Partial Replacement Of Cement With Marble Dust And Fly Ash

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ABSTRACT

Since last few years marble is considered one of the most important decorative building materials. Marble powder is one of the materials which affect the environment and health problems. It is produced from sawing, shaping, and polishing process. This Paper aims to study the effect of using marble dust & Fly ash as partially replace with cement on different ratio of concrete .The main variable taken into consideration is the percentage of marble dust and fly ash as partial replacement of cement content in concrete mixes. Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits. Marble stone industry generates both solid waste and stone slurry. Fly ash is produced in thermal industries.

This research work describes the feasibility of using the marble dust and thermal industry waste in concrete production as partial replacement of cement. The use of marble dust and fly ash in concrete formulations as a supplementary cementations material was tested as an alternative to traditional concrete. The cement has been replaced by marble dust and fly ash accordingly in the range of 0% (without marble dust and fly ash), 5%, 10%, 15% & 20% by weight of cement for M-25 mix. Concrete mixtures were produced, tested and compared in terms of compressive with the conventional concrete. These tests were carried out to evaluate the mechanical properties for the test results for compressive strength up to 28 days are taken.

Keywords—FLY ASH, MARBLE DUST, CEMENT, FINE AGGREGATE, COARSE AGGREGATE.

I. INTRODUCTION

Concrete is widely used construction material consisting of cementing material, fine aggregates, coarse aggregates and required quantity of water. The Marble dust is waste product obtained while cutting the marble blocks. The Fly Ash is also a waste obtained from industries. This will help to use the industrial waste product and contributes in ecofriendly construction.

In Civil Engineering "Cement" plays the important role as it is impossible to produce any sustainable infrastructure without use of cement. We can say everything is incomplete without "Cement", as construction industry is rapidly growing with new innovations and ideas. Traditionally, we use only cement in concrete for giving the strength to concrete but sometimes it is not possible to reach the exact strength, so that after a long and continue research pozzolanic materials get introduced to the world. Pozzolans are commonly used as an addition to Portland cement concrete mixtures to increase the long-term strength and other material properties of Portland cement concrete, in some cases reduce the material cost of concrete. Pozzolanic materials can be divided into two-groups" natural pozzolana and artificial pozzolana. Fly ash is used extensively as a partial replacement of cement. However, though the inclusion of fly ash in concrete gives many benefits, such inclusion causes a significant reduction in early strength due to the relatively slow hydration of fly ash. Nevertheless, fly ash causes an increase in workability of concrete. Quarry dust has been proposed as an alternative to river sand that gives additional benefit to concrete. Quarry dust is known to increase the strength of concrete over concrete made with equal quantities of river sand, but it causes a reduction in the workability of concrete. In this paper fly ash replaced by cement by 0%, 5%, 10%,15%,20% and 25%. The marble dust& fly ash replaced by cement by 0%, 5% , 10%, 15%, 20%.

II. MATERIALS

A. *Cement*

The ordinary Portland cement confirming to IS 4031 was used for the preparation of specimens. OPC 53 grade was used.

B. *Fine aggregate*

Fine aggregate is used in the experimental investigation and confirming to zone-II of IS 383-1970.Sand is used in the work which has the particle was less than 4.75mm.

C. Coarse aggregate

The coarse aggregate particles passing through 20mm and retained on 12.5 mm I.S Sieve used as the natural aggregate which met the grading requirement of IS 383-1970.

D. Water

Water is the most important and least expensive ingredient of concrete. A part of mixing water is utilized in the hydration of cement to form binding matrix in which the inert aggregates are held in suspension until the matrix has harden. The remaining water serves as a lubricant between the fine and coarse aggregate and makes concrete workable.

E. Marble dust

Crushed or powdered marble, sometimes used as a basic carbonate, and frequently used in art as an inert pigment, in the plaster used in frescos, in surface coatings, etc.

Fig 1- Marble dust

F. Fly ash

The ash produced at thermal power stations by burning of coal and lignite is known as fly ash.

III. Material Properties

A. Cement - Opc 53 grade

- Specific gravity -3.16
- Fineness modulus -3%
- Consistency -32%
- Initial setting time-35 mins
- Final setting time -10Hours

B. Fine aggregate

- Specific gravity -2.5
- Fineness modulus -5.27
- Water absorption 0.85%
- Bulk density-1782.46kg/m^3

C. Coarse aggregate

- Specific gravity -2.6%
- Fineness modulus -5.7
- Water absorption 0.56%
- Bulk density-1693.46kg/m^3
- Impact test -17.72%

D. Marble dust

TABLE I - Chemical composition of marble dust

COMPONENT	WEIGHT OF %
Cao	68.6
Mgo	22.13
Sio_2	3.89
Al_2o_3	2.785
Fe_2o_3	0.603
Cr_2o_3	0.24
Zno	0.20
Tio	0.549

E. Fly ash

TABLE II: Chemical composition of FLY ASH

COMPONENTS	WEIGHT OF %
Sio_2	59
Al_2o_3	21
Fe_2o_3	3.70
Cao	6.90
Mgo	1.40
So_3	1.00
K_2o	0.90
Loi	4.62

TABLE III: Mix design

Grade of concrete –M25

Water	Cement	Fine Aggregate	Coarse Aggregate
197.16	438.13	506.74	1206
0.45	1	1.15	2.7

For quantity of materials taken by per meter cube size mix proportions are given below table IV

TABLE IV: Mix Proportions

Mix ID	Cement (kg/m^3)	Fine agg. kg/m^3	Coarse agg. (kg/m^3)	Marble dust (kg/m^3)	Fly ASH (kg/m^3)
CC (0%)	5.4	6.6	14.7	0	0
5%	5.130	6.6	14.7	135	135
10%	4.860	6.6	14.7	270	270
15%	4.590	6.6	14.7	405	405
20%	4.32	6.6	14.7	540	540

Mix Proportion ID

a. M0- cement+F.A+C.A

b. M5-cement+F.A+C.A+5% Of Marble dust &Fly ash

c. M10-cement+F.A+C.A+10% Of Marble dust &Fly ash(With cement)

d. M10-cement+F.A+C.A+15% Of Marble dust &Fly ash(With cement)

e. M10-cement+F.A+C.A+20% Of Marble dust &Fly ash(With cement)

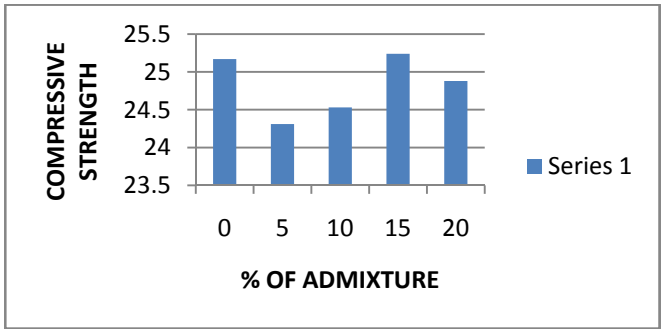

Fig 2 - Compressive strength

IV. EXPERIMENTAL WORK

A. Mechanical properties

Compressive strength

Compressive test was conducted in universal compressive testing machine of capacity 200 kN at a loading rate of 2.5 kN/sec. The compressive strength will achieved for thus combination results are below

TABLE V: Compressive strength

Mix Id	7 days (N/mm^2)	28days (N/mm^2)
M 0	16.67	31.55
M 5	15.77	30.88
M 10	16.22	31.33
M 15	16.88	32.22
M 20	16.44	32

Fig 1 - Compressive strength

Split tensile strength

Split tensile strength test was conducted in universal compressive testing machine of capacity 200 kN at a loading rate of 2.5 kN/sec.

TABLE VI : Split tensile strength

Mix Id	28 days (N/mm^2)
M 0	3.81
M 10	4.13
M 20	3.71

Fig 3 - Split tensile strength

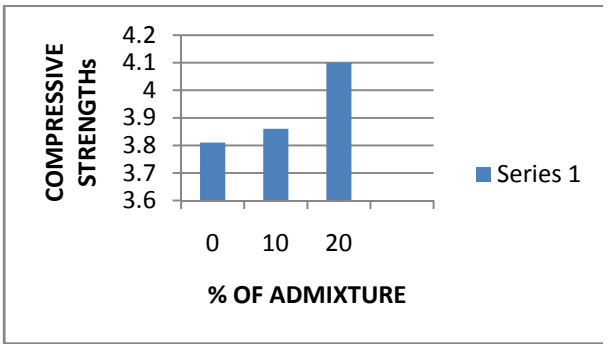

Fig 4 - Split tensile strength

V. RESULT AND DISCUSSION

Compressive strength

The compressive strength had achieved in 15% mix is high. That compressive strength result 16.88 N/mm^2 for 7 days and 28 days strength is 32.22 N/mm^2.The low compressive strength is given M 5 mix proportions.

Split tensile strength

The split tensile strength had achieved in M15 mix is high. That Split tensile strength maximum result 4.13N/mm^2 for 28 days.The low split tensile strength is given M20 mix proportions.

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