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Light Weight Bricks Using Waste EPS Beads

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Abstract: ***Demand of construction materials is increasing day by day, Technology has improved a lot in construction techniques of structures. Earlier structures were constructed with heavy materials, but in present time of construction light weight materials like AAC blocks, hollow blocks, and light weight wall panels are also used to decrease the dead load of a building. The EPS beads are the lightweight material which is mixed in a mixture of cement, fly ash, sand and water to develop light weight blocks and bricks. This Experimental work intended to investigate mechanical properties of lightweight bricks and compare its functions with conventional bricks. EPS Geofoam is a light substance that has been utilized in construction applications since last few decades. EPS has good thermal insulation properties with stiffness and compression strength comparable to medium clay. In, this experimental investigation effort is made to develop light weight brick by combining EPS beads with cement fly-ash and sand.***

Keywords: ***Bricks, EPS beads, Fly-Ash, Compressive strength, Density.***

I. INTRODUCTION

Light weight concrete was popular through the ages, Light weight concrete is used to produce load bearing wall panels, and also as the material for construction of floating marine structures [6]. One of the main problems associated with the use of conventional light weight aggregates produced from clay, slate and shale in concrete is that these porous aggregates absorb very large amount of the water mixed in concrete [7]. This is affecting the performance of the concrete, apart from the fact that it is difficult to maintain specific water content during the casting. Also, this absorption of water by the aggregates will means that the additional water will be required to maintain the slump at acceptable levels. These increased water contents requires higher cement contents, even without any benefit. In this, Experimental work, investigation is made to make the brick of composite material, as a substitute to the Fly-Ash & Clay Brick. In this work the EPS beads are added in different quantities in the mixture of cement, fly-ash, and sand to produce light weight material. EPS is stable, low density foam, which consists of 98% of air and 2% of EPS material [8]. It has closed structure and cannot absorb water. It has good impact resistance. EPS is used as packaging material used in medical industry. It is also a non-biodegradable material, so it creates disposal problems. Utilizing recycled EPS as a construction material will be a good waste disposal method. The EPS beads can be easily mixed into mortar or concrete to produce lightweight material with a wide range of density. An application of light weight EPS mortar includes walls, cladding panels, tilt up panels and composite flooring [2].

II. MATERIALS USED

A. Following materials are used

1) Cement: The Portland Pozzolana Cement (PPC) was used, conforming to IS 1489 – 1991 (Part 1). Properties of cement were investigated in lab are shown in Table 1.

Table 1: Properties of Cement

Sr. No.	Physical Property	Results
1.	Initial setting Time	115 minutes
2.	Final Setting Time	170 minutes
3.	Specific Gravity	3.07
4.	Fineness	3%
5.	Compressive strength 28 days	32N/mm^2

2) Fly Ash: Fly ash taken for this Experimental investigation is from Parichha thermal power plant, Jhansi, U.P. Physical

properties of fly ash are given in table 2.

Table 2: Physical properties of fly ash

Sr. No.	Physical Property	Results
1.	Specific Gravity	2.34
2.	Bulk Density	1110 kg/m^3

3) *Sand:* Locally available river sand is used as fine aggregate. Sieve analysis, Specific gravity and water absorption test were carried in the laboratory. The sieve analysis of sand leads us to confirm that it comes under Zone II category. The test results of specific gravity fineness modulus and water absorption are shown in table 3.

Table 3: Properties of Fine Aggregates

S. No.	Test	Result
1.	Specific gravity	2.62
2.	Fineness Modulus	2.64
3.	Water Absorption	0.5%

4) *EPS Beads (Expanded polystyrene beads):* Expanded polystyrene beads (EPS) waste used for this experimental work has been taken from Balaji Thermocol Industries, Malanpur, Gwalior, M.P. Waste was converted into beads form with the help of EPS Shedder. Properties of EPS beads are shown in table 4.

Figure1: EPS Beads size from 1mm to 5 mm

Table 4: Properties of EPS Beads

S. No.	Properties	Result
1.	Size	1 mm to 5 mm
2.	Weight (Bulk Density)	9.5 kg/m^3
3.	Specific Gravity	0.011

5) *Water:* Potable water available in the laboratory was used. The water was free from organic impurities and its PH value was 6.5.

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III. EXPERIMENTAL PROCEDURE

A. Preparation of Bricks

In this investigation four types of bricks are prepared by using different proportions of cement, fly ash, sand, EPS beads and water which is given in table 5. Conventional method is used for making bricks. Brick moulds of size (230x110x70) mm were oiled and kept ready. First all the ingredients cement, fly ash, sand and EPS beads were mixed thoroughly in dry state to make a homogeneous mixture. Then to the mixture of cement, sand, fly ash, EPS beads, water is added gradually to achieve proper consistency. Mixing was done within 4-5 minutes. The mould was filled with the wet mix and is vibrated by using vibrating table for 30 seconds. After finishing the brick samples were demoulded after 24 hours, and further brick samples were kept for drying for 2 hours

Table 5: Quantities of materials in 1 m^3

Material / Samples	Quantities in kg/m^3				
	Cement	Fly Ash	Sand	EPS	Water
FAB	195	680	1070	0	250
LWB1	416	-	670	4.38	208
LWB2	250	650	-	3.3	340
LWB3	250	250	350	5	225
LWB4	300	300	-	5.87	240

B. Curing

Bricks were kept completely immersed in water and cured for the periods of 3, 7 and 21 days

IV. RESULTS

After curing, the bricks are weighed after completely drying. The water absorption and compressive strength tests were performed on the bricks.

A. Weight Analysis

The bricks are weighed after completely drying. The weight of light weight bricks (LWB1, LWB2, LWB3, and LWB4) are weighed and compared to the weight of fly ash brick. The weight reduction is carried out by keeping the weight of fly ash brick as a reference. The results of weight reduction are given in table 6.

Table 6: Weight Analysis

Samples	Weight per brick (kg)	Weight reduction (%)
FAB	3.44	0.0
LWB1	1.93	43.8
LWB2	1.60	53.4
LWB3	1.51	56.1
LWB4	1.07	68.8

B. Water Absorption Test

The bricks were tested in accordance with the procedure laid down in IS 3495 (Part 2). Water absorption test results of light weight brick are shown in table 7.

Table 7: Water absorption percentages

Samples	Water absorption %
FAB	16%
LWB1	10%
LWB2	8.5%
LWB3	11%
LWB4	13%

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C. Compressive strength

The compressive strength is carried out according to procedure confirming to IS3495 (Part 1):1976. In the universal testing machine the brick was placed centrally on the bottom plate. Then without any movement the upper plate of the universal testing machine was lowered down up to the brick was hold tightly. Then at a uniform rate the load was applied. The results of compressive strength are given in table 8. And the variation in compressive strength is shown in the figure 2.

Table 8: Compressive Strength

Sample	Compressive strength in N/mm^2		
	3 days	7 days	21 days
FAB	2.8	4.7	7.86
LWB1	3.46	5.33	7.6
LWB2	2.5	3.9	5.5
LWB3	2.26	3.12	4.66
LWB4	1.26	2.1	3.66

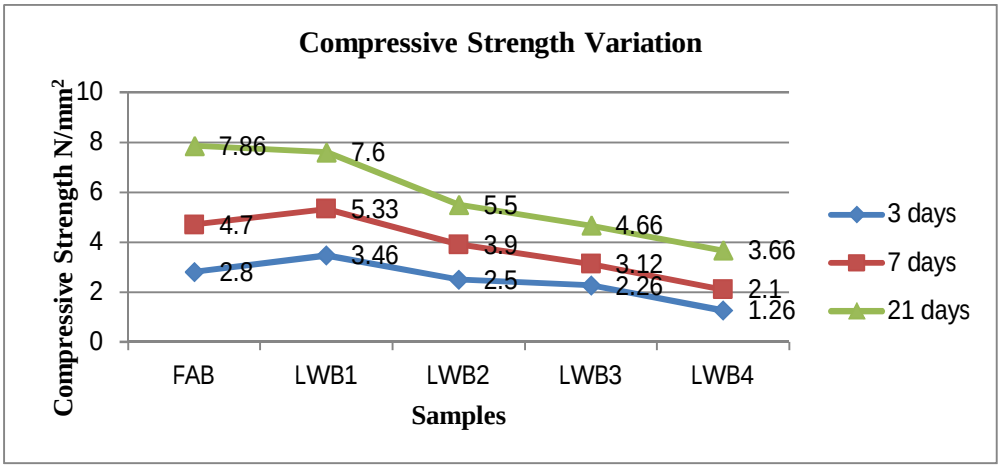

Figure 2: Compressive strength test results of bricks at different curing stages

D. Density Variation of Samples

The density variation analysis was carried out on different proportion of material of light weight brick. Figure 3 shows the variation in densities of different samples.

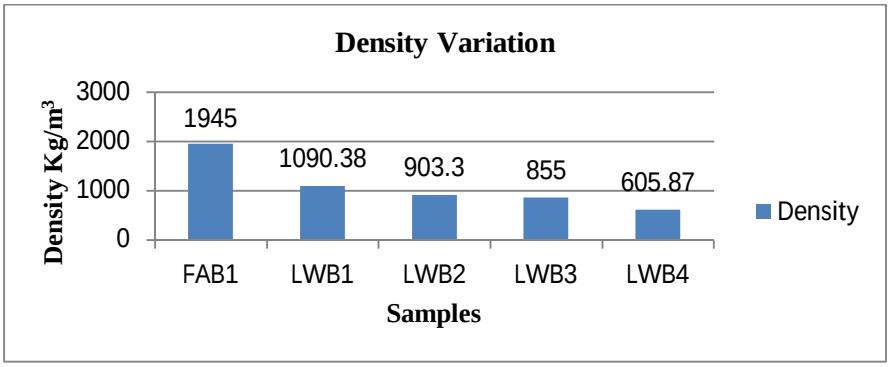

Figure 3: Density variation of bricks

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V. CONCLUSION

The following conclusions were drawn from the experimental work;

A. EPS bricks give good workability and could easily be compacted and finished.

B. The water absorption of EPS beads bricks are found to be less than fly ash brick, which is a good sign, as bricks should posses less water absorption.

C. The sample LWB1 (7.6N/mm^2) has possessed equivalent strength as fly ash brick (FAB = 7.86N/mm^2), which can be come under 2nd class brick (7N/mm^2) category. And other light weight sample (LWB2, LWB3, and LWB4) shows a higher result than a third class brick (i.e. higher than 3.5N/mm^2).

D. Light weight brick sample LWB4 possesses to be a lightest brick samples among the all samples (weight reduction from FAB = 68.8%) and produce the strength more than the third class brick. And its weight is about its 1/3rd of the FAB.

E. Initial finding have shown that the lightweight bricks using EPS beads has a desirable strength to be an alternative construction material for the construction of wall.

F. The strength of light weight bricks using EPS beads are low for lower density mixture. This resulted due to increase of beads throughout the sample caused by the Air entraining admixture.

G. Light weight bricks using EPS bead reduced the dead load of the building which gives better stability in seismic situations.

H. Also concluded that designed mix proportions are useful in cladding panels and tilt up panels.

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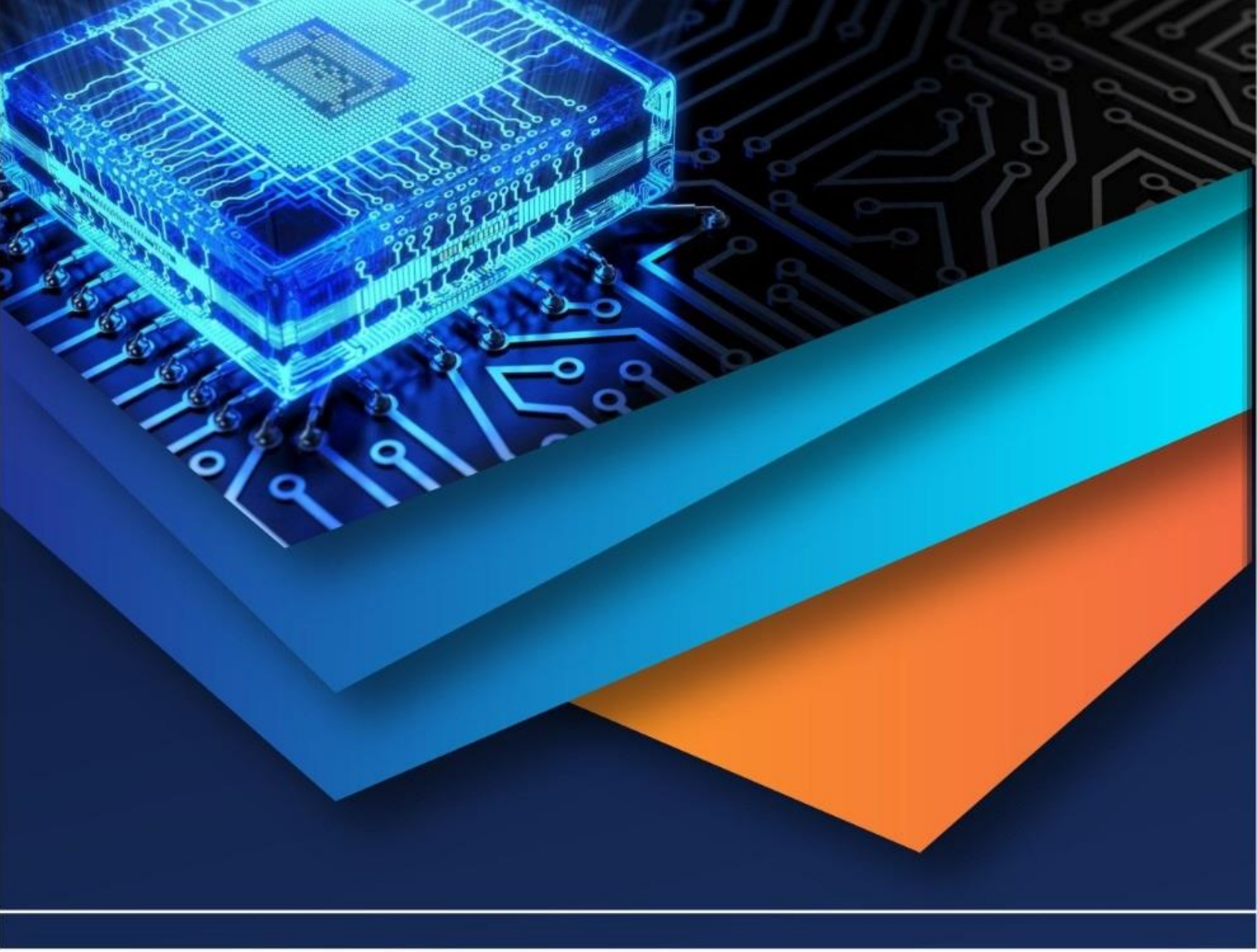

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