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# Parametric Study on Durability Criteria of Self Compacting Concrete using Quaternary Blending: A Review

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**Abstract—***Out of the world's vast infrastructure concrete is the choice of the construction material. Now a day's specifications of concrete like durability, workability, compactness and quality of concrete has become more important. Durability is defined as ability to resist weathering action, chemical attack, abrasion; chloride attack etc that is durable concrete will retain its original form, quality and serviceability when exposed to its environment. To overcome problems in concrete a concrete of new era is developed called Self Compacting Concrete (SCC). SCC is a innovative concrete that is able to flow under its own weight and it does not require vibration for placing and it can fill the formwork and achieving full compaction in congested reinforcement. Supplementary Cementitious Material (SCM's) like Ground Granulated Blast Furnace Slag (GGBS), Fly-ash, micro-silica are added in the concrete to increase the durability, quality, and properties of concrete. The use of SCM's which is by-product from industrial waste serves both the purposes of sustainability and effective waste management. . In this research paper, analysis of various study conducted on SCC incorporated with various SCM's has been carried out.*

**Keywords***: Durability, GGBS, flyash, micropause100, Self Compacting Concrete, sustainability.*

## 1. INTRODUCTION

Indian construction industry accounts to a total of 10-12 million tons of waste annually and over 50% of it being concrete and masonry waste [1]. It has contributed to advancement in civilisation throughout history. It has many advantages because of its versality, easy to mould, excellent resistance to water, ability to consume waste, ability to work with reinforcing steel. It has disadvantages also such as low tensile strength, low toughness, and leads to cracking. Cement is the key ingredient of concrete products. Manufacturing of one tonne of portland cement leads to one tonne of generation of carbon dioxide ($CO_2$) and lots of mineral extraction[2]. Construction waste management has become one of the major environmental problems. $CO_2$ is known to be the green house gas and cement industry alone generates 7% of it. For reducing $CO_2$ and making the concrete Eco-friendly there are number of ways for construction industry such as using less portland cement , use of SCM's, incorporating recycled aggregates in concrete.

There are various types of concrete like high performance concrete, self compacting concrete, geo-polymer concrete, high volume fly-ash concrete, reactive powder concrete etc.

From the above concretes Self Compacting Concrete is the most revolutionary development in the past years. SCC is developed to ensure adequate compaction and facilitate placement of concrete in structures with congested reinforcement and in restricted areas. It offers a more industrialized production. It reduces the task of workers and reduce the technical cost of the construction.

The main reasons for employment of SCC are as follows:-

- No eliminate noise during vibration.
- To reduce the construction period.
- To ensure compaction in the structures especially in congested reinforcement or confined zones.

## 2. OBJECTIVES OF STUDY

- To analyse the various researches conducted on SCC incorporating with GGBS and Micro-silica.
- To decide objectives and scope for the dissertation work.

## 3. LITERATURE REVIEW

Various work has been carried out in SCC using GGBS and Micro-silica. The main objective is to review the engineering and durability parameters by incorporating with various SCM's. The various research work carried out are as follows.

**K.L.N.Madhav Rao [1]:** Had conducted study on Self-Compaction Concrete to improve strength & make concrete economical, so a mix of M30,M40 Grades is prepared with adding chemical admixture, a Retarder Basically Which also increases strength and workability &replacing cement with

GGBS. Strength shows that adding of chemical admixture results in increase the initial setting time and decrease in the w/c ratio. Compressive strength is increased by replacing 50% of GGBS for cement and maintained w/c ratio as per mix design obtained, the mineral admixture replacement have a better workable concrete.

**Divya Anusha Naidu**[2] : investigated on the performance of class-F fly ash and GGBS concrete specimens made by cement replacement levels with super plasticizer and test on fresh concrete were carried out as per EFNARC guidelines. M35 grade concrete were determined for the hardened properties evaluate the performance of class-F fly ash and GGBS concrete specimens made by cement replacement levels with super plasticizer and test on fresh concrete were carried out as per EFNARC guidelines. Improvement of bond strength in SCC, using this type of concrete instead of normal concrete in construction, produces significant advantages.An average increase in compressive strength of 60% has been obtained for SCC, whereas 30% was the increase in splitting tensile strength.

**J. M .Srishaila**[3] :- investigated on the fresh, hardened and stress-strain behaviour of SCC blended with GGBS and silica fume. To find the ductility factor for different combination of GGBS and Silica fume using Saenz Model. From the research it was concluded that As the percentage of GGBS increased Workability properties get reduced because of flakiness and elongated shape of GGBS and also silica fume is denser in appearance. When cement is replaced by 20% of GGBS and 6% of silica fume it is found that percentage increase in compressive strength from 7 days to 28 days is about 12.8% and from 28 days to 56 days this was about 1.6%. Ductility factor increases with increase in percentage of silica fume.

**Pradnya p. Urade(6)** :- study is carried out and the behavior of SCC with Ground Granulated Blast Furnace Slag & Fly Ash is investigated. The effect of use of above mineral admixture fines on fresh properties of SCC is studied. The mix proportion for M 30 was based on the Modified Nan-Su method. It was concluded that The addition of 10 %, GGBFS and Fly Ash in SCC mixes increases the self compact ability characteristic like filling ability, passing ability, flowing ability and segregation resistance. Economically competitive SCC can be produced by replacing up to 50% of OPC with GGBFS & FA Ash.

**Karthik Poovaiah D** :- investigation was carried on strength aspects like compressive strength, flexural strength and split tensile strength, and durability aspects like rapid chloride penetration test(RCPT) of high performance self-compacting concrete with different mineral admixtures. The influence of mineral admixtures on the workability, mechanical strength and durability aspects of self-compacting concrete are studied. It was concluded that The application of silica fume and GGBS in concrete mixture has significantly increased and enhanced the properties of the concrete whether it is in wet stage or in harden condition. Silica fume provide mechanical strength to high performance self compacting concrete. High performance self compacting concrete with GGBS and silica fumes exhibits better performance in compression as compared to its flexure.

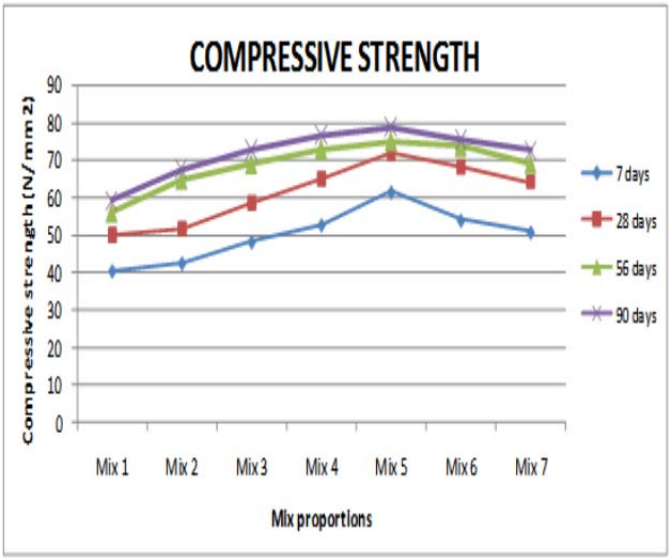



**Fig. 1: Variation of compressive strength with different mix proportions**

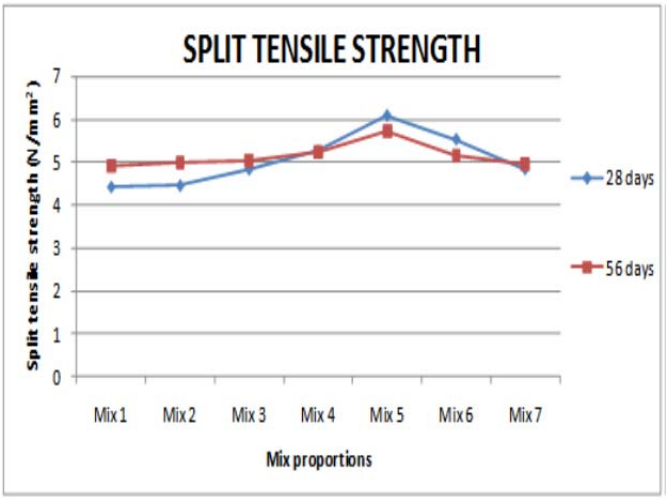
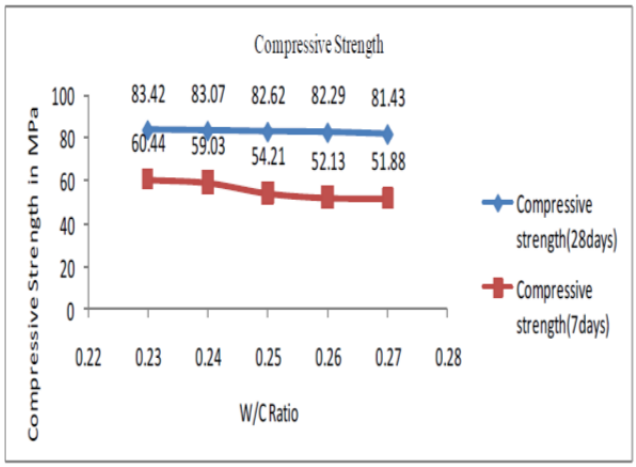



**Fig. 2: Variation of split tensile strength with different mix proportions**

**Mallikarjuna Reddy V** (7):- An experimental research on the workability and mechanical properties of self-compacting concrete. Work focused on concrete mixes having Water/Cement ratios of 0.23, 0.24, 0.25, 0.26 and 0.27, with a Packing Factor of 1.12. The Concrete mixes contains different proportions of GGBS, Super plasticizers, water binder ratios and constant proportions of Cement, Micro Silica, VMA, Coarse aggregate and Fine aggregate for different Water

Cement ratios. The mix proportions are obtained on the basis of NAN-SU mix design.



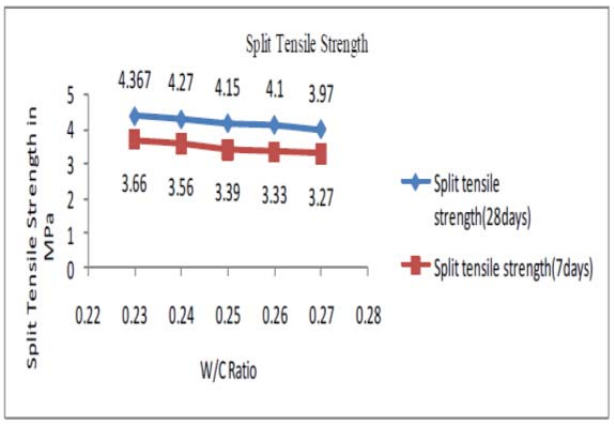




**Fig. 3: w/c Ratio Vs Split tensile strength**

It was concluded that required minimum slump is achieved for a w/c ratio of 0.23 with optimum strength for M70 grade high strength self compacting concrete. Required minimum strengths are achieved for a w/c ratio 0.27 with optimum slump for M70 grade high strength self compacting concrete. For water cement ratio 0.25 fresh and hardened state properties of high strength self-compacting concrete are moderate.

**Sabeer alavi.c et al (9):** Investigated on strength aspects like compressive, flexural and split tensile strength and the workability tests (slump, L-box, U-box and T50). aimed to investigate the effect of GGBS as mineral admixtures on the fresh and hardened properties of SCC. In this study Portland cement (PC) is replaced with 10%, 20%, 30%, 40% and 50% of GGBFS. For 30% GGBFS replacement, the fresh properties observed were good as compared to 10%, 20%, 40% and 50% GGBS replacement. Hence if we increase the GGBFS replacement we can have a better workable concrete.

## 4. OUTCOMES:-

The various research conducted on SCC on high strength concrete the following outcomes measured are as follows:-

- Ductility factor increases with increase in percentage of silica fume.
- Economically competitive SCC can be produced by replacing up to 50% of OPC with GGBS.
- GGBS can be used as an alternative material for cement, reducing cement consumption and reducing the cost of construction.
- Mixes with different fillers like silica fume help in attaining a high early strength, which is very useful in pre-cast applications.
- It has been found that with increase in superplasticizer dosage the workability is increased.
- When the coarse aggregate content is reduced better flow in SCC can be achieved due to the less blocking effect.
- The water cement ratio is kept between 0.2 to 0.30 for high strength.
- Silica fume provide mechanical strength to high performance self compacting concrete

## 5. CONCLUSION

(SCC) technology save time, cost, enhance quality, durability and moreover it is a green concept. But there is less research work done on durability assessment of concrete. So my dissertation work will be carried out to derive Optimum Dosage of GGBS for different grade of concrete (M60 AND M80). To study Rheological properties of fresh concrete using SCM's.To study Mechanical properties of hardened concrete through compressive strength for 7 days, 28 days, 91 days. To study durability properties of hardened concrete through Water Permeability (56 days), Chloride Penetration (56 days), Carbonation (56days), Corrosion Resistance (56 days).

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