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Study on Strength Properties of Concrete With Partial Utilization Of Quarry Dust And Waste Foundry Sand

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Abstract: The possibility of replacing fine aggregate with industrial waste products such as waste foundry sand and quarry dust which offers technical and environmental advantages which are of great importance in the present context of sustainability in the construction sector. This study investigated the effect of quarry dust in concrete as partial replacement of fine aggregate in various percentage (0%-25%), on concrete properties such as mechanical (compression strength, split tensile strength, flexural strength) of 28 days curing of m20 grade of concrete as per IS-10262-2019. As the result of quarry dust replacement concrete, we obtain the optimum percentage of quarry dust and fix the value as constant and add foundry sand as partial replacement of fine aggregate in various percentage (0%-25%) in the m20 grade concrete. And we are going to test the compression strength, split tensile strength, flexural strength of 7days and 28 days curing of cement concrete to determine the strength of concrete. This study increase the use of industrial waste material.

Keywords: Quarry Dust, Waste foundry sand, Compression strength, Split tensile strength, Flexural strength.

I. INTRODUCTION

The use of concrete in the development of construction is an integral part of modern civilization. The main constituent of concrete is cement, sand and aggregate which play an important role in the mix design. The consumption of sand is increase due to the rapid development of infrastructure growth.

Quarry dust is a by-product of the crushing process which is a concentrated material to use as aggregates for concreting purpose, especially as fine aggregates. In quarrying activities, the rock has been crushed into various sizes; during the process the dust generated is called quarry dust and it is formed as waste. So it becomes as a useless material and also results in air pollution. Therefore, quarry dust should be used in construction works, which will reduce the cost of construction and the construction material would be saved and the natural resources can be used properly. Quarry dust has been used for different activities in the construction industry, such as building materials, road development materials, aggregates, bricks, and tiles.

Foundry sand is mostly used for metal casting it contains high quality silica sand with uniform physical characteristics. It is a by-product of the ferrous and nonferrous metal casting industry, where sand has been used for centuries as a moulding material because of its unique engineering properties. In modern foundry practice, sand is typically recycled and reused through many production cycle.

Both quarry dust and foundry sand is to be used in the concrete as a fine aggregate to minimize the usage of natural aggregate and to check the properties of the concrete. Although strength of the concrete is most important, it is also necessary that concrete is durable, workable and possess a good service life.

II. LITERATURE REVIEW

Charles K. Kankam et al This paper presents results of study on concrete using quarry dust to replace fine aggregate at levels of 0%, 25% and 100% by weight. Design mix are preferred to achieve M25, M30, M35, M40 and M45 for each of three replacement level. The results shows that all grades have max modulus of elasticity at 25% and min at 100% replacement.

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Bismark K. Meisuh et al In this paper the effect of quarry dust on the flexural strength of concrete has been experimentally studied and reported in this paper. The concrete used was prepared by replacing 25%, and 100% of sand by weight with quarry dust. The specimen were prepared using concrete strength ranging from 25N/mm2 to 47N/mm2for the thee replacement of 0%,25%, 100% to obtain compressive and flexural strength.

Gustavo J.L Coppio et al, this paper investigates the surface electrical resistivity and compressive strength of concrete by using 100% replacement of fine aggregate using foundry sand. The used foundry sand is taken directly from the steel industry and discarded in land filling for long period of time. The mix ratio is 1:2:3 and there w/c ratio is 0.5.

Maria Auxiliadora de barros martins et al This paper investigate the experimental study of concrete made with waste foundry exhaust sand as partial; replacement of fine aggregate as the proportion of 0% ,10%, 20%, 30%,40%, 50% by weight. In order to obtain the compressive strength of more than 25 Mpa. The mechanical properties such as compressive strength, splitting tensile strength, modulus of elasticity, water absorption, which is concerned with durability of the concrete. The result indicates the increase in the strength and durability.

Gurpreet Singh et al this experimental investigation was performed to evaluate the strength and durability properties of concrete mixture, in which natural sand was partial replaced with waste foundry sand. Natural sand was replaced with five percentage (0%, 5%, 10%, 15% and 20%) of waste foundry sand by weight. Compression and split tension test were carried out to evaluate the strength properties of concrete at the age of 7days, 28 days and 91days. Test result indicate a marginal increase in strength and durability properties of plain concrete by inclusion of waste foundry sand as a partial replacement of fine aggregate.

III. MATERIALS AND METHODS

Concrete is the most widely used man made materials in the construction world. It contains following materials,

1. Cement
2. Sand
3. Coarse aggregate
4. Quarry dust
5. Foundry sand

CEMENT:

Cement is used as a binding material in the concrete. Portland cement gets its strength from chemical reactions between the cement and water. The process is known as hydration. This is a complex process that is best understood by first understanding the chemical composition o1 cement. Portland cement is manufactured by crushing, milling and proportioning the following materials:

- Lime or calcium oxide, CaO: from limestone, chalk, shells, shale or calcareous rock.
- Silica, SiO2: from sand, old bottles, clay or argillaceous rock.
- Alumina, Al2O3: from bauxite, recycled aluminium, clay
- Iron, Fe2O3: from clay, iron ore, scrap iron and fly ash.
- Gypsum, CasO4.2H20: found together with limestone

Unlike Ordinary Portland Cement, Portland Pozzolana cement (PPC) is manufactured by combination of pozzolanic materials. Pozzolana is an artificial or natural material which has silica in it in a reactive form. Along with pozzolanic materials in specific proportions, PPC also contains OPC clinker and gypsum. These pozzolanic materials includes volcanic ash, calcined clay or silica fumes and fly ash which make around 15% to 35% of cement weight.

TABLE. 1 PROPERTIES OF CEMENT

TEST CONDUCTED	RESULTS
Initial setting time	35min
Specific gravity of cement	2.95

FINE AGGREGATE

The sand passes through 4.75mm and retained on 150 micron sieve are used. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent. In this work zone-III grade sand is used.

TABLE. 2 PROPERTIES OF FINE AGGREGATE

TEST CONDUCTED	RESULTS
Fineness modulus	3.05
Specific gravity	2.65

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QUARRY DUST

The quarry dust passes through 4.75mm and retained on 150 micron sieve are used. The purpose of the quarry dust is to fill the voids in the coarse aggregate and to replace the fine aggregate.

TABLE. 3 PROPERTIES OF QUARRY DUST

TEST CONDUCTED	RESULTS
Fineness modulus	6.27
Specific gravity	2.65

FOUNDRY SAND

The foundry sand passes through 4.75mm and retained on 150 micron sieve are used. The purpose of the foundry sand is to fill the voids in the coarse aggregate and to replace the fine aggregate.

TABLE. 4 PROPERTIES OF FOUNDRY SAND

TEST CONDUCTED	RESULTS
Fineness modulus	3.05
Specific gravity	2.65

COARSE AGGREGATE

The Coarse aggregate used was broken crushed stone which of size pass through 40 mm sieve and retained in 20 mm sieve. It is well graded i.e, different particle size and cubical in shape.

TABLE. 5 PROPERTIES OF COARSE AGGREGATE

TEST CONDUCTED	RESULTS
Specific gravity	2.71
Fineness modulus	4.05

WATER

The water used for mixing and curing the concrete is the potable water available in the campus.

IV EXPERIMENTAL INVESTIGATION

The test to be performed with various ratio of quarry dust and waste foundry sand to determine the compression strength ,split tensile strength and flexural strength using the suitable mould of concrete for 28 days curing.

SPECIMEN PREPARATION

PREPARATION OF MOULD

Before casting of the specimen, the mould was cleaned and fully tightened. The inner side of the mould was coated with oil.

MIXING

Mix the cement, fine aggregate, quarry dust, foundry sand and coarse aggregate on a water tight none-absorbent platform until the mixture is thoroughly blended and is of uniform

CASTING

During the casting of the concrete a large opening is needed. When the mold is filled, shake slightly to get rid of the bubbles. A compact size causes a high temperature. It's recommended to cover the mould with foil for one day to prevent their concrete from drying out.

COMPACTION

Manual compaction of concrete specimen is carried out. It shall be a round, straight steel rod with at least the tamping end rounded to a hemispherical tip of the same diameter as the rod. Both ends rounded, if preferred. Tamping rod diameter is 16 mm and its length is 600 mm.

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Fig. 1 Compaction of Specimen

DEMOULDING

Test cube, cylinder and prism specimens should be demoulded in 24 hours after they have been made. If after this period of time the concrete has not achieved sufficient strength to enable demoulding without damaging the specimens then the demoulding should be delayed for a further 24 hours. When removing the concrete specimens from the mould, take the mould apart completely. Take care not to damage the specimens because, if any cracking is caused, the strengths may be reduced.

CURING

Fig. 2 Curing of specimen

The test specimens are stored in moist air for 24 hours and after this period the specimens are marked and removed from the molds and kept submerged in clear fresh water until taken out prior to test.

V TESTING OF SPECIMENS

COMPRESSIVE STRENGTH

Compressive strength is the ability of material or structure to carry the loads on its surface without any crack or deflection. A material under compression tends to reduce the size, while in tension, size elongates. Compressive strength formula for any material is the load applied at the point of failure to the cross-section area of the face on which load was applied.

Compressive Strength = Load / Cross-sectional Area

TABLE. 6 COMPRESSIVE STRENGTH RESULTS

S.No	% of Quarry dust	Compressive strength (28 days) Mpa
1	0%	26.31
2	5%	28.88
3	10%	29.77
4	15%	30.22
5	20%	32.00
6	25%	24.44

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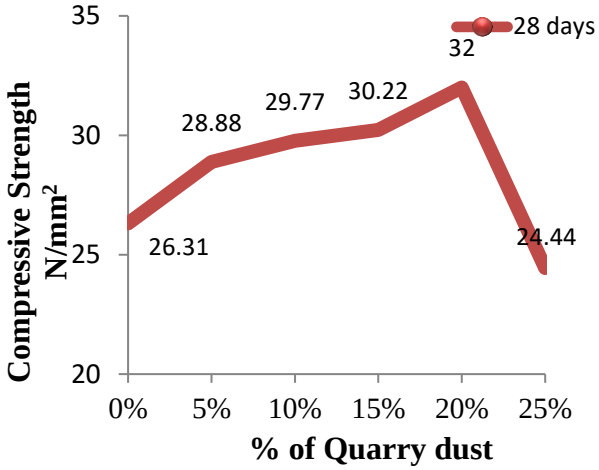

Fig. 3 Compression strength of quarry dust

TABLE. 7 COMPRESSIVE STRENGTH RESULTS

S.No	% of Quarry dust	% of Foundry sand	Compressive strength (28 days) Mpa
1	20%	5%	29.2
2	20%	10%	29.42
3	20%	15%	24.97
4	20%	20%	23.64
5	20%	25%	22.66

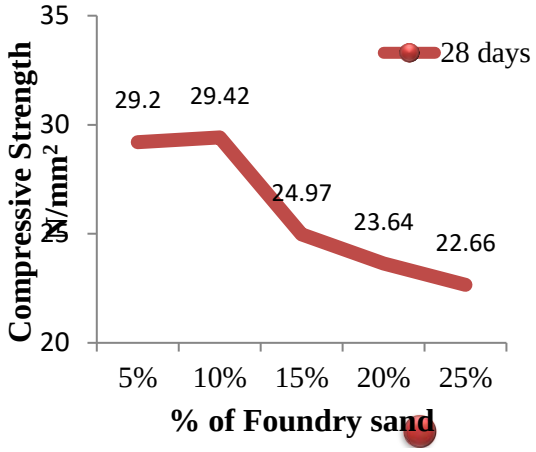

Fig. 4 Compression strength of quarry dust with foundry sand

SPLIT TENSILE STRENGTH

A method of determining the tensile strength of concrete using a cylinder which splits across the vertical diameter. It is an indirect method of testing tensile strength of concrete.

TABLE. 8 SPLIT TENSILE STRENGTH RESULTS

S.No	% of Quarry dust	% of Foundry sand	Split tensile strength (28 days) Mpa
1	20%	5%	3.04
2	20%	10%	3.11
3	20%	15%	2.68
4	20%	20%	2.54
5	20%	25%	2.47

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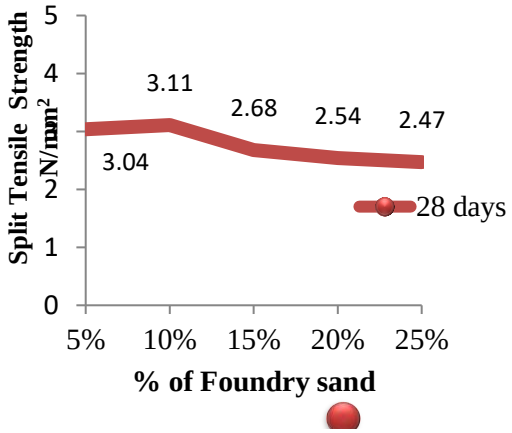

Fig. 5 Split tensile strength of cylinder

FLEXURAL STRENGTH

Flexural strength is one measure of the tensile strength of concrete. It is u measure of an un-reinforced concrete beam or slab to resist failure in bending it is measured by loading 6*6-inch (150x150 mm) concrete beams with a span length of at least three times the depth.

TABLE. 9 FLEXURAL STRENGTH RESULTS

S.No	% of Quarry sand	% of Foundry sand	Flexural strength (28 days) Mpa
1	20%	5%	2.8
2	20%	10%	3
3	20%	15%	2.5
4	20%	20%	2.35
5	20%	25%	2.0

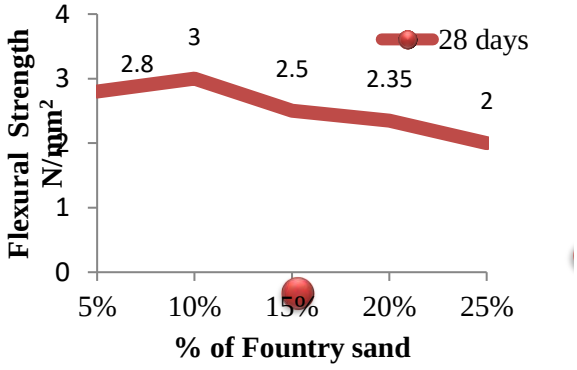

Fig. 6 Flexural strength of prism

VI RESULT AND DISCUSSION

COMPRESSIVE STRENGTH

- Compressive strength of 28days curing of concrete cube with partial replacement of quarry dust (0%-25%).
- Compressive strength of 28days curing of concrete cube with partial replacement of quarry dust 20% & foundry sand (0%-25%).

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SPLIT TENSILE STRENGTH

- A method of determining the tensile strength of concrete using a cylinder which splits across the vertical diameter.
- Split tensile strength of 28days curing of concrete cylinder with partial replacement of quarry dust 20% & foundry sand (0%-25%).

FLEXURAL STRENGTH

- Flexural strength of 28days curing of concrete prism with partial replacement of quarry dust 20% & foundry sand (0%-25%).

VII CONCLUSION

One of the ways to improving sustainability is to reduce the human consumption of natural resources. Based on the results findings it was observed that quarry dust and waste foundry sand are one of the best suitable materials for replacing fine aggregate. While recommending the application of quarry dust waste material in concrete, the present authors recommend that future studies may be taken up on this replacement technique in cement mortar for wider applications in ceiling and wall plastering work applications, and other concrete mix ratios.

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REFERENCES

[1]. Charles K. Kankam , Bismark K . Meisuh , Gnida Sossou, Thomas K. Buabin (201) "Stress-strain characteristics of concrete containing quarry dust as partial replacement of sand" construction material volume 7 (2017) pp 66-72
[2]. Bismark K . Meisuh , Charles K. Kankam , Thomas K. Buabin (2017) "Effect of quarry rock dust on the flexural strength of concrete" construction material volume 8 (2018) pp 16-22
[3]. S N Raman , T Ngo, P Mendis , H B Mahmud "high-strength rise husk ash concrete incorporating quarry dust as a partial substitute for sand" construction and building materials 25(2011) pp 3123-3130
[4]. Trilok Gupta , Shubham Kothari , Salman Siddique , Ravi K Sharma , Sandeep Chaudhary "Influence of stone processing dust on mechanical , durability and sustainability of concrete" construction and building material 223(2019) 918-927
[5]. Gurpreet Singh , Rafat Siddique "Effect of waste foundry sand as partial replacement of sand on the strength ,ultrasonic pulse velocity and permeability of concrete" construction and building material 26 (2012) pp 416-422
[6]. V Divya Prasad , E Lalith Prakash , M Abishek , K Ushanth Dev , C K Sanjay Kiran "study on concrete waste foundry waste foundry sand , fly ash and polypropylene fibre using Taguchi method" materials today : proceedings 5 (2018) 23964 - 23973
[7]. Thiruvenkatam Manoharan,Dhamothiran Laksman, Kaliyannan Mylsamy, Pandian Sivakumar , Anirbid Sircar(2017) "Engineering properties of concrete with partial utilization of used foundry sand" waste management 71 (2018) pp 454- 460
[8]. Gustavo J.L Coppio, Maryangela Geimbz de Lima ,Julia W. Lencioni, Luciana S. Cividanes, Paulo P.O.L Dyer, Silvelene A. Silva (2019) "Surface electrical resistivitu and compressive strength of concretye with the use of waste foundry sand as aggregate" construction and building material 212 (2019) pp 514-521
[9]. Maria Auxiliadora de barros martins ,regina mambeli Barros , Gilbert silva (2018) "Study of waste foundry exhaust sand ,WFES, AS a partial substitute of fine aggregate in conventional concrete" sustainable cities and society 45(2019) pp187-196
[10].Indian Standard Code of Practice for Plain and Reinforced Concrete (Fourth Revision) IS: 456:2000" (2000) Bureau of Indian Standards, New Delhi.
[11].Unnikrishna pillai S., Devdas Menon (2009) "Reinforced Concrete Design", published by McGaw Hill Education (India) Private Limited, Third Edition.
[12].IS 10262 (2019): Guidelines for concrete mix design proportioning [CED 2: Cement and Concrete].