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# Review Paper on Strength Properties of M30 Concrete with Partial Replacement of Cement by GGBS and Polypropylene Fibers

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**ABTRACT**

Innovative concrete that flows under its own weight is known as self-compacting concrete (SCC). Compaction doesn't require any outside vibration. This concrete is appropriate for applications where crowded reinforcement is employed because of its various benefits. Self-compacting concrete was created in this study employing the ideal amount of GGBS (Ground-Granulated Blastfurnace Slag) at 25% by weight of cement as a partial replacement of cement, and Polypropylene fibres were also added to the concrete to boost its strength.

In comparison to conventional self-compacting concrete and conventional self-compacting concrete with polypropylene fibres, the maximum compressive strength, split tensile strength, and flexural strength were obtained on replacement of pond ash at 30% and Foundry Sand at 20% at 7, 21, and 28 days. The durability tests of sulphate attack, water absorption, and acid attack were performed on the fibre reinforced self-compacting concrete specimens with 30% Pond ash and 20% foundry sand as replacements for river sand and 25% of GGBS as a replacement for cement. According to the findings, 20% by weight of foundry sand was the ideal alternative for fine aggregate in various mixes of fiber-reinforced self-compacting concrete. Industrial wastes including foundry sand, pond ash, and GGBS have been shown to be highly helpful in advanced building techniques

**Keywords: -** Self Compacting Concrete, Fibre Reinforced Self Compacting Concrete, Pond ash, Natural river sand,

## 1. 1 Introduction

Due to its flexibility, concrete is a strong building material that is frequently utilised in a variety of construction applications. Globally, billions of tonnes of concrete are produced annually. For a nation to function well and to support the expansion of its economy, infrastructure development is crucial. It raises residents' standards of living and aids in a nation's economic development. Self-Compacting Concrete (SCC) is a novel type of concrete that achieves full compaction even in the presence of crowded reinforcement, flows under its own weight, and entirely fills the formwork. Vibration is not necessary for placement or compaction. It is now a highly appealing option for civil engineering construction since it has substantially enhanced the construction practise. In the year 1980, In Japan, self-compacting concrete was created. The fine aggregate volume is greater than the coarse aggregate volume in SCC, which has a high powder concentration. Because finer particles enhance the flowing characteristics of concrete and coarser particles block free flow, the fine aggregate volume to coarse aggregate volume ratio is often maintained at 60:40. This form of concrete requires the use of superplasticizers to increase the material's flow, and SCC requires the use of viscosity modifying agents to keep the mixture homogeneous. SCC is seen as an ecologically friendly concrete since it reduces noise pollution and increases worker safety on construction sites without the need of mechanical vibrators.. One of the components of self-compacting concrete is mineral admixture. additional cementitious components such fly ash

## 1. 2 Literature survey & background

Self compacting concrete (SCC) is a new type of concrete that was created for the first time by Professor Hajme Okamura in 1986 to improve building quality and boost durability by making concrete more workable (Ozawa et al., 1988). SCC is a concrete that has a great flowability along with strong stability. The concrete can fill every corner of the formwork it is applied to using these two parameters alone, without the aid of any external vibration. Passing ability is a characteristic that SCC must constantly possess in order to fill in densely packed areas of reinforced concrete buildings (Ozawa et al., 1989). The SCC in its most recent iteration tackles a number of issues related to worker expertise, the complexity of reinforcement, the type and shape of structural sections, pumpability, segregation resistance, and, more specifically, compaction. The Self Compacting Concrete is more durable and has a high fines content. Self Compacting Concrete has the same ingredients as regular concrete, including cement, water, fine and coarse aggregates, and chemical and mineral admixtures. SCC stands apart from regular concrete in that it contains more particles, high range water reduction agents (Super Plasticizers), and viscosity moderating agents (VMA), all of which to some extent change the rheological characteristics (Lazniewska et al., 2013). The three workability criteria of SCC listed by EFNARC are segregation resistance, passage ability, and filling ability. There aren't many ways published for figuring out SCC's workability qualities. The most popular and used tests among them are slump 6 flow, J-ring, V- funnel, L-box, U- box, and fill box. Utilising the right mortar and limiting the amount of coarse aggregate is how to achieve self-compactibility. Additionally, superplasticizer (SP) and lower water content are also employed (Okamura et al., 1995). Viscosity modifying admixtures (VMA) should be used in order to establish the best mix design for SCC (Aggarwal et al., 2008). VMA make the SCC more viscous and stop segregation (Lachemi et al., 2002). Mineral admixtures, which are finely split components added to concrete as distinct ingredients either before or during mixing (Erdogan et al., 1997), are one alternative method for lowering the cost of SCC. The cost will be decreased, especially when the mineral admixtures are industrial by-products or waste materials, if the mineral admixtures can replace some or all of the chemical admixtures without compromising the qualities of SCC. Moreover, the durability and long-term strength will be improved by the mineral admixtures (Selcuk et al., 2010). Increased productivity, a material that is more cohesive and homogeneous with no honeycombs, higher strength and durability, a superior finish, flexibility in crowded reinforced sections, a reduction in the size of structural components, and other benefits are only a few of the benefits of SCC over conventional concrete. By eliminating noise pollution and creating a secure environment for formwork owing to the absence of vibration compaction, SCC improves the working environment and creates a pleasant work environment. As a result, the Concrete Society (2005) describes SCC as a subtle revolution in the building sector. SCC is now being utilised widely in the pre-cast industries throughout Europe. However, when compared to regular concrete, SCC is more sensitive and less robust due to the use of admixtures and increased fines content, necessitating greater comprehension and quality control.

### *1.2.1 Optimization study of foundry sand*

Numerous studies have demonstrated that adding foundry sand to the mix when producing fiber-reinforced concrete increased the parameters for the material's strength and durability. In self-compacting concrete, foundry sand was used in place of natural sand in amounts ranging from 5% to 60% by Attar et al. (2010), who also investigated the concrete's varied fresh and hardened qualities. According to the findings, compressive strength marginally increased when the partial replacement was 20% and decreased when the replacement percentage went over 60%. The use of foundry sand as a partial replacement for sand in self-compacting concrete was researched by Siddique et al. in 2013. The foundry sand (FS) was used in place of some of the natural sand throughout the experimental examination to assess the strength and durability features of SCC. Four percentages of FS by weight (0%, 10%, 15%, and 20%) were used to replace the natural sand. Self-compacting concrete's new characteristics were investigated. To assess the strength characteristics of concrete at 7, 28, and 56 days, split tensile and compressive strength tests were performed. Sulphate resistance was tested for durability at 7, 28, and 56 days (Bassuoni et al., 2009), and a rapid chloride permeability test was run at 28 days. According to test results, using foundry sand (FS) as a partial replacement for sand up to 15% increased the compressive strength and split tensile strength of self-compacting concrete. For 8 concrete mixtures, sulphate attack resistance and quick chloride permeability were increased. By using foundry sand in place of the natural river sand and substituting it with quarry rock dust, Prasad et al. (2015) investigated the characteristics of fibre reinforced Self-Compacting Concrete (FRSCC). For the M 40 Grades of Concrete, a link between the tensile strength and compressive strength, flexural strength and compressive strength of SCC was established. This substitution of natural river sand with quarry rock dust and used foundry sand. The values of SCC's compressive strength, split tensile strength, and flexural strength were compared to the Indian Standard Codal Provisions with and without the substitution of natural river sand with quarry rock dust and used foundry sand. The M40 grade's 28-day compressive strength goal was met by substituting 30% used foundry sand and 40% quarry rock dust for natural river sand. It was determined that spent foundry sand and quarry rock dust may be utilised as fine aggregate in fibre reinforced self compacting concrete and were comparable to self compacting concrete made with natural aggregate. Glass fibres can be optimally added to self-compacting concrete to increase the split tensile strength in QRD and UFS based SCC.

## 1.3 Conclusion

Following are some key findings from research on the partial replacement of cement with GGBFS conducted by several researchers:-

1. By reducing CO2 emissions and conserving natural resources, the reuse of slag as a by-product helps to lower environmental pollution.

2. Compressive strength typically declines when GGBFS percentage grows in young people, but increases as GGBFS percentage increases in older people.

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