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An Experimental Research Investigating the Effect of Quarry Dust and M Sand on Strength Properties of Conventional Concrete

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ABSTRACT: The research highlights the potential of using quarry dust as a sustainable alternative to manufactured sand in the production of Mixed concrete. Mixed concrete is recognized for its thermal resistance, making it suitable for various construction applications. The study emphasizes the depletion of river sand, prompting an exploration into manufactured sand and quarry dust as viable substitutes. Natural sand is frequently utilised in concrete as a fine aggregate. Because illegal sand mining has driven up the cost of legal sand and lowered the ground water table, a replacement for fine aggregate must be found without sacrificing strength. Quarry dust and manufactured sand have been used in this study's design of concrete mix M30 to replace natural sand. Castings included cubes with a standard mould size of 150 mm x 150 mm x 150 mm, cylinders with a standard size of 150 mm in diameter and 300 mm in height, and beams with a standard size of 100 mm x 100 mm x 500 mm to test the effects of adding manufactured sand and quarry dust to concrete. A casting of three cubes has been given to each set of replacements. After 7 days, 14 days, and 28 days of curing, these specimens' compressive strength, split tensile strength, and flexural strength were evaluated. The outcomes were contrasted with control samples. Both replacement types were found to increase the strength of the concrete.

KEYWORDS: Manufactured sand, Normal sand, Quarry dust, Cement concrete, compressive strength, split tensile strength, and flexural strength

I.INTRODUCTION

Quarry dust and manufactured sand are two alternative materials that can be used in concrete production. Both materials have gained attention due to the increasing demand for natural sand and the environmental concerns associated with its extraction. Understanding their properties, benefits, and applications is crucial for optimizing concrete performance.

Quarry Dust is a byproduct of the crushing process of rocks in quarries. It consists of fine particles that are produced when larger stones are crushed into smaller aggregates. Quarry dust typically contains a high percentage of fines (particles smaller than 4.75 mm) and can vary in composition depending on the type of rock being processed.

Manufactured Sand Also known as crushed sand, this material is produced by mechanically crushing rocks or stones to create fine aggregates suitable for concrete production. The manufacturing process allows for better control over particle size distribution and shape compared to natural river sand.

Properties of Quarry Dust and Manufactured Sand

- Both quarry dust and manufactured sand exhibit unique physical and chemical properties that influence their performance in concrete:
- Particle Size Distribution: The grading of these materials affects the workability, strength, and durability of concrete. Ideally, both quarry dust and manufactured sand should have a well-graded particle size distribution to optimize packing density.
- Shape and Texture: Manufactured sand often has a more angular shape compared to natural sand, which can enhance interlocking between particles but may require adjustments in water content during mixing.

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- Chemical Composition: The mineralogical composition can affect the reactivity of the aggregates with cement paste. It is essential to ensure that quarry dust does not contain harmful impurities such as clay or organic matter that could adversely affect concrete quality.

Benefits of Using Quarry Dust and Manufactured Sand

Utilizing quarry dust and manufactured sand offers several advantages:

Sustainability: Both materials help reduce reliance on natural sand sources, which are becoming increasingly scarce due to over-extraction. This contributes to sustainable construction practices.

Cost-effectiveness: Quarry dust is often less expensive than traditional aggregates due to its availability as a waste product from stone crushing operations. Similarly, manufactured sand can be produced locally, reducing transportation costs.

Improved Concrete Properties: Research indicates that incorporating quarry dust or manufactured sand can enhance certain mechanical properties of concrete, such as compressive strength, tensile strength, and durability when properly proportioned.

II. OBJECTIVE OF VIEW

Objective of View Quarry Dust & M sand with PPC cement

1. To understand the objective of using Quarry Dust M sand with PPC cement, it is essential to consider the properties and benefits of each component in construction.
2. Quarry 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, quarry 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 Quarry Dust (QD), and M Sand (MS). Their review showed that Quarry Dust (QD), and M Sand (MS) has increased the mechanical properties of concrete and has the potential to produce durable concrete.
6. The percentages of Quarry Dust (QD), and M Sand (MS) added to replace sand were 5%, 10%, 15%, 20%, 25% and 30% of the sand by weight.

III.METHODOLOGY

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

To study the effect of Quarry 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 Quarry 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.

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 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 Quarry 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 Quarry Dust and M Sand on various concrete properties. Comparing the performance of these mixes with traditional concrete mixes.

 Interpretation of Results:

Drawing conclusions based on the data analysis regarding the effectiveness of using Quarry Dust and M Sand in concrete production. Discussing implications for practical applications in construction.

 Recommendations:

Providing recommendations for optimizing the use of Quarry Dust and M Sand in concrete mixtures based on the study findings. Suggesting areas for further research or improvements in practice.

Materials

Cement | Coarse Aggregates | Fine Aggregates | Quarry Dust | M Sand | Water

Figure 1: Mix concrete

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IV.RESULTS & DISSCUSSION

Mix Proportion of Concrete in Percentage and by weight

Table no 1; Mix Concrete By Weight (kg/m3)

Mix designation	Cement kg/m3	Fine Aggregate kg/m^3	Quarry Dust kg/m3	M- Sand kg/m^3	Coarse Aggregate kg/m^3	Water kg/m
M-QD-0+MS-0	448.60	752.71	0.00	0.00	1064.65	197.40
M-QD-30+MS-0	448.60	314.02	225.81	0.00	1064.65	197.40
M-QD-25+MS-5	448.60	314.02	188.18	37.64	1064.65	197.40
M-QD-20+MS-10	448.60	314.02	150.54	75.27	1064.65	197.40
M-QD-15+MS-15	448.60	314.02	112.91	112.91	1064.65	197.40
M-QD-10+MS-20	448.60	314.02	75.27	150.54	1064.65	197.40
M-QD-5+MS-25	448.60	314.02	37.64	188.18	1064.65	197.40
M-QD-0+MS-30	448.60	314.02	0.00	225.81	1064.65	197.40

Compressive Strength Test

Table no 2; Compressive Strength Test at 7 and 28 days

Mix designation	Average Strength (N/mm2)	Increase Percentages in strength at 7 days	Average Strength (N/mm2)	% Increase in strength at 28 days
M-QD-0+MS-0	**23.82**	**0**	**31.99**	**0**
M-QD-30+MS-0	**24.21**	**2.14**	**33.43**	**4.5**
M-QD-25+MS-5	**24.59**	**3.77**	**34.17**	**6.81**
M-QD-20+MS-10	**25.01**	**5.52**	**35.11**	**9.74**
M-QD-15+MS-15	**25.66**	**8.27**	**35.61**	**11.33**
M-QD-10+MS-20	**26.15**	**10.33**	**36.4**	**13.79**
M-QD-5+MS-25	**26.03**	**9.83**	**34.86**	**8.97**
M-QD-0+MS-30	**25.54**	**7.77**	**34.46**	**7.72**

V.CONCLUSION OF THE WORK

1. The concrete mix made using Granite Dust, and M-Sand with fine aggregate Replacement, 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-QD-0+MS-0 is Compressive Strength 23.82 N/mm2 with 0.00 % Increase in strength at 7 days Mix designation of nominal concrete M-QD-10+MS-20 is Compressive Strength 26.15 N/mm2 with 10.33 % Increase in strength at 7 days.
3. Comparative analysis to nominal concrete with multi bended Mix concrete, Mix designation of nominal concrete M-QD-0+MS-0 is Compressive Strength 26.47 N/mm2 with 0.00 % Increase in strength at 7 days Mix designation of nominal concrete M-QD-10+MS-20 is Compressive Strength 28.61 N/mm2 with 18.07 % Increase in strength at 14 days.
4. Comparative analysis to nominal concrete with multi bended Mix concrete, Mix designation of nominal concrete M-QD-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-QD-10+MS-20 is Compressive Strength 36.40 N/mm2 with 13.79 % Increase in strength at 28 days.

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