International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 07 | July 2019 www.irjet.net p-ISSN: 2395-0072

AN EXPERIMENAL STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE WITH GRANITE SLURRY AND CEMENT WITH GGBS

Kavya B R[1], Chandrashekar A R[2]

[1]Post Graduate in Structural Engineering, BIET College, Davanagere-577004, India
[2]Asst. Professor, M. Tech Structural Engineering, BIET College, Davanagere

---

Abstract - *The increase in the number of industries leads to the production of waste materials which were harmful to the environment. So to avoid this, industrial waste materials are used to replace the ingredients of the concrete during its preparation. The most commonly used fine aggregate is river sand. River sand is expensive because of its scarcity. So some alternatives have to found for river sand. Granite slurry is the waste material generated from the granite industry. The granite slurry is replaced to the fine aggregate at an interval of 10%, 15%, 20%, 25% and 30%. And also in this investigation another waste material GGBS is used for replacing cement. GGBS is the waste material produced from the iron industry. GGBS is replaced at an interval of 10%, 20%, 30% and 40%. These replacements will reduces the quantity of materials and also protect the environment from the pollution. The main aim of this work is to study the increase in strength of concrete with the replacement of granite slurry for fine aggregate and GGBS for the cement and is compared to the conventional concrete.*

Key Words: Cement, Fine aggregate, Coarse aggregate, Ground granulated blast furnace slag, granite slurry

1.INTRODUCTION

Concrete is the most frequently used building material because of its capability to accept any shapes while wet and its strength development characteristics when it hardens. The term concrete refers to a mixture of fine aggregates and either gravel or crushed stone as coarse aggregate and are combined together using cement as binder material. Due to higher rate of progress in construction, the requirement of concrete is increased. Ordinary Portland cement is the most commonly used constructional materials. It is estimated that for the production of 1 tonne of cement about 1 tonne of carbon dioxide will released to the environment.

This will affect the atmosphere. So in order to reduce the pollution some alternatives for this cement has to be found. So, the cement is partially replaced with the industrial wastes like Ground Granulated Blast Furnace Slag, Fly ash, etc.

Fine aggregate is an important component of concrete, the most commonly used fine aggregate is natural river sand. The demand of natural river sand is high in developing Countries. The non-availability of satisfactory amount of ordinary river sand for making cement concrete is affecting the development of construction. In order to reduce the dependency on natural aggregates as the main source of fine aggregates in concrete, industrial wastes like granite powder is used in concrete mixture as a partial replacement of natural sand. It is one of the by-products in granite stone Cutting process.

This project describes the usage of the granite powder in concrete production as partial replacement of Fine Aggregate and Ground Granulated Blast Furnace as a partial replacement for cement.

2. MATERIALS AND THEIR PROPERTIES

2.1 MATERIAL USED

1. Cement
2. Coarse aggregate
3. Fine aggregate
4. Granite slurry
5. Ground granulated blast furnace slag
6. Water

2.2 CEMENT

Cement is the most important and common material which will helps in binding of aggregates with the help of water. The most commonly available Portland cement of 43-grade was used for the investigation. The tests conducted on cement are

Table- 1: Characteristics of Cement

Serial no.	Characteristics	Values
1.	Soundness value	1mm
2.	Initial setting time	45min
3.	Fineness	4%
4.	Specific gravity	3.15
5.	Standard consistency	30%

2.3 COARSE AGGREGATE

Crushed quarry stones are generally used as coarse aggregate. Locally available crushed coarse aggregates are used and the size of the coarse aggregate used in this work was 20 mm and 12.5 mm. the physical properties of the coarse aggregates are as follows.

Table- 2: Characteristics of Coarse aggregate

Serial no.	Characteristics	Values
1.	Water absorption	0.3%
2.	Specific gravity	2.60
3.	Water content	0.71%
4.	Bulk density	
I	Loose	$14KN/m^3$
II	Compacted	$16KN/m^3$

Fig-1: Coarse aggregate

2.4 FINE AGGREGATE

The fine aggregates are the naturally available river sand. In the present work the fine aggregate is collected from local sources. The river sand used in the work is conforming to zone II of Indian standard 383-1970 code book.

Table-3: Characteristics of Fine aggregate

Serial no.	Characteristics	Values
1.	Water absorption	1.35%
2.	Specific gravity	2.53
3.	Water content	0.29%
4.	Grading	Zone II
4.	Bulk density	
I	Loose	$14KN/m^3$
II	Compacted	$16KN/m^3$

2.5 GRANITE SLURRY

Granite belongs to igneous rock family. It is a waste obtained by cutting granite stone. Granite slurry is used as a partial replacement of fine aggregate. As the granite powder is very fine in nature will fill the voids formed while mixing the concrete.

Fig-2: Granite Powder

Table-4: Characteristics of Granite Powder

Serial no.	Characteristics	Values
1.	Specific gravity	2.562
2.	Fineness	11%
3	Water absorption	5.07%

2.6 GROUND GRANULATED BLAST FURNACE SLAG

Fig-3: Ground granulated blast furnace slag

GGBS is a by-product of iron manufacturing industry. Its chemical composition is similar to chemical composition of ordinary cement. It is used as a partial replacing material for cement. It is obtained from the iron manufacturing industry.

2.7 WATER

It is an important ingredient of concrete as it will participates in the chemical reaction with cement. water should be free from salts and impurities. In the present work water is required for mixing purpose and also for curing of moulds. Clean potable water free from salts should be used for mixing1concrete of various proportions.

3. EXPERIMENTAL INVESTIGATION

3.1 MIX DESIGN

1. Grade designation : M35
2. Type of cement : OPC 43
3. Min cement content : 320 kg/m^3
4. Maxi nominal size of aggregate: 20mm
5. Water cement ratio: 0.40
6. Workability : 75mm
7. Exposure condition : Mild
8. Type of aggregate : Crushed

Test data for materials

a. Cement used : OPC 53 grade b. Specific gravity of

1. Cement : 3.15
2. Coarse aggregate: 2.60
3. Fine aggregate : 2.53

Mix proportion

Cement : 340kg/m^3 Water : 136 liter Fine aggregate : 725.328 kg Coarse aggregate : 1216.17 kg Water cement ratio : 0.40
Ratio : 1:2.13:3.57:0.4

4. TESTING OF FRESH AND HARDENED CONCRETE

4.1 TESTING OF FRESH CONCRETE

1. SLUMP CONE TEST

To measure the workability of concrete slump test is carried. It gives an idea of water content to be added for concrete.

Fig-4: Slump cone test

Table-5: Slump Values

Mix	Slump Value in mm	Type of Slump
M1	72	True Slump
M2	65	True Slump
M3	68	True Slump
M4	70	True Slump
M5	69	True Slump
M6	65	True Slump
M7	68	True Slump
M8	69	True Slump
M9	72	True Slump
M10	70	True Slump
M11	69	True Slump

4.2TESTING OF HARDENED CONCRETE

1. Compressive strength test
2. Split tensile test
3. Flexural strength test
4. Water absorption test

5. RESULTS AND ANALYSIS

5.1 COMPRESSIVE STRENGTH

The size of cube is 150mmx150mmx150mm. The cubes were tested for 28 days curing and the compressive strength test is conducted on compression testing machine. The compressive strength for the conventional concrete was observed as 44.23N/mm^2 which increases to 48.55N/mm^2 with the replacement of 20% of GP for fine aggregate and 30% of GGBS for cement.

Compressive strength in (N/mm^2)
= Load / Area

Fig: 5.3 Compression Testing Machine

Table-6: Compressive Strength in concrete at 28 days

Serial no.	Mix proportion	Compressive strength(N/mm^2)
1.	M1	44.23
2.	M7	46.34
3.	M8	47.26
4.	M9	48.55
5.	M10	46.53
6.	M11	41.28

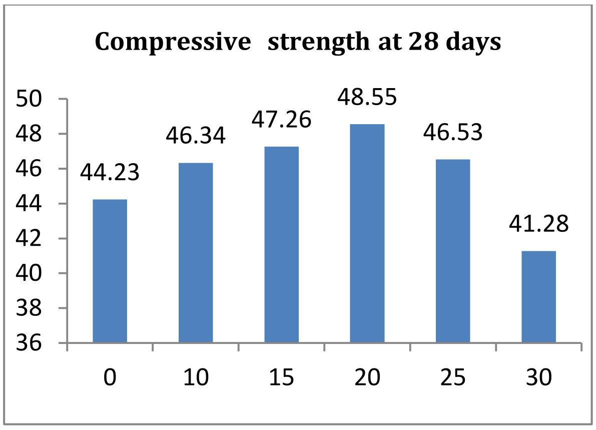

Chart-1: Compressive strength

5.2 TENSILE STRENGTH

The Cylinders were also tested for 28 days of curing. This test is also carried out in compression testing machine. It is necessary to test the split tensile to determine the load at which the concrete may crack. The dimension of the cylinder is 150mm diameter and 300mm length.

Fig: 5.4 Tensile strength Testing Machine

Tensile strength = $2P/\pi DL$ (N/mm^2)

P - Failure load
D - Diameter of the specimen
L – Length of the specimen

Table-7: Tensile strength in concrete at 28 days

Serial no.	Mix proportion	Tensile Strength(N/mm^2)
1.	M1	2.21
2.	M7	2.31
3.	M8	2.37
4.	M9	2.42
5.	M10	2.08
6.	M11	2.32

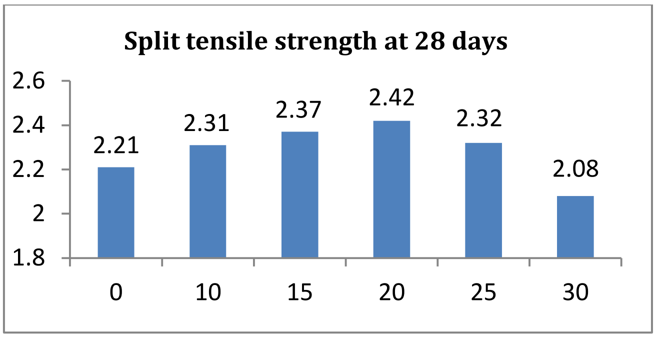

Chart-2: Split tensile strength

5.3 FLEXURAL STRENGTH

For beams also the curing is done for 28 days and the sizes of the moulds were 500mmx 100mm x100mm. For testing of beams flexural strength is calculated.

Table-8: Flexural strength in concrete at 28 days

Serial no.	Mix proportion	Flexural Strength(N/mm^2)
1	M1	3.53
2.	M7	3.70
3.	M8	3.78
4	M9	3.88
5	M10	3.72
6.	M11	3.30

Flexural strength = $3Pa/bd^2$ (N/mm^2)
P – Load
a – Length of the specimen
b – Breadth of the specimen
d – Depth of the specimen

Fig-6: Flexural strength test

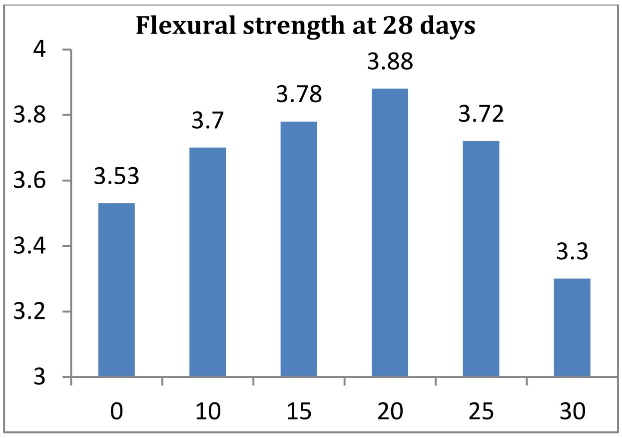

Chart-3: Split tensile strength

5.4. WATER ABSORPTION TEST

Water absorption test aids to determine the water absorption capacity of concrete. The saturated water absorption is given by the difference between the water saturated cube weight and the oven dry cube weight expressed as a percentage of oven dry cubes weight.

Water absorption (%) = ((W_W-W_D) / (W_D)) X 100

Where,

W_W = weight of specimen after immersing in water.

W_D = weight of oven dried specimen.

Table-9: Water absorption of concrete at 28 days

Mix proportio	Water Absorption (%)
M1	2.09
M2	1.69
M3	1.42
M4	1.62
M5	1.37
M6	1.47
M7	2.67
M8	1.25
M9	1.47
M10	1.35
M11	1.01

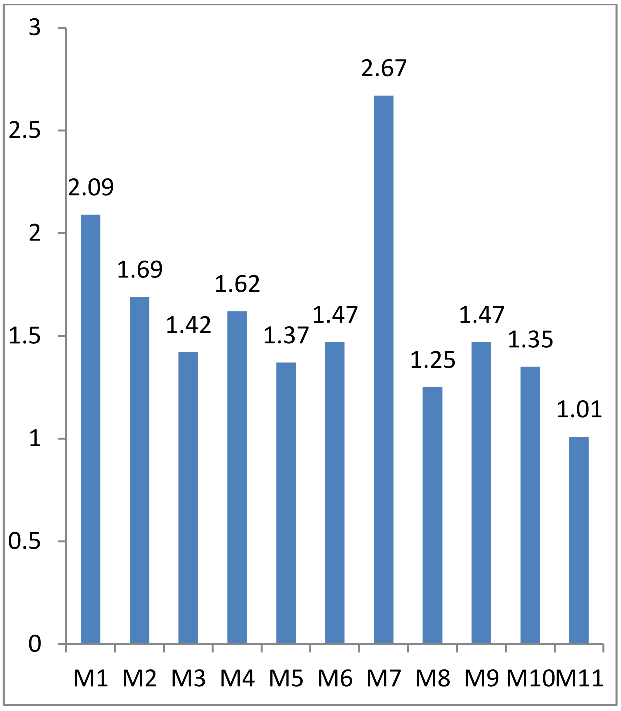

Chart-4: Water absorption

6. CONCLUSION

- The compressive strength of concrete with 20% of Granite slurry and 30% of GGBS is increased up to 9.76% compared to conventional concrete cubes.
- The Split tensile strength of the concrete with 20% of Granite slurry and 30% of GGBS is increased up to 9.50% compared to conventional concrete cylinder.
- The Flexural strength of concrete with 20% of Granite slurry and 30% of GGBS is increased up to 9.91% compared to conventional concrete.
- The optimum percentage of granite slurry is 20% and GGBS is 30%.
- The optimum water absorption is 1.01 which is obtained at 30% replacement of granite slurry and 30% of GGBS.

7. REFERENCES

1. A.Arivumangai, T. Felixkala, "Strength and Durability Properties of Granite Powder Concrete" Journal of Civil Engineering Research 2014.

2. Adigun Ema, Cost Effectiveness of Replacing Sand with Crushed Granite Fine in the Mixed Design of Concrete. IOSR Journal of Mechanical and Civil Engineering .2013; 10 (1): 01-06

3. Baboo Rai , Khan Naushad H , Abhishek Kr , Tabin Rushad S and Duggal S.K, "Influence of Marble powder/granules in Concrete mix", International Journal

of Civil and Structural Engineering, Vol 1, No 4, 2011, PP 827-834.

4. Divakar, "Experimental investigation on behaviour of concrete with the use of granite fines", International Journal of Advanced Engineering Research and Studies.

5. Felixkala T and Partheeban P, "Granite Powder Concrete", Indian Journal of science and Technology, Vol 3, no 3, mar 2010, PP 311-317.

6. Joel M. use of crushed granite fine as replacement to river sand in concrete production. Leonardo electronic journal of practices and technologies. Leonardo electronic journal of practices and technologies. 2010:17: p. 85-96

7. K.Kayathri, C. Vigneshkumar, M. Gohila Rani and K. Karthik "Effect of Copper Slag, Fly Ash and Granite Power as a Partial Replacement in Fine Aggregate" International Journal of Innovative Research in Science, Engineering and Technology Volume 3, Special Issue 5, July 2014.

8. Khan K. M. and Ghani U. (2004), "Effect of blending of Portland cement with the Ground granulated blast furnace slag on the properties of concrete".

9. Kefeng Tan and Xincheng PU, Strengthening effects of finely ground fly ash, granulated blast furnace slag and their Combination, Cement and Concrete Research, 28 (12), 1998, 1819 -1825.

10. Kefeng Tan and Xincheng P. U, Strengthening effects of finely ground fly ash, granulated blast furnace slag and their combination, Cement and Concrete Research, 28 (12), 1998, 1819 -1825.

11. Martin O'Connell, Ciaran M C Nally, and Mark G. Richardson (2012). "Performance of Concrete Incorporating GGBS in Aggressive Wastewater Environments". Construction and Building Materials, 27 (1), 368-374.

12. Shariq M, Prasad J, (2008), "Strength development of cement mortar and concrete incorporating GGBS", Vol. 9, No. 1, Asian Journal of civil Engineering.

13. Vijayalakshmi M, Sekar Ass, Prabhu G. G. Strength and durability properties of concrete made with granite industry waste. Construction and Building Materials.2013; 46: 1–7

14. Wang Ling, Tian Pei, and Yao Yan (2004), "Application of Ground Granulated Blast Furnace Slag in High Performance Concrete in China". International workshop on sustainable development and concrete technology organized by china building materials academy, prc, 309-317.

8 BIOGRAPHIES

KAVYA B R
M. Tech (structural engineering)
Department of civil engineering
B.I.E.T College Davanagere

CHANDRASHEKAR A R
Asst. professor
Department of civil engineering
B.I.E.T College Davanagere