

## LIGHT WEIGHT CONCRETE BY USING EPS BEADS

**Prof. Ashish S. Moon<sup>1</sup>, Lokesh S. Selokar<sup>2</sup>, Anuradha I. Patle<sup>3</sup>, Dhanshree S. Bhojar<sup>4</sup>,  
Swati D. Kowale<sup>5</sup>, Sumaiyasarvat S. Quaz<sup>6</sup>**

<sup>1</sup>Assistant Professor in Department of Civil Engineering, SRPCE, Nagpur, Maharashtra, India.-441203

<sup>2-6</sup>Student of Department of Civil Engineering, SRPCE, Nagpur, Maharashtra, India.-441203

**Abstract** - The objective is to compare the compressive strength of conventional concrete with lightweight concrete comprising 30% of fly ash and expanded polystyrene as per IS code 10262- 2009. The effect of inclusion of expanded polystyrene on the compressive strength of lightweight concrete was studied. The cube of consists of 5%, 10%, 15%, 20%, 25% and 30% EPS for M25 mix design. As per experiment we know the 5% EPS beads sample has high compressive strength as compare to other sample and found to be 8 and 11 for 7 and 28 days curing period respectively.

**Key Words:** Lightweight Expanded polystyrene etc.

### 1. INTRODUCTION

Lightweight aggregate can be naturally occurring but they are relatively scarce. Most of the lightweight aggregate material that is used for lightweight concrete manufactured by some means. For example, thermal treatment or pre-processing of certain naturally occurring minerals can produce an aggregate having a cellular or foam-like structure, hence a lower bulk specific gravity. Blast furnace is an example of a lightweight aggregate. Fly ash can used in pervious concrete a substitute for portion of the cement. The advantage of using fly ash is obvious. Fly ash is a by-product of coal burning in power plant, its utilization saves the energy required to product the cement. It has been as road bedding. The dead load concrete is very high because of high density thereby load on the structure increase, to reduce this dead load there is used of lightweight concrete is necessary. This lightweight concrete can be used in replacement of coarse aggregate. The lightweight concrete 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 bead is causes of concern to environment lists. In this case, coarse aggregate is replaced by EPS beads. EPS is a lightweight plastic material it made of fine spherical shaped particles particle which are consists of about 98% and 2% polystyrene .lightweight concrete with EPS beads are used for reduce self weight in structure, curtain wall, cladding panels, till – up panels, and to produce load bearing concrete blocks.

### 2. LITERATURE REVIEW

Comprises of light weight and low density aggregate which mix with a type of concrete mix which is known as light weight concrete 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 concrete is the key point of attraction. .as compare to both, standard commercial concrete has more compressive strength than light weight concrete, In structural construction industry the light weight concrete trends because of increasing compressive strength achievement. By the densification of mixing strength can be increased and light weight concrete 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 results of an investigation study on the effects of using expanded polystyrene beads (EPS ) in a lightweight concrete as a potential aggregates. In this project eps beads are used in the form of aggregate. In this study, we get to know that in

Aggregate the foam which is used is a thermally modified waste EPS foam. By heat treatment method we had get modified waste expanded polystyrene aggregates (MEPS) by a hot air oven at 125°C for 20 min and keeping EPS foams in that oven. By introducing the weight concrete can be produced: (1) gas-sing material like-aluminium powder or we can use fibre, (2) plastic granules like aggregates, e.g., expanding urethanes foam(EPS), urethane or different polymer materials.

Monali Patil, et al (2016) This paper present the outcomes of an exploratory examination into the engineering properties like, the compressive property and splitting property of polystyrene aggregates concrete different in thickness. In Germany 1950 a unyielding cellular plastic is unusual explore which had named EPS or expanded polystyrene. Since 1958 the expanded polystyrene has been came into force and work in wrapping things. In this it is made up of 98% of gas but the remaining is of small, global EPS beads-which itself create of co<sub>2</sub> and hydrogen. With the quickly evolution and technology growth, the use of replacement for aggregates in concrete has been grow a lot. In concrete building like enlarged glass and EPS beads etc.. gradually different and new substance are being made and work as renewal of aggregate in concrete raising.

Abdulkadir kan ,et al (2007) in this paper to determine the effect of cement and expanded polystyrene ratio, M25 mix design by volume were used. In this experiment EPS beads taken for the mixture were constant at 0.02 to 1. The examination of the final result leads to a final decision that with the grow of cement to EPS beads ratio in that the mixes, the final thickness, compressivness, splittingness rise when it has been compared to the controlsample.

Abhijitsinh Parmar et al (2015) Research Report, he observed the Activites and Progress of Light Weight Concrete. In his research report he was focusing on performance of EPS light weight Concerete's Compressive Strength Test, density and supplementry test and also compared with other types of Light weight Concrete. In his report he says that the increase in usage of Lightweight concrete in green buildings and sea structures all over the world shows the success of this concrete. Further he says " The freedom to tinker with the properties of the concrete by altering the making process and components gives greater flexibility to creative minds while emphasizing the fundamentals of concrete design."

Linchang Miao et al(2016) In his research report, observe that EPS volume ratio of 0 %, 20 %, 30 %, and 40 % by replacing matrix or coarse aggregate, Shows that the two design styles had nearly the same compressive strength. He applied Frequency of 5 Hz, 50000 or 100000 times and cyclic loading of 40 KN, 50KN, and 60 KN, The results of this research had practical significance on using EPS beads concrete in some long-term recyctic dynamic load engineering . Further he says The L.W.C. (Light Weight Concrete) has no pollution effect to the environment because manufactured EPS particle consumes little energy, and the particle has no poison and harm.

Bengin M A Herki, et al (2020) Volcanic materials such as pumice are used in the production of concrete as partial replacement of natural aggregate concrete (LWAC) utilizing a locally available lightweight aggregate (LWA) called pumice aggregate (PA) . This novel LWAC is made by partial replacement of coarse aggregate with different replacement levels of 10%, 20%, 30%, 40% and 50% of PA by volume. This study id focused to determine the mechanical and durability properties of LWAC to find the optimum replacement level of PA. The properties of PA were reported by conducting comprehensive series of tests on workability, compressive strength, density, and total water absorption and ultrasonic plus velocity (UPV). It is concluded that the LWAC has sufficient strength and adequate density.

Anil Pratap Singh, et al (2018), A Study on Light Weight Concrete It is use for minimizing the dead load of structure. so it is very essential to reducing the overall cost of project. The main purpose are EPS beads is used in engineering. Since at least the 1950s. The polystyrene aggregate to produce light weight concrete with the unit weight varying from 1200 to 2000 kg/m<sup>3</sup>. The properties are good thermal insulation, the lower the thermal conductivity. Aggregate, both in concrete and mortar. EPS beads can be conventional concrete making material.

Jaydeep Singh et al (2017), studied the light weight concrete - Expanded Polystyrene (EPS) is a light weight material. Expanded Polystyrene waste in a granular form is used as light weight aggregate to produce light weight non - structural concrete with the unit weight varying from 950 kg /m<sup>3</sup> to 1350 kg/m<sup>3</sup>. It is considered to be one of the best sensor materials available and used widely since the 1950s. It is properties are such as compressive strength, modulus of elasticity, drying shrinkage and creep of polystyrene aggregate concrete varying in density.

Vandale Amar Diliprao, et al (2019) deals with the study of polystyrene foam is thermoplastic material obtain by Polymerization of styrene. In construction has lot of advantages by using of expanded polystyrene as compare use of conventional material which result in sustainable future. EPS is versatile durable material that offers excellent insulation property. As the structure of consist of 98% air it's initial thermal properties are maintain throw out it's working life. It can be manufacture in a wide rage of shape & sizes. The use expanded polystyrene in construction has lot of advantage compare with use of conventional material which result in sustainable future. EPS is use as lightweight aggregate to produced lightweight concrete with unit weight less than 1000kg/m<sup>3</sup> which make it as lightweight concrete coarse aggregate is measure contributor for heavy weight of concrete as replaciny it with EPS beads result reduction of the density of concrete

Daneti Saradhi Babua et al (2003) Investigated the influence of the EPS beads or polystyrene aggregate size content, on strength and moisture migration characteristics of light weight concrete. from the study's it is cover that the expanded polystyrene beads and unexpanded beads we're use as light weight aggregate in concrete. which contain fly ash and aluminum powder as supplementary cementious materials. Light weight concrete with heavy rang of concrete densities (1000-1900 kg/m<sup>3</sup>)were studies, mainly because of to know the compressive strength, split tensile strength, moment of moisture and absorption. And from, there result indicated that for aggregate size and concrete density, concrete along with UEPS aggregate shows 70% higher compressive strength as compared to EPS aggregate. EPS aggregate concrete with small size of polystyrene beads exhibited higher compressive strength was noticable in low density concrete when it was compared with higher density concrete.

### 3. EPS EXPANDED POLYSTYRENE

The white foam plastic material form solid beads of polystyrene is known expanded polystyrene .expanded polystyrene is a very light weight with a very low thermal conductivity low moisture absorption and excellent cushioning properties. Expanded polystyrene foam is the rather low maximum operating temperature ~800c its physical properties do not change within its survive temperature range (i.e. up to 1670F\750c) for long term

temperature exposure. Expanded polystyrene insulation and building product its important mechanical property



CUBE OF EPS BEADS

The dielectric strength of EPS is dielectric constant measure in the frequency range of 100-400 MHI and gross density from 20-40 kg/m<sup>3</sup> lies between 1.02-1.04. antistatic agent comply with electronic industry and military packing specification may be treated with moulded .EPS is not hydrosopic small amount of water absorbed when eps immersed in water the cell wall are water proof water can only penetrate foam through the tiny channels between the fuse beads. There are three stages for the conversion of expandable polystyrene to expanded polystyrene.ie pre-expansion maturing stabilization and moulding. For production of polystyrene the crude oil refinery product styrene is use. The polystyrene beads are impregnated with forming agent pentane to manufacture expanded polystyrene EPS has many properties.



STANDARD SIZE OF MOULD

Expanded polystyrene (EPS) beads are use as partial replacement to coarse aggregate. There are many advantages to be again foam the use of EPS in lightweight



concrete expanded polystyrene concrete (also known as eps concrete or lightweight concrete) is from of concrete known for its lightweight concrete made from cement and expanded polystyrene .It has been used as road bedding in geo- stabilization projects and as sub -grading for rail road track age. It is popular material for use environmentally “ green “homes” Lightweight comprise is extremely lightweight making it ideal for transport and insulation due to increase of construction activities in all places there is need to do something to reduce use of raw material and to decrease dead load of structure so that because of increasing of construction activities demand of raw materials or at higher level. As we know that concrete have dead load very high due to the high density 2400 Kg/m<sup>3</sup> that’s why load on the gets increase. So that to reduce this dead load of structure and to obtained this purpose we need to produced light weight concrete and we can use this light weight concrete in our non-structural member like partition wall panel walls where load are low. For lessen the dead load of structure in order to make light weight concrete there is need replace standard aggregate with lighter materials and standard aggregate can be replace by gas or foam.

#### 4. MATERIALS AND MIX PROPERTIES

The materials use in this were cement ,river and with a fineness modulus of 2.85, crushed granite with maximum size 10mm , eps beads two types of fibre, poly fibre chemical admixture.

##### MECHANICAL PROPERTIES OF EPS BEADS

- Specific gravity :- 0.011
- Bulk Density :- 6.88 kg per cub meter
- Particle Size :- 8-10 mm dia
- Water Absorption :- 3.5 % by vol.
- Compressive strength :- 0.089

##### MIXIBILITY

The workability and durability of expanded concrete were poor during the mixing process. Therefore, after numerous mixing, a method of mixings similar to the sand wrapping technique was utilizes to make EPS concrete.

The still moulds of cube 150x150x150mm and 150x300mm were oiled properly before filling the mortar in cube and cylinder moulds. The mortar is filled in cube and cylinder in three layer with a hand compaction after adding each layer of mortar. After filling the moulds completely the excess mortar were removed from the mould with the help of travel and it used for levelling the surface.

After 24 hours setting time, concrete samples, were demoded taken for casting and curing.



MIXIBILITY OF CONCRETE

##### CURING AND CASTING

A number of test specimens light weight concrete with esp. wad prepare at different percentage of eps beads (by volume of CA+FA). The light weight concrete was designed for MW5 mix design as per IS. The cube and cylinder specimen of size 150 x150x150 and 150x300 mm were prepared as 5% ,10%, 15%,20%,25% and 30% of esp. (by volume of CA+FA) after 7,14 and 28 days of curing they were tested for compressive strength test and split tensile test. Properties of EPS beads Light weight concrete Property Average value

- Density - 13kg\m<sup>3</sup>
- Compressive strength - 0.089Mpa
- Flexural Strength - 0.22 Mpa
- Water Absorption - 4.2% by vol. Specific gravity of cement – 3.14
- Specific gravity of fine aggregate– 2.42
- Specific gravity of EPS Beads– 0.012 fineness Modules of fine aggregate – 3.01
- Bulk Density of fine aggregate – 1645 kg/m<sup>3</sup>

### 5. COMPARISON BETWEEN COMMON BRICK AND EPS CONCRETE BLOCKS

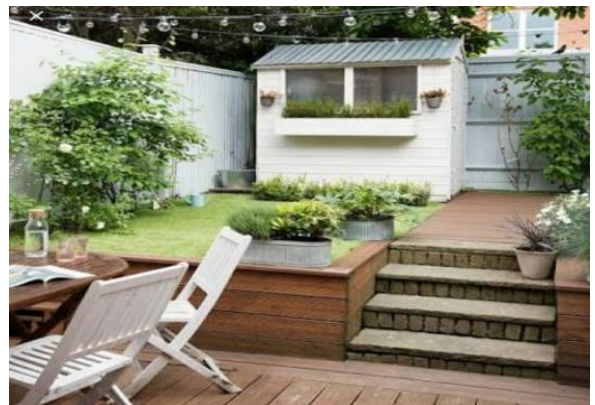
1. Compressive strength is the major difference between the both the clay bricks and concrete brick. Compressive strength means the resistance of concrete bricks against compression of loading. The compressive strength of concrete bricks is more than of clay brick it has been clear because of the material used in clay brick and concrete bricks.
2. The water resistant property of concrete bricks makes it very beneficial in construction work because water resistant property means waterproof and useful.
3. But the clay bricks have a property that it has well known to last for 1000 years and more, while the concrete bricks are only known for around 60-100 years so it has been clear that the life span of concrete bricks is lesser than of clay brick.
4. Concrete bricks are not so environment friendly than of clay bricks because they are not made up of natural resources but clay bricks are made up of and by environment prospective the clay bricks are best.
5. The main point is there is strength in concrete work and beauty in clay according to architect.

### 6. APPLICATION OF EPS CONCRETE

1. It is mostly used as loose fill insulation in masonry construction where it can reduce fire, rain, reduce noise transmission, do not rot and terminate resistance.
2. It is used to manufacture cement and plaster-based plates.



3. It is used in the production of heat insulated light wall panels.
4. Used in the bridge to prevent freezing.
5. It is used to be utilized as thermal insulation in the form of bricks and blocks over flat roofs of non-loading walls.
6. Light weight concrete used in construction of stairs, windows, garden walls, etc.



7. It is used in construction of roof slabs, small houses with load bearing walls, etc. Since, the strength of L. W. C.





## 7. CONCLUSION

It is concluded by the previous studies and research that partial replacement of aggregate with expanded polystyrene (EPS) beads make the concrete lighter than the conventional normal concrete. The strength increase slightly. Durability of the concrete also better estimated.

This study gives an idea to use a waste material in construction work. This study forces us to use other waste materials and check for construction work. The bearing strength of polystyrene aggregate concrete is increased with an increase in the ratio of total area to bearing area. With the increase in the polystyrene aggregate content, the ratio of the bearing strength to the compressive strength increased.

## 8. LIMITATIONS

1. The strength of lightweight concrete using EPS beads are low for lower density mixture.
2. This resulted in increment of voids throughout the sample caused by the Air entraining admixture. Thus the decrease in compressive strength of the concrete.
3. Density is one of the important parameters which can control many physical properties in light weight concrete and it is mainly controlled by the amount.
4. The use of various fibres such as coconut shell fibres, plastic fibres AQUA polyfibres ,etc. can increase the load carrying capacity of concrete in tension and flexure.
5. And also suppresses the crack formation.

6. It has been found from experimental data which shows that the compressive strength depends on the inclusions size of EPS beads, the smallest the size the highest the performance.
7. Lower porosity imparting the concrete more water tightness.
8. Mixing time is longer than conventional concrete to assure proper mixing.
9. Light weight concrete are porous and shows poor resistance.
10. 1Waste utilization making it more environmental friendly.

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**Prof. Ashish S. Moon**  
(Assistant Professor in Department of Civil Engineering, SRPCE, Nagpur)



**Lokesh S. Selokar**  
(Final Year Civil Engineering Student from Smt. Radhikatai Pandav College of Engineering, Nagpur)



**Anuradha I. Patle**  
(Final Year Civil Engineering Student from Smt. Radhikatai Pandav College of Engineering, Nagpur)



**Sumaiyasarvat S. Quazi** (Final Year Civil Engineering Student from Smt. Radhikatai Pandav College of Engineering, Nagpur)



**Swati D. Kowale**  
(Final Year Civil Engineering Student from Smt. Radhikatai Pandav College of Engineering, Nagpur)



**Dhanshree S. Bhoyar**  
(Final Year Civil Engineering Student from Smt. Radhikatai Pandav College of Engineering, Nagpur)