Experimental Study on Properties of Lightweight Sandwich Concrete Blocks using EPS Sheet

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***Abstract*— In civil engineering, due to development the demand for construction material increases, hence leading to prominent effect on economic system of nation. In construction field, concrete is most important ingredient. This increases quest for use of sustainable and eco-friendly materials in construction industry. In thus project work, using Expanded Polystyrene (EPS). It is a non-biodegradable waste material which is coming from packaging industry. Substituting partially M sand and coarse aggregate by inserting EPS Sheet, to achieve decent compressive strength and water absorption result. This project focus on investigating the characteristics of M25 grade concrete. The EPS Sandwich Concrete Block is a new creation block, in which Expanded Polystyrene (Thermocol) material is used. And it gives a supplementary property to the block. Hence these blocks are useful in many climatic conditions. When this Thermocol Sandwich Concrete Block is used in construction work, they reduce the construction time as well as construction cost. Also, there is no necessity of finishing. Twenty-four blocks of size 150mmX150mmX150mm were prepared using mixture of cement, M sand, aggregate and EPS, without using any bonding material. The paper highlights the study properties such as compressive strength and water absorption of EPS based concrete blocks which is compared with conventional concrete.**

Keywords*— *Expanded Polystyrene (EPS), compressive strength, water absorption, Sandwich Concrete Block, Thermocole, M Sand, Coarse aggregates.

1. INTRODUCTION

The basic necessary need for human beings is cloth, food, water and shelter. Due to growth in construction industry, there is huge demand of construction materials. For sustainable development to utilization of alternating materials in construction and application of industrial waste materials is very important aspect of sustainability.

Light weight concrete (lwc's) blocks are easier to transport because they are lighter than standard concrete and clay bricks, even when being delivered in the same volume. so, the cost of transportation is much lower, and you save in logistics costs. and because they are light weight, they are more energy efficient to be transported to high altitude areas without straining the cargos engine and causing more emission.In construction, the quality and strength of building materials are critical to the longevity and performance of the structure concrete it's one of the most commonly used materials to build a wide array of structure, but as builders are looking in to environmentally friendly and cost-effective resources, the use of lightweight concrete blocks has become widely accepted and sought-after by discerning construction companies and building owners. it is currently a viable substitute to red clay bricks when making walls.

Lightweight is one those modern type concrete blocks that are used in many wase in buildings construction because of its weight which is fairly small compare to other concrete blocks. the benefit of lightweight concrete blocks is that it is to deal with meaning that it is more workable, reduction of dead load it is generally less cost than other materials, fast duration period easy application compare to other materials such as timber and steel .

Using lwc's have a lower cost of construction and go through energy efficient manufacturing and installation. these blocks are major part o most building construction, it has a primary role in building martials as construction walls this concrete block are usually referred to as a concrete masonry unit.

ADVANTAGES:

- Reduction in dead loads making savings in foundations and reinforcement.
- Improved thermal properties.
- Improved fire resistance.
- Savings in transporting and handling precast units on site.
- Reduction in formwork and propping.

2. OBJECTIVES

- To study the compressive strength of lightweight sandwich concrete block with EPS sheet.
- To study the water absorption test of lightweight sandwich concrete block with EPS sheet.
- To compare the compressive strength and water absorption test with conventional concrete blocks.
- Effective utilization of materials like EPS sheet for blocks construction.

3. MATERIALS AND METHODOLOGY

Every study requires specific material and methodology plays and it plays an important role to achieve the objective of the study. In this study, an attempt has been made to understand the property of light weight sandwich concrete blocks using EPS sheet and condition of light weight sandwich concrete blocks by conducting the basic tests.

3.1 MATERIALS USED

A. **Cement:** Ordinary Portland Cement (OPC) of 'KESHAV CEMENT' brand was used in this study. OPC of grade 43 cement will be used. The raw material used in the manufacture of Portland cement comprises four principal compounds. They are tricalcium silicate, dicalcium silicate, tricalcium aluminate, tetra calcium, alumino ferite.

B. **Sand:** in this study M sand is used. normally M sand is made by devastating of large stones or

rocks. It is also a substitute for locally river sand for the constructions.

C. **Water:** in this study normally tap water was used. It's is one of the most important constituents.

D. **Expanded Polystyrene:** EPS sheets are having a width 40mm, 30mm, 20mm, 10mm were used as central core in Lightweight Sandwich Concrete Blocks.

Figure 1: EPS Sheet

3.2 MIX DESIGN

The mix proportion for conventional M25 grade concrete was derived as IS 456-2000.Type of cement was OPC 53 grade.

Table No. 1 MIX PROPORTION

W/C Ratio	Cement (kg)	Sand (kg)	Aggregates (kg)
0.47	1	1.5	2.18

During experiment we required 20 liters water, 50kg of Cement, 45kg of Sand, 90kg of Coarse Aggregate.

It has been found that density of concrete increases with increase in cement volume. Experiment shows that as the EPS sheet width goes on increasing the volume of cement required as well as number of aggregates required goes on decreasing thus decreasing the density.

Figure2: Casting of Blocks (150mmX150mmX150mm)

Concrete blocks were made using EPS (thermocol) sheet of different length and thickness. Thermocol Sandwich Concrete Block were cured for 24 hours after casting.

3.3 MIXING AND PROCEDURE OF THERMOCOL SANDWICH CONCRETE BLOCKS

To perform different test, blocks were prepared using molds. Block size were 150mmX150mmX150mm were prepared manually by using EPS (thermocol). During preparation of blocks, no bounding material was used. Cement of OPC 43 grade and crushed sand was used and W/C ratio 0.5 was used for making mortar. The mortar mixing was carried out by conventional method of mixing. To compare results of EPS blocks, conventional bricks of size 150mmX150mmX150mm were casted.

Figure 3: Mold for casting concrete blocks

Dry mix containing cement, sand, coarse aggregate was prepared and mixed for about 2 minutes. It was then transferred into molds kept on vibrator machine for minute.

3.4 PROCEDURE

- Place the molds on vibrating machine and pour wet concrete mix inside the mold into two layers with EPS in between.
- Vibrate the concrete through the table vibrator
- Vibration should not be more otherwise, segregation will occur.
- Also, EPS sheets of different length and thickness were used, during casting we observed that if the thickness of sheet exceed above 3.5 cm, during vibration it would come to the top leaving the concrete mix down and also cause bleeding.
- During casting we made Concrete Sandwich Block without using any bounding materials.
- After filling molds with wet concrete and EPS sheet, level the surface and designation to each specimen, Demold the specimen after 24 hours.

Figure 4: Designation given to blocks

4. TEST CARRIED ON THERMOCOL SANDWIH CONCRETE BLOCKS:

The blocks were cured for 7, 14, 28 days and were tested using compression testing machine. The load was applied until the block failure.

1. Compression Strength Test

7 days, 14 days and 28 days compressive strength test were performed in accordance with ISTMC 39. the lightweight sandwich concrete sample was capped with neoprene pads before being placed in the loading frame for testing. A temperature and unit weights of the samples were taken. Compressive strength was calculated as.

$C = P/A$

Where C is the compressive strength (N/mm^2),

P is the failure load of the specimen (N),

A is the surface area of the applied load (mm^2).

2.Water Absorption Test

The blocks samples were treated for curing. The test samples was determined at 28days curing. After removal from curing

the weight was weighed (W1). Then samples were dried at a constant temperature at 105ºC until constant weight (W2) was reached. Water absorption was calculated as

WA = (W1-W2)/W2 X 100%

Where, WA is the water absorption (%),

W1 is the wet weight of the concrete block (kg) and

W2 is the dry weight of the concrete block (kg)

5.RESULTS

Table no.2 Initial basic test on materials:

SL.NO	TEST	AVERAGE VALUE	PERMISSIBLE LIMIT
1	Specific gravity on cement	3.15	3.12 to 3.19
2	Specific gravity on fine aggregate	2.52	2.53 to 2.67
3	Specific gravity on coarse aggregate	2.6	2.5 to 3.2
4	Normal consistency on cement	28%	26 to 33%
5	Initial setting time on cement	38min	Min 30min
6	Final setting time on cement	250min	Max 600min
7	Flakiness index	29%	<30%
8	Elongation index	14%	<30%
9	Aggregate crushing test	27%	<30%
10	Aggregate impact test	22%	<24%
11	Los Angeles abrasion test	24%	<30%
12	Water absorption on coarse aggregate	0.5%	<2%
13	Water absorption on fine aggregate	1%	<2%

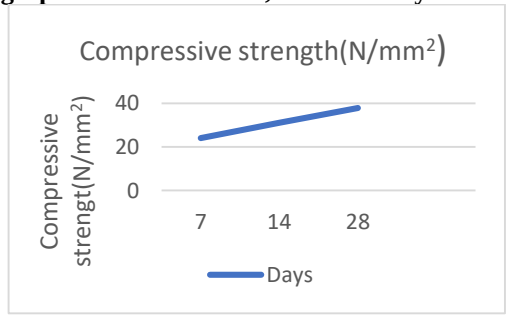
5.1 COMPRESSION STRENGTH TEST ON EPS BLOCKS

Testing on conventional

Table no.3: On 7, 14 and 28 days curing result

Days	COMPRESSIVE STRENGTH(N/mm^2)
7	24.08
14	31.09
28	37.87

Showing graphical variation of 7,14 and 28 days



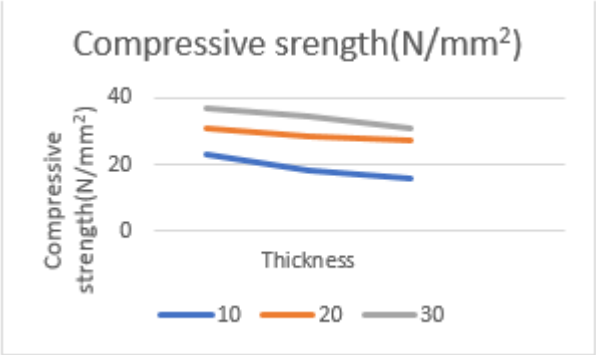
Testing on EPS Blocks having dimensions-

1.100mmX100mmX10mm
2.100mmX100mmX20mm
3.100mmX100mmX30mm

Table no.4: On 7,14 and 28 days curing result

THICKNESS (mm)	COMPRESSIVE STRENGTH(N/mm^2)		
	7days	14days	28days
10	22.87	30.91	37.03
20	17.95	28.56	34.77
30	15.57	27.01	30.97

Showing graphical variation of 7,14 and 28 days



From the this performed experiments, it is observed that concrete block with EPS Sheet size 150mmX70mmX35mm have less compressive strength (1.5 N/mm^2) as compared. Hence, as the sheet size increases there is decrease in density of cement as well as decrease in number of aggregates used thus leading to decrease in compressive strength. Whereas, concrete block with EPS sheet size 150mmX150mmX20mm have more compressive strength (2.326 N/mm^2).

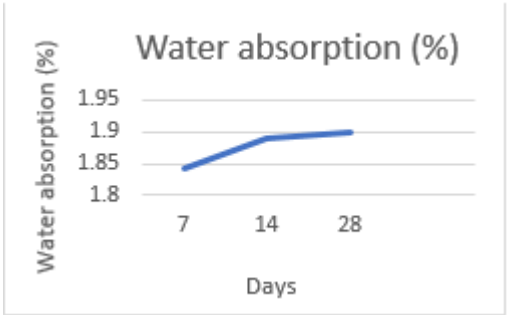
5.2 Water Absorption Test on EPS Blocks

Testing on conventional

Table no.5: On 7, 14 and 28 days curing result

Days	WATER ABSORPTION (%)
7	1.842
14	1.89
28	1.90

Showing graphical variation of 7,14 and 28 days

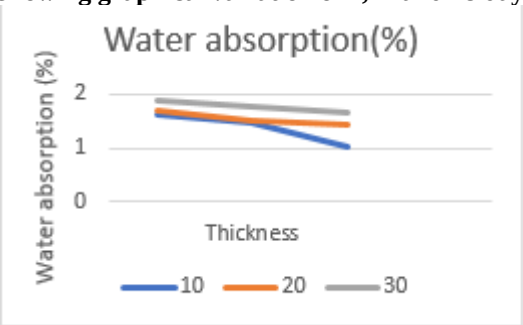


Testing on EPS Blocks

Table no. 6: On 7,14 and 28 days curing result

THICKNESS (mm)	WATER ABSORPTION (%)		
	7days	14days	28days
10	1.628	1.70	1.88
20	1.462	1.50	1.77
30	1.03	1.45	1.65

Showing graphical variation of 7,14 and 28 days



COMPRESSION STRENGTH TEST: -Average compressive strength of Thermocole Sandwich Concrete Block is 34.23 N/mm^2

WATER ABSORPTION TEST: - Average water absorption of Thermocole Sandwich Concrete Block is 1.76%

6. CONCLUSIONS

The paper mainly examines the properties of Thermocol Sandwich Concrete Block. Based on the limited study done on project, following conclusions are drawn**.**

1. We have observed that, the use of EPS sheet in Concrete Blocks have led to achieve good compressive strength as well as better water absorption properties. Also, it is lightweight as compared to other building properties.
2. It is easy in handling. This reduces the cost and significantly cuts down the construction time.
3. We have also observed that, if the sheet size increases above 30mm there is decrease in its compressive strength.
4. It also serves as a solution for EPS (thermocole) disposal thus, proving ecofriendly method of construction.
5. results also suggest that EPS concrete block has scope for nonstructural construction applications, like wall panels, partition walls, etc.
6. Thermocol Sandwich Concrete Block hence proved to be cheaper method of construction.

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