International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9, Issue-7, May 2020

Influence of GGBS and Marble Dust on Mechanical Properties of Concrete

Sivakumar.S, Chandrasekar.A, Jaideep.C, Kameshwari.B

Abstract: ***Concrete is a extensively used material in construction. Due to high tech upgrading, the concrete have been matured to augment the equity of concrete. Now a day's various studies have been conducted to make concrete with waste materials with the intension of reducing cost and demand of materials. This paper investigates the mechanical goods of concrete using Ground Granulated Blast furnace Slag (GGBS) and Marble Dust (MD) as a limited replacement of cement and fine aggregate respectively. Based on previous literature survey, 40% of GGBS and 10, 20 and 30% of MD are taken for the present study. The present research work is aimed at studying the mechanical properties of M20 grade concrete using GGBS and MD. Compressive strength and Split tensile strength were carried out for 7, 28 and 56 days and insignificant increases in the strength were observed for concrete specimens admixed with GGBS and MD when compared with conventional concrete.***

Keywords: GGBS, Marble Dust, Compressive Strength, Split Tensile Strength, Concrete.

I. INTRODUCTION

Concrete is that the very commonly used material in construction and poised of cement, fine aggregate (sand) and coarse aggregate with water which amalgamate with time. Concrete has molded into different shape and has desirable properties. It is brittle in nature. Fundamentally, concrete is more strong and durable. Portland cement is the mostly and commonly used type of cement for production of concrete such as blast furnace slag, fly ash, Met kaolin, Silica fume and Rice husk ash. Ordinary Portland Cement (OPC) is used as the energy demanding in the production of concrete. Water cement ratio plays a vital role which consequences of disparate farms such as workability, strength and durability. Concrete is used for the structure of beams, columns, slabs, foundations and other load bearing rudiments. Insufficiency of fine aggregate since of diminution of usual possessions made concrete manufacturers to look for appropriate alternative for fine aggregate.

Revised Manuscript Received on May 30, 2020.
***** Correspondence Author
Dr.Sivakumar S*, Associate Professor, Department of Civil Engineering, PSNA College of Engineering & Technology, Dindigul, India. Email:ssiva333@gmail.com
Chandrasekar A, Assistant Professor, Department of Civil Engineering, PSNA college of engineering & Technology, Dindigul, India.Email: acscvl@gmail.com
Jaideep C, Associate Professor, Department of Civil Engineering, PSNA College of engineering & Technology, Dindigul, India.Email:cjaideep4@gmail.com
Dr.Kameshwari B, Professor, Department of Civil Engineering, BVC Engineering College, Andhra Pradesh India.*Email: kamesh.b68@gmail.com*

One such option is named as "Marble Dust". Marble Dust is the wastes from marble industries are actuality on the loose from marble cutting, glint, processing and crumbling and that is sieved and prepared to collection particle size of natural sand so as to be used as fine aggregate in a construction work.

II. MATERIALS

A. Cement

Cement is also a binder substance that used for construction. Ordinary hydraulic cement (OPC) was used.

B. Aggregate

Aggregate are the imperative materials in concrete. They became remains of the concrete and dipping their shrinkage. The coarse aggregate passing through a 20mm and retained on 10mm sieve is employed during this study. Fine aggregate in compliance to Zone III of IS: 383 – 2016 has been used.

C. Ground Granulated Blast furnace Slag (GGBS)

GGBS is also a by-product iron manufacturing which when supplementary to concrete enhance its properties like workability, strength and sturdiness. The ore is condensed to iron and then the outstanding materials from a slag that floats on top of the iron. The quenching optimizes the cementitious properties and cultivates grime a small amount like coarse sand. GGBS has been widely exploited in Europe, and gradually more within us and in Asia (particularly in India, Japan and Singapore) for its dominance in concrete durability, approaching the lifespan of buildings from fifty years to 100 years. It is worn to build durable concrete structures combination with OPC. It gains strength over a longer period in production conditions. It increases the workability of concrete.

Fig. 1 Ground Granulated Blast furnace Slag

D. Marble Dust (MD)

Generally marble has been used as a relic since the traditional times. Accordingly, marble waste as a by-product may be a essential material which necessary ample environmental disposal attempt. Moreover, recycling waste without proper execution may result in environmental problems greater than the waste itself.

Fig. 2 Marble Dust

Marble Dust may be a waste material created for the duration of the congregation of marble. A bulky capacity of powder is developed during the cutting process. The result's that about 25% of the first marble mass is lost within the type of dust. Marble dust will be used as an admixture in concrete, so strength of the concrete will be improved.

III. EXPERIMENTAL INVESTIGATION

A. Materials used and their properties

Ordinary Portland Cement 53 Grade has been used in this experimental investigation as per Indian Standard Specifications. Fine aggregate was river or natural sand passing through IS 4.75 mm sieve confirming to zone III and nominal size of coarse aggregate is 20mm as per the specifications.

B. Mix proportions

The concrete mix proportion was 1:1.55:2.9 as per 10262-2019, with a water cement ratio of 0.48. Three additional concrete mixes (M1, M2 and M3) were balanced where cement was replaced with 40% GGBS by weight and along with fine aggregate was replaced with 10%, 20% and 30% . Mix proportions are shown in Fig.3 and Table.1.

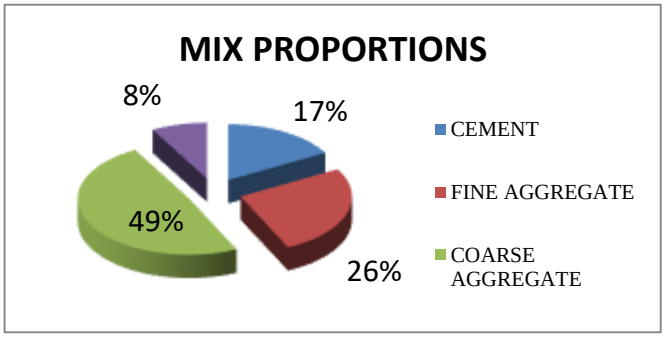

Fig. 3 Mix Design

Table 1 Concrete mix proportion with 40% GGBS with MD 10, 20 and 30%

MIX DESIGNATION	CC	M1	M2	M3
Cement (kg/m^3)	393	236.4	236.4	236.4
Sand (kg/m^3)	652.9	587.6	522.3	457
Coarse aggregate (kg/m^3)	1149.2	1149.2	1149.2	1149.2
GGBS (kg/m^3)	0	157.6	157.6	157.6
MD (kg/m^3)	0	65.28	130.57	195.86
Water (lit/m^3)	197	197	197	197

IV. RESULT AND DISCUSSION

A. Compressive strength

Compressive strength test result are given in Table 2 and shown in Fig 4 and Fig 5. There is a high augment in compressive strength of ratio M3 (GGBS 40% and MD 30%) as compared to conventional concrete. At the age of 7, 28 and 56 days, there is a trivial amplifies in compressive strength of M1, M2 and M3 when compared to control concrete. Compressive strength result is shown in Fig.4, Fig.5 and Table 2 respectively.

Fig. 4 Compressive strength

Table 2 Test Result for Compression Strength

Description	Conventional concrete	M1(40% GGBS and 10%MD)	M2(40% GGBS and 20%MD)	M3(40% GGBS and 30%MD)
7 DAYS (N/mm^2)	18.3	19	19.45	19.81
28 DAYS (N/mm^2)	26.91	27.03	28.22	31.64
56 DAYS (N/mm^2)	27.32	27.92	28.67	32.7

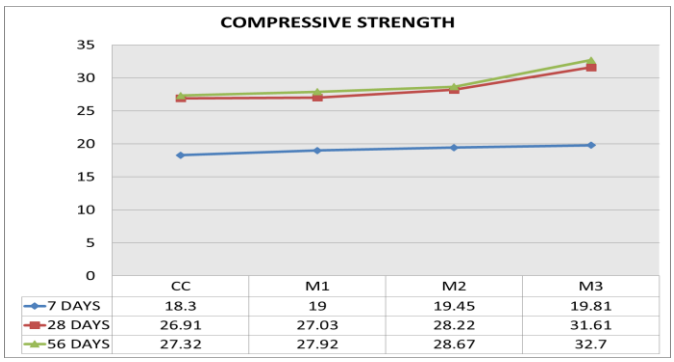

Fig 5 Development of Compressive Strength

B. Splitting tensile strength

Split tensile strength test results have been given in Table 3 and shown in Fig 6 and Fig 7. There is a elevated raise in split tensile strength of ratio M3 (GGBS 40% and MD 30%) as correlated to conventional concrete.

At the age of 7, 28 and 56 days, there is a increase in split tensile strength of M1, M2 and M3 when compared to control concrete. Split tensile strength result is shown in Fig.6, Fig.7 and Table 3 respectively.

Fig. 6 Split tensile strength

Table 3 Test Result for Split Tensile Strength

Description	Conventional concrete	M1(40% GGBS and 10%MD)	M2(40% GGBS and 20%MD)	M3(40% GGBS and 30%MD)
7 DAYS (N/mm2)	1.7	1.85	1.97	2.15
28 DAYS (N/mm2)	2.29	2.39	2.48	2.67
56 DAYS (N/mm2)	2.4	2.52	2.66	2.78

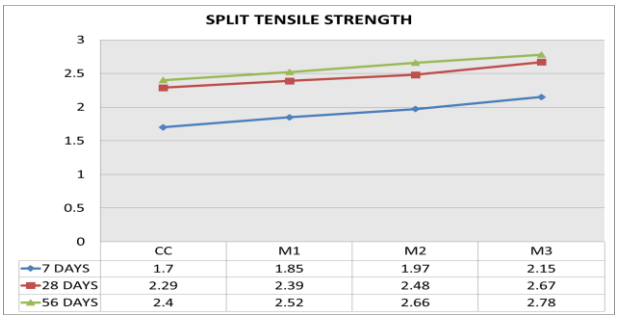

Fig 7 Development of Split tensile Strength

V. CONCLUSION

The experimental work was conceded out to develop the mechanical properties in order to discover the prospect of using waste material such as GGBS and MD as a partial replacement of cement and fine aggregate in M20 grade of concrete. The accomplished compressive and split tensile strength of concrete of various percentages with GGBS 40% and MD 10%, 20% and 30% was related with conventional concrete. The test results have been proved that GGBS and MD have a probable to be used as replacement of cement and fine aggregate respectively. The mechanical properties of concrete is increased with the highest strength achieved at 40% GGBS and 30% MD replacement level.

REFERENCES

1. ACI 318-08, 'Building code requirements for structural concrete and commentary (ACI 318R-99)', Detroit: American Concrete Institute.
2. Ali A. Aliabdo, Abd Elmoaty M. Abd Elmoaty, Esraa M. Auda, "Re-use of waste marble dust in the production of cement and concrete", Construction and Building Materials Vol 50 (2014), pp-28–41.
3. Ankita Khatri, Abhishek Kanoungo, and Dr. Umesh Sharma, (2017) "Use of waste marble dust in Concrete", Vol 32, pp 98-99.
4. Bahar Demirel, (2010) "The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete", Vol. 5(9), pp. 1372-1380.
5. Deepankar Kumar Ashish, (2018), "Concrete made with waste marble powder and supplementary cementitious material for sustainable development", Journal of Cleaner Production, Vol 18, pp-6-7.
6. Kirti Vardhan, Rafat Siddique, Shweta Goyal (2019), "Strength, permeation and micro-structural characteristics of concrete incorporating waste marble", Construction and Building Materials, Vol 203 (2019), pp- 45–55.
7. K.I. Syed Ahmed Kabeer, Ashok Kumar Vyas, (2018), (Utilization of marble powder as fine aggregate in mortar mixes", Construction and Building Materials, Vol 165 (2018), pp- 321–332.

AUTHORS PROFILE

Dr.S.Sivakumar has completed his Doctoral degree in Faculty of Civil Engineering from Anna University, Chennai. Currently he is working as Associate Professor in Department of Civil Engineering at PSNA College of Engineering and Technology, Dindigul, Tamilnadu (India). His specializations include Structural Engineering in Concrete materials and modeling. His current research interests are strength and durability behavior of concrete with alternative materials with respect to predict the results using different algorithms. He is a member of ISTE and published 5 papers in various International Journals and also presented papers in national and international conferences.

Mr.A.Chandrasekar is currently doing research in Faculty of Civil Engineering from Anna University, Chennai. He completed his PG degree (Construction Engineering and Management) in Faculty of Civil Engineering from Anna University, Chennai. Presently he is working as Assistant Professor in the Department of Civil Engineering at PSNA College of Engineering and Technology, Dindigul, Tamilnadu (India). His specializations include Construction Management and Concrete materials. He is a member of ISTE and published 4 papers in various International Journals and also presented papers in national and international conferences.

Mr.C.Jaideep has completed his M.E. in Environmental Engineering from Government college of Technology, Coimbatore, Bharatiar University and B.E in Civil Engineering from PSNA College of Engineering and Technology, Dindigul, Madurai Kamaraj University. Currently he is working as Associate professor in the Department of civil Engineering, PSNA College of Engineering and Technology, Dindigul, Tamilnadu, India. He is a member of ISTE and published 8 papers in various international journals.

Dr.B.Kameshwari is a professor of Civil Engineering at BVC Engineering College, Andhra Pradesh. She received her Bachelor and Masters Degree in Civil and Structural Engineering from Regional Engineering College, Tiruchirapalli, Tamilnadu and obtained her Doctoral degree from Alagappa University, Karaikudi. Her current areas of research interests include Health monitoring of structures, cementitious composites, Nano materials, Evolution of Ultra high performance concrete and soil stabilization. She has published more than 25 research papers in international journals.