International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue 09
August 2017

A Study on Properties of Concrete by Partial Replacement of Concrete with Ggbs and Fly Ash

[1] RELANGI SAI KRISHNA SUPRETHA, [2]Dr.D.VENKATESWARLU, [3]Ms.DIVYA ANUSHA NAIDU

[1]Pg Scholar, Godavari Institute Of Engineering & Technology, Rajahmundry

[2]Professor& HOD , Department of Civil Engineering , Godavari Institute Of Engineering & Technology, Rajahmundry

[3]Assistant Professor, Department of Civil Engineering Godavari Institute Of Engineering & Technology, Rajahmundry

ABSTRACT:

Concrete is playing a significant role in the growth of infrastructural and industrial segments for many decades. But concrete is not an environmentally-friendly material due to its destructive resource consuming nature. The basis of this research is to investigate the effects of using recycled materials in varying amounts on the fresh and hardened properties of concrete. The recycled materials used in this study are Ground granulated blast furnace slag (GGBS) and recycled concrete aggregates. GGBS was used as partial cement replacement and recycled aggregates as replacement for fine and coarse aggregate. The basic properties of natural and recycled aggregate were determined. The mix design was done to obtain a concrete mix (control mix) of grade M40. Mixes were prepared by replacing 40, 50 and 60% of natural aggregates with recycled aggregates. Then its fresh and mechanical properties were determined along with control mix. From test results concrete with 50% replacement of aggregate with recycled aggregates shows adequate strength compared to control mix. Mixes were prepared by replacing 40, 50 and 60% of cement with GGBS together with 50% replacement of recycled aggregates. From test results concrete with 40% and 50% replacement of cement with GGBS together with 50% replacement of recycled aggregates shows adequate strength compared to control mix.

Keywords – Fine aggregate; Recycled Aggregates; Ground Granulated Blast Furnace Slag.

INTRODUCTION Concrete which is the most versatile material for construction, is playing a significant role in the growth of infrastructural and industrial segments.

Presently annual worldwide concrete production is about 12 billion tones. Aggregates have been readily available at economic prices and of qualities to suit all purposes. But now a days the cost of aggregates have risen fastly over the past few years. Production of cement emits CO2 in a harmful manner. About 7% of the world's CO2 emission is attributed to Portland cement industry. Also large amount of natural resources like lime stone, clay etc… is required for its production. That is concrete is not an environmentally-friendly material due to its destructive resource consuming nature. It will, however, remain the major construction material being used worldwide. Using recycled concrete from old demolished structure as a replacement to aggregates is a good practice to conserve natural aggregates. Another practical solutions to conserve natural resources is to use supplementary cementitious material such as fly ash, slag, silica fume etc… as a replacement to cement thereby the microstructure, mechanical and durability characteristics of concrete can be improved. In this study a sustainable concrete is proposed which consists of substantial amount of supplementary cementitious material as a replacement to cement and recycled aggregate instead of natural aggregates. Ground granulated blast furnace slag is used as the supplementary cementitious material. A demolished stair case which is of about 23 years old is recycled and used in the place of coarse and fine aggregate. The mix proportion is to be done to obtain a M40 grade concrete. Mixes with different contents of Recycled aggregates (40%, 50% and 60%) as replacement to natural aggregates is examined and GGBS (40%, 50% and 60%) as replacement to cement is examined. The conventional mix and other mixes are to be tested for the fresh, mechanical and durability properties. The results are then compared with the conventional mix. The main objective of this project is to find how effectively supplementary cementitious material (GGBS) and Recycled coarse and fine aggregate can be combined together and the optimum percentage of replacement of recycled concrete aggregates to natural aggregates and GGBS to cement. The strength and durability properties of concrete are also to be studied for various replacement percentages of GGBS and Recycled aggregate.

A. Recycled Concrete Aggregates Construction and demolitions are processes that go hand in hand. The demolished building rubble in India generally goes to waste in landfills. After few years construction and demolition waste will be more than half of the national total waste in most countries of the world. Recycling of these concrete waste materials from demolished building can provide a solution to this problem. Landfills are becoming increasingly difficult to find, are too remote from the demolition site, or are too costly to maintain. At the same time sources of supply of suitable aggregate for making concrete are continuously being exhausted. The recycling of demolished building demolition waste materials into new buildings can provide a solution to these problems. Recycling is the act of processing the used material for use in creating new product. In order to reduce the usage of natural aggregate, recycled aggregate can be used as the replacement materials. Recycled aggregate are comprised of crushed, graded inorganic particles processed from the materials that have been used in the constructions.

B. Ground Granulated Blast Furnace Slag (GGBS) Ground granulated blast furnace slag, limestone powder, fly ash and silica fume are successfully used in concrete as a cement replacement which are cement saving, energy saving and cost saving and moreover cause environmental and socioeconomic benefits. Blast furnace slag is a nonmetallic byproduct produced in the process of iron making (pig iron) in a blast furnace and 300kg of Blast furnace slag is generated when 1 ton of pig iron produced. Blast furnace slag is mildly alkaline and exhibits a pH in solution in the range of 8 to 10 and does not present a corrosion risk to steel in pilings or to steel embedded in concrete made with blast furnace slag cement or aggregates. GGBS is used to make durable concrete structures in combination with ordinary Portland cement. GGBS concrete has slightly slower strength development at early ages. At 7 days GGBS concretes will have 50 to 60% of its characteristic strength compared. At 28 days GGBS concrete may fully develope its characteristic strength and will continue to develop strength past 90 days. It is good practice to make 56 day cubes when using GGBS concrete at 50% and above should there be any concern over later strength development.

2.LITERATURE REVIEW:

[1] Basil Johny et al studied the properties of sustainable concrete using slag and recycled concrete aggregates. GGBS was replaced for 40%, 50% and 60% of cement and optimum

percentage was found out. For the mixes prepared by replacing 50% cement with slag and 50% coarse aggregate, it satisfies the strength criteria required for an M30 mix

[2] M L Berndt studied the properties of sustainable concrete containing fly ash, slag and recycled concrete aggregates by replacing cement by a percentage of fly ash or slag and natural aggregates by recycled concrete aggregates. The mixes containing 50% slag gave best overall performance

[3] Md Shakir Ahmed et al studied the strength of concrete with percentage replacement in natural coarse aggregate (NCA) with recycled concrete aggregates (RCA) for M20 mix concrete. The strength of concrete decreases as the percentage of RCA increases.

[4] S Arivalagan used GGBFS at various replacement levels and evaluated its efficiencies for M35 mix at different ages. M35 mix concrete is considered to perform the test by-weight basis by replacing 20%, 30% and 40% of cement by GGBS. It was observed that GGBS-based concretes have achieved an increase in strength for 20% replacement of cement at the age of 28 days.

3.SCOPE OF WORK

From the literature review it is observed that attempts made only either GGBS or fly ash is replaced alone with cement or aggregate but research has not done by replacing GGBS with cement and fly ash with fine aggregate simultaneously.

Hence, the experimental program going to be undertaken investigates:

1. To determine properties of the GGBS and fly ash
2. Mix proportioning for replacement materials.
3. To investigate mechanical properties of concrete such as Compressive strength, Split tensile strength, Modulus of Elasticity, Flexural strength of GGBS and fly ash blended concrete in comparison with ordinary concrete.
4. To arrive the optimal percentage of replacement by those materials.

4.MATERIALS

Cement

As per requirements, 53 grade ordinary Portland cement confirming to IS 8112:1989 will be used.

Aggregates

According to the requirements coarse and fine aggregates confirming to IS 383:1970 will be used.

GGBS and Fly Ash

This is one of the cementitious materials using in our research program. The GGBS, Fly ash is locally available and the tests were carried out as per IS: 1727-1967.

Water

The water used for casting and curing purpose is free from organic impurities and its pH value lies between 6 and 8.

Tests of Fine aggregate and Coarse aggregate

The following tests conducted on coarse and fine aggregates

1. Grading of aggregates
2. Bulk density of aggregate in loose state and rodded state
3. Specific gravity

5.Mix Design Procedure

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative properties with the object of producing concrete of certain maximum strength and durability as economically as possible.

5.1.Factors affecting the choice of mix proportions

The various factors affecting the mix design are:

(a) Compression Strength:

It is one of the important properties of concrete and influences may other describable properties of the hardened concrete. The mean compression strength required at a specific age, usually 28days, determines the nominal water-cement ratio of the mix. The other factor affecting the strength of concrete at a given age and cured at a prescribed temperature is the degree of compaction. According to Abhram's law the strength of fully compacted concrete is inversely proportional to the water-cement ratio.

(b) Workability:

The degree of workability required depends on three factors. They are size of the section to be concreted, the amount of reinforcement, and the method of compaction to be used. For the narrow and complicated section with numerous corners or inaccessible parts, the concrete must have a high workability so that full compaction can be achieved with a reasonable amount of effort. The desired workability depends on the compacting equipment available at the site.

(c) Durability:

The durability of concrete is its resistance to the aggressive environmental conditions. High strength concrete is generally more durable than low strength concrete.

In the situations when the high strength is not necessary but the conditions of exposure are such that high durability is vital, the durability requirement will determine the water-cement ratio.

(d) Maximum Nominal size of Aggregate:

In general, larger the size of aggregate, smaller is the cement requirement for a particular water-cement ratio, because the workability of concrete increases with increase in maximum size of the aggregate. However, the compression strength tends to increase with the decrease in size of aggregate.

(e) Grading and type of aggregate:

The grading of aggregate influences the mix proportions for a specified workability and water-cement ratio. Coarser the grading leaner will be the mix which can be used. Very lean mix is not desirable since it does not contain enough finer material to make the concrete cohesive. The type of aggregate influences strongly the aggregate-cement ratio for the desired workability and stipulated water-cement ratio. An important feature of a satisfactory aggregate is the uniformity of the grading which can be achieved by mixing different size fractions.

International Journal of Research
Available at
https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue 09
August 2017

TEST RESULTS AND DISCUSSIONS

The Testing of hardened concrete plays an important role in controlling and confirming the quality of cement concrete works. One of the purposes of testing hardened concrete is to confirm that the concrete used at site has developed the required strength. As the hardening of concrete takes time, one will not come to know, the actual strength of concrete for some time. This is an inherent disadvantage in conventional test.

Casting and Curing of Specimens

For ordinary concrete, fine aggregate and cement were weighed and mixed thoroughly; the coarse aggregate was then added and mixed with the above. The required amount of water was added and mixed thoroughly to get uniform concrete mass. When admixtures added first it thoroughly mixed with sand and then added with cement and mixed it properly.

For preparing the specimen for determining the compressive, tensile, flexural strength and Young’s modulus, permanent steel moulds of standard size were used. The fresh concrete was filled in mould. Care should be taken to see that the concrete was compacted perfectly. All the moulds were demoulded after 24 hours of casting and curing.

Tests on Hardened Concrete

The tests conducted on hardened concrete are tabulated below.

Table : Tests on Hardened Concrete

S.No	Experiment	IS Code
1	Compressive Strength	IS:516-1959
2	Splitting Tensile Strength	IS:516-1959
3	Modulus of Elasticity	IS:516-1959
4	Flexural Strength	IS:516-1959

Compressive Strength of Concrete

Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform, and partly because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. The compression test is carried out on specimens cubical or cylindrical in shape. The cube specimen is of the size 15 X 15 X 15 cm.

The compressive strength of concrete was carried out conforming to IS: 516-1959. Steel moulds of size 150mmx150mmx150mm were used to cast concrete. For each replacement ratio six cubes were casted to obtain the strength at 7 days and 28 days respectively. The test result is in table 4.2.1(a)

CONCLUSION:

From the Literature review available a conclusion can made that

•GGBS replaced cement up to 40-50% will increase its strength, durability properties, chemical resistance.

•Fly ash replaced with sand also improves the mechanical properties and durability, chemical resistance properties of concrete when replaced with optimum percentages

The hardened properties of concrete gets enhanced by partially replacing with cement with GGBS, sand with Fly ash separately and combinely. Based on the experimental investigations the following conclusions are drawn.

1.Compressive strength, splitting tensile strength, flexural strength, and modulus of elasticity improves when compared with conventional concrete in both the cases.

•When fly ash replaced with sand alone.

•GGBS replaced with cement and fly ash replaced with sand.

2.The maximum compressive strength, split tensile strength, flexural strength are maximum for 30% Fly ash (F2) replaced with sand.

3.By considering cost and strength parameters two mixes to be considered as optimal & economical i.e., F2 , G2F2

4.The % decrease in cost for both F2 and G2F2 for 1m3 concrete is about 1.4% and 4.96% respectively.

5.Therefore, by considering the results of the investigation suggests that mixes, F2 (30% Fly Ash replaced with sand), G2F2 (30% GGBS replaced with cement and 30% fly ash replaced with sand) could be conveniently used in structural concrete.

REFERENCES

[1] Anand Kumar B .G. "Effective Utilization of Fly Ash and Supplementary Cementitious Materials in Construction Industry", Journal of Advanced Technology in Civil Engineering, pg 107-114

[2] Ganesh Babu. K, Sree Rama Kumar. V, "Efficiency of GGBS in concrete", Journal of cement and concrete composites, science direct, pg: 1031-1036

[3] Gengving Li,Xiaohuazhao, "Properties of concrete incorporating Fly ash and GGBS slag", Journal of cement and concrete composites, science direct, pg:293-299

[4] IS 10262:2009 Concrete Mix proportioning-Guidelines, BIS 2009

[5] IS: 456:2000 Plain And Reinforced Concrete -Code Of Practice, BIS 2000

[6] M.S.Shetty, "Concrete Technology", S.Chand & Company Ltd, 2009

[7] Martin O Connell, Ciaran McNally, Mark G. Richardson, "Performance of concrete incorporating GGBS in aggressive wastewater environments", Journal of Construction and Building Materials, Science Direct, pg 368-374

[8] Murali Lal Gambhir, "Concrete Technology", McGraw Hill Education (India) Pvt. Ltd, 2013

[9] Oner. A , Akyuz. S, "An experimental study on optimum usage of GGBS for the compressive strength of concrete", Journal of Cement & Concrete Composites, Science Direct , pg no:505-514

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue 09
August 2017

[10] Ozkan Sengul, Mehmet Ali Tasdemir, "Compressive Strength and Rapid Chloride Permeability of Concretes with Ground Fly Ash and Slag", Journal of materials in civil Engineering, ASCE, pg 494-501