

# EFFECTIVENESS ON MECHANICAL PROPERTIES OF M60 GRADE SELF COMPACTING CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY DIFFERENT MINERAL ADMIXTURES LIKE GGBS LIME POWDER AND METAKAOLIN AT VARIOUS PERCENTAGES

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***Abstract** Production of cement brings about the discharge of green house gases which at last prompts an unnatural weather change on one hand. On other hand consumption of crude materials like lime stone. So by utilizing elective materials we can lessen the creation of cement. Presently a day's the majority of the analysts are centered around replacement of cement with other mineral admixtures like Ground granulated blast furnance slag(GGBS), Metakaolin and lime powder and so forth without bargaining its mechanical properties and durability. Self compacting concrete doesn't need vibration for setting and compaction.*

*This study presents the outcomes on various mechanical properties of self compacting concrete utilizing the standard Portland cement, GGBS, lime powder and metakaolin as binding material in making concrete. The hardened concrete properties like compressive strength, split tensile strength and flexural strength are found in trial work and comparison made with normal concrete.*

*Key words: M60 grade, SCC, GGBS, Lime powder and Metakaolin*

## 1. INTRODUCTION

Concrete is, in fact, the most regularly used domestic development material. Engineered concrete electricity and lifespan are largely decided through acceptable compaction all through installation. Inadequate compaction will minimize the overall performance of mature concrete in situ substantially. Self-compacting concrete has been delivered to supply terrific compaction and homogeneity of the solid concrete, as properly as to inspire its placement,

in particular in congested reinforcing structures and confined regions.

It all commenced in 1988 at Tokyo University, when Okamura and colleagues developed the integral idea of SCC (1998). Self-compacting concrete (SCC) used to be first developed in the late 1980s. Originally, SCC standards have been thinking to be a way to enhance the long-term steadiness of structures with crowded reinforcement elements. Since its debut, it has sparked a lot of curiosity. Because of the extended overall performance and working environment, it has been referred to be the most great strengthen in concrete manufacturing for decades.

SCC is a self-compacting concrete that fills the total shell except the want for exterior exertion (in the shape of mechanical vibration, floating, poking etc.). The concrete need to have an suitable diploma of passing capacity, filling ability, and consistency in order to fill the complete region and go with the flow via the shell barring any exterior effort. Cohesiveness turns into an problem due to the fact of the heterogeneous persona of concrete, its excessive fluidity, and the truth that it contains substances with various unique gravities, for the reason that it is very tough to hold its parts in a cohesive kingdom the place increased mass particles have a tendency to sink down.. However, growing the quantity of finer fabric will tackle this issue. SCC is now a very favored choice in the usual constructing area due to the fact to its gorgeous undemanding features.

### Objectives and scope

From the exploration information there are numerous papers, projects which infers that SCC is fast

developing cement for future exercises in development industry. Thusly, in useful perspective growing such cement in financial contemplations with adequate sturdy and strength quality in it is the fundamental target.

From that point to decrease in cost examination, squander materials of industry which isn't destructive for Human's usage is proposed to use in utilization of development exercises. Lime powder, Metakaolin two significant mineral admixtures bargains in this task while GGBS goes about as a pozzolana material in concrete substance.

## LITERATURE STUDIES

**B.B.Sabir et.al (2005)** According to the research, replacing cement with metakaolin in concrete and mortar results in a significant increase in pore structure, which eventually leads to concrete resistance to hazardous solutions. The study also explicitly states that metakaolin is a very effective pozzolan, resulting in increased early strength with no drawbacks and modest long-term strength enhancement. The resistance of mortar and concrete to the transit of water and diffusion ions, which leads to matrix deterioration, was shown to be significantly improved.

**Murali.G et.al (2012)** claimed that metakaolin can be used as a partial substitute for cement in concrete. Metakaolin used to be effectively used in concrete to extend the strength characteristics. The most appropriate quantity of alternative used to be suggested as 7.5 percent, which improved the compressive electricity of concrete by means of 14.2%, the break up tensile energy with the aid of 7.9%, and the flexural strength via 9.3%.

**J.M. Khatib et.al (2012)** It deals with the density, ultrasonic pulse velocity, and compressive strength of a combination having a large proportion of metakaolin as a partial replacement for cement, according to the researchers. In this study, up to 50% metakaolin was utilised to substitute cement in 10 percent increments. Specimens are cured in water at 20 degrees for 28 days after de-molding. When we look at density, we see that it decreases as the proportion of metakaolin increases; generally, the

percentage of metakaolin is greater than 30%. The strength of concrete can be increased by up to 40% when metakaolin is added; however, the greatest strength is obtained at 20% addition, when the strength is 47 percent greater. The strength of metakaolin is expected to decrease by 50 percent. 10% and the 30% Metakaolin mixes exhibit an increase in strength of around 37%.

## 2. Materials used for the study

For this experimental study initially collect the necessary materials to make self compacting concrete the details of materials collection and specification are discussed in the below

### *Cement*

Ordinary Portland cement of 53 grade was used in this experimentation changing in accordance with I.S. – 12269-1987. For the current assessment I was assembled ultra tech concrete of 53 evaluation from neighborhood. The model concrete pack used in this examination is showed up in the underneath figure 1. The particular gravity 3.14 and consistency 28%.



**Figure 1:** OPC 53 grade Cement  
*Sand (FA)*

Locally accessible zone II with specific gravity 2.53, water absorption 2.5% and fineness modulus 2.92, changing according to I.S. – 383-1970. It is the aggregates which passes through 4.75 mm IS sieve and contains fundamentally quite a phenomenal extent of coarser as is permitted by detail which are appeared in the figure 2.



**Figure 2:** Fine aggregates (Sand)

#### **Gravel (CA)**

Coarse aggregates are those stones which are retained on IS 4.75mm IS sieve number the coarse aggregates which are used in this experimental work is shown in below figure 3 the specific gravity is 2.6 and bulk density is 1523 Kg/m<sup>3</sup> with water absorption is 2%.



**Figure 3:** 10mm size coarse aggregates

#### *Mineral admixtures*

##### *GGBS*

The Ground granulated blast furnace slag (GGBS) which is collected from JSW Allahabad is used in this experimental work.

##### *Metakolin*

Metakolin is the fine powder material which is utilized to improve the concrete strength and durability. The metakolin is appeared which is accessible at Adhipathi minerals kothapally.

##### *Lime powder*

Lime is fine powder which is collected from local areas used in this study.

##### *Super plasticizer*

Super plasticizer of master ease 3709 is used in this current study which is 1% of weight of the cement content.

### **3. Experimental investigation**

For determine the mechanical properties of M60 grade self compacting mix cube, cylinders and beams are casted. The cubes of 150mmX150mmX150mm, cylinders of 150mm dia and 300mm length and beams of 150mmX150mmX500mm are utilized. All the specimens are permitted to curing for 7days, 28 days at ambient temperature. Different mechanical properties of M60 SCC is determined. The compressive strength and split tensile of concrete is find by using compression testing machine (CTM). The flexural strength is controlled by utilizing two point load test.

The different mix proportions used for this study is shown in the below table. Different proportions of GGBS, metakolin and lime powder is used as replacement for cement.

**Table 1:** Mix proportions used for the study

Mix	Cement	GGBS	Metakolin (MK)	Lime powder (LP)
M1	75%	25%	0%	0%
M2	75%	15%	0%	10%
M3	75%	15%	10%	0%
M4	75%	10%	0%	15%
M5	75%	10%	15%	0%

### **4. Testing procedure**

#### *Fresh concrete tests*

Workability of concrete is determined by using EFNARC guidance for M60 SCC for different mix proportions. The workability tests like slump cone, L

box, V funnel and U box test is determined the test results are shown in the below table.

**Table 2:** Workability tests results on concrete

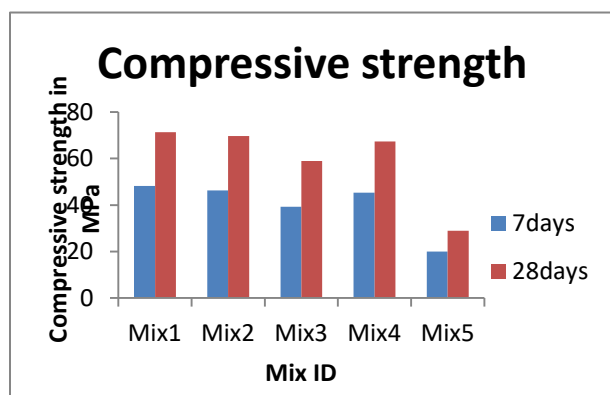
Property	M1	M2	M3	M4	M5
Slump (mm)	650	630	615	590	570
L-box (ratio)	0.9	0.86	0.81	0.75	0.7
V-funnel (sec)	10	11	12.5	14	16
U-box (ratio)	0.8	0.75	0.77	0.8	0.79

*Harden concrete tests*

The hardened tests like compressive, split ductile and flexural strength of M60 grade Self compacting concrete is determined for 7 days and 28 days restoring by utilizing different extents of GGBS, metakolin and lime powder as a substitution for concrete.

*Compressive strength*

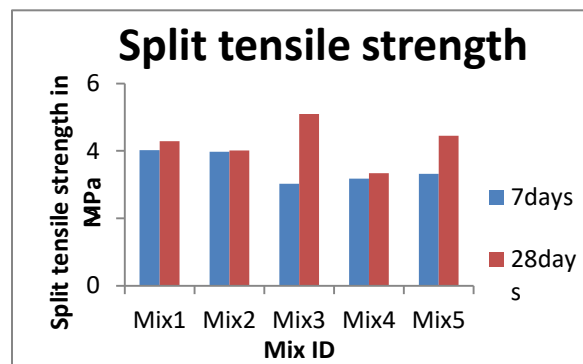
The compressive strength is resolved for 7 days and 28 days examples age by utilizing compression testing machine (CTM). The outcomes are appeared in the below table and chart.



**Graph 1:** Comparison of compressive strength of concrete

*Split tensile strength*

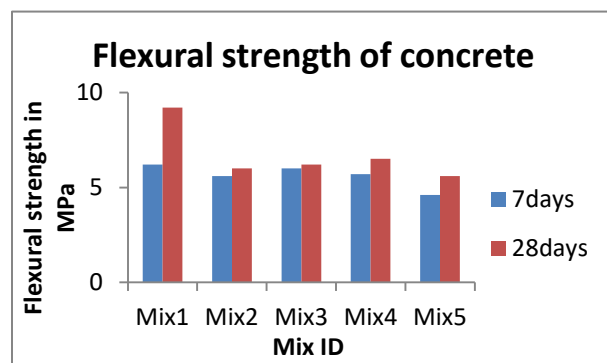
The split tensile is resolved for 7days and 28 days restoring. The split tensile is controlled by utilizing compression testing machine (CTM) the test outcomes are appeared in below table and chart



**Graph 2:** Comparison of split tensile strength

*Flexural strength*

The flexural strength of SCC is resolved for 7 days and 28 days restoring days to radiates example. The flexural strength is dictated by two point load test machine. The test outcomes are appeared in the below table and chart.



**Graph 3:** Comparison of flexural strength of concrete

**5. Conclusions of the study**

1. Mix 1 obtained maximum compressive strength when cement is partially replace with 25% of GGBS compressive strength of M60 grade SCC Concrete.
2. For Mix 2 also at par with conventional

concrete when cement was partially replace with GGBS.

3. For Mix 3 Split tensile strength is highest when compared.
4. The maximum flexural strength occurred for mix1 i.e addition of ggbs to 70% of cement without adding lime powder and metakaolin.

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