International Journal For Technological Research In Engineering
Volume 5, Issue 10, June-2018 *ISSN (Online): 2347 - 4718*

DETERMINATION OF THE EFFECTS ON STRENGTH PROPERTIES OF CONCRETE M25 BY PARTIAL REPLACEMENT OF CEMENT WITH MARBLE POWDER AND FLY ASH

Anil Kumar[1], Mr. Rohit Kumar[2]
[1]M.Tech scholar, [2]Assistant professor Department of Civil Engineering PPIMT, Hisar

ABSTRACT: The present study work was carried out to determine the effect of marble powder and fly ash on the strength properties of concrete grade M25 by partial replacement of cement with marble powder and fly ash. Marble powder and fly ash both are byproducts or waste of marble industries and coal thermal plant respectively. So to reuse of these by-products and to fulfill the objectives of the dissertation the cement is replaced by marble powder and fly ash in the percentage of 0%, 4%, 8%, 12%, 16%and 20% in present study work. The three strength properties of concrete are determined in experimental work namely compressive strength, split tensile strength and flexural strength at the curing age of 7days and 28 days respectively. After the experimental work, it was found that the 12% replacement of cement by marble powder and fly ash enhance the compressive, split and flexural strength properties of concrete as compared to the ordinary M25 grade concrete. The test result also shows the possibility about the reuse of byproduct or waste in construction line especially in concrete manufacturing to enhance the strength properties of concrete as well as to control the different kind of pollution which is originated by these type waste or byproduct.

Key words: Marble powder, Fly ash, Compressive strength, Split tensile strength and Flexural strength.

I. INTRODUCTION

Concrete is very oldest and most utilizable construction material in the world mainly due to its long durability, high compressive strength and ability to carry extreme weather condition. It can be moulded in any desired shape according to need. The key ingredients of concrete are cement, fine aggregate and coarse aggregate with a desired quantity of fresh water. During the manufacturing of cement (an ingredient of concrete) a lot of environmentally hazardous gases are originates in the surrounding areas which can harm the environment as well as human being health. So to control the environmental pollution due manufacturing of cement and to control the manufacturing quantity of cement in construction line a trend is going on from past years that replacement of cement by byproduct like byproduct of marble industries in the form of marble powder, by-product of coal thermal power plant in the form fly ash etc. The use of these type of byproduct is the best way to save the natural resources like marble, coal etc. as well as to control the environmental pollution which was caused by these byproduct or waste materials. So to fulfill the requirements of dissertation an experimental work was carried out to determine the effect of waste material or byproduct like marble powder and fly ash on the strength properties of M25 grade concrete by partial replacement of cement with marble powder and fly ash in the proportion of 0%, 4%, 8%, 12%, 16%and 20%.

II. MATERIALS

2.1 CEMENT:

Ordinary Portland Chetak cement grade 43 manufactured by Birla Corporation Limited has been used in this dissertation work. It was purchased from village Barwa, Haryana. In the concrete laboratory of our institute different Cement related tests were carried out to find out the physical properties of cement. The physical properties related to cement are given in table no.2.1.

TABLE 2.1 PHYSICAL PROPERTIES OF CEMENT

CEMENT PROPERTIES	TEST RESULTS	SPECIFIED VALUE AS PER IS:8112-1989
cement Consistency (%)	33	----
Specific gravity	3.15	3.15
Initial setting time (minutes)	38	>30
Final setting time (minutes)	259	<600
Compressive strength (N/mm^2) (i) 3 days (ii) 7 days (iii)28days	 25.10 36.60 48.90	 >23 >33 >43
Soundness (mm)	1.00	10
Fineness of Cement (%)	5	10
Colour	Grey	----
Physical shape	Powder	----

2.2 SAND:

The river sand which is passed through the 4.75 mm sieve and confirming the requirements of IS: 383-1970 Zone –II has been used in this investigation work as a fine aggregate. The sand was purchased from the Village- Choudharywas, District – Hisar (Haryana) from a building material supplier shop. The properties of sand or fine aggregate is given in table no. 2.2

TABLE 2.2 PROPERTIES OF SAND OR FINE AGGREGATE

S.NO.	PHYSICAL PROPERTIES	RESULTS
1	Specific gravity of sand	2.60
2	Fineness modulus of sand	2.76
3	Surface moisture	1%
4	Grading	Zone-II as per IS: 383-1970

2.3 COARSE AGGREGATE:

Coarse aggregates were purchased from the Village – Choudharywas, District – Hisar (Haryana) from a Building material shop. Maximum 20mm sized aggregates were used in the experimental work to fulfill the requirements of the dissertation. The different properties related to coarse aggregates are given in table no. 2.3.

TABLE 2.3 PROPERTIES RELATED TO COARSE AGGREGATE

S.NO.	PHYSICAL PROPERTIES	RESULTS
1	Specific gravity of Coarse Aggregate	2.59
2	Fineness modulus of C. A.	6.99
3	Water Absorption	1.15 %
4	Toughness	10.73%
5	Physical Shape	Angular
6	Free moisture content	Nil

2.4 MARBLE POWDER:

To achieve the target of investigation work marble powder was purchased from a building material shop of District Hisar, Haryana. It was white in colour. The physical and mechanical properties of marble powder are given in table 2.4

TABLE 2.4 PHYSICAL PROPERTIES OF MARBLE POWDER

SR.NO.	CHARACTERISTICS	RESULT
1	Color	White
2	Physical shape	Powdered
3	Specific Gravity	2.72
4	Fineness	9%

2.5 FLY ASH:

Fly ash obtained from Rajiv Gandhi Thermal Power Plant was used in this dissertation work. It is the byproduct of coal combustion industries. Fly ash of class F confirming IS 3812-1981 in grey colour has been used in dissertation work. Rajiv Gandhi Thermal Power Station located at khedar in Hisar district, Haryana India. Different properties of fly ash are given in table 2.5.

TABLE 2.5 - PHYSICAL PROPERTIES OF FLY ASH

SR. NO.	CHARACTERISTICS	RESULTS
1	Color	Dark Grey
2	Physical shape	Powdered
3	Specific gravity	2.49
4	Fineness	8.5%

2.6 WATER:

Potable water with pH value 7.8 has been used in this dissertation work for mixing of concrete ingredients and also for curing of concrete. It confirming the requirements of IS: 456-2000.

FIG. (I) CONCRETE INGRADIENTS AND ADMIXTURES

III. MIX PORPORTION

TABLE 3.1- MIX PROPORTION FOR MARBLE POWDER AND FLY ASH BASED CONCRETE MIX

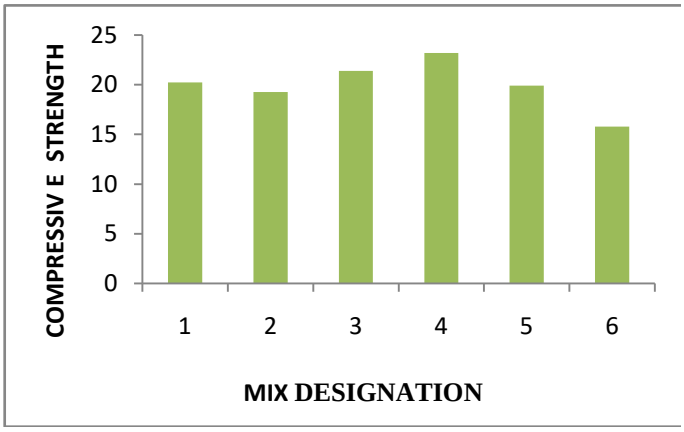
MIX	MP & FA (%)	Water (kg)	Cement (kg)	C.A. (kg)	Fine Agg. (kg)	M.P. (Kg)	Fly Ash (Kg)
M1	0	15	33.450	86.97	55.86	0	0
M2	4	15	32.112	71.00	40.62	0.669	.669
M3	8	15	30.774	71.00	40.62	1.338	1.338
M4	12	15	29.436	71.00	40.62	2.007	2.007
M5	16	15	28.098	71.00	40.62	2.676	2.676
M6	20	15	26.760	71.00	40.62	3.345	3.345

IV. EXPERIMENTAL RESULT

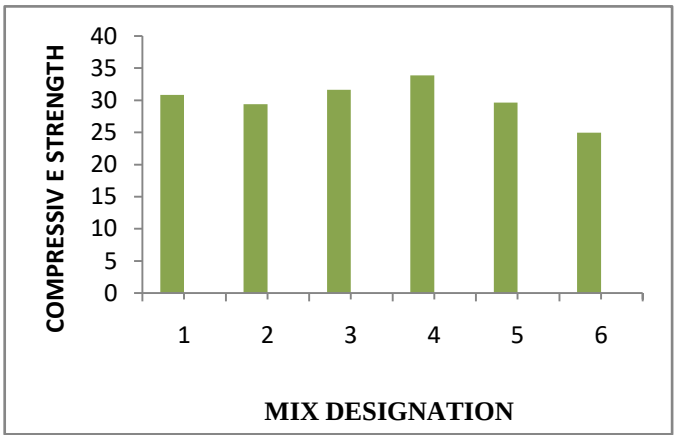
TABLE 4.1 – COMPRESSIVE STRENGTH

Mix Designation	Percentage of M.P. & F.A.	Compressive strength at 7day (N/mm^2)	Compressive strength at 28days (N/mm^2)

MX1	0	20.22	30.82
MX2	4	19.26	29.40
MX3	8	21.40	31.63
MX4	12	23.18	33.85
MX5	16	19.92	29.62
MX6	20	15.78	24.96



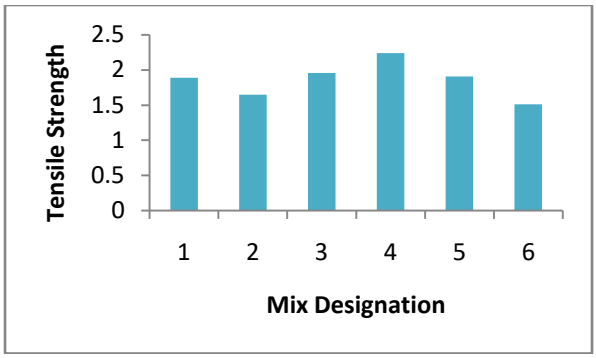
GRAPH 4.1(A) – COMPRESSIVE STRENGTH AT 7DAYS



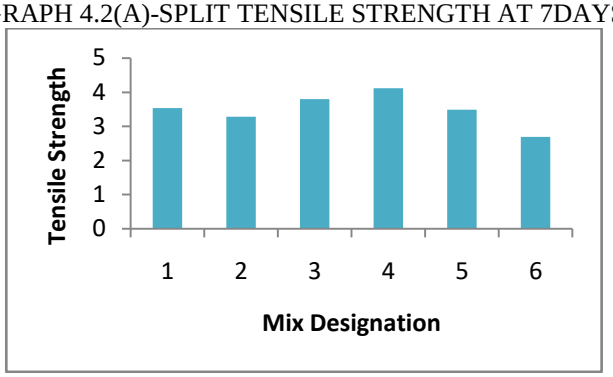
GRAPH 4.1(B) - COMPRESSIVE STRENGTH AT 28 DAYS

TABLE 4.2- SPLIT TENSILE STRENGTH

Mix Designation	Percentage of M.P. & F.A.	split tensile strength at 7days (N/mm2)	Average split tensile strength at 28days (N/mm2)
MX1	0	1.89	3.54
MX2	4	1.65	3.28
MX3	8	1.96	3.80
MX4	12	2.24	4.12
MX5	16	1.91	3.49
MX6	20	1.51	2.69



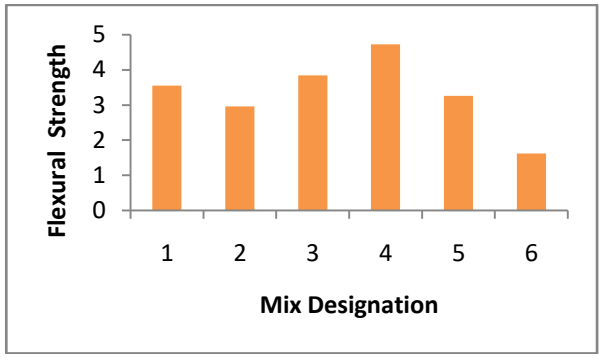
GRAPH 4.2(A)-SPLIT TENSILE STRENGTH AT 7DAYS



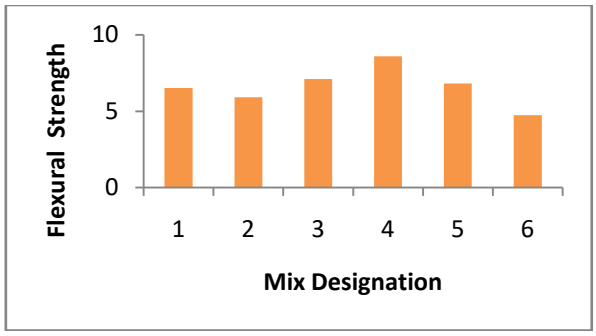
GRAPH 4.2(B)-SPLIT TENSILE STRENGTH AT 28 DAYS

TABLE 4.3- FLEXURE STRENGTH

Mix Designation	Percentage of M.P. & F.A.	flexural strength at 7 days(N/mm^2)	flexural strength at 28 days(N/mm^2)
MX1	0	3.55	6.52
MX2	4	2.96	5.92
MX3	8	3.84	7.11
MX4	12	4.73	8.59
MX5	16	3.26	6.81
MX6	20	1.62	4.14



GRAPH 4.3(A)-FLEXURE STRENGTH AT 7 DAYS



GRAPH 4.3-FLEXURE STRENGTH AT 28 DAYS

V. CONCLUSION

(i)The results obtained from the present study indicates that it is feasible to replace the cement by marble powder and fly ash for enhancing the strength characteristics of concrete M25 grade, thus the marble powder and fly ash can be used as an alternative material for the production of concrete.

(ii)It may prove as a solution for the waste disposal problems and to minimize the cost of construction because it is available easily in a wide range and in cheap rate as compared to cement.

(iii)Up to the 12% replacement of cement with marble powder and fly ash increase the compressive strength of concrete at curing age of 7days and 28 days respectively. By the analysis, it was found that about 12% replacement of cement by marble powder and fly ash gives 15%and 10% more compressive strength as compared to the M25 grade traditional concrete at 7days and 28 days examination of the compressive strength of concrete. After that more addition of marble powder and fly ash gradually decrease the compressive strength characteristics of concrete.

(iv)The split tensile strength of concrete is increased with the addition of marble powder and fly ash up to12% replacement with cement. Further addition of marble powder and fly ash like 16% and 20% resulted in a decrease in split tensile strength of concrete mix. However the split tensile strength for the concrete mix containing 12 % replacement of marble powder and fly ash by weight of cement increased about 16% split tensile strength of concrete as compared to control mix at 28 days testing of concrete.

(v) The flexural strength of concrete mix containing 12% replacement of marble powder and fly by weight of cement in M25 concrete mix provide similar trend obtained from compressive strength and split tensile strength of concrete. The flexural strength increased about 31% at the 12% replacement of cement by marble powder and fly ash in concrete mix M25 as compared to the 0% replacement of cement by marble powder and fly ash in concrete M25 grade. After that further increase in the percentage of marble powder and fly ash in concrete mix decreases the flexural strength of concrete as compared to the control mix.

(vi)From compressive strength test, splitting tensile strength and flexural strength test it can be concluded that the best proportion of marble powder and fly ash are 12% by weight of cement for both the curing age of 7days and 28 days.

VI. FUTURE SCOPE

(a)The effect of replacement of cement by marble powder and fly ash in different percentages other than this dissertation can be investigated in future.

(b)The durability studies of concrete containing marble powder and fly ash can be taken up in further investigations.

(c)The marble powder and fly ash can be used for development of self-compacting concrete in future investigation.

(d)The further experimental work can be done by changing other substitution materials and their combinations with Cement.

(e)The effect of replacement of cement by marble powder and fly ash can be checked on the high grade of the concrete mix like M30, M40, and M50 etc.

(f)In future investigation marble powder and fly ash can be replaced with sand to determine the different strength properties of concrete.

REFERENCE

[1] Neha Yadav, Navinderdeep Singh (2018), " A Review on the concrete mix by adding marble waste powder and fly ash" International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 02, e-ISSN: 2395-0056 p-ISSN: 2395-0072, Feb-2018.pp1136-1137.

[2] S Suthandra Devi , R.Ramya, R.Keerthika(2018), "Experimental study on concrete by partial replacement of fly ash and marble powder for cement" IJARTET,2018, pp 152-156.

[3] Virendra Singh, Pratik Gajjar(2017), "Experimental study to enhance the strength properties of self-compacting concrete using waste marble dust and fly ash" Journal of Emerging Technologies and Innovative Research (JETER), ISSN-2349-5162, Volume 4, Issue 11, November 2017.pp 428-434.

[4] A.Sathesh Kanna, G.Sangara Pitchai Raj(2017), "Partial replacement of cement with marble dust and fly ash" SSRG International Journal of Civil Engineering- (ICRTCETM-2017), ISSN: 2348 – 8352 Special Issue – April 2017,pp-728-731.

[5] Prof. Mallesh M, Abhilash K(2017),"An Experimental Investigation on Strengths Characteristics of Concrete with the Partial Replacement of Cement by Mineral Admixture" International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, p-ISSN: 2395-0072, Volume: 04 Issue: 10 | Oct - 2017,pp1417-1423.

[6] S Praveenkumar*, K Murugesan(2017), "Influence of Marble Powder and Fly Ash in Fresh and Hardened Properties of Self Compacting Concrete" International Journal of ChemTech Research, Vol.10 No.8, ISSN: 0974-4290, ISSN(Online):2455-9555, Year2017, pp 314-319.

[7] Darzi Musaib A,Bhumre Shivkumar(2016), Review paper on "Effective partial replacement of cement and sand with fly-ash and marble powder to make green concrete" International Research Journal of

Engineering and Technology (IRJET), e-ISSN: 2395 -0056, p-ISSN: 2395-0072 , Volume: 03 Issue: 07 | July-2016 ,pp 1408-1410.

[8] Santosh Kumbhar, Mahesh Patil(2016), "Green concrete by using industrial waste material- fly ash, quarry dust, marble powder" International Journal of Research in Advent Technology E-ISSN: 2321-9637Special IssueNational Conference" VishwaCon'16", 19 March 2016.pp 40-45.

[9] Disha Singh, Mohd. Afaque Khan(2016),"Review on the study of the compressive strength of concrete rete using marble dust as partial replacement of cement" International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056, p-ISSN: 2395-0072, Volume: 03 Issues: 03 | Mar-2016,pp-524-526.

[10] Raman Kumar, Ankit(2016), "An experimental study of marble powder on the performance of concrete" International Journal of Civil Engineering and Technology (IJCIET), Volume 7, Issue 4, ISSN Print: 0976-6308 and ISSN Online: 0976-6316, July-August 2016, pp. 491–497.

[11] Rohit Kumar, Er. Jitender Dhaka (2016), "To determine the effect on the properties of concrete M30 by partial replacement of cement with marble powder" International Journal for Technological Research in Engineering (IJTRE), ISSN (Online): 2347 - 4718, Volume 4, Issue 1, September-2016, pp 98-102.

[12] IS: 456-2000, "Code of practice plain and reinforced concrete" , Bureau of Indian standard New Dehli.

[13] IS: 8112 -1989, "Indian standard of OPC", 43 grade specification (second version).

[14] IS: 383 -1970, "Specification for coarse and fine aggregate from natural sources for concrete" Bureau of Indian standards New Delhi.

[15] IS: 10262- 2009, "Indian Standard, recommended guidelines for concrete mix designs", Bureau of Indian Standard, New Delhi.

[16] Krishan P Pala, Krunal J Dhandha(2015), "Use of Marble Powder and Fly Ash in Self Compacting Concrete" IJIRST –International Journal for Innovative Research in Science & Technology, Volume 1, Issue 12, May 2015, ISSN (online): 2349-6010.pp 475-479.

[17] Mr. Lokesh Kumar , Prof. Gautam Bhadoriya (2015), " The Result of Partial Replacement of Cement by using Waste Fly Ash and Natural Sand by using Waste Marble Dust, Stone Dust on Mechanical Properties of Concrete" IJSTE - International Journal of Science Technology & Engineering | Volume 2 | Issue 06 | ISSN (online): 2349-784X ,December 2015,pp31-35.

[18] Pooja J.Chavhan, Prof. S. D. Bhole(2014), "To Study the Behaviour of Marble Powder as Supplementary Cementitious Material in Concrete" Int. Journal of Engineering Research and Applications, ISSN: 2248-9622, Vol. 4, Issue 4(Version 1), April 2014, pp.377-381.

[19] IS: 10262 – 1982,"Mix design", Bureau of Indian standard, New Delhi.

[20] IS: 516 – 1959, "Methods of tests for strength of concrete", BIS, New Delhi.

[21] Dr. S.K. Handoo, Advisor (Technical), Cement Manufacturers Association, 2018 Conference "Fly ash utilization"– Expo – Awards March 15-16, 2018.

[22] Kirti Vardhan, Shweta Goyal, "Effect of partial replacement of cement with marble powder in cement pastes" in the Year 2014.

[23] M. L. Gambhir -Concrete Manual, Fourth Edition, Published Dhanpat Rai &Co. (PVT.) Ltd., Delhi-110006.

[24] M. S. Shetty, Concrete Technology Theory, And Practice, 6th edition Published by S. CHAND & COMPANY LTD., New Delhi.

[25] Neville, A. M., Properties of Concrete, Fourth Edition, Prentice Hall, Harlow, UK.

[26] S.K.Duggal –Building Material 3rd edition, New Age international limited Publishers, New Delhi110002.

