TO STUDY THE PARTIAL REPLACEMENT OF CEMENT BY GGBS AND NATURAL SAND BY MANUFACTURED SAND IN CONCRETE USING DIFFERENT DOSAGES OF ADMIXTURE

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Abstract

As we all familiar with the term concrete that, it is a mixture of cement, fine aggregates, coarse aggregates & water. Cement manufacturing industries liberates about 1 tonne of Co_2 in the atmosphere while producing 1 tonne of cement. Similarly fine aggregates i.e. natural sand is increasingly becoming scares and costlier day by day. In order to meet the demands, concrete industry are constantly looking for supplementary cementitious materials and fine aggregates. Fly ash, ground granulated blast furnance slag, rice hush ash & manufactured sand are the industrial wastes and this materials can be used as supplementary to cement and fine aggregates by partially replacing it. In this experimental investigation, natural sand (NS) is partially replaced with manufactured sand (MS) & cement is partially replaced with GGBS. This experimental investigation is carried out in two phases, in 1st phase M30 grade of concrete is produced by replacing 0%, 20%, 40%, 60%, 80% & 100% of NS by MS with addition to three different dosages of admixture to determine optimum percentage of replacement of NS By MS & optimum admixture content at which max compressive strength is obtained. It is found by results that, when 60% of NS is replaced with MS with 1.50% of admixture max strength is achieved. In 2nd phase cement is replaced by 10%, 20%, 30% & 40% of GGBS with different dosages of admixture. It is observed that as dosage of the admixture increases strength also increases.

Keywords : Ground granulated blast furnance slag (GGBS), cement, Natural sand (NS), Manufactured sand (MS), Admixture.

I. Introduction

Concrete is an artificial material in which the aggregates i.e. both fine and coarse are bonded together by cement, when mixed with water. Concrete can also be considered as a material which

consistsof a binding material within which there are embedded fragments of aggregates. The demand on concrete is likely to increase in future to match the requirement resulting from growing population, housing, transportation and other amenities. At present, there is scarcity of conventional fine and coarse aggregates required for concrete making due to continuous demand on concrete for construction. For reducing the cost of concrete and also to meet the demand, locally available waste materials, such as, ground granulated blast furnance slag, fly ash, silica fume, rice husk, saw dust, rock flour and ceramic scrap replacing cement or aggregate can be used.

The objectives of the investigation are :

1. To determine the physical properties of ground granulated blast furnance slag.
2. To determine the physical properties of M SAND.
3. To determine the physical and chemical properties of 53 grade cement.
4. To determine the physical properties of coarse and fine aggregates.
5. To obtain the maximum percentage of replacement of GGBS & M SAND in modified concrete.
6. To determine the optimum percentage of admixture which gives optimum strength to concrete.
7. To study and compare conventional concrete and modified concrete for the different strength characteristics.
8. Obtaining the results of different properties mentioned above and analyzing the same.

II. Material Characterization

Following Materials Has Been Used In The Present Experimental Investigation :

2.1 Cement :

OPC 53-Grade Was Used In This Investigation. It Conforms To IS : 8112 – 1989 With a Specific Gravity Of 3.15 & Normal Consistency of 33%.

2.2 Aggregates :

Natural sand having specific gravity of 2.62, fineness modulus of 2.88 & water absorption of 0.96%. Manufactured sand collected from near-by crusher having specific gravity of 2.70, fineness modulus of 3.20 and water absorption of 1.10% . both natural sand & manufactured sand conforms to grading zone II of IS : 383 – 1970 has been used.

Coarse aggregates passing through 20mm sieve and retained on 12.5mm sieve having specific gravity of 2.71 and water absorption of 0.50% is used in the present investigation.

2.3 water :

Clean potable water free from organic substances is used in this investigation both for mixing and curing of concrete.

2.4 Mineral Admixture (GGBS) :

Ground granulated blast furnance slag having specific Gravity of 2.90 and bulk density of 1100 kg/m^3 is used.

2.5 Chemical admixture (superplasticizer) :

Master Rheobuild 1100 is used to reduce water content to obtain maximum workability.

III. Experimental Investigation

3.1 Mix Proportioning :

The M30 concrete mix is designed as per IS : 10262 - 2009 & IS : 456 -2000. This Research is conducted in two phase, in 1st phase mix of M30 grade concrete with replacement of 0%, 20%, 40%, 60%, 80% & 100% of natural sand by manufactured sand with addition to three different dosages of admixture is carried out to determine optimum percentage of replacement of NS By MS & optimum admixture content at which max. compressive strength is achieved. In 2nd phase cement is replaced by 10%, 20%, 30% & 40% of GGBS. Mixing time of concrete by manual means is totally 5 minutes. Compaction is done by using a 16mm rod in layers with 25 strokes for each layer. Before curing, concrete is left for 24 hours in the moulds and then demoulded and placed in curing tanks until the day of testing. 3 specimens were prepared for each set, and tested after 7 days & 28 days of curing from the date of casting.

3.2 Method Of Testing :

Compressive strength of cubes is tested as per IS : 516-1959, split tensile strength of concrete on cylinders is done as per IS : 5816-1999 & flexural strength on pcc beams is tested as per IS : 516-195

IV. Results& Discussions

After 7 & 28 days of curing, compression, split tensile & flexural strength tests were conducted on concrete and there results have been discussed below.

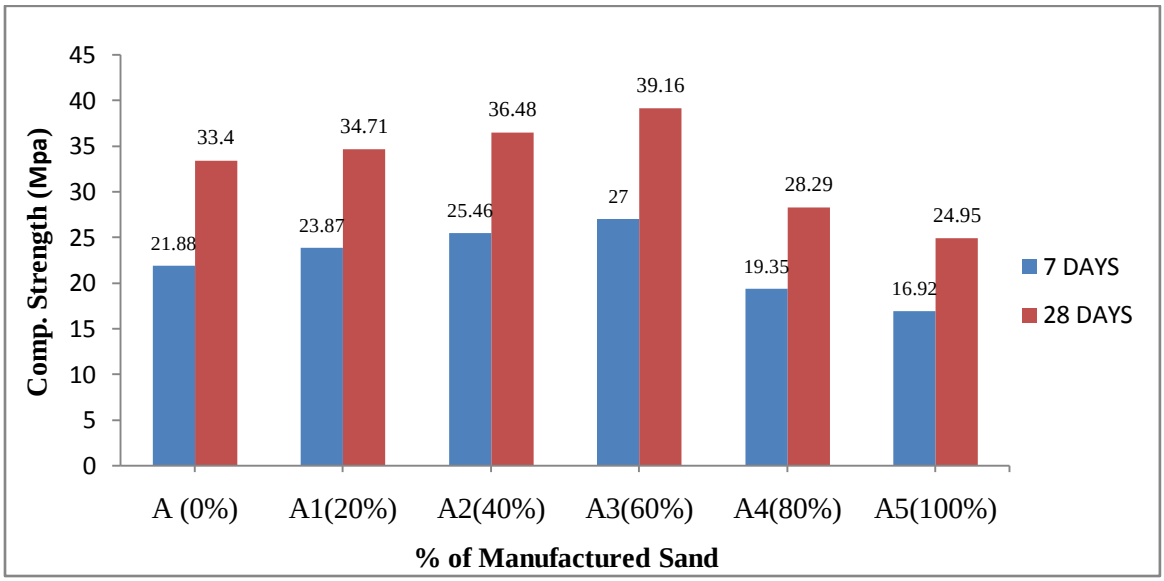

Fig 4.1 : Graphical Representation of % Variation of Manufactured Sand v/s Compressive Strength With 0% Admixture For 7 days & 28 days curing

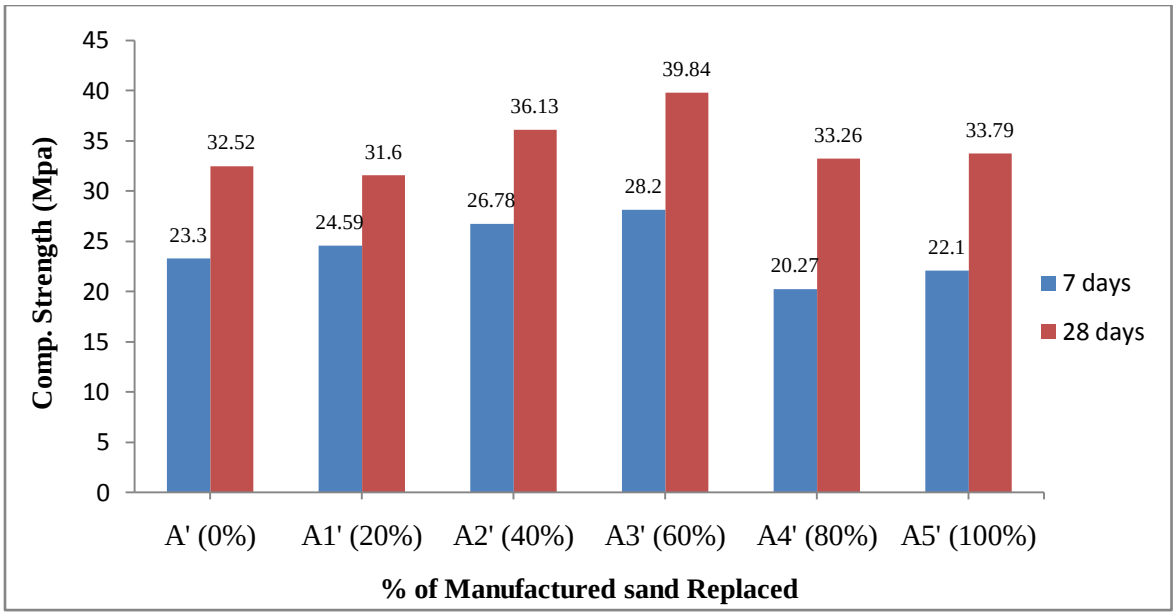

Fig 4.2 : Graphical Representation of % Variation of Manufactured Sand v/s Compressive Strength With 1.0% Admixture For 7 days & 28 days curing

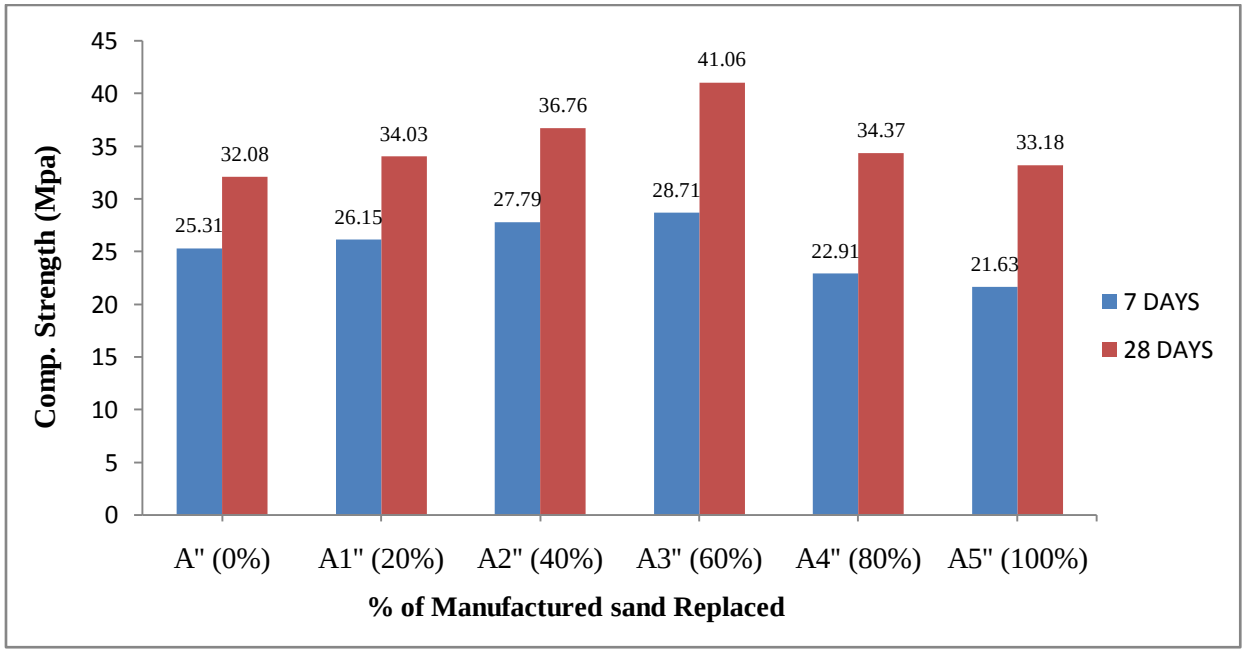

Fig 4.3: Graphical Representation of % Variation of Manufactured Sand v/s Compressive Strength With 1.50% Admixture For 7 & 28 days curing

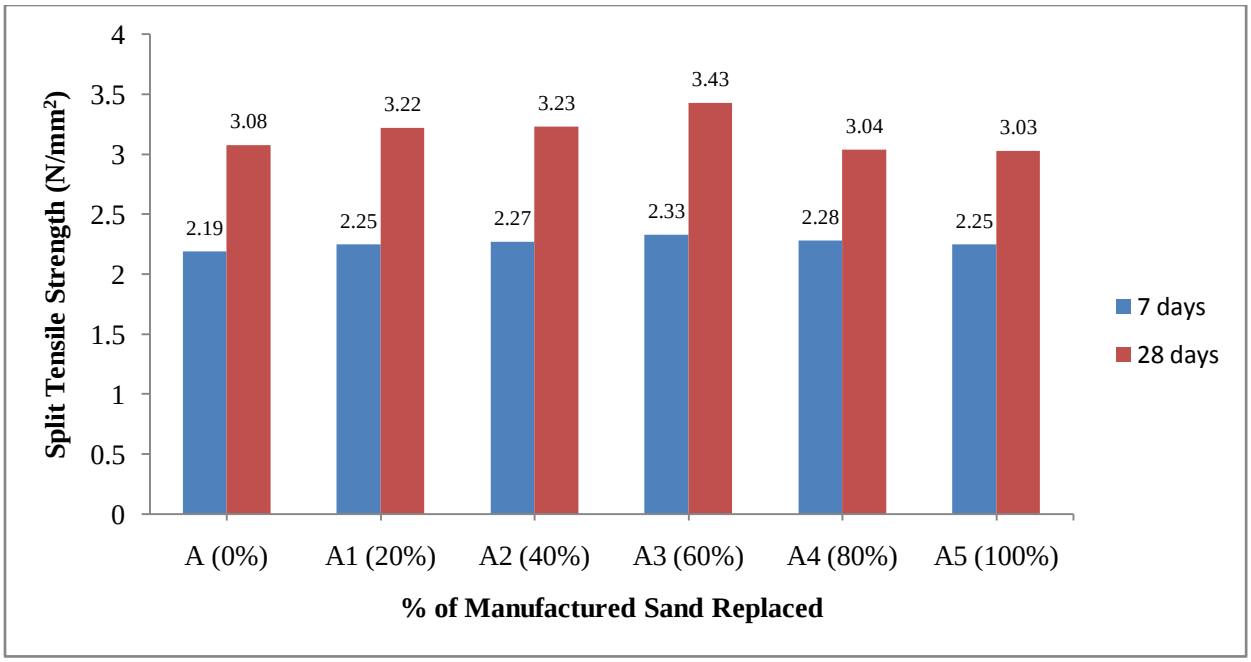

Fig 4.4 : % Variation of Manufactured Sand v/s Split Tensile Strength With 0% Admixture For 7 Days & 28 Days

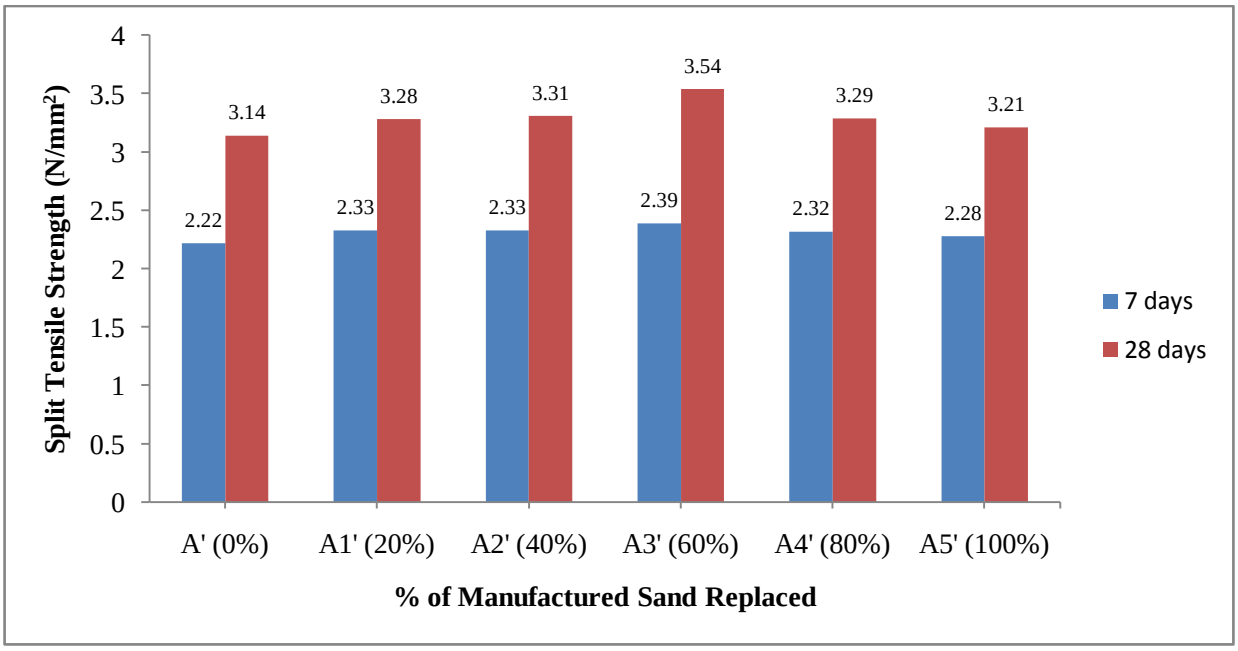

Fig 4.5 : % Variation of Manufactured Sand v/s Split Tensile Strength With 1.0% Admixture For 7 Days & 28 Days

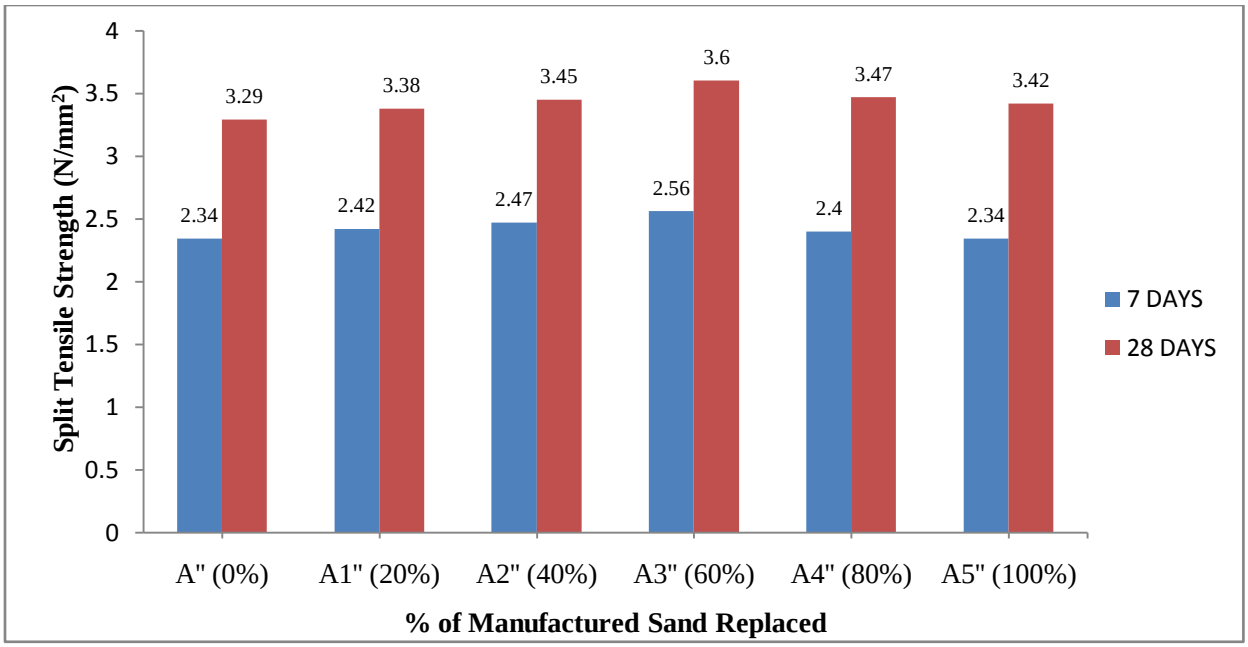

Fig 4.6 : % Variation of Manufactured Sand v/s Split Tensile Strength With 1.50% Admixture For 7 Days & 28 Days

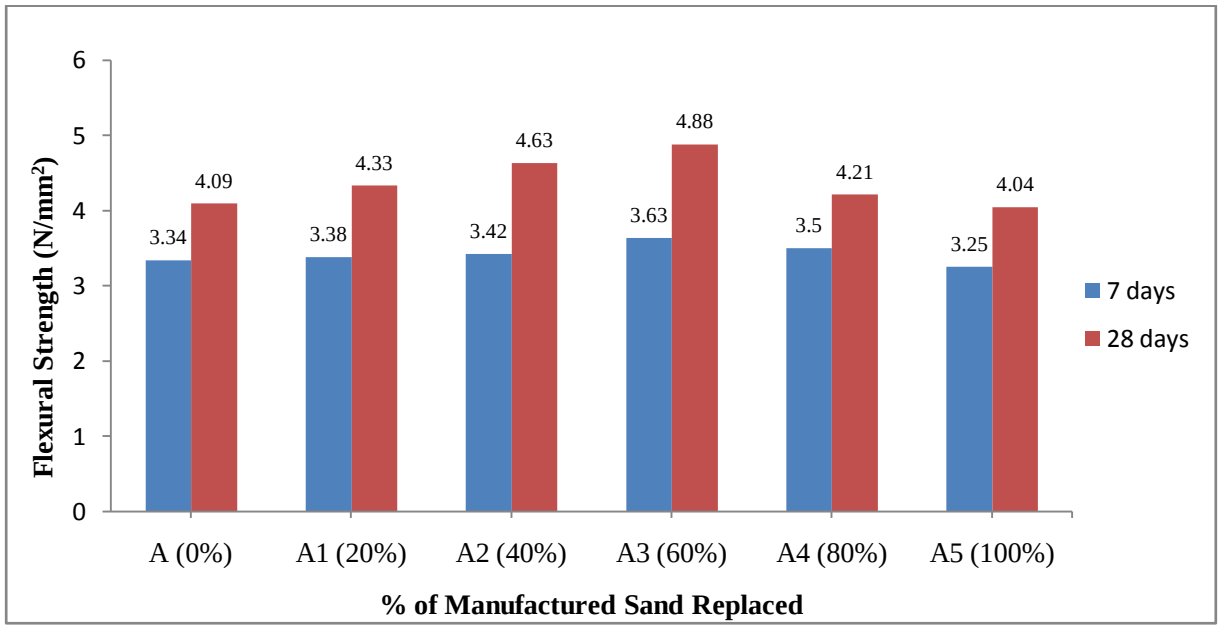

Fig 4.7: % Variation of Manufactured Sand v/s Flexural Strength With 0% Admixture For 7 Days & 28 Days

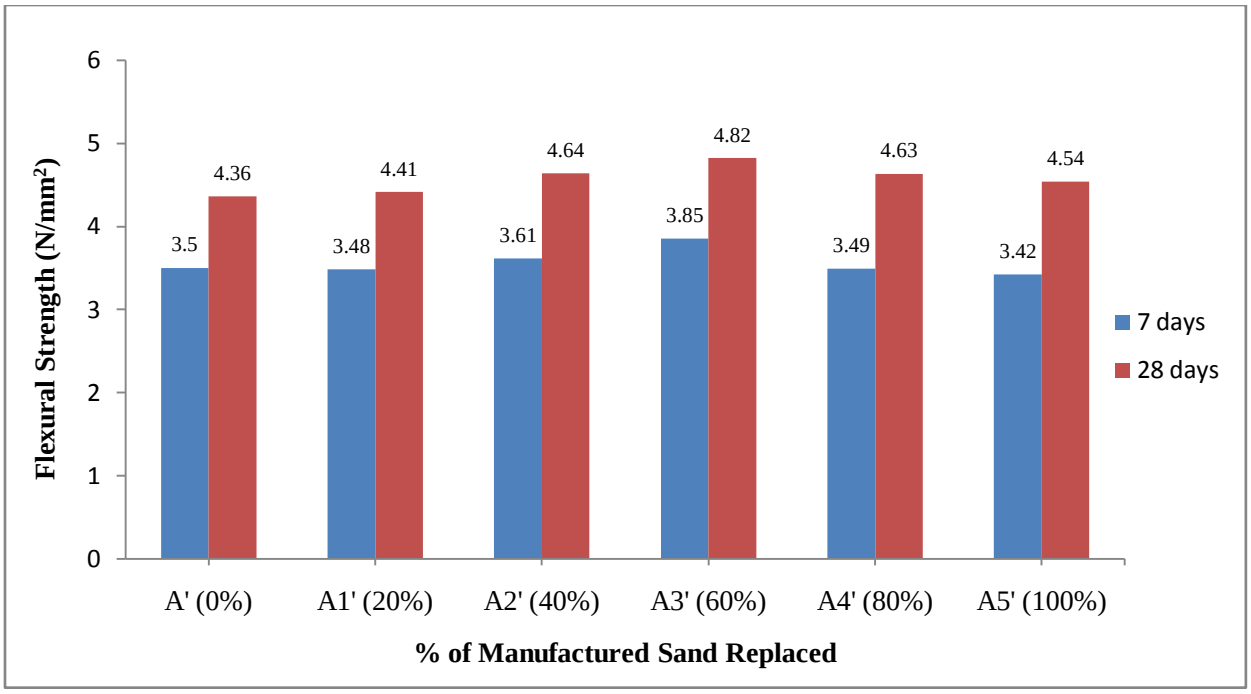

Fig 4.8 : % Variation of Manufactured Sand v/s Flexural Strength With 1.0% Admixture For 7 Days & 28 Days

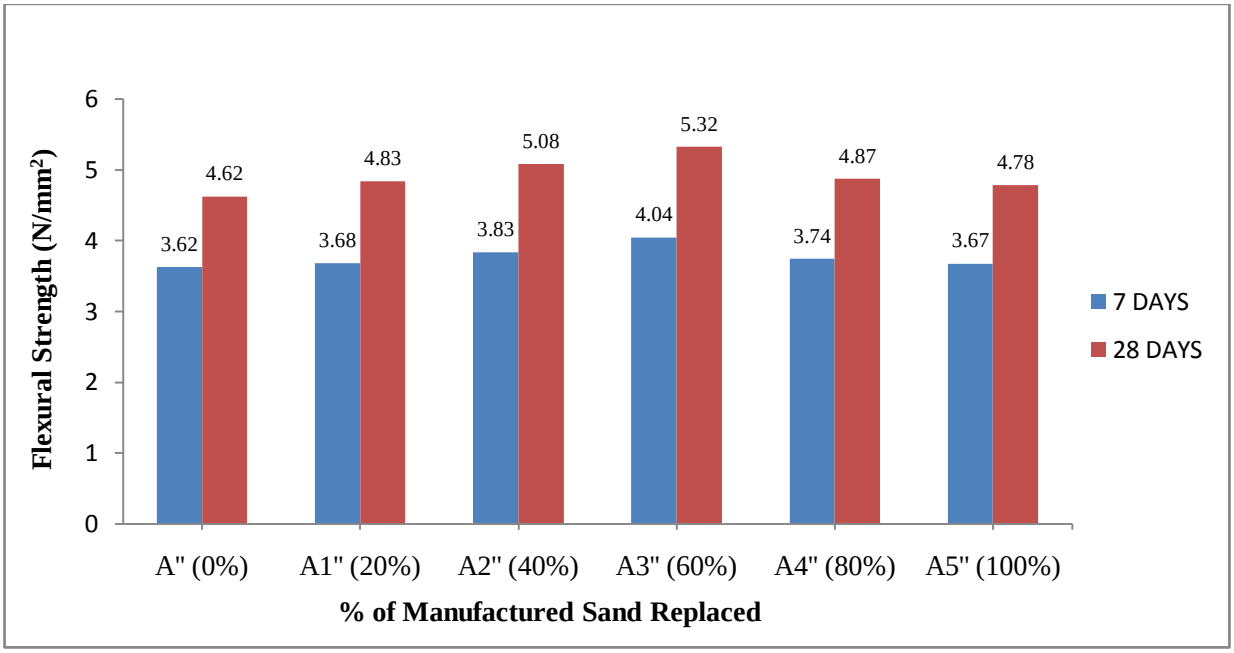

Fig 4.9: % Variation of Manufactured Sand v/s Flexural Strength With 1.50% Admixture For 7 Days & 28 Days

Figure 4.1 to 4.9 represents compressive, split tensile & flexural strength test results after 7 days and 28 days of curing period i.e. with the replacement of natural sand by manufactured sand with 0%, 1.0% & 1.50% dosage of admixture. For all tests, Strength is maximum when 1.50% admixture dosage is used with combination of 40% NS & 60% MS.

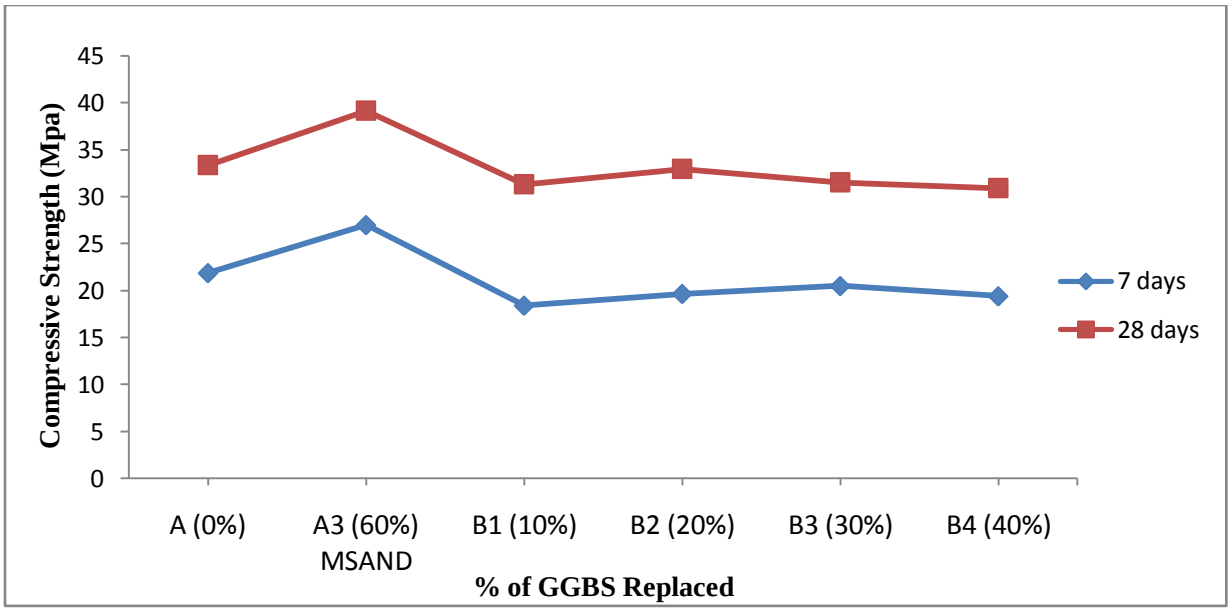

Fig 4.10 : % Variation of GGBS v/s Compressive Strength With 0% Admixture For 7 Days & 28 days

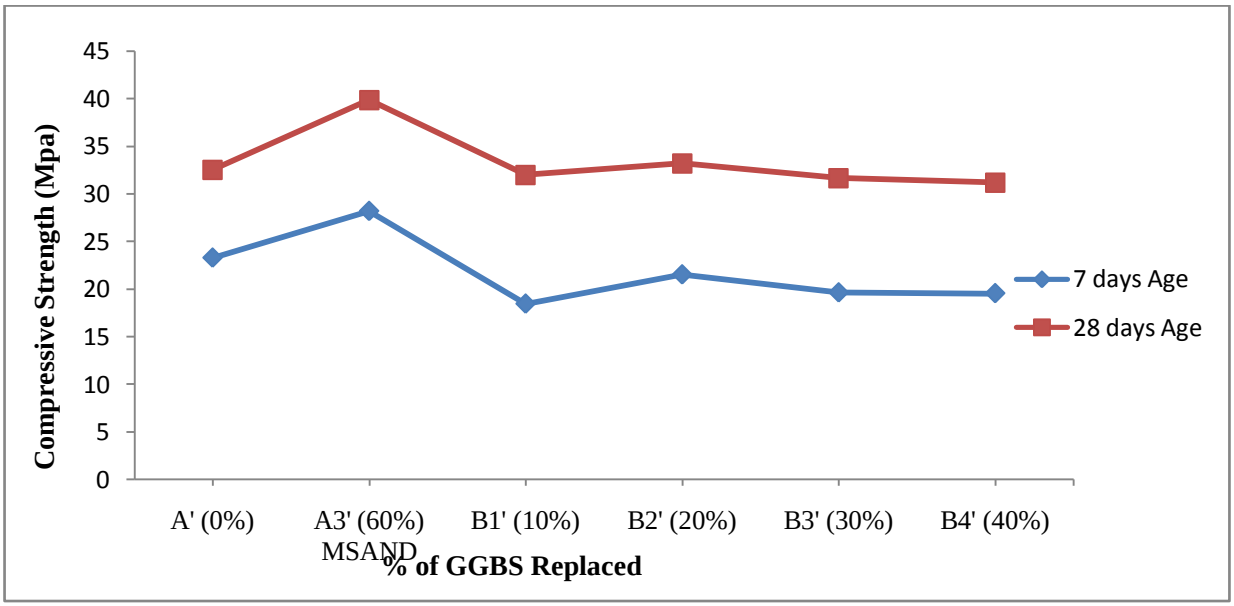

Fig 4.11 : % Variation of GGBS v/s Compressive Strength With 1.0% Admixture For 7 Days & 28 days Curing

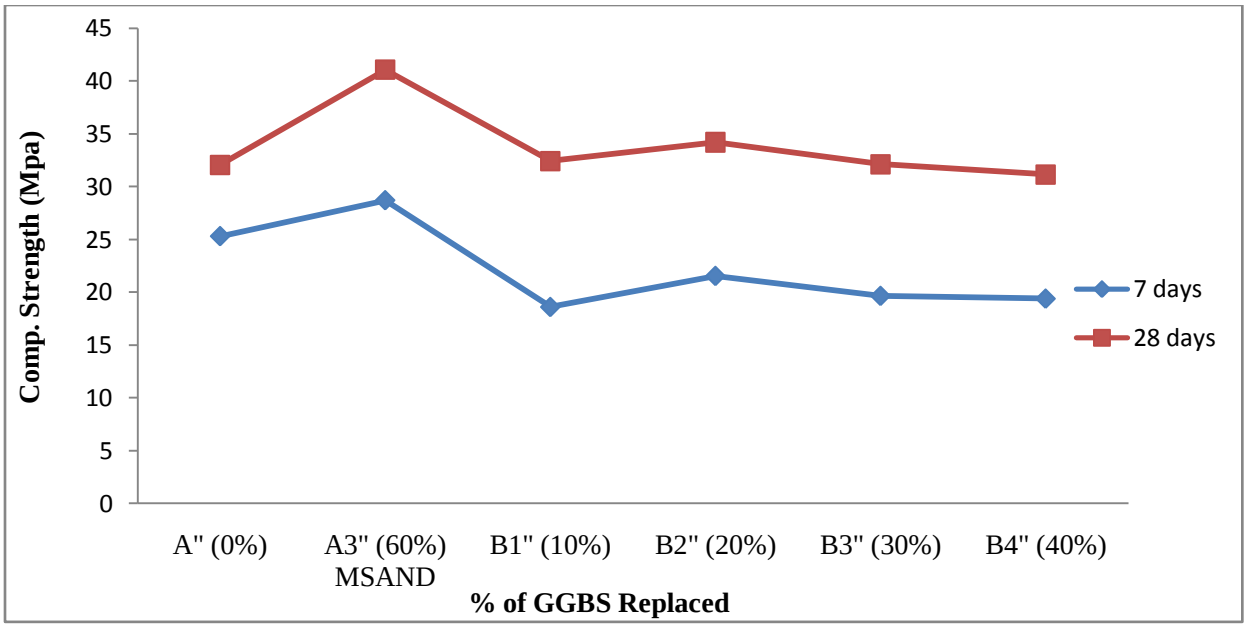

Fig 4.12 : % Variation of GGBS v/s Compressive Strength With 1.50% Admixture For 7 Days & 28 days Curing Period

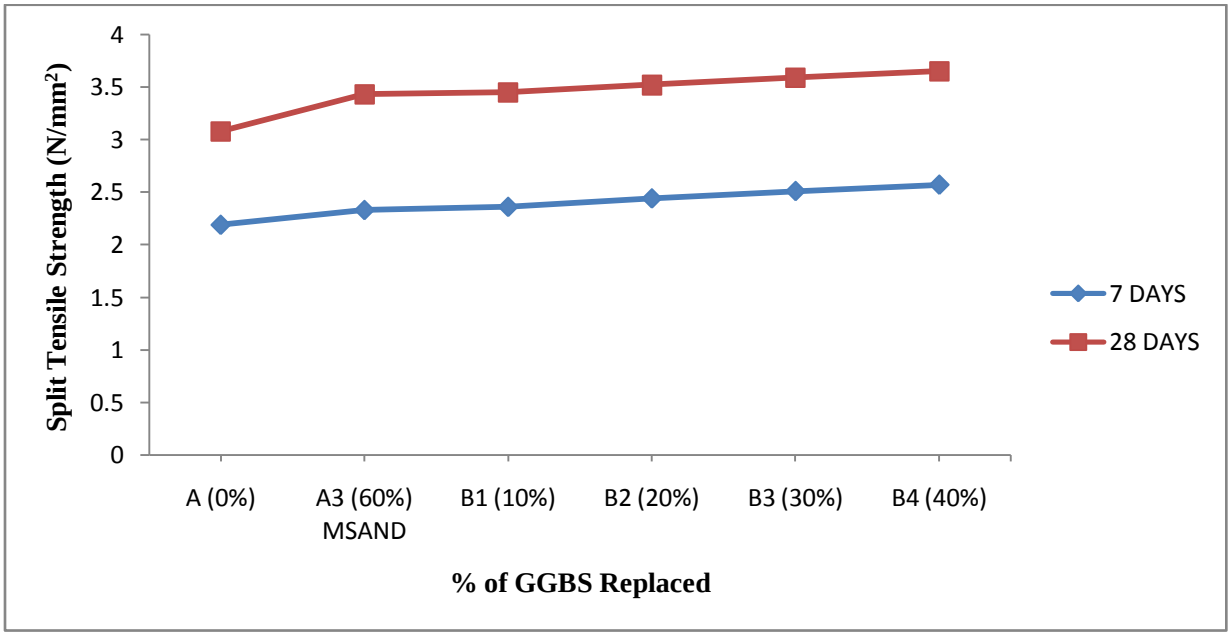

Fig 4.13 : % Variation Of GGBS v/s Split Tensile Strength With 60% Msand As Constant & 0% Admixture For 7 Days & 28 Days Curing

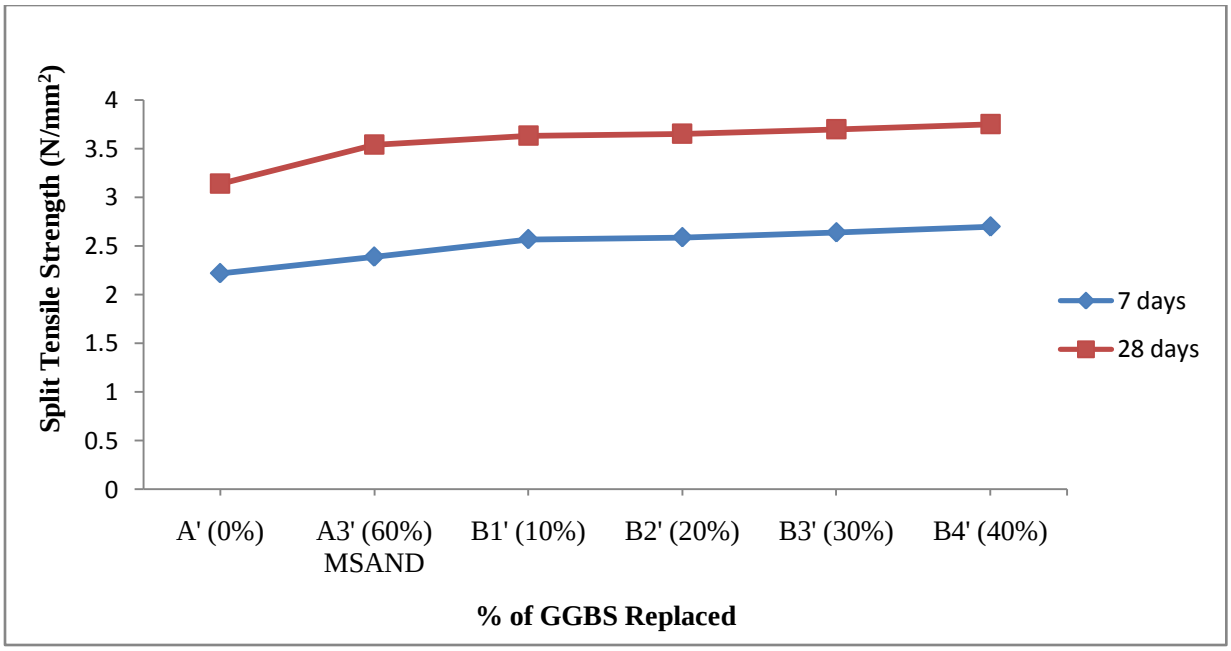

Fig 4.14 : % Variation Of GGBS v/s Split Tensile Strength With 60% Msand As Constant & 1.0% Admixture For 7 Days & 28 Days Curing Period

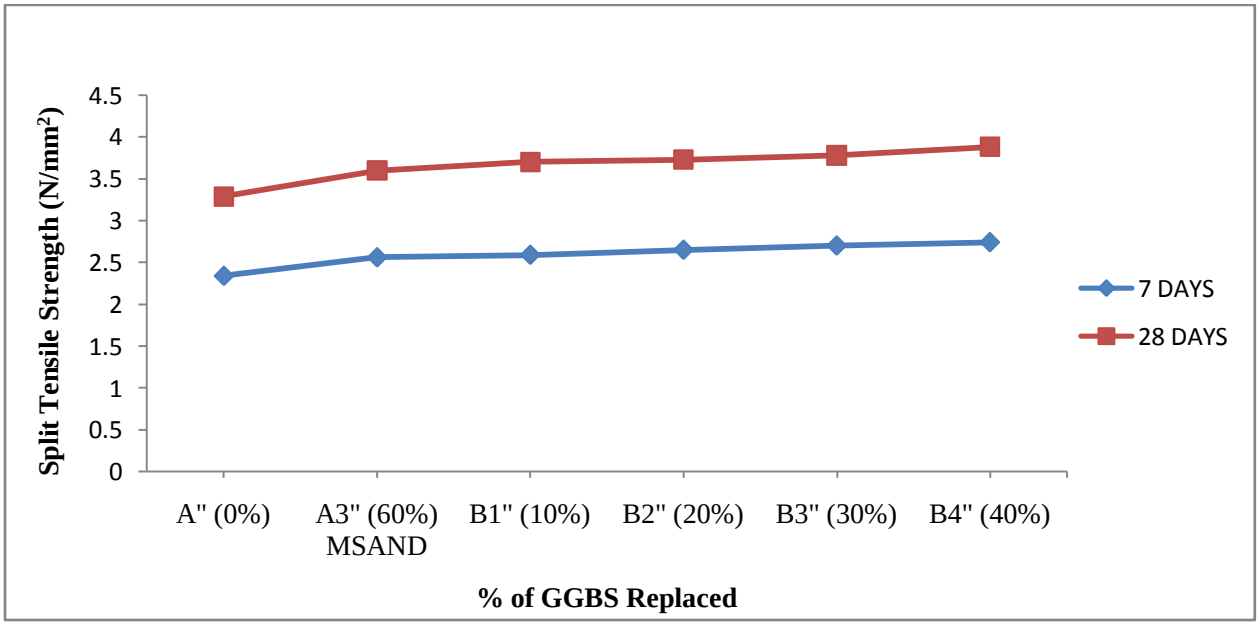

Fig 4.15 : % Variation Of GGBS v/s Split Tensile Strength With 60% Msand As Constant & 1.50% Admixture Dosage For 7 Days & 28 Days Curing Age

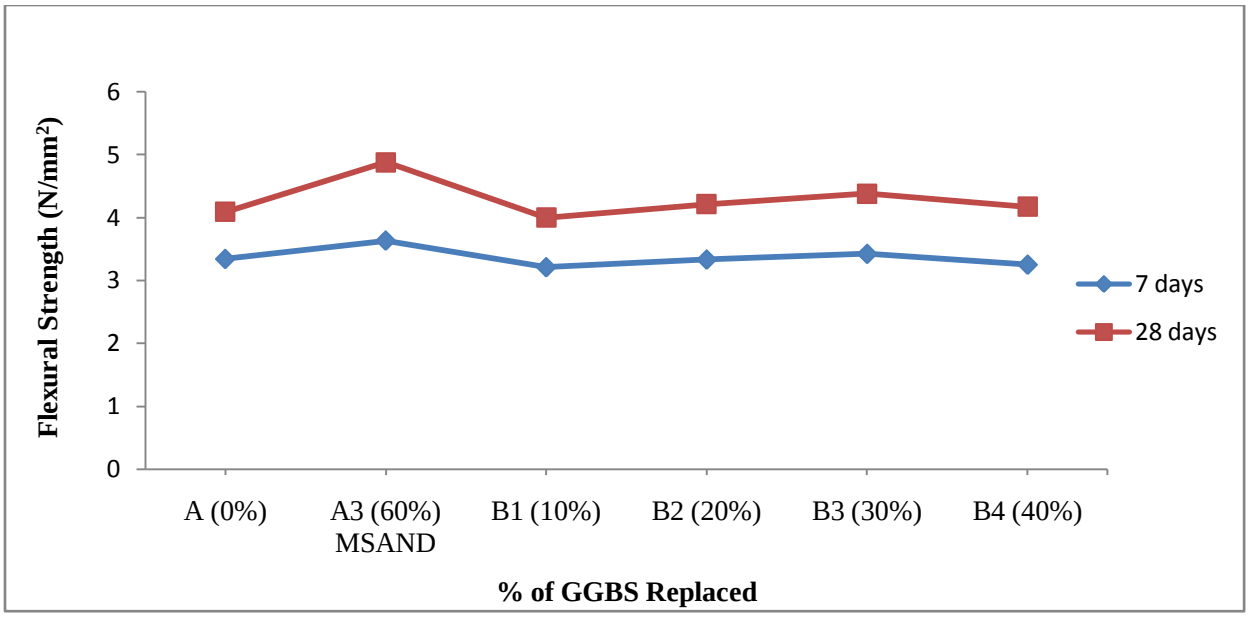

Fig 4.16 : % Variation of GGBS v/s Flexural Strength With 0% Admixture For 7 Days & 28 Days Curing

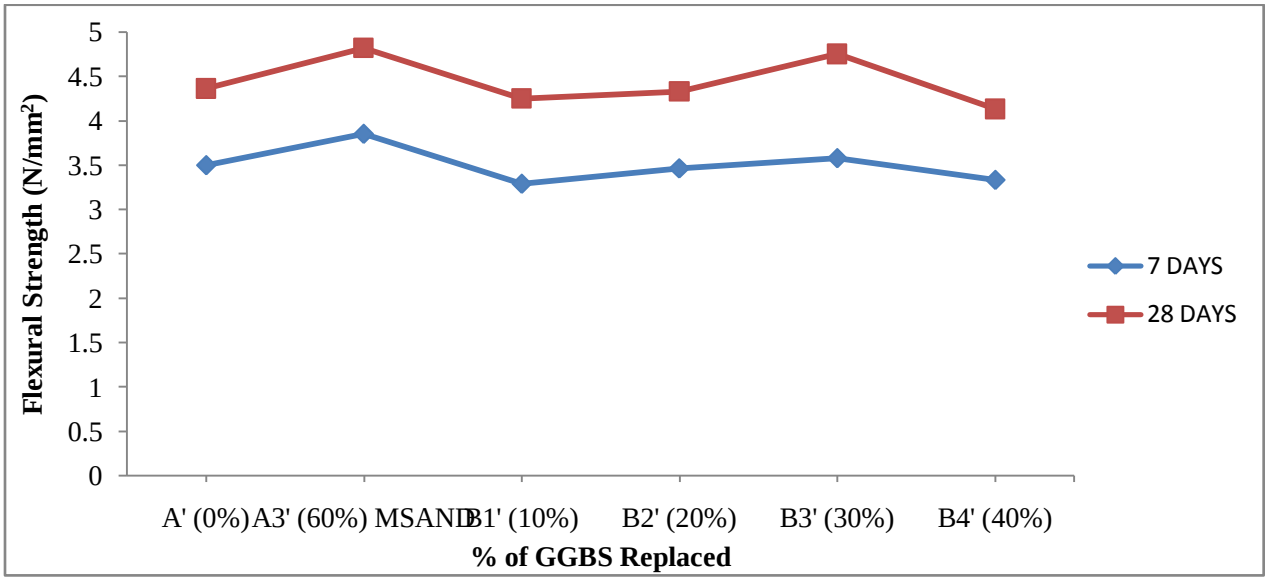

Fig 4.17 : % Variation of GGBS v/s Flexural Strength With 1.0% Admixture For 7 Days & 28 Days Curing

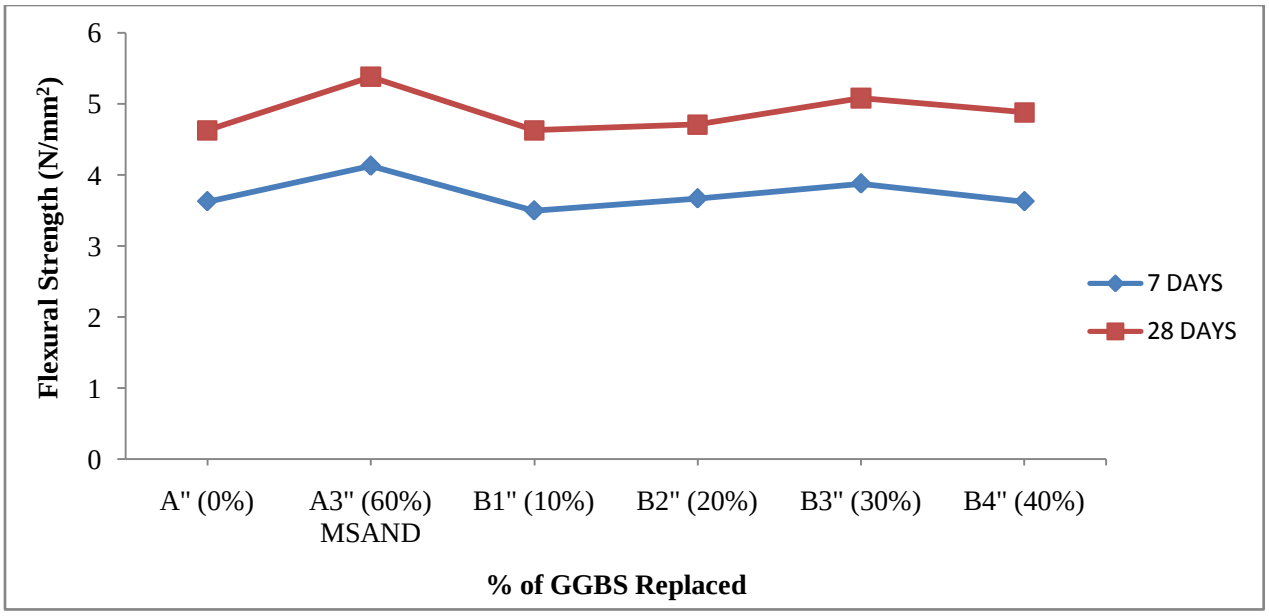

Fig 4.18 : % Variation of GGBS v/s Flexural Strength With 1.50% Admixture For 7 Days & 28 Days Curing Period

From Figure 4.10 to 4.18 represents compressive strength, split tensile strength & flexural strength with variation of GGBS for 0%, 1.0% & 1.50% dosages of admixture. We can observe that strength of concrete increases as the dosage of admixture increases.

V. Conclusion

Based on the results obtained above, the following conclusion is drawn

1. Compressive strength of concrete increases with increase of percentage of Manufactured sand upto certain limit.
2. Compressive strength of concrete increases with increase in dosage of admixture.
3. M30 grade Concrete acquires maximum compressive strength for 60% replacement of natural sand by manufactured sand and for 1.5% dosage of admixture.
4. Split tensile strength of concrete increases upto certain limits, when natural sand is replaced with manufactured sand and then decreases.
5. Split tensile strength of concrete is max, when cement is replaced with 40% of GGBS & 60% of natural sand replaced with manufactured sand for max admixture dosage.
6. Flexural strength of concrete is maximum, when natural sand is replaced with 60% of Msand for 1.50% admixture dosage.
7. Flexural strength will be max. if 30% of cement is replaced with GGBS by keeping 60% of M sand as constant replacement for fine aggregates.
8. Comp. strength of concrete for 0% admixture is 39.16 Mpa and for 1.50% dosage is 41.06 Mpa. It shows that, as the dosage of admixture increases, compressive strength also increases.
9. Split tensile strength of concrete is 3.65 & 3.88 N/mm² after 28 days of curing for 1.50% of admixture content.
10. From the above investigation, it is revealed that manufactured sand can be used as an alternative to natural sand.
11. & cement can be partially replaced with ground granulated blast furnance slag.

Acknowledgement

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