERIALS IN CONCRETE BLOCKS"** under our supervision from September 2022 to April 2023.

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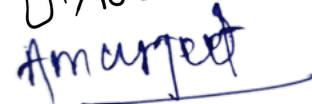
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DECLARATION

We ABISHEK D (Reg. No. 39200001) and AMARJEET YADAV (Reg. No. 39200005) hereby declare that the Project Report entitled “**PARTIAL REPLACEMENT OF FINE AGGREGATES WITH RECYCLED MATERIALS IN CONCRETE BLOCKS**” done by us under the guidance of Mrs. B. PRIYADHARSHINI is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering.

DATE: 13.04.2023

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SIGNATURE OF THE CANDIDATES

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ABSTRACT

The demand of construction materials in the construction industry is increasing day by day. To overcome the material cost and reliability, sustainable waste materials were utilized for the extensive construction works. To make environmentally sustainable, the granite sand collected from Granite industry were used in the current study. In this study, the concrete blocks of M25 grade were casted using the granite sand replacement material to fine aggregate. Coconut fibers were used as layers in concrete blocks to provide insulation from high temperatures. Fine aggregate is replaced with granite sand of 5%, 10%, and 15%. The physical testing of materials (cement, sand, granite powder, coarse aggregate) in concrete blocks were tested after 7 days and 28 days of curing. A comparative study was made for concrete blocks and conventional blocks in terms of strength after 7 days and 28 days of curing. Paraffin wax, a [Phase Change Material] is embedded in the concrete blocks. This PCM significantly reduces the energy required for cooling in the hot season up to 20%, while reducing the energy required for cooling in the cold season up to 10%.

TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE NO
	ABSTRACT	5
	LIST OF SYMBOLS AND ABBREVIATIONS	9
	LIST OF TABLES	10
	LIST OF FIGURES	11
1	INTRODUCTION	13
	1.1 GENERAL	13
	1.2 REUSE OF BUILDING MATERIALS	13
	1.3 PCM	15
	1.4 ECONOMICAL ASPECTS	15
2	LITERATURE SURVEY	16
	2.1 GENERAL	16
	2.2 REVIEW OF THE LITERATURES	16
3	AIM AND SCOPE OF THE STUDY	19
	3.1 AIM OF THE STUDY	19
	3.2 OBJECTIVE OF THE STUDY	19
	3.3 SCOPE OF THE STUDY	19
4	METHODOLOGY AND MATERIALS	20
	4.1 METHODOLOGY	20
	4.2 GRANITE SAND	21
	4.3 M SAND	24
	4.4 CEMENT	27
	4.41 FINENESS OF CEMENT	27
	4.42 SOUNDNESS OF CEMENT	27
	4.43 CONSISTENCY OF CEMENT	27
	4.44 COMPRESSIVE STRENGTH	28
	4.45 SETTING TIME OF CEMENT	28
	4.46 HEAT OF HYDRATION	28
	4.47 LOSS OF IGNITION	28

4.48 BULK DENSITY	29
4.49 SPECIFIC GRAVITY	29
4.50 CHEMICAL PROPERTIES OF CEMENT	29
4.5 COARSE AGGREGATE	31
4.51 SHAPE AND SIZE MATTER	33
4.6 COCONUT FIBERS	34
4.7 PARAFFIN WAX	38
5 EXPERIMENTAL INVESTIGATION	41
5.1 MIX PROPORTION	41
5.2 EXPERIMENTAL STUDY	42
5.3 SLUMP CONE TEST	42
5.4 FACTORS WHICH INFLUENCE THE CONCRETE SLUMP TEST	42
5.5 EQUIPMENTS REQUIRED FOR SLUMP CONE TEST	43
5.6 CASTING AND CURING OF CUBES	44
5.7 CURING OF SPECIMENS	45
5.8 PURPOSE OF CURING	45
6 RESULTS AND CONCLUSION	46
6.1 COMPRESSIVE STRENGTH TEST	46
6.2 COMPRESSIVE STRENGTH OF CUBES	47
6.3 STRENGTH OF CONVENTIONAL CUBES AFTER 7 DAYS	48
6.4 STRENGTH OF GRANITE SAND MIX AFTER 7 DAYS	49
6.5 RESULTS OF CONVENTIONAL CUBES AFTER 28 DAYS	51
6.6 FLEXURAL STRENGTH	53
6.7 FLEXURAL STRENGTH ON BEAM	54
6.8 FLEXURAL STRENGTH TEST RESULTS ON	55

	BEAM	
	6.9 COMPARATIVE STUDY BETWEEN STRENGTH OF RECYCLED MATERIALS THEN NORMAL STRENGTH OF CONCRETE	55
	6.10 COST BENEFIT ANALYSIS	56
7	CONCLUSION	57
	7.1 CONCLUSION	57
	REFERENCES	58

LISTS OF SYMBOLS AND ABBREVIATIONS

EXPANSIONS	ACRONYMS
CALIFORNIA BEARING RATIO	CBR
COARSE AGGREGATE	CA
COHESION	C
COMPRESSIVE STRENGTH	Qu
DEGREE	0
FINE AGGREGATE	FA
INDIAN STANDARDS	IS
KILONEWTON	KN
MINUTES	M
NUMBER OF BLOWS	N
PERCENTAGE	%
SPECIFIC GRAVITY	G
UNIVERSAL TESTING MACHINE	UTM
WATER CEMENT RATIO	W/C
WATER CONTENT	W

LIST OF TABLES

TABLE NO	TITLE	PAGE NO
4.1	GRANITE POWDER PROPERTY	24
4.2	PHYSICAL PROPERTIES OF COCONUT FIBERS	36
4.3	CHEMICAL PROPERTIES OF COCONUT FIBERS	36
5.1	MATERIALS USED IN CONCRETE BLOCKS	41
6.1	STRENGTH OF GRANITE SAND MIX AFTER 7 DAYS	49
6.2	STRENGTH OF GRANITE SAND MIX AFTER 28 DAYS	51
6.3	FLEXURAL STRENGTH OF BEAM	55
6.4	COST BENEFIT ANALYSIS	56

LIST OF FIGURES

FIGURE NO	TITLE	PAGE NO
4.1	METHODOLOGY FLOW CHART	20
4.2	GRANITE SAND	21
4.3	GRANITE PIECES FOR CRUSHING PROCESS	22
4.4	SIEVED GRANITE SAND	23
4.5	M SAND	24
4.6	CEMENT	27
4.7	CEMENT WEIGHED	31
4.8	COARSE AGGREGATE	32
4.9	COCONUT FIBERS	35
4.10	COCONUT FIBERS SEPERATING PROCESS	37
4.11	PARAFFIN WAX	39
5.1	SLUMP CONE TEST	43
5.2	MOULDS	44
5.3	CURING PROCESS	45
6.1	COMPRESSION TESTING MACHINE	46
6.2	CONCRETE BLOCK PLACED	47
6.3	DIFFERENT PERCENTAGES OF GRANITE SAND MIX	48
6.4	COMPARISON STUDY	48
6.5	CONVENTIONAL CONCRETE STRENGTH AFTER 28 DAYS	50
6.6	COMPARISON STUDY BETWEEN NORMAL CONCRETE VS CONVENTIONAL AFTER 28DAYS	50

6.7	STRESS STRAIN CURVE	52
6.8	UNIVERSAL TESTING MACHINE	53
6.9	FLEXURAL STRENGTH	54
6.10	COMPARITIVE STUDY	55

CHAPTER 1

INTRODUCTION

1.1. GENERAL

India is an industrializing nation on the rise. Every day, the population grows, and this trend will continue. These two contribute significantly to the development of numerous types of solid waste, the majority of which is discarded in an indiscriminate manner. These actions have a harmful impact on the ecosystem and the health of several animals. Furthermore, many researchers have made attempts to guarantee that part of these wastes are recycled and used in the creation of different alternative materials as a way of sustainable technology in order to maintain the environment among numerous alternate building materials. The building sector has grown to be a significant consumer of resources as well as a contributor to pollution. Prior to the start of construction, the technical, environmental, and economic viability of alternative systems must be taken into consideration. This is made possible by environmentally integrated production, reuse, and recycling.

1.2 Reuse of Building Materials

The article focuses on reusing building materials as a means of promoting sustainable development and environmental preservation. The utilisation of recycled materials in concrete blocks has expanded in a range of contemporary architectural applications, increasing demand. Construction trash can be salvaged, repurposed, and recycled in a variety of ways to decrease waste and boost revenue. The requirement for process innovation, ongoing improvement, and cost savings in the processes through lower resource and utility costs are all addressed by sustainable development. This article demonstrates that there are alternatives to contemporary building materials.

Aggregates, cementitious materials paste consisting of cementitious materials and water, and concrete are the three main components. Significant challenges exist for the local government in identifying possibilities and recycling waste items. Future manufacturing processes in the construction industry will need to incorporate sustainability, either by using new eco-friendly natural raw

materials and waste products or by assisting in the reduction of CO₂ emissions into the atmosphere. Including waste from a variety of other industrial operations in their manufacturing procedures can aid in achieving this goal. Waste materials come in a wide variety of forms and features, as well as in the uses they may be suitable for. It depends on the waste materials' properties how well they may be used.

One of the main objectives of the building materials and construction sector is to recycle waste materials to protect the environment and consume commodities responsibly. Additionally, this lowers the price of the concrete and does away with the need for new aggregates. Buildings will affect long-term energy use, so new construction should adhere to minimum standards for energy efficiency that are adapted to the environment in the area. Best practices in this area should focus on making the best use of elements that can improve energy performance. The technical, environmental, and economic viability of alternative energy supply systems should be taken into consideration, as their application is typically not explored to its full potential. This can be done once by the Member State, through a study that produces a list of energy conservation measures, for typical local market conditions, meeting cost-effectiveness criteria.

If the measure, or measures, are considered practicable, specific studies may be ordered before building begins. Recycling-friendly building materials can help you cut back on waste, pollution, and energy use. Recycling building and demolition debris has become crucial as the construction industry strives to be sustainable. These ecological practises have been strengthened by the introduction of new building materials made from recycled construction and demolition debris. Since recycled aggregate offers an alternative to conventional natural concrete, its potential to contribute to a sustainable future has been investigated. Experimental studies revealed that the strength of concrete made with recycled material was lower than that made with natural aggregate. Recycling aggregate must be widely employed, and even natural aggregate must be replaced, for the construction industry to be sustainable.

The use of recycle materials in concrete blocks for civil industry purposes is becoming increasingly common due to its more advantageous qualities. In this

study the Granite sand are used as partial replacement of fine aggregates in M-sand. By using this waste materials in construction the river sand and m sand can be reduced. This creates a positive impact on In effectiveness of using coconut fiber as a thermal insulation.

1.3 PCM

Concrete blocks use paraffin wax, a water-resistant substance. Recycling building materials is obvious if you consider the enormous amount of material utilised in construction. Reusing materials lowers the need for new resources, lowers the cost of producing and delivering new materials, and does away with the need to dump waste in landfills. Due to its excellent economics and commitment to environmental protection, recycled aggregate is frequently used in modern engineering. Because reuse needs fewer resources, less energy, and fewer labour hours than recycling, disposal, or the creation of new goods from virgin materials, many reuse programmes have developed from local solid waste reduction targets. Reuse offers a great, environmentally friendly substitute for traditional waste management.

1.4 ECONOMICAL ASPECTS

Reuse has long been a vital strategy for bringing materials to the world's many underprivileged communities. Reuse is still a great way to bring people the food, clothes, supplies they need for their homes and businesses, medical equipment they need, and other things they need. Reuse nevertheless helps the community in other ways. Reusing resources reduces the economic burden compared to producing new items from virgin materials. Green building, also known as sustainable design and construction, is a comprehensive strategy that lessens the building's impact on the environment, requires less upkeep, and gives its occupants a more pleasant place to work. The full experimental study on recycled aggregate with various stable strengths mixed quickly by the suggested method is presented in this chapter.

CHAPTER 2

LITERATURE SURVEY

2.1 GENERAL

The following major research project has been taken from international journals as reference to analyze the concepts for the project.

2.2 REVIEW OF THE LITERATURES

Prokopskia et al. (2022) conducted research on the partial replacement of sand with granite powder. The average density of concrete rises as a result of the inclusion of granite dust. The primary factor contributing to the strength increase of concrete with dust is the partial substitution of sand with dust, which results in the collection of the microstructure of the cement matrix. Concrete's early and grade strength are both improved by granite dust.

Kishan Jain and Gaurav Sancheti(2021) conducted research on the slump value of concrete with granite powder. The proper transportation and placement of concrete are governed by the slump. It refers to how easily the concrete can be worked. The elements are the primary factor causing the decline. While cement sand and aggregates are made more workable by water and plasticizers.

G. Anusha et al.(2021) investigated the experimental examination of concrete paver block qualities using granite powder in place of cement. The marble and granite industries recently expanded. India continuously generates more than 3500 cubic metres of leftover granite powder slag. Granite Powder is frequently created by granite tile makers. A significant issue is the absence of granite fines from the polishing sector.

Habibunisa syed and Ruben Nerella Sri Ramachand Maduru(2020) studied about the Role of coconut coir fibers in concrete Along with the progressive impact on the environment, construction costs rise. Coconut fibres are widely available at the test location, making them a relatively viable option for use as reinforcing components in concrete. Comparing concrete with various fibre contents to conventional concrete or prestressed concrete was done.

Coconut fibres vary between 0.6% and 1% of their total weight depending on several strength parameters like bending, tensile, and compressive strength.

Molkani pavan kumar and Chandrakala(2019) had studied about on the basis of Concrete by partial replacement of fine aggregates with waste granite powder Concrete is the main construction materials in the world. River sand is becoming a scarce commodity and hence an exploitation alternative to it has become imminent. In the present study the detailed characteristic studies of concrete is carried out by partial replacement of natural sand by waste granite powder in concrete composition with different composition (5%,10%,20%).

Prajapati Ashruti et.al (2019)The world's construction materials would not be complete without concrete. The behaviour of concrete must be studied. The price of construction goes up as a result. By decreasing that, we can use the granite powder replacement as a partial replacement in concrete.

Joseph Iwaro and Abrahams Mwash(2019) Masonry walls with coconut fibre insulation for thermal comfort The advantages of insulating outside walls are practised in many tropical nations. In order to promote energy efficiency and thermal comfort in buildings, coconut fibre, a byproduct of other industries, can be utilised as thermal insulation in masonry walls.

Smt. K. Chandrakala and Molkani Pavan Kumar (2019) Concrete with waste granite powder used to partially replace the fine aggregates The world's primary building material is concrete. Since river sand is becoming a more limited resource, a replacement to it is soon to be developed. In the current study, concrete compositions with varying compositions (0%, 10%, and 20%) were used to carry out extensive characteristic studies by partially substituting waste granite powder for natural sand.

P Vinod Kumar Naidu and Ajay M Nair (2018) conducted research on the phase change analysis of paraffin wax.A straightforward and affordable experimental setup made consisting of a solar parabolic concentrator, a hot water bath, a water pump, a test section, insulating boxes, a T type thermocouple, and a data gathering system has been built to examine the performance of paraffin wax.

John kevern and Rosicky Methode Kalombe(2020) had studied about the Low- cost phase change materials (paraffin wax) based concrete for curing In this study, a low-cost aggregate for thermal energy storage was made using a variety of organic phase-change compounds with features that make it appropriate for storing heat under freezing conditions. So, for cold climates, paraffin wax offers a viable and appropriate solution.

IP.Shehdeh Ghannama et.al (2016) had studied about the Experimental study of concrete made with granite and iron powders as partial replacement of sand Granite Powder (GP) and Iron Powder (IP) are industrial byproducts generated from the granite polishing and milling industry in powder form respectively.Iron Powder (IP) and Granite Powder (GP), which are produced as powdered byproducts of the granite milling and polishing industries, respectively. These byproducts are mainly wasted and pose a risk to human health because they are easily inhaled and airborne.

Danny Santoso Mintorogo et al. in (2015) The use of coconut fibre as an exterior eco-insulation to reduce solar heat radiation on a horizontal concrete roof was researched by Numerous rows of two- to three-story buildings housing offices and shops have been constructed in the central business district as a result of modern architecture concepts and the economy's rapid growth. The rooftops of those structures are made of flat, naked, uninsulated concrete.

Madduru Sri Rama Chand et al.(2014) explored the use of paraffin wax as an internal curing agent in regular concrete. Concrete that has been properly cured is more durable, harder on the surface, and less porous.When compared to conventional curing, self-curing chemicals can increase the water retention capacity of concrete and decrease water evaporation

P.Sundar,M.J et.al had studied about the (2010)Recycling of wastes for value-added applications in concrete blocks. The use of waste materials as an aggregate replacement in concrete blocks has the advantageous environmental consequences of lowering the consumption of natural resources typically used as aggregates and reducing current solid waste.

CHAPTER 3

AIM AND SCOPE OF THE STUDY

3.1 AIM OF THE STUDY

The aim of the study was described below,

Investigate the strength of partial replacement of fine aggregates with recycled materials in concrete blocks.

3.2 OBJECTIVE OF THE STUDY

- I. To determine the compressive strength of the cubes when using the fine aggregate partially by 5%,10% AND 15%..
- II. To determine the flexural strength of the material.
- III. Comparative study when using recycled materials in blocks than conventional methods.

3.3 SCOPE OF THE STUDY

Using Recycled materials in concrete blocks which is suitable for use at various construction purposes. It is reliable as natural aggregate and safe to use. Reduced cost by using granite powder as fine aggregate. Coconut fibres as natural fibres in concrete blocks for thermal insulation.

CHAPTER 4

METHODOLOGY AND MATERIALS

4.1 METHODOLOGY

The methodology of the experimental study using partial replacement of granite sand and recycled material is shown in the flowchart give below in fig 4.1

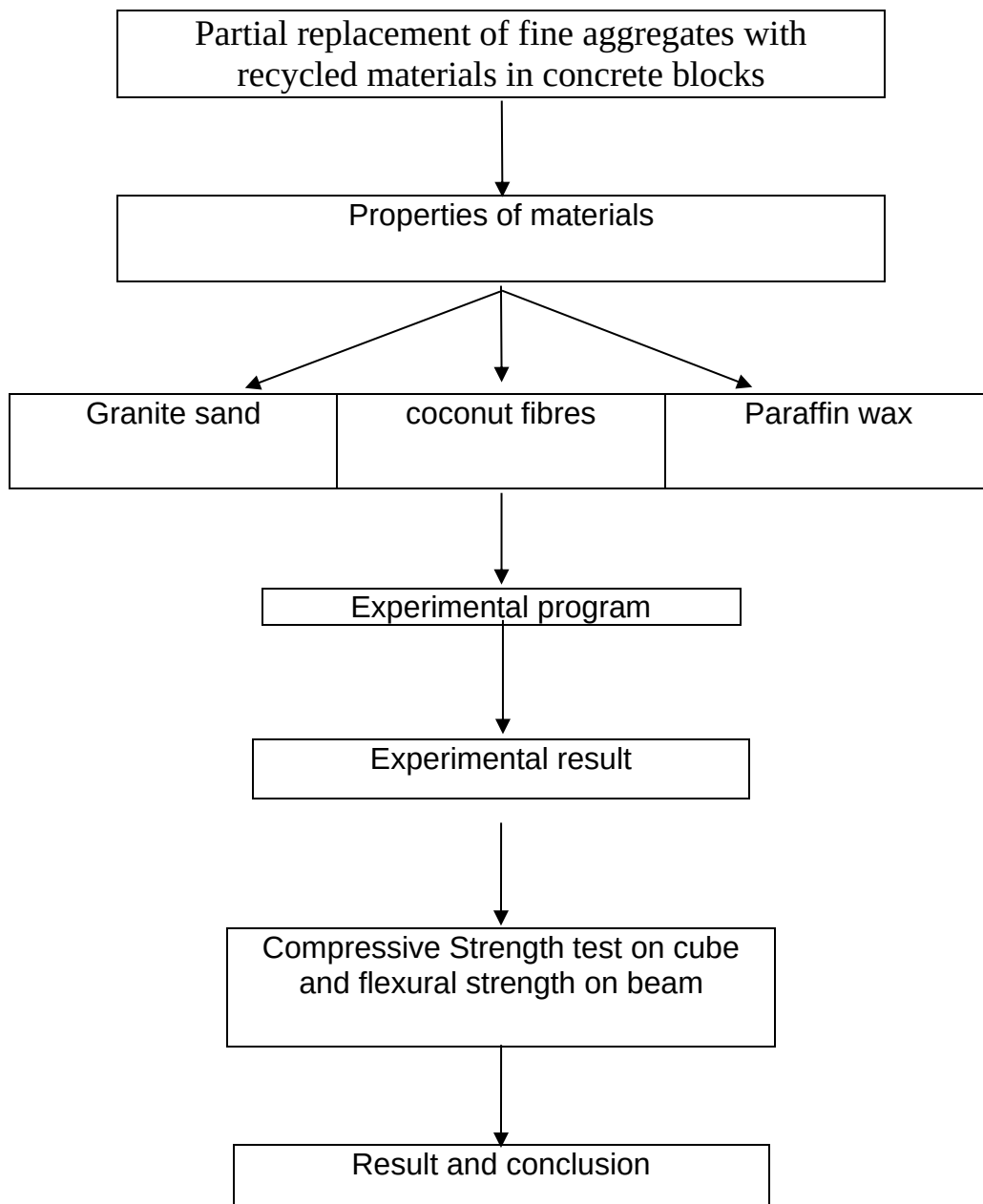


Figure 4.1: Methodology Flow Chart

4.2 GRANITE SAND

Granite is a typical rock type and a fantastic illustration of how sand is formed. Pink and white feldspar, which makes up granite, undergoes chemical breakdown to become other substances. Quartz (grey), another essential component of granite, is present. Quartz has a high chemical weathering resistance. It doesn't change into another mineral at all. That is how quartz will remain. Though very slowly, it ultimately moves into solutions. As a result, the quartz grains produced by disintegrating granite will primarily be carried by running water in the form of sand grains.



Figure 4.2 Granite sand

Here is a photo of a sand sample made of disintegrated granite. It is made of of feldspar and angular quartz grains. A major indication that this sand sample has not been moved far from its source region and that the climate cannot be humid and hot is the quantity of feldspar and the angularity of the grain. Sand is a byproduct of previously extant rocks. Therefore, it is made up of minerals that were present in the rocks before to the start of the disintegration.

There is one crucial factor, though: Sand is found in a hostile environment where only the strongest survive. the ones that are most resilient to weathering. One of these minerals is quartz. Because it is so common, it predominates in most sand

samples. It makes around 12% of the crust. Quartz is only exceeded in abundance by feldspars. Tourmaline, zircon, rutile, and other relatively uncommon minerals are all exceedingly resistant to weathering, but they rarely make up more than a small percentage of sand's mineral makeup. These minerals are referred to as heavy minerals as a group. Sand occasionally may have larger quantities of heavy minerals. Typically, hydrodynamic sorting produces this. River currents or sea waves separate heavier grains from lighter ones. Placers are such occurrences, and they are frequently exploited as a reliable source of minerals. When granite boulders are crushed or chopped, granite powder is the waste product. Granite powder waste deposits have grown recently as a result of the considerable growth of the stitching business, despite the fact that this material is now underutilized.



Figure 4.3 Granite pieces for crushing process

Waste made of granite powder is now a dangerous environmental issue. This problem's potential solutions are currently being investigated. There have been attempts to use waste granite powder as an additive in cementitious mixes for a number of years, and there are increasingly more studies being done on cementitious mixes that contain this additive. There is also research being done on the partial replacement of fine aggregate in cementitious mortars. They claimed that adding granite powder to mortars increased their compressive strength.

River sand is the fine material that is utilised the most frequently worldwide. Due to the high expense of transportation from natural sources and the challenges caused by widespread resource depletion, river sand is expensive.

The availability and use of river sand are less desirable as a replacement for granite sand from the granite industry due to transportation alternatives, environmental restrictions, and other factors. Granite dust is a byproduct of the stone-cutting and stone-grinding processes. The granite bits left over after the manufacturing process is complete are regarded as garbage.



Figure 4.4 Sieved Granite sand

by minimising the trash generated by the stone chunks. The granite dust has a rough, crystalline surface texture and is made up of uneven, angular, and porous particles. The size of the particles is almost identical to fine sand. It can be machine-crushed, sieved in accordance with sand ratio, and utilised as a partial replacement for sand. A product as practical as fine aggregate for concrete. The primary parameter examined in the study is M25 grade concrete with sand replacements of 5%, 10%, and 15% by granite sand.

According to test results, using granite sand and aggregates has improved the performance of concrete in terms of strength and durability

Table 4.1 Granite powder property

SL.NO	PROPERTY	VALUES
1	Specific gravity	2.6 – 2.8
2	Bulk density	2500-2650kg/m ³
3	Fineness modulus	2.43

4.3 M SAND

M Sand's full name is Crushed sand and made fine aggregate are other names for manufactured sand. M-Sand can be used in place of river sand for making concrete. Rocks, quarry stones, or bigger aggregate pieces are crushed into sand-size particles in a plant or quarry to create manufactured sand. The crushed sand is graded, rinsed, and shaped into a cube for use as construction material.



Figure 4.5 M sand

M-Sand is manufactured sand with a particle size of less than 4.75mm. An alternative to river sand is manufactured sand. The ecosystem is harmed when river sand is taken out of the river. The amount of groundwater drops, and the water dries up. Sand from rivers is dragged down, which lowers the water table, and without sand, river water evaporates in full sunshine, making it difficult for tree roots to access water.

Crushed sand is suggested for use. It is an affordable and environmentally friendly substitute for natural sand. All construction-related uses of crushed sand are permitted, with the exception of plaster, waterproofing, and stone bedding. Because of its cubical, angular shape and abrasive texture, crushed sand is preferable for concrete. Although it is made by crushing aggregate and does not contain any silt, occasionally it may contain some dust if screening is not done properly. There is no moisture in it. When it is employed in concrete, the concrete sets up somewhat more quickly. Concrete manufactured using M sand has greater compressive and flexural strengths than concrete made from natural sand.

When compared to river sand, concrete's permeability when utilised in construction is extremely low. Because it is synthetically made, there are no large materials. Compared to river sand, crushed sand has less slump. There are no marine items in it. Crushed sand has a bulk density of 1.75 gm/cm³. Depending on the parent rock, crushed sand has a specific gravity of 2.5 to 2.9. When employing crushed sand in concrete, bulkage adjustment during mix design is not necessary. Crushed sand has an old surface moisture capacity of up to 10%. It is less contaminated than river sand.

It is less contaminated than river sand. Compared to natural sand, it has a less negative impact on the environment. Producing it nearby the construction site is an option. lowering the cost of shipping and guaranteeing a steady supply. For RCC work, brickwork, and blockwork, it is very advised.

More affordable than river sand. About 1000 cubic metres of crushed sand are produced each year. It is accurately graded in the proportion needed for

construction. It doesn't contain an organic substance that is soluble and impacts how quickly cement sets. The accessibility and expense of shipping M-Sand are other justifications for its use. Since manufactured sand can be made by crushing strong granite rocks, it can be easily found nearby, saving on transportation costs from distant river sand beds.

As a result, using synthetic sand as an alternative building material can reduce construction costs. Another benefit of utilising M-Sand is that it may be used dust-free and that its sizes can be readily managed to ensure that it fits the necessary grading for the job at hand. The produced sand is the best sand for use in construction because it has the necessary fines gradation and physical characteristics including form, smooth surface textures, and consistency.

Sand's physical characteristics increase concrete's strength by minimising segregation, bleeding, honeycombing, voids, and capillary action. Thus, the appropriate grade of sand for the specified purpose aids in the concrete's ability to fill spaces left by coarse particles, as well as to become more compact and dense, both of which increase concrete's strength.

4.4 CEMENT

An constituent in concrete and mortar, this powdered mixture of alumina, silica, lime, iron oxide, and magnesium oxide is burned together in a kiln.



Figure 4.6 Cement

4.41 Fineness of Cement

The fineness of cement is determined by the cement's particle size. In the final step of the cement production process, the clinker is ground to the requisite fineness for excellent cement. The fineness of cement is crucial because cement hydration rate and cement particle size are directly correlated.

4.42 Soundness of Cement

The ability of cement to resist shrinking after hardening is referred to as soundness. After setting, high-quality cement maintains its volume without experiencing delayed expansion brought on by too much free lime and magnesia.

4.43 Consistency of Cement

The ability of cement paste to flow is consistency. It is measured by Vicat test. In Vicat Test Cement paste of normal consistency is taken in the Vicat's Apparatus. The plunger of the apparatus is brought down to touch the top surface of the cement. The plunger will penetrate the cement up to a certain depth depending on the consistency.

4.44 Compressive Strength

The most typical strength test is this one. It is necessary to apply a compressive load on a test specimen (50 mm) till failure. Between 20 and 80 seconds must pass throughout the loading process.

4.45 Setting Time of Cement

When water is added, cement sets and becomes harder. The fineness of the cement, the cement-to-water ratio, the chemical composition, and the presence of admixtures can all affect how long it takes for the cement to set. The initial setting time and final setting time of cement used in building shouldn't be excessively low or high. Consequently, two setting times are calculated: **Initial set:** When the paste begins to stiffen noticeably (typically occurs within 30-45 minutes)

- I. **Final set:** When the cement hardens, being able to sustain some load (occurs below 10 hours)

4.46 Heat of Hydration

Hydration is the process that occurs when water is added to cement. Heat is produced during hydration, and this heat can both improve cement quality and help keep the curing temperature constant in cold climates. On the other side, excessive heat generation, particularly in large constructions, may lead to unwelcome stress. The presence of C3S and C3A in cement, as well as the water-cement ratio, fineness, and curing temperature, all have an impact on the heat of hydration. By comparing the dry and partially hydrated cement at the 7th and 28th days, the difference between the two is used to compute the heat of hydration of Portland cement.

4.47 Loss of Ignition

Weight loss occurs when a cement sample is heated between 900 and 1000°C (i.e., until a constant weight is attained). This weight loss while heating is accounted for as ignition loss. Pre-hydration and carbonation can result from improper, extended storage or adulteration during transport or transfer; both of these conditions may be revealed by a rise in ignition loss.

4.48 Bulk density

Water replaces air where it would typically be present when cement and water are combined. Because of this, cement's bulk density is not particularly significant. Depending on the amount of cement composition, cement has a wide variety of densities. Cement can range in density from 62 to 78 pounds per cubic foot.

4.49 Specific Gravity (Relative Density)

Calculations involving mixture proportioning typically use specific gravity. Other forms of cement, such as portland-blast-furnace-slag and portland-pozzolana cement, may have specific gravities of around 2.90. Portland cement has a specific gravity of 3.15.

4.50 Chemical Properties of Cement

The cement is sulfate-resistant due to its low C₃A concentration. Gypsum slows down C₃A's hydration, which releases a lot of heat in the initial stages. No more than a little amount of strength is offered by C₃A. In cement with more than 8% C₃A, type I cement contains up to 3.5% SO₃. When less than 8% C₃A is present, Type II cement contains up to 3% SO₃.

Tricalciumaluminate(C₃A)

Low content of C₃A makes the cement sulfate-resistant. Gypsum reduces the hydration of C₃A, which liberates a lot of heat in the early stages of hydration. C₃A does not provide any more than a little amount of strength. Type I cement: contains up to 3.5% SO₃ (in cement having more than 8% C₃A) Type II cement: contains up to 3% SO₃ (in cement having less than 8% C₃A)

I. Tricalciumsilicate(C₃S)

C₃S causes rapid hydration as well as hardening and is responsible for the cement's early strength gain an initial setting.

II. Dicalciumsilicate (C₂S)

As opposed to tricalcium silicate, which helps early strength gain, dicalcium silicate in cement helps the strength gain after one week.

III. **Ferrite** **(C₄AF)**

Ferrite is a fluxing agent. It reduces the melting temperature of the raw materials in the kiln from 3,000°F to 2,600°F. Though it hydrates rapidly, it does not contribute much to the strength of the cement.

IV. **Magnesia** **(MgO)**

The manufacturing process of Portland cement uses magnesia as a raw material in dry process plants. An excess amount of magnesia may make the cement unsound and expansive, but a little amount of it can add strength to the cement. Production of MgO-based cement also causes less CO₂ emission. All cement is limited to a content of 6% MgO.

V. **Sulphurtrioxide**

Sulfur trioxide in excess amount can make cement unsound.

VI. **Ironoxide/Ferricoxide**

Aside from adding strength and hardness, iron oxide or ferric oxide is mainly responsible for the color of the cement.

VII. **Alkalies**

The cement's alkali content is determined by the proportions of sodium oxide (Na₂O) and potassium oxide (K₂O). It can be challenging to control the setting time of cement when it contains high levels of alkali. Concrete that contains calcium chloride and low alkali cement may discolour. Ground granulated blast furnace slag in slag-lime cement must be "activated" by the addition of alkalis in order to become hydraulic. The formula $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ yields a limit for the total alkali content of 0.60% that is optional.

VIII. **Freelime**

Free lime, which is sometimes present in cement, may cause expansion.

IX. **Silicafumes**

In order to enhance a number of qualities, particularly compressive strength, abrasion resistance, and bond strength, silica fume is added to cement concrete. The inclusion of silica fume can provide unusually high strength, despite the fact that setting time is prolonged. As a result, Portland cement projects that demand high strength typically use Portland cement that contains 5-20% silica fume.

x. **Alumina**

Due to the fact that alumina is chemically resistant, cement with a high alumina content may endure extremely cold temperatures. Additionally, it accelerates setting while weakening cement.



Fig 4.7 cement weighed

The cement known as Ordinary Portland Cement (OPC) is produced and used all over the world. For all uses, including concrete, it is frequently used. Concrete, which is commonly used, is created when OPC is combined with aggregates and water.

4.5 COARSE AGGREGATE

In addition to water and portland cement, aggregates are inert granular materials like sand, gravel, or crushed stone that are a necessary component of concrete. Aggregates must be free of absorbed chemicals, clay coatings, and other fine contaminants that could cause concrete to degrade in order to make a suitable concrete mix. The two different kinds of aggregates, fine and coarse, make up 60 to 75 percent of the total volume of concrete. The majority of the particles in fine aggregates typically pass through a 3/8-inch filter and are often made of natural sand or crushed stone. Any particle larger than 0.19 inches is considered a coarse aggregate, which typically has a diameter between 3/8 and 1.5 inches. The majority of the coarse aggregate used in concrete is made up of gravel, while the majority of the remaining material is crushed stone. Natural

gravel and sand are typically extracted by digging or dredging from a pit, river, lake, or ocean floor. The process of crushing quarry rock, boulders, cobbles, or big gravel results in crushed aggregate. Recycled concrete is a practical supply of aggregate and has been successfully utilised in new concrete, soil-cement, and granular subbases.



Figure 4.8 Coarse aggregate

Aggregate is processed after harvesting, including crushing, screening, and washing to ensure optimum cleanliness and gradation. If more improvement is required, a benefaction procedure like jigging or heavy media separation can be performed. The aggregates are handled and stored after processing to reduce segregation, deterioration, and contamination. The qualities of freshly mixed and hardened concrete, mixture ratios, and economy are all significantly influenced by aggregates. As a result, choosing aggregates is a crucial task. Although some variance in aggregate attributes is anticipated, the following factors are taken into account:

- I. Grading
- II. durability
- III. particle shape and surface texture
- IV. abrasion and skid resistance
- V. unit weights and voids

VI. absorption and surface moisture

Grading is the process of figuring out how big the aggregate's particles will be. Grading restrictions and the maximum size of the aggregate are listed since they have an impact on the quantity of aggregate used, as well as the amount of cement and water needed, as well as the workability, pumpability, and durability of concrete. In general, a wide range of grading can be utilised without significantly affecting strength if the water-cement ratio is adjusted correctly. Certain aggregate particle sizes are excluded from the size continuum when gap-graded aggregate is specified. To achieve homogeneous textures in exposed aggregate concrete, gap-graded aggregate is used. To prevent segregation, the mix proportions must be closely regulated.

4.51 Shape and Size Matter

More so than the qualities of cured concrete, the properties of freshly mixed concrete are influenced by particle shape and surface roughness. To generate workable concrete, rough-textured, angular, and elongated particles need more water than smooth, rounded compact aggregate. To keep the water-cement ratio constant, the cement content must also be raised. In general, flat and elongated particles should be avoided or kept to no more than 15% of the aggregate weight. The volume that graded aggregate and the spaces between them will occupy in concrete is measured by unit-weight. The amount of cement paste needed for the mix depends on how much space there is between the particles. Aggregates with angles raise the void content. Improved grading and larger sizes of well-graded aggregate reduce the void content. The internal structure of aggregate is composed of solid material and spaces that may or may not contain water, therefore absorption and surface moisture are examined while choosing aggregate. The water content of the concrete mixture must be changed to account for the aggregate's moisture levels.

When an aggregate is used in concrete that is frequently susceptible to abrasion, such as in heavy-duty floors or pavements, abrasion and skid resistance are crucial. Different aggregate minerals polish and wear at various rates. In severely abrasive environments, harder aggregate might be chosen to

reduce wear. Coarse aggregate is a term used in construction to describe a type of material that is commonly used in the production of concrete. It is typically made up of various materials such as gravel, crushed stone, and recycled concrete. It works in combination with cement and fine aggregate to create a strong and durable concrete mixture that can withstand various environmental and physical stresses. In contrast to hand-broken aggregates, which only contain one size of stone, machine-crushed aggregates are made of stones of varied sizes.

Although there are many different ingredients or components used to make concrete mix, coarse aggregates account for the majority of the mix's volume and are one of its key constituents. In most cases, the aggregates are obtained through blasting at stone quarries, breaking by hand, or using crusher equipment. In contrast to hand-broken aggregates, which only contain one size of stone, machine-crushed aggregates are made of stones of varied sizes. The term "coarse aggregate" refers to materials whose maximum size can be up to 63 mm and are large enough to be retained on a 4.75 mm sieve size. Coal, lignite, soft pieces, and clay lumps should not make up more than 5% of the total weight of coarse aggregate. The following criteria must be present in and met by the aggregates used in building construction. The grade of the concrete is influenced by the quality of the concrete used in its production. To withstand crushing, aggregate needs to be robust and tough.

Concrete must contain durable aggregates. Concrete coarse aggregates should be chemically inert. They shouldn't have a lot of angular, pointy, or hard particles in them. Water absorption in aggregates shouldn't be higher than 5% of their real weight. They ought to be porous and delicate in texture. The appropriate coarse aggregate size should allow it to pass through an IS 63 mm sieve while remaining on an IS 4.75 mm sieve.

4.6 COCONUT FIBERS

Coconut fibre, which is obtained from the husk of the coconut fruit, is one of the natural fibres that are widely available in tropical areas. Additionally known as coir fibre. The outer shell of a coconut is where coconut fibre is found. Respectively. Approximately 500 000 tonnes of coconut fibre are produced

annually worldwide, according to the official website of the 2009 International Year for Natural Fibres. Ripe coconuts that have fallen from the tree can easily be picked up. The coconut seed's outer layers are treated and spun into fibres known as coir.

Retting is a form of curing in which the husks are maintained in a setting that promotes the growth of naturally existing bacteria.



Figure 4.9 coconut fiber

This process causes the husk's pulp to partially degrade, allowing the coir fibres and a byproduct known as coir pith to be extracted from it. Green coconut husks are retted in saltwater, while fully mature coconut husks are retted in freshwater.

Hemp, coir, ramie, and jute are examples of natural fibres with mechanical characteristics including density, elongation at break, strain, and failure that are comparable to some synthetic fibres. When tensile stresses are applied, cementitious concrete might become weaker but remain robust under compressive loads.

Different kinds of fibres can be incorporated into the concrete to increase its tensile strength. One of the natural fibres utilised in the creation of durable and high-strength products is coconut fibre (coir).

The table 4.2 below provides an explanation of the physical characteristics of coconut fibres, including their length, density, tenacity, break elongation, diameter, rigidity of modulus, swelling in water, and moisture content.

Table 4.2 physical properties of coconut fibers

Physical Properties	Range
Length in inches	6-8
Density (g/cc)	1.40
Tenacity (g/Tax)	10.0
Breaking elongation%	30%
Diameter in mm	0.1-1.5
Rigidity of Modulus	1.8924
Swelling in water (diameter)	5%
Moisture at 65% RH	10.50%

The chemical properties of the coconut fibers including lignin, cellulose, Hemi cellulose, pectin related content, water soluble, ash are explained in the below table 4.3

Table 4.3 chemical properties of coconut fibers

CHEMICAL PROPERTIES	RANGE
Lignin	45.84%
Cellulose	43.44%
Hemi-Cellulose	00.25%
Pectin's and related Compound	03.00%
Water soluble	05.25%
Ash	02.22%

Bristle coil, buffering coil, brown fibres, and white fibres are the four main subtypes of coir. The brown coconut fibre, which is typically quite thick, abrasive, and robust, is the most commonly utilised type. Coconut fibre is robust, stable, and adaptable thanks to the majority lignin content and lower cellulose percentage. The engineering qualities of concrete are improved by the addition of coconut fibres. Before being used in concrete, coconut fibres are processed as natural fibre. Concrete's compressive strength, flexural strength, and split tensile strength are all increased with the addition of coconut fibres. The findings also revealed that there were six keywords that were frequently used in research on coconut fibre in concrete: coconut fibres, tensile strength, reinforced concrete, compressive strength, concretes, and fibres.



Figure 4.10 Coconut fiber separating process

Different kinds of fibres can be incorporated into the concrete to increase its tensile strength. One of the natural fibres utilised in the creation of durable and high-strength products is coconut fibre (coir). The concept of sustainability is widely acknowledged in the context of contemporary construction. The expense

of construction has escalated along with the deteriorating impact on the environment, despite the fact that the construction industry is undergoing a tremendous revolution in terms of both technology and materials used. This led to the adoption of a more balanced strategy with the environment serving as its central theme in order to improve the quality of life. As a result, natural fibres like coconut have been adopted to increase the strength of concrete. fibre like Coconut for the strength enhancement in concrete.

At the test site, coconut fibre is widely accessible, which makes it a very practical option for concrete reinforcement. Additionally, it serves as a new source of revenue for coconut farmers who profit from the increased demand brought on by the building sector. As well as this. Coir mattress trash can be disposed of using this manner, which will lessen the need for new waste disposal facilities and minimise the burden on already overburdened landfills and incinerators.

4.7 PARAFFIN WAX

The colourless or solid paraffin wax is made of a mixture of hydrocarbon molecules with 20–40 carbon atoms and is generated from petroleum, coal, or oil shale. Slack wax, a residue of the refinement of lubricating oil and a mixture of wax and oil, serves as the feedstock for paraffin. De-oiling or de-waxing the slack wax is the first stage in the production of paraffin wax. The crystallisation process separates the oil. The slack wax is often heated, combined with one or more solvents, like a ketone, and then cooled. Wax separates from the solution and crystallises as it cools, leaving just oil.

Both the liquid (oil and solvent) and the solid (wax plus some solvent) streams of this mixture are separated by filtering. "Product wax" (also known as "press wax") and "foots oil" are the end products that are created after the solvent is recovered through distillation. Semi-refined wax is regarded as being more refined than fully refined wax because it contains less oil. To get rid of colours and smells, the product wax may undergo additional processing. Finally, the wax may be combined to produce desirable qualities like melt point and penetration. Either liquid or solid paraffin wax is offered for sale. Modifying the paraffin wax's

crystal characteristics is frequently helpful in industrial applications, usually by adding branching to the existing carbon backbone chain.



Figure 4.11 Paraffin wax

There are numerous other applications for paraffin wax. It is frequently employed as lubricant, electrical insulation, and in the production of candles and crayons. The idea of self-curing compounds is to boost concrete's water retention capacity by reducing water evaporation from it in comparison to traditional curing. Many substances, such as polymeric glycol and paraffin wax, have the ability to self-cure.

Maintaining a suitable moisture content during the early stages of concrete curing is necessary for the development of the desired characteristics. Concrete that has been properly cured is more durable, has a harder surface, and is less porous. In addition to helping to develop strength, preventing moisture loss also helps to reduce permeability, avoid shrinkage, and enhance resistance to

abrasion. It is not always practicable to get a good and thorough cure, especially with higher grade concretes. Self-curing agents can be used to address this issue.

In contrast to conventional curing, the idea behind self-curing chemicals is to increase the water retention capacity of concrete by reducing water evaporation from it. A variety of substances, such as polymeric glycol and paraffin wax, can function as self-curing compounds. In this study, the role of paraffin wax as a self-curing agent is examined, along with the effects of several curing regimes that mimic conventional curing techniques.

Concrete grade, paraffin wax kind and dosage, curing conditions, and curing age are some of the criteria. As a performance standard for the examined curing chemicals, weight loss and compressive strength are established. It has been discovered that the best curing compounds for higher grade concrete are those with a lower dose (0. 1%) of liquid paraffin wax compounds.

CHAPTER 5

EXPERIMENTAL INVESTIGATION

5.1 MIX PROPORTION

The mix proportion for M25 grade concrete was developed using techniques. For the mix proportions created, Tables 5.1 include features such total aggregate aggregate-cement ratio (A/C), water-cement ratio (w/c), coarse aggregate fine aggregate ratio (CA/FA), and fine aggregate e, granite sand, total aggregate ratio (S/a)

M25 GRADE OF CONCRETE-1:1:2

In our project totally six different mix ratios used in M25 grade of concrete for partial replacement of fine aggregate in granite powder and partial replacement of coarse aggregate. The materials that is used to check the compressive strength and tensile strength of materials using different percentages of granite sand mix. The quantity and the types of materials used are described below in table 5.1

Table 5.1 Materials used in concrete blocks

MATERIALS	QUANTITY(kg)
Cement	8.5
M sand	13.08
Granite sand	8.72
20 mm coarse aggregate	16.99
12.5 mm coarse aggregate	11.29
Water	3.86
Coconut fiber	1.0%
Paraffin wax	148 g

5.2 EXPERIMENTAL STUDY

The percentage of M25 grade mix was established after accounting for the various sorts of ingredients. Mechanical parameters determine the M25 concrete grade. After mixing, fresh concrete is poured into the mould, excess concrete is scraped off, and the concrete is then tested using a slump cone. Six standard 150 mm x 150 mm x 150 mm cubes and one rectangular beam with dimensions of 500 mm x 100 mm x 100 mm each were cast to test the compressive strength and tensile strength. the procedure of curing concrete panels to make sure all of their specifications are met.

5.3 SLUMP CONE TEST

The purpose of the concrete slump test, also known as the slump cone test, is to assess the workability or consistency of the concrete mix produced in the laboratory or on the construction site as the project is being carried out. To ensure that concrete is of a consistent quality throughout the construction process, concrete slump tests are performed from batch to batch. The slump test is the simplest, least expensive, and fastest way to determine if concrete is workable. It has been commonly utilised for workability tests since 1922 as a result of this. The workability of concrete is often determined by the concrete slump value, which also reveals the water-cement ratio. However, other factors, such as the qualities of the ingredients, the mixing process, dosage, and admixtures, can also have an impact on the concrete slump value.

5.4 Factors which influence the concrete slump test:

- I. Material properties like chemistry, fineness, particle size distribution, moisture content and temperature of cementitious materials. Size, texture, combined grading, cleanliness and moisture content of the aggregates.
- II. Chemical admixtures dosage, type, combination, interaction, sequence of addition and its effectiveness.
- III. Air content of concrete,
- IV. Concrete batching, mixing and transporting methods and equipment.
- V. Temperature of the concrete.

- VI. Sampling of concrete, slump-testing technique and the condition of test equipment.
- VII. The amount of free water in the concrete.
- VIII. Time since mixing of concrete at the time of testing.
- IX. It is practically always utilised on building sites. The slump test is quite straightforward and user-friendly. It may be completed quickly and also requires relatively little equipment. Due to its many benefits, the slump test is very well-liked worldwide. The workability of concrete is not directly assessed during the slump test. Instead, the consistency of the concrete is measured, which provides a basic idea of the mix's workability.

5.5 Equipments Required for Concrete Slump Test

Slump cone, non-porous base plate, measuring scale, and temping rod are the components of the slump test mould. The test mould is a frustum of a cone with a height of 30 cm, a bottom diameter of 20 cm, and a top diameter of 10 cm. The tamping rod is 60 cm long, 16 mm in diameter, and rounded on one end.



Figure 5.1 Slump cone test

First, the mold's inside surface is thoroughly cleansed. On the surface, oil is applied. After that, a base plate is put on top of the mould. The foundation plate

needs to be non-porous, horizontal, clean, and smooth. Three layers of new concrete are poured into the mould. With a tamping rod, each layer is tamped more than 20 to 25 times. In the entire mould, the tamping is applied consistently to all surfaces. Excess concrete should be removed after filling the mould, and the surface should be levelled.

5.6 CASTING AND CURING OF CUBES

The cubes are cleaned and oiled before casting. If the cubes are oiled properly the concrete mix will be clearly setting on the mould.



Figure 5.2 moulds

The various mix ratios in concrete cubes were done with this mix design of M-25 grade concrete casted. After casting of the cubes the cubes were left for curing purpose.

5.7 CURING OF SPECIMENS

Curing is a process that produces a harder, tougher, or more stable linkage (like an adhesive bond) or substance (like concrete) as a result of a chemical reaction (like polymerization) or physical activity (like evaporation). It will keep concrete at

a suitable temperature and moisture level for a sufficient amount of time to allow hydration to produce the necessary concrete qualities. Concrete's quality will decline if curing is neglected during the early stages of hydration. Concrete will not have the desired binding and strength properties if curing is not done after placement. The specimens will be positioned on a body of water. After casting for 24 hours, specimens were removed from the mould right away and immersed in clean, fresh water.

5.8 Purpose of curing

The correct curing process significantly increases the concrete's resistance to abrasion. The concrete surface is shielded from the elements by curing. Water must be present in order to trigger the chemical reaction that gives concrete its setting time. Concrete becomes more resilient and impermeable, and its tendency to shrink is lessened.

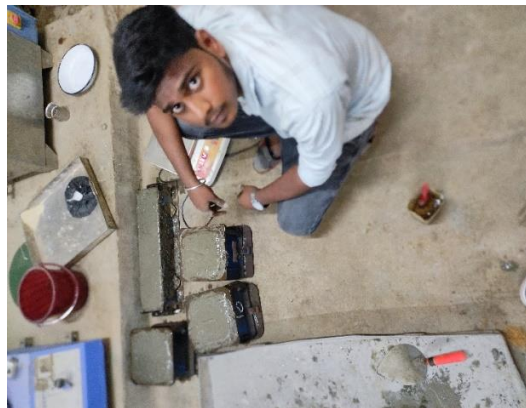


Figure 5.3 Curing Process

Every fifteen days, the fresh water tanks used to cure the specimens were drained, cleaned, and refilled. All specimens maintained under water were kept at least 15 cm below the surface. Depending on the age of curing required, the specimens were cured either 7 days or 28 days.

CHAPTER 6

RESULTS AND DISCUSSION

6.1 COMPRESSIVE STRENGTH TEST

After 24 hours after casting, the specimens were removed from the moulds and immersed in clean, fresh water. The specimens were cured for 7 or 28 days, depending on the amount of curing necessary. The fresh water tanks used to cure the specimens were drained, cleaned, and replaced every fifteen days. All specimens were held at least 15 cm below the surface of the water. The machine has been calibrated to meet the requirements.



Figure 6.1 Compression Testing Machine

The plates have been cleaned, the oil level has been checked, and everything is ready for testing. Cube specimens were taken from the curing tank after 7 days and 28 days of curing and cleaned to eliminate surface water. The specimens were placed on the machine's swiveling head such that the load was applied in the center.

6.2 COMPRESSIVE STRENGTH OF CUBES

The mechanical properties derived from specimens assessed in accordance with Indian Standard Test Protocols (as per IS: 516) are described.

The M25 concrete grade, two distinct admixtures, and three different curing times are the variables of the investigation. The M25 grade's compressive strengths are shown in detail.



Figure 6.2 concrete block placed

The tool has capabilities of 50KN, 100KN, 500KN, 1000KN, 2000KN, 3000KN, and 5000KN. The cubes are removed from the curing process, dried, and tested in a compression testing equipment. The opposite of a tensile test, which pulls the specimen apart, is a compression test, which presses the specimen together. Either full-size replicas of the actual components or machined material specimens can be used for testing. It typically consists of the top and lower test tool as its main parts. Using the tools requires a great degree of flexibility and a versatile, interchangeable tool. worldwide standards-defined specimens. The abundance of various specimens, materials, and parts. The compressive load or stress that a material can withstand before breaking is measured by a compressive strength test. Typically, the test sample is a cube or cylinder.

6.3 STRENGTH OF CONVENTIONAL CUBES AFTER 7 DAYS

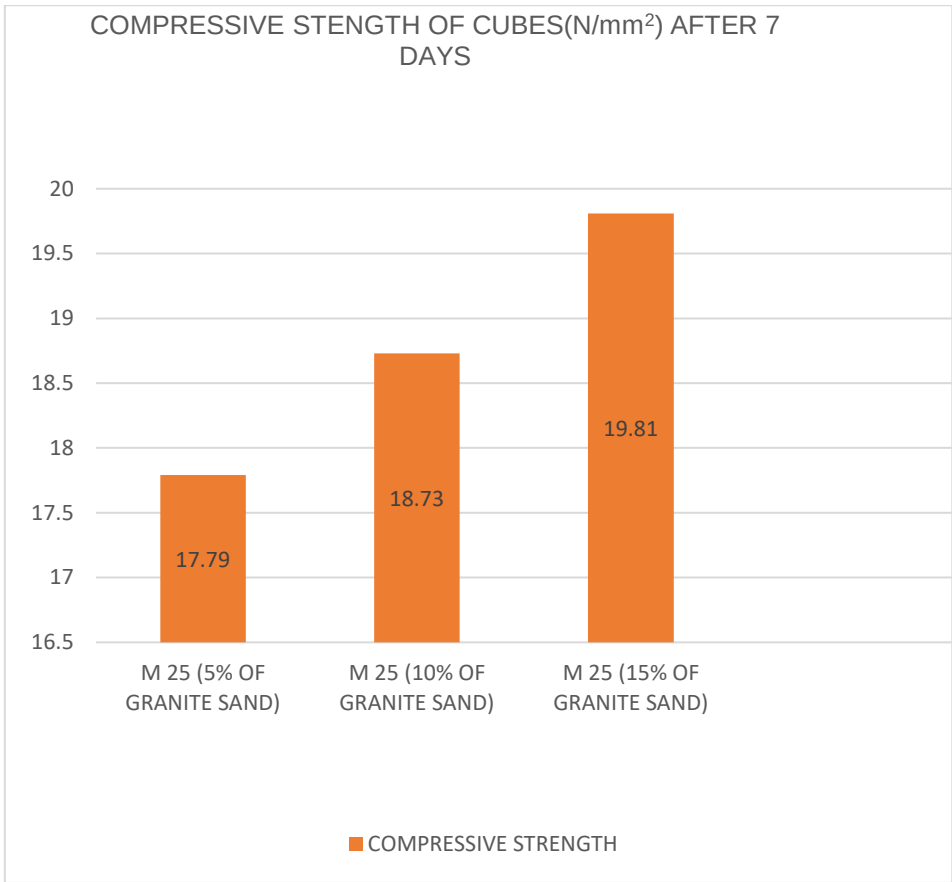


Figure 6.3 Different percentage of granite sand mix

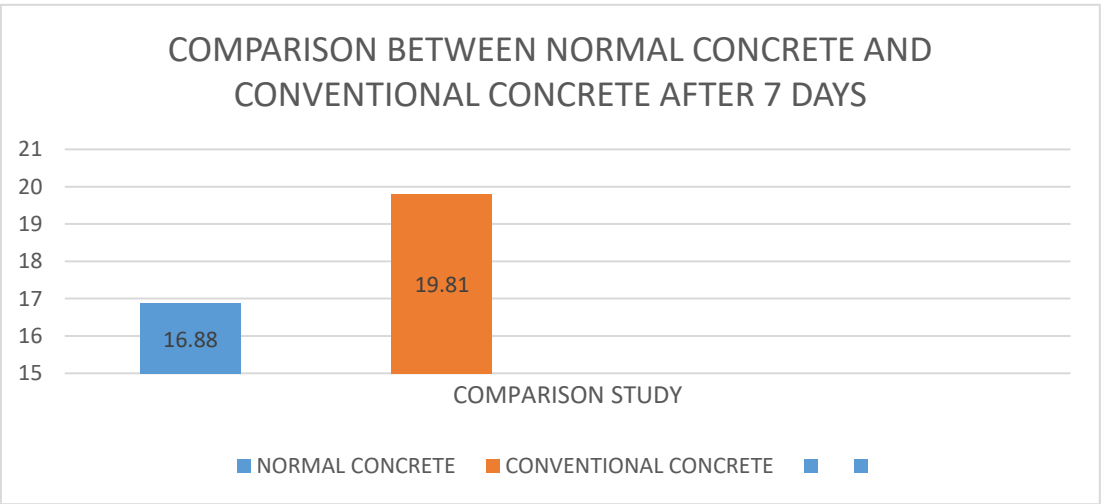


Figure 6.4 comparsion study between normal concrete vs conventional concrete after 7 days

This study shows that the comparison between the normal concrete and conventional concrete after 7 days. Blue colour chart indicates the normal concrete strength after 7 days. Orange colour chart shows the conventional concrete strength after 7 days. Normal concrete strength after 7 days 16.88 and conventional strength concrete strength of granite sand 15% mix is 19.81. From this study it is shown that usage of granite mix by 15% increases the concrete strength.

6.4 STRENGTH OF GRANITE SAND MIX AFTER 7 DAYS

The strength of granite sand mix and their strength after 7 days are listed below of different percentages of granite sand mix and some recycled materials including coconut fibers, paraffin wax and some other aggregates after attaining strength is shown in the table 6.1

Table 6.1 strength of granite sand mix

MIX SAMPLES	AREA	GRANITE SAND	COMPRESSIVE STRENGTH(N/mm ²)
M 25(5% OF GRANITE SAND)	150*150mm	5%	17.79
M 25(10% OF GRANITE SAND)	150*150mm	10%	18.73
M 25(15% OF GRANITE SAND)	150*150mm	15%	19.81

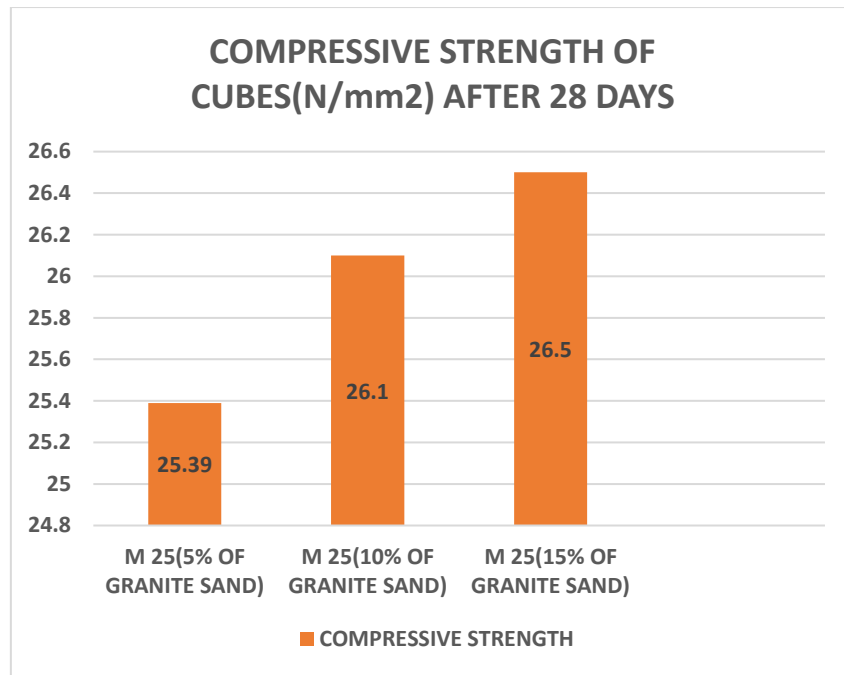


Figure 6.5 coventional concrete strength after 28 days

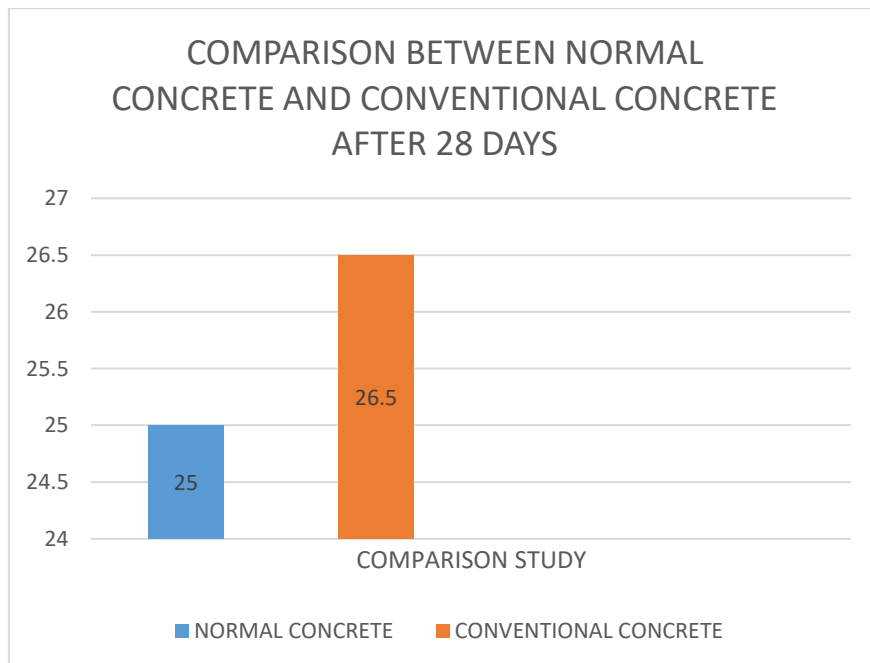


Fig 6.6 comparsion study between
normal concrete vs conventional concrete after 28 days

This study shows that the comparison between the normal concrete and conventional concrete after 28 days. Blue colour chart indicates the normal concrete strength after 28 days. orange colour chart shows the conventional

concrete strength after 28 days. Normal concrete strength after 28 days 25.00 and conventional strength concrete strength of granite sand 15% mix is 26.50. From this study it is shown that usage of granite mix by 15% increases the concrete strength.

6.5 RESULTS OF CONVENTIONAL CUBES AFTER 28 DAYS

The strength of granite sand mix and their strength after 28 days are listed below in the table 6.2

Table 6.2 strength of granite sand mix

MIX SAMPLES	AREA	GRANITE SAND	COMPRESSIVE STRENGTH(N/mm ²)
M 25(5% OF GRANITE SAND)	150*150mm	5%	25.39
M 25(10% OF GRANITE SAND)	150*150mm	10%	26.10
M 25(15% OF GRANITE SAND)	150*150mm	15%	26.50

This table shows the different percentage of granite sand mix after 28 days. In this study for 28 days three cubes of different percentages are mixed and filled in the moulds of 150*150mm. After using all aggregates including fine aggregate as M sand for partial replacement of granite sand, coarse aggregate, coconut fibers for thermal insulation, paraffin wax as internal curing agent, water and cement. They are mixed up and filled in the mould and left for curing. After 28 days of curing the cubes are taken out and compressed in a compression testing machine. This includes 5%, 10% and 15% of granite sand. 5% of granite sand mix gives 25.39N/sq.mm. 10% of granite sand mix gives 26.10N/sq.mm and 15% of granite sand gives 26.50N/sq.mm. The highest percentage of 15% of granite sand mix gives the highest strength than normal concrete strength.

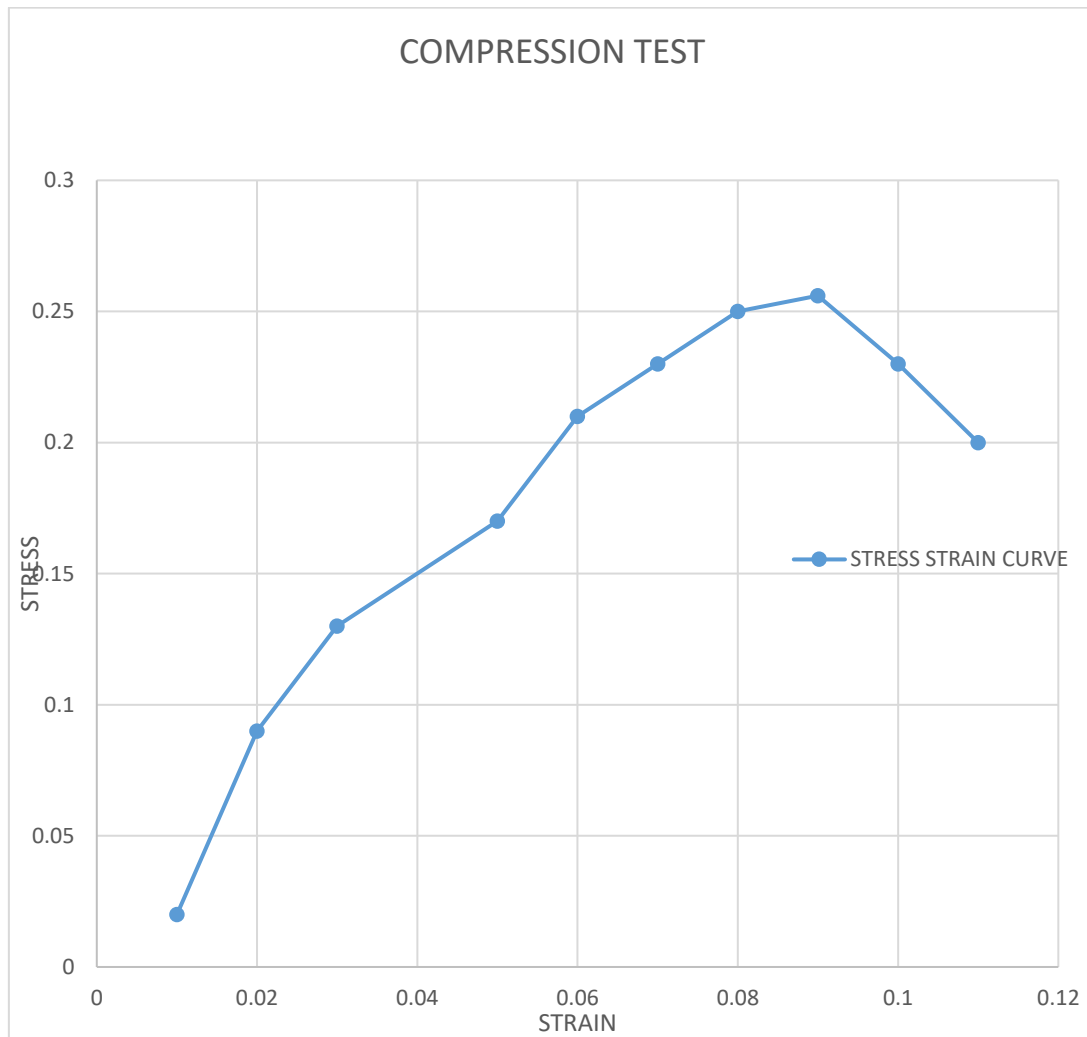


FIGURE 6.7 STRESS STRAIN CURVE

From the graph

$$Q_u = 0.2650 \text{ N/mm}^2$$

$$C = q_u / 2$$

$$C = 0.2650 / 2$$

$$C = 0.13 \text{ N/MM}^2$$

6.6 FLEXURAL STRENGTH

The tensile strength of concrete is indirectly assessed by the flexural test. The stress in a material right before it gives in a flexure test is known as flexural strength, often referred to as modulus of rupture, bend strength, or transverse rupture strength. It evaluates a concrete beam or slab's resistance to failure due to bending.



Figure 6.8 universal testing machine

Flexural test findings for concrete are represented as a rupture modulus, abbreviated as (MR) in MPa or psi. It should be noted that the modulus of rupture value obtained by the centre point load test configuration is around 15% lower than that obtained by the three-point load test configuration. The most common test is the transverse bending test, which involves employing a three-point flexural test technique to bend a specimen with either a circular or rectangular cross-section until it fractures or yields. The material's highest internal stress at the point of yield is represented by the flexural strength. Given the symbol in this instance, it is assessed in terms of stress. Additionally, it has been found that bigger

concrete specimen sizes result in low rupture moduli. Additionally, the concrete's rupture modulus is between 10 and 15 percent of its compressive strength. It is affected by mixing ratios, size, and the volume of coarse aggregate utilised in specimen assembly.

6.7 FLEXURAL STRENGTH OF BEAM

The flexural strength of the beam are calculated after the curing purpose using the aggregates including granite sand, M-sand, cement, water and the coarse aggregate,paraffin wax.The ultimate load and flexural strength are shown in the figure 6.9

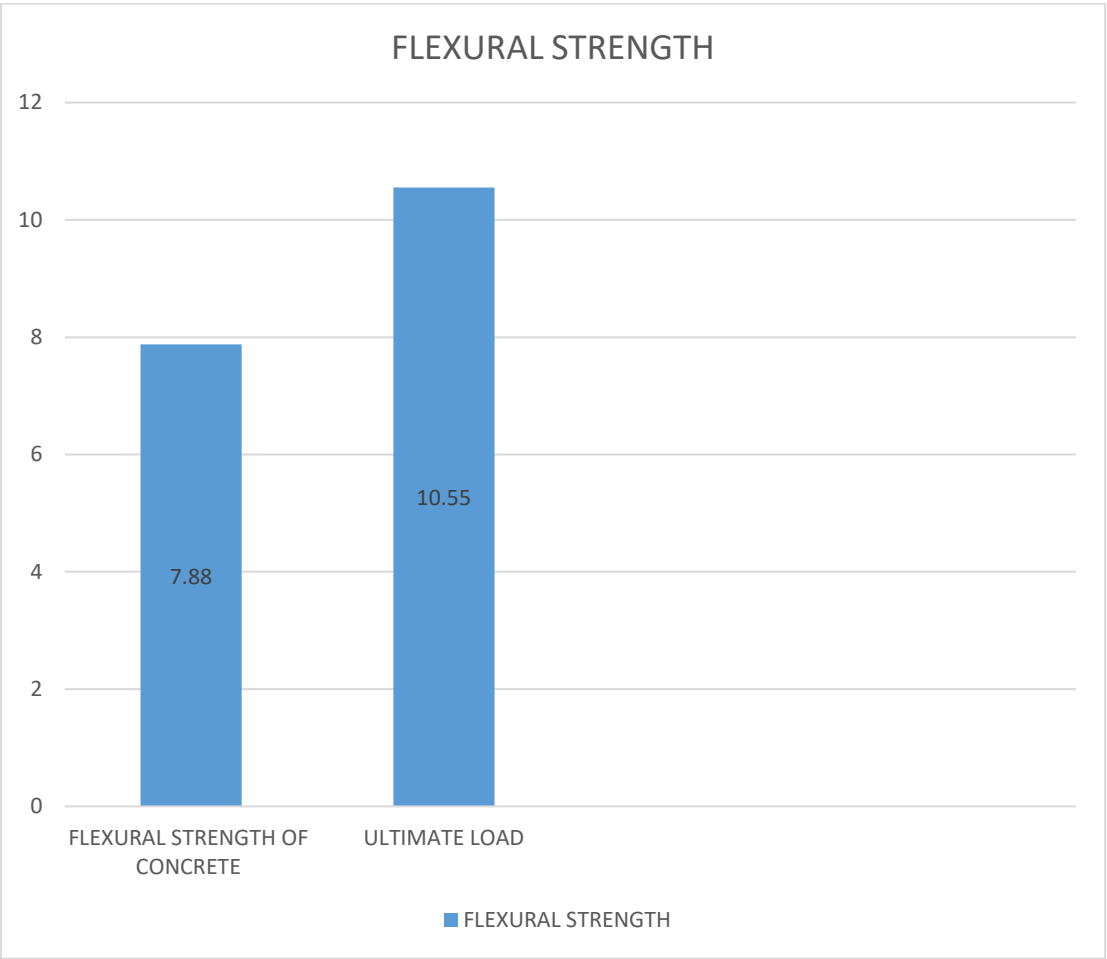


FIGURE 6.9 FLEXURAL STRENGTH

6.8 FLEXURAL STRENGTH TEST RESULTS ON BEAM

The beam length of 500, breadth of 100 and height of 100 are taken over the flexural strength and attains the maximum flexural strength as shown in the below table 6.3

TABLE 6.3 FLEXURAL STRENGTH OF THE BEAM

Sl.No	Identificati on Mark On Samples	L	B	H	Ultimate Load(Kn)	Flexural Strength (N/ Mm ²)
1	Beam	500	100	100	10.50	7.88

6.9 COMPARATIVE STUDY BETWEEN STRENGTH OF RECYCLED MATERIALS THAN NORMAL STRENGTH OF CONCRETE

The below chart shows the comparative strength of the concrete in normal concrete vs conventional concrete after 7 days and 28 days.

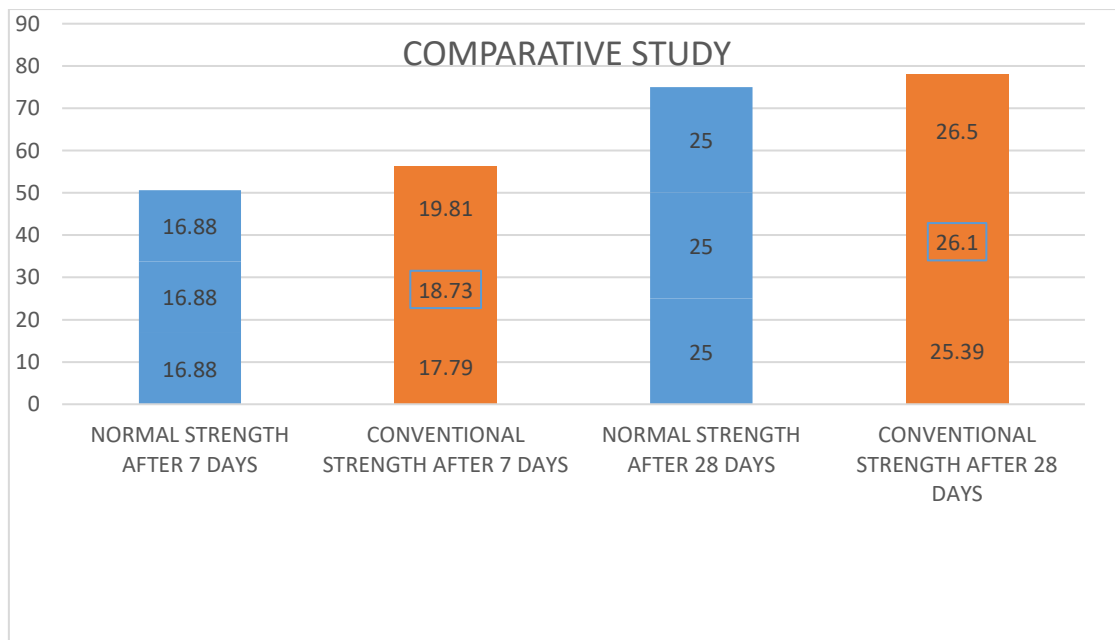


Figure 6.10 comparative study

6.10 COST BENEFIT ANALYSIS

The below materials are taken from different locations which is available inside the Chennai. Cement we acquired in falcon industries. Coarse aggregate and m sand acquired in amman sands. Paraffin we acquired at wax chemicals. Granite pieces we acquired at gundupalli marbles and coconut fibers we acquired from coconut fiber industry. These are shown in the below table 6.4

Table 6.4 COST BENEFIT ANALYSIS

SL.NO	MATERIALS	QUANTITY(IN KG)	COST(IN RS)	JUSTIFICATION
1	CEMENT	8.5	Lab	Acquired at falcon industries
2	M-SAND	13.08	100	Acquired at amman M sand
3	20 COARSE AGGREGATE	16.99	50	Acquired at amman M sand
4	12.5 COARSE AGGREGATE	11.29	50	Acquired at M sand
5	GRANITE SAND	8.72	FREE COST	Acquired from gundupalli granites
6	COCONUT FIBRES	1.5	FREE COST	Acquired from coconut fibers industry
7	PARAFFIN WAX	0.50	100	Wax chemicals

CHAPTER 7

7.1 CONCLUSION

- I. The utilization of granite sand in concrete shows better results over in compressive and tensile strength.
- II. From the experimental investigation, the usage of granite sand up to 10% and 15% increases compressive strength gradually.
- III. Average compressive strength of concrete cubes after 07 days for M-25 grade is 19.81N/mm²
- IV. Average compressive strength of concrete cubes after 28 days for M-25 grade is 26.50N/mm²
- V. From the test results, it is evident that granite sand mix in concrete exhibit more compressive strength.
- VI. The strength of the mix increases with addition of 10% of granite powder and 15% identified as optimal mix content.
- VII. These concrete cubes can be used in the construction of at low cost.
- VIII. Granite sand is an environmentally friendly building ingredient that can be used in place of fine aggregate. Additionally, this effectively lowers the price of locally accessible building supplies. When using this granite sand as partial replacement the amount of river sand and m sand can be reduced which can create a positive impact on environment.
- IX. For reducing the temperature, coconut fibres and paraffin wax (PCM) were used as layers in the concrete while casting. This fibre and PCM helps in reducing the energy for cooling surfaces in hot climates and helps to keep the room cold.

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