

**Experimental and Numerical Investigation on
Cellular light weight Concrete Block- An alternate
for conventional blocks**

Submitted in partial fulfillment of the requirements for the
award of Bachelor of engineering degree in civil engineering

By

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SATHYABAMA

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

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SRIVISHAL E (REG 38200901)** and **SAI VIKAS T (Reg.No.38200038)** carried out the project entitled "**Experimental and Numerical Investigation on Cellular light weight Concrete Block – An alternate for conventional bricks**" under my supervision from December 2021 to April 2022.


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DECLARATION

We **SRIVISHAL E (REG.NO. 38200901)** and **SAI VIKAS T (Reg.No.38200038)** hereby declare that the project report entitled "**Experimental and Numerical Investigation on Cellular light weight Concrete Block – An alternate for conventional bricks**" done by us under the guidance of **Dr. C. Manoj Kumaar, M.E., Ph.D,** is submitted in partial fulfillment of the requirements for the award of **Bachelor of Engineering degree in Civil Engineering**

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ABSTRACT

Cellular lightweight concrete blocks are made by horizontally slicing a still plastic block of cellular concrete mass resting on a first support. The slices are then moved over one by one. The treatment prevents the body slices from cementing together during the subsequent steam-hardening process and may also improve the hardened slab quality. Blocks are a widely used building material all over the world for constructing walls, pavement, and other masonry elements. Clay is fired in high temperature kilns to make traditional blocks. Extensive research is being conducted on the production of blocks from industrial wastes due to a scarcity of natural resources used as raw materials in the manufacturing of blocks. This paper describes an experimental study conducted on fly ash blocks. As a result, the current investigation was undertaken in order to confirm the suitability, feasibility, and potential use of *Prosopis juliflora* (seemai karuvela maram). The wood of *Prosopis juliflora* has been converted into ash for use as a partial replacement for cement. This investigation also aims to make efficient use of waste materials, as fly ash is a byproduct of thermal power plants. Various tests, such as the compressive strength test and the water absorption test, are used to investigate the properties of the cellular blocks. For testing and validation of the new type of block, 10%, 20%, and 30% fly ash have been added.

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LIST OF SYMBOLS AND ABBREVIATIONS

ACRONYMS	EXPANSIONS
Kg	kilograms
%	percentage
KN	Kilo Newton
Mm	millimeter
M ²	meter square
M [^]	Meter c
P j	Prosopsis juliflora
FEA	Fine element analysis

CHAPTER 1

INTRODUCTION

1.1 GENERAL

A block is a masonry building material used to construct walls, pavements, and other features. The term block originally referred to a clay unit, but it is today used to refer to any rectangular unit put in mortar. Fired blocks were used in the olden days. Burnt blocks, also known as synthetic stone, are one of the most durable and powerful building materials, having been used since 5000 BC. Air-dried blocks, also known as mud blocks, have a longer history than fired blocks and include a mechanical binder such as straw. Blocks are set in guides in a variety of styles called bonds, which are combined to form blockwork, and can be laid in a variety of mortars to keep the blocks together and create a long-lasting structure. *Prosopis juliflora* is a tree that absorbs a lot of water from the ground and the air. The Tamil Nadu government just began uprooting the tree with the assistance of pwd. As a result, *Juliflora* has been widely used in industries, power plants, incineration, and other processes, resulting in increased residue formation. Industrial trash (waste) is accumulating to a significant extent, causing environmental and economic problems. A block is a type of masonry material that is used to build walls, pavements, and other structures. Originally, the term block referred to a clay unit, but it is now used to describe to any rectangular block set in mortar. Back in the day, fire blocks were used. Burnt blocks, also known as synthetic stone, have been utilised in construction since 5000 BC and are one of the most durable and powerful building materials. Air-dried blocks, also known as mud blocks, are older than burnt blocks and contain a mechanical binder such as straw. Concerns over their disposal have been raised by the omics community. Because cement produces a large amount of greenhouse gases, experts are forced to look for alternatives, such as sustainable building practices. The research on using *Prosopis Juliflora* ash as a partial replacement for cement in cellular light-weight concrete blocks is summarised in this publication. The biomass (herbaceous material, wood, or bark), the burning method (fixed bed or

fluidized bed), and the collection location all influence the ash's characteristics. Wood ash is a potential concern since it is largely made up of small particles that can easily be transported into the air by winds, creating respiratory difficulties in those who live near the dump site or poisoning groundwater by leaching harmful compounds into the water. A long-term ash management approach that incorporates ash into natural cycles is essential as the cost of ash removal rises and the volume of ash expands.

CHAPTER 2

LITERATURE REVIEW AND METHODOLOGY

2.1 GENERAL

First and primarily, various books and journals were collected for reference and studied prior to beginning project work in order to have an idea of how the project should be. Alternative building blocks are used in this project. As a result, the fundamental and essential characteristics of blocks were first investigated.

2.2 LITERATURE SURVEY

Santha Kumar, et al, (August 2021) Investigation of the possibility of using GFP as a basis of alternative resources for the manufacture of CLWC. In this investigation, the weight ratios of GFP to binder were 0.8: 1, 1: 1, and 1.2: 1. In this research, we tested three different foam binder ratios: 0.025, 0.05, and 0.1. Experimental results showed that the foam file ratio had a greater result on CLWC's flow capacity, compliance, strength, absorption, and permeability voids compared to the GFP binder ratio. As shown by microscopic image analysis, the GFP binder ratio and foam binder ratio have a important effect happening the distribution of CLWC voids in the fresh and cured stages.

Vinoda, et al, (November 2021) to investigate Waste disposal is one of the most challenging for engineers. As a result, waste materials such as EPS (expanded polystyrene) have been incorporated into solid concrete blocks to provide an alternative. Quarrying and processing operations have so had a lower environmental and economic impact. When compared to alternative materials like steel and wood, Cost reductions, rapid compaction, and ease of use are just a few of the benefits of lightweight foamed concrete. Purity of water, Compressive strength and thermal conductivity tests were performed on hardened blocks loaded with EPS beads.

Abrahama, et al, (November 2021) Investigating the quality of 1200 kg / m³

foam concrete made from palm oil industrial waste, specifically palm oil fuel ash with 10-fold substitution and palm oil clinker with 50% and 100% sand substitution. To do. Six different foam concrete mixtures were ready and subjected to fresh density, flow table, ultrasonic pulse rate (UPV), compressive strength, and cleavage stress tests. The results show that using 10% POFA as a cement substitute and 50% POC sand gives the required structural strength. The combination with POC100POFA10 showed maximum compressive strength during air curing. On the other hand, the blend with POC50 showed the highest compressive strength under water curing.

Fuat Koksak Emrah, et al, (March 2020) To analyse Mortar is being studied as one of the most crucial components of cement-based mixtures. Aggregate also has a great outcome on the things of mortar. Usual and creased fine aggregates are widely applied in the production of mortar for a variety of uses and purposes, including energy savings in buildings and plants. Vermiculite and discarded polystyrene are used as aggregates in mortar. Reduces both unit weight and thermal conductivity. This is important for insulation. Mortars were created using five different ratios of vermiculite + polystyrene / cement, namely 3, 4, 5, 6, and 7. Each ratio was tested with 100% vermiculite by volume and 100% polystyrene, and 25%, 50%, and 75% combinations. The mortars, each measuring 4 x 4 x 16 cm in diameter, were manufactured to study physical, mechanical and thermal properties. Due to the very high porosity of up to 67.2%, it was found that vermiculite and polystyrene can be used in the mortar to produce mortars with density levels of 393-946 kg / m³. This affects thermal conductivity, reducing 0.09 W / mK is possible. The compressive strength ranges from 0.57 to 5.89 MPa.

Abhishek Jain, et al, (November 2020) Investigate the use for the long-term manufacturing Granite waste (GW) and fly ash are used to make self-filling concrete. as an alternative to fine aggregate and cement (SCC). Slump was used to assess new homes. T500 flow, Vfunnel, Jring, and Lbox tests, and curing properties were evaluated ultimate strength, bending strength, water absorption, and ultrasonic pulse velocity tests were used to determine the strength of the material. Rice field. According to the data, the integration of GW adversely affected the freshness

attribute. Fly ash, on the other hand, has improved freshness characteristics and partially compensated for the adverse effects of GW on freshness characteristics. Adding GW to the SCC blend improved toughness properties.

Ajay Chourasia, et al, (May 2020) The goal of this research is to look into the seismic performance of constrained masonry (CM) structures using a new lightweight cellular (LWC) panel under displacement controlled quasi-static reverse periodic sideway loads. .. The LWC panel measures 590270140 mm and has four vertical holes 60 mm in diameter and a trough-shaped groove 35 mm high for locking along the overall length. Using a 140 mm widewall and a 100 mm thick reinforced concrete (RC) slab, we built a full-scale CM building with floor plans of 2.91 m, 2.91 m and a height point of 3.01 m. The two vertical holes in the slab were filled with 8 mm diameter vertical rebar infused with M20 concrete during the construction of the CM building. A 140mm RC tie column with four 10mm diameter reinforcing bars was inserted into the corner, and the other two were exposed.

Giuseppe, et al, (2019) This study examines the effect of sawdust on the rock physics of hard blocks. Block samples were collected using clay soils rich in quartz and phyllosilicates and high in carbonate content, without the use of chemicals. Sawdust was added in 2.5% by weight, 5% by weight and 10% by weight to prepare similar blocks. The blocks were fired in an electric furnace at 800 degrees Celsius, 950 degrees Celsius, and 1100 degrees Celsius. The inclusion of sawdust did not affect the mineralogy of burned blocks. The most refractory block was the block with a sawdust content of 10% at 800 ° C. When the salt crystallization test was performed, the block with the least amount of sawdust and the most fire temperature was the most elastic. As the temperature of the fire increased, the concentration of quartz decreased, carbonates and layered silicates disappeared, and new silicates (zeiginite, wollastonite, anorthite, diopside) were formed.

Wong Lee, et al, (June 2020) To address some limitations of rock-filled gabions, this study proposes lightweight concrete foam as an alternative pad material. The effectiveness of concrete foam used to protect reinforced concrete barriers from falling rocks has been investigated in large pendulum impact tests. Six bouldering hits were performed in succession with an energy of up to 70 kJ.

Researchers have investigated the thickness of two different concrete foams. It is 0.4m and 0.6m. If the collision energy is 70kJ, The maximum transfer load can be reduced by 48 percent and 71 percent by increasing the pad thickness from 0.4m to 0.6m. Sixth influence. The better the load distribution to the wall and the lower the stress concentration, the thicker the cushion. In addition, the maximum penetration depth of 0.4 m thick concrete foam at the 6th collision with an impact energy of 70 kJ is 0.29 m, which is 72% of the original damping layer thickness. According to current design standards (ASTRA 2010) and Gibson and Ashby models, For up to 6 successive impacts with an impact energy of 70 kJ, a minimum thickness of 0.58 m is required.

Xin Liu, et al, (November 2021) To investigate the common filler for subsoil is aerated concrete (LCC). LCC quality inspection during casting builds quality control and saves time, but little research is done. LCC proposed surface strength and strength along the depth in this study. field test equipment and methods. Based on actual technical cases in Guangdong Province, using the proposed measuring equipment and methods, LCC proposed surface strength and strength along the depth in this study.

Mustafa Sarıdemir, et al, (December 2021) To study the effects of binary composites on the mechanical, microstructure and durability of alkaline activated lightweight concrete (AALWAC) containing basalt pumice, the main purpose of this study is mechanical, microstructure and durability. To study the effect of two-component composites on. Contains the characteristic of AALWAC, basalt pumice (BP). Blast furnace slag (GGBFS) and fly ash (FA) are used as preliminary steps, and the $\text{SiO}_2 / \text{Na}_2\text{O}$ ratio of sodium silicate (Na_2SiO_3) and caustic soda (NaOH) is used as the activator (Ms). AALWAC's compressive strength (f_c), bending strength (f_{fs}), split strength (f_{sts}), and water absorption are all evaluated. AALWAC FC and weight loss are also assessed individually when exposed to high temperatures, acid and sulfate loads. X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), and polarizing microscopy (PLM) studies are used to study the effects of high temperatures on the microstructure of AALWAC.

SEM and PLM studies show that as the temperature of AALWAC increases, so does the deterioration, modification, discoloration, porosity, and cracking of the microstructure.

Sajan, et al, (October 2019) In summary, foamed concrete is an innovative and versatile building material composed of cement and fine aggregate combined with at least 20% air bubbles. These lightweight foam concrete blocks with bulk densities of less than 1800 kg / m³ allow for the production of tight spaces. On the other hand, foamed concrete blocks have high heat insulation and are easily accepted by the construction industry. This study details the further development of foam concrete using fly ash as a cement alternative. The addition of fly ash in an amount of 40% by weight of cement proved to be advantageous.

Premrudee Kanchanapiya, et al, (August 2018) To investigate which blends are optimal for making lightweight concrete from polyisocyanurate waste. The examination takes into account the manufacturing process's technical qualities as well as its economic viability. The ideal composition was presented and debated. The manufacture of LWC-PIRW is economically possible, according to the economic feasibility analysis.

Xin Liu, et al, (August 2020) In this article, we considered the strengthening mechanism of fly ash-filled LCCs (LCCFFAs) in terms of microstructure such as porosity and skeletal properties. The rules of variation in mean pore size (PS), pore roundness value (PRV), and fractal dimension (FDPD) of pore distribution were described using different fly ash contents. Microscopic PS, PRV, and FDPD properties have been found to be associated with overall compressive strength and wetness density. Differences in skeletal structure evolution between LCCs and LCCFFAs were also investigated, suggesting that the differences were related to the effects of fly ash bead and particle loading 28 days ago. On the other hand, the pozzolan reaction of fly ash and the hydration reaction of cement mutually reinforce the densification of the skeletal structure after 28 days. Finally, we examined the SEM energy spectral plot to clarify the amplification mechanism in more detail.

Vinith Kumar, et al, (August 2018) To explore the foam concrete consists of

cement, fly ash, water and an air gap. The foam is made of the foaming agent sodium lauryl ether sulfate. Effervescent concrete is a lightweight material with a high air content of 10% to 70% and low compressive strength and durability. Studies have shown that the fewer air gaps connected, the less the decrease in compressive strength, but the greater the number of air gaps, the greater the thermal resistance. Examine the thermal resistance and compressive strength. Six separate batches of foam concrete were created, using different air concentrations of 15%, 17%, and 20%, respectively. Foam concrete cubes and plates are used for pressure and heat testing. The dry density of foam concrete is in the range from. The compressive strength of foam concrete ranges from 2.5 to 6.5 MPa and the dry density ranges from 860 kg / m³ to 1245 kg / m³.

AmrithaRaj, et al, (June 2019) To investigate the comprehensive examination of the physical and functional properties of foam concrete. An in-depth examination of foamed concrete's components, fresh state, and physical properties. A brief overview of foam concrete made from various types of foam. A variety of mechanical and functional properties are also presented. A brief overview of the various applications of foam concrete is also provided.

Supratic Gupta, et al, (September 2021) To analyseWaste tyre rubber is an environmentally friendly building material. Rubberized concrete's thermal resistance, sound absorption, and vibration damping are summarised (RC). The size, texture, and amount of doped rubber all have a significant impact on the properties of RC. For non-structural applications, RC is recommended to reduce energy loss, noise, and vibrations.

Chinnu, et al, (July 2021) To explore The utilisation of industrial and agricultural by products in lightweight concrete is examined. It is reported that 14 by-products were recycled as aggregates in lightweight concrete. The use of nine by products as pozzolans in lightweight concrete is discussed. Changes in the properties of fresh and hardened lightweight concrete are specified. Lower replacement levels of lightweight concrete result in improved performance.

Shrikant Harle, et al, (2019) To explore, the falling weight deflectometer

(FWD) and cores taken from concrete road slabs were tested on ordinary cement concrete pavements installed in Mumbai city in the early days. A test of ultrasonic pulse velocity (UPV) was performed prior to crushing the concrete cores. The deflections were found to be within the limits stipulated by Indian codes as well as studies conducted in other regions of the world during the tests. Aside from that, a concrete pavement model is required to check stresses and strains. The many components of stress and strain are visualised using software graphics. The stress, strain, and deformation of the model after traffic loads are discussed in this work.

2.3 METHODOLOGY

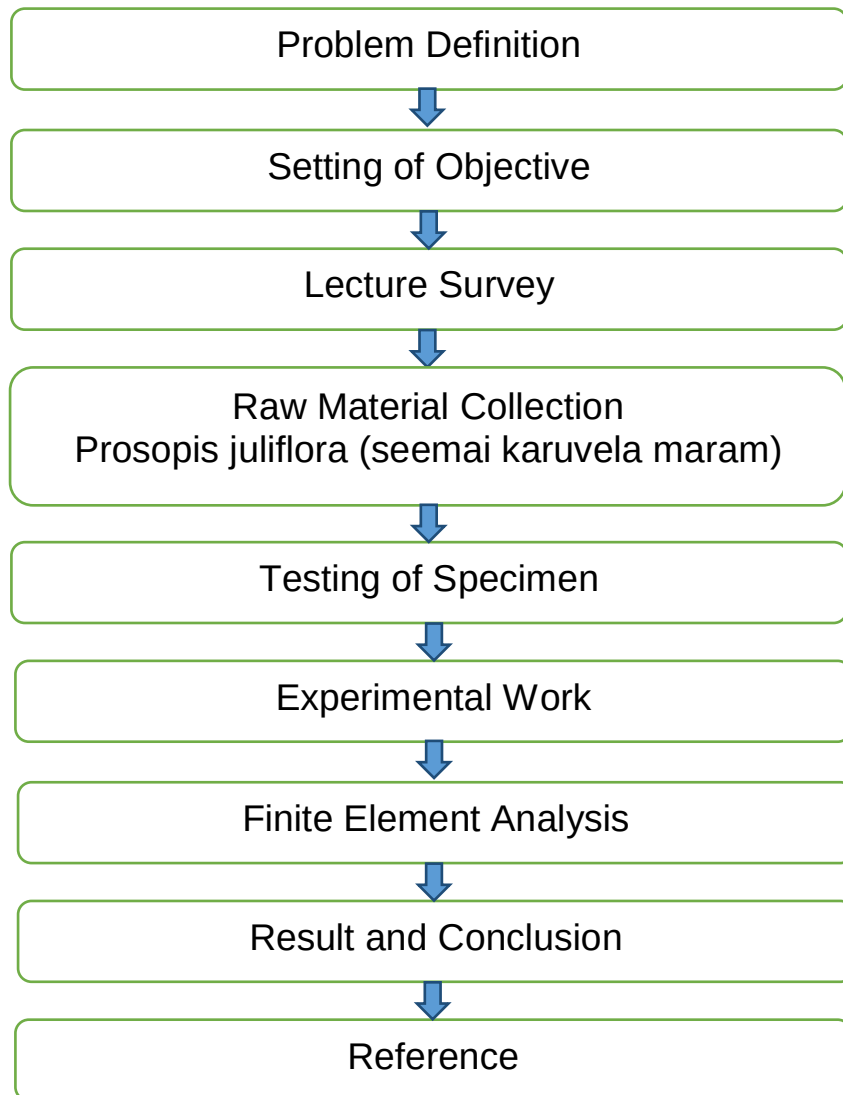


Fig 2.1: Methodology

CHAPTER 3

AIM AND SCOPE

3.1. OBJECTIVE

1. To investigate the physical properties of the materials used in cellular light weight concrete blocks
2. To investigate the water absorption test for the cellular light weight concrete blocks
3. To study the compressive strength of blocks, flexural test by laboratory experiments for different days of curing.
4. To investigate the numerical analysis and experimental characterization of cellular light weight concrete blocks.

3.2 SCOPE

1. Cellular light weight concrete block has greater strength than the burnt clay block
2. Cellular light weight concrete block has less weight compared to the burnt clay block
3. By using PJ ash it increases the underground water level
4. It is also investigated that the project's final output will have a positive impact on the use of PJ ash concrete in civil engineering construction projects.

CHAPTER 4

MATERIALS AND METHODS

4.1. COLLECTION OF RAW MATERIALS

The chosen material are Prosopis Juliflora fly ash material as to chosen because of easy availability on all place and reduce on the cost of manufacturing block.

4.1.1 Prosopis Juliflora Ash (PJ Ash):

A prosopis juliflora is a plant that has been declared unfit for a certain situation, or "a plant in the wrong place." Common examples are plants that are undesired in human-controlled habitats such as farm fields, gardens, lawns, and parks. The term "prosopis juliflora" has no botanical significance because a plant that is a prosopis juliflora in one context is not a prosopis juliflora in another, and where one species of plant is a valuable crop plant, another species in the same genus could be a serious Prosopis juliflora, such as a wild bramble growing among cultivated loganberries.

In gardens and other cultivated places, many plants that are easily confused for prosopis juliflora are planted. Any plant that grows or reproduces rapidly outside of its normal habitat, or is invasive, can be described as invasive. Outside of the plant world, the term "prosopis juliflora" is sometimes used to disparage species.

Table 4.1 Physical and chemical Properties of Prosopis juliflora (PJ Ash)

Tests	Prosopis Juliflora Ash (PJ Ash)
Physical Properties	
Specific Gravity	2.8
Consistency	23%
Chemical properties	
Calcium oxide	59.45%
Potassium oxide	23.85%
Sulfur trioxide	4.44%
Magnesium oxide	1.70%
Silicon dioxide	1.19%
Sodium oxide	0.84%
Ferric oxide	0.57%



Fig 4.1: Prosopis Juliflora



Fig 4.2: Collecting the sample of Prosopis Juliflora



Fig 4.3: Prosopis Juliflora Ash (PJ Ash)

4.1.2 Cement

Cement of grade 53 can be used for bending of material. Portland pozzolana cement accommodate to IS: 269-1976 and IS: 7031-1968 was used in this study. The cement is of 53grade and the tests conducted on cement are tabulated.

Table 4.2 Physical and chemical Properties of cement

Tests	Cement
Physical Properties	
Specific Gravity	3.18
Consistency	25%
Initial setting Time	30 minutes
Final setting time	550 minutes
Chemical Properties	
Calcium oxide	63.12%
Potassium oxide	0.63%
Sulfur trioxide	1.43%
Magnesium oxide	2.16%
Silicon dioxide	24.52%
Sodium oxide	0.44%
Ferric oxide	3.51%

4.1.3 Water

All raw materials can be mixed with water. As well as binding for the block's construction. For mixing and curing the block, ordinary potable tap water from the laboratory was used.

Table 4.3 Properties of water

S.No	Property	Value
1.	P _h	7.1
2.	Taste	Agreeable
3.	Appearance	Clear

4.1.4 River Sand

River sand is a naturally occurring sand that is collected from riverbanks. It is the most common sort of sand used in building. River sand is sand with small particles. It has a silky feel to it. As a result, it's employed for plastering projects that demand a flawless finish, as well as RCC projects.

River sand has a whitish-grey hue to it. This sand binds well with cement, aggregates, and water to build concrete because of its smooth and fine texture. River sand is widely utilized in construction since it is less expensive than other types of sand because it is collected naturally.

4.1.5 Specific Gravity Test

Using a Le Chatelier flask or a specific gravity bottle, determine the specific gravity of cement. Weigh a Le Chatelier Flask or Specific Gravity Bottle with its cork that is clean and dry (W1). Fill the flask halfway with cement (approximately 50 grammes) and weigh it with the cork (W2). Fill the flask with kerosene (polar liquid) until it is about half filled. To release entrapped air, thoroughly mix with a glass rod. Stir in more kerosene until the liquid is flush with the graduated mark. Weigh the outside after drying it (W3). If a vacuum pump is available, entrapped air can be evacuated. Clean the flask and replace it with clean kerosene to the graduated mark. Afterwards, dry the outside and weigh it (W4)

4.1.6 Consistency Test

The consistency of cement paste is described because the consistency that lets in the Vicat plunger to penetrate to a intensity of 5-7 mm from the lowest of the Vicat mold. In order to decide the preliminary therapy time, very last therapy time, cement strength, and cement compressive strength, it's miles vital to decide the quantity of water sure to the cement in every scenario. In this experiment, a Vicat equipment is used to decide the quantity of water that desires to be brought to a selected cement to supply a cement paste with ordinary consistency.

4.2. Specimen Preparation

In this project, we can design for the 4 types of specimen by change in the admixture of blocks. The different admixture are

Clc 0: 0% Prosopis JulifloraPJ ash for cement

Clc 10: 20% Prosopis Juliflora(PJ ash) for cement

Clc 20: 30% Prosopis Juliflora(PJ ash) for cement

Clc 30: 30% Prosopis Juliflora (PJ ash) for cement

4.3. STANDARD MIX DESIGN

The M15 grade block was designed in this study. The weight proportion of the mix is 1:4, with a water cement ratio of 0.4. It was suggested that the qualities of block be investigated.

Physical properties of materials utilised in the experiment were determined in this experiment. In potable water, M15 grade reference block was combined and cured.

Table 4.4 Mix Design of samples

SAMPLES	CEMENT (grams)	PJ ASH (grams)	SAND (grams)	WATER CEMENT RATIO
Clc 0	667	0	2.688	0.4
Clc 10	600	67	2.688	0.4
Clc 20	537	134	2.688	0.4
Clc 30	469	201	2.688	0.4

4.4 TESTING OF SPECIMEN

The compressive testing equipment and the water absorption test will be used to test the prepared portion.

4.4.1 Compression Strength Test

The block's compression strength bears the brunt of the load. At an age of 7,14,28 days, the crushing strength of block is commonly described and assessed by 215mm x 102.5mm x 65mm. Because it is straightforward to excute and because most of the desirable qualities of a block are qualitatively related to its compressive strength, it is the most common test on hardened block. A wooden mould made of Tee wood with dimensions of 215mm x 102.5mm x 65mm was used to cast the block filled. The mould and its base were tightly damped together to prevent leakage during casting. After 7, 14, or 28 days of curing, the block is put through its paces on a compression machine.



Fig 4.4: Compression Test on Block

Average Compressive strength = Avg. Load / Area of material

Table 4.5 Readings of Compression strength

S.No	Material	Avg. Load on 7 days curing (KN)	Avg. Load on 14 days curing (KN)	Avg. Load on 28 days curing (KN)	Avg. Compressive Strength @7 days(N/mm ²)	Avg. Compressive Strength @14days(N/mm ²)	Avg. Compressive Strength @28days(N/mm ²)
1	Clc	395	562	802	19.85	24.60	30.14
2	Clc 10	421	574	812	19.1	26.90	36.65
3	Clc 20	487	620	842	21.29	28.10	38.20
4	Clc 40	452	615	818	20.5	27.90	37.11

4.4.2 Water Absorption Test

The water absorption test can be used to determine the hybrid material's absorption value. After 14 days of being removed from the form, the average dry weight of block specimens can be measured. The average weight of block specimens after one day of immersion in water. For each block specimen, the percentage of water absorption was assessed, which provided an indirect indication of durability. (Block size:215mm x 102.5mm x 65mm)

Wet Weight – Dry Weight = Water Absorption Percentage



Fig 4.5: water absorption test

Table 4.6 Readings of Water Absorption

Mix Proportion	Initial water 7days (kg)	Final water 7 days (kg)	Water absorption 7 days %
Clc	3.094	3.294	6.5
Clc 10	3.640	3.771	3.5
Clc 20	3.927	4.048	3.0
Clc 30	3.795	3.930	3.5

Mix Proportion	Initial water 14 days (kg)	Final water 14 days (kg)	Water absorption 14 days %
Clc	3.102	3.320	6.8
Clc 10	3.642	3.771	3.5
Clc 20	3.927	4.048	3.1
Clc 30	3.795	3.930	3.6

Mix Proportion	Initial water 28 days(kg)	Final water 28 days(kg)	Water absorption 28 days %
Clc	3.088	3.294	6.7
Clc 10	3.641	3.77	3.6
Clc 20	3.927	4.048	3.1
Clc 30	3.795	3.930	3.5

4.4.3 Flexural Strength Test

In a flexure test, flexural strength is defined as the stress that a material experiences immediately before it yields. It's sometimes called rupture modulus, bend strength, or fracture strength. The most typical test is the transverse bending test, which entails employing a three-point flexural test process to bend a specimen with a circular or rectangular cross-section until it fractures or gives. A material's flexural strength is the maximum stress it can withstand at the time of rupture. It's determined by how much stress you're experiencing. (150mmx50mmx700mm block size)



Fig 4.6: flexural strength test

Table 4.7 Readings of Flexural strength

S.No.	Material	Flexural strength(N/mm ²) 7 days	Flexural strength(N/mm ²) 14 days	Flexural strength(N/mm ²) 28 days
1	Clc	4.7	6.13	7.84
2	Clc 10	5.32	6.98	7.96
3	Clc 20	5.50	7.12	8.32
4	Clc 30	4.85	6.47	7.50

4.4.4 Numerical Analysis

Introduction to ANSYS

Ansys is a finite element computing tool that may be used to solve heat transfer and structural engineering problems. Static, elastic, plastic, thermal, stress, rigid stress, large deflection, bilinear element, dynamic analysis, model, harmonic response, linear time history, nonlinear time history, and heat transfer analysis are all capabilities of the ANSYS solution. One, two or three dimensional analyzes can be performed, with element harmonic and asymmetric options available ANSYS also comes with a comprehensive graphics package as well as significant pre- and post-processing capabilities.

Choosing the software

The first thing to examine is how structural mechanics knowledge can benefit you and your company. In order to investigate this, structural-mechanical functional areas should be examined. Under service load, structural analysis can be used to calculate linear static stresses and displacements in structures such as the vehicle body and engine. In addition, optimization may be required to build bodies with a specific offset while keeping material thickness as low as possible. A software requirements list should be drawn up to determine which of the available packages can be used. Most of the time, there will be no single package that will meet all of the standards, but there will be many packages that will meet parts of them.

Feature selection,

Any structures that would need to be explored in terms of geometry. This will tell whether a two-dimensional or three-dimensional problem-solving program is necessary. A static analysis procedure is outlined below.

The procedure for a static analysis consists of three main steps:

1. Create the model
2. Apply loads and get the solution

3. Check the results

1. Create the model:

To begin developing the model, define the element types, element real constants, material properties, and model geometry.

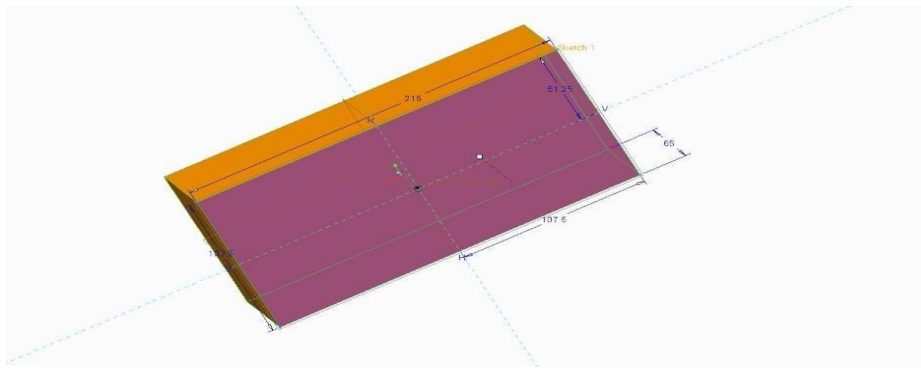


Fig 4.7: model of the block

2. Apply loads and get the solution:

In this stage, the loads (boundary conditions) are determined, and the solution is found.

3. Check the results:

Following the completion of the solution, the static analysis findings are presented in the post-processing stage.

Stress acting on the model

Table 4.8 Results of stress

Load N	Stress(MPa)
500	0.19532
1000	0.39064
1500	0.58597

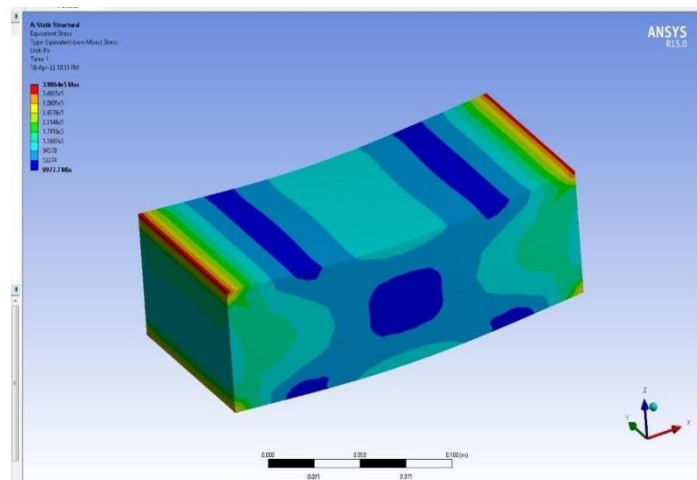
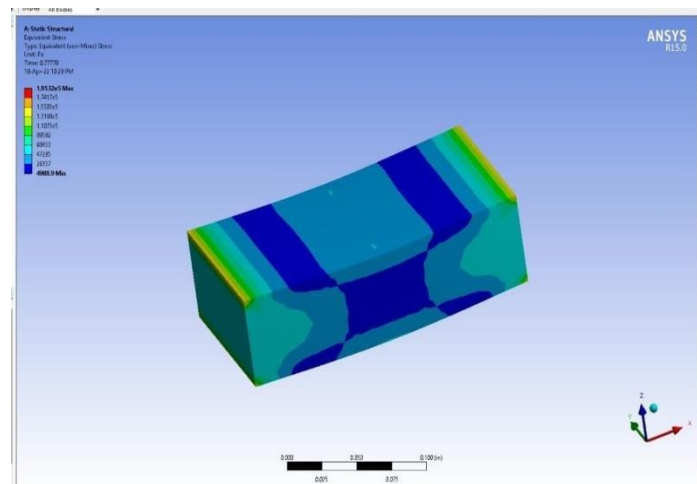
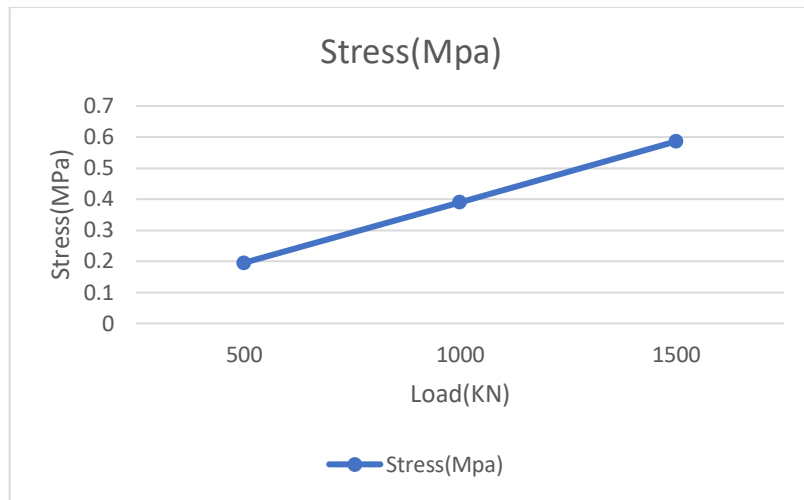


Fig 4.10: Stress load of 1000N

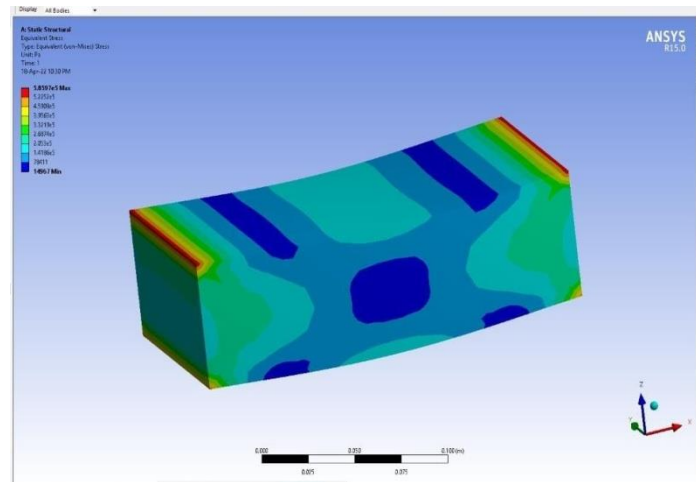


Fig 4.11: Stress load of 1500N

Table 4.9 Analysing different level stress acting on the block

S.No.	Stress acting on block in different coloures	The stress acting on 500N (MPa)	The stress acting on 1000N (MPa)	The stress acting on 1500N (MPa)
1	Red	0.19532	0.39064	0.58597
2	Orange	0.17417	0.34835	0.52258
3	Yellow	0.15303	0.30605	0.45908
4	Lime Green	0.13188	0.26376	0.39563
5	Green	0.11073	0.22146	0.33219
6	Light Green	0.089582	0.17916	0.33219
7	Aqua blue	0.068433	0.13687	0.2053
8	Turquoise	0.047285	0.09457	0.14186
9	Navy blue	0.026137	0.052274	0.078411

Table 4.10 Results of Deformation

Load (N)	Deformation (mm)
500	0.00038685
1000	0.0007737
1500	0.0011605

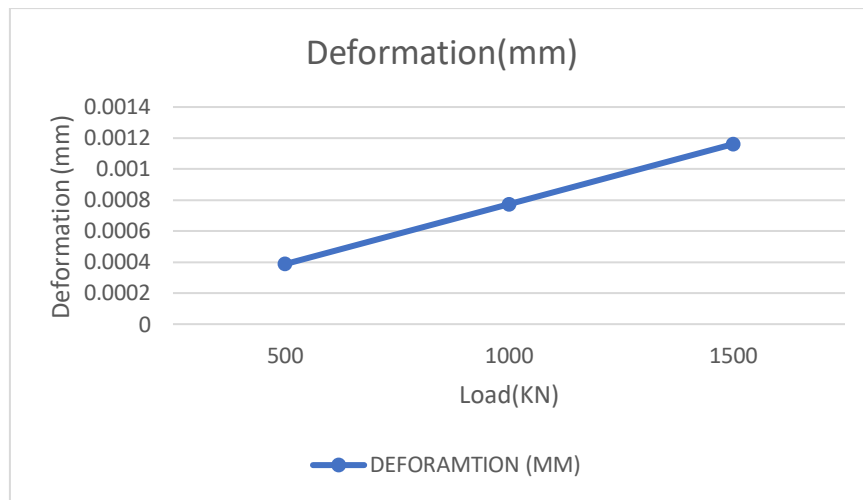


Fig 4.12: Graphical representation of Deformation

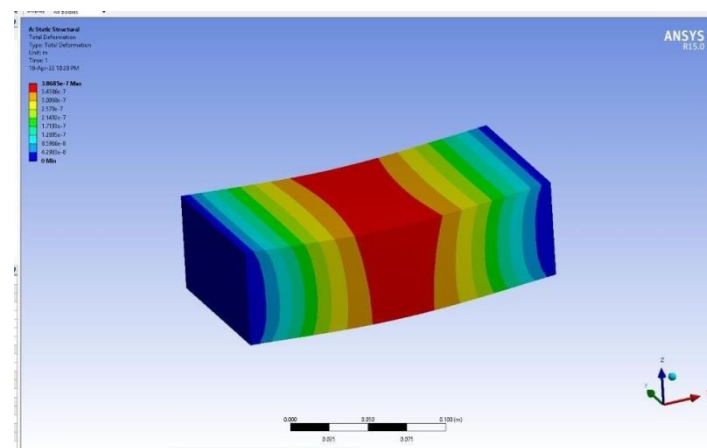


Fig 4.13: Deformation of model (500N)

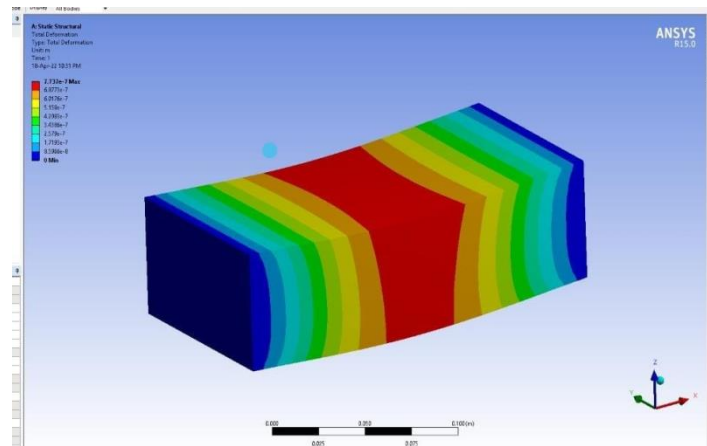


Fig 4.14: Deformation of model (1000N)

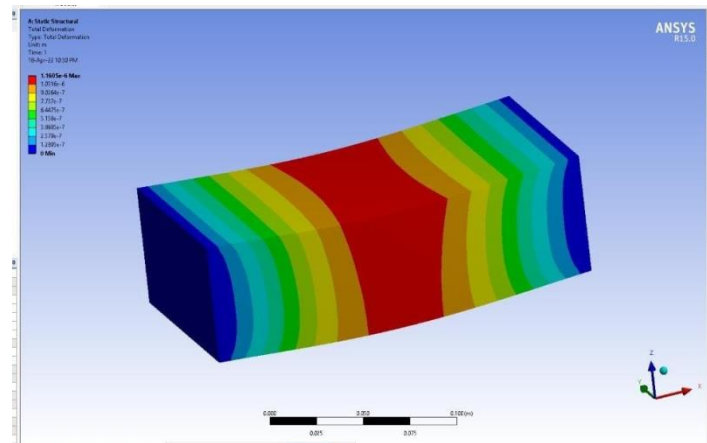


Fig 4.15: deformation of the block (1500N)

Table 4.11 Analysing different level deformation acting on the block

S.No	Stress acting on block in different colures	The stress acting on block at 500N(mm)	The stress acting on block at 1000N(mm)	The stress acting on block at 1500N(mm)
1	Red	0.00038685	0.0007737	0.0016055
2	Orange	0.00034386	0.00068773	0.0010316
3	Yellow	0.0003008	0.00060176	0.00090264
4	Lime Green	0.0002579	0.0005158	0.0007737
5	Aqua Blue	0.00021492	0.00042983	0.00064475
6	Light Green	0.00017193	0.00034386	0.0005158
7	Aqua Blue	0.0001289	0.0002579	0.00038685
8	Turquoise	0.000086	0.00017193	0.0002579
9	Navy Blue	0.000043	0.000085	0.0001289

CHAPTER 5

RESULTS AND DISCUSSION

5.1 RESULTS OF WATER ABSORPTION TEST

Here the mix Clc samples with 0% replacement of PJ Ash have high % of Water Absorption, but weightless when compared to other mixes Clc 10, Clc 20 ,Clc 30.

Mix Clc 30 samples with 30% replacement of PJ Ash has less % of Water Absorption and weighs slightly heavy when compared to mixes Clc & CLc 10 , but has high % of Water Absorption and weightless when compared to mix Clc 20.

Mix Clc 20 samples with 20 % replacement of PJ Ash has less % of Water Absorption, but weighs slightly heavy when compared to other mixes Clc, Clc 10& Clc 30.

Mix Clc 10 samples with 10% replacement of PJ Ash has less % of Water Absorption and weighs slightly heavy when compared to mix Clc, but has high % of Water Absorption and weightless when compared to mix Clc 20 & Clc 30.

The existence of minute pores confers marked capillary properties on block ceramics. In particular, all blocks absorb water by capillary action. With all replacements of PJ ash, the average value will be taken as a graph value.

Table 5.1 Results on water absorption test

Mix Proportion	Water absorption 7 days %	Water absorption 14 days %	Water absorption 28 days %
Clc	6.5	6.8	6.7
Clc 10	3.5	3.5	3.6
Clc 20	3.0	3.1	3.1
Clc 30	3.5	3.6	3.5

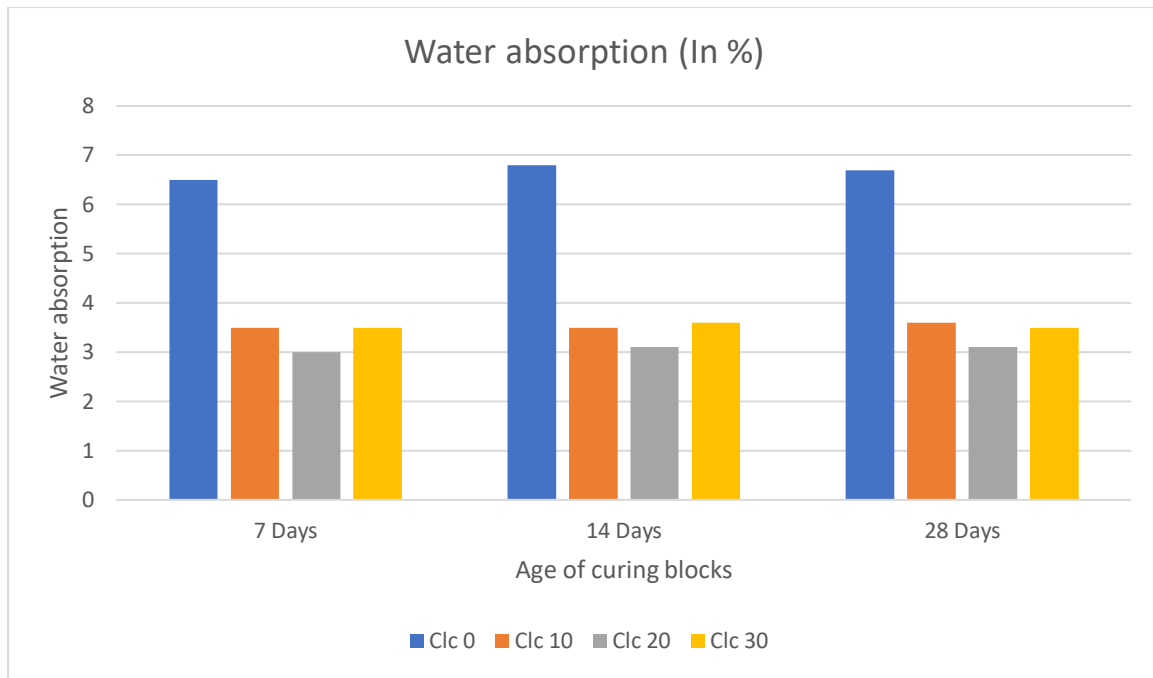


Fig 5.1: Graphical representation of water absorption test on 7, 14, and 28 days

5.2 RESULTS OF COMPRESSION TEST

These are the results of the Compression test after conducting the test:

Here the mix Clc samples with 0% replacement of Fly ash have less in Compressive strength when compared to other mixes.

Mix Clc 20 samples with 20 % replacement of PJ ash has high compressive strength, the sample from 28 days had the maximum compressive strength when compared to all other mixes

Mix Clc 30 samples with 30% replacement of PJ Ash has less compressive strength when compared to mix Clc 20 and have high compressive strength when compared to mix Clc & Clc 10.

Mix Clc 10 samples with 10% replacement of PJ ash has less Compressive strength when compared to mix Clc 20 & Clc 30 and have high compressive strength when compared to mix Clc.

Table 5.2 Results on compressive strength test

S .No	Material	Avg. Compressive Strength 7 days(N/mm2)	Avg. Compressive Strength 14 days(N/mm2)	Avg. Compressive Strength 28 days(N/mm2)
1	Clc	19.85	24.60	30.14
2	Clc 10	19.1	26.90	36.65
3	Clc 20	21.29	28.10	38.20
4	Clc 40	20.5	27.90	37.11

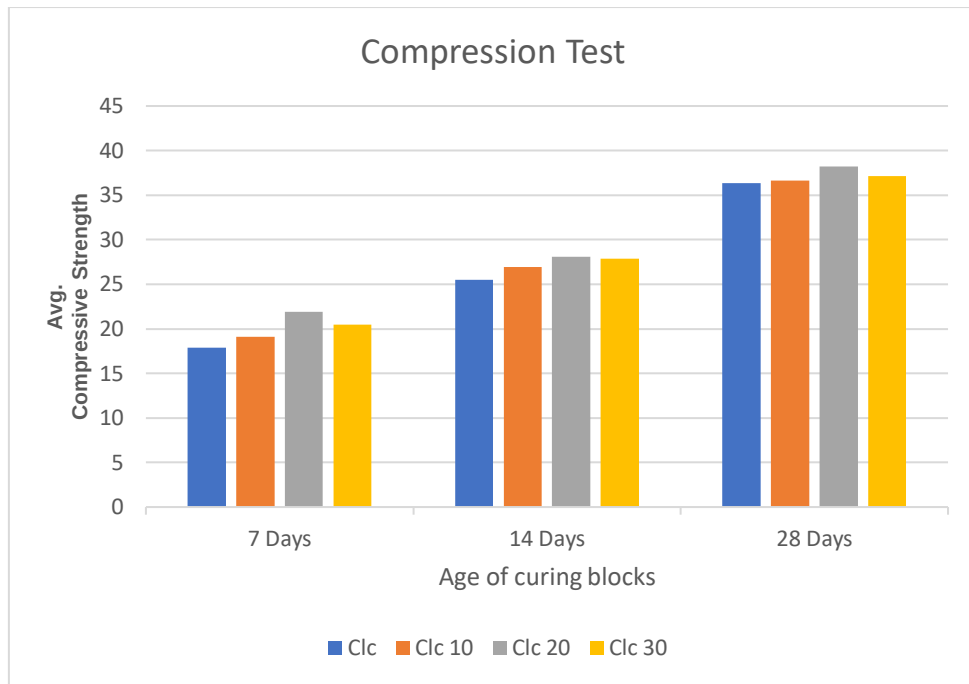


Fig 5.2: Graphical representation of compression test on 7, 14, and 28 days

5.3 RESULTS OF FLEXURAL STRENGTH TEST

These are the the flexural strength results test after conducting the test:

Flexural loading of sample Clc have less strength compared to all other sample. Here the mix Clc samples with 0% replacement of PJ ash have less in Flexural strength when compared to other mixes.

Formally the exact working condition of the material testing we have found that the sample Mix Clc 2 samples with 20 % replacement of PJ ash has high Flexural strength, the sample from 28 days had the maximum Flexural strength when compared to all other mixes.

When increase of fly ash the material strength slightly decrease for the Mix Clc samples with 30% replacement of PJ Ash has less Flexural strength when compared to mix Clc 20 and have high Flexural strength when compared to mix Clc & Clc 10.

Table 5.3 Readings of Flexural strength

S.No.	Material	Flexural strength(N/mm2) 7 days	Flexural strength(N/mm2) 14 days	Flexural strength(N/mm2) 28 days
1	CLc	4.7	6.13	7.84
2	Clc 10	5.32	6.98	7.96
3	Clc 20	5.50	7.12	8.32
4	Clc 30	4.85	6.47	7.50

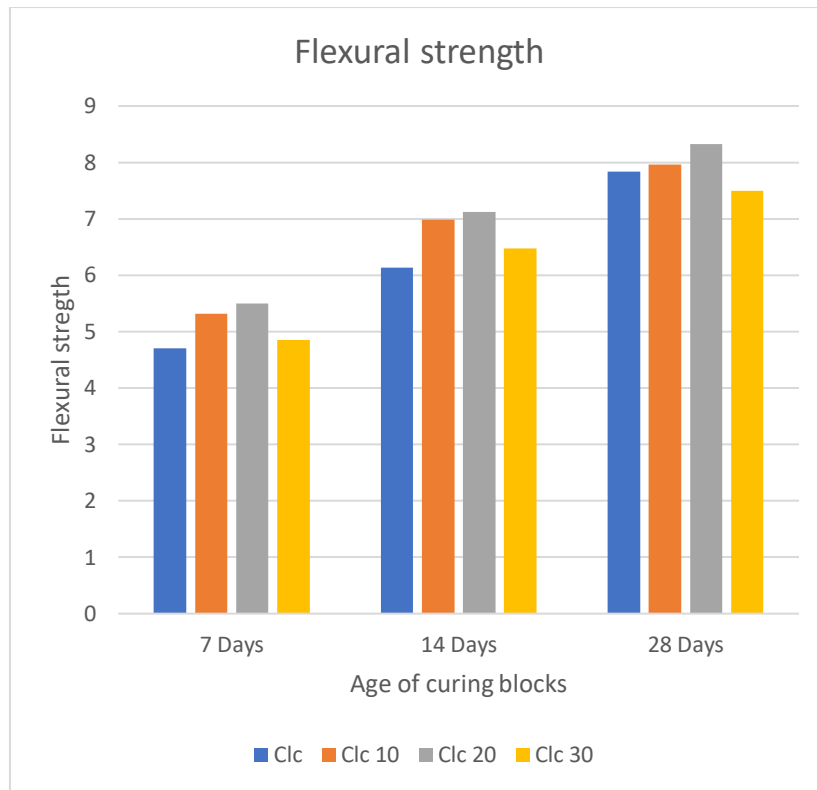


Fig 5.3: Graphical representation of flexural strength on 7, 14, 28 days

5.4 COMPARISON BETWEEN EXPERIMENTAL AND ANALYTICAL ON COMPRESSION STRENGTH

When testing of the material in FEA for the observed value of the block sample of 20% PJ ash material property, we found that the stress for the block increases with loading.

Stress factor at the edges of the block also under controlled factor for the applied load. Observed that the FEA model for PJ ash block obtained is under safe condition.

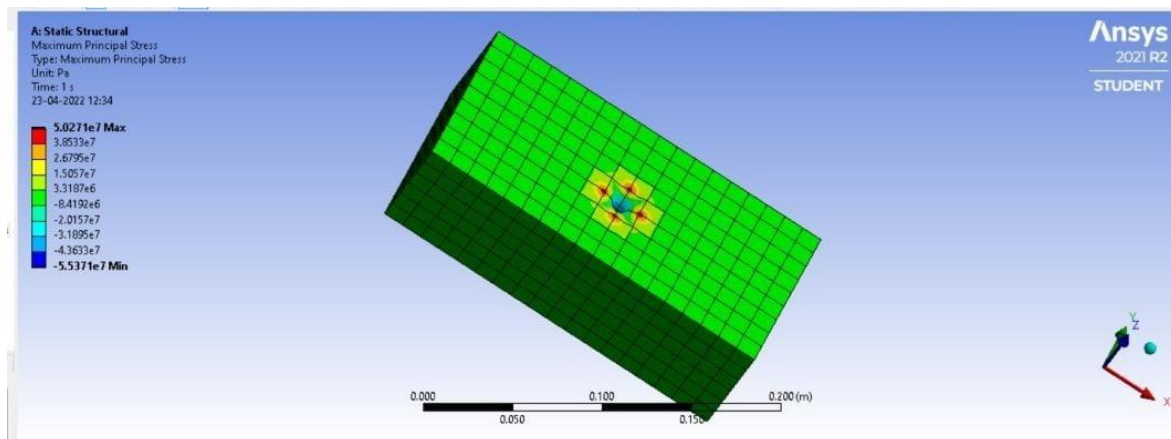


Fig 5.4 Results of analytical compression stress

Table 5.4 Comparison between experimental and analytical on compression strength

Experimental compression strength(N/mm ²)	Analytical stress(Mpa)
38.20	50.27

5.5 COMPARISON BETWEEN EXPERIMENTAL AND ANALYTICAL ON FLEXURAL STRESS

When testing of the material in FEA for the Flexural loading of the block sample of 20% fly ash material property, we found that the stress and deformation for the block increases with loading.

Here but we observed that the for the obtained material for the block we have good sound strength enough for obtaining the construction purpose Stress factor at the edges of the block also under controlled factor for the applied load Observed that the FEA model for PJ ash block obtained is under safe condition

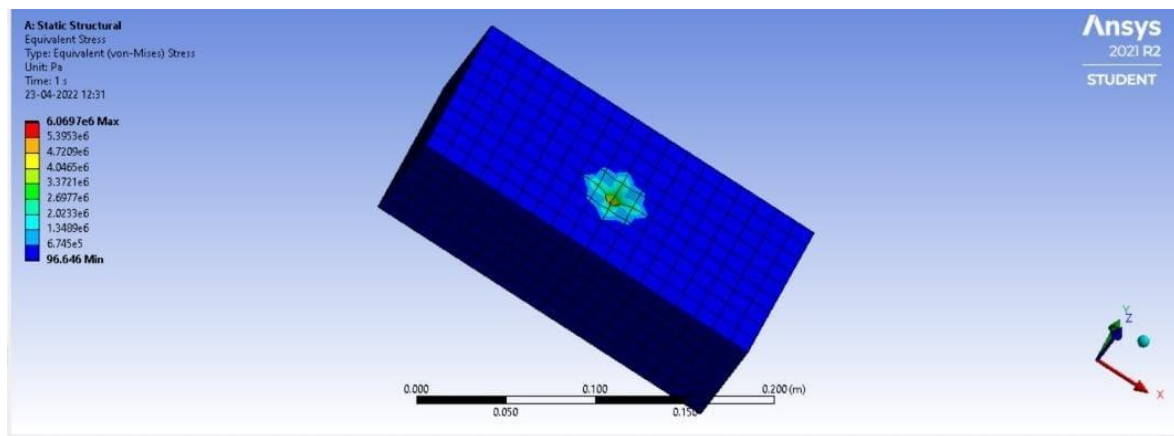


Fig 5.5 Results of analytical flexural stress

Table 5.5 Comparison between experimental and analytical on flexural stress

Experimental stress(n/mm2)	Analytical stress(Mpa)
8.32	6.06

CHAPTER 6

CONCLUSION

This review indicates that an effective method of utilising *Prosopis juliflora* ash has been developed and implemented in the block. Various tests have been conducted and concluded that PJ ash Block is less expensive than other blocks and has a higher strength. Using this in this case Various laboratory experiments on clc block samples were carried out in this project. Some of them have been completed and verified, including a compressive strength study, a water absorption study, and a flexural strength study.

Finally, the findings of this study show that:

The compression and flexural strength of clc blocks, as well as water absorption, were increased when the percentage of PJ ash was increased. However, replacing 20% of the cement with PJ ash strengthened the compression and flexural strength of the blocks.

Also This models can be created using ANSYS software, where the model dimensions, element types, and meshing procedures are set through trial and error in order to attain the study's desired accuracy and convergence.

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