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Utilization of GGBS and Steel Slag for Betterment of High Strength Concrete - Review

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***Abstract:** It should be confined to the study and comparison of the effects of replacement of cement by steel slag and GGBS on the 28 days compressive strength and tensile strength. To evaluate the compressive strength of concrete by replacing cement with GGBS and steel slag at varying percentages of 15%, 30% and 45% for M30 and M40 grade of concrete with respect including steel slag. Steel slag and GGBS should an industrial by-product of steel industry. It should be the problem of disposal as waste and is of environmental concern. The demand for aggregate in construction industry should rapidly and so is the demand for concrete. Thus they are becoming more important to seek suitable alternatives for aggregates in the future. So there are the material should be prefer in the concrete material in the future….!!*

I. INTRODUCTION

Concrete is a very strong and versatile mould able construction material. It consists of cement, sand and aggregate (e.g., gravel or crushed rock) mixed with water. The cement and water form a paste or gel which coats the sand and aggregate so that should be enough to resists all types of strengths. When the cement has chemically reacted with the water, it hardens and binds the whole mix together. The initial hardening reaction usually occurs within a few hours. It takes some weeks for concrete to reach full hardness and strength. Concrete can continue to harden and gain strength over many years. On its own, concrete has excellent resistance to compression (crushing), but is very poor in tension (stretching). To give it good load bearing capability when under tension, it has to be reinforced with steel slag, GGBS, polymer strands or fibres. Bars and strands can be tensioned during casting of pre-cast concrete structures such as floor and bridge beams. When the concrete has set, the tension is released and the reinforcement tries to pull back to its original length, but can't, as it is now bound into the set concrete. It thus imparts a pulling force which gives the cast structure great strength.

A. Introduction of Ground Granulated Blast Furnace Slag(GGBS)

Fulton (1974), Rajamane et al. (1998) investigated the workability of concrete strengthing with containing GGBS in greater details and suggested that the matrix containing GGBS exhibited more workability due to the increased gel content and increased cohesiveness of the gel. Ground Granulated Blast furnace Slag (GGBS) is made by product from the blast furnaces used to make iron. These operations at a temperature of about 1500 degrees centi. and are with a carefully controlled mixture of iron ore, coke and limestone etc. The iron ore is less to iron and the remaining materials from a slag that above on top of the iron. This slag is periodically tapped off as a molten liquid and if it is to be used more and more for the manufacture of GGBS it has to be rapidly quenched in increases volumes of water. The quenching optimises the cementitious properties and produces granules similar to coarse sand.

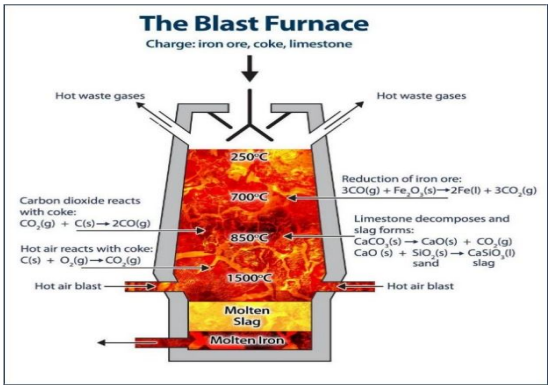


Figure 1.1 Ground Granulated Blast furnace Slag (GGBS)

B. Introduction of Steel Slag

Steel slag made by product obtained either from conversion of iron to steel with chemical process in a Basic Oxygen Furnace (BOF), or by the melting of scrap material to make steel process of the Electric Arc Furnace (EAF). The molten liquid is a different effects of silicates and oxides that would be solid form with cooling process and forms steel slag. Steel slag is well defined by the American Society for Testing and Materials (ASTM) as a non-metallic product, calcium silicates and ferrites combined with fused oxides of iron, aluminum, manganese, etc. So those are developed simultaneously with steel in basic oxygen, electric arc. There are two states producing the most steel slag are Ohio and Indiana in united states. The chemical composition and cooling of molten steel slag have a great effect on the properties modification with respect to existing of solidified steel slag.

There are two method of production of steel furnace slag.

Basic Oxygen Furnace (BOF) Electric Arc Furnace (EAF)

1) *Basic Oxygen Furnace (BOF):* The hot liquid gel material of metal from the blast furnace, scrap and fluxes, which contain lime (CaO) and dolomitic lime, are made to a furnace. A lance is lowered into the converter and then oxygen in entered with high pressure. The oxygen then combines with and removes the impurities as shown in Fig. 1(a). These should not be pure material of consist mainly of carbon in the form of gaseous carbon monoxide, phosphorous and some iron as liquid oxides, which combine with using different type of lime to form steel slag. At the end of the final stage, the steel in the liquid form is retains into the scoop or ladle while the slag is retained at the top in the vessel and is then easily removed in separate slag pot. This slag is in molten state and is then processed to remove all free metallic impure materails with help of magnetic separation process and then sized into normally construction aggregates.
2) *Electric Arc Furnace (EAF):* This method does not use hot metal, but uses cold steel scraps. Charged material is heated to a liquid state by means of an electro static method. The electricity has no electrochemical process (cathode-anode) on the metal, making it perfectly suited for melting scrap. During the melting process, other metals are added to the steel to give the required good chemical composition. Meanwhile oxygen is blown into the EAF to purify the steel. This slag which floats on the surface of molten steel is then poured off

II. LITERATURE REVIEW

A. D. Suresh and K. Nagaraju [1]

in this paper author, has investigated With the same content of cementations material (the total weight of Portland cement plus GGBS), similar 28 day strengths to Portland cement will normally be achieved when using up to 50% GGBS. By comparison, a 50 % GGBS concrete will typically achieve about 45 to 55 % of its 28 day strength at seven days, with a gain of between 10 and 20 % from 28 to 90 days. At 70 % GGBS, the seven day strength would be typically around 40 to 50 % of the 28 day strength, with a continued strength gain of 15 to 30 % from 28 to 90 days.

B. Analysis Of Strength Characteristics Of Ggbs Concrete [3]

in this experimental study, shows that GGBS – based concretes have achieved an increase in strength for 20% replacement of cement at the age of 28 days. Increasing strength is due to filler effect of GGBS. With the addition of 40 % of GGBS as a replacement of cement for M35 grade of concrete there is no change in degree of workability.

C. Study On Cementitious Properties Of Steel Slag [13]

In this research study, shows that Contents of C2S and C3S in steel slag act as an important factor that influences activity of steel slag powder. The more their contents are, the higher activity is. Concrete produced by steel slag powder as admixture can obtain an increased strength. GISS is the best admixture for concrete which avoids low alkalinity and poor durability caused by GGBFs as the only admixture.

D. Mechanical Properties of Concrete Using Steel Slag Aggregate [6]

in this research author, shows that Compressive strength of steel slag concrete increases in 6 % compared to the conventional coarse aggregate concrete. Split tensile strength of steel slag concrete increases in 28 % compared to the conventional coarse aggregate concrete. Flexural strength of steel slag concrete increases in 34 % compared to the conventional coarse aggregate concrete.

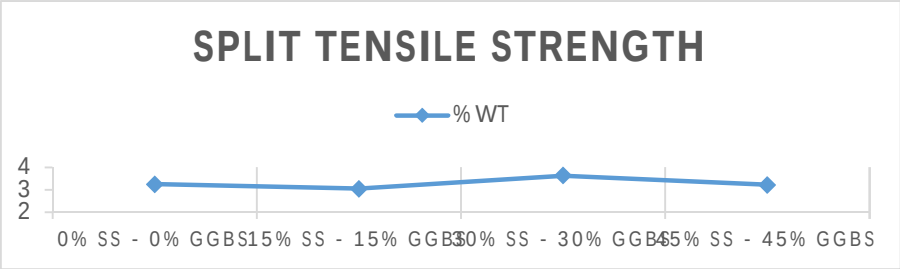
E. Use of steel Slag as Partial Replacement of Sand to Concrete [7]

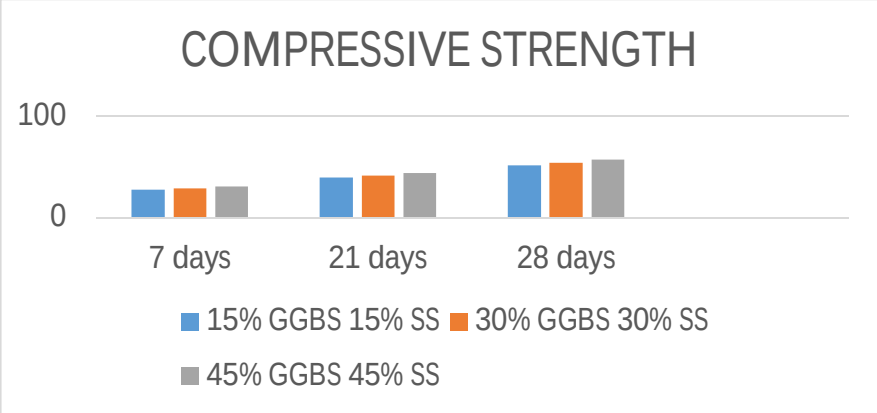
in this review paper author, shows that The strength characteristics of concrete mixtures had been computed in the present work by replacing 10%, 20% and 30% iron slag with the sand. On the basis of recent testing, subsequent conclusions were drawn.

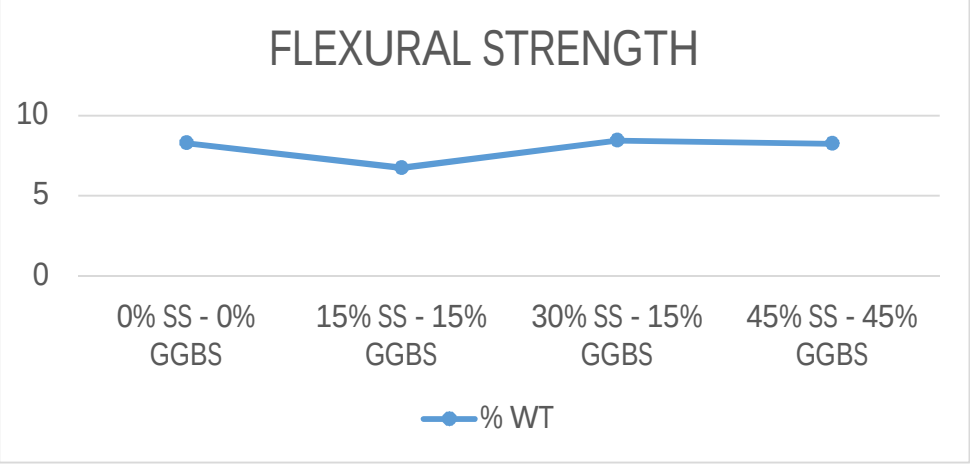
After adding 10% iron slag in the mix, there was an increase of 26% after 7 days, 50% increase after 28 days and 43% increase after 56 days as compared to the control mix. By adding 20% and 30% iron slag , there was large amount of increase in percentage i.e. 68%, 91%, 78% and 125%, 113% , 87% after 7, 28 and 56 days respectively.

1) Mix Design : M30 Proportions

a) Cement: 300 kg/m3
b) Steel Slag: 15% - 50%
c) GGBS: 15% - 50%
d) Fine Aggregate: 801
e) Coarse Aggregate: 1095.65
f) Water: 178.40
g) Super plasticizer: 1.24







III. CRITICAL REMARKS

A. It should be more strengthen for high concrete grade.

B. It should be more and more useful for nowadays for high rise building as well as dams and bridge.

C. GGBS should be avoid the effects like silica effects, and protect concrete effects due to chemical properties and physical property.

D. Steel slag is used for instant strength with good results and high percentage effect according to other admixtures and also with GGBS it works hardly and make good strength concrete

IV. CONCLUSION

A. Based on study we conclude that,

1) According to GGBS and Steel Slag betterment of the concrete easily and more impacted.

2) Other admixture are not impacted normally according to its uses so GGBS and steel slag more effected in high rise building.

3) Its durability more so it is useful in bridge and dam also.

4) Effects of chemical properties are negotiable.

5) More useful in high grade concrete with M30 and more effectivly.

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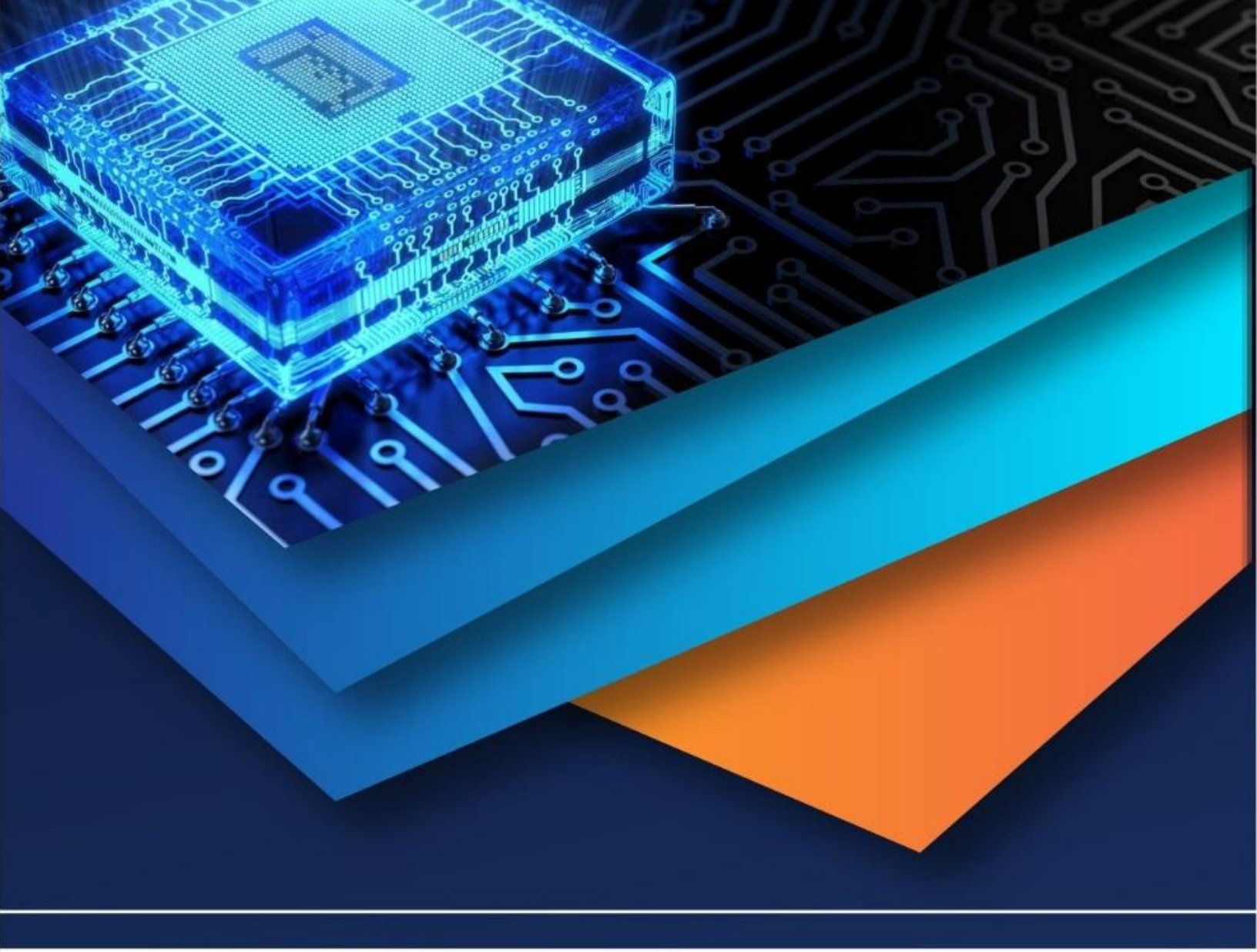

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