PROPERTIES OF LIGHTWEIGHT CONCRETES MADE OF EPS BEADS

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A Thesis Submitted To The Department Of Civil Engineering In Partial Fulfillment For The Degree Of Bachelor Of Science In Civil Engineering

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Section:- 16B
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Dedicated

To

"Our Honorable Teachers"

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ABSTRACT

Lightweight Concretes Cylinder has a history of more than two-thousand years and its technical development is still proceeding. This review starts with a retrospective that gives an idea of the wide range of applications covered by lightweight Concretes Cylinder during the last century. Although lightweight Concretes Cylinder is well known and has proven its technical potential in a wide range of applications over the past decades, there are still hesitations and uncertainties in practice.. Therefore, aspects are highlighted that often are the cause of misunderstandings, such as nomenclature or the informational value of certain tests. Frequently occurring problems regarding the mix design and production of lightweight Concretes Cylinder are addressed and the unintended consequences are described**.** Sylhet sand was used as partial replacement of EPS beads (0%, 5%, 10%, 15% Total 15-cylinder specimen of 100mm diameter and 200mm height and 10 slab specimens were prepared for testing purposes. Performance of the lightweight Concretes Cylinder was assessed in terms of their compressive strength, water permeability, chloride ion permeability and thermal conductivity tests. Compressive strength of 0%, 5%, 10%, 15% EPS lightweight Concretes Cylinder are. Density of 0%, 5%, 10%, 15% EPS lightweight Concretes Cylinder are 2580, 2330, 1160, kg/m3.

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Chapter 1
INTRODUCTION

1.1. General

Lightweight aggregate can be naturally occurring but they are relatively scarce. Most of the lightweight aggregate materialthatis used for lightweight Concretes Cylindermanufactured by some means. For example, thermal treatment or preprocessing of certain naturally occurring minerals can produce an aggregate having a cellular or foam-like structure,hence a lower bulk specific gravity.Blastfurnace is anexampleof a lightweight aggregate.Flyashcanusedin pervious Concretes Cylinder a substitute for portion of the cement. The advantage of using fly ash is obvious. Fly ash is a byproduct of coal burning in power plant, its utilizationsaves the energy required to product the cement. It has been as road bedding. The dead load Concretes Cylinder is very high because of high density thereby load on the structure increase, to reduce this dead load there is used of lightweight Concretes Cylinder is necessary. This lightweight Concretes Cylinder can be used in replacement of coarse aggregate. The lightweight Concretes Cylinder can be achieved in number of ways like either by introducing gas or foam or by replacing the standard aggregates with lighter materials. This method will have major impact on the economic system of any country and try is made to address the possibility of utilizing EPS beads. EPS beat is causes of concern to environment lists. In this case, coarse aggregate is replaced by EPS beats. EPS is a lightweight plastic material it made of fine spherical shaped particles particle which are consists of about 98% and 2% polystyrene .lightweight Concretes Cylinder with EPS beads are used for reduce self weight in structure, curtain wall, cladding panels, till – up panels, and to produce load bearing Concretes Cylinder. Concretes Cylinder kilns are the top air polluter in seven major cities in the country, particularly during dry season when most Concretes Cylinders are made, turning the air quality of these metropolises "Severely unhealthy".

Typical Concretes Cylinder houses located in tropical places without proper ventilation can experience high temperatures which are usually greater than the outside dry bulb temperature (Jorge L. Alvarado E. M., 2008). Unwanted thermal energy accumulates in buildings and dwellings from a variety of sources, such as heat from interior appliances, equipment, and occupants; solar radiation; and radiation- or convection-induced heat transfer and air infiltration through walls. Undesirable thermal energy storage is a critical issue in the tropics where cement-based materials (i.e. Concretes Cylinder) are routinely used in the construction of buildings. Concretes Cylinder and other cement-based material can absorb thermal energy for long periods.

1.2.Objective of Study:

The objectives of this study are as follows:

i. To produce lightweight Concretes Cylinder.
ii. To investigate the physical and mechanical properties of the LightWeight Concretes Cylinder.

1.3. LightWeight Concretes Cylinder with EPS Beads:

We make Concretes Cylinder by EPS beads with cement and sand mixing materials and casting Cylinder in laboratory. It makes ratio 0%-15% EPS Beads and 100%-85% Stone chips, cement and sands.

1.4. APPLICATION OF ALTERNATIVE BUILDING MATERIAL

The customary building construction trend in Bangladesh usually focuses on the use of burnt clay Concretes Cylinders for the infill and Reinforced Cement Concretes Cylinder frame structures. Under the study project the researcher try to establish CSEB, and others material as an infill wall material.

1.5.Significance of Research

Providing new knowledge to the contractors and developers about alternative lightweight Concretes Cylinders produced by EPS beads and EPS board with mortar. The used EPS board and EPS beads are lightweight and having good thermal insulation property. At present, Bangladesh government is encouraging to use alternative building cylinder instead of burnt clay Concretes Cylinders in all government project. These Concretes Cylinders may be the solution in this condition. In the

Fig 1.1 : Casting In Cylinder With EPS BEADS

construction process of these Concretes Cylinders no smoke is produced and huge amount of energy can be saved required for cooling purposes. To satisfy green building requirements and promoting sustainable development, these Concretes Cylinders may be use in Bangladesh.

1.6.Organization of Thesis

The layout of the thesis is written through six chapters in the following sequence. **Chapter One** deals with the importance, objectives and significances of the research in a comprehensive style. The first chapter is the introduction to our work. **Chapter Two** is literature review which includes the definhion of themrn1 insulation, advantages of thermal insulation, some common materials used for thermal insulation, Previous studies on alternate building Concretes Cylinder having thermal insulation prope1ty. **Chapter Three** contains Methodology and Experimental Prograom, Mix Design, Density EPS beads, Manual mixing. **Chapter Four** contains the experimental results along with the data, figure and graphs obtained from the laboratory tests and discussions on the test results. **Chapter Five** describes conclusion of the research work and recommendation for further research.

Chapter 2

LITERATURE REVIEW

2.1 General

Comprises of light weight and low density aggregate which mix with a type of Concretes Cylinder mix which is known as light weight Concretes Cylinder i.e. In self -weight and dead loads it increases the volume of mixing simultaneously providing considerable decrement. Because of low density high volume aggregates the formation of voids with air entrapping takes place and as the thermal conductivity and low density in light weight Concretes Cylinder is the key point of attraction. .as compare to both, standard commercial Concretes Cylinder has more compressive strength than light weight Concretes Cylinder, In structural construction industry the light weight Concretes Cylinder trends because of increasing compressive strength achievement. By the densification of mixing strength can be increased and light weight Concretes Cylinder can be used in both structural and non-structural if there is a addition of superplasticizer and fibre. Abdulkar kan , et al(2009) This paper reports the resultsof an investigation study on the effects of using expanded polystyrene beads (EPS) Currently EPS is used for disposable coffee cups and as cushioning material for packaging and shipping. In recent years, various researches on using EPS in Concretes Cylinder have been conducted. Reinforced Concretes Cylinder roof slabs can be an ideal alternative to traditional roofs considering the better cyclone resistance that can be offered due to the self-weight. However, the Concretes Cylinder slabs do not perform satisfactorily in warm humid tropical climatic conditions and tend to act as heated bodies for the occupants in free running spaces. As a solution, a robust roof slab insulation system is proposed and its thermal performance was determined experimentally using small and large-scale models. With comfort models developed for the people acclimatized to tropical climatic conditions, Insulated roof slabs could provide acceptable indoor conditions while providing many valuable benefits such as cyclone resistance, regaining of land lost for the house and the possibility of creation of roof top gardens. Insulating roof slabs is identified as a better passive way to make buildings thermally comfortable.

2.2Thermal Concretes Cylinder

Thermal Concretes Cylinder is produced using EPS Sheet with both side mortar. The advantage of thermal LightWeight Concretes Cylinder is that it has good thermal and sound insulation properties. Moreover, the weight of the LightWeight Concretes Cylinder is almost half of the traditional or Cylinder LightWeight Concretes Cylinder.

2.3 Study on Heat Insulation System and EPS

Thermal insulation is an important contributor and very practical and logical first step towards obtaining energy efficiency. Nowadays it is a major concern to reduce the difference of indoor and outdoor room temperature.

Vadim Nikitin and Andrzej Lapko used capillary porous material in real wall and slab structures which was exposed to ambient air. Heat transfer in multilayer sandwich panel was studied. foamed polyurethane was used in Concretes Cylinder. It was found that the improvement of computational accuracy of modelling of the thermal engineering problems requires an accurate real parameters which characterize capillary-porous structural materials (Vadim Nikitin, 2006).

Qairuniza Roslan et. al. (2016) implanted optimum roof pitch and ventilated roof approaches in current design of roof slab which reduced internal room temperature and also economical (Qairuniza Roslan, 2016).

Sofia Knapic et. al. (2016) produced Prototype boards of high-density expanded cork agglomerates (230 and 290 kg/m^3). Tensile strength, hardness, thermal conductivity, and reaction to fire was observed. It is good for heat insulation (Knapic, Santos, Pereira, & Machado, 2017)

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Dr. Mohammad S. Al-Homoud used various type of heat insulating material and conducted research and found that Fiberglass (open cell structure) Expanded Polystyrene (closed cell foam) Extruded Polystyrene (closed ce!J foam) have Thermal conductivity 0.035-0.032,0.038- 0.037,0.032-0.030 (W/m-K), which are good heat insulator (Al-Homoud, 2005).

Bing Chen and Juanyu Liu used styrene-butadiene rubber (SBR) latex as a polymeric admixture in lightweight expanded polystyrene (EPS) Concretes Cylinder, in this case SBR increased flexural strength. Unmodified EPS Concretes Cylinders without SBR show the highest flexural strength and concluded that the strength development of the polymer-modified EPS Concretes Cylinders strongly depends on the curing conditions (BingChen, 2007).

Bjørn Petter Jelle concluded that nowadays there exist no single thermal insulation material which can satisfy thermal conductivity, perforation vulnerability, building site adaptability, mechanical strength, fire protection, fume emission during fire, robustness, climate ageing durability resistance towards freezing/thawing cycles, water resistance, costs and environmental impact. New design should be made to reduce heat insulation (Jelle, 2011).

Bing Chen and Juanyu Liu created EPS Concretes Cylinder with reinforced steel fiber and found that Fine silica fume can increase the strength of EPS Concretes Cylinder (at most 15%) and also steel fiber increases its strength, increases shrinkage resistance properties (Bing Chen, 2004).

Bing Chen and Juanyu Liu used styrene-butadiene rubber (SBR) latex as a polymeric admixture in lightweight expanded polystyrene (EPS) Concretes Cylinder, in this case SBR increased flexural strength. Unmodified EPS Concretes Cylinders without SBR show the highest flexural strength and concluded that the strength development of the polymer-modified EPS Concretes Cylinders strongly depends on the curing conditions (BingChen, 2007).

Chapter 3

METHODOLOGY AND EXPERIMENTAL PROGRAM

3.1 MATERIALS

Cement: Ordinary Portland Cement (Type I) was used which is locally available and its specific gravity is 3.15.

Sand: Sylhet sand was used for producing lightweight building Concretes Cylinder and local sand was used for capping building Concretes Cylinder specimen for performing compressive strength test.

EPS beads: Expanded polystyrene (EPS) beads was used with cement sand mixture to reduce the amount of cement and sand in mortar and dead weight of the Concretes Cylinder

(a) Cement

(d) Sylhet Sand

(c) Stone Chips

(e) EPS Beads

Figure 3.1 Materials used in this Project

3.2 DETERMINATION OF MATERIAL PROPERTIES

3.2.1 Unit Weight:

The unjt weight is the weight per urut volume of a material. The symbol of unit weight is y. A commonly used value is the urnt weight of water on Earth at 4°C, wmch is 9.807 kN/m^3 or 62.43 lbf/ft^3• The terms specific gravity, and less often specific weight, are also used for relative density Deterrrunation of the unit weight of coarse and fine aggregates in a compacted condition. **ASTM** Test Method C 29 represents unjt weight in a compacted or loose condition and calculation of voids in fine, or coarse aggregates. It is essential for selecting proportions for Concretes Cylinder mixtures.

3.2.2 Fineness Modulus:

The Fineness modulus is an empirical figure obtained by adding the total percentage of the sample of an aggregate retained on each of a specified series of sieves, and dividing the sum by 100. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates (ASTM C 125, C 136) was used to deterrrune fineness modulus offine aggregates.

3.3 Determination of Density

Density is a measurement that compares the a.mount of matter an object has to its volume. An object with much matter in a certain volume has rugh density. An object with little matter in the same amount of volume has a low density. Density is found by dividing the mass of an object by its volume. The process of rruxing Concretes Cylinder can be modified to f01m a higher or lower density of Concretes Cylinder end product. After remolding the cylindrical mold, the mass, diameter and height of the specimen was taken. It was done before starting of curing process. Finally, the density was calculated by dividing the mass by the volume of the specimen. In figure 3.2 shows the measurement of density of EPS beads.

Figure 3.2 Density measurement of EPS beads

a) PREPARATION OF MIX DESIGN

3.3.1 Unit Weight Of Materials Lightweight Concretes Cylinder :

An appropriate mix design ratio was Calculated to prepare the mortar required to produce light weight building Concretes Cylinder according to the ACI standards.

Table 3. **1: Mix** Proportions for 4 Types of Concretes Cylinder Cylinder

Materials	Cement (Kg/m3)	Sand (Kg/m3)	EPS Beads (Kg/m3)	Stone Chips (Kg/m3)
Unit Weight	287	924	3.832	1680

i) Mixing procedures

For relatively less amount of mortar required manual hand mix procedure was used for mixing Concretes Cylinder. All the constituent materials were collected and weighed properly. The weighted materials were taken in a pan and mixing process was completed. The manual mixing processis shown in Figure 3.3.

Figure 3.3 Manual mixing

Figure 3.4. Collected Types of Cylinder

b) Determination of Compressive Strength

Compressive strength test of Concretes Cylinders are performed according to **ASTM** C67-03 to determjne the load carrying capacity of Concretes Cylinders under compressjon with the help of compression testing machine. Thjs is one of the most important and significant properties of building Concretes Cylinder. In this report the compressive strength of different types of building Concretes Cylinder including burnt clay Concretes Cylinder were deterrruned at the age 28 days. The typical setup for compressive strength of LightWeight Concretes Cylinder.

Figure 3.4: Typical setup for compressive strength determination

The compressive strength was determined by using equation (1)

C = P/A………………………. (1)

Where,

C = Compressive strength

P = Failure load

A = Contact area

i) Determination of Water Absorption

Water absorption test on Concretes Cylinders Cylinder are conducted according to ASTM C-67-80 to determine durability property of Concretes Cylinders such as degree of burning, quality and behavior of Concretes Cylinder Cylinder in weathering. A Concretes Cylinder having water absorption of less than 7% provides better resistance to damage by freezing. The water absorption by Concretes Cylinders increase with increase in pores. So, the Concretes Cylinders, which have water absorption less than 3percent can be called as vitrified. This test provides the percentage of water absorption of Concretes Cylinders and procedure of the same is discussed below. Dry the specimen in a ventilated oven a temperature of 105°C toll5°C till it attains substantially constant mass. Immerse completely dried specimen in clean water for 24 hours.

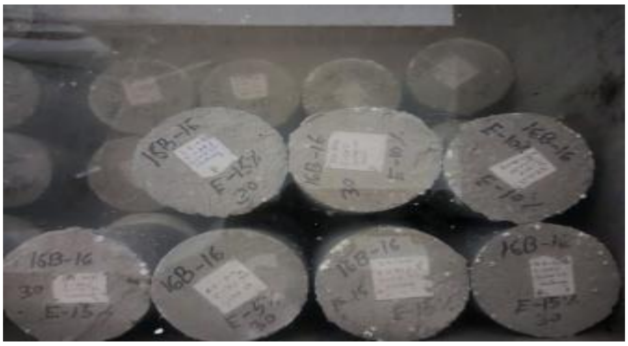

Figure 3.5: Water Absorption

ii) Determination of Density of cylinder Concretes Cylinder LightWeight :

Density is a measurement that compares the amount of matter an object has to its volume. An object with much matter in a certain volume has high density. An object with little matter in the same amount of volume has a low density. Density is found by dividing the mass of an object by its volume. We have collected data of length, width and height of the Concretes Cylinder. Then we determine density of the Concretes Cylinder by dividing weight by the volume of the Concretes Cylinder.

Chapter4

RESULTS AND DISCUSSIONS

In this chapter, the result obtained from the experimental investigations are reported using necessary graphs, histograms and tables. All the values reported are the average of the three trials in each case in this study.

4.1 WATER ABSOPATION

The bulk density of 4 types of Cylinder were determined. Among these, 2 types of Concretes Cylinder were prepared. Other two types of Concretes Cylinder were burnt clay Concretes Cylinder and commercial solid Concretes Cylinder made of cement, sand and crushed stone. These densities are shown in figure 4.1. It was observed that the density of Cylinder with NT and EPS beads is less than other types which indicates that the Concretes Cylinder made of EPS Beads is lighter than other types of Concretes Cylinder.

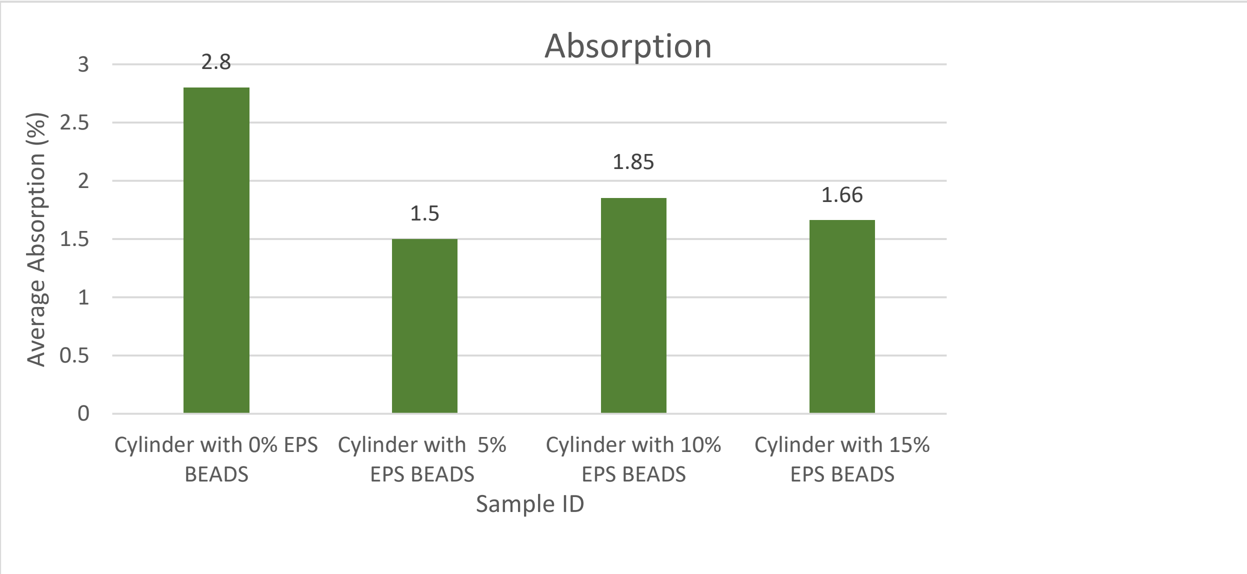

Figure 4.1 Absorption of Different Types of Building Lightweight Concretes Cylinder

4.2 Absorption Of Different Types Of Lightweight Concretes Cylinder

Compressive Standard Test Method for Compressive Strength of Cylindrical Concretes Cylinder Specimen was used to determine compressive strength of specimens. Strength of Concretes Cylinder is one of the most important and significant properties. In this report the compressive strength of different types of specimens were determined at the age of 28 days. The typical setup for compressive strength of Concretes Cylinder. Total 5 type of specimen were prepared. The differences between planned and actual densities of polystyrene foamed Concretes Cylinder were higher than foamed Concretes Cylinder specially for specimens with higher volume of EPS due to the contribution of polystyrene particles. In this study, sand volume was replaced by EPS beads volume (Ali A. Sayadi, 2016) . There density is shown in figure :

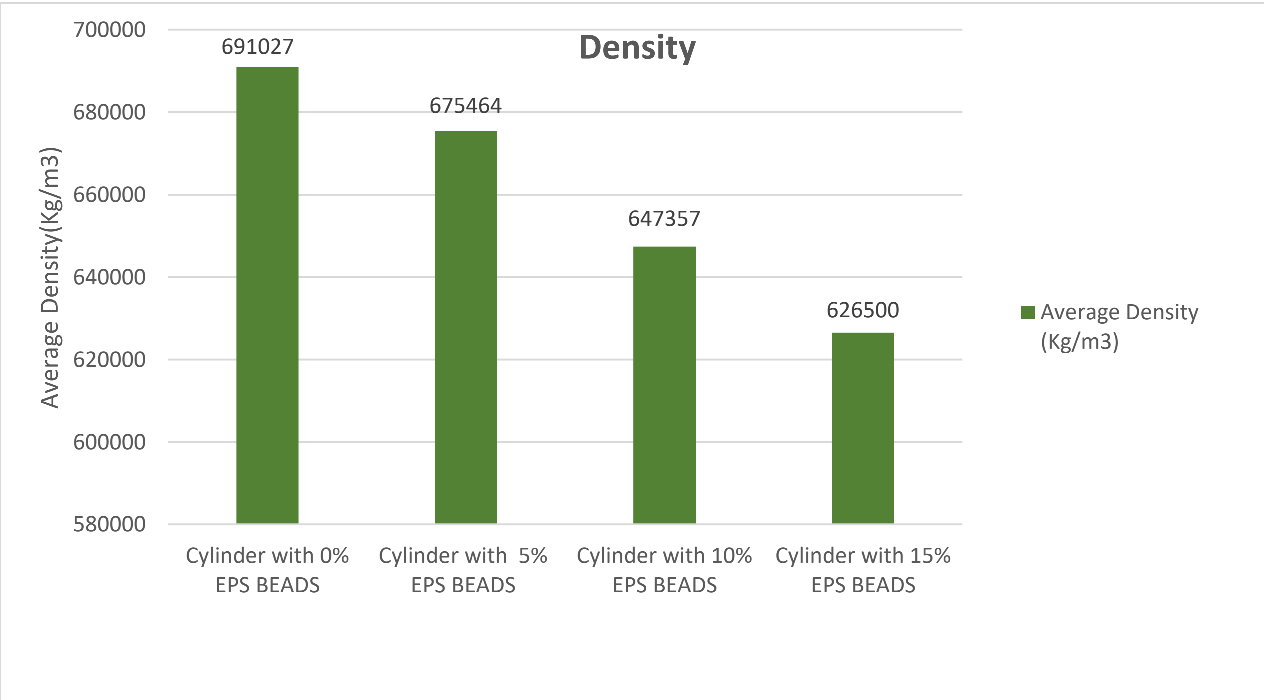

Figure 4.2 Oven Dry of Different Types of Lightweight Concrete of Cylinder

4.3 Compressive Strength of Cylinder :

Compressive strength of Concretes Cylinder was determined for 28 days of curing. In a previous study, comparison of compressive strength reveals that Concretes Cylinder with 82.22% EPS volume reached a strength of 0.08 MPa after 28 days, while the strength of 0.067, 0.24, 0.29 and 0.85 MPa was obtained for specimens containing 73.10, 67.40 and 45.0% polystyrene beads, respectively (Ali A. Sayadi, 2016)

Figure 4.3 Casting in Lightweight Concretes of Cylinder

Solid Lightweight Concretes Cylinder Made Of Cement, Sand And Crushed Stone. There Compressive Strength Is Shown In Figure 5.3.

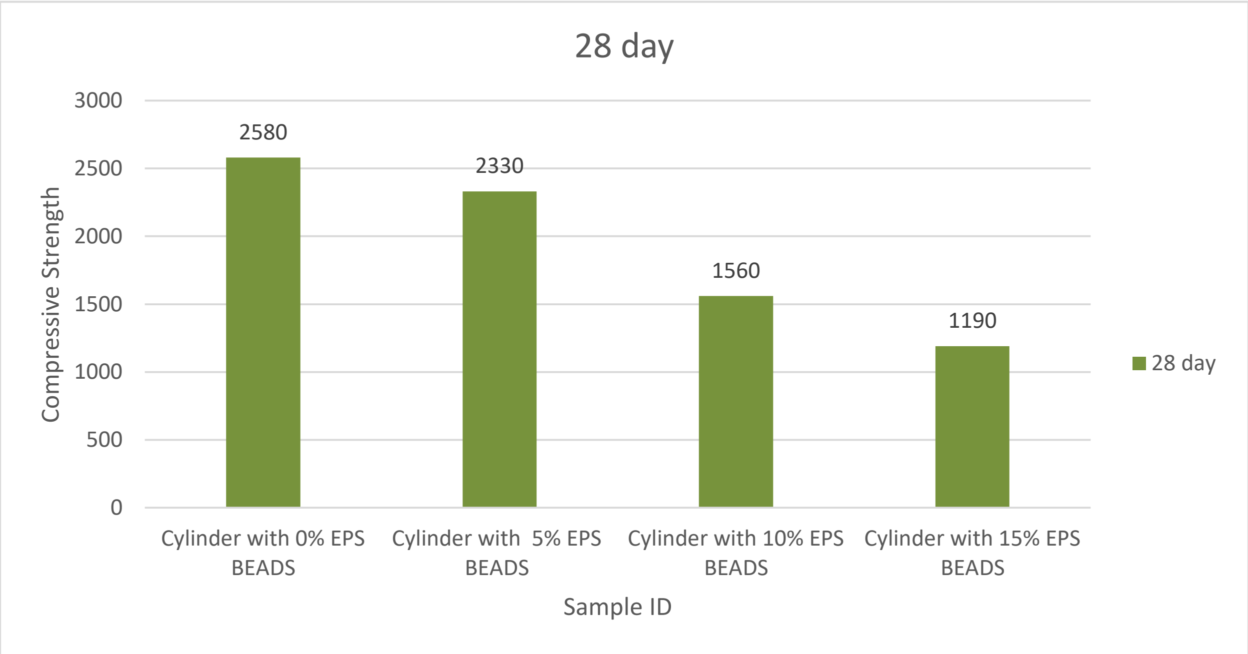

Figure 4. 4 Comparison of Compressive strength of Different Types of Cylinder Concretes

In this study, the 28 days compressive strength found for the Concretes Cylinder with NT Concretes Cylinder NT with EPS beads are 1190 and 2580 psi respectively. These are less than the compressive strength of clay Concretes Cylinder. The compressive strength of commercial solid Concretes Cylinder found was 2040 psi which is less than the compressive strength of Concretes Cylinder with EPS board. The minimum compressive strength of Concretes Cylinder is 1190 psi. It is observed that, compressive strength of Concretes Cylinder with EPS beads satisfy the minimum compressive strength cylinder.

Chapter 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The main objective of this project is to study the effectiveness of lightweight building Concretes Cylinder made of EPS beads. In this study, It was observed that the density of Concretes Cylinder with EPS beads is less than other types which indicates that the Concretes Cylinder made of EPS Beads is lighter than other types of Concretes Cylinder. It was observed that the compressive strength of Concretes Cylinder with EPS beads is slightly less than other type of Concretes Cylinder but the density of this type of Concretes Cylinder is lower than other type of Concretes Cylinder which proves it lighter. The water absorption of Concretes Cylinder with EPS beads and Concretes Cylinder with NT and EPS beads are 10.5 and 9.6% respectively. These values are less than the absorption of clay Concretes Cylinder. These values are very close to the absorption of commercial solid Concretes Cylinder. In this study, the 28 days compressive strength found for the Concretes Cylinder with NT and Concretes Cylinder with NT and EPS beads are 1800 and 1740 psi respectively. These are less than the compressive strength of clay Concretes Cylinder. The compressive strength of commercial solid Concretes Cylinder found was 2040 psi which is less than the compressive strength of Concretes Cylinder with EPS board. The minimum compressive strength of Cylinder is 1190 psi. It is observed that, compressive strength of Concretes Cylinder with EPS beads satisfy the minimum compressive strength cylinder. The RCPT test result found for the Concretes Cylinder with NT and EPS beads, Concretes Cylinder with NT and EPS beadsand commercial solid Concretes Cylinder were 3582, 3163 and 4321 coulombs respectively.

5.2 Recommendations

The following recommendation may be proposed for further study:

5.2.1 Number of sample for each test should be increased.

5.2.2 Before using this types of Concretes Cylinder commercially in building construction more extensive research is need to be done.

5.2.3 For satisfying strength requirement, strength improving admixtures can be used fo1further research.

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APPENDIX

Table 1: Water Absorpation Data

Types of Cylinder	Sample. No.	**Water Absorpation**		Absorpation(%)	Average Absorpation(%)
		Dry Wt.	SSD Condition		
0% oF EPS BEADS	01	3993	4109	2.90 %	2.80
	02	4044	4154	2.72 %	
	03	3883	4031	3.811 %	
	04	3897	3967	1.79 %	
5 % oF EPS BEADS	01	3813	3895	2.15 %	1.50
	02	4012	4053	1.02 %	
	03	3871	3910	1.0074 %	
	04	3893	3934	1.053 %	
	05	3827	3915	2.299 %	
10 % oF EPS BEADS	01	3694	3731	1.0016 %	1.85
	02	3658	3780	3.33 %	
	03	3807	3885	2.04 %	
	04	3711	3755	1.18 %	
	05	3793	3858	1.71 %	
15% oF EPS BEADS	01	3583	3600	0.474 %	1.66
	02	3653	3722	1.88 %	
	03	3617	3686	1.90 %	
	04	3684	3715	0.84 %	
	05	3653	3770	3.202 %	

Table 2: Dry Density Data

Types of Cylinder	Sample. No.	**Oven Dry Weight**	**Dry final Value**	**Average Dry final Value**
0% oF EPS BEADS	01	3938	703214	691027
	02	3941	703750	
	03	3760	671428	
	04	3840	685714	
5 % oF EPS BEADS	01	3732	666428	675464
	02	3917	699464	
	03	3783	675535	
	04	3763	671964	
	05	3718	663928	
10 % oF EPS BEADS	01	3538	631785	647357
	02	3566	636785	
	03	3799	678392	
	04	3577	638750	
	05	3646	651071	
15% oF EPS BEADS	01	3426	611785	626500
	02	3512	627142	
	03	3450	616071	
	04	3515	627678	
	05	3639	649821	

Table 3: Compressive Strength

Types of Cylinder	Sl. No	Load (KN)	Load (lb)	Area	Load (lb) / A	Strength of cylinder (average) (lb/in^2)
0% oF EPS BEADS	01	140	31472	12.56	2505.73	**2580**
	02	147	33045.6	12.56	2631.02	
	03	137	30797.6	12.56	2452.04	
	04	151	33944.8	12.56	2702.61	
5 % oF EPS BEADS	01	131	29448.8	12.56	2344.65	**2330**
	02	133	29898.4	12.56	2380.45	
	03	133	29898.4	12.56	2380.45	
	04	125	28100	12.56	2237.26	
	05	128	28774.4	12.56	2290.96	
10 % oF EPS BEADS	01	87	19557.6	12.56	1557.13	**1560**
	02	82	18433.6	12.56	1467.64	
	03	90	20232	12.56	1610.83	
	04	87	19557.6	12.56	1557.13	
	05	89	20007.2	12.56	1592.93	
15% oF EPS BEADS	01	67	15061.6	12.56	1199.17	**1190**
	02	71	15960.8	12.56	1270.76	
	03	63	14162.4	12.56	1127.58	
	04	70	15736	12.56	1252.87	
	05	59	13263.2	12.56	1055.99	

[Note : 1 KN = 224.8 lb]