International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** XII **Month of publication:** December 2021

DOI: https://doi.org/10.22214/ijraset.2021.39225

Experimental Study on Light Weight Concrete Block with Double Core and Double Mesh Using Granulated Corn COB

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Abstract: A light weight concrete block using granulated corncob as an aggregate is investigated in this research work. Considering corn cob after removing the corn is said to be agricultural waste. Finding practical uses of this waste for manufacturing concrete block may preserve the environment and also allow green technologies. These concrete blocks are studied in terms of compressive strength, water absorption; density and unit weight were experimentally studied. The results obtained are submitted which shows that corn cob blocks have sufficient material properties for non-structural application in building for construction of partition walls. This is the alternative for blocks in expanded clay, expanded polystyrene, particles of cork, coconut coir etc. In this research a clay brick is compared as a reference block or control block. Nine specimen blocks were prepared in a size of 400mm x 200mm x 100mm and cured for 7 days, 14 days and 28 days and subjected to compressive strength test, water absorption test and density. The results are compared with conventional clay bricks. Corn cob blocks offered a good strength, low density and less water absorption.
Keywords: Agricultural waste, compressive strength, durability, granulated corn

I. INTRODUCTION

There are many building materials based on agricultural wastes such as bamboo, cork, bagasse, cereal, straw, rice husks, sunflower hulls, banana stocks, coconut coir, palm leaf, corn cob etc., there were many experiments and research using the above waste materials have been investigated as filling material in concrete block in the construction industry.

Corn cob has an additional advantage of not colliding with other material even though they may have similar micro structures and chemical composition. The main scope of this research work consists on analyzing the potential use of corn granulated as a sustainable aggregate solution in light weight concrete block for walls in a building as an alternative to other product.

Affordability, sustainability and quality are the three factors which dictate the design of the product, to full fill these three requirements are the big challenge. The light weight corn cob concrete block presented in this paper was designed mainly as a partition wall for nonstructural elements. The density, compressive strength, unit weight and water absorption tests were compared with conventional clay bricks. This paper is structured with sample preparation and equipment's used are described and the experimental results obtained are presented and discussed with conventional clay bricks.

II. LITERATURE REVIEW

Alavez-Ramirez, et.al (2012) conducted experiment on thermal conductivity of coconut fibre filled ferro cement sandwich blocks. The study evaluates the potential use of coconut fibre as thermal isolating filler for ferro cement block walls in sandwich configuration of schools and houses roofing in Puerto Escondido, Oaxaca, Mexico.

Thermal conductivity measurements were performed to compare the thermal behavior of ferro cement block walls filled with coconut fibre to other typical building materials of the region. Measured thermal conductivities for red clay brick, hollow concrete block and lightweight concrete brick block walls are 0.93, 0.683 and 0.536 W/m K respectively. Thermal conductivity of the proposed configuration is 0.221 W/m K and that is lower than typical materials used for home-buildings in this region.

NahroRadiHusein,et.al (2013) conducted experimental study on using lightweight web sandwich block using thermocol as a floor and a wall. The experimental investigation was focused on the strength capability of lightweight web sandwich block (LWSP). This study deals with the LWSP's strength under flexural loading (one-point load & third point load) by treating these LWSPs as a floor and also, studying LWSP strength under axial load by treating these LWSPs as a wall.

Thirteen specimens of LWSP was casted in this study with size of (500 mm*400 mm*100 mm), with core size of (450 mm*105mm*60 mm), three prism cores are used in each block. Ten specimens are LWSP with aerated concrete as a core and three LWSP with thermocol as a core which are encased by ferro cement with difference water cement ratio (w/c) and difference waterproofing admixture.

The performance of the LWSP is investigated in terms of first crack load, load-deflection curve for flexural load with (one-point loading and third point loading), modules of rupture, ultimate flexural load, axial load-deformation curve and the failure mode.

The unit weight of the LWSPs which have aerated concrete as a core is (1850-1950) kg/m3 and the unit weight of the LWSPs which have thermocol as a core (1250-1300) kg/m3.

Al-Tuhami Abu Zeid& Al-TuhamiAbdAllahb (2012) conducted experimental study on precast hollow-block reinforced concrete bearing walls. This study deals with technique for enhancing the behavior of sandwich block bearing walls under in-plane loads. The suggested technique is based on presenting a complete interaction wall block in the two directions, by using fully interacting vertical and horizontal concrete ribs along with the traditional two parallel concrete layers.

Each wall block consists of light weight filling material blocks, two parallel reinforced concrete layers and reinforced concrete ribs. The longitudinal reinforcement of the ribs is slightly protruded outside the wall block to be used for assembling the reinforced concrete walls and slabs in the building construction site. The filling material blocks may be polystyrene-foam or any light weight filler material having good thermal and sound insulation and allows for concreting without crushing. In the present work, experimental study and technical details of the suggested technique along with those of the traditional sandwich blocks are presented.

The experimental work is conducted on full scale specimens to verify the applicability and efficiency of the proposed method. Results indicated that the ultimate loads, failure modes, and load deflection relationships of the proposed walls are greatly improved by using the suggested technique.

Al-Tuhami Abu Zeid Al-TuhamiAbdAllah and Ahmed Ismail Gabr (2012) conducted experimental study on flexural behavior of RC sandwich and hollow block bearing walls. The suggested technique was based on presenting a fully composite action of sandwich block bearing walls by adding longitudinal and transverse concrete ribs along with the existing two parallel concrete wythe. The aim of this paper is to examine the effect of the presence of ribs that connects the two concrete wythe for enhancing structural behavior of the wall blocks that exposed to bending loads. Experimental work and 3D numerical analysis of sandwich blocks as well as hollow block bearing wall blocks subjected to flexural load is conducted. Parametric study is carried out in order to focus on the main sensitive parameters as span to depth ratio and wythe thickness that influence the flexural capacities of wall blocks.

D. Surrya Prakash, D. Praveen Kumar (2014) conducted experimental study on natural fibre sandwich composite blocks-analysis, testing and characterization. The paper deals about the development, comparison, testing and analysis of composite materials and sandwich composite blocks. In this paper we have carried out testing of mechanical and physical properties of coir composites, SMC laminate, bamboo composite, cement bonded wooden particle composite. Then we have used SMC laminate on coir composite so as to increase its strength. Also we have carried out tensile test for bamboo composite, coir composite, cement bonded composite. Then we have compared the values of these composites. Water absorption test and flame test of coir composite, bamboo composite has been carried out, so as to find out the mechanical and physical properties of composite materials. Finally, bending test and analysis of sandwich composite blocks has been carried out for bamboo-EPS sandwich block and bison-EPS sandwich block to understand the characteristics of sandwich composite blocks

JagadeshSunku, Abhaya Shankar (2014) conducted experimental Study on eco-friendly inorganic bonded sandwich blocks (Aerocon blocks). This paper reports the production of inorganic bonded sandwich blocks (Aerocon blocks) made of two fibre reinforced cement sheets enclosing a light-weight core composed of portland cement, binders and a mix of silicaceous and micaceous material aggregates. The use of fly ash and its substitution for timber-based products makes the blocks eco-friendly. Aerocon blocks are resistant to water, fire, termites and rodents which makes them withstand adverse weather conditions. Also, they exhibit very good thermal and acoustic insulation properties. Blocks are strong, durable, light weight and easily re-locatable. Design of the product and method of application makes it suitable for seismic and cyclone prone zones. Blocks are also suitable for fast track construction by elimination of onsite wet plastering and curing. The blocks have wider applications such as external load bearing walls, Internal partition walls, flooring and roofing, fascias, sun hoods, infill or veneer walls with steel or concrete structures, louvers, shelves.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
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III. OBJECTIVES

1) To produce corn cob concrete block with light weight density between 400-500 kN/m^3.
2) To investigate the strength under axial load to use the block for partition walls
3) To investigate the durability by water absorption, compression strength and density.

IV. METHODOLOGY

Specimen block of size 400x200x100 mm were prepared using corn cob as filling material using welded wire mesh, cement, m-sand with water cement ratio of 0.45 and tested for 7 days, 14 days and 28 days of curing.

V. SPECIMEN DETAILS

Double Core with Double Mesh (DCDM)

Nine specimens casted and tested for compression, water absorption density and unit weight Index for the specimen is given as DCDM-7, DCDM-14 and DCDM-28

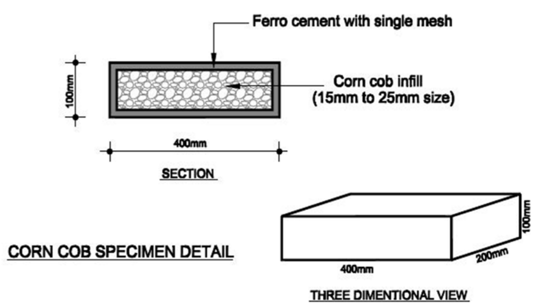

Fig. 5.1 3 dimensional and sectional view

VI. STEPS IN CASTING BLOCKS

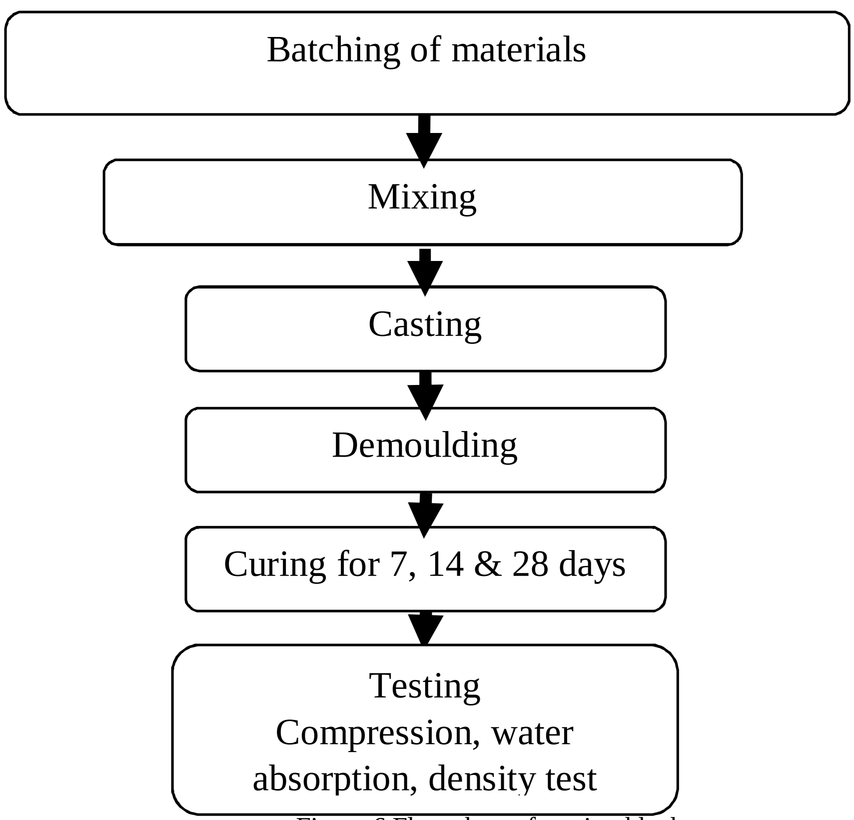

Figure 6 Flow chart of casting block

VII. MATERIALS TESTING

A. *Testing Procedure*

To investigate the properties of the materials which are to be used for casting the specimens, various laboratory tests were performed as per IS 2386 Part I -1963 and IS 4031- 1981.

B. *Sieve Analysis of fine Aggregate*

Set of sieves ranging 4.75mm, 2.36mm, 1.18mm, 600µ, 300µ, 150µ, pan
Grading of fine aggregates (As per 383)

Sieve	Mass Retained in (Grams)	Individual % Retained	Cumulative% Retained	Passing the sieve %	Grading Limits Zone II
10 (mm)	0	0	0	100	100
4.75 (mm)	10.7	2	2	98	90-100
2.36 (mm)	69.1	13	15	85	75-100
1.18 (mm)	102.7	20	35	65	60-90
600 (µm)	103.7	20	55	45	35-59
300 (µm)	122	24	79	21	8-30
150 (µm)	94.6	18	97	3	0-10
Pan	5.95	3	100	0	---
Total	535.0	100	----	----	---

Table 7.2 Sieve Analysis of Fine Aggregate

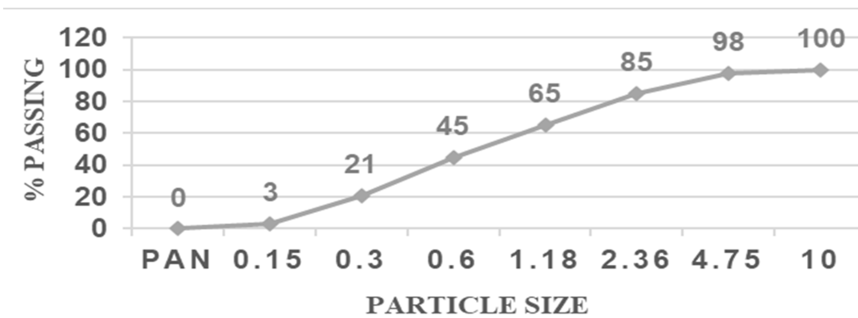

Fig.7.2 Sieve Analysis of Fine Aggregate

C. *Fineness Modulus fine Aggregate*

Total weight taken for sieve analysis = 535 gm
Total cumulative % weight retained on the pans = 283 gm
Fineness modulus of fine aggregate = Total cum % retained / 100
= 283/ 100
= 2.83

D. *Specific Gravity of fine Aggregates*

Specific gravity of aggregate is the ratio of its weight of an equal volume of water reference temperature -4°C. Specific gravity of aggregate is useful for calculating void content in aggregate.Specific gravity of fine aggregate is = 2.634

E. *Properties of Cement*

Specific Gravity = 3.14
Standard Consistency = 32%
Initial Setting Time = 60 min
Final setting time = 150 min

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
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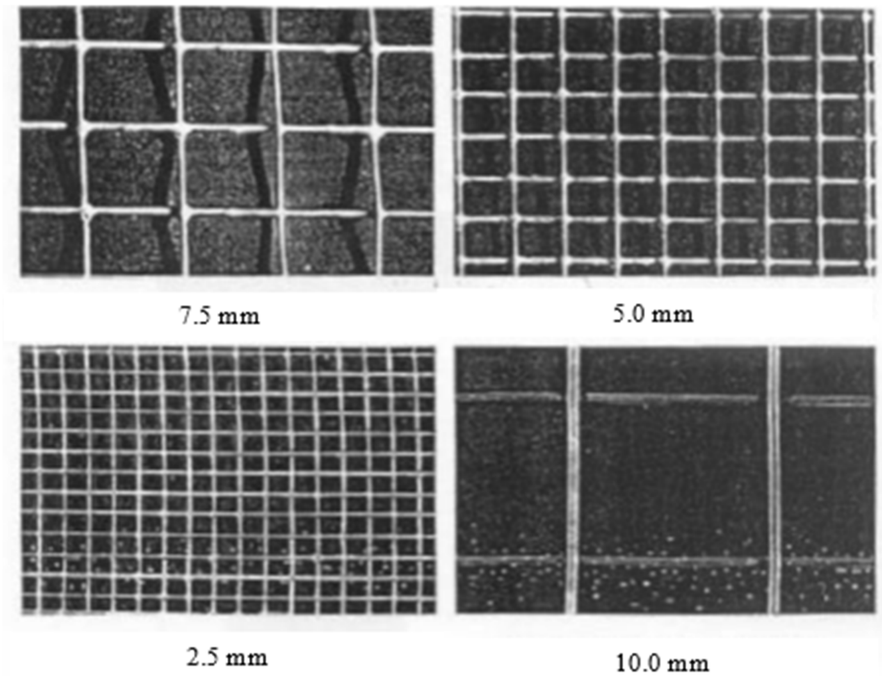
F. Weld Mesh

Mesh with various size with diameter between 1.0mm and 0.5mm as shown in figure



G. Formulation of Mix Design

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of required strength, quantity, durability and workability as economically as possible, is termed as concrete mix design. Since there are no standards for mix proportioning of blocks, this project is carried out with the formulation of the design procedure. In normal concrete, water content in kg/m^3 is used, which indirectly gives the values of cement content through use of graph. This method is not suitable for this type of block, because such graphs do not exist for this type of blocks. So a rational proportioning method based on solid volume calculation is adopted to determine the cement content.

S.NO	MATERIALS	QUANTITIES IN Kg/m3	PROPORTION
1	Cement	350	1
2	Fine aggregate	700	2
3	Water-cement ratio	143.2	0.45

Table 7.7Mix Proportion of Mortar

VIII. DETAILS IN METHODOLOGY

A. Allocation of raw materials like cement, sand, mesh and core material measuring as per requirement.
B. Cover block 12.5 mm.
C. Preparation of mortar is done with water cement ratio of 0.45
D. The mould of size 400 x 200x 100 mm is made.
E. Casting of blocks will be done and kept for 1 day in mould
F. Curing of blocks in water is done after removing from mould
G. Checking all test after curing for 7^{th}, 14^{th} and 28^{th} days.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
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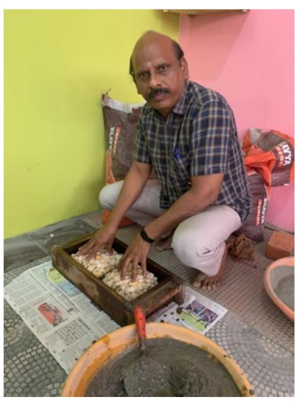
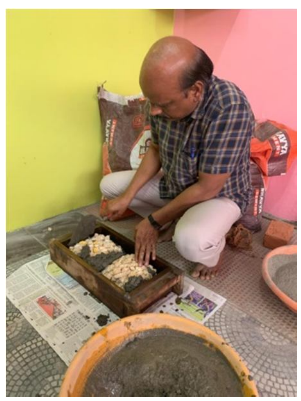
IX. MANUFACTURING / CASTING DETAILS:

Steps taken for casting blocks.

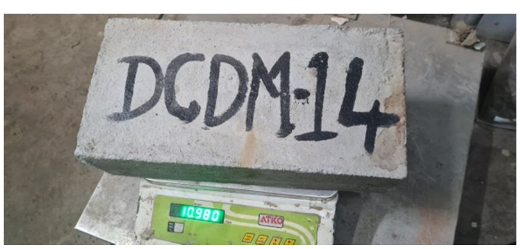
1) Collection of corn cob without corn from the market.
2) Removing all dust by cleaning with water and dried.
3) Cut into pieces of 15mm to 25mm size (granulated corn)
4) Making welded mesh as box of size 75 mm x 175 mm x 375 mm, filled with granulates.
5) Placing corn filled mesh in the mould and fill with morter.
6) Keeping the block in the mould for one day.
7) Curing the block for 7days, 15 days and 21 days.



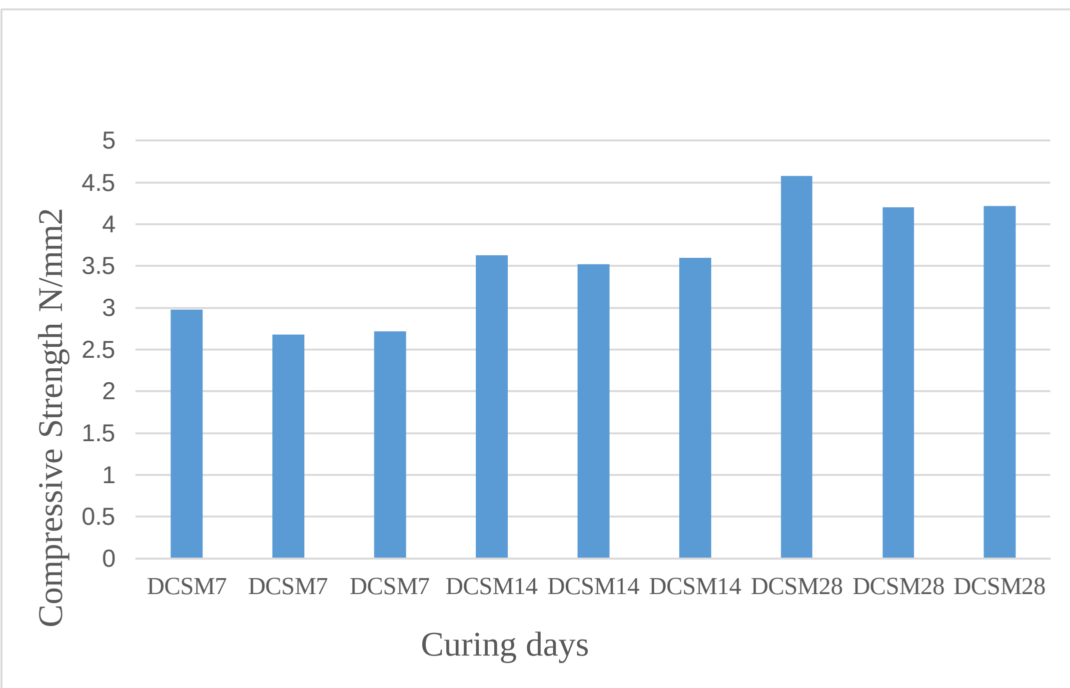

Steps taken for testing of blocks.

- Transportation of cured blocks to the lab.
- Finding weight in the loading machine of each block.
- Placing block in the compression machine for strength.
- For water absorption test soaking of blocks in water for 2 days and dried for one day
- Calculate the percentage of water by difference in weight.



Sl. No.	Specimen Index	Failure load	Compressive strength N/mm^2
1	DCDM- 7	90.0 kN	2.98
2	DCDM-7	98.0 kN	2.68
3	DCDM-7	96.0 kN	2.72
4	DCDM-14	129.0 kN	3.63
5	DCDM-14	130.0 kN	3.52
6	DCDM-14	128.0 kN	3.60
7	DCDM-28	220.0 kN	4.58
8	DCDM-28	223.0 kN	4.20
9	DCDM-28	240.0 kN	4.22

Clay bricks compressive strength is 2.40 kN/mm^2 to 2.60 kN/mm^2.



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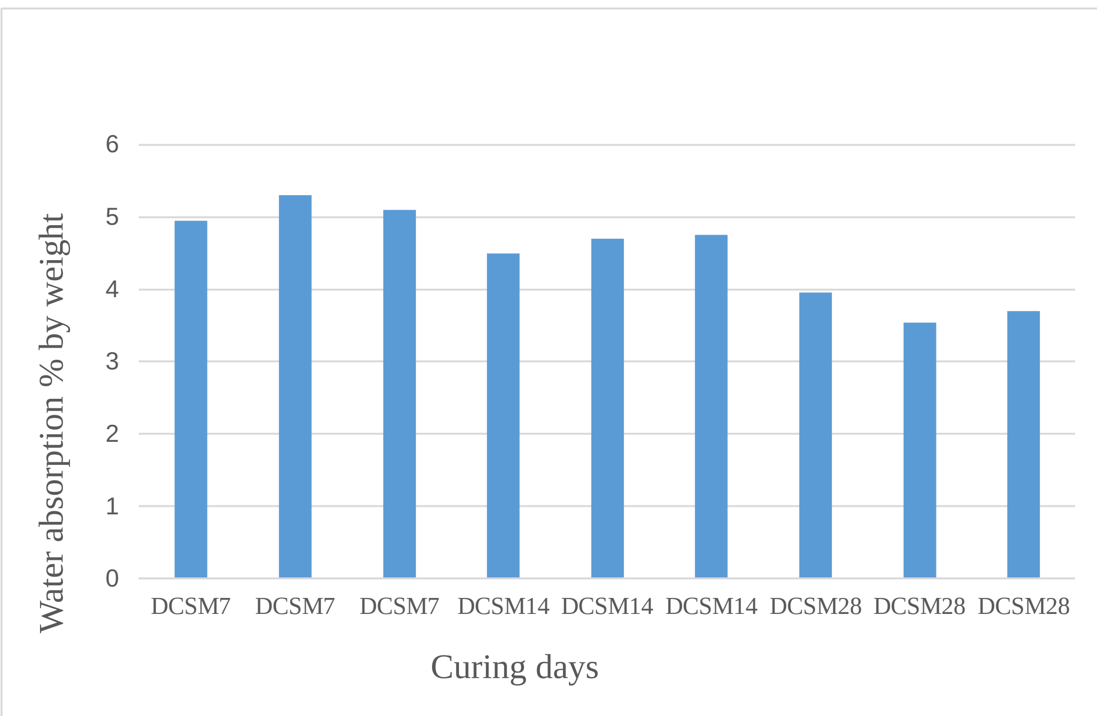
Sl. No.	Specimen Index	Dry weight (Kg)	Wet weight (Kg)	Water absorption % By weight	Average %	Requirements IS:12894-2002
1	DCDM- 7	11.82	12.50	4.95	5.08	Not more than 20%
2	DCDM-7	11.85	12.48	5.30		
3	DCDM-7	11.70	12.46	5.10		
4	DCDM-14	11.20	12.10	4.50	4.75	Not more than 20%
5	DCDM-14	11.30	12.15	4.70		
6	DCDM-14	11.50	11.98	4.75		
7	DCDM-28	10.72	11.48	3.96	3.73	Not more than 20%
8	DCDM-28	10.92	11.50	3.54		
9	DCDM-28	10.90	12.12	3.70		

Water absorption of clay bricks is 16% of water by weight.



X. RESULT AND DISCUSSION

Compressive strength of blocks:

Strength of corn cob concrete block is tested in a compressive strength testing machine. As expected, the corn cob concrete block showed significant enhancement in strength. When it is compared with conventional clay bricks corn cob shows higher strength i.e.

1) DCDM-7 is 1.21 times strength compared to clay bricks.
2) DCDM-14 is 1.43 times strength compared to clay bricks.
3) DCDM-28 is 1.73 times strength compared to clay bricks.
4) Less water absorption, clay bricks absorb more % of water by weight (16%) than corn cob blocks which absorbs 3.73% to 5.08% by weight.

XI. DISCUSSIONS

1) Strength of corn cob is higher than clay bricks so we can use it for construction of partition walls.
2) Construction cost is slightly less than clay bricks.
3) Less consumption of water in construction.
4) Corncob blocks are light in weight.

XII. CONCLUSION

A. Light weight corncob concrete block showed a significant resistant proportion.

B. The role of wire mesh was in a strength capacity and in failure mode, prevents sudden brittle failure.

C. Corncob concrete blocks are being used in credible projects. It is also necessary that the government should start promoting these environment friendly constructions,

D. Government authorities have put a stop to the mining of sand due to environmental concern, but the manual operations in the sand mining have increased its price.

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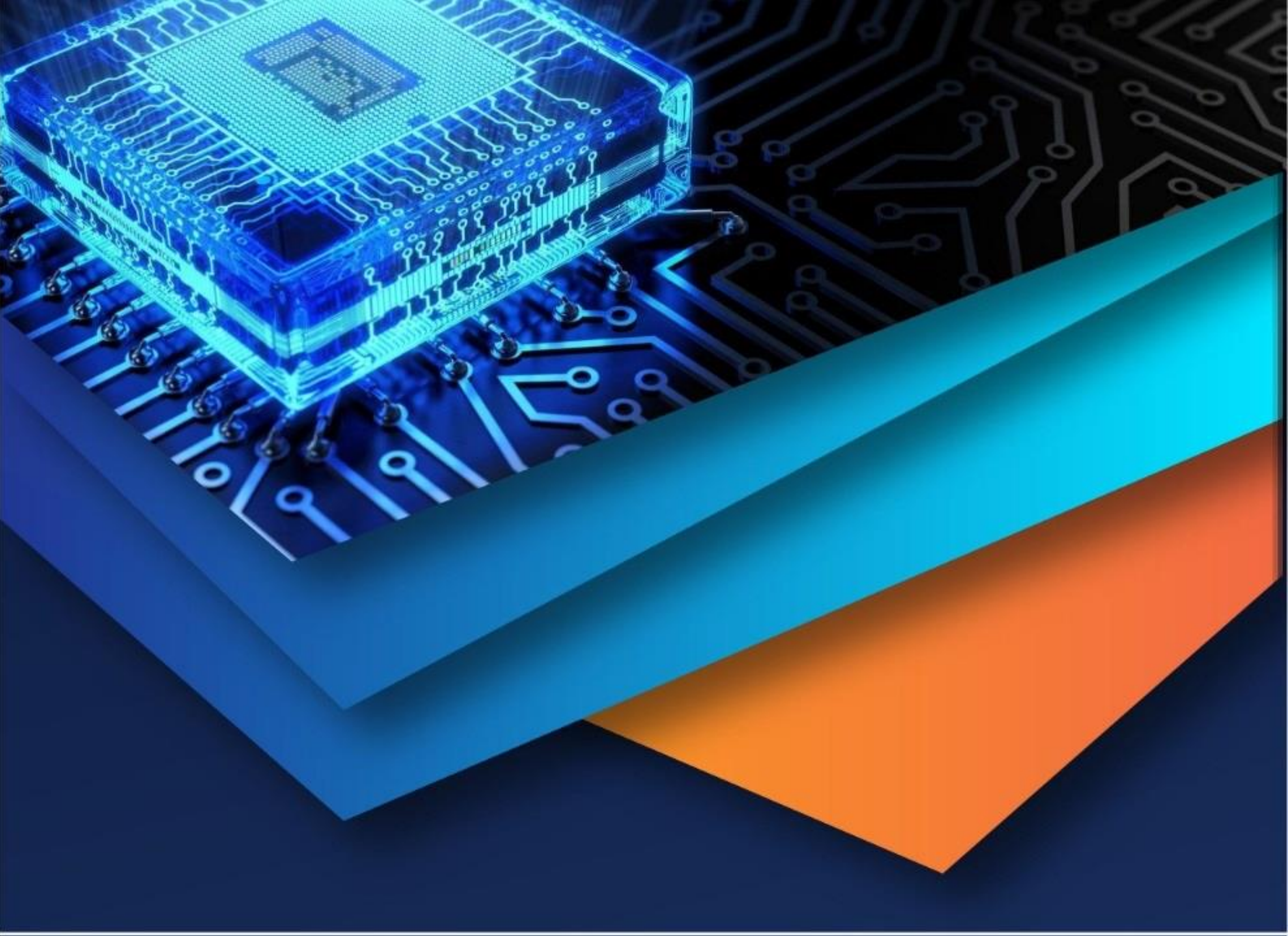

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