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Experimental Study on Perfomance of Concrete with Concrete Waste and GGBS

E.Nainar* S. Sahaya Pravin and Khekiye Aye

Assistant professor, Department of Civil Engineering, St. Joseph University, Nagaland - 797115, India.

ABSTRACT

In India, recent years construction and demolished concrete waste handling and management is the challenging issue faced by several area. Due to strict environmental laws and lack of dumping sites in urban areas, demolished waste disposal is a great problem. It is desirable to recycle demolished concrete waste in order to protect natural resources and reduce environmental pollution's in this research, an attempt has been made to assess the suitability of M_{25} grade concrete with partial replacement of coarse aggregate with concrete waste and cement with GGBS in concrete making.Experimental tests to be conducted in the concrete by casting cubes, cylinders. The compressive strength was observed to increase by about 25%-30%. The percentage replacement of GGBS and concrete waste for cement and coarse aggregate are about 10%,20%,30%,40%,50%.Advantage of using GGBS and concrete waste as follow, Costsaving Environment protection and Reduces corrosion.

KEYWORDS: Ground Granulated Blast Furnace Slag (GGBS), Demolished concrete, Compressive Strength, Split Tensile Strength, and Workability.

*Corresponding Author

E. Nainar

Assistant Professor,

Department of Civil Engineering,

St. Joseph University,Nagaland- 797115.

Email id: enainar@gmail.com

Contact No. 9578367665

1. INTRODUCTION

The main aim of our studies high volume replacement of Coarse aggregate and cement in concrete by Waste concrete and GGBS and to study work ability and compressive strength of concrete which is the one of the most important fundamental properties of concrete. For determining the compressive strength of M_{25} grade concrete, replaces the cement and coarse aggregate use in waste concrete and GGBS from 10% to 50% at an interval of 10% and the obtaining results are compared with conventional concrete. Aggregate is one of the main ingredients in producing concrete. It covers 75% of the total for any concrete mix. The strength of the concrete produced is dependent on the properties of aggregates used. However, the construction industry is increasingly making higher demands of this material and is feared to accommodate the many requests at one time. Hence need for an alternative coarse aggregate arises. The aim for this project was to determine the strength and durability characteristics of high strength structural concrete by using recycled coarse aggregates, which will give a better understanding on the properties of concrete with recycled aggregates. The scope of this project was to investigate the possibility of using low cost recycled coarse aggregates as an alternative material to coarse aggregate in high strength structural concrete. The experimental investigation were carried out using detailed strength and durability related tests such as compressive strength test of cubes, split tensile strength test of cylinders, modulus of elasticity tests acid resistance test, test for saturated water absorption and porosity. The tests were conducted by replacing the coarse aggregates in high strength concrete mixes by 0, 10, 20, 30, 40 and 50% of recycled coarse aggregates. A 50% replaced mix with reduced w/c ratio was also tested. From the experimental investigation it was found that recycled coarse aggregates can be used for making high strength concretes by adjusting the w/c ratio and admixture contents of the mix.[1]

Concrete is a mixture of cement, fine aggregate, coarse aggregate and water. Concrete plays a vital role in the development of infrastructure Viz., buildings, industrial structures, bridges and highways etc. leading to utilization of large quantity of concrete. High Performance Concrete (HPC) is a concrete meeting special combinations of performance and uniformity requirements that cannot be always achieved routinely by using conventional constituents and normal mixing. This leads to examine the admixtures to improve the performance of the concrete. On the other side, cost of concrete is attributed to the cost of its ingredients which is rare and expensive, this leading to usage of economically alternative materials in its production. This requirement is drawn the attention to explore new replacements of ingredients of concrete. The present paper focuses on investigating characteristics of M_{30} concrete with partial replacement of cement with Ground Granulated Blast furnace Slag(GGBS) and sand with the sand. The cubes and cylinders are tested for both compressive and tensile strengths. It is found that by the partial replacement of cement with GGBS and sand with sand helped in improving the strength of the concrete substantially compared to normal mix concrete.[2]

Based on the present and experimental investigation studies the following conclusions can be drawn

1. Compressive strength of concrete can be improved by using admixtures.
2. The percentage of increase in the compressive strength are 19.64 and 8.03% at the age of 7 and 28 days and the percentage of increase in the split tensile strength is 1.83% at the age of 28 days, by replacing 30% of aggregate with 1.5% admixture.
3. GGBS can be used as one of the alternative material for the cement.
4. From the experimental results 50% of cement can be replaced with GGBS.

2.MATERIALS AND METHODS

2.1. Cement

- Aggregate
  - I. Fine aggregate
  - II. Coarse aggregate
- Water
- Concrete waste
- GGBS (Ground Granulated Blast Furnace Slag)

2.2. Mineral Admixture

It is defined as a material, other than cement, water and aggregate; it is used as an ingredient of concrete and is added before or during mixing. The replacement of cement with natural Pozzolanic binders is common. Pozzolanic cementious material. Mineral admixtures make mixture more economical, reduce permeability, and increase strength, so we use GGBS as a mineral admixture.

2.3 GGBS

Ground Granulated Blast Furnace slag (GGBS) is a by- product of steel manufacture industry. Ground granulated blast furnace slag (GGBS) is a by-product from the blast-furnaces used to make iron. These operate at a temperature of about 1,500 degrees centigrade and are fed with a carefully controlled mixture of iron-ore, coke and limestone. The iron ore is reduced to iron and the remaining materials form a slag that floats on top of the iron. This slag is periodically tapped off as a molten liquid and if it is to be used for the manufacture of GGBS it has to be rapidly quenched in large volumes of water. The quenching, optimizes the cementitious properties and produces granules similar to a coarse sand. This 'granulated' slag is then dried and ground to a fine powder.

Figure 1. Ground Granulated Blast Furnace slag

2.4 Concrete waste

In India, recent years construction and demolished concrete waste handling and management is the challenging issue faced by several area. Due to strict environmental laws and lack of dumping sites in urban areas, demolished waste disposal is a great problem. It is desirable to completely recycle demolished concrete waste in order to protect natural resources and reduce environmental pollution. The present investigation to be focused on recycling demolished waste materials in order to reduce construction cost and resolving housing problems faced by the low income communities of the India. The crushed construction and demolished concrete wastes is segregated by sieving to obtain required sizes of aggregate, several tests were conducted to determine the aggregate properties before recycling it into new concrete.

Figure 2.Concrete waste

2.5 Super-plasticizer

Conplast SP430 is a chloride free, super plasticising admixture based on selected sulphonated naphthalene polymers. It is supplied as a brown solution which instantly disperses in water. It is added to give the workability and to reduce the water absorption.

Figure3. SP430

3. RESULTS AND DISCUSSION

The usage of GGBS in the concrete for construction will reduce the production of cement and thus CO_2 emission in atmosphere will also get reduced.10%, 20% and 30% 40% 50%of the cement was replaced by GGBS and coarse aggregate was replaced by waste concrete and tested (**Table.1,2, 3,4, 5,6**). Out of which 30% of the cement replaced by GGBS powder and coarse aggregate replaced by waste concrete provides compressive and tensile strength slight higher to the conventional concrete.

The present study focuses on the structural behavior of reinforced concrete beam with Ground Granulated Blast furnace Slag (GGBS).It is an inexpensive replacement of Ordinary Portland Cement (OPC) used in concrete, and it improves fresh and hardened properties of concrete. Experimental investigation included testing of eight reinforced concrete beams with and without GGBS. Portland cement was replaced with 40% GGBS and GleniumB233 was used as super plasticizers for the casting of beams. The results of laboratory investigation on the structural behavior of reinforced concrete beams with GGBS are presented. Data presented include the load-deflection characteristics, cracking behavior, strain characteristics and moment- curvature of the reinforced concrete beams with and without GGBS when tested at 28 days and 56 days. The investigation revealed that the flexural behavior of reinforced GGBS concrete beams is comparable to that of reinforced concrete beams. [2]

On the basis of our comparative analysis of test results of the basic properties of concrete with three different percentages of coarse recycled aggregate content (0%, 50% and 100%), the following conclusions are made. The way of preparing recycled aggregate for concrete mixtures influences the concrete workability: workability of concrete with natural and recycled aggregate is almost the same if water saturated surface dry‖ recycled aggregate is used. Also, if dried recycled aggregate is used and additional water quantity is added during mixing, the same workability can be achieved after a prescribed time. Additional water quantity depends on the time for which the same workability has to be achieved. It is determined as water quantity for which the recycled aggregate absorbs for the same period of time. Bulk density of fresh concrete is slightly decreased with increasing quantity of recycled aggregate. The type of coarse aggregate has no influence on the air content in concrete. Concrete compressive strength mainly depends on the quality of recycled aggregate. The modulus of elasticity of concrete also decreases with increasing recycled aggregate content as a consequence of lower modulus of elasticity of recycled aggregate compared to natural aggregate. Shrinkage of concrete depends on the amount of recycled concrete aggregate. Concrete with more than 50% of recycled coarse aggregate has significantly more shrinkage compared to concrete with natural aggregate. Increased shrinkage is a result of the attached mortar and cement paste in the recycled aggregate grains. The bond between recycled aggregate concrete and reinforcement is not significantly influenced by recycled concrete aggregate, because it is realized through new cement paste.[3]

The experiment proves that cement is replaced by GGBS and coarse aggregate is replaced by waste concrete can be used as partial replacement of cement& coarse aggregate in concrete. The reuse of the slag is helped to protect the environment from pollution.[3-8].

4. CONCLUSION

The suitability of M_{25} grade concrete with partial replacement of coarse aggregate with concrete waste and cement with GGBS in concrete making. Experimental tests to be conducted in the concrete by casting cubes, cylinders. The compressive strength was observed to increase by about 25%-30%. The percentage replacement of GGBS and concrete waste for cement and coarse aggregate are about 10%,20%,30%,40%,50%. Advantage of using GGBS and concrete waste as follow, Cost saving Environment protection and Reduces corrosion.

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Table1: Mix 1 (0%) Ordinary Concrete

Specimen	Area (mm^2)	Max load in KN	Compressive strength in N/mm^2
Cube	150 x 150	680	30.22
Cylinder	17672	230	3.25

Table 2: Mix 2 (10%) { 10% GGBS + 10 % waste concrete }

Specimen	Area (mm^2)	Max load in KN	Compressive strength in N/mm^2
Cube	150 x 150	620	27.56
Cylinder	17672	210	2.97

Table 3: Mix 3 (20%) { 20% GGBS + 20 % waste concrete }

Specimen	Area (mm^2)	Max load in KN	Compressive strength in N/mm^2
Cube	150 x 150	660	29.33
Cylinder	17672	225	3.18

Table 4: Mix 4 (30%) { 30% GGBS + 30 % waste concrete }

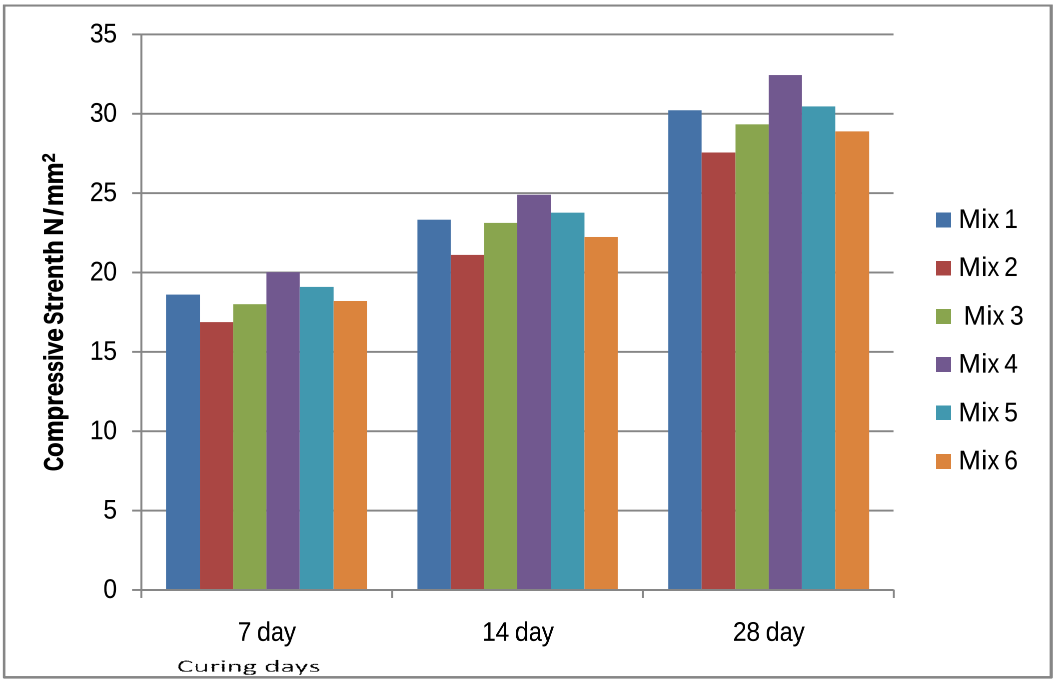
Specimen	Area (mm^2)	Max load in KN	Compressive strength in N/mm^2
Cube	150 x 150	730	32.44
Cylinder	17672	245	3.46

Table 5: Mix 5 (40%) { 40% GGBS + 40 % waste concrete }

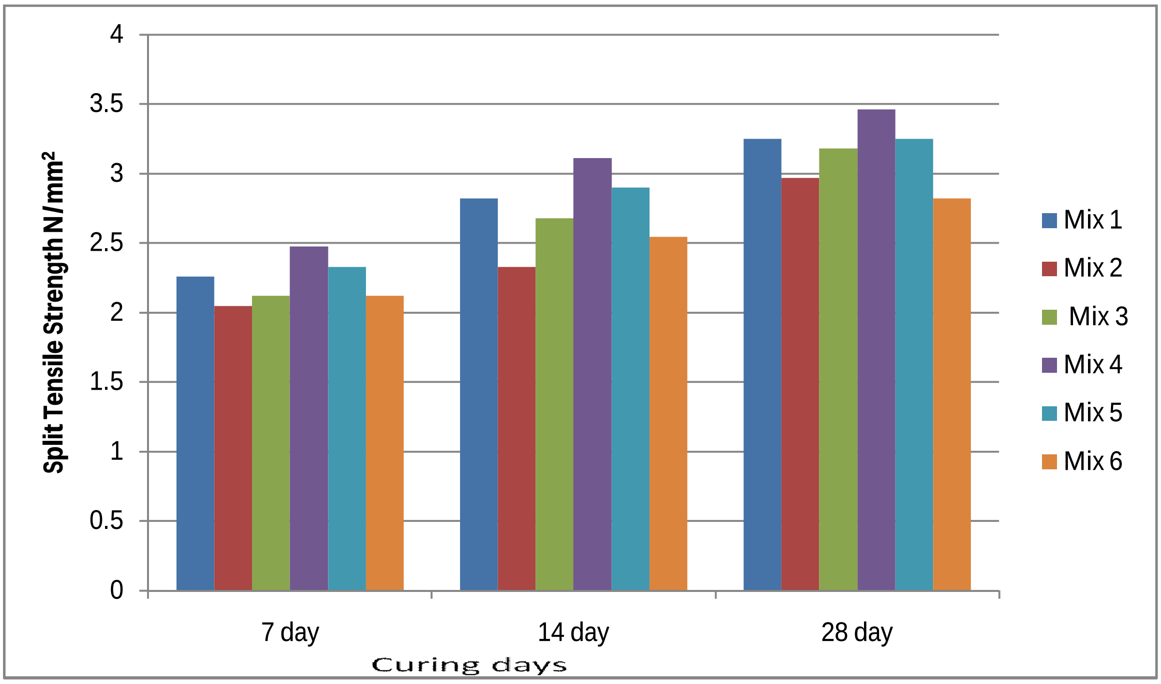
Specimen	Area (mm^2)	Max load in KN	Compressive strength in N/mm^2
Cube	150 x 150	685	30.44
Cylinder	17672	230	3.25

Table: 6 Mix 6 (50%) { 50% GGBS + 50 % waste concrete }

Specimen	Area (mm^2)	Max load in KN	Compressive strength in N/mm^2
Cube	150 x 150	630	28.89
Cylinder	17672	200	2.82



Graph 1: Comparison of Compressive Strength for 7, 14 and 28 days



Graph 2: Comparison of Split tensile strength for 7, 14 and 28 days