Experimental Study on Partial replacement of Sand with Marble Dust Powder in high strength concrete

AADIL GULZAR

M.Tech Scholar
Department of Civil Engineering
Structural Engineering, Swami Devi Dyal College of Engineering & Tech /Kurukshetra University Haryana, India

***Abstract*: Concrete is a versatile engineering composite material made with cement, sand, aggregates and admixtures in some cases. Extensive use of concrete leads to the scarcity of natural aggregates. Because of this reasons the reuse of demolished construction wastes and solid waste like marble dust powder from manufacturing units came into the picture to reduce the solid wastes from demolition and manufacturing units and as well as to decrease the scarcity of natural basic aggregate. My aim is to study the suitability alternative to. Demolished building wastes are used to partial replacement of the fine aggregate with marble powder. M45 of concrete mix has been taken and casted into cubes and astrength tests have been conducted.**

In this paper I conduct an experiment on partial replacement of sand with marble dust powder at different % of mdp which are 20,25,30,35,40%. After conducting tests we observe that the strength goes on increasing upto the 30% replacement of sand with mdp but at 35 and 40% of replacement the strength goes decreasing but still not decreased than the target mean strength as we used the glass fiber in the concrete mix whiuch gives more strength to concrete.So we came to conclude that we can replace sand with mdp upto 40% with glass fiber used in the mix

Keywords: cement, marble dust powder, Glass fiber, fine aggregate, course aggregate

1 Introduction

Cement concrete is the material which is widely used in construction throughout the world. Concrete consists of paste and aggregates. The paste comprises of water and cement and the aggregate portion is composed of sand and aggregates. The other ingredients that are used in concrete, cement is the most important ingredient, that in contact with water, makes a paste and this paste binds the aggregates together into a solid mass. The cement is produced in a large quantity. The production of cement is expected to cross 53 million tons by 2018. In the production of cement large amount of CO2 is emitted which produces adverse effects on the environment. Per researchers, every 1 ton of cement manufacture releases 0.6 ton of carbon dioxide that greatly contribute to the global warming. Therefore, immediate action is needed to be taken to minimize the production and usage of cement for the safety of environment. Coal during pulverization. In the furnace, carbon, other combustible matter burns,

2 LITERATURE REVIEW

Deepankar K. Ashish, Surender, K. Verma1a, Ravi Kumar and Nitisha Sharma [1]
Department of Civil Engineering, PEC University of Technology, Chandigarh 160-012, India
Maharaja Agrasen Institute of Technology, Maharaja Agrasen University, Baddi 174-103, India
Department of Civil Engineering, Kurukshetra University, Kurukshetra 136-119, India

Ali A. Aliabdo, Abd Elmoaty M. Abd Elmoaty, Esraa M. Auda [2]
Structural Engineering Department, Faculty of Engineering, Alexandria University, Egypt.Re-use of waste marble dust in the production of cement and concrete

Vienna G. Pathan1, Md. GulfamPathan [3] Their investigation revealed that replacing of cement with marble waste powder up to 20% reduces the slump of concrete mixes, whereas replacement of sand by marble waste powder up to 20% enhances the slump of the concrete mixes. In concrete production replacement of 5% cement by marble waste powder gives comparable compressive and flexural strength as of marble waste free concrete specimens but increasing the replacement range beyond 5% results in strength reduction. In concrete production, replacing of sand up to 20% by marble waste powder gives similar strength as of concrete mixes with 100% sand both at early and latter ages.

Manju Pawar et.al [4] A Study has been conducted on Periodic Research, The Significance of Partial replacement of Cement with Waste Marble Powder. They found that the effect of using marble powder as constituents of fines in mortar or concrete by partially reducing quantities of cement has been studied in terms of the relative compressive, tensile as well as flexural strengths. Partial replacement of cement by varying percentage of marble powder reveals that increased waste marble powder (WMP) ratio result in increased strengths of the mortar and concrete .Leaving the waste materials to the

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Corinaldesi V et al.,[7] Marble as a building material especially in palaces and monuments has been in use for ages. However the use is limited as stone bricks in wall or arches or as lining slabs in walls, roofs or floors, leaving its wastage at quarry or at the sizing industry generally unattended for use in the building industry itself as filler or plasticizer in mortar or concrete. The result is that the mass which is 40% of total marble quarried has reached as high as millions of tons. This huge unattended mass of marble waste consisting of very fine particles is today one of the environmental problems around the world

3 EXPERIMENTAL PROGRAMME

Experimental programme comprises tests on cement, Rice husk ash, Brick kiln powder fine Aggregate, Coarse Aggregate,

3.1 Ordinary Portland cement

OPC 43 grade cement is used for this whole experimental study.

Ordinary Portland cement of 43 grade were tested for different tests and physical test results on OPC were as follows:

1) Normal consistency 12%

2) Initial Setting time 35 min.

3) Final Setting Time 275 min.

4) Specific Gravity 3.13

3.2 Marble dust powder

Rice Husk Ash was tested for different tests and test results as follows:

1) Normal Consistency 17%

2) Initial Setting time 85 min.
3) Final sitting time 385 min.

4) Compressive Strength 7 N/mm^2
5) Specific Gravity 2.62

3.3 Fine Aggregate

1) Sand conforms to zone I
2) Sand is well graded
3) Specific gravity of sand is 2.27
4) Fineness moduls of sand is 2.48
5) Free Moisture Content 1.8%

3.4 Coarse Aggregate

1) Specific gravity of coarse aggregate is 2.94
2) Fineness modlus 2.47
3) Free Moisture Content 0.2

3.5 Glass Fiber

1) Tensile strength 11n/mm
2) Tenacity 4.3-5.9gm/den
3) Density 2.2gm/c.c
4) Specific gravity 2.40

Details of mix proportion: Grade of concrete is M45, having ratio **1:1.52:2.35** the design is based on IS 10262-2009 and Water/cement ratio = **0.34**

Table: 1.1 Details of mix proportion

S.NO	% OF CEMENT	% OF MARBLE POWDER	FINE AGGREGATE	COARSE AGGREGATE	GLASS FIBER
1	99.5%	0%	2.586	3.868	0.5%
2	99.5%	20	2.06	3.868	0.5%
3	99.5%	25	1.94	3.868	0.5%
4	99.5%	30	1.81	3.868	0.5%
5	99.5%	35	1.67	3.868	0.5%
6	99.5%	40	1.55	3.868	0.5%

3.6 Workability: It is observed that degree of workability is medium as per BIS (IS: 456-2000) for the normal concrete. It is also observed that, as the percentage of MDP increases from 0% to 22%, the mix becomes stiffer, and workability results in low slump value. Low slump value may have great impact on the workability of concrete.
Workability of concrete mixtures was measured by performing slump and compaction factor tests as per procedure given in Indian standard BIS: 1199-1959.

- **Slump test:** Slump test was performed in laboratory to determine the workability of controlled concrete and the effect of MDP and on fresh concrete.

- **Compaction Factor Test**: - Compaction factor test was performed in laboratory to determine the workability of concrete. The compaction factor is the ratio of weights of partially compacted to fully compacted concrete.

S.no	Design mix	Slump value	Compaction value
1	Normal mix	65mm	0.91
2	MIX 1	75mm	0.92
3	MIX 2	80mm	0.89
4	MIX 3	110mm	0.93
5	MIX 4	70mm	0.94
6	MIX 5	65mm	0.91

Fig.2 Slump Vs. % of replacement of MDP with cement

3.7 Specimen Details

Cube specimens of 150 mmx150mmx150mm size for compressive strength, Cylinder specimens of size 150 mm diameter x 300 mm height and prisms of size 100mm x 100mm x 700mm were cast to study the mechanical strength properties such as compressive strength, split tensile strength and flexural strength according to Indian standards.

3.8 Casting and curing:

The moulds were tightly fitted and all the joints were sealed by plaster of Paris in order to prevent leakage of cement slurry through the joints. The inner side of the moulds was thoroughly oiled before going for concreting. The mix proportions were put in miller and thoroughly mixed. The prepared concrete was placed in the moulds and is compacted using needle& plate vibrators. The same

process is adopted for all specimens. After specimens were compacted the top surface is leveled with a trowel. The operation of curing is designed to overcome thebproblems of loss of hydration. The prepared specimens are cured in curing tank for a period of 7, 14 and 28 days.

4 EXPERIMENTAL METHODOLOGY.

4.1Compressive strenghth test

the compressive strength test was performed to check the strength of specimen after 7 and 28 days.the mould having dimensions 150mm x150mm x150mm and then mould is filled with concrete in different preportions of mdp the mould was given the vibration by vibrator.After that the mould was done for curing for 7 and 28 days on which different values of strength was obtained after testing of specimen in crushing strength test machine

4.2 flexure strength test

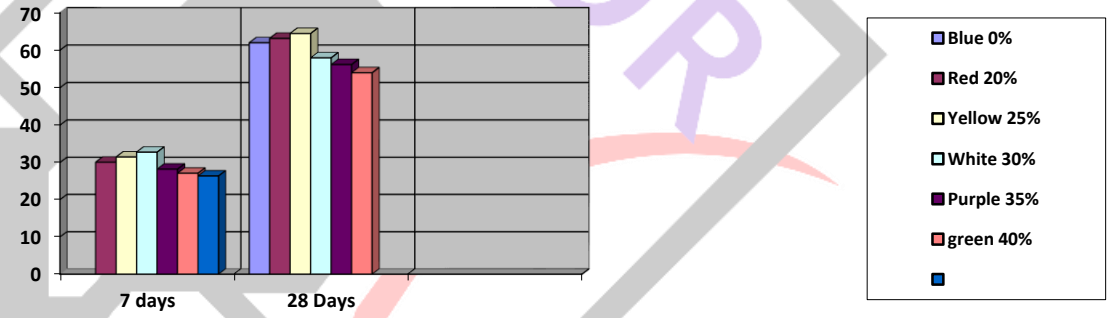
The standard sizes of beam specimen were 15x15x70 cm. The beam moulds conform to IS:10086 1982.The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days.. Test specimens shall be stored in water at a temperature of 24^0 34 ^{0}c for 48 hours before testing. These specimens were tested under flexural testing machine The specimens shall be tested immediately on removal from the water while they are still in the wet condition

4.3 Tensile Strength Test.

For tensile strength test, cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category, three cylinders were tested and their average value was reported

5.1 EXPERIMENTAL RESULTS

Results of M45 grade of OPC concrete filled with various proportions of Marble dust powder for compressive strength, split tensile strength also for flexural strength test are shown in table below

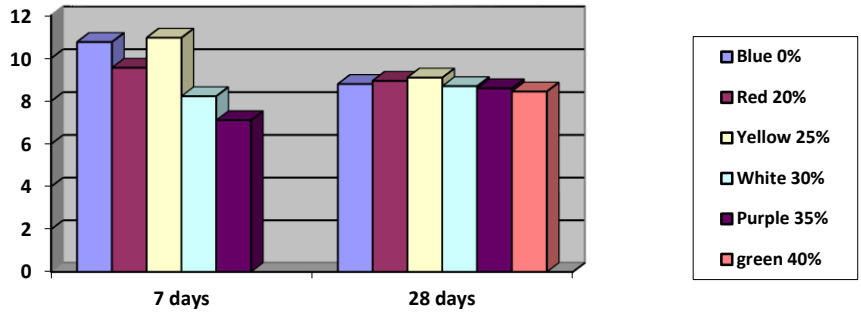


In The Histogram above along Y axis is Compressive Strength and along X-axis is replacement of MDP with different period of curing

Fig: 5.1 Compressive strength Vs. % of replacement

Table 1.1 compressive strength after 7 and 28 days

MIX DESIGN	%Replacement of marble dust powder	Compressive strength(mpa) after 7 days of curing	Compressive strength(mpa) after 28 days of curing
Control mix	0%	30.5	62.20
Mix 1	20%	31.55	63.50
Mix 2	25%	32.10	64.55
Mix 3	30%	28.66	58.30
Mix 4	35%	27.33	56.77
MIX5	40%	26.40	54.40



In The Histogram above along Y axis is Flexural Strength and along X-axis is replacement of MDP after 28 days of curing

Fig. 5 Flexural strength Vs. % of relacement

Table 1.2 flexure strength after 7 and 28 days

S .No	Mix designation	Average flexural strength After 7 days	Average flexural strength After 28 days
1	MX-MDP 1	4.20	8.80
2	MX-MDP 2	4.40	8.95
3	MX-MDP 2	4.55	9.10
4	MX-MDP 3	4.20	8.70
5	MX-MDP 4	4.10	8.60
6	MX-MDP 5	4.00	8.45

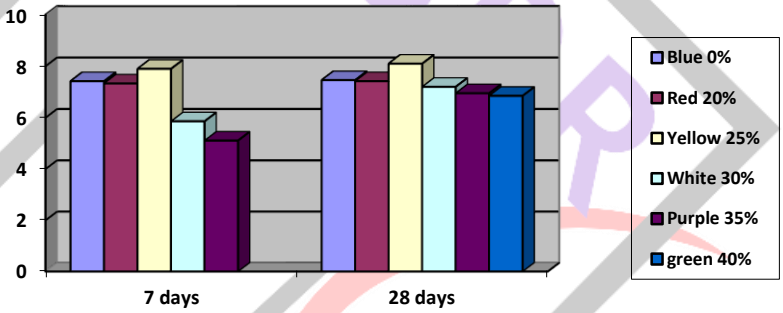


Table 1.2 Tenssile strength after 7 and 28 days

S.No	Mix designation	Average split tensile after 7 days N/mm²	Average split tensile after 28 days N/mm²
1	MX-MDP 1	3.25	7.46
2	MX-MDP 2	3.30	7.42
3	MX-MDP 2	4.10	8.10
4	MX-MDP 3	3.10	7.20
5	MX-MDP 4	2.90	6.95
6	MX-MDP 5	2.70	6.85

In The Histogram above along Y axis is Split Tensile Strength and along X-axis is replacement of MDP after 28 days of curing

Fig. 4 Spilt tensile strength Vs. % of replacement of MDP

5.2 CONCLUSION

It can be seen from the results of this study that use of marble dust replacement of sand in for the construction purpose should be encouraged where there comparitive cost advantage, the following conclusions can be made from this study.

[1] The workability increased with increase of marble powder.
[2] The mechanical properties also increased with increasing of curing days.
[3] The compressive strength increased with increase of replacement of sand with marble powder up to 30% replacement and then got decreased
[4] It was observed that 1.81%,1.92% and 2.58% of strengtrh increased compared to normal mix with 30% replacement of marble powder at 7 and 28 and days respectively.

[5] It was observed that 0.43%,11.6% and 5.6% of spilt tensile strength incresed at 30% of marble powder compared to normal mix at 7 and 28days respectively.
[6] It was noticed that 1.22%, 2% and 3.8% of flexural strength increased at 30% replacement of marble powder compared to normal mix at 7,14 and 28 days respectively.
[7] Considerable reduction in strength was observed at 35% and 40% replacement of marble powder.
[8] Strength, spilt tensile strength and flexural strength 30% replacement with marble powder is found to increased
[9] best alternative for replacement as increase in percentage of strength is high compared to other variations in the mix 3(30%)

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