# A STUDY ON SELF COMPACTING CONCRETE

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**Abstract** - *A self compacting concrete (SCC) is a flowing concrete mixture that is able to consolidate under its own weight. In certain instances the addition of super plasticizers and viscosity modifier are added to the mix, reducing bleeding and segregation. Silica sand is a byproduct obtained from cement manufacturing process. Pumice Powder is a natural material of volcanic origin produced by the release of gases during the solidification of lava. It acts as a filler material and due to this property, the pores in concrete are reduced which improves moisture resistivity of concrete. In this project, cement is partially replaced by pumice powder in different percentages such as 0%, 10%, 20%, 30% and fine aggregate is partially replaced with silica sand in percentages such as 50%. Enfiqsuper plasticizer – 400 and Poly carboxylic either type super plasticizers are used to achieve the desired workability. The design mix used for this project is M40 grade concrete. In this project compressive strength, split tensile strength and flexural strength are determined.*

***Key words:*** *Concrete, Pumice, Plasticizer, Compressive*

## 1. INTRODUCTION

Self-compacting Concrete is an innovative concrete that does not require any vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction even in the presence of congested reinforcement. Successful self-compacting concrete must have high fluidity (for flow under self-weight), high segregation resistance (to maintain uniformity during flow) and sufficient passing ability so that it can flow through and around reinforcement without blocking or segregating. The longer curing time improves the geo polymerization process resulting in higher compressive strength. Increase in compressive strength was observed with increase in curing time. The compressive strength was highest when the specimens were cured for a period of 96 hours. However the increase in strength after 48 hours was not significant. Compressive strength of concrete increased with the increase in curing temperature from 60°C to 70°C however an increase in the curing temperature beyond 70°C decreased the compressive strength of self-compacting geo polymer concrete. One alternative to reduce the cost of self-compacting concrete is the use of additions. The most often used fillers increasing viscosity of self-compacting concrete mixtures are fly ash, glass filler, limestone powder, silica fume and quartzite filler. Fly ash, ground granulated blast furnace slag and silica fume were the most frequently applied in self-compacting concrete. The incorporation of mineral admixtures also eliminates the need for viscosity-enhancing chemical admixtures. The lower water content of the concrete leads to higher durability, in addition to better mechanical integrity of the structure. It is also known that some mineral admixtures may improve archeological properties and reduce thermally-induced cracking of concrete due to the reduction in the overall heat of hydration and increase the workability and long-term properties of concrete. One of the most important differences between self-compacting concrete and conventional concrete is the incorporation of mineral admixture. Since cement is one of the most expensive components of concrete, reducing the cement content is one of the economical solutions. Besides these economic benefits, the use of by products or waste materials reduces environmental pollution. In this study, it is aimed to investigate the effect of fly ash, silica fume, and ground granulated blast furnace slag as mineral admixtures on the fresh and hardened properties of Self- Compacting geopolymer Concrete. Fresh concrete tests such as slump flow, L-box, T500, U- box and hardened concrete tests such as compressive strength, split tensile strength, Flexural strength were conducted. Durability concrete test such as saturated water absorption, Porosity, Acid attack, Carbonation depth, Alkalinity measurement were conducted.

### 1.1 SCOPE

Fly ash, a principal by-product of coal burning power plants, is an industrial waste product containing large amounts of silica, alumina and small amount of unburned carbon, which pollutes environment. Fly ash has real disposal problems and should hence be utilized effectively for various purposes. It is possible to produce sustainable, SCGC concrete mixtures with Fly ash, Silica fume and GGBFS instead of cement. Very little research has been conducted in the preparation of SCGC concrete using high volume fly ash, and other pozzolans.

### 1.2 OBJECTIVE

1. To determine the following characteristics for self-compacting geopolymer concrete.
2. To determine the Compressive Strength of cube.
3. To determine the Split Tensile Strength of cylinder.
4. To determine the Flexural Strength of prism.
5. To determine the Durability strength for cube, cylinder and prisms at 28 days to be performed.

### 1.3 ADVANTAGES OF SCC

1. Easier and rapid placement in members with dense reinforcement and complicated Form work.
2. Fast construction and reduction in cost of production.
3. Reduction on site manpower for all operations.
4. Relatively low W/C, result in rapid strength development, improved quality strength and durability.
5. Produces good surface finishes particularly for slabs.
6. Cost efficient and rational solution in thin overlays on prefabricated elements and thinner concrete section can be cast easily.
7. Reduce noise levels in plants and at construction sites due to absence of vibration safer and clear working environment.

### 1.4 DISADVANTAGES OF SCC

1. Dense joints between formwork for deep elements are required for SCC with high fluidity. But problem can be solved by pouring concrete in smaller lifts.
2. Increased form work pressure requires slower casting rate for walls.
3. Presumptive poor surface quality of walls to increased costs of finishing works when removable formwork is used.
4. Low W/C ratio results in rapid drying and thus requires increased curing to avoid increased plastic shrinkage.
5. SCC is more prone to settlement cracking, need steam curing.
6. The mixing time may be longer than for conventional vibrated concrete.

## 2. REVIEW OF LITERATURE

Anuradha et al (2013) reported that 100% replacement of cement by fly ash and 100% replacement of river sand by manufactured sand. The workability of Self Compacting Geopolymer Concrete (SCGC) for various molarities and hardened properties of SCGC were investigated in this paper. The work focused on the concrete mixes with a fixed water-to-geopolymer solid (W/Gs) ratio of 0.33 by mass and a constant total binder content of 450 kg/m$^3$. According to the workability test results the sodium hydroxide (pellet) molarities concentration is kept as 12M since it yield both good workability and compressive strength. There placement of GGBFS with 30% and replacement to Silica fume by 10% (Mix) shows high compressive strength, split tensile strength and flexural strength then other percentage of replacement. The Material achieves early strength when heat curing is adopted instead of ambient curing. If the replacement of GGBFS and Silica fume increases more than 30% and 15% respectively, it does not satisfy the workability requirements of SCGC.

B.H.Vpai et al (2014) presented Self-Compacting Concrete (SCC) is a type of concrete that has the capacity to consolidate under its own weight. The current trend all over the world is to utilize the treated and untreated industrial by-products, domestic waste etc. As a raw material in concrete, which gives an eco-friendly edge to the concrete preparation process. This practice not only helps in reuse of the waste material but also creates a cleaner and greener environment. This study aims to focus on the possibility of using industrial by-products like Ground Granulated Blast furnace Slag (GGBS) and Silica fumes (SF) in preparation of SCC. The usage of these powders is proposed as a replacement for cement in the production of SCC by adopting the much popular Nan Su et al. method of mix design. The paper deals with comparison of performances of GGBS and SF based SCC mixes The SCC mixes containing GGBS and that containing SF as powder material tested for their fresh properties as per EFNARC guidelines, have satisfied the norms laid down by EFNARC. From this it can be concluded that achieving fresh SCC properties is possible by adopting the Nan Su et al. method when these industrial by-products are used as powders. The GGBS based SCC has good Compressive strength, Split tensile strength and flexural Strength when compared to the SF based SCC. The low strength of SF based SCC is possibly due to the high amount of SF (50.19%) in the mix.

## 3. MATERIALS USED

- Low calcium class fly ash
- Ground Granulated Blast Furnace Slag (GGBFS)
- Silica fume
- Manufacture sand
- River sand
- Coarse aggregate
- Sodium silicate solution
- Sodium hydroxide solution
- Super plasticizer

## 4. METHODOLOGY

- Introduction

- Literature review
- Testing of materials
- Mix design
- Casting of cubes
- Test on fresh concrete
- Test on hardened concrete
- Durability studies
- Result and discussion
- Conclusion

## 5. RESULTS AND DISCUSSION

### 5.1 COMPRESSIVE STRENGTH OF CONCRETE

The graph shows the improvement in the strength on 28 days of curing for different percentage of fine aggregate. To increase the stability of fresh concrete (cohesiveness) using increased amount of fine materials in the mixes. The results showed that fly ash could be used successfully in producing self- compacting high-strength concrete.

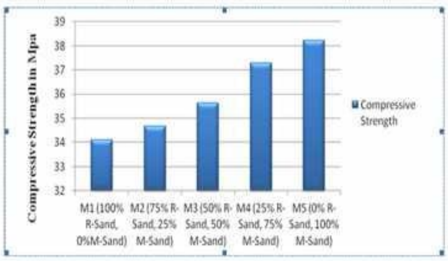


**Chart 2 Compressive strength of concrete**

### 5.2 SPLIT TENSILE STRENGTH

The graph shows the improvement in the strength on 28 days of curing for different percentage of fine aggregate. The tensile strength is tested for the 3 cubes for each proportion. The graph indicates that there is a increase in the compressive strength by gradually increases (100% River sand 0% M-sand to 0% River sand 100%M-sand) the amount of manufacturing sand in concrete.

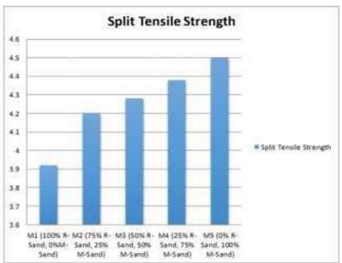


**Chart 1 Split Tensile strength on concrete**

## 6. CONCLUSIONS

The test results of compression value and split tensile value is increases with the gradually increase of replacing the amount of fine aggregate. Higher value of compression value is obtained by replacing the amount of (0% river sand & 100% M-sand) fine aggregate in both the cases.

- Workability gets increased by using alkalinity solution.
- Cementitious property of fly ash increased by using silica fume and GGBFS.
- Self-compacting concrete Geopolymer concrete can be used in any type of weather condition it will be good and due long life and durable when compare to normal concrete.
- But care should be taken while using acid resistance area

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