SUITABILITY OF MARBLE POWDER AS A FINE AGGEREGATE IN CONCRETE

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Abstract- The majority of civil engineering structures are constructed of concrete, which is the fundamental building material. High-quality concrete is made with materials. Cement, fine aggregate, coarse aggregate, admixtures, chemical admixtures, and water make up concrete.

The marble contributes enormously to any country's financial turn of events. In view of the amount of marble saves, Pakistan depends on the marble powder area, which adds to the nation's Gross domestic product. Additionally, the marble industry is producing more marble powder, which continues to pose environmental risks. At the same time, natural resources and reserves are shrinking, prompting an immediate demand for a product that resembles sand. This study found that replacing up to 20% of the fine aggregate in concrete with marble powder improves its mechanical properties and compressive and tensile strength with increasing curing days.

Watchwords Fractional fine totals substitution marble powder strong waste materials concrete, regular assets protection.

Keywords-Partial fine aggregates replacement marble powder solid waste materials concrete, natural resources conservation.

1. Introduction

A. Concrete

B. Concrete is derived from the Latin word "Concretus," which meaning compact or condensed. Concrete is a paste made from coarse and fine aggregate, cement, sand, water, and additives.

C. Marble

The main marble producing countries are Italy, China, Tuckey, India, Egypt, Spain, Brazil, Algeria, Sweden, and France. India is the world's third largest producer of marble, accounting for over 10% of global marble powder production. Furthermore, stone is mostly imported and processed in countries such as Pakistan, the United States, Egypt, Germany, France, and Greece. A large amount of marble trash is generated at various phases of stone mining and processing activities. Up to 60% of which is created solely by marble quarrying.

Fig.1.Marble

Marble dust is used to manufacture counters, construction stones, sculptures, floors and a variety of other products by combining it with concrete, cement or synthetic resins. Because of the crystallised particles found in marble dust, the object has an iridescent appearance. These refined
Marble artefacts are frequently seen in high-end settings. Marble dust-based synthetic marble artefacts are more often utilised than real marble objects. Marble dust is frequently used as a paint primer and filler in canvas paintings.

Application as a hardening agent for the rubber industry and as an additive for thermoplastics:

- Power covering, paints and fired industry.
- Polyester glass fiber reinforced o Calfskin fabric and deck applications.
- The application of detergent.
- Glass industry (in assembling sheet and optical glasses).

Advantages:

• Marble residue can be utilized as an added substance in cement to fortify the strength of the substantial.

• We can lessen the amount of pollution in the environment by using this marble dust.

• Marble dust is joined with cement, concrete, or engineered tars to make ledges, development stones, and different items.

• White cement is produced using marble dust.

• Marble has superior binding properties and is less expensive than cement.

Disadvantages:

• Marble dust is not available everywhere.

• Marble dust raises soil alkalinity.

• The stone industry accounts for only 20% of the final output.

• Marble dust has a negative impact on soil fertility.

Problems by Waste Marble Powder (WMP):

The WMP poses major challenges to the environment's ecosystem, physical, chemical, and biological components. • It has a negative impact on land production due to lower porosity, water absorption, water percolation, and so on.

• It becomes airborne when dried, causing significant air pollution. • Affecting water quality during the rainy season, limiting storage capacity, and harming aquatic life.

• It has a negative impact on people's social and industrial activities because the heaps of powder that remain dispersed around the country are an eyesore and degrade the aesthetics of the entire region.

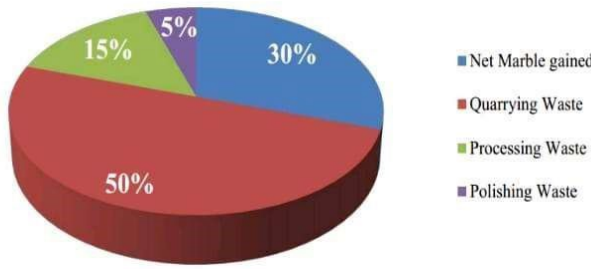


Fig.2.Marble product and waste

2.LITERATURE REVIEW

2019: Syed Furquan Almmed The examination was done in concrete, a heterogeneous combination of coarse and fine concrete total and a limited quantity of water, for this postulation. Cement's compressive strength increases. After 28 days of curing in water, the compressive strength of 5% marble powder partially replaced with fine aggregate is 40.88N/mm2. Marble powder somewhat replaces fine all out in concrete, which deals with the significant's compressive strength. Moreover, the consequences of the tests exhibit that extra marble powder can be fill in for fine all out in the concrete gathering partially.

Govind Lal Gehlot, Govind For M-25, the sand has been supplanted by marble in the levels of 10%, 20%, and 30 percent by weight of concrete. These tests were coordinated to evaluate the mechanical properties for the test disclosures, which included compressive strength for up to 28 days and compressive strength increases of 10-20% when marble was used instead of fine all out. As the degree of marble rises, the flexibility of significant declines. Concrete made with recycled marble saves a lot of money. The joining of marble powder into the substantial diminished its permeability and water maintenance, two qualities that fundamentally affected the end-product.

Mrs. Kaleeswari and Gopi R. (2017): Marble powder can be added to concrete in proportions of 0%, 5%, 10%, 15%, 20%, and 25% by weight of cement to increase its compressive strength, split tensile strength, flexural strength, and modulus of elasticity , respectively. Substantial strength is tried north of seven, fourteen and 28 days utilizing 3D squares and chambers. The fundamental research that was carried out to determine whether marble powder could be used as a partial replacement material serves as the foundation for the investigation of concrete properties like workability, strength, and durability.

Gameiro et al. (2013) inspected the impacts of marble mining waste supplanting 20%, 50%, and 100% of the ordinary fine complete on concrete with a steady water-to-substantial proportion of 0.55. They came to the conclusion that, in substantial blends, replacing sand with marble digging waste by as much as 20% improved their mechanical and toughness properties. Moreover, they found that the convenience diminished because of an expansion in the fine iota surface area, which might have been brought about by adjusting the water-significant degree. As the proportions of marble mining waste replacing the fine total increased, the proportion of water to solidify increased, reducing compressive strength.

A study led by Gencel and others (2012) investigated the possibility of using squashed marble waste as a halfway substitute for conventional fine totals at rates ranging from 0% to 40% for the construction of substantial clearing blocks. When compared to control concrete, they discovered that substituting marble powder for 10% to 40% of the fine total decreased compressive strength, thickness, and water assimilation by 22%, 5%, and 28%, respectively. It was furthermore found that after 40% replacement, scratched spot resistance extended by 20.14% and relative strength adversity after freeze-thaw out block dropped by 4.43%.

3. OBJECTIVES

This venture's main role is to attempt a trial examination to work on the properties of marble powder as fine totals in concrete. The primary goals of this study are as follows:

1. to investigate the effects of substituting marble powder for fine concrete particles at various levels.

2. to learn about marble powder's freshness and hardness.

3. Examine the mechanical properties of concrete, such as its compressive, split, and flexural strengths.

4. by adjusting the fineness proportion, confidence in using marble powder will increase.

5. To create an alternative to sand by utilising discarded marble dust.

4.MATERIALS AND METHODOLOGY

GENERAL: The characteristics of the fixings used in the substantial do not completely determine the strength of cement. The materials used in the preliminary are recorded under. The physical parameters of the materials, which are listed in the tables that correspond to them, are determined by tests carried out in accordance with IS standards. Cement, fine aggregate, and course aggregate's physical properties were examined for the purpose of gathering test data for the components of the design mix. The fundamental laboratory materials tests that were carried out on the collected materials are listed below.

Materials Utilized In The Substantial

- Cement
- Coarse aggregate
- Water

Cement, marble powder: OPC 43, the most widely used cement in everyday portland cement, was utilized for general concrete structures. The final putting time, fineness, soundness, specific gravity, popular consistency, and compressive best, specific gravity 3.15, were all determined through the bond's various tests.

COARSEAGGREGATE: The definition of coarse aggregates is the maximum amount of coarse material that can be retained on a 4.75-millimeter IS sieve and the smallest amount of coarse material that is permitted by the standard. Grade the coarse aggregates in accordance with IS 383 - 1970 requirements.

WATER: Water is the most important component in making mortar. It must not contain anything that harms the hydration of cement or mortar's durability. By and large, water that is protected to drink can likewise be utilized for substantial blending. With sufficient chemical admixture inclusion, water-to-cement ratios of 0.27 to 0.36 are frequently utilized, and values as high as 0.40 have been utilized successfully. The relationship between strength and the ratio of water to cementitious material is unclear because, in contrast to conventional concrete, light weight concrete has a paste content that is lower than the content of voids between the particles.

POWDER OF MARKER: Marble is used a lot in architecture and sculpture these days, and marble powder is made by cutting and dressing marble. The marble waste form was still wet after being cut and ground, so it was dried and sieved with an IS-90 micron sieve before being mixed with sand in a specific proportion.

5.METHODOLOGY

This approach was utilized to research the attributes of new and solidified concrete. The experimental work includes the next procedure.

The development of the M30 cement grade was completed in accordance with the codal requirements of IS 10262-2009. The significant mixes contained moving proportions of marble powder: 0%, 5%, 10%, 15%, 20%, and 100%. New and hardened qualities of the made mixes were analyzed.

Mixing and Filling of Concrete In Moulds

After the batching was finished, water was added as needed, and mixing was done using a shovel by turning it over and over until colour homogeneity was reached. Water was poured with caution to avoid overflowing. By taming, the uniform slurry was placed in the mould in three levelsEach layer is repeated 25 times to fill voids within the moulds and compare the concrete. The manual compaction methods in cubes are depicted in the figure below.

Fig.3. Filling mortar in Moulds

Fig.4. Casting of blocks

Fig.5. Designation given to blocks

TABLE 1: BASIC TEST ON CEMENT

Sl No	Test	Reference	Results
11	Finess of Cement	Is :4031 - 1976	7%
22	Normal Consistency	Is:4031-Pt.4	28%
33	Specific Gravity	Is:2720-Pt3	3.1
44	Initial Setting Time	Is:4031-1968	38min
55	Final Setting	Is:4031-1968	300

TABLE. 2: TEST ON COARSE AGGREGATE

Sl No	Test	Reference	Results
1	Sieve analysis	IS:2720-Pt-4	2.7
2	Specific gravity	IS:2380-Pt-3	2.6
3	Water absorption	IS:2386-Pt-3	0.5%
4	Flakiness index Elongation index	IS:2386-1963	29% 14%
5	Aggregate crushing test	IS:2386-Pt-4	27%
6	Aggregate impact test	IS:2386-Pt-4	22%
7	Los Angeles abrasion test	IS:2386-Pt-4:1963	24%

Following the mixing and filling of concrete in moulds. After 24 hours, the concrete cubes are taken from the mould and stored in a curing chamber for 7 and 28 days.

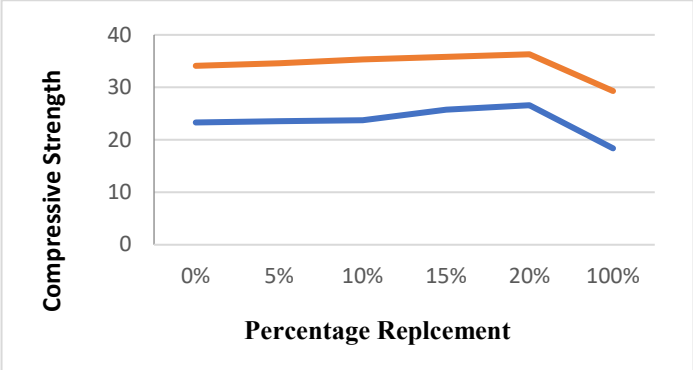
TABLE. 3:TEST ON MARBLE POWDER

Sl No	Property	Results
1	Specific gravity	2.4
2	Density	575 kg/m^3
3	Mean particle size	0.1µm
4	Min surface area	2500m^2/kg
5	Particle shape	Spherical

Fig. 6: Compressive strength

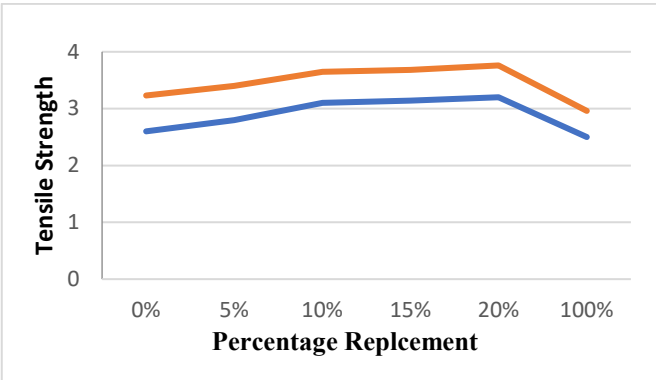
5. RESULTS

SL NO	Replacement of Marble Powder	Compressive Strength (N/mm^2)	
		7 DAYS	28 DAYS
1	0%	23.32	34.1
2	5%	23.57	34.6
3	10%	23.72	35.3
4	15%	25.75	35.8
5	20%	26.59	36.3
6	100%	18.37	29.3



Compressive Strength representation of 7 days and 28 days cube strength

SL NO	Replacement of Marble Powder	Tensile Strength (N/mm²)	
		7 DAYS	28 DAYS
1	0%	2.6	3.23
2	5%	2.8	3.4
3	10%	3.1	3.65
4	15%	3.14	3.68
5	20%	3.2	3.76
6	100%	2.5	2.96



Tensile representation of 7 days and 28 days cube strength

6. CONCLUSION

- Up to 20% fine aggregate replacement with marble powder increases the compressive and tensile strength of concrete.
- Increasing the proportion of marble in concrete reduces its compressive and tensile strength.
- As the amount of marble powder increased, so did the workability.
- As the number of curing days increased, so did the mechanical qualities.
- The increase in concrete strength when sand was replaced with Marble Powder demonstrated that it may be efficiently used in the making of concrete, contributing to the reduction of natural resource utilisation in concrete.
- For compressive strength and spilt tensile strength, 20% substitution with marble powder is found to be the optimum replacement option since the percentage gain in strength is high when compared to other modifications in the mix.

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