

AN EXPERIMENTAL INVESTIGATION OF THE IMPACT OF M SAND AND GRANITE DUST ON THE STRENGTH CHARACTERISTICS OF CONCRETE

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ABSTRACT

The study on the effect of Granite Dust and M Sand on Concrete evaluates the impact of using granite dust and M sand as partial replacements for natural sand in concrete. Through a series of experimental investigations, the researchers assess the optimal percentage of replacement for these materials by conducting compressive strength tests on cube and cylindrical specimens. Additionally, reinforced concrete beams are cast using the blended fine aggregate to analyze their behavior under flexural loading. The study includes determining ultimate strength, load-deflection characteristics, crack patterns, ductility, and flexural rigidity of the concrete beams. The outcomes are compared with control concrete beams to draw conclusions on the feasibility of substituting natural river sand with granite dust and M sand in concrete production. An experimental investigation has been carried out to explore the possibility of using the granite Dust, and M Sand as a partial replacement of sand in concrete. Total twenty-seven cubes and nine beams of concrete with Granite Dust (GD), and M Sand (MS) were prepared and tested. The percentages of Granite Dust (GD), and M Sand (MS) added to replace sand were 5%, 10%, 15%, 20%, 25% and 30% of the sand by weight. It was observed that substitution of 15% of sand by weight with granite Dust in concrete was the most effective in increasing the compressive and flexural strength compared to other ratios. The test result showed that for 15% ratio of GP in concrete, the increase in the compressive strength was about 25% compared to normal concrete. Similar results were also observed for the flexure. It was also observed that substitution of up to 20% of sand by weight with M Sand in concrete resulted in an increase in compressive and flexural strength of the concrete.

Keywords: Concrete, Sand, Compressive Strength, flexural Strength, Granite Dust (GD), And M Sand (MS).

1. INTRODUCTION

The Concrete plays a very critical role in the design and construction of the nation's infrastructure the most expansively used construction matter in the world is probably concrete with about six billion tones being produced every year. The framework needs of our nation is expanding step by step and with concrete is a fundamental constituent of development material in a huge bit of this infra-underlying framework, it is important to upgrade its qualities through strength and solidness. Concrete is a moderately fragile material. Expansion of strands to substantial makes it a more pliable material. Plain concrete cement has a few weaknesses like low elastic, restricted pliability, little protection from breaking, high fragility helpless sturdiness.

Exploratory examinations have shown that strands improve the mechanical properties of cement, for example, flexural strength, compressive strength, rigidity, creep conduct, sway opposition and sturdiness. Among them, polymer filaments and the steel strands appreciate prevalence in the area of cement. Clearly the conduct of HFRC relies upon the viewpoint proportions, directions, mathematical shapes, circulations and mechanical properties of strands in substantial blends. from a fragile to a more flexible material. In terms of per capita consumption, it is only next to water. The most enormous individual material element in the built environment is concrete. Significant environmental and economic benefits may be realized if the embodied energy of concrete can be reduced without decreasing the performance or increasing the cost.

2. OBJECTIVE OF VIEW

Objective of View Granite Dust & M sand with PPC cement

1. To understand the objective of using Granite Dust M sand with PPC cement, it is essential to consider the properties and benefits of each component in construction.
2. Granite dust is a byproduct of granite stone processing and is often used as a substitute for sand in concrete mixtures. It is known for its durability, strength, and abrasion resistance, making it a suitable material for construction applications. When used in concrete mixes, granite dust can enhance the strength and durability of the concrete due to its mineral composition.

3. M Sand (Manufactured Sand) is a fine aggregate produced by crushing hard stones or rocks. It is free from impurities and has consistent particle size distribution, making it an ideal alternative to river sand in construction. M sand helps improve the workability and strength of concrete while reducing the environmental impact associated with sand mining.
4. PPC Cement (Portland Pozzolana Cement) is a type of blended cement that consists of pozzolanic materials such as fly ash, volcanic ash, or calcined clay along with Portland cement clinker. It offers improved workability, durability, and resistance to aggressive chemicals compared to ordinary Portland cement. The addition of pozzolanic materials enhances the long-term strength and durability of concrete structures.
5. A study reviewing past research on replacing sand with Granite Dust (GD), and M Sand (MS). Their review showed that Granite Dust (GD), and M Sand (MS) has increased the mechanical properties of concrete and has the potential to produce durable concrete.
6. The percentages of Granite Dust (GD), and M Sand (MS) added to replace sand were 5%, 10%, 15%, 20%, 25% and 30% of the sand by weight.

3. MATERIALS USED

3.1 Portland Pozzolana Cement (PPC)

Portland Pozzolana Cement (PPC) is a type of blended cement that consists of Portland clinker, pozzolana particles, and gypsum in specific proportions. It is produced by either intergrading OPC clinker with pozzolanic materials or grinding OPC clinker, gypsum, and pozzolanic materials separately and blending them thoroughly. Pozzolana is a material containing reactive silica that can chemically react with calcium hydroxide to form compounds with cementitious properties. PPC is suitable for various construction applications such as hydraulic structures, marine works, mass concreting, masonry mortars, and plastering.

3.2 Fine Aggregate

Fine aggregate serves as the structural filler in concrete mixes, occupying a significant volume. It influences various properties of concrete such as dimensional stability, elastic properties, damage tolerance, proportions of the mixture, hardening capabilities, and shrinkage behavior.

3.3 Coarse Aggregates

Coarse washed aggregates are a type of coarse aggregate that has been cleaned through a washing process to remove impurities such as clay, dirt, and debris. These aggregates are typically used in concrete production and drainage systems due to their cleanliness and quality. The washing process ensures that the aggregates are free of fine materials that could potentially affect the performance and durability of concrete.

3.4 Granite Dust

Granite dust, also known as M-10 or manufactured sand, is a finely crushed aggregate derived from granite. It is primarily used in construction and landscaping applications, particularly for the installation of paver stones and dry set patios. The fine nature of granite dust makes it highly compactible, which is essential for creating a stable base for various outdoor surfaces.

3.5 M Sand

Manufactured Sand (M-Sand) is a substitute for river sand, primarily used in concrete construction. It is produced by crushing hard granite stone into sand-sized particles, typically less than 4.75 mm in size. The manufacturing process involves several steps to ensure that the final product meets the required specifications for construction use.

3.6 Water

Concrete is a composite material made primarily of four key ingredients: cementitious material, fine aggregates, coarse aggregates, and water. Among these components, water plays a crucial role in the formation and strength of concrete. The following sections will detail the importance of water in concrete, the effects of excess water, and considerations regarding water quality.



Cement (PPC), Fine Aggregate Coarse Agg. Granite Dust M Sand Water

Figure no 1; Ingredients of Mix Concrete

4. METHODOLOGY

Method The researchers conducted a series of experiments where different proportions of granite dust and M sand were added to conventional concrete mixes. The concrete specimens were then tested for compressive strength, flexural strength, and split tensile strength according to standard testing procedures. The test results were compared with those of conventional concrete without any replacements to evaluate the effects of granite dust and M sand on the strength properties.

Methodology of the Effect of Granite Dust and M Sand on Concrete

To study the effect of Granite Dust and M Sand on concrete, a comprehensive methodology is essential to ensure accurate results and meaningful conclusions. The methodology for this research would typically involve several key steps:

Literature Review:

- Conducting a thorough review of existing literature on the use of Granite Dust and M Sand in concrete mixtures. This step helps in understanding previous research findings, methodologies used, and gaps in knowledge that need to be addressed.

Material Selection:

- Selecting appropriate samples of Granite Dust, M Sand, cement, aggregates, and other materials required for concrete mix preparation. Ensuring the quality and properties of these materials meet relevant standards.

Mix Design:

- Developing concrete mix designs with varying proportions of Granite Dust and M Sand to assess their impact on concrete properties such as strength, durability, workability, and shrinkage. Following standard procedures like IS 10262 or ACI methods for mix design.

Sample Preparation:

- Preparing test specimens according to the designed mix proportions in controlled laboratory conditions. Ensuring proper curing methods are employed to simulate real-world conditions.

Testing Procedures:

- Conducting a series of tests on the prepared concrete samples, including compressive strength tests, flexural strength tests, durability tests (such as water absorption and chloride ion permeability), and shrinkage tests.

Data Analysis:

- Analyzing the test results statistically to evaluate the influence of Granite Dust and M Sand on various concrete properties. Comparing the performance of these mixes with traditional concrete mixes.

5. RESULTS AND DISCUSSION

5.1 Compressive Strength

Table no 1 Mix design proportions for various granite Dust (GD) and M -Sand in percentages

Mix design	C	FA	GD	M-S	CA	W/ C ratio
M-GD-0+MS-0	100	100	0	0	100	0.44
M-GD-30+MS-0	100	70	30	0.00	100	0.44
M-GD-25+MS-5	100	70	25	5.00	100	0.44
M-GD-20+MS-10	100	70	20	10.00	100	0.44
M-GD-15+MS-15	100	70	15	15.00	100	0.44
M-GD-10+MS-20	100	70	10	20.00	100	0.44
M-GD-5+MS-25	100	70	5	25.00	100	0.44
M-GD-0+MS-30	100	70	0	30.00	100	0.44

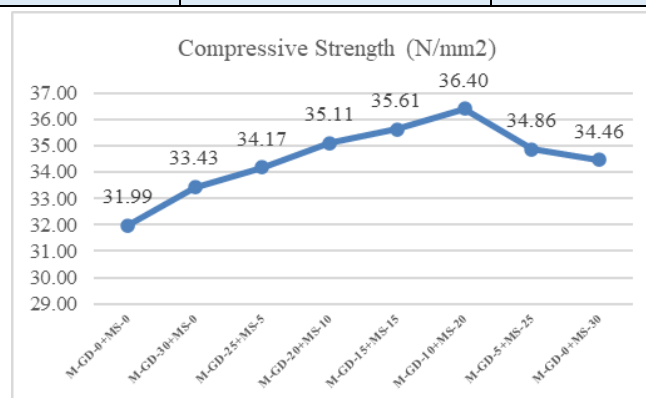
Table no 2 Mix design proportions for various granite Dust (GD) and M -Sand By Weight (kg/m³)

Mix designation	C kg/m ³	FA kg/m ³	GD kg/m ³	MS kg/m ³	CA kg/m ³	Water kg/m
M-GD-0+MS-0	448.60	752.71	0.00	0.00	1064.65	197.40
M-GD-30+MS-0	448.60	314.02	225.81	0.00	1064.65	197.40
M-GD-25+MS-5	448.60	314.02	188.18	37.64	1064.65	197.40

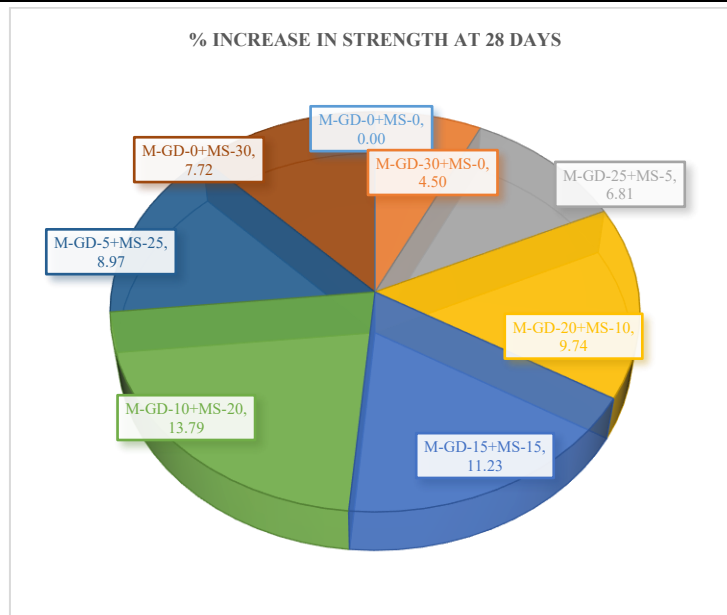
M-GD-20+MS-10	448.60	314.02	150.54	75.27	1064.65	197.40
M-GD-15+MS-15	448.60	314.02	112.91	112.91	1064.65	197.40
M-GD-10+MS-20	448.60	314.02	75.27	150.54	1064.65	197.40
M-GD-5+MS-25	448.60	314.02	37.64	188.18	1064.65	197.40
M-GD-0+MS-30	448.60	314.02	0.00	225.81	1064.65	197.40

Table no.3 Compressive Strength (N/mm²) at 28 days

Mix designation	Load (KN)	Compressive Strength (N/mm ²)	Average	% Increase strength
M-GD-0+MS-0	716.00	31.82	31.99	0
	722.00	32.09		
	721.00	32.04		
M-GD-30+MS-0	739.60	32.87	33.43	4.50
	755.60	33.58		
	761.30	33.84		
M-GD-25+MS-5	759.60	33.76	34.17	6.81
	774.50	34.42		
	772.30	34.32		
M-GD-20+MS-10	785.60	34.92	35.11	9.74
	789.10	35.07		
	795.00	35.33		
M-GD-15+MS-15	798.00	35.47	35.61	11.33
	801.00	35.60		
	805.00	35.78		
M-GD-10+MS-20	815.00	36.22	36.40	13.79
	820.00	36.44		
	822.00	36.53		
M-GD-5+MS-25	788.00	35.02	34.86	8.97
	785.00	34.89		
	780.00	34.67		
M-GD-0+MS-30	778.00	34.58	34.46	7.72
	773.00	34.36		
	775.00	34.44		



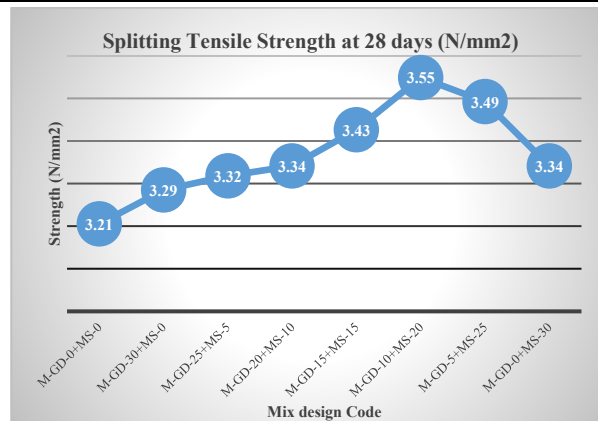
Graph 1 Compressive Strength (N/mm²) at 28 days



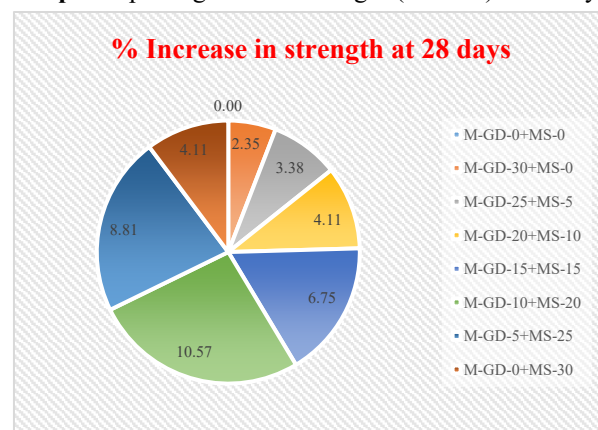
Graph no. 2 comparatives result in Increase Strength in percentages at 28 days

Table no.3 Splitting Tensile Strength (N/mm²) at 28 days

Mix designation	Load (KN)	Splitting Tensile Strength (N/mm ²)	Average	% Increase strength
M-GD-0+MS-0	224.00	3.17	3.21	0.00
	226.00	3.20		
	230.00	3.25		
M-GD-30+MS-0	228.00	3.22	3.29	2.35
	234.00	3.31		
	235.00	3.32		
M-GD-25+MS-5	237.00	3.35	3.32	3.38
	235.00	3.32		
	232.00	3.28		
M-GD-20+MS-10	235.00	3.32	3.34	4.11
	236.00	3.34		
	238.00	3.37		
M-GD-15+MS-15	242.00	3.42	3.43	6.75
	244.00	3.45		
	241.00	3.41		
M-GD-10+MS-20	248.00	3.51	3.55	10.57
	252.00	3.56		
	253.00	3.58		
M-GD-5+MS-25	248.00	3.51	3.49	8.81
	247.00	3.49		
	246.00	3.48		
M-GD-0+MS-30	238.00	3.37	3.34	4.11
	234.00	3.31		
	237.00	3.35		



Graph 1 Splitting Tensile Strength (N/mm2) at 28 days



Graph no. 2 comparatives result in Increase Splitting Tensile Strength in percentages at 28 days

6. CONCLUSION

1. All the main points of the research work are written in this section. Ensure that abstract and conclusion should not same. Graph and tables should not use in conclusion. The concrete mix made using steel slag, bottom ash, and silica fume with coarse aggregate, fine aggregate, and, cement respectively, on the performance of HPC showed good physical properties of concrete mixes.
2. Comparative analysis to nominal concrete with multi bended Mix concrete, Mix designation of nominal concrete M-GD-0+MS-0 is Compressive Strength 31.99 N/mm2 with 0.00 % Increase in strength at 7 days Mix designation of nominal concrete M-GD-10+MS-20 is Compressive Strength 36.40 N/mm2 with 13.79 % Increase in strength at 28 days.
3. Comparative analysis to nominal concrete with multi bended Mix concrete, mix designation of nominal concrete Mix CC Splitting Tensile Strength is 3.88 N/mm2 with 0.00 % Increase in strength at 28 days Mix designation of nominal concrete Mix C153030 Splitting Tensile Strength is 3.55 N/mm2 with 10.57 % Increase in strength at 28 days.

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