

EXPLORING THE MECHANICAL PROPERTIES OF CONCRETE WITH GROUNDNUT SHELL AS A REPLACEMENT OF FINE AGGREGATE

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

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of S.SIDHU (Reg. No. 40200705) and S.K.MITHULKIRUTHIK (Reg.No.40200007) who carried out the project entitled **"EXPLORING THE MECHANICAL PROPERTIES OF CONCRETE WITH GROUNDNUT SHELL AS A REPLACEMENT OF FIN AGGREGATE"** under our supervision from October 2023 to April 2024.

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DECLARATION

We, S.SIDHU (Reg.No.40200705) and S.K.MITHULKIRUTHIK (Reg.No. 40200007) hereby declare that the Project Report entitled "**EXPLORING THE MECHANICAL PROPERTIES OF CONCRETE WITH GROUNDNUT SHELL AS A REPLACEMENT OF FINE AGGREGATE**" done by us under the guidance of Dr.S. Vanitha is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering.

DATE: 02/04/2024

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1. 
2. 

SIGNATURE OF THE CANDIDATES

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ABSTRACT

Researchers are also examining the role of policy and regulation in promoting sustainability in construction and resource management. They are evaluating the effectiveness of existing regulations and proposing new policies to incentivize sustainable practices and discourage environmentally harmful activities. Evaluate the physical and chemical properties of groundnut shells to determine their suitability as a replacement for fine aggregate in concrete. This involves conducting tests to assess parameters such as particle size distribution, density, moisture content, and compressive strength.

63 concrete samples were casted using groundnut shell replacements of 0%, 10%, 20%, 30%, 50%, 70%, 100% and tested for 7days, 14days and 28 days for compressive strength tests. Determine the density of the groundnut shell-based concrete panels using standard methods such as ASTM C138/C138M - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete. From the results of the laboratory tests the density of the cubes ranged from 830kg/m³ for cubes with only groundnut shells to 2160kg/m³ for cubes with only sand as fine aggregates.

The average compressive strength range for 0% ground shell to 100% ground shell was 5.83N/mm² to 0.9N/mm² at 7 days, 8.07 to 0.5 N/mm² at 14 days and Discuss the compressive strength results obtained from the testing of groundnut shell panels at different ages (7 days and 28 days). Highlight the observed increase in compressive strength over time, reaching a maximum of 0.6 N/mm² at 28 days. Compare the achieved compressive strength values with typical requirements for structural concrete. Note that the obtained strengths may not meet the minimum standards for structural applications, indicating limitations in load-bearing capacity. Replacements of 30 to 70% had suitable strength and can be used for this purpose.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Portland cement concrete is known for its excellent strength in compression. This makes it suitable for supporting heavy loads and resisting forces that tend to crush or compress it. The most common method to overcome the weakness in tension is by reinforcing the concrete with materials like steel rods (rebar) or mesh. These reinforcements are placed strategically within the concrete to resist tensile forces and help distribute loads more evenly, thereby reducing the likelihood of cracking and increasing the overall strength and durability of the structure. Concrete is used extensively as a construction material because of its versatility. Concrete made with Portland cement indeed exhibits strength in compression but is relatively weak in tension. This characteristic is fundamental to understanding the behavior of concrete structures. This drawback can be overcome by providing steel in tension zone. By combining the high compressive strength of concrete with the tensile strength of steel reinforcement, RCC structures can withstand higher loads and stresses compared to plain concrete. At the same time durability of concrete is also important. Durability is mainly affected due to cracks developed by creep and shrinkage. This can be avoided by using certain chemical admixtures. As mentioned earlier, reinforcing concrete with steel bars or mesh helps distribute stresses and can help prevent crack propagation. The reinforcement acts as a barrier to limit the width and extent of cracks, reducing their impact on the overall structural integrity. In an attempt to control the so formed cracks has led to the development of FIBER REINFORCED CONCRETE (FRC), obtained by dispersing in concrete, very small sized reinforcement called fibres. Fiber reinforcement improves the flexural strength of concrete, making it more resistant to bending and shear forces. This is particularly beneficial in applications such as pavements, industrial floors, and earthquake-resistant structures, where flexural strength is critical.

1.2 REPLACEMENT OF FINE AGGREGATE

Using manufactured sand helps conserve natural resources by reducing the need for extracting sand from riverbeds, beaches, and other natural sources. This

can mitigate the environmental impact associated with sand mining and dredging activities. The compressive strength of this concrete cube was measured after 5%, 10%, 15%, 20%, 25%, 30%, 35%. Included in these percentages were 5%, 10%, 15%, 20%, 25%, 30%, 35%, and 40%. In addition, the experiment findings indicate that up to thirty percent of natural sand can be manufactured sand helps conserve natural resources by reducing the need for extracting sand from riverbeds, beaches, and other natural sources. This can mitigate the environmental impact associated with sand mining and dredging activities..

1.2.1 TYPES OF MATERIALS USED FOR REPLACEMENT

1. Fly ash
2. Silica fume
3. Limestone fines
4. Rice husk ash
5. Palm oil fuel ash
6. Sugarcane bagasse ash
7. Groundnut shell powder
8. Groundnut shell ash
9. Glass powder

1.3 GROUNDNUT SHELL POWDER

In the present research, the locally available in the season of groundnut shell is partially crushed by the grinder mill in oil mill is taken for the research. Fine aggregate partially replaced by groundnut shell in the percentage of 5,10,15,20 in concrete and its specific gravity is 1.54. Groundnut shells can be used as a replacement for fine aggregate in concrete production. Groundnut shells typically have a coarser texture compared to fine aggregate like river sand.. Use of groundnut shells as partial replacement for fine aggregate in concrete production resulted in a reduction in the density of the concrete.

1.4 SILICA POWDER

Microsilica reacts with calcium hydroxide in the cement paste to form additional calcium silicate hydrate (C-S-H) gel, which is the primary strength-contributing phase in concrete. This results in increased compressive and flexural strength of the concrete. The densification of the cement paste due to the addition of microsilica leads to reduced permeability, which improves the concrete's resistance to penetration by water, chloride ions, and other harmful substances.

This, in turn, enhances the durability of concrete structures, especially in aggressive environments such as marine or industrial settings.



1.5 MECHANICAL PROPERTIES OF GROUNDNUT SHELL POWDER CONCRETE

Groundnut shell powder are known to enhance the mechanical performance of concrete with regard to its split tensile, flexural strength and compressive test. Following are an overview of these characteristics.

1.5.1 Compressive strength

The effect of steel fibres on the concrete compressive strength is much debated in literature. It has been found by many researchers that the inclusion of steel fibre in concrete increases its compressive strength value. This increase ranges between marginal and significant increases in compressive strength. The effect of fibres on the compressive strength is attributed to two stabilising actions according to Grübl et al. (2001). First, a larger amount of pores in the concrete admixture, which decreases the compressive strength and second factor, would be the fibre bridging effect across the micro cracks, which results in an increased compressive strength. The concrete compressive strength of the material depends on the magnitude of these effects and it may change. The effect of steel fibres on the compressive strength therefore depends on the concrete mixture, the kind and amount of steel fibres and the manufacturing process. Despite the increase in the compressive strength of the concrete, it is unclear whether the addition of steel fibres influences the rotation capacity of plastic hinges. Steel fibres as well as stirrup reinforcement increase the confining capacity of concrete. This is reflected in the

stress-strain relationship of concrete with a more ductile post-peak behaviour. For steel fibres, the orientation of the fibres needs to be perpendicular to the compressive loading in order to be effective.

1.5.2 Split tensile strength

Traditional concrete is inherently weak in tension, but the inclusion of steel fibers effectively reinforces the concrete matrix, increasing its tensile strength. As a result, fiber-reinforced concrete exhibits higher resistance to cracking and improved structural integrity under tensile loading.

1.5.3 Flexural strength

The proportions of cement, aggregates, water, and admixtures in the concrete mix significantly affect its flexural strength. The type, size, shape, and gradation of aggregates used in the concrete mix influence its flexural strength. Flexural strength typically increases with age as the concrete continues to gain strength through hydration. The presence of reinforcement, such as steel bars or fibers, can significantly enhance the flexural strength of concrete

CHAPTER 2

LITERATURE STUDY AND METHODOLOGY

2.1 GENERAL

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

2.2 REVIEW OF THE LITERATURE

Sabat et al, 2011 investigated the use of groundnut shell ash (GSA) as a cement replacement in cement mortar and concrete. Their findings suggest that GSA can enhance the properties of cement mortar and concrete, offering potential for sustainable construction practices.

Akinyemi et al, 2012 provided a review of the utilization of agricultural waste in concrete. Their study highlights the potential of agricultural waste materials for sustainable construction practices, offering opportunities for reducing the environmental footprint of the construction industry.

Raji et al. 2013 explored the influence of groundnut shell ash (GSA) on the mechanical properties of concrete. Their findings indicate that GSA can positively affect mechanical properties such as compressive strength and flexural strength, highlighting its potential as a supplementary material in concrete production.

Dash et al, 2013 studied the strength characteristics of concrete using groundnut shell ash and rice husk ash as partial replacements for cement. Their research indicates that incorporating these materials can improve the strength properties of concrete, offering possibilities for sustainable construction practices.

Malagavelli et al, 2013 studied the use of groundnut shell ash (GSA) as a cement replacement on the strength of concrete. Their findings indicate that GSA can positively influence the strength properties of concrete, offering possibilities for sustainable construction practices. (2013)

Malagavelli et al, 2013 investigated the influence of groundnut shell ash (GSA) as a fine aggregate replacement on the properties of concrete. Their study suggests that GSA can enhance the properties of concrete, offering potential for sustainable construction practices. (2013)

Raji et al,2014 conducted a study on the effect of groundnut shell ash (GSA) as a cement replacement in concrete. Their findings suggest that GSA can positively influence the properties of concrete, offering potential for sustainable construction practices.

Afolayan et al,2014 explored the sustainable use of groundnut shell ash (GSA) as a partial replacement for cement in concrete. Their study suggests that GSA can contribute to sustainable construction practices, offering possibilities for reducing the environmental impact of construction activities.

Adeyemi et al. 2014 conducted an evaluation of concrete properties incorporating groundnut shell ash (GSA) as a partial replacement for cement. Their study suggests that GSA can improve various performance parameters of concrete, offering possibilities for sustainable construction practices.

Venkateshwaran et al. 2014 performed an experimental study to assess the strength characteristics of concrete by partially replacing cement with groundnut shell ash (GSA). Their findings suggest that GSA can enhance the strength properties of concrete, indicating its potential as a supplementary material in concrete production.

Baral et al. 2014 investigated the mechanical properties of concrete incorporating groundnut shell ash (GSA) as a partial replacement for cement. Their study indicates that GSA can positively influence mechanical properties such as compressive strength and tensile strength, offering potential for sustainable construction practices.

Malagavelli and Nagendra ,2014 provided a review of the performance of coconut shell as a coarse aggregate in concrete. Their study suggests the viability of coconut shell as a sustainable alternative in concrete production, offering potential for reducing the environmental impact of construction activities.

Ganiron Jr. et al. 2014 investigated the impact of groundnut shell ash (GSA) as a cement replacement on the strength properties of concrete. Their study suggests that GSA can enhance the strength of concrete, offering opportunities for sustainable construction practices.

Ambily et al,2015 studied the properties of concrete using coconut shell ash and groundnut shell ash as partial replacements for cement. Their research suggests that incorporating these materials can improve the properties of concrete, contributing to sustainable construction practices.

Chandrasekaran and Kalaivani,2015 investigated the use of groundnut shell ash (GSA) as a fine aggregate replacement in concrete. Their study suggests that GSA can effectively enhance concrete properties, offering potential for sustainable construction practices.

Prabavathy et al,2015 assessed the strength characteristics of concrete incorporating groundnut shell ash (GSA) with varying water/cement ratios. Their study indicates that GSA concrete exhibits favorable strength properties, highlighting its suitability for structural applications.

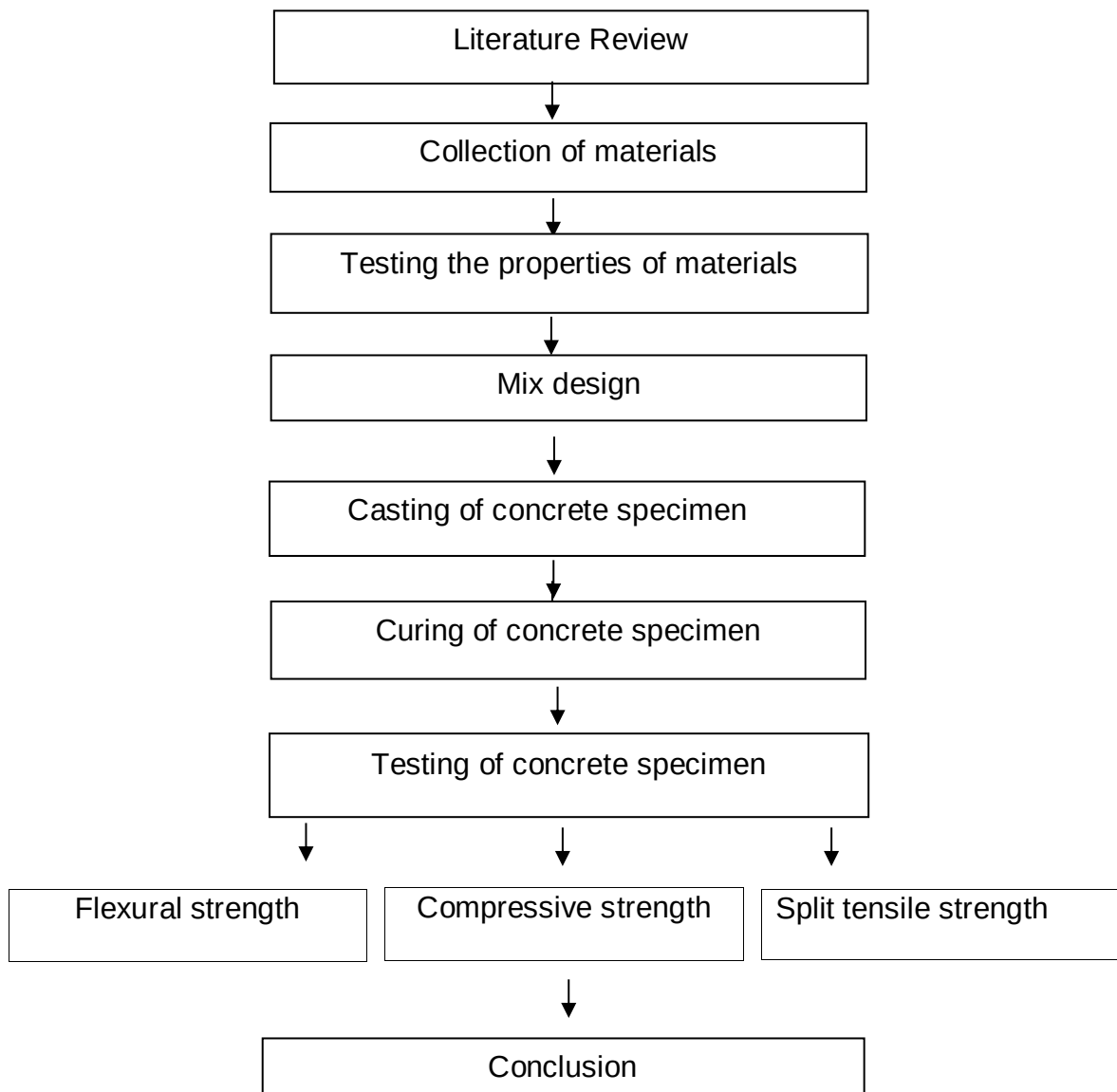
Ugonna et al. 2015 conducted durability studies on concrete containing groundnut shell ash (GSA) to evaluate its resistance to environmental factors. Their findings suggest that GSA concrete demonstrates promising durability characteristics, indicating its potential for long-term performance in harsh conditions.

Folorunso et al. 2016 investigated the performance of groundnut shell ash (GSA) as a partial replacement for cement in concrete. Their findings indicate that GSA can enhance the performance of concrete, offering possibilities for sustainable construction practices.

Verma et al,2016 explored the role of water hyacinth in the phytoremediation of heavy metal-contaminated water bodies. Their study highlights the potential of water hyacinth for sustainable environmental remediation, offering possibilities for mitigating water pollution. (2016)

Haridharan and Sivakumar,2016 investigated the strength characteristics of concrete using groundnut shell ash (GSA). Their findings suggest that GSA can enhance the strength properties of concrete, indicating its potential as a supplementary material in concrete production. (2016)

2.3 METHODOLOGY OF THE PROJECT



CHAPTER 3

OBJECTIVE AND SCOPE

3.1 OBJECTIVE

- To determine the optimum utilization of groundnut Shell powder as a replacement of fine aggregate in concrete
- To determine the properties of fresh concrete
- To determine the mechanical properties of hardened concrete
- To compare the AAC blocks with conventional concrete blocks.
- The strength properties being studied in our project are as follows:
 - Compressive Strength
 - Split Tensile Strength
 - Flexural strength

3.2 SCOPE

- Experimental test results indicate that up to 20% replacement of the fine aggregate by groundnut shell can attain higher compressive strength, split tensile strength and lower water absorption test at the ages of 28,60 and 90 days.
- The effects of the groundnut shells on the workability of fresh concrete were determined by the slump and compacting factor value tests the strength and durability properties of concrete were tested and compared with the conventional concrete.
- By comparing these test results, it was found that 5% replacement of groundnut shell shows better results than the conventional concrete for both strength and durability tests

CHAPTER 4

MATERIALS AND EXPERIMENTAL WORK

4.1 MATERIALS

The testing of the ingredient materials of concrete such as cement, fine aggregate and coarse aggregate are carried out and results are presented below.

4.1.1 CEMENT

Cement is a binding material used in construction to bind other materials together. It is typically a fine powder made from limestone, clay, shale, or other materials, which are heated to a high temperature and then ground into a fine powder. When mixed with water, cement forms a paste that hardens and binds to other materials, such as sand, gravel, or crushed stone, to form concrete or mortar.

There are various types of cement used in construction, each with its own specific properties and applications. The most common type is Portland cement, which comes in several varieties such as Type I, Type II, Type III, and Type V, each with different compositions and performance characteristics. Other types of cement include blended cements, such as Portland slag cement (PSC) and Portland pozzolana cement (PPC), which incorporate supplementary materials to improve certain properties or reduce environmental impact.

Cement plays a crucial role in construction projects, providing the strength and durability needed for various structures, including buildings, bridges, roads, and dams. It is a fundamental component of concrete, which is one of the most widely used construction materials globally.

TABLE 4.1 Properties of cement

Physical properties	Values of OPC used
Standard consistency	29.2%
Initial setting time	45 Minutes
Final setting time	265 Minutes
Specific gravity	3.15

4.1.2 Fine aggregate

Fine aggregate / sand is an accumulation of grains of mineral matter derived from the disintegration of rocks. Gravel is a loose aggregation of small stones or pebbles. It is characterized by its larger particle size compared to sand but smaller than cobblestone or boulders. Gravel is often used as a coarse aggregate in concrete, providing bulk and strength to the mixture. Unlike cement, gravel is not a binding material but rather a component used in concrete mixes. Sands that have been sorted out and separated from the organic material by the action of currents of water or by winds across arid lands are generally quite uniform in size of grains. Sand extracted from river beds is a widely used source of commercial sand. Rivers naturally erode and transport sediment, including sand, downstream. Much of the earth's surface is sandy, and these sands are usually quartz and other siliceous materials. The most useful commercially are silica sands, often above 98% pure. Beach sands have various industrial and commercial applications. They are used in the extraction of various elements such as silica, zircon, and monazite, which have economic value. Additionally, sand is a key ingredient in the production of mortar and concrete, where it serves as a fine aggregate. Beach sands are also used for polishing and sandblasting applications due to their abrasive properties.

Clear sands are employed for filtering water. Sand is sold by the cubic yard (0.76 m³) or ton (0.91 metric ton) but is always shipped by weight. The weight varies from 1,538 to 1,842 kg/m³, depending on the composition and size of grain. Construction sand is not shipped great distances, and the quality of sands used for this purpose varies according to local supply cement testing, standard sand is used

as a reference material for determining the consistency and setting time of cement pastes. The fine aggregate is passing through 4.75 mm sieve and had a specific gravity of 2.6. The grading zone of fine aggregate is zone II as per Indian Standard specifications.

Type Natural (Ghaggar)

Specific gravity = 2.66

Water absorption = 1%

Free (surface) moisture = 1.4

Table 4.2 Sieve analysis result for fine aggregate

Sieve Analysis result			
IS sieve size	Percent retained	Cumulative % retained	Percent passing
10mm	0.00	0.00	100
4.75mm	5.20	5.20	94.80
2.36mm	3.00	8.20	91.80
1.18mm	8.60	16.80	83.20
600 microns	25.80	42.60	57.40
300 microns	32.80	75.40	24.60
150 microns	20.70	96.10	3.90
Note: Conforming to grading zone II of Table 4 of IS:383 - 1970			

4.1.3 COARSE AGGREGATE

Coarse aggregates are characterized by their larger particle size compared to fine aggregates (such as sand). They typically range in size from 3/8 inch (9.5 mm) to several inches in diameter, depending on the specific application and desired properties of the concrete mix. The commercial stone is quarried, crushed, and graded. The last is a term used to designate basalt, gabbros, diorite, and other dark coloured, fine-grained igneous rocks. Graded crushed stone is composed of fragments of a single type of rock, such as granite, limestone, basalt, or sandstone.

The sizes are from 20mm to 4.75mm in although larger sizes may be used for massive concrete aggregate. Machine chorused granite broken stone angular in shape is use as coarse aggregate.

20mm Graded

Type Crushed stone aggregate

Specific gravity = 2.64

Water absorption = 0.5%

Free (surface) moisture = 0

Table 4.3 Sieve analysis result for coarse aggregate

Sieve Analysis result			
IS sieve size	Percent retained	Cumulative retained %	Percent passing
40mm	0.00	0.00	100
20mm	0.60	0.60	99.40
10mm	73.50	74.10	25.90
4.75mm	22.90	97.00	3.00
Note: Conforming to Table 2 of IS:383 - 1970			

4.1.4 WATER

Portable water free from salts was used for casting and curing of concrete as per IS: 456-2000 recommendations.

4.1.5 GROUNDNUT SHELL POWDER

Groundnut shells were obtained from nearby farms. It is washed and the soil dust particles are removed from it. Aster that it is crushed into the size of 4.74mm b mechanical process. The groundnut shell fulfills+ the fine aggregate properties



Groundnut shell (GNS), which is an agro-waste with little or no commercial value, accounts for 20% of the total weight of the pod.

Fig 4.1 Groundnut shell powder

4.2 TESTING

4.2.1 Fineness of Cement

Before breaking down the lumps, visually inspect the cement sample to identify any large or compacted areas. Air-set lumps typically form when moisture enters the cement bag or container, causing the particles to clump together. Then accurately weigh about 100grams of the cement and place it on a standard 90 micron IS Sieve. Continuously sieve the cement for about 15 minutes. Then weigh the residue left after 15 minutes of sieving. The percentage residue should not exceed 10%.

4.2.2 Determination of Specific gravity of Cement

Volume of sample taken as 60g.

Specific Gravity for cement: $\frac{[(W2 - W1)]}{(W2 - W1) - (W3 - W4) \times 0.79}$

Table 4.4 Specific Gravity of Cement

S.G 1	S.G 2	S.G 3	Average
3.14	3.16	3.15	3.15

4.2.3 Determination of Specific Gravity of Fine Aggregate

Volume of sample taken as 1000g

$$\text{Specific Gravity} = \frac{(W2 - W1)}{(W2 - W1) - (W3 - W4)}$$

Table 4.5 Specific Gravity of Fine Aggregate

Sl.No	Weight Of Pycnomter In Gms (W1)	Weight Of Pycnomter + Sand In Gms (W2)	Weight Of Pycnomter + Sand + Water In Gms (W3)	Weight Of Pycnomter + Water In Gms (W4)
1.	610	1325	1905	1460
2.	610	1360	1930	1460
3.	610	1405	1970	1460

S.G 1	S.G 2	S.G 3	Average
2.65	2.67	2.68	2.67

4.2.4 Determination of Specific Gravity of Coarse Aggregate

Volume of sample taken as 1000g.

$$\text{Specific Gravity} = \frac{(W_2 - W_1)}{(W_2 - W_1) - (W_3 - W_4)}$$

Table 4.6 Specific Gravity of Coarse Aggregate

Sl.No	Weight Of Pycnomter In Gms (W1)	Weight Of Pycnomter + Coarse Aggregate In Gms (W2)	Weight Of Pycnomter + Coarse Aggregate + Water In Gms (W3)	Weight Of Pycnomter + Water In Gms (W4)
1.	630	958	1593	1234
2.	630	988	1570	1234
3.	630	951	1590	1234

Limitations: Specific gravity of coarse aggregate should be 2.5 – 3.0

S.G 1	S.G 2	S.G 3	Average
2.56	2.68	2.7	2.66

4.2.5 Workability test on fresh concrete by Slump cone method

Workability can be defined as the property of concrete which determines the amount of useful internal work necessary to produce full compaction. A mix must be workable enough to fill the form spaces completely, with the assistance of a reasonable amount of spading and vibrating. Since a fluid mix does this more readily than a dry or stiff mix, one can see that workability varies directly with fluidity. The variation in workability characteristics of fresh concrete were determined by the slump test, flow table test and compaction factor test (IS: 5516 - 1996).

The variation of workability of fresh concrete is measured in terms of slump (IS: 1199 - 1959). The slump test is indeed widely recognized as one of the most commonly used methods for assessing the consistency of freshly mixed concrete. It

does not measure all factors contributing to workability, nor is it always representative of the placeability of the concrete. The slump cone apparatus is typically made of metal, such as steel or aluminum, to ensure durability and resistance to deformation during testing.

Bottom diameter : 20 cm
 Top diameter : 10 cm
 Height : 30 cm

Table 4.7 Slump cone test

S.No.	Fiber content by weight of cement (%)	Slump test
1	0	100
2	0.25	95
3	0.5	90
4	0.75	85
5	1	80
6	1.5	75
7	2	70

4.3 MIX DESIGN

Design stipulations for proportioning

- a) Grade designation : M₂₀
- b) Type of cement : OPC- 53 grades
- c) Max. size of aggregate : passing 20mm & retaining on 10mm sieve
- d) Minimum W/C ratio : 0.5
- e) Workability : 400 kg/m³
- f) Exposure condition : Good
- g) Method of concrete placing : moderate
- h) Degree of supervision : Good

Test data for materials

- a) Cement used : OPC-53 grade
- b) Specific gravity of cement : 3.15
- c) Chemical admixture : -
- d) Specific gravity of
 - Coarse aggregate : 2.66
 - Fine aggregate : 2.67
- e) Water absorption
 - Coarse aggregate : 0.5%
 - Fine aggregate : 1.0%

Target mix strength for proportioning

M20 = 1:1.5:3
 Characteristic Compressive strength of Concrete @ 28 Days = 20N/mm²
 Total Volume = 1+1+2 = 4
 FOS = 1.54 – 1.57
 (Take FOS = 1.57)
 Dry Volume = 1.57 x Wet Vol.

(i) Quantity of Cement

= 1/1+1+2 x 1.57
 = 0.3925 m³
 Unit Weight of cement = 1440 Kg/m³
 0.3925 m³ of cement = 1440 x 0.3925
 Cement for 1 m³ of concrete = 565.2 Kg/m³
 L x B x H = 0.15 x 0.15 x 0.15
 V = 0.0034 m³
 For 0.0034 m³ of concrete = 565.2 x 0.0034
Cement = 1.921 Kg

(ii) Quantity of Sand

= 1/1+1+2 x 1.57
 = 0.3925 m³
 Unit Weight of sand = 1600 Kg/m³
 0.3925 m³ of sand = 1600 x 0.3925
 Sand for 1 m³ of concrete = 628 Kg/m³
 For 0.0034 m³ of concrete = 628 x 0.0034

Sand

= 2.135 Kg

(iii) Quantity of Coarse aggregate

$= 2/1+1+2 \times 1.57$

$= 0.785 \text{ m}^3$

Unit Weight of aggregate

$= 1560 \text{ Kg/m}^3$

0.785 m³ of aggregate

$= 1560 \times 0.785$

Aggregate for 1 m³ of concrete

$= 1224.6 \text{ Kg/m}^3$

For 0.0034 m³ of concrete

$= 1224.6 \times 0.0034$

Coarse aggregate

= 4.163 Kg

(iv) W/C Ratio (Cement = 1.921 Kg)

W/C

$= 0.5$

W / 1.921

$= 0.5$

W

$= 0.5 \times 1.921$

Water

= 0.96 litre

Table 4.8 Mix proportions

Water	Cement	Fine Aggregate	Coarse Aggregate
0.96 litre	1.921 kg	2.135 kg	4.163 kg

4.4 PROCEDURE FOR CASTING OF CUBES AND CYLINDERS

The size of cube mould is 150x150x150mm, pour concrete in the cubes in three layers. After placing each layer of concrete into the formwork, ensure it is spread evenly and uniformly across the surface. The initial 24-hour curing period allows the concrete to undergo the early stages of hydration and gain sufficient strength to be handled without damaging its structural integrity. During this time, the concrete remains in the mould to maintain its shape and prevent deformation. Place the cube in testing machine and record the maximum load applied to the conventional & SFRC concrete cubes. Take average strength of specimen cubes.

The size of cylinder mould is 150x300mm, pour concrete in the cylinders in three layers: After placing each layer of concrete into the formwork, ensure it's spread evenly and uniformly across the surface. After that submerge the specimen in clean, fresh water until the time of testing. Place the cylinder in testing machine and record

the maximum load applied to the conventional & SFRC concrete cubes. Take average strength of specimen cylinders.

4.4.1 Concrete strength according to days

- 7 days - 65%
- 14 days - 90%
- 28 days - 100%



Fig 4.2 Preparation of concrete



Fig 4.3 Preparation of groundnut shell powder as a reinforced concrete



Fig 4.4 Casting of cubes by using groundnut shell powder



FIG 4.5 Casting of cylinders by using groundnut shell powder



FIG 4.6 Mixing of concrete



FIG 4.7 CASTING OF CUBE

CHAPTER 5

RESULTS AND DISCUSSION

5.1 COMPRESSIVE STRENGTH FOR GROUNDNUT SHELL POWDER



Fig 5.1 Testing of Cube



Fig 5.2 Failure of cube

Table 5.1 Compressive strength for cube

Casting Date	01.02.2024
Testing Date	08.02.2024,15.02.2024,29.02.2024
Mixing Ratio	M20,10% Admixture
Admixture Material	Groundnut 10% Added

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Compressive Strength (N/mm²)
1	C1	7	8.321	150x150	22500	300	13.33
2	C2	14	8.428	150x150	22500	410	18.22
3	C3	28	8.216	150x150	22500	455	20.22

Sample Details: Cube

Casting Date	01.02.2024
Testing Date	08.02.2024,15.02.2024,29.02.2024
Mixing Ratio	M20,20% Admixture
Admixture Material	Groundnut 20% Added

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Compressive Strength (N/mm²)
1	C1	7	8.568	150x150	22500		13.11
2	C2	14	8.395	150x150	22500	395	18.00
3	C3	28	8.617	150x150	22500	463	20.57

Sample Details: Cube

Casting Date	01.02.2024
Testing Date	08.02.2024,15.02.2024,29.02.2024
Mixing Ratio	M20,30% Admixture
Admixture Material	Groundnut 20% Added , Silica 10%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Compressive Strength (N/mm²)
1	C1	7	8.235	150x150	22500	290	13.00
2	C2	14	8.518	150x150	22500	388	17.24
3	C3	28	8.423	150x150	22500	475	21.11

Casting Date	02.02.2024
Testing Date	09.02.2024,16.02.2024,01.03.2024
Mixing Ratio	M20,40% Admixture
Admixture Material	Groundnut 30% Added , Silica 10%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Compressive Strength (N/mm²)
1	C1	7	8.218	150x150	22500	291	12.93
2	C2	14	8.361	150x150	22500	379	17.00
3	C3	28	8.415	150x150	22500	399	18.00

Sample Details: Cube

Casting Date	01.02.2024
Testing Date	09.02.2024,16.02.2024,01.03.2024
Mixing Ratio	M20,50% Admixture
Admixture Material	Groundnut 40% Added , Silica 10%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm ²)	Failure Load (KN)	Compressive Strength (N/mm ²)
1	C1	7	8.128	150x150	22500	210	9.33
2	C2	14	8.235	150x150	22500	293	13.02
3	C3	28	8.364	150x150	22500	305	16.00



Fig 5.3 Compression strength of cube

5.2 SPLIT TENSILE STRENGTH FOR CYLINDER



Fig 5.4 Testing on cylinder

Table 5.2 Split Tensile for cylinder

Casting Date	01.02.2024
Testing Date	08.02.2024,15.02.2024,29.02.2024
Mixing Ratio	M20,10% Admixture
Admixture Material	Groundnut 10% Added

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Split Tensile Strength (N/mm²)
1	CI 1	7	12.221	150x300	45000	115	1.62
2	CI 2	14	12.128	150x300	45000	150	2.12
3	CI 3	28	12.216	150x300	45000	200	2.82

Sample Details: Cylinder

Casting Date	01.02.2024
Testing Date	08.02.2024,15.02.2024,29.02.2024
Mixing Ratio	M20,20% Admixture
Admixture Material	Groundnut 20% Added

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Split Tensile Strength (N/mm²)
1	CI 1	7	12.326	150x300	45000	123	1.73
2	CI 2	14	12.245	150x300	45000	162	2.29
3	CI 3	28	12.152	150x300	45000	221	3.12

Sample Details: Cylinder

Casting Date	01.02.2024
Testing Date	08.02.2024,15.02.2024,29.02.2024
Mixing Ratio	M20,30% Admixture
Admixture Material	Groundnut 20% Added, Silica 10%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Split Tensile Strength (N/mm²)
1	CI 1	7	12.168	150x300	45000	130	1.83
2	CI 2	14	12.235	150x300	45000	170	2.40
3	CI 3	28	12.346	150x300	45000	228	3.22

Sample Details: Cylinder

Casting Date	02.02.2024
Testing Date	09.02.2024,16.02.2024,01.03.2024
Mixing Ratio	M20,40% Admixture
Admixture Material	Groundnut 30% Added, Silica 10%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Split Tensile Strength (N/mm²)
1	CI 1	7	12.178	150x300	45000	110	1.55
2	CI 2	14	12.258	150x300	45000	148	2.09
3	CI 3	28	12.312	150x300	45000	195	2.75

Sample Details: Cylinder

Casting Date	01.02.2024
Testing Date	09.02.2024,16.02.2024,01.03.2024
Mixing Ratio	M20,50% Admixture
Admixture Material	Groundnut 40% Added, Silica 10%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Split Tensile Strength (N/mm²)
1	CI 1	7	12.221	150x300	45000	105	1.48
2	CI 2	14	12.128	150x300	45000	135	1.90
3	CI 3	28	12.216	150x300	45000	180	2.54

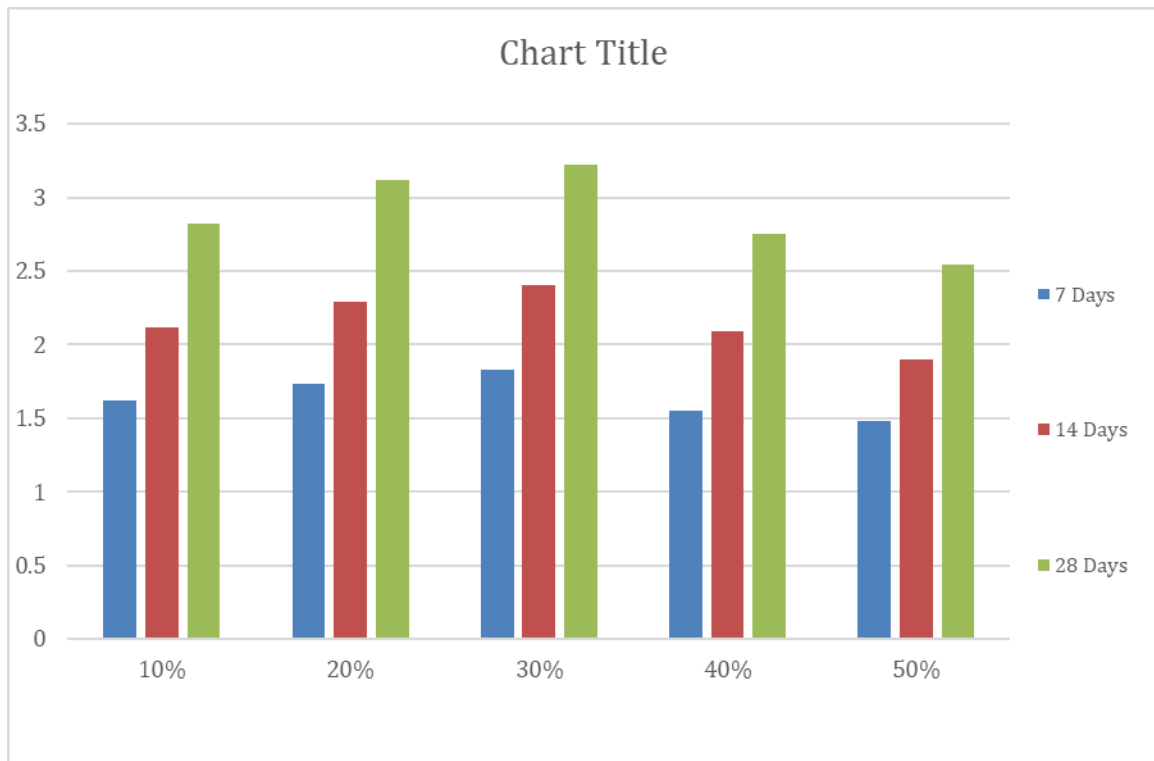


Fig 5.5 Split tensile strength of cylinder

5.3 FLEXURAL STRENGTH OF BEAM



Fig 5.6 Testing of flexural strength of beam



Casting Date	01.02.2024
Testing Date	08.02.2024,15.02.2024,29.02.2024
Mixing Ratio	M20,10% Admixture
Admixture Material	Groundnut 10% Added

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm ²)	Failure Load (KN)	Flexural Strength (N/mm ²)
1	B1	7	12.060	500x100	50000	17	2.88
2	B2	14	12.071	500x100	50000	23	3.35
3	B3	28	12.050	500x100	50000	27	3.36

Casting Date	02.02.2024
Testing Date	09.02.2024,16.02.2024,01.03.2024
Mixing Ratio	M20,20% Admixture
Admixture Material	Groundnut 20% Added

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Flexural Strength (N/mm²)
1	B1	7	12.128	500X100	50000	15	2.71
2	B2	14	12.261	500X100	50000	24	3.42
3	B3	28	12.167	500X100	50000	26	3.56

Casting Date	01.02.2024
Testing Date	08.02.2024,15.02.2024,29.02.2024
Mixing Ratio	M20,30% Admixture
Admixture Material	Groundnut=20%, Silica 10%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm²)	Failure Load (KN)	Flexural Strength (N/mm²)
1	B1	7	12.233	500X100	50000	16	2.8
2	B2	14	12.256	500X100	50000	21	3.20
3	B3	28	12.010	500X100	50000	28	3.70

Casting Date	02.02.2024
Testing Date	09.02.2024,16.02.2024,01.03.2024
Mixing Ratio	M20,40% Admixture
Admixture Material	Groundnut=30%, Silica 10%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm ²)	Failure Load (KN)	Flexural Strength (N/mm ²)
1	B1	7	12.060	500x100	50000	13.5	2.57
2	B2	14	12.071	500x100	50000	18.4	3.00
3	B3	28	12.050	500x100	50000	20.8	3.19

Casting Date	02.02.2024
Testing Date	09.02.2024,16.02.2024,01.03.2024
Mixing Ratio	M20,50% Admixture
Admixture Material	Groundnut = 30%, Silica 20%

S. No	Sample Code	Age of Cube (Days)	Weight of Sample (kg)	Size (mm)	Area (mm ²)	Failure Load (KN)	Flexural Strength (N/mm ²)
1	B1	7	12.331	500x100	50000	12.9	2.51
2	B2	14	12.335	500x100	50000	16.2	2.81
3	B3	28	12.345	500x100	50000	18.9	3.04

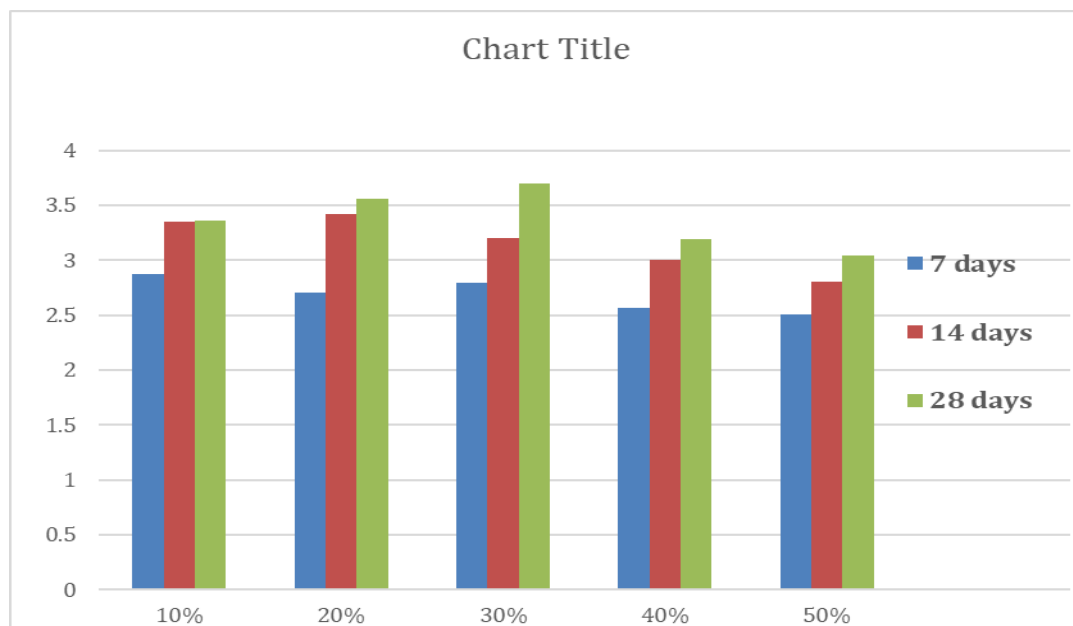


Fig 5.7 Flexural strength for beam

CHAPTER 6

SUMMARY AND CONCLUSION

Based on the experimental investigations carried out, the following conclusions are made:-

- It is observed that the compressive strength and split tensile strength & flexural strength for M₂₀ concrete.
- The compressive strength, split tensile strength and flexural strength of reinforced concrete composed with groundnut shell powder is found to be maximum at 30%.
- The maximum compressive strength is obtained about 19.19N/mm² for groundnut shell powder at 28 days for 30% as a replacement
- It is observed that compressive strength between groundnut shell powder reinforced concrete and conventional concrete is 30% higher.
- The maximum split tensile strength is obtained about 2.89N/mm² for groundnut shell powder at 28 days for 30% as a replacement.
- The maximum flexural strength is obtained about 3.37N/mm² for groundnut shell powder at 28 days for 30% as a replacement.
- It is observed that split tensile strength between groundnut shell powder reinforced concrete and conventional concrete is 30% higher.
- It is found that workability of concrete gets reduced with the increase in groundnut shell powder content.

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