International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 2, No. 2, June - August, 2017
Pages 101-111 | Cosmos Impact Factor (Germany): 5.195
Received: 24.06.2017 Published : 18.08.2017

FEASIBILITY STUDY ON UTILIZATION OF MARBLE AND FINE BLAST FURNACE SLAG IN MAKING CONCRETE

[1]Edara Krishna Reddy & [2]P.Kumanan

[1]Professor, [2]Assistant Professor

Department of Civil Engineering, Dhanalakshmi Srinivasan College of Engineering, Coimbatore.

Abstract – The objective of this study is to evaluate the performance on concrete properties utilization of marble slurry and Ground-granulated blast furnace slag by partial replacement of fine aggregate and cement OPC (43-grade). GGBS is a supplementary cementious material which is produced by iron or steel industries. And Marble slurry is obtained from marble industry which is found by cutting, polishing, and dressing up to 30% wastes. By utilization of these materials partial replacement fine aggregate up to 40% as interval of 8% and cement up to 20% by GGBS Efforts for improving the performance of concrete over the past few years suggest that cement replacement materials along with mineral& chemical admixtures can improve the strength, workability and durability characteristics of concrete. In this study we performing in concrete mixture the standard tests like slump, compressive strength of cube, flexural strength of cube, and splitting tensile strength of cylinder for 7 and 28 days respectively.

***Key Words*:** compressive strength, workability, marble slurry, concrete, Ground-granulated blast furnace slag, flexural strength, splitting tensile strength

1. INTRODUCTION:

The use of supplementary cementious material in concrete constructions not only prevents these materials to check the pollution but also to enhance the properties of concrete in fresh and hydrated states. Supplementary cementious materials are different types like Ground-granulated blast furnace slag, fly ash, silica fume, and marble powder etc. Ground-granulated blast-furnace slag can also be utilized as a high range water reducer to improve compressive strength or as a super workability aid to improve flow.

The main benefits of SCMs are their ability to replace certain amount of cement and still able to display Cementitious property, thus reducing the cost of using Portland cement. These are the following base papers on this study as:

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

Kishan Lal Jain (2016) have experimental program to effect on strength properties of concrete of by using Ground-granulated blast furnace slag by partial replacing cement and addition of Ground - granulated blast furnace slag without replacing cement. In this study Ground- granulated blast furnace slag has been used to OPC which varies from 5% to 25% at interval of 5% by total weight of OPC.

This study calibrates the performance of concrete mixture in terms of slump, compressive strength for 7 days and 28 days, flexural strength of beam 28 days and splitting tensile strength of cylinder for 28 days respectively.

Raj.P.Singh kushwah, at all (2015) have experimental study on Utilization of "Marble Slurry" In Cement Concrete Replacing Fine Aggregate. AS per results of Practical examination this material Marble slurry shows a good and acceptable strength when added in Cement Mortar and Cement Concrete Both (replacing sand). It can be used as a filler material (up to 30% replacing sand) showing same strength as of control

1.2. Selection of chemical admixture: Admixtures are ingredients other than basic ingredients cement, water and aggregates that are added to concrete batch immediately before or during mixing to modify one or more of the specific properties of concrete in fresh and hardened state. Added in small quantity either in powder or liquid form.

Fig.1 chemical admixture

1.1.1 Purpose of admixture:

1.To modify fresh property

i) Increase the workability without increasing the water cement ratio or decrease the water content at the same workability.
ii) Retard or accelerate the time of initial setting.
iii) Reduce or prevent the settlement or create slight expansion.
iv)Modify the rate or capacity of bleeding.

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

2. To modify harden property
i) Reduce the heat of evolution.
ii) Accelerate the rate of strength development at early stages.
iii) Increase the durability
iv) Decrease the permeability of concrete.

1.1.2 Classification of chemical admixtures:

- There are various type of chemical admixture which are used in construction and they are retarding admixture, accelerating admixture, water reducing admixture, air-entraining admixture, Super plasticizing admixture and retarding super plasticizing admixture.

- **Super plasticizers,** also known as plasticizers or high-range water reducers (HRWR), reduce water content by 12 to 30 percent and can be added to concrete with a low-to-normal slump and water-cement ratio to make high-slump flowing concrete in this thesis i.e. napthabased water reducing super plasticizer as per IS 9103:1999used.The super plasticizer which is used for the experimental performance is Kavassu Plast SP-431/ Shaliplast SP-431.

1.2 Concrete Mix Design:

"Mix Design is the science of determining the relative proportions of the ingredients of concrete to achieve the desired properties in the most economical way."

1.2.1 Concrete Mix Proportioning:
Mix proportion is process for mixing of cement, sand, coarse aggregate and water mainly in which it is required to keep balance of mixing ratio and mix has been conducted for trial mix, & control mix with Ground-granulated blast-furnace slag which are given below

Trial Mix:

Trials have been made on a concrete mix of standard ratio given in IS 456:2000 for M25 to know the exact strength of concrete. There have also been trials on three concrete mixes without using admixture and two trials taken with admixture (naphtha based super plasticizer) as per IS 10262:2009 for M25.

Control Mix
Control mix was designed as per IS 10262:2009 specification and recommendation which are given below
Table -2: Control Mix Proportion for M25

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

S.NO.	Materials	Weight (Kg/m3)	Slump (mm)
1	Cement OPC (43-Grade)	357	118
2	Coarse Aggregate (20mm)	694	
3	Coarse Aggregate (10mm)	482	
4	Fine Aggregate	721	
5	water	168	
6	Aggregate @ 1% of content	3.57	
7	W/C Ratio	0.47	

2. Ground-granulated blast furnace slag (GGBS)

Ground granulated blast furnace slag (GGBS) is a by-product from the blast furnaces used in the iron manufacturing industry. It has low absorption and denser packing features (smaller particles of Ground-granulated blast-furnace slag between the OPC grains). Ground-granulated blast-furnace
slag is typically an off-white color.

Fig.1 Ground-granulated blast furnace slag

Table -1: Physical and chemical properties of Ground-granulated blast furnace slag

Physical properties	Range	Chemical properties	Range
Bulk Density	750-850	CaO	30-34
Surface Area	8000cm2/gm	Al2 O3	18- 25
Particle shape	Irregular	Fe2 O3	0.8- 3.0
Particle size	N/A	SO3	0.1- 0.4
d50	<7 micron	MgO	6-10
d95	<20 micron	SiO2	30- 36
Specific gravity	2.9		

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

3. Marble slurry: Marble has been commonly used as a building material since the ancient times. The industry's disposal of the marble slurry material constitutes one of the environment problems around the world. Marble blocks are cut into smaller blocks in order to give them the desired smooth shape. These types of waste are generated during processing of marble by dressing; cutting and polishing up to 25% original mass in waste the form of dust. Now days marble wastes are produced from marble industry by waste in the form of dust is the environmental problems around the world.

3.1 Utilization of Marble Slurry:

- As a filler material for roads and embankments.
- For manufacture of bricks(central brick research board, Roorkee)
- Making cement concrete (partially replacing sand)
- Making cement mortar(partially replacing sand
- Hollow blocks and wall tiles
- Manufacture of ground calcium carbonate
- Manufacture of lime

Table-3 Physical and chemical properties of marble slurry

Physical Properties	**Range**	**Chemical Properties**	**Range**
Colour	White	Cao	28-35
Texture	Powder	MgO	10-14
Particle size	4.75 mm-75 micron	Al2O3	1.09
Fineness modulus	0.91	Sio2	11.38
Natural moisture content	0% (if under proof)	Fe2O3	1.10
Solubility in water	Totally in soluble	So3	0.008
Densification	Lesser (compare to cement)	R2O3	1-2.5
Specific gravity	2.56	Loss of Ignition	35-40

4. Result Analysis:

4.1 Workability test result: Workability shows the behavior of the fresh concrete during time of mixing, handling, delivery and placement at the point of placement of concrete and then at time of compaction and finishing of the surface.

Design is done on the basis of slump 100mm-120mm and the slump was found 118 mm for M25 grade concrete many variations have seen while checking for slump of different concrete mixes.

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

Table-4 Slump on **Replacement** of OPC by Ground-granulated blast-furnace slag and fine aggregate by Marble slurry For M25 Grade

S.No	Mix (CEMENT+GGBS)&(SAND+MS)	Slump (mm)
1	OPC+GGBS (100+0) &SAND+MS(100+0)	118
2	OPC+GGBS(80+20) &SAND+MS(92+8)	132
3	OPC+GGBS (80+20) &SAND+MS(84+16)	145
4	OPC+GGBS (80+20) &SAND+MS(76+24)	150
5	OPC+GGBS (80+20) &SAND+MS(68+32)	154
6	OPC+GGBS (80+20) &SAND+MS(60+40)	159

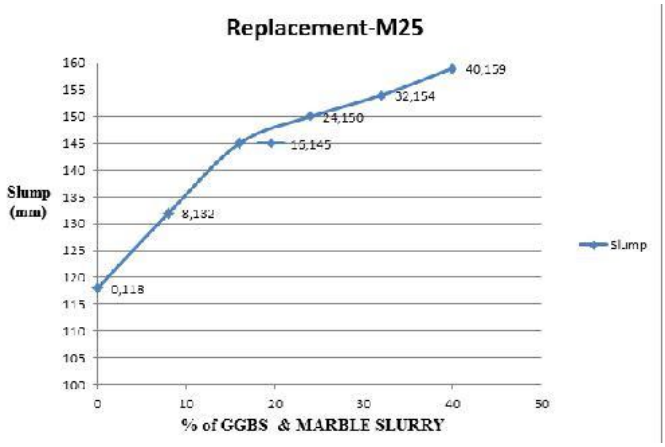


Chart -1: Effect of Ground-granulated blast-furnace slag and Marble slurry on Slump of Concrete (M-25) on Replacement

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

4.2 Compressive Strength: The compressive strength of GGBS and Marble slurry mixes was measured with cube specimen of size 150mm (length) x 150mm (width) x 150mm (depth).The specimens were tested after curing for 7 days and 28 days fully immersed in water tank as per IS 516:1959 for method of tests for strength of concrete.

Fig.2 Testing cube for Compressing Strength by Compressive Testing Machine

Table-5 7& 28 Days Compressive Strength of Cube on **Replacement** of Ground-granulated blast-furnace slag into OPC and Marble slurry with fine aggregate for M25 Grade

S.No	Mix (Cement+GGBS)&(Sand +Marble slurry)	Average For Compressive Strength(N/mm2)	
		7 Days	28 Days
1	OPC+GGBS (100+0)&SAND+	28.12	38.76
	MS(100+0)		
2	OPC+GGBS (80+20)&SAND+	23.13	37.09
	MS(92+8)		
3	OPC+GGBS	24.34	37.68
	(80+20)&SAND+MS(84+16)		
4	OPC+GGBS (80+20)&SAND+	24.72	38.15
	MS(76+24)		
5	OPC+GGBS (80+20)&SAND+	24.84	38.69
	MS(68+32)		
6	OPC+GGBS	22.73	35.22
	(80+20)&SAND+MS(60+40)		

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

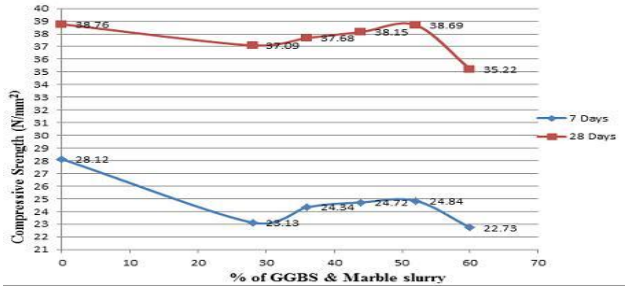


Chart-2 Effect of Ground-granulated blast-furnace slag and Marble slurry on Concrete of M25 Grade on Replacement for 7& 28 Days Compressive Strength of Cube

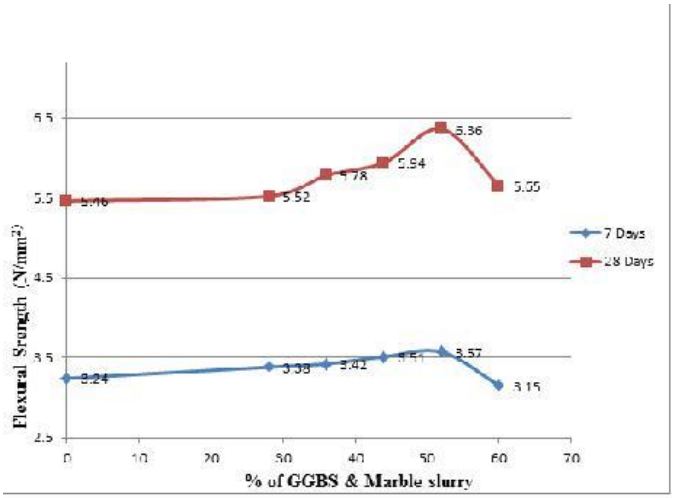
4.3 Flexural Strength

The Flexural strength of GGBS and Marble slurry mixes was measured with beam specimen of size 700mm (length) x 150mm (width) x 150mm (depth).The specimens were tested after curing for 28 days fully immersed in water tank as per IS 516:1959 for method of tests for strength of concrete. The Centre point loading method was used for this testing

Table-6 7**&**28 Days Flexural Strength of Beam on **Replacement** of OPC by Ground-granulated blast-furnace slag and Fine aggregate by Marble slurry For M25 Grade

S.No	Mix (Cement+GGBS)&(Sand +Marble slurry)	Average For Flexural Strength(N/mm2)	
		7 Days	28 Days
1	OPC+GGBS(100+0)&SAND+ MS(100+0)	3.24	5.46
2	OPC+GGBS(80+20)&SAND+ MS(92+8)	3.38	5.52
3	OPC+GGBS(80+20)&SAND+ MS(84+16)	3.42	5.78
4	OPC+GGBS(80+20)&SAND+ MS(76+24)	3.51	5.94
5	OPC+GGBS (80+20)&SAND+MS(68+32)	3.57	6.36
6	OPC+GGBS(80+20)&SAND+ MS(60+40)	3.15	5.65

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019



5. CONCLUSIONS

By experimental work the results of Slump test, Density test, Compressive Strength test, Flexural Strength test and Splitting Tensile Strength test. Following conclusions have been drawn

- On partial replacement up to 40% in the interval of 8%of Fine aggregate by Marble slurry and up to 20% of cement by Ground-granulated blast-furnace slag, the slump of the concrete mix was increased as compare to the slump of control mix concrete.

- Compressive strength of concrete was increased in mixes of M25, when partial replacement of OPC by Ground-granulated blast-furnace slag and Marble slurry and higher strength was found on up to 20% addition of Ground-granulated blast-furnace slag by replacement of OPC and Marble slurry up to 40% by replacement of Fine aggregate with M25 grade.

- Flexural strength of concrete was increased in mixes of M25when partial replacement of OPC by Ground-granulated blast-furnace slag and Fine aggregate by Marble slurry and higher strength was found on 20% addition of Ground-granulated blast-furnace slag and up to 40% Marble slurry.

- Splitting tensile strength was increased in mixes of M25 concrete grade when partial replacement of OPC by Ground-granulated blast-furnace slag and Fine aggregate by Marble slurry and higher strength was found on 20% addition of Ground-granulated blast-furnace slag and up to 40% Marble slurry.

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

- On 20% partial replacement of OPC by Ground-granulated blast-furnace slag and up to 40% of Fine aggregate by Marble slurry of M25 grade concrete, the compressive strength was greater than the target compressive strength of normal M25 concrete.

- On 20% partial replacement of OPC by Ground-granulated blast-furnace slag up to 40% of Fine aggregate by Marble slurry of M25 grade concrete, the flexural strength was observed greater than flexural strength of normal M25 grade concrete.

- On 20% partial replacement of OPC by Ground-granulated blast-furnace slag and up to 40% of Fine aggregate by Marble slurry of M25 grade concrete, the splitting tensile strength was observed greater than the splitting tensile strength of normal M25 grade concrete due to C-S-H gel develops an internal system of tiny pores, called gel pores, which are hundreds or thousands times smaller than the original capillary pores of OPC so decrease in voids increase the splitting tensile strength.

- Using GGBS and Marble Slurry wastes in concrete mix proved to be very useful to solve environmental problems and reduces some extent the requirement of cement in large quantity. Therefore, it is recommended to reuse these wastes in concrete to move towards sustainable development in construction industry.

ACKNOWLEDGEMENT
We express sincere thanks to **Prof. Kaushal Prasad Verma** for his kind cooperation of our Project Thesis/Dissertation. Words are inadequate in offering our thanks to **Er. Sachin Kumar** Assistant professor in Civil engineering Department, for consistent encouragement and support for consistent encouragement and support for shaping our Project Thesis/Dissertation in the presentable form.

REFERENCES

[1] KishanLal Jain (2016) have experimental work to Effect on strength properties of concrete of by using Ground-granulated blast furnace slag by partial replacing cement and addition of Ground -granulated blast furnace slag without replacing cement. SSRG internal journal of civil engineering (ssrg-ijce) volume 3 issue 5 may (2016)
[2] Lokesh kumar, prof. Gautam Bhadouria (2015) have investigated Effect of Partial Replacement of Cement by Fly Ash and Fine Aggregate by Marble Dust, Stone Dust on Concrete Properties IJSTE - International Journal of Science Technology & Engineering | Volume 2 | Issue 6 | December 2015 ISSN (online): 2349-784X
[3] Sabnam T A and Shibi Varghese (2016) have investigated the experimental study on properties on ternary blended concrete using Ground granulated blast furnace slag and

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 2, June - August, 2019
Pages 1-10 | Cosmos Impact Factor (Germany): 5.195
Received: 02.09.2019 Published : 24.09.2019

marble powder. International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2763 Issue 08, Volume 3 (August 2016)

[4] Raj.p.singhkushwah, Prof (Dr.) Ishwar Chand Sharma, and Prof (Dr.) PBL Chaurasia (2015) have experimental study on Utilization of "Marble Slurry" In Cement Concrete Replacing Fine Aggregate. American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-04, Issue-1, pp-55-58

[5] Siddharth P. Upadhyay and M. A. Jamnu "Effect on Compressive strength of High Performance Concrete Incorporating Ground-granulated blast-furnace slag and Fly Ash" International Journal Of Innovative Research & Development, ISSN 2278 – 0211,volume 3, issue 2,pp.124-128, February 2014.

[6] Shetty M.S. "Concrete Technology" Chand S. and Co. Ltd., India (2004).

[7] IS: 456-2000, "Plain and Reinforced Concrete - Code of Practice "Bureau of Indian Standards, New Delhi, India.

[8] IS: 2386-1963 (Part I to Part III), "Indian Standards Method of Test for Aggregate for Concrete", Bureau of Indian Standards, New Delhi, India.

[9] IS: 383-1970, "Indian Standard Specification for coarse and fine aggregates from Natural Source for Concrete", Bureau of Indian Standards, New Delhi, India.

[10] IS: 8112-1989, "Specifications for 43-Grade Portland Cement", Bureau of Indian Standards, New Delhi, India.

[11] IS: 10262-1982," Guidelines for Concrete Mix Design", Bureau of Indian Standards, New Delhi, India..

[12] IS: 516-1959, "Indian Standard Code of Practice-Methods of Test for Strength of Concrete", Bureau of Indian Standards, New Delhi, India.

[13] IS: 5816-1999, "Method of Test Splitting Tensile Strength of Concrete", Bureau of Indian Standards, New Delhi, India.

[14] IS: 9103-1999, "Specification for Concrete Admixtures" Bureau of Indian Standards, New Delhi, I