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Experimental Investigation on Concrete by Partial Replacement of Marble Powder and Bore Well Sand

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ABSTRACT

Concrete is the most widely used construction material in civil engineering industry because of its high structural strength and stability. Leaving the waste materials to the environment directly can cause environmental problem. Marble stone industry generates both solid waste and stone slurry. The concrete industry is constantly looking for supplementary material with the objective of reducing the solid waste disposal problem. In this paper cement is replace by marble powder the research is carried out by using M25 grade concrete with replacement of 5%, 10%, 15% marble powder by cement in addition of 50% replacement of normal sand by bore well sand and is carried out to determine the optimum percentage of replacement at which maximum compressive Strength, split tensile strength, flexural strength is achieved.

Keywords: Marble powder, Bore well sand, water cement ratio, compressive strength, tensile strength test.

1. INTRODUCTION

Marble is a metamorphic rock resulting from the transformation of a pure limestone. The purity of the marble is responsible for colour and appearance: it is white if the limestone is composed solely calcite (100% CaCO3). Marble is used for construction and decoration marble is durable, has a noble appearance, and is consequently in great demand. A large quantity of powder is generated during cutting process. The result is that the mass of marble waste which is 20% 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 concrete is heterogeneous mix of cement, aggregates and water. The global consumption of natural mix is too high due to extensive use in concrete. The demand for natural sand is quite high in developing countries owing to rapid infrastructural growth which results supply scarcity. To overcome from this crisis, partial replacement of natural sand with marble powder sand is economic alternative. The concrete industry is constantly looking for supplementary material with the objective of reducing the solid waste generated by disposal problem. Marble powder is among the solid waste generated by industry. in this research we prepared the three specimen for each sample cubes for compressive strength test, cylinder for spli tensile strength test, flexural strength test on hardened concrete are destructive test while destructive test includes includes compressive strength test as per IS: 516 - 1959, split tensile strength test as per IS: 5816-1999.

2. EXPERIMENTAL INVESTIGATION

2.1 Portland Pozzolona Cement (Ppc)

Cement must develop the appropriate strength. It must represent the appropriate rheological behavior. Generally same types of cements have quite different rheological and strength characteristics, particularly when used in combination with admixtures and supplementary cementing materials. In this present study 53 grade Portland Pozzolona Cement (PPC) is used for all concrete mixes. The cement used is fresh and without any lumps. Fineness, or particle size of Portland cement affects Hydration rate and thus the rate of strength gain.

2.2 Fine Aggregate

Fine aggregate normally consists of natural, crushed, or manufactured sand. Natural sand is the usual component for normal weight concrete. The maximum grain size and size distribution of the fine aggregate depends on the type of product being made. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape.

2.3 Course Aggregate

Broken granite stone/gravel and its size is 4.75mm gauge plus i.e., retained on 4.75mm IS sieve. Coarse aggregates are particles greater than 4.75mm, but generally range between 9.5mm to 37.5mm in diameter. They can either be from Primary, Secondary or Recycled sources. Primary, or 'virgin', aggregates are either Land- or Marine-Won. Gravel is a coarse marine-won aggregate; land-won coarse aggregates include gravel and crushed rock.

2.4 Marble Powder

Marble powder from ghat road nagpur powder is 2.842 gmm/cc, fineness by sieving 24.4 %, specific surface area (cm2/gm) $11.4*10^3$ Marble is a metamorphic rock resulting from the transformation of a pure limestone.

2.5 Bore Well Sand

The Bore well sand produced during the boring the soil, its left without no use and become a waste material. its are easy to available where the bore work done at construction site.

3. RESULT AND DISCUSSION

3.1 Compressive strength

At the time of testing, each specimen must keep in compressive testing machine. The maximum load at the breakage of concrete block will be noted. From the noted values, the compressive strength may calculated by using below formula.

Compressive Strength = Load / Area

Size of the test specimen=150mm x 150mm x 150mm

3.2 Split Tensile strength

Split Tensile Test is the theoretical maximum indirect tensile stress obtained by splitting the specimen under a concentrated compressive line load. The size of cylinders 300 mm length and 150 mm diameter are placed in the machine such that load is applied on the opposite side of the cubes are casted

3.3 Flexural strength

Flexural strength is the theoretical maximum tensile stress reached in the bottom fibre of a test beam during a flexural strength test. During the testing, the beam specimens of size 7000mmx150mmx150mm were used. Specimens were dried in open air after 7 days of curing and subjected to flexural strength test under flexural testing assembly.

3.4 Tests on Hardened Concrete

Table 3.1 Compressive strength test

% of MP	Compressive strength (Mpa) at 7 days	Compressive strength (Mpa) at 28 days
0	19.8	33.87
5	20.83	34.5
10	21.33	35.7
15	18.79	30.32

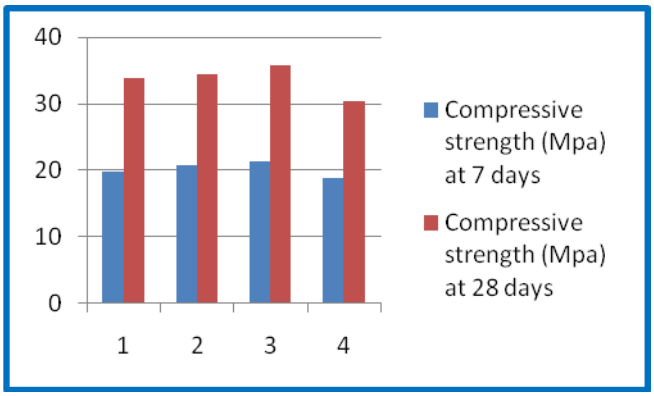

Fig 3.1 Compressive Strength for various % replacements

The specimen contained 10% of partially replaced by cement with 50% replacement of river sand by bore well sand. We observed that Compressive strength of mixes decreases as the replacement of marble powder increases. But with 10 % of marble powder gives higher strength.

We observed that tensile strength of mixes decreases as the replacement of marble powder increases.

Table 3.2 Split Tensile strength test

% of MP	Split Tensile Strength at (Mpa) 7 days	Split Tensile Strength at (Mpa) 7 days
	2.45	2.9
5	3.1	3.25
10	3.75	3.9
15	2.8	3.1

But with 10 % of marble powder and 50% replacement Normal River sand by bore well sand gives higher strength compared to control mix

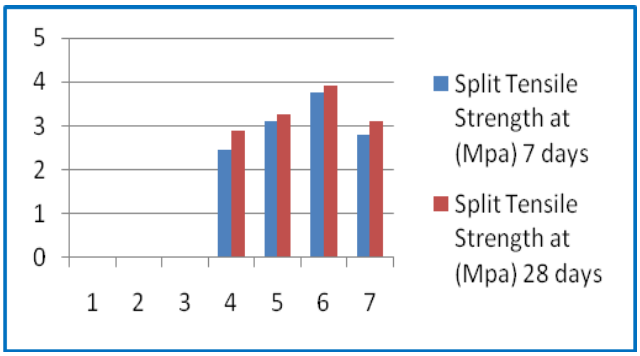

Fig 3.2 Flexural Strength for various % replacements

Table 3.3 Flexural strength test

% of MP	Flexural Strength at (Mpa) 7 days	Flexural Strength at (Mpa) 28days
0	3.11	4.27
5	3.14	4.38
10	3.2	4.95
15	3.03	3.84

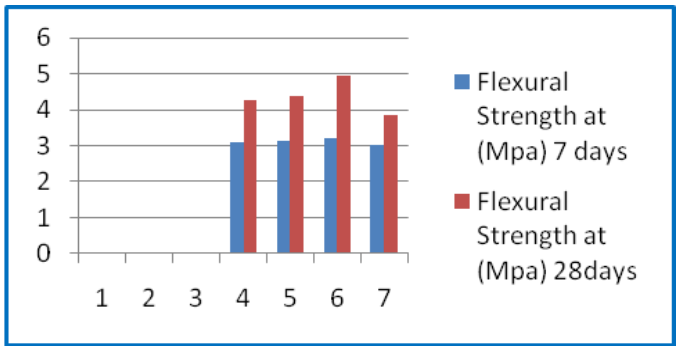

***Fig 3.3** Flexural Strength for various % replacements*

We observed that Flexural strength of mixes decreases as the replacement of marble powder increases. But with 10 % of marble powder and 50% replacement Normal River sand by bore well sand gives higher strength compared to control mix.

CONCLUSION

- Up to 10% replacement of cement and 50% replacement of river sand with waste marble and bore sand respectively there is a increase in all mechanical properties.

- The replacement of 10% of cement and 50% replacement of river sand with waste marble powder and bore sand respectively attains maximum compressive, tensile strength, flexural strength.
- The optimum percentage for replacement of marble powder with cement and it is almost 10% cement and 50% river sand for both cubes cylinders and prism.
- To minimize the costs for construction with usage of marble powder and bore sand which is freely or cheaply available more importantly.
- To realm of saving the environmental pollution by cement production; being our main objective as Civil Engineers.

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Conflict of Interest

None of the authors have any conflicts of interest to declare.