International Journal of Recent Research and Review, Vol. XV, Issue 4, December 2022

ISSN 2277 – 8322

EXPERIMENTAL STUDY ON THE BEHAVIOUR OF CONCRETE BY PARTIAL REPLACEMENT FOR RICE HUSH ASH, SILICA FUME & IRON SLAG WITH CEMENT

Anav Gupta, Sourabh Lalotra, Dr Anchal Sharma

Sri Sai College Of Engineering & Technology

L.K Gujral Punjab Technical University

***Abstract*— Concrete is currently the most frequently utilized substance on the planet. This research compares the performance of concrete when various admixtures are employed as a partial substitute for cement in the mix. Silica Fume, Rice Husk Ash, and other mineral admixtures are employed here. Cement can be partially replaced with iron slag. All of these materials are industrial waste products that may be found in large quantities. Available these days these materials have a high silica concentration and pozzolanic characteristics, and they may be used in a variety of applications. In the production of High Performance Concrete, it is utilized to substitute cement. The two most important characteristics of concrete are compressive and flexural strength, which are computed for hardened concrete to examine load bearing capability for design reasons. As a result, a comparison research is highly valuable for determining the sort of minerals admixtures to be employed.**

I. INTRODUCTION

In today's world, cement is the most commonly utilised substance. It's employed in various kinds of construction projects. However, the production of cement is not a sustainable process since it emits a considerable quantity of CO2, which is the major component of greenhouse gases. As a result, finding a suitable material to partially replace cement in concrete mix design is unavoidable. Highly siliceous materials such as silica fume, rice husk ash, and iron slag have good pozzolanic characteristics. As a result, these materials can be utilised as a partial replacement for cement in concrete to enhance its qualities. The impact of using silica fume to make High Performance Concrete was investigated.

Admixture

Chemical admixtures, in addition to cement, water, and aggregates, are key elements in concrete that are used to enhance concrete quality, manageability, and speed up or slow down the setting time. The heat of hydration, accelerate or retard setting time, Workability, water reduction, dispersion and air-entrainment, impermeability, and durability considerations are all features that may be adjusted with admixtures. Chemical admixtures and mineral admixtures are the two forms of admixtures. Chemical admixtures such as accelerators, retarders, water-reducing agents, super plasticizers, and air entraining agencies are widely utilised. Mineral admixtures include fly ash, blast furnace slag, silica fume, and rice husk ash. Chemical admixtures are used for a variety of reasons, including: Admixtures can be used to postpone the chemical reaction that occurs when the concrete begins to set. These admixtures are used in the production of concrete pavement, allowing for extra time to finish them. Admixtures are sometimes used to strengthen the resilience of concrete to severe frost or freeze/thaw cycles. These admixtures also have a strong resilience to wetting and drying cycles.

Uses of Admixtures

Concrete admixtures are used to change the characteristics of the material in a variety of ways. Enhancing workability, extending or shortening cure times, and enhancing concrete strength are all popular applications. Admixtures can also be used to modify the colour of cement for aesthetic purposes.

Types of Admixtures

- Silica Fume
- Rice Husk Ash
- Iron Slag

II. OBJECTIVES

- To study about the different type of admixtures in concrete, as a replacement.
- To sturdy the properties of iron slag, rice husk ash and silica fume.
- To know the properties of admixtures
- To improve and enhance the concrete strength
- To use the admixture and well know it for the replacement.

III. METHODOLOGY

Cement

In a more technical meaning, cement refers to the binders used in construction and civil engineering projects. Cement is a broad term for all forms of adhesives. These cement are composed of powders that have been finely ground and are then mixed with water to form a solid mass. Setting and hardening are caused by hydration, the chemical reaction of the cement compounds with water to create tiny crystals or a gel-like substance with a huge surface area. Because of their ability to hydrate, hydraulic cement is a common name for construction cement, which will even set and harden in water. The most important of these is Portland cement. Even though cement can be used "neat," or as a grouting material, its common use is as mortar and concrete, where it is coupled with aggregate, an inert substance.

Aggregate

Aggregate is the component that is combined with cement, bitumen, lime, gypsum, or another adhesive when making concrete or mortar. The finished product's volume, stability, resistance to wear and erosion, and other necessary physical characteristics are all provided by the aggregate. Commonly used aggregates include sand, crushed or broken stone, gravel (pebbles), broken blast-furnace slag, boiler ashes (clinkers), burned shale, and burned clay. Fine aggregate is often made up of sand, crushed stone, or crushed slag screenings, and coarse aggregate is made up of gravel (pebbles), shattered stone pieces, slag, and other coarse materials. Fine aggregate is used to make thin concrete slabs or other structural elements when a clean surface is desired; coarse aggregate is utilized to make more substantial sections. Granular aggregates and a cementing agent are mixed to produce concrete or hydraulic mortar. They are used to construct and maintain a range of buildings, including roads, walkways, parking lots, airport runways, and railways. They are crucial components in the creation of concrete, mortar, and other building materials.

Silica Fume

Silica fume is a by-product of the production of silicon metal or ferrosilicon alloys. One of silica fumes' best uses is in concrete. Due to its chemical and physical properties, it is a very reactive pozzolan. Silica fume-produced concrete has the potential to be very durable and robust. When required, silica fume is easily accessible from manufacturers of concrete admixtures and is only applied when the concrete is being prepared. When pouring, finishing, and curing silica-fume concrete, concrete builders need to exercise particular caution. Silicon metal and its alloys are produced in electric furnaces, such as the ones shown in this image. The primary components are wood chips, coal, and quartz.

Iron Slag

The impurities from iron ore, scrap metal, and other ferrous feed materials are eliminated by adding limestone (or dolomite), lime, and silica sand to blast furnaces and steel furnaces, reducing the heat requirements of the iron- and steelmaking processes. Iron and steel slag, commonly referred to as ferrous slag, is produced by this procedure. After forming a dominant calcium silicate melt that floats on top of the molten crude iron or steel, iron slag is removed from the liquid metal. For typical iron ore grades, the production of blast furnace slag will be between 0.25 and 0.30 metric tonnes per tonne of crude iron produced (60 to 66 per cent iron). After the entrained metal is removed, between 10 and 15 per cent of the entire output of crude steel will be made up of steel furnace slag.

Rice Husk Ash

Rice mills create rice husk ash, a by-product of agriculture. The "husk" or "hull" refers to the covering of rice grains or seeds. This covering protects the seed or grain throughout the growing season. Hard materials like lignin and opaline silica are formed from the husk. When burned properly, rice husk contains silica in substantial proportions (SiO_2). It can therefore be used as a supplementary cementitious component in addition to cement to make concrete products. When paddy is processed, rice comprises 80% of the weight and husk comprises 20% of the weight. This husk can also be used as fuel to generate power or steam, among other things. About 75% of the organic volatile stuff in rice husk is organic. During the burning process, the remaining 25% of the weight of this husk is transformed into ash. The name of this ash is "rice husk ash" (RHA). A rice hull ash is another name for it. The cement and concrete industries use rice husk ash, an active pozzolana, in a variety of ways. Because using RHA minimises the need for cement and lowers the overall cost of producing concrete, it is less expensive. Reduced cement needs result in reduced environmental pollution from cement plants, which improves both the economy and the environment. They also offer a practical means to dispose of this agricultural waste product, which has few alternate uses.

Test of Concrete

- Compressive Strength of Concrete
- Flexural Strength
- Split Tensile Test

Fig. 1 Compressive Strength Test

Fig. 2 Flexural Strength Test

Fig. 3 Split Tensile Test

Fig. 4 Cube Casted for Experimental Work

4. RESULT & DISCUSSION

Result of Concrete

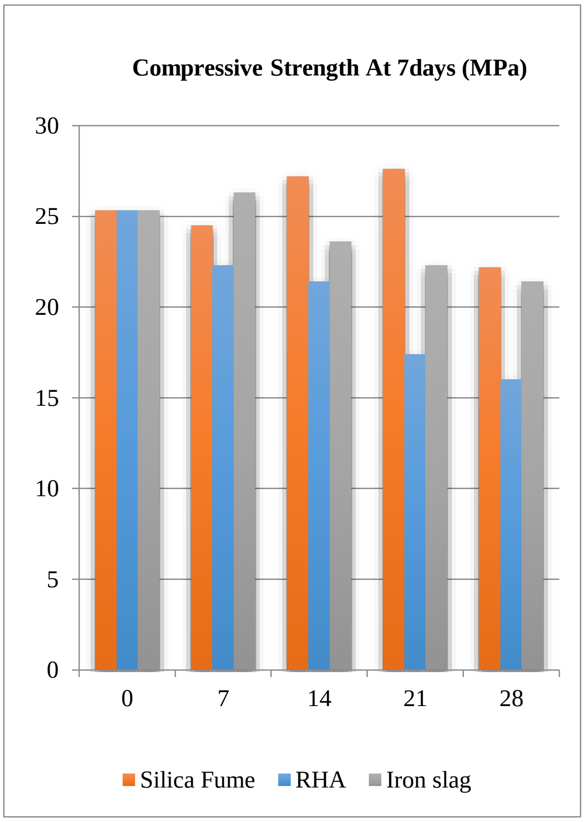

Fig. 5 7 days Compressive Strength of Concrete with varying % of mineral admixture as replacement of cement

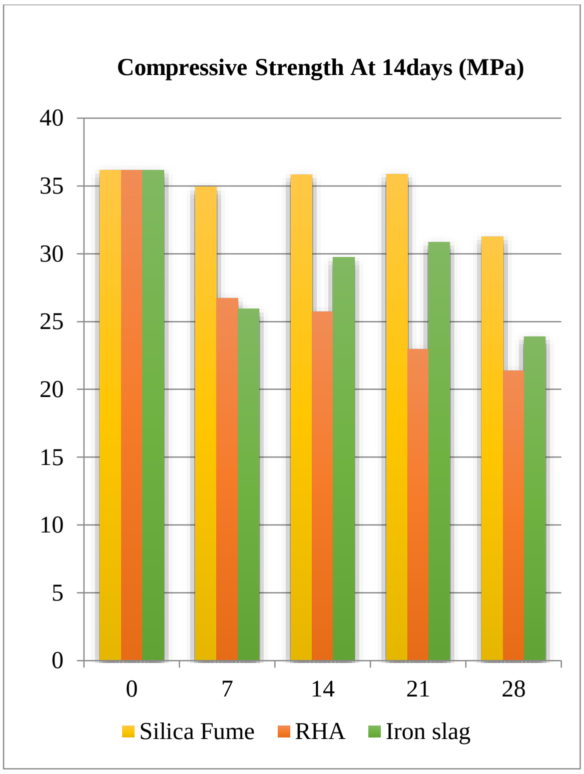

Fig. 6 14 days Compressive Strength of Concrete with varying % of mineral admixture as replacement of cement

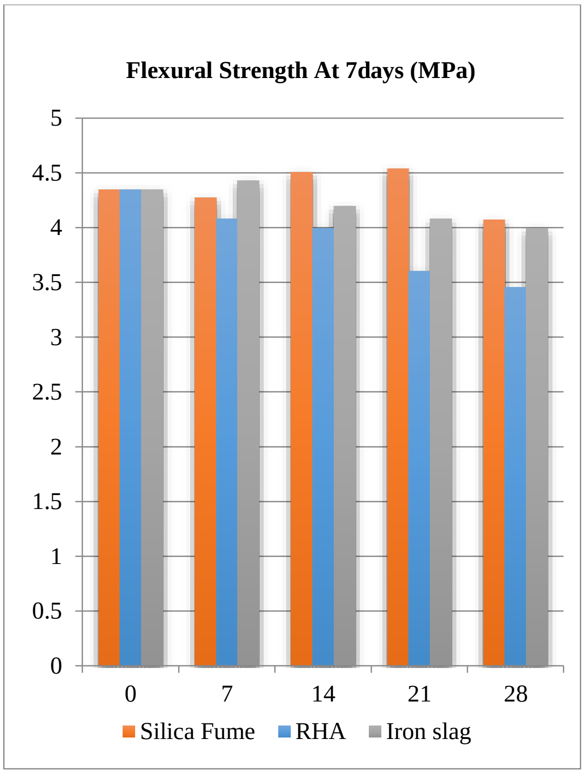

Fig. 8 7 days Flexural Strength of Concrete with varying % of mineral admixture as replacement of cement

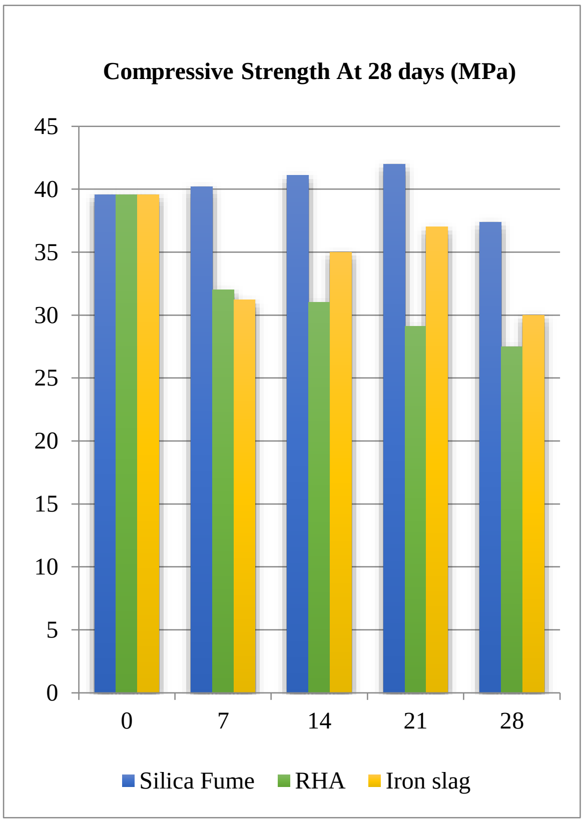

Fig. 7 28 days Compressive Strength of Concrete with varying % of mineral admixture as replacement of cement

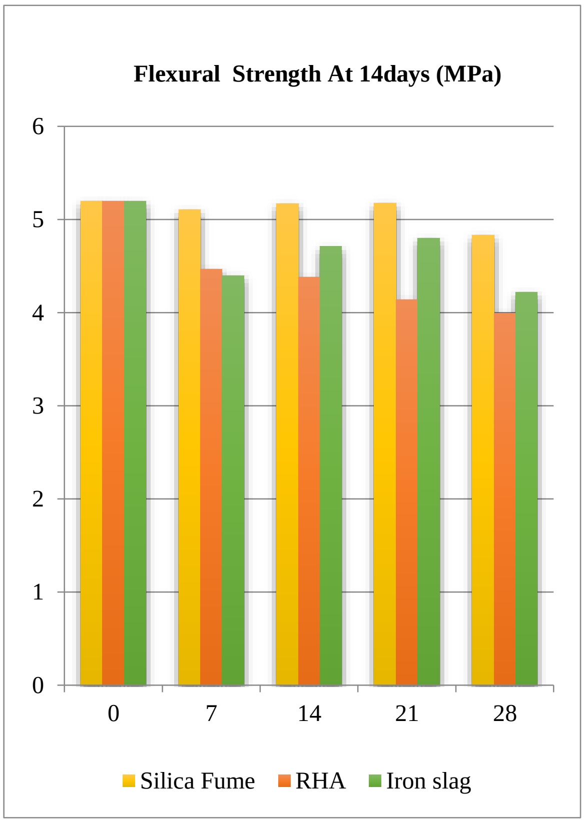

Fig. 9 14 days Flexural Strength of Concrete with varying % of mineral admixture as replacement of cement

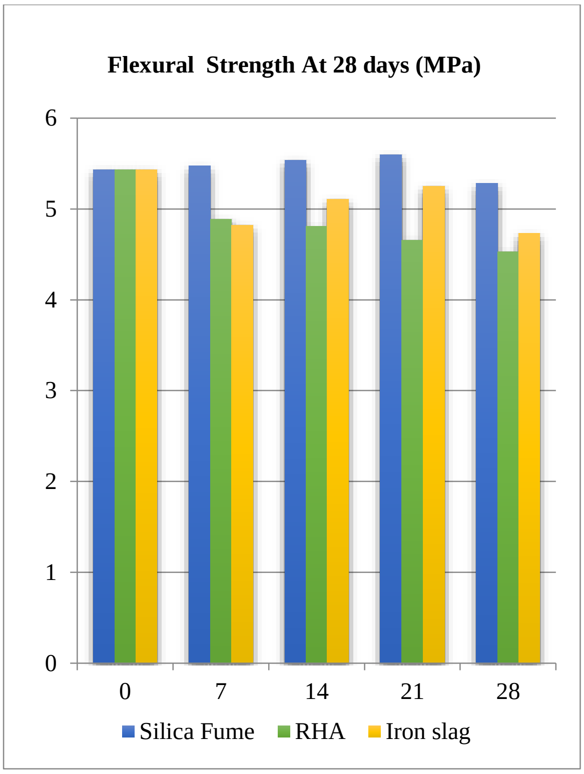

Fig. 10 28 days Flexural Strength of Concrete with varying % of mineral admixture as replacement of cement

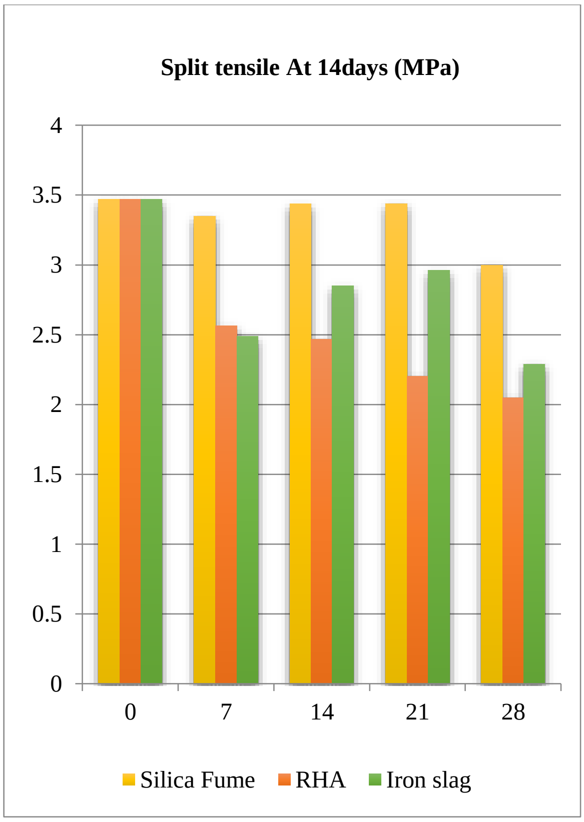

Fig. 12 14 days Split Tensile Strength of Concrete with varying % of mineral admixture as replacement of cement

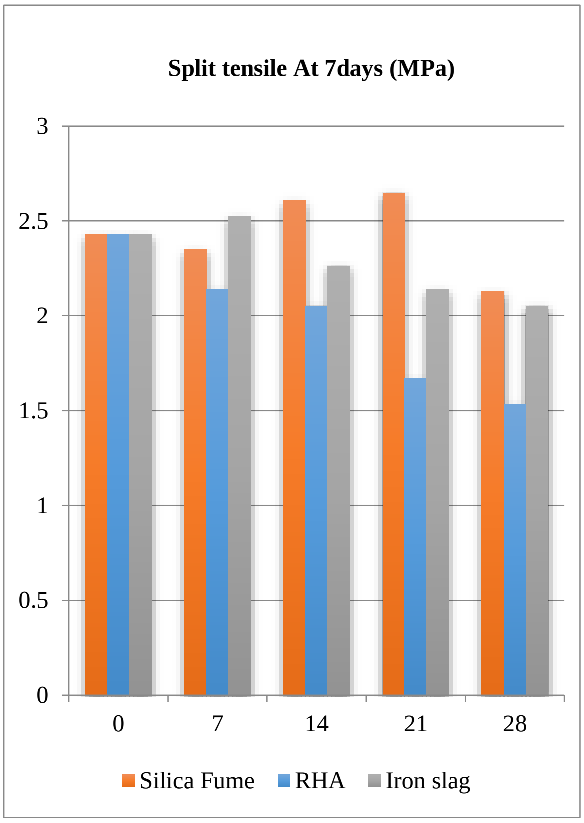

Fig. 11 7 days Split Tensile Strength of Concrete with varying % of mineral admixture as replacement of cement

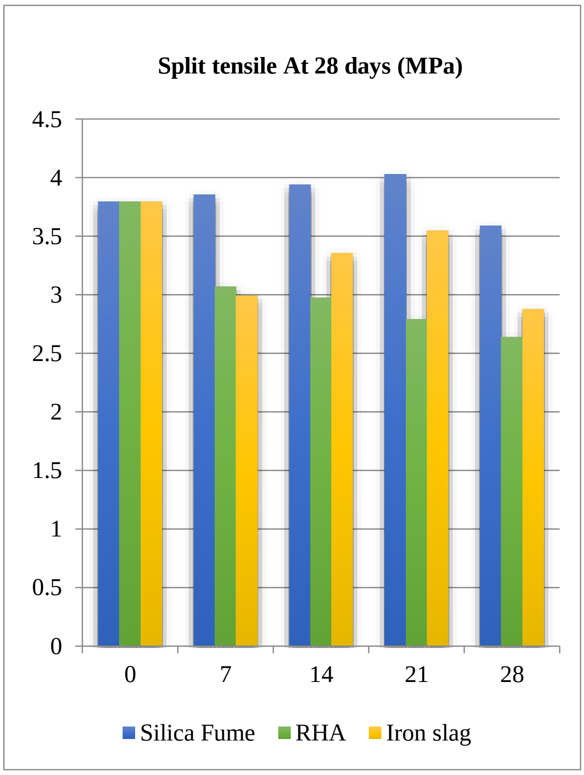

Fig. 13 28 days Split Tensile Strength of Concrete with varying % of mineral admixture as replacement of cement5

IV. CONCUSSION

Compressive strength test

- At 7 days Compressive strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 27.6MPA till 21% Silica fume after that compressive strength start dropping.
- At 7 days Compressive strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 22.3MPA till 7% Rice Husk Ash after that to compressive strength start dropping.
- At 7 days Compressive strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 26.3MPA till 7% Iron Slag after that to compressive strength start dropping.
- At 14 days Compressive strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 35.87MPA till 21% Silica fume after that to compressive strength start dropping.
- At 14 days Compressive strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 26.73MPA till 7% Rice Husk Ash after that to compressive strength start dropping.
- At 14 days Compressive strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 30.87MPA till 21% Iron Slag after that to compressive strength start dropping.
- At 28 days Compressive strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 42.00MPA till 21% Silica fume after that to compressive strength start dropping.
- At 28 days Compressive strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 32.00MPA till 7% Rice Husk Ash after that to compressive strength start dropping.
- At 28 days Compressive strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 37.00MPA till 21% Iron Slag after that to compressive strength start dropping.

Flexural strength test

- At 7 days Flexural strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 4.538MPA till 21% Silica fume after that to compressive strength start dropping.
- At 7 days Flexural strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 4.079MPA till 7% Rice Husk Ash after that to compressive strength start dropping.
- At 7 days Flexural strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 4.429MPA till 7% Iron Slag after that to compressive strength start dropping.
- At 14 days Flexural strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 5.1737MPA till 21% Silica fume after that to compressive strength start dropping.
- At 14 days Flexural strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 4.465MPA till 7% Rice Husk Ash after that to compressive strength start dropping.
- At 14 days Flexural strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 4.799MPA till 21% Iron Slag after that to compressive strength start dropping.
- At 28 days Flexural strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 5.597MPA till 21% Silica fume after that to compressive strength start dropping.
- At 28 days Flexural strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 4.886MPA till 7% Rice Husk Ash after that to compressive strength start dropping.
- At 28 days Flexural strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 5.254MPA till 21% Iron Slag after that to compressive strength start dropping.

Split tensile strength test

- At 7 days Split Tensile strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 2.647MPA till 21% Silica fume after that to compressive strength start dropping.

- At 7 days Split Tensile strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 2.139MPA till 7% Rice Husk Ash after that to compressive strength start dropping.

- At 7 days Split Tensile strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 2.522MPA till 7% Iron Slag after that to compressive strength start dropping.

- At 14 days Split Tensile strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 3.440MPA till 21% Silica fume after that to compressive strength start dropping.

- At 14 days Split Tensile strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 2.563MPA till 7% Rice Husk Ash after that to compressive strength start dropping.

- At 14 days Split Tensile strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 2.960MPA till 21% Iron Slag after that to compressive strength start dropping.

- At 28 days Split Tensile strength due to Addition of varying % of Silica fume as Replacement of Cement occurs maximum compressive strength is 4.028MPA till 21% Silica fume after that to compressive strength start dropping.

- At 28 days Split Tensile strength due to Addition of varying % of Rice Husk Ash as Replacement of Cement occurs maximum compressive strength is 3.069MPA till 7% Rice Husk Ash after that to compressive strength start dropping.

- At 28 days Split Tensile strength due to Addition of varying % of Iron Slag as Replacement of Cement occurs maximum compressive strength is 3.548MPA till 21% Iron Slag after that to compressive strength start dropping.

V. FUTURE SCOPE OF WORK

- This study of work also carries forward with M25, M300 occurs M35 grades of concrete.
- On these samples non-destructive testing also performed occurs studies their results.
- This study also in future studies with metakaolin occurs plastic waste as replacement materials.

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