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Comparative Analysis of M Sand and Fly Ash on Strength of Concrete

PROF. A. R. BANSOD1,MR.BHUMESHWAR V. JADHAV[2], MR. ASHISH V.PAWAR[3]

MISS.NEHA A.PARBAT[4] ,MISS.DAKSHATA N. INGOLE[5] , MISS.VAISHANAVI P. KINAKE[6]

MISS.ARPITA V. BHAVARE [7], MR.RAHUL G. LANDE[8]

1 Assistant Professor, Civil Department, Jagadambha College of Engineering And Technology,Yavatmal,445001 . 2345678 Undergraduate Students, Civil Department, Jagadambha College of Engineering And Technology, Yavatmal,445001

ABSTRACT:

Concrete is one of the most widely used materials in the world, second only to water in terms of global consumption. With the rapid growth of the construction industry, the demand for concrete continues to increase, which in turn requires large quantities of natural resources such as river sand and aggregates. However, the availability of river sand has become increasingly scarce due to illegal mining and over-exploitation. Additionally, cement, which serves as the binding material in concrete, is a key ingredient, and the most commonly used type is Portland cement. Unfortunately, the production of 1 ton of cement releases approximately 1 ton of CO_2 into the atmosphere, contributing to environmental concerns. To address these issues, supplementary cementitious materials are being considered as substitutes for cement. In this study, fly ash and Manufactured Sand (M Sand) are explored as replacements for conventional cement and river sand, respectively. The study compares the compressive strength and tensile strength of concrete made with these replacement materials to that of conventional M20 grade concrete. The aim is to evaluate the potential benefits of using these alternatives to enhance sustainability in concrete production.

KEYWORDS: M sand ,Fly Ash , Cement , Aggregate, Compressive Strength

1.INTRODUCTION:

Concrete is the most frequently used building material around the world. It consists of bonding materials, aggregates (fine and coarse) and water. In many cases, additional information is included. Cement is the most frequently used bonding material in concrete, and various types of cement are available depending on the project requirements. Of these, Portland cement is the most frequently used for general construction purposes. Micro-aggregate is used in the mixture. It is usually natural river sand that corresponds to Zone II.

Due to the rapid growth of industrialization and urbanization, the demand for concrete is steadily increasing. This increases the consumption of natural resources such as river sand. Furthermore, cement production is associated with the release of approximately 1 ton of CO_2 for each ton produced, contributing to environmental pollution and climate change. This represents a major threat to both the environment and human health.

As a result, researchers focused on the use of alternative materials in concrete to reduce negative environmental impacts, conserve natural resources, and reduce construction costs. To address these concerns, materials such as flying ash and manufactured sand (M-sand) were looked into replacement fabrics. This study evaluates the strength properties of concrete containing flight ash and M20 sand and compares it with traditional M20 concrete .

2.Material Collection:-

2.1 Cement:-

The cement used in this project was the regular Portland Cement 53 (OPC 53). All cement properties were determined according to 12269-1987. The specific weight of cement was 3.15, with first and final definition times recorded at 55 or 258 minutes. The standard consistency of cement was 32%.

The advantages ofincrease the construction flexibility of architects and engineers, allowing for slimmer and economical creation of sections. Thedevelops high initial strength, removes plate and jet shapes faster, accelerates structure and reduces central costs.

creates extremely durable acoustic concrete due to its very low alkali, chloride, magnesia and free lime content.

Chloride content minimizes almost negligible chloride content, particularly in hard environments, and minimizes the risk of corrosion in concrete structures. The

achieves considerable cement savings in front of the custer segment due to the high initial strength of concrete production from the classes M15, M20, M25.

Physical Properties ofcement .

Cement:

Portland cement is usually identified based on the following physical properties for quality control:

1. Set time: Cement paste time is required.

2.Soundness: Cement ability to maintain volume after setting.

3.Fine: Cement particle size distribution affecting hydration and strength.

4.Pressure Resistance: A key indicator of compression resistance, cement quality.

2.2Course aggregate

A typical rough sizeGreat Aggargate was 20 mm. These aggregates are covered locally and recorded as a confidential module of 2.78, with a specific gravity of 7.

2.3 Fine -Aggregate

Fine -Aggregate was local sand, 4.75 -mm Sive. The specific weight of the fine unit was 2.60.

2.4.Water:-

The water used in the experiment was drinking water and met the requirements for construction work. Flugasche is the product of coal burning at power plants. Burns burns carbon and fleeting materials, but mineral contaminants such as sound, slate and feldspar are integrated into the suspension. These combined materials form spherical, glass-like particles known as flying ash. Airbag particles are mostly fine balls or hollow ecospheres, and contain even smaller balls.

2.5 Fly-ash:-

The size of theflight is generally similar or slightly larger than Portland cement particles. Airbags are collected from electrostatic waste or exhaust gases with bag filters during the combustion process.

Flight ash chemical composition is mainly composed of silicate glass containing silicon dioxide, aluminum oxide, iron and calcium. Actors of this colour range from dark gray to yellowish.

Class-F Flight Results: Generated in two categories, generated from charcoal therabone or bit coal. This type of flight ash includes pozzolan and iron oxide.

This flying ash is usually used as a mineral mix in concrete to improve durability and handling options.

2.6 M Sand:-

M sand also known as Manufactured Sand, has become an important substitute for natural river sand due to the depletion of natural sand resources and the rising demand in the construction industry. Natural river sand consists of weathered and worn-out rock particles, with various grades based on the amount of wear. However, the availability of quality river sand is limited, and it often needs to be transported from distant locations, which increases costs.

Due to the rapidly depleting natural sand resources and the rising cost of transportation, the demand for manufactured sand, which is produced using modern machinery, has increased. Manufactured sand provides a solution by being readily available, economically feasible, and meeting construction needs. For optimal performance, it should be well-graded, meaning it contains particles ranging from 150 microns to 4.75 mm in the correct proportions. When the fine particles are in the proper ratio, the sand will have fewer voids, requiring less cement for concrete mixes and leading to cost savings. Additionally, manufactured sand has fewer impurities compared to natural river sand, making it ideal for concrete applications.

Key Benefits of Manufactured Sand:-

1.Higher Crushing Strength: The sand particles should be durable and capable of withstanding heavy loads.

2.Smooth Surface Texture: The particles should have a smooth surface, which enhances the quality of concrete.

3.Grounded Edges: The edges of the particles must be rounded or ground to avoid sharpness, which can affect the quality of the mix.

4.Adequate Fines Ratio: The amount of fines (particles below 600 microns) should not be less than 30%.

5.Absence of Organic Impurities: Manufactured sand should be free of any organic contaminants that could affect the durability of concrete.

6.Low Silt Content: The silt content should be no more than 2% for crushed sand, ensuring the quality and longevity of the concrete.

7.Controlled Fine Particle Content: The quantity of fines smaller than 75 microns should not exceed 15%, as excessive fines can reduce the strength and workability of concrete.

Overall, the growing need for manufactured sand is driven by the limited availability of high-quality river sand, and it serves as a more sustainable and cost-effective solution for the construction industry.

3MATERIALS PROPERTIES:

3.1 Fresh Concrete Properties

- **Setting of Concrete:-**

The setting of concrete refers to the process where the material transitions from a liquid to a solid state as it hardens. This process is essential for determining the time available for working with the concrete before it becomes difficult to manipulate.

- **Water Content or Water-Cement Ratio:-**

The amount of water used in a concrete mix in relation to the amount of cement is crucial to achieving the desired strength and durability. A higher water-cement ratio may result in a more workable mix, but it could reduce the final strength of the concrete.

- **Amount and Type of Aggregate:-**

Aggregates (fine and coarse) make up a large portion of concrete and significantly impact its properties, including workability, strength, and durability. The type, size, and proportion of aggregates affect how well the concrete mix performs.

- **Workability:**

Workability refers to how easy it is to mix, transport, place, and compact concrete without causing issues like segregation or bleeding. The workability of concrete is influenced by its water content, mix proportions, and the size of the aggregates used.

- **Segregation and Bleeding**:-

Segregation occurs when the components of the concrete (like aggregates and cement paste) separate, leading to inconsistencies in the mix. It can result from improper mixing, excessive workability, or factors like poor transportation or placement methods. This can cause shrinkage and cracking, often in the form of small cracks perpendicular to the surface.

Bleeding is when water rises to the surface of fresh concrete as the heavier components settle. This happens because the solid components can't hold all the mixing water. Bleeding continues until the cement paste stiffens and the water stops rising.

- **Slump Test:-**

The slump test measures the workability of fresh concrete by assessing how much it settles or "slumps" when placed in a cone-shaped mold. The test helps determine the consistency of the mix, which is influenced by the water content and the proportion of aggregates.

3.2 Hardened Concrete Properties

- **Compression Test on Concrete Cubes:**

Compressive strength is a key indicator of concrete's quality. To test this, cubes or cylinders of concrete are subjected to pressure, and the maximum load they can withstand before failing is recorded. Compressive strength is typically measured in N/mm^2. For testing, cubes of 15 cm on each side or cylinders with a 15 cm diameter are used. The concrete specimens are often tested at different stages, such as after 7, 14, and 28 days of curing. The strength of cylinders can also be calculated based on cube test results.

4 .Mix Design

Definition

Mix Design choose concrete and if you decide to share relative to objectswith a specific minimum strength and durability as economically as possible, choose the appropriate components It’s the process.

Mix Design Goals

Concrete Mixing Design Goals are:

1. The first goal is to achieve a defined minimum strength.

2. The second goal is to make concrete in an economical way. In terms of cost, all concrete depends mainly on two factors: material costs and labor costs.

3. Formwork ,Batch .

4 The labor costs due to mix, transportation and healing are the same for excellent concrete.

- **Factors to consider in a mix design**

1. Concrete grade

2. Cement Type

3. Overall Aggregation

4.Type and Size

5. Water/Cement Ratio

6.Processability

7. Concrete density.

8.air content

- **Mix Design Goals:**

The main objectives of concrete mixing design are as follows:

1. Strength Requirements: To achieve the minimum strength required for concrete.
2. Economic Use: Design your mix in the cheapest way, taking into account materials and labor costs. Material costs play a greater role as labor costs such as foamwork, batch, mixing, transport, healing and more remain constant for all types of concrete.
3. Factors to consider in mix desing .

Mix Design:

1. Concrete Quality: Desired concrete strength after 28 days.

2.Cement Type: The type of cement used affects the mixing properties.

3.Unit Type and Size: The type and size of the aggregate affect the strength, workability and durability of concrete.

4.Mixing and Hardening Methods: The techniques used for mixing and healing affect the final quality of concrete.

5.Water/Cement Ratio: The cement to cement ratio affects the strength and workability of concrete.

6.degree of workability: The lightness of concrete can be placed and compressed.

7.Betton Density: The mass per concrete volume of a unit affects its strength and durability.

8.Air Content: Percentage of hollow chambers in concrete mix that affect durability and freezer.

These factors help you determine a balanced, long lasting, and economical concrete mix.

- **Split Tensile Test on Cylinder:**

Concrete is much stronge in compression than in tension. Tension can arise due to factors like shrinkage, temperature changes, or the rusting of reinforcement. To measure concrete's tensile strength, a split tensile test is used, where a cylinder is subjected to a force that causes it to split. This helps estimate the concrete's ability to withstand tension.

- **Flexural Test on Beams:**

The flexural test measures how well a beam or slab can resist bending or failure under load. It is often conducted using unreinforced concrete beams with a specific span-to-depth ratio. The flexural strength, known as the "Modulus of Rupture" (MR), is usually about 12 to 20% of the compressive strength of the concrete.

5 .Test Procedure

- **General Procedure**

This experimental research program focuses on the evaluation of the mechanical properties of concrete by replacing cement with flying ash, sand as base ash, and glass. I'm guessing it. The reference concrete mix used is grade M20 with a water-cement ratio of 0.43. The coarse units previously used have particle sizes ranging from 2 mm to 20 mm. An intensive experimental programme was conducted, the effects of internal healing on various concrete properties,

1. fresh properties: robbery and density.
2. Mechanical Properties: Pressure Resistance, Bending Strength,

Pressure Strength Test

Pressure Strength Test is one of the most important tests for assessing the overall quality of concrete. There is insight into whether concrete was properly executed. The most frequently used cube size is 15 cm x 15 cm x 15 cm. The concrete is poured and compressed to avoid cavities. After 24 hours, the shape is removed and the test sample is placed in water for healing. The surface of the sample is smoothed due to uniformity. After 7-28 days of healing, samples are tested using a compression tester to determine the compressive strength.

Split Tensity Strength Test

Train strength is an important property of concrete. As a rule, it is not expected to resist concrete tension due to its concrete properties and low tensile strength. However, determining tensile strength is important to predict loads that may cause cracking. Cracks are a type of voltage failure. In addition to bending testing, indirect methods such as shared train testing can be used to determine tensile strength. Due to the challenge of correct storage of samples, direct voltage tests are difficult to perform on a test machine and apply a pure, uniform tractor with no eccentricity. Even a slight eccentricity can introduce bending and axial forces, which leads to different levels of voltage. Therefore, an indirect method is recommended.

In thesplit train test, compressive loads are applied along the generator on the opposite side of the concrete cylinder and are placed horizontally between the two printing plates. Load load induces an even tensile voltage along approximately 2/3 of the load diameter, leading to obstacles caused by tensile stress.

Bending Strength Test

Bending Test Measures the bending or bending properties of a material. Also known as cross-beam tests, it involves placing the sample between two supports and using loads at 3 points, or using two support points in a 3-point or 4-point bending test. Maximum voltage and maximum stretch are calculated based on incremental loads. The results are usually displayed in graphical format. This will display tabular values that include the bending strength of the broken sample and the revenue strength of the unbroken sample. Materials tested in bending strength tests usually include plastics, composites, metals, ceramics and wood.

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