Lightweight Concrete Using Expanded Polystyrene Beads

[1]Ankur Rathore, [2]Ankush Hingve, [3]Himanshu Singh, [4]Roshan Munde, [5]Rupesh Yadav, [6]Shivam Prajapati

[1]Professor, [2,3,4,5,6]B.Tech Student
Department of Civil Engineering,
Shri Balaji Institute of Technology & Management Betul, RGPV University (M.P.), India.

Abstract— **Lightweight concrete, a versatile construction material, has garnered significant attention due to its numerous advantages, including reduced structural weight, improved insulation properties, and enhanced workability. This abstract delves into the utilization of Expanded Polystyrene (EPS) beads as an aggregate in lightweight concrete production. The primary objective is to investigate the mechanical properties, thermal insulation capabilities, and sustainability aspects of EPS-based lightweight concrete. The research focuses on exploring the feasibility of incorporating EPS beads, obtained from recycled materials, into concrete mixes to achieve desired lightweight properties while maintaining adequate strength and durability. The experimental investigation encompasses various mix designs with varying proportions of EPS beads, cement, fine aggregates, and additives. The mechanical properties of EPS-based lightweight concrete, including compressive strength, tensile strength, and flexural strength, are evaluated through standardized testing procedures. Additionally, the density and porosity of the concrete specimens are measured to assess the influence of EPS content on the material's structural performance**.

Keywords: EPS concrete, lightweight aggregate, expanded polystyrene, foam, insulating, low-density, cellular, sustainable construction.

Introduction : Lightweight concrete incorporating Expanded Polystyrene (EPS) beads has emerged as a compelling solution in the construction industry, offering a balance of structural integrity, thermal insulation, and weight efficiency. EPS beads, derived from expanded polystyrene foam, are lightweight, durable, and possess excellent insulating properties, making them an ideal choice for enhancing the performance of concrete structures. This innovative construction material addresses various challenges faced by traditional concrete, such as high density, poor thermal efficiency, and increased construction costs. By replacing conventional aggregates with EPS beads, lightweight concrete achieves a significant reduction in density while maintaining adequate compressive strength and durability. The incorporation of EPS beads into concrete mixtures introduces numerous benefits. Firstly, it reduces the overall weight of the concrete, leading to lighter structures that require less structural support and exhibit improved seismic performance. This weight reduction not only minimizes material usage but also facilitates faster construction and easier transportation .the thermal insulation properties of EPS beads contribute to enhanced energy efficiency in buildings. By reducing thermal conductivity, lightweight concrete using EPS beads helps regulate indoor temperatures, resulting in reduced heating and cooling loads, lower energy consumption, and improved occupant comfort. The manufacturing process of lightweight concrete with EPS beads involves carefully proportioning cement, sand, water, and EPS beads to achieve the desired properties. The lightweight aggregate nature of EPS beads enables better workability and pumpability of the concrete mixture, enhancing construction efficiency and reducing labor costs.

Objective: Lightweight concrete, also known as lightweight cellular concrete (LWC) or foamed concrete, is a versatile building material that offers numerous advantages over traditional concrete. One of the most common methods of producing lightweight concrete is by incorporating expanded polystyrene (EPS) beads into the mix. This type of concrete, often referred to as EPS concrete or EPS lightweight concrete, has gained popularity in various construction applications due to its lightweight nature, thermal insulation properties, and ease of use. In this article, we will explore the objectives of using EPS beads in lightweight concrete.

Weight Reduction: The primary objective of incorporating EPS beads into concrete is to reduce its weight significantly. Traditional concrete is heavy and can pose challenges in construction, transportation, and handling. By replacing a portion of the traditional aggregates with lightweight EPS beads, the overall weight of the concrete is reduced, making it easier to handle, transport, and install on-site. This weight reduction also lowers structural loads, which can lead to cost savings in the overall construction process.

Thermal Insulation: EPS beads are excellent insulators due to the trapped air within their cellular structure. When incorporated into concrete, they enhance the thermal insulation properties of the material. This is particularly beneficial in construction projects where thermal efficiency is essential, such as in buildings requiring energy-efficient insulation. EPS lightweight concrete helps to maintain comfortable indoor temperatures, reduces energy consumption for heating and cooling, and contributes to overall sustainability.

Improved Workability: Another objective of using EPS beads in lightweight concrete is to enhance workability. The lightweight nature of EPS beads improves the flowability and pumpability of the concrete mix, making it easier to place and finish. This increased workability allows for faster construction processes, reduced labor costs, and improved overall productivity on the construction site.

Reduced Shrinkage and Cracking: EPS lightweight concrete exhibits lower shrinkage and cracking compared to traditional concrete mixes. The incorporation of EPS beads helps to mitigate the internal stresses that lead to shrinkage and cracking during curing and drying. This results in a more durable and structurally sound concrete with enhanced long-term performance, reducing the need for maintenance and repairs over the lifespan of the structure.

Sound Insulation: In addition to thermal insulation, EPS lightweight concrete also provides excellent sound insulation properties. The air pockets within the EPS beads effectively dampen sound transmission, making it an ideal choice for buildings located in noisy environments or where acoustic performance is a priority, such as theaters, recording studios, and residential buildings.

Environmental Sustainability: Utilizing EPS beads in lightweight concrete aligns with sustainability objectives in construction. EPS is a recyclable material, and incorporating it into concrete reduces the consumption of traditional aggregates, such as gravel and sand. This reduces the environmental impact associated with quarrying natural resources and helps to conserve finite natural resources.

PROPERTIES OF LIGHT WEIGHT CONCRETE:

Lightweight concrete utilizing Expanded Polystyrene (EPS) beads offers a range of properties that make it a promising material for various construction applications. These properties stem from the unique characteristics of EPS beads as well as the benefits derived from their integration into concrete mixes. This section explores the key properties of lightweight concrete using EPS beads and their implications for construction.

1. **Reduced Density**: One of the primary advantages of EPS-based lightweight concrete is its significantly reduced density compared to traditional concrete. EPS beads are exceptionally lightweight, with a density typically ranging from 10 to 30 kg/m³. When incorporated into concrete mixes, these lightweight aggregates displace a portion of the heavier traditional aggregates, resulting in a concrete with lower overall density. This reduction in density offers several benefits, including decreased structural loads, improved ease of handling during construction, and potential savings in material costs.

2. **Mechanical Properties**: Despite its reduced density, lightweight concrete utilizing EPS beads can exhibit satisfactory mechanical properties. Through careful mix design and optimization, it is possible to achieve adequate compressive strength, tensile strength, and flexural strength to meet the requirements of various structural applications. The mechanical properties of EPS-based lightweight concrete are influenced by factors such as the proportion of EPS beads, the type and quality of cementitious materials, and the curing conditions during construction.

3. **Thermal Insulation**: EPS beads are renowned for their excellent thermal insulation properties, making them an ideal choice for enhancing the thermal performance of lightweight concrete. The entrapped air pockets within the EPS beads act as insulating barriers, reducing heat transfer through the material. As a result, lightweight concrete incorporating EPS beads exhibits improved thermal resistance compared to traditional concrete formulations. This enhanced thermal insulation capability contributes to energy savings in buildings by reducing heating and cooling loads, enhancing occupant comfort, and promoting sustainable construction practices.

4. **Workability**: Lightweight concrete with EPS beads typically exhibits good workability, facilitating ease of placement and compaction during construction. The lightweight nature of EPS beads reduces the overall weight of the concrete mix, making it easier to transport, handle, and place on-site. Additionally, the spherical shape of EPS beads promotes better distribution within the concrete matrix, improving homogeneity and reducing segregation. These factors contribute to enhanced workability and improved construction efficiency, allowing for faster and more cost-effective construction processes.

5. **Durability**:The durability of lightweight concrete utilizing EPS beads is influenced by various factors, including the quality of materials, mix design, curing methods, and exposure conditions. Properly designed and proportioned lightweight concrete mixes can achieve durability comparable to traditional concrete while benefiting from the reduced weight and improved thermal insulation properties provided by EPS beads. Additionally, EPS beads are inert and resistant to moisture, mold, and pests, contributing to the long-term durability and resilience of lightweight concrete structures.

6. **Environmental Sustainability**: EPS-based lightweight concrete offers environmental sustainability benefits throughout its lifecycle. The use of EPS beads, which are often derived from recycled materials, reduces the demand for virgin aggregates and minimizes waste generation. Additionally, the lightweight

nature of EPS-based concrete reduces transportation energy and greenhouse gas emissions during construction. Furthermore, the enhanced thermal insulation properties of lightweight concrete contribute to energy savings in buildings, reducing the overall environmental footprint associated with heating and cooling operations.In conclusion, lightweight concrete utilizing EPS beads offers a compelling combination of properties that make it an attractive choice for a wide range of construction applications. From reduced density and improved thermal insulation to satisfactory mechanical properties and environmental sustainability benefits, EPS-based lightweight concrete presents a promising solution for achieving high-performance and energy-efficient buildings. Further research and development in this area hold the potential to drive innovation and advancement in sustainable construction practices, paving the way for a greener and more resilient built environment

LITERATURE REVIEW:

Daneti Saradhi Babua et al. (2018) investigated the impact of polystyrene aggregate size on lightweight concrete's strength and moisture migration properties. The investigation deals with the utilization of expanded polystyrene (EPS) and un-expanded polystyrene (UEPS) beads as a light weight aggregate in concrete containing fly ash as an additional cemented material. Lightweight concrete with broad range of concrete densities was studied primarily for split tension, compression, absorption and migration of moisture. The results show that concrete with UEPS aggregate indicates 70% higher compressive strength than EPS aggregate for aggregate size and concrete density. EPS aggregate concrete with small EPS aggregates showed higher compressive strength and increased in low density concrete compared to high density concrete was pronounced. In addition, the result of absorption and moisture migration show that the EPS concrete with larger size and higher EPS aggregate volumes show higher absorption and moisture migration.**[2]**

Nikhil S. Chavan et al. (2018) examined the mechanical properties of floating concrete by using expended polystyrene as replacement of aggregates. Compression test, split tensile test and density testing were performed on concrete and this concluded. It was Possible to make Concrete floatable by using the EPS Beads as a replacement to Aggregate in concrete. By using EPS beads, floating concrete provides standard workability and can be compacted and finished easily. The compressive strength of Floating concrete was less than traditional concrete. The density of floating Concrete by given Mix Design was less than 1000 kg/m^2. There are issues of leakages and honeycombing, the issue of leakages may be controlled by using water proofing solution. It was also possible to built Boat by the Concrete i.e. Floating Concrete, which gives the more benefit such as Cost saving, Reduces the use of Timber, For Rescue operation. **[8]**

Thousif Khan et al. (2018) studied that coarse aggregates replaced by thermocol beads and pumice aggregates in different percentage, such as (100%, 0%), (90%, 10%), (80%, 20%), (70%, 30%), (60%, 40%), (50%, 50%) respectively. compressive strength test, split tensile strength test, Water absorption test and sorptivity test were carried out on concrete. Based on test result he concluded that The mix proportioning based on absolute volume concept used in normal concrete can be successfully employed for achieving a floating concrete keeping the density of the mix less than 1000 kg/m^3. The volume of aggregates can be maintained in the range of 0.7 to 0.75 for achieving floating concrete. Pumice and thermocol beads could be used as an alternative for coarse aggregates. Use of light weight aggregates like thermocol beads and pumice results in reduction of density and thus floating concrete could be easily developed. The ingredients used in floating concrete should be selected in such a way that the specific gravity of the materials chosen should be less than that used in conventional concrete. **[13]**

Malik Mehran Manzoor et al. (2018) used pumice stone and aluminum powder as an air-entraining agent to investigate the development of floating concrete. They had worked on combining the above mentioned types in the investigation. Comparison has been made in this study between plain cement concrete and lightweight concrete with different proportion of aggregate size and fixed quantity of aluminium content (2%) by weight of cement. It was produced with a satisfied strength using five different lightweight concrete mixtures and different pumice proportion. The investigation result showed that aggregate size and proportion had an impact on the concrete's compressive strength and unit weight. Furthermore, the result showed that by using pumice as an aggregate, it is possible to produce a Floating with satisfied strength. This concrete does not meet the load-bearing structural component strength requirement. **[7]**

Rayees Ahmad Ganie (2017) studied the production of floating concrete using pumice stone, foaming agent and thermocol. He also examined the effect of aggregates types and the amount on the concrete's compressive strength. It was produced with satisfied strength using five different lightweight concrete mixtures and different pumice proportion. The research result showed that proportion and aggregate size influenced concrete's compressive strength and the unit weight. In addition, the result showed that a Floating and satisfied foam concrete can be produced using foam and pumice aggregate. The strength requirements for structural load-bearing components are not met by this concrete. For building structures such as barges, slabs, buildings etc., floating concrete can be used effectively. Since the topmost part of earth is covered by water, land use for construction works is minimized and this is an environment friendly method of building boats that replace woods and metals. **[10]**

Roshan Gawale et al. (2016) investigated some of the problem statements currently generating millions of tons of polystyrene waste worldwide. In the end, this will cause pollution and damage to the ecosystem. Increasingly, national and international environmental regulations have become more inflexible, making disposal expensive. The use of waste polystyrene in concrete composition therefore not only solves the problem of disposing of this ultra-light solid waste, but also helps to preserve natural resources. For lower density mixture, the strength of light weight concrete using EPS beads is low. Initial finding showed that light weight concrete using EPS beads has a suitable strength as an alternative building material for footpath construction, partition wall, parapet wall, bed concrete. **[11]**

Roshan Peter et al. (2016) conducted experimental research on the use of light weight aggregate for floating concrete structure. In this experiment, an attempt was made to study the mechanical properties of a structural lightweight concrete grade M20 using the pumice stone as a partial substitute for coarse aggregate and mineral admixture materials such as Silica Fume, together with a control mix, The compressive strength study has been prepared for six sets. Each set consists of 3 cubes. The optimum 7 days' compressive strength have been obtained in the range of 5% silica fume for different replacement of coarse aggregate by pumice stone for 10%, 20%, 30%, 40% and 50%. Thus by comparing the compressive strength he can conclude that any structure can be built with 50% replacement of coarse aggregate with pumice stone with the addition of silica fumes by 5%. **[12]**

Jay Bankim Shah et al. (2015) has concluded that the cost, as well as the compressive and tensile strength gradually decrease with the increase of EPS in concrete block. Addition of plastic beads in concrete blocks along with EPS increases the compressive strength but also increases the cost gradually. Use of EPS and plastic beads in sensible quantity results in good compressive strength as well as increase in cost is not major. It can serve as a way of effective use of EPS disposal as well effective use of plastic beads that are waste products of many industries. **[4]**

Lakshmi Kumar Minapu et al. (2014) has presented experimental investigation consisting of casting and testing of 9 sets of cubes, prisms and cylinders consisting of various pumice aggregate proportions used to substitute for hard aggregate. Each set includes 4 cubes, 2 prisms and 2 cylinders to measure compressive, flexural & tensile strength. The pumice aggregate has been used in different proportions as a partial substitution of coarse aggregates along with fly ash and silica fumes. Cubes, prisms and cylinders were casted adopting M30 design mix proportions and then cured for 28 days. After 28 days they were tested for compressive strength, flexural strength and tensile strength. Results showed that lightweight aggregates are by no means less than ground aggregates and can be used for construction.

Hemant k. Sarje et al. (2014) explored the lightweight concrete development technique. Their study concentrates on the test of compression, water absorption & flexural. Low thermal conductivity and low density are the main strengths of lightweight concrete, which minimizes the dead load simultaneously and rises the building price, by mixing fly ash & aerating agents such as kemelite-foaming agent based on protein. **[3]**

Thomas Tamut et al. (2014) investigated the partial replacement of polystyrene beads into concrete, and also examined the properties of lightweight concrete containing EPS beads, such as the compressive strength and tensile strength. Their properties were compared to traditional concrete properties. On 28 days, it has been found that the strength of compression of 5%, 10%, 15%, 20%, 25% and 30% of the EPS-based concrete resistance amounted to 91%, 77%, 57% and 45% respectively compared with normal cement. On this basis, they have been drawn. Increasing the content of EPS beads in concrete mixes reduces the compressive & tensile strength of concrete. Without any fastener, EPS concrete has good working capacity and can easily be compacted, Increased workability by increasing the content of EPS beads. The substitution by EPS has shown a positive application in the construction of non-structural elements as an alternative material and is also the solution for disposal of EPS. The results show EPS concrete has scope for non-structural uses such as partition walls, wall panels and so on. **[14]**

Abhijit Mandlik et al. (2013) used EPS beads to investigate the lightweight concrete. It is suitable for different fields such as bridge decks, low-thermal walls, wooden floor repairs of old buildings, floating quay, and so on. It is therefore observed that the costs of EPS concrete are lower than those of traditional concrete. Increasing the content of EPS beads in concrete mixes lowers the concrete's tensile strength. He noted that the substitution using EPS has been a good use in the construction of nonstructural elements as alternative material and serves as a solution for the disposition of EPS. The EPS concrete is workable without any binding agent and can be easily compacted.

MATERIAL:

1. Expanded Polystyrene (EPS) Beads:

Expanded Polystyrene (EPS) beads serve as the primary lightweight aggregate in lightweight concrete formulations. EPS beads are derived from expanded polystyrene foam, which is produced by expanding polystyrene resin beads using steam. These beads are lightweight, inert, and possess excellent thermal insulation properties. EPS beads are available in various sizes and densities, allowing for customization of lightweight concrete mixes to meet specific performance requirements.

2. Cementitious Materials:

Cementitious materials, such as Portland cement, fly ash, and supplementary cementitious materials (SCMs) like silica fume or slag, are used as binders in lightweight concrete. Portland cement acts as the primary binding agent, providing cohesion and strength to the concrete mixture. Fly ash and SCMs can be added as partial replacements for Portland cement to improve workability, reduce water demand, and enhance long-term durability. The selection and proportioning of cementitious materials depend on factors such as desired strength, durability, and sustainability objectives.

3. Fine Aggregates:

Fine aggregates, typically consisting of sand or crushed stone dust, are used to fill the voids between particles in lightweight concrete mixes. Fine aggregates contribute to the overall workability, cohesion, and density of the concrete mixture. The gradation, shape, and quality of fine aggregates play a crucial role in determining the mechanical properties and surface finish of lightweight concrete. Properly graded fine aggregates ensure uniform distribution and compaction of the concrete mix, leading to improved structural performance.

4. Coarse aggregates:

Coarse aggregates, typically consisting of crushed stone, gravel, or recycled concrete, play a crucial role in lightweight concrete utilizing EPS beads. These larger-sized aggregates provide structural stability, bulk, and dimensional stability to the concrete mix. In lightweight concrete, coarse aggregates are carefully selected to optimize density reduction while ensuring adequate strength and durability. The gradation and quality of coarse aggregates influence the workability, density, and mechanical properties of lightweight concrete, making them essential components in achieving desired performance characteristics for construction applications.

5. Sand:

Sand, a vital component in concrete mixtures, is a granular material primarily composed of finely divided rock and mineral particles. It serves as the fine aggregate in concrete, filling the voids between larger aggregates and binding them together with cement paste. Sand contributes to the workability, cohesion, and density of concrete mixes, ensuring proper consolidation during placement and compaction. The quality and gradation of sand influence the strength, durability, and surface finish of concrete structures. With its availability, affordability, and versatility, sand remains indispensable in construction, facilitating the production of high-quality concrete for various building applications.

6. Aggregate chips:

Aggregate chips, also known as crushed stone chips or gravel chips, are coarse aggregates used in concrete, asphalt, and other construction applications. These chips are typically produced by crushing larger rocks or gravel into smaller, angular fragments of various sizes. Aggregate chips range in size from small particles to larger pieces, depending on the specific requirements of the project. They provide structural support, stability, and drainage capabilities to construction materials. Aggregate chips are commonly used in road construction, drainage systems, landscaping, and concrete mixes to enhance strength, durability, and aesthetic appeal. Their diverse sizes and shapes make them versatile materials for various construction projects.

Water is a critical component in lightweight concrete mixtures, serving as a medium for hydration and chemical reaction between cementitious materials. The water-to-cementitious material ratio (w/cm) is a key parameter that influences the workability, strength, and durability of lightweight concrete. Careful control of the water content is essential to achieve optimal workability without compromising the final properties of the concrete. Excessive water can lead to segregation, reduced strength, and increased shrinkage, while insufficient water can result in poor workability and incomplete hydration.

MIX DESIGN:

In the lightweight weight concrete, we have mix and replace the material we have add material according to design and also change the mix percentage of material .

We can design a m15 Grade concrete according to these grades of normal concrete we have use the 1:2:4 material

Here,

1 is the cement ratio
2 is the sand ratio &
4 is the aggregate ratio

but we have change the design of mixing ratio

CEMENT:

100% of cement

SAND:

Sand will be replaced by 30% of aggregate dust/chips & another 70% of sand are same

AGGREGATE:

Aggregate will be replaced to 40% of coarse aggregate and 60% of fine aggregate

but we can replace the 60% of fine aggregate to EPS bead we have used the 30% of fine aggregate and 30% of EPS beads

CONCRETE MIXING DESIGN FOR M15 GRADE CONCRETE FOR 1m3

M15 = 1:2:4

CEMENT = 1/1+2+4 X 1440 (1440 density of cement)
= 205.714 kg/m3

SAND = 2/1+2+4 X 1600 (1600 density of sand)
= 457. 142 kg/m3

AGGREGATE = 4/1+2+4 X 2300 (2300 density of aggregate)
= 1314.285 kg/m3

COARS AGGREGATE (40%) = 1314.285 X 40 /100
= 525.714 kg/m3

FINE AGGREGATE (30%) = 1314.285 X 30 / 100
= 394.28 kg/m3

REPLACE 30% OF FINE AGGREGATE TO EPS BEADS

If 100% aggregate replace with EPS beads then quantity of eps beads

EPS beads(100%) = 4/1+2+4 X 25 (25 density of EPS beads)
= 14.28 kg/m3

Then 30% of EPS beads replace with concrete

EPS beads (30%) = 14.28 x 30 / 100
= 4.284 kg/m3

REPLACEMENT OF SAND TO AGGREGATE DUST

SAND(70%) = 205.714 X 70 /100
= 143.99 kg/m3

AGGREGATE DUST (30%) = 1314.285 X 30 /100
= 61.71 kg/m3

TESTING ON MATERIALS:

1]. AGGREGATE IMPACT TEST:

The aggregates impact value is a determining measure of resistance to sudden impact or shock, which may differ from its resistance to gradually applied compressive load

Result:

1]. Weight of mold W1 = 1913gm
2]. Total weight (agg. + mold) W2 = 2500gm
3]. Aggregate weight (W3) = 587gm
4]. 2.36 Sieve passing weight (W4) = 58gm
5]. Aggregate impact value = W4/W3 X 100
= 58/587
= 9.847 %

LOS ANGLES ABRAVATION TEST:

The Los Angeles Abrasion Test is a standard method used to assess the hardness, toughness, and abrasion resistance of aggregates. It provides valuable information about the durability and suitability of aggregates for use in various construction applications, particularly in road construction and pavement design.

Procedure:

1. **Sample Preparation:**

A sample of the aggregate is collected and prepared by sieving to obtain the desired particle size range, typically between 9.5 mm and 12.5 mm.

2. **Test Apparatus:**

The test apparatus consists of a hollow steel drum with an internal diameter of 700 mm and a length of 500 mm. The drum is mounted on a horizontal axis and rotated at a speed of 30 to 33 revolutions per minute.

3. **Test Specimen Preparation**:

The aggregate sample is placed in the steel drum along with a specified number of steel balls or rods, usually 12 to 16 balls with a diameter of 48 to 50 mm. The drum is then rotated for a predetermined number of revolutions, typically 500 to 1000 revolutions.

4. **Sieving**:

After the specified number of revolutions, the aggregate sample is removed from the drum and sieved through a set of standard sieves. The fines produced during the abrasion process are collected and weighed.

5. **Calculation of Abrasion Loss**:

The abrasion loss, also known as the Los Angeles Abrasion Value, is calculated as the percentage of the original weight of the aggregate sample that is lost due to abrasion. It is calculated using the formula:

6. Result:

Weight of agg.(W1) = 5000gm
Agg. retained on 1.7mm Sieve (W2) = 4240gm
So, W1 –W2 =
760gm
Los angles abrasion value = W1 – W2/W1 X 100
= 760/5000 X 100
= **15.2%**

SLUMP TEST:

The slump test is a widely used method in the construction industry to assess the workability of concrete mixes. In this experiment, we aim to investigate the effect of varying water-to-cement ratios on the workability of concrete using the slump test. By adjusting the water content in concrete mixes, we will observe how changes in water content influence the slump values, providing insights into the relationship between water-to-cement ratio and concrete workability.

Slump Test:

- Moisten the inside of the slump cone to prevent concrete adherence.

- Fill the slump cone with concrete in three equal layers, compacting each layer with 25 blows of the tamping rod.
- After compacting the final layer, strike off any excess concrete from the top of the cone.
- Carefully lift the slump cone vertically, allowing the concrete to settle or slump.
- Measure and record the slump value using a measuring tape**.**

RESULT**: 2 CM SLUMP**

COMPRESSIVE STRENGTH TEST:

A compressive strength test on concrete is a crucial procedure used to determine the strength of concrete. Compressive strength is the capacity of a material to withstand axially directed pushing forces. In the context of concrete, it refers to the ability of concrete to resist compression.

Here's how the compressive strength test on concrete is typically conducted:

1. Sample Preparation: Concrete samples are usually cast in cylindrical molds. These samples are cured under controlled conditions to ensure the concrete gains sufficient strength. The standard curing period is 28 days, although shorter periods can be used for specific purposes.

2. Sample Retrieval: After the curing period, the cylindrical samples are retrieved from the molds. Care is taken to ensure that the ends of the cylinders are flat and parallel to each other.

3. Testing Setup: The cylindrical specimen is placed horizontally on a sturdy testing machine. The machine is capable of applying a load gradually and measuring the resulting compression force.

4. Loading: The machine applies a steadily increasing load to the specimen until it fractures. The rate of loading is typically within a specified range to ensure consistency.

5. Recording Results: As the load is applied, the compression force and deformation are continuously monitored. The maximum load at which the specimen fails is recorded.

6. Calculation of Compressive Strength: The compressive strength of the concrete is calculated by dividing the maximum load applied during the test by the cross-sectional area of the specimen. The result is expressed in units of force per unit area, typically megapascals (MPa) or pounds per square inch (psi).

Compressive strength is a fundamental property of concrete and is crucial for assessing the quality and durability of concrete structures. It is used extensively in the construction industry to ensure that concrete meets the required strength specifications for specific applications.

COMPRESIVE STRENGTH RESULT 7 DAY , 14 DAY , 28 DAY

7 DAY - **40 kn/m2**

14 DAY - **42 kn/m2**

28 DAY **- 45 kn/m2**

ADVANTAGES OF EPS BEADS CONCRETE:

Using Expanded Polystyrene (EPS) beads as lightweight aggregates in concrete offers several advantages, making it a popular choice in construction applications. Here are some of the key advantages of lightweight concrete using EPS beads:

1. Reduced Density:

EPS beads are lightweight, which significantly reduces the density of the concrete. This property makes lightweight concrete ideal for applications where weight is a concern, such as in construction of high-rise buildings, precast elements, and structures where dead load needs to be minimized.

2. Improved Insulation:

EPS beads have excellent thermal insulation properties. Incorporating them into concrete enhances the insulation capacity of the material, reducing heat transfer through the structure. This can lead to energy savings in buildings by reducing the need for heating and cooling.

3. Ease of Handling:

Lightweight concrete made with EPS beads is easier to handle and transport compared to conventional concrete. The reduced weight makes it easier to pour, place, and finish, which can contribute to increased productivity and reduced labor costs.

4. Better Workability:

The lightweight nature of EPS beads improves the workability of concrete, making it easier to mix and pump. This can result in improved construction efficiency and quality of the finished product.

5. Reduced Shrinkage:

Incorporating EPS beads into concrete can help reduce shrinkage cracking, which is a common issue in conventional concrete. The lower density and reduced water content in lightweight concrete help minimize shrinkage, leading to improved durability and long-term performance.

6. Sound Insulation:

Lightweight concrete containing EPS beads offers good sound insulation properties, making it suitable for applications where noise reduction is important, such as in residential and commercial buildings.

7. Structural Performance:

Despite being lightweight, EPS beads can contribute to the structural performance of concrete when properly engineered. Lightweight concrete made with EPS beads can still provide adequate strength and durability for various structural applications.

8. Environmental Benefits:

EPS beads are recyclable and environmentally friendly, making them a sustainable choice for construction materials. Incorporating recycled EPS beads into lightweight concrete can help reduce the environmental impact of construction projects.

DISADVANTAGES OF EPS BEADS CONCRETE:

While lightweight concrete using Expanded Polystyrene (EPS) beads offers several advantages, there are also some disadvantages to consider:

1. Creep and Long-Term Deformation:

EPS beads may exhibit creep behavior over time, leading to long-term deformation of the concrete. This can result in structural issues and reduced performance in applications where dimensional stability is critical.

3. Fire Hazard:

EPS beads are flammable, and the use of EPS in lightweight concrete can pose a fire hazard. In the event of a fire, EPS beads can melt and release toxic gases, contributing to fire spread and posing risks to occupants and firefighters.

4. Moisture Absorption:

EPS beads have a tendency to absorb moisture, which can lead to dimensional changes and reduced durability of lightweight concrete over time. Moisture absorption can also increase the risk of mold and mildew growth in humid environments.

5. Environmental Concerns:

While EPS beads are recyclable, the production and disposal of EPS materials can have environmental impacts. EPS is derived from petroleum-based products and may contribute to pollution and greenhouse gas emissions during manufacturing and disposal.

6. Compatibility with Cement Paste:

The lightweight nature of EPS beads can create challenges in achieving proper bonding with the cement paste. Poor bonding can result in reduced mechanical properties and durability of lightweight concrete.

7. Cost Considerations:

Lightweight concrete using EPS beads may have higher material costs compared to conventional concrete due to the added expense of incorporating EPS beads. Additionally, special handling and construction techniques may be required, which can increase labor costs.

8. Limited Use in Certain Applications:

Due to its lower strength and potential long-term deformation, lightweight concrete with EPS beads may not be suitable for all construction applications, particularly those requiring high structural performance or resistance to extreme conditions such as seismic activity or heavy impact loads. Overall, while lightweight concrete using EPS beads offers advantages such as reduced weight and improved insulation, it is important to carefully consider the potential disadvantages and limitations in order to make informed decisions regarding its use in construction projects.

EPS BEAD CONCRETE USES:

Expanded Polystyrene (EPS) beads are used in various construction applications where lightweight concrete is beneficial. Some common applications include:

1. Insulating Concrete Forms (ICFs):

EPS beads are frequently used in the construction of Insulating Concrete Forms, which are interlocking modular units that serve as permanent formwork for cast-in-place concrete walls. The EPS beads provide insulation and reduce the overall weight of the structure.

3. Roof Insulation:

Lightweight concrete made with EPS beads is used as roof insulation in flat and low-slope roofs. The lightweight nature of the concrete reduces the structural load on the building while providing thermal insulation.

4. Floor and Decking Systems:

Lightweight concrete with EPS beads is used in floor and decking systems where weight reduction is desirable, such as in high-rise buildings, parking structures, and residential construction.

5. Slope Stabilization:

EPS beads mixed with concrete are used for slope stabilization and erosion control in landscaping and civil engineering projects. The lightweight nature of the material helps prevent soil erosion while reducing the load on the slope.

6. Prefabricated Panels and Blocks:

EPS beads are incorporated into prefabricated panels and blocks to create lightweight building components for walls, partitions, and façade systems. These panels offer advantages in terms of ease of handling, transportation, and installation.

7. Acoustic Insulation:

Lightweight concrete with EPS beads is used for acoustic insulation in walls, floors, and ceilings to reduce sound transmission between interior spaces or from exterior sources.

8. Tilt-up Construction:

EPS beads are used in tilt-up construction panels to reduce weight and improve insulation properties. Tilt-up construction involves casting concrete panels on-site and then lifting them into position once cured.

9. Pipe Insulation:

EPS beads are used to manufacture pre-formed pipe insulation sections for thermal insulation in plumbing and HVAC systems.

Future Scope:

1.Enhanced Sustainability: As environmental concerns continue to grow, there will be a greater emphasis on sustainable construction materials. Lightweight concrete with EPS beads offers significant potential for reducing the environmental footprint of construction projects due to its lower material usage, energy efficiency benefits, and potential for recycling EPS waste.

2. Advanced Insulation Properties: Research and development efforts are likely to focus on further improving the thermal insulation properties of lightweight concrete with EPS beads. Innovations in bead manufacturing techniques and concrete formulation could lead to materials with even lower thermal conductivity, offering superior energy efficiency in buildings.

3. Increased Strength and Durability: While lightweight concrete with EPS beads already exhibits satisfactory strength characteristics, future developments may aim to enhance its mechanical properties further. This could involve exploring additives or reinforcements to improve tensile strength, flexural strength, and durability, expanding its applicability in structural and high-load-bearing applications.

4. Innovative Construction Techniques: Advances in construction methodologies and techniques may lead to the development of new ways to utilize lightweight concrete with EPS beads. Prefabrication, 3D printing, and modular construction methods could be optimized to leverage the lightweight nature and ease of handling of EPS-based concrete, enabling faster and more efficient construction processes.

5. Integration with Smart Technologies: The integration of lightweight concrete with EPS beads into smart building systems could revolutionize the construction industry. By incorporating sensors, actuators, and IoT (Internet of Things) technology, buildings constructed with EPS-based lightweight concrete could become more energy-efficient, sustainable, and responsive to occupants' needs.

6. Exploration of New Applications: The versatility of lightweight concrete with EPS beads opens up opportunities for new applications in various sectors beyond traditional construction. These may include infrastructure projects, lightweight cladding systems, soundproofing solutions, and even aerospace and marine applications where lightweight, durable materials are essential.

CONCLUSION:

In conclusion, lightweight concrete utilizing Expanded Polystyrene (EPS) beads emerges as a versatile and promising material in the realm of construction. Through a thorough examination of its advantages, considerations, and potential applications, it becomes evident that EPS bead lightweight concrete offers a compelling solution to various challenges while unlocking opportunities for innovation and sustainability.

The primary advantage of EPS bead lightweight concrete lies in its ability to significantly reduce the structural weight, thereby easing handling, transportation, and installation processes. This characteristic not only enhances construction efficiency but also contributes to cost-effectiveness, particularly in projects where load-bearing capacity and dead load reduction are crucial factors.

Moreover, the incorporation of EPS beads into lightweight concrete enhances its thermal insulation properties, leading to improved energy efficiency and occupant comfort in buildings. By minimizing heat transfer through walls, floors, and roofs, EPS bead lightweight concrete helps regulate interior temperatures, thereby reducing the reliance on mechanical heating and cooling systems and lowering energy consumption and operational costs over time.

Additionally, the lightweight nature of EPS bead concrete enhances its workability, facilitating easier mixing, pouring, and finishing processes. This aspect not only improves construction efficiency but also allows for greater design flexibility, enabling the creation of complex shapes and architectural features that may be challenging to achieve with conventional concrete.

Furthermore, EPS bead lightweight concrete offers sound insulation benefits, dampening noise transmission between interior spaces and enhancing the acoustic comfort of occupants. In environments where noise pollution is a concern, such as residential buildings, educational institutions, and commercial spaces, this property of EPS bead concrete contributes to a quieter and more conducive atmosphere.

However, it's essential to acknowledge the considerations and challenges associated with EPS bead lightweight concrete. These include potential reductions in compressive strength compared to traditional concrete, fire safety concerns due to the combustible nature of EPS beads, moisture management issues, and environmental considerations related to production, disposal, and recycling of EPS materials.

Addressing these challenges requires careful engineering, robust quality control measures, and adherence to regulatory standards to ensure the safety, durability, and sustainability of EPS bead lightweight concrete structures. Collaborative efforts among stakeholders, including designers, engineers, contractors, manufacturers, and policymakers, are essential to navigate these complexities and maximize the benefits of EPS bead lightweight concrete while mitigating potential risks.

In conclusion, EPS bead lightweight concrete represents not only a material innovation but also a catalyst for transformative change in construction practices. By harnessing its advantages and addressing its considerations, EPS bead lightweight concrete has the potential to create resilient, energy-efficient, and aesthetically pleasing built environments, paving the way for a sustainable and inclusive future in construction.

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