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Mechanical Properties of Concrete with Quarry Dust and Marble powder

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ABSTRACT: The need for environmentally friendly building materials has sparked a wave of study into improving concrete's qualities while lessening its impact on the environment. This research looks into the viability of using marble powder and quarry dust in place of some fine aggregate while making concrete. Two plentiful and frequently untapped resources are marble powder, a waste product from processing marble, and quarry dust, a by-product of stone crushing processes. In this experiment, fine aggregate in concrete mixes was replaced with different ratios of quarry dust while keeping the percentage of marble powder at 15% constant. To determine compressive and split tensile strengths for 28,56 and 90 days.

KEY WORDS: Quarry Dust, Marble powder, Environment, Compressive Strength, Split Tensile Strength.

I. INTRODUCTION

Cement, aggregates (such sand and gravel), and water are the main ingredients of concrete, a widely used and adaptable building material. Because of its strength, resilience, and adaptability, it has been a mainstay of contemporary construction for generations. In many different construction applications, such as buildings, bridges, roads, dams, and infrastructure projects, concrete is essential.

A by-product of the crushing of stones in quarries, quarry dust is sometimes referred to as stone dust or crusher dust. It is made up of fragments that are produced when rocks are crushed to make aggregates for building, ranging in size from fine dust to gravel-sized stones. Despite being viewed as a waste product in the past, quarry dust has a number of qualities that make it a potentially useful resource for a range of uses, including building.

Marble processing enterprises produce marble powder as a by-product when they cut, grind, and polish marble blocks into different sizes and forms for architectural and ornamental uses. The finely crushed calcium carbonate and other mineral particles found in marble make up this powder. Marble powder has historically been seen as a waste material, but because of its special qualities, it is a desirable option for a variety of uses, especially in the building industry.

II. OBJECTIVES

1. To evaluate the use of marble powder and quarry dust as fine aggregate.
2. To ascertain the concrete's split tensile and compressive strengths.

III. MATERIALS

3.1 Cement: A substance called cement is utilized in construction as a binding agent to keep the other building materials attached to one another. In concrete, fine aggregate fills in the spaces left by coarse aggregate, which makes up the bulk of the mixture. While mortar consists of only plain cement combined with water and fine aggregate, concrete consists solely of cement mixed with coarse aggregate.

3.2 Fine Aggregate: Fine aggregates are natural sand particles that are extracted from the earth during mining. They can be any ¼" or smaller crushed stone particle size. Since the size, or grading, of this aggregate is what leads to the frequent description of this product as 1/4' minus. A 4.75 mm IS Sieve is considered to be the material that passes through as fine aggregate. Sand in River Grading Zone II.(Grain of medium size).

3.3 Coarse Aggregate: A coarse aggregate is one that is maintained at a sieve size greater than 4.75 mm. Particle sizes can range from 10 to 20 mm, however self-compacting concrete has been reported to employ particles as large as 40 mm.

3.4 Marble Powder: Marble powder is a fine material that is obtained as a by-product during the processing of marble, a metamorphic rock composed primarily of calcium carbonate (CaCO₃). Marble powder is typically produced during the cutting, grinding, and polishing of marble blocks into various shapes and sizes for architectural and decorative purposes. It consists of finely ground particles, often with a smooth texture, resulting from the pulverization of marble.

3.5 Quarrydust: Quarry dust, also known as stone dust or crusher dust, is a by-product of stone crushing operations in quarries. It is generated when rock is crushed into smaller particles during the process of extracting aggregates for construction purposes. Quarry dust consists of fine particles ranging from dust to gravel-sized fragments, depending on the crushing process and the type of rock being crushed.

IV. EXPERIMENTAL INVESTIGATIONS

4.1 Compressive Strength Results: Standardized laboratory tests are used to assess the compressive strength of concrete. These tests are typically performed on cylindrical or cubic specimens that are subjected to progressively increasing compressive loads until failure.

Table 1: Compressive Strength of Concrete with Quarry dust and Maintaining Constant Percent Of Marble Powder As Partial Replacement Of Cement.

S.No	% of Quarry dust+ 15%Marblepowder	Compressive strength (N/mm ²)		
		28 days	56 days	90 days
1	0%	49.83	54.28	58.24
2	15%+10%	60.39	65.81	70.58
3	15%+20%	64.33	70.13	75.29
4	15%+30%	67.78	73.89	79.47
5	15%+40%	66.32	72.28	77.58

4.2 Split Tensile Strength Test: A cylindrical specimen is positioned horizontally between two compressive platens of a testing apparatus in a split tensile strength test for concrete. The specimen experiences a diametrically applied compressive force that causes it to split and fracture along its length. Split tensile stress is the tensile stress that develops perpendicular to the applied force.

Table 2: Split tensile Strength of Concrete With Quarry dust and Maintaining Constant Percent Of Marble Powder As Partial Replacement Of Cement.

S.No	% of Quarry dust+ 15%Marblepowder	Split tensile strength (N/mm ²)		
		28 days	56 days	90 days
1	0%	4.87	5.31	5.69
2	15%+10%	5.94	6.47	6.94
3	15%+20%	6.56	7.14	7.62
4	15%+30%	6.91	7.53	8.01
5	15%+40%	6.62	7.26	7.75

V. CONCLUSIONS

1. The compressive strength results for 28, 56 and 90 days of normal concrete are 49.83 , 54.28 and 58.24N/mm².
2. The split tensile strength results for 28, 56 and 90 days of normal concrete are 4.87,5.31 and 5.69 N/mm².

3. By maintaining 15% of marble powder constant and incorporating 30% of quarry dust, the compressive strength results for 28, 56 and 90 days is 67.78, 73.89 and 79.47 N/mm².
4. By maintaining 15% of marble powder constant and incorporating 30% of quarry dust, the split tensile strength results for 28, 56 and 90 days is 6.91, 7.53 and 8.01 N/mm².

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