International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

CONCRETE BLOCKS BY REPLACEMENT OF RECYCLED AGGREGATES AND PARTIAL REPLACEMENT OF CEMENT BY GGBS

Shambhavi Shirur[1], Sushma M J[2], Prateeksha K N[3] K M Pavitra[4]

[1]*SHAMBHAVI SHIRUR, Student, Dept of civil Engineering*
[2]*SUSHMA M J, Student, Dept of civil Engineering*
[3]*PRATEEKSHA K N, Student, Dept of civil Engineering*
[4]*K M PAVITRA, Student, Dept of civil Engineering*
[5]*MANJUNATH M, Professor, Dept. of Civil Engineering, S. T. J. Institution of technology, Karnataka, India*
[6]*D S MAGANUR, H.O.D, Dept. of Civil Engineering, S. T. J. Institution of technology, Karnataka, India*

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.*

***Key Words*: Fine aggregate; Recycled Aggregates; Ground Granulated Blast Furnace Slag; compression strength; split tensile strength.**

1. INTRODUCTION

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

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.

Ground Granulated Blast Furnace Slag

Ground Granulated Blast Furnace Slag (GGBS) is a recyclable material created when the molten slag from melted iron ore is quenched rapidly and then ground into a powder. This material has cementitious properties and has been used as a replacement for cement for over 100 years. Recently, Wisconsin has begun using it in some of its highway projects. Wisconsin has experienced several problems with GGBS, which include slow strength gain and decreased surface quality. Countering these problems, GGBS concrete has higher late strength and lower permeability. This project investigates these GGBS characteristics and has several objectives. Ground Granulated Blast Furnace Slag (GGBS) is a byproduct of the steel industry.

Uses of GGBS

The major use of GGBS is in ready mixed concrete, and it is utilized in a third of all UK, ready-mix‟ deliveries. Specifies are well aware of the technical benefits, which GGBS imparts to concrete, including:

Better workability, making placing and compaction easier.

Lower early age temperature rise, reducing the risk of thermal cracking in large pours.

Elimination of the risk of damaging internal reactions such as ASR

High resistance to chloride ingress, reducing the risk of reinforcement corrosion

High resistance to attack by sulphate and other chemicals

Considerable sustainability benefits.

Value engineering benefits

Recycled concrete aggregates reduce the need for virgin aggregates. This in turn reduces the environmental impact of the aggregate extraction process.

Produce specification sized recycled aggregates at any given location.

Avoid haul-off costs and landfill disposal fees.
Eliminate the expense of aggregate material imports and exports.

Minimize impact to community infrastructure by reducing import and export trucking.

2. AIMS and Objectives

OBJECTIVES:

To find out the ways of cost saving such as transportation and excavation etc

To carry out the different tests on cement, fine aggregate, recycled aggregates, natural (coarse) aggregates.

To carry out the test on blocks made by recycled aggregates and partial replacement of cement by GGBS

3. STUDY AREA

- The enormous quantities of demolished concrete are available at various construction sites.
- Many old buildings, concrete pavements, bridges and other structures have overcome their age and limit of use due to structural deterioration beyond repairs and need to be demolished.
- The structures, even adequate to use are under demolition because they are not serving the needs in present scenario.
- Structures are turned into debris resulting from natural disasters like earthquake, cyclone and floods etc.
- New construction is required for better economic growth.

4. LITREATURE REVIEW

[1] Jayalakshmi Nair and Basil Johny (2016): have study about the effects of using recycled materials in different quantity with concrete and GGBS on control of design of M40. From these test results concrete with 40% and 50% replacement of cement with GGBS together with 50% replacement of recycled aggregates shows adequate strength compare to control mix. The maximum compressive strength of 28 days cubes is 49.33N/mm^2. For 50% recycled aggregates used.

[2] M Manjunath and K Prakash (2016): also study on effect if supplementary cementious materials on strength of recycled aggregates concrete. The study was based of reference concrete mix of grade M20 using natural aggregates and partially replacement of coarse aggregates by recycled aggregates. The maximum compressive strength of 28 days cubes is 28.37N/mm^2 for 0% recycled aggregates used and 10% GGBS replacement of cement.

[3] S K Singh (2013): As per research work compare some of the mechanical properties of recycled aggregate concrete with the natural aggregate concrete. The two different mix proportions of characteristic strength of 20N/mm^2 (M20) and 25 N/mm^2 (M25) commonly used. The proportions of the ingredients constituting the concrete mixes are 1:1.5:2.9 and 1:1.2:2.4 with water cement ratio 0.50 and 0.45 respectively for M20 and M25

grade concrete.

[4] S D Thanvi and Alok Kumar (May 2016): Aim of the study is to evaluate the performance effect the concrete of mineral admixture such as silica fume and fly ash has mineral admixture in concrete. when it is mixed in cement concrete for workability, durability and strength o f concrete using OPC (43 grade) this study investigates the performance of concrete under influence of silica fume and fly ash in terms of slump, compressive strength for 7 days and 28 days, flexural strength of beam is 28 days and splitting tensile strength of cylinder for 28 days respectively.

5. MATERIALS

Ordinary Portland cement: OPC of 53 grade cement was used throughout the coarse of investigation. Specific gravity of cement is 3.15.
Fine aggregate: The River sand is used as fine aggregate confirming to the requirement of IS456-2000 having specific gravity of 2.62 and fineness modulus of 2.86 has been used as fine aggregate for this study.
Coarse aggregate: it is obtained from local quarry in its. Has been used for the study, confirming to IS 456 – 2000 is used. Maximum Size of aggregate use is 20mm with specific gravity of 2.707.
Ground Granulated Blast furnace Slag (GGBS): GGBS a co product produced simultaneously with iron, molten blast furnace slag is cooled instantaneously by quenching in large volume of cold water, known as granulation, to produce granulated blast furnace slag.
Water: the water used for experiments was portable water confirming as per IS456-2000

6. METHODOLOGY

Methodology part involves following stages:
Collection of scrap aggregates from the site

1. Laboratory analysis of aggregate samples.
2. Design mix for M30 grade concrete.
3. Casting and testing of concrete cubes.
4. Comparison of strength and discussion.

Specimens:

Cubes of size 150x150x150mm, cylinders of size 300x150mm are to be casted for testing compressive strength, and splitting tensile strength of corresponding mixes. Age of the specimens for compressive strength is 7 and 28 days and splitting tensile strength is 7 and 28 days.

Mix design for M 30 grade concrete as per IS: 10262 – 1982

❖ **Stipulations for proportioning**

1. Grade designation : M 30
2. Type of cement : OPC 53 grade conforming IS: 8112 – 1989
3. Maximum nominal size of aggregate: 20 mm (Table 5 of IS: 456 – 2000)
4. Maximum water-cement ratio: 0.41 (Table 5 of IS: 456 – 2000)
5. Exposure condition: Severe
6. Method of concrete placing: Conventional
7. Degree of supervision: Mild
8. Type of aggregate: Crushed angular aggregate
9. Chemical admixture type: Conplast sp430

❖ **Test data for materials**

❖ Cement used: OPC 53 grade conforming IS: 8112 – 1989

❖ Specific gravity of cement : 3.125

❖ Chemical admixture : Conplast sp430

❖ Specific gravity of
- Coarse aggregate : 2.67
- Fine aggregate : 2.66

- Water absorption
  - Coarse aggregate : 0.6%
  - Fine aggregate : 1.0%

MIX PROPORTION RATIO: 1:2.3:3.7

Mix grade	M30
Mix designation	CM
w/c	0.41
Cement (kg)	34.216
Fine aggregate (kg)	159.2
Coarse aggregate (kg)	239.76
Super plasticizer (kg)	1.24

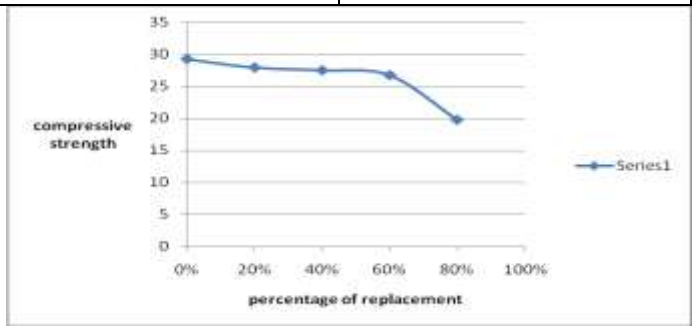
TEST ON CONCRETE

***A.* Fresh Properties**

i) Slump test

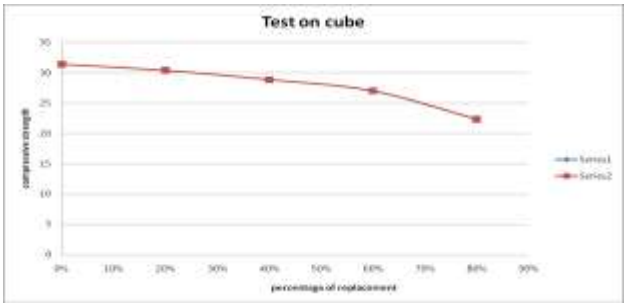
ii) Compacting factor test

Percentage (%)	Compressive Strength (N/mm2)
0	29.27
20	27.94
40	27.50
60	26.75
80	19.75



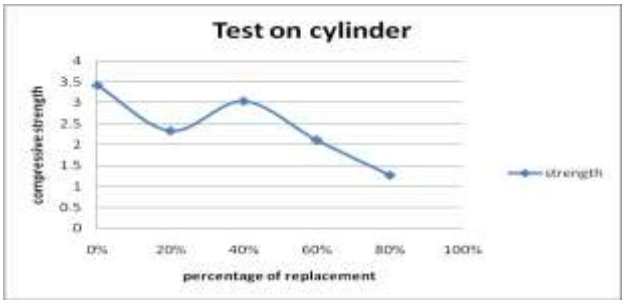
7 Days curing

Percentage (%)	Compressive strength(N/mm^2)
0	31.41
20	30.38
40	28.87
60	27
80	22.33



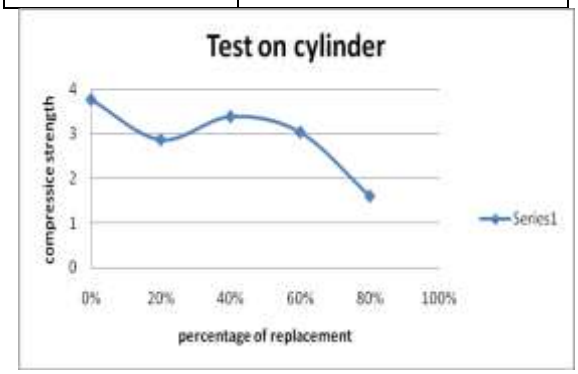
28 Days curing

Percentage (%)	Compressive Strength
0%	3.42
20%	2.33
40%	3.04
60%	2.11
80%	1.27



7 Days curing

Percentage (%)	Compressive Strength
0%	3.77
20%	2.87
40%	3.39
60%	3.04
80%	1.61



28 Days curing

7.CONCLUSION

The following conclusion may be drawn based on the observation made in the experimentation

- Slump test and compaction factor test were conducted to find out the workability of concrete. All the mixes used for the study shows adequate workability.
- When mixes were made by replacing 20, 40, 60% coarse aggregate with recycled coarse aggregate, 60% RCA mix shows good results in terms compressive strength, and splitting tensile strength.
- When mixes were prepared by replacing 20, 40, 60% cement with GGBS together with 60 RCA, 40% and 60% replacement of cement with GGBS shows a better result in terms of compressive strength. Even though the values are lesser than that of CM, it meet the requirement of M30 grade concrete.

8. REFERENCES

1. Basil Johny, prof. M V George, Dr. Elson John, study of properties of sustainable concrete using slag and recycled concrete aggregates, international journal of research engineering and technology, Vol-3-issue-9, September 2014.
   M L Berndt, Properties of Sustainable Concrete containing fly ash, slag and recycled concrete aggregate, Construction and Building Material, 2009.
2. Tushar R Sonawane, Use of recycled aggregate in concrete, International Journal of Engineering Research & Technology, Vol. 2 Issue 1, January-2013.
3. S. Gangaram, V. Bhikshma, M. Janardhana, Strength and durability aspects of recycled aggregate concrete, International Journal of Research in Engineering and Technology, Vol. 3 Special Issue 13, December-2015.

Authors

Shambhavi Shirur
Student,
Dept of civil Engineering
S T J I T Ranebennur
Email:-
shambhavi.shirur76@gmail.com

Prateeksha K N
Student,
Dept of civil Engineering
S T J I T Ranebennur
Email:-
prateekshakn1997@gmail.com

Sushma M J Student,
Dept of civil Engineering
S T J I T Ranebennur
Email:- jalisushma@gmail.com

K M Pavitra
Student,
Dept of civil Engineering
S T J I T Ranebennur
Email:- kmpavitra430@gmail.com