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Study of Strength of Pavement by Replacement of Natural Sand with Quarry Dust in Concrete Mix Design

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Abstract : This study has been undertaken to investigate the Concrete plays an important role and large stones are used in many construction projects. Natural river sand, one of the main components of the stone, is becoming cheaper due to high transportation costs. The use of large resources can cause environmental problems. Better alternatives and new materials are needed to overcome these problems. Quarry dust is the waste generated during quarrying. Recently it has become more popular as a good replacement for good mix. Additionally, the use of quarry dust as aggregate reduces production costs by partially replacing hydrosand. The design mix of M20 class concrete modified with 0%, 50% and 100% sand was taken into account and slump and compressive strength tests and laboratory analyzes were carried out. In this case, the hardening behavior of the stone is examined using quarry powder. This project uses M20 concrete mix ratio. Various materials were used to cast the 150mm concrete slab. Treated cells were crushed on days 14 and 28 to measure compressive strength. The results showed that the compressive strength of concrete made from quarry dust increased with days without much change in compressive strength. In addition, this study will help us see the differences in the composition of different stones at different times by reaching the good properties of different stones.

I. INTRODUCTION

Quarry dust is a product obtained from rock. Crushing is a concentrated material used to make aggregate, especially fine aggregate, for concrete. During the quarrying process, the stone is broken into different sizes; The dust formed during operation is called furnace dust and is formed as waste. Therefore, it becomes a bad material and causes air pollution. Therefore, the use of sand in construction projects can reduce construction costs, save on construction materials and use natural resources. The importance of concrete in pavement construction is its ability to provide strong, durable and versatile materials that meet the stringent requirements of transportation. Concrete blocks are safe and efficient, reduce maintenance costs and play an important role in the overall performance and safety of the road network.But there are some signs that India's early-stage security development has slowed in recent years. Indian Road Congress has recently been working on road safety in India within the scope of various projects. Natural river sand, one of the main components of concrete, is becoming increasingly expensive due to high transportation costs. In addition, the use of large resources can also cause environmental problems. Better alternatives and new materials are needed to overcome these problems. Quarry dust is the waste generated during quarrying. Recently it has become more popular as a good replacement for good mix. Additionally, the use of quarry dust as aggregate reduces production costs by partially replacing sand

II. METHODOLOGY:

MATERIALS USED

PROPERTIES OF CEMENT

Compound	Pozzolana Portland Cement (%)
SiO_2	28 % - 32 %
Al_2O_3	7 % - 10 %
Fe_2O_3	4.9 % - 6 %
CaO	41 % - 43 %
MgO	1 % - 2 %
SO_3	2.4 % - 2.8 %
Loss on Ignition	3 % - 3.5 %
Specific Gravity	3.4
Initial Setting time	38 min
Final Setting time	475 min
28 Days Compressive strength	36.7 Mpa

PHYSICAL PROPERTIES OF QUARRY DUST

Sr No.	Characteristics	Values
1	Effective Particles Size D10 D30 D60	 0.44 mm 0.55 mm 0.63 mm
2	Specific Gravity	2.65
3	Bulk Density	1.7 kg/m^3
4	Water absorption	0.5 %

PHYSICAL PROPERTIES OF FINE AGGREGATES

Sr No.	Characteristics	Values
1	Type	Crushed
2	Specific Gravity	2.66
3	Fineness Modulus	6.83
4	Water absorption	0.56

PHYSICAL PROPERTIES OF COARSE AGGREGATES

Sr No.	Characteristics	Values
1	Specific Gravity	2.45
2	Fineness Modulus	2.56
3	Water absorption	0.85 %
4	Bulk Density	1.4 kg/m^3

PROCEDURE

For Cube test two types of specimens ither cubes of 15cm x15cm x 15cm or 10cm x 10cm x10cm depending upon the size of aggregates are used. As for our project we picked 15cm x 15cm x 15cm cube mould. To make concrete slurry we use weight batching. For M20 grade of concrete the ratio of the concrete is 1:1.5:3 i.e. 1part of cement, 1.5 part of sand and 3 parts of aggregate. To perform the cube test we first measure all the material using weighing machine and gathered them in clean plain surface. The materials were then dry mixed manually by using shovel until all the material were mixed thoroughly and is of uniform colour. For the further procedure crushed sand were brought and added to the dry mixed materials. The water/cement was maintained while mixing the materials by adding parts of crushed sand when required the concrete was mixed until the concrete appears to be homogeneous and of the desired consistency After the concrete was made, the moulds were properly cleaned and were applied oiled so the surface of the cube should be even from all the sides the concrete was then poured into the mould by using trowel, The concrete was tamped at regular intervals for not less than 25 strokes per layer using a tamping rod the excess amount of water present in the concrete was removed by tamping the mould on the plain surface due to which the formation of air bubbles were denied After removing the excess water and air bubbles the top most surface of the concrete cube was smoothen with the help of a trowel. The cubes were then kept undisturbed for one day so that setting of concrete can take place and We can further send the cubes for curing 7, 14 and 28 days respectively three cubes of each sample were made out of which two were kept for 14 days of curing and two were kept for 28 days of curing After the curing period was over the cubes were took out from the tank and were send for testing which leads to the end of our concrete cubes test. The cube specimen was tested for compressive strength at the end of 7 days and 28 days. The specimen was tested after the surface gets dried. The load was applied on the smooth sides without shock and increased continuously till the specimen failed. The mean compressive strength is calculated

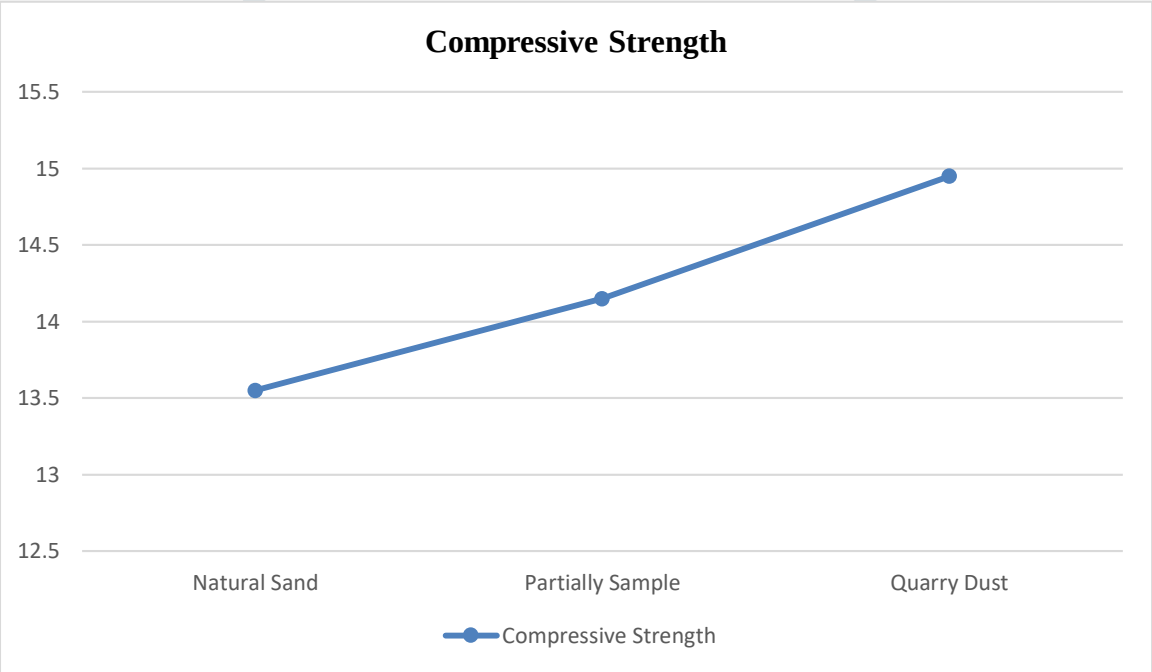
III. RESULT AND OBSERVATION

COMPRESSIVE STRENGTH IN 7 DAYS

			Compressive	Average

Sr. No.	Sample	Weight	Strength (N/mm^2)	Compressive strength (N/mm^2)
1	Natural sand	8.34 kg	13.3	13.55
		8.40 kg	13.8	
2	Partially	8.30 kg	14	14.15
		8.38 kg	14.3	
3	Quarry Dust	8.34 kg	14.8	14.95
		8.36 kg	15.1	

GRAPH OF COMPRESSIVE STRENGTH IN 7 DAYS

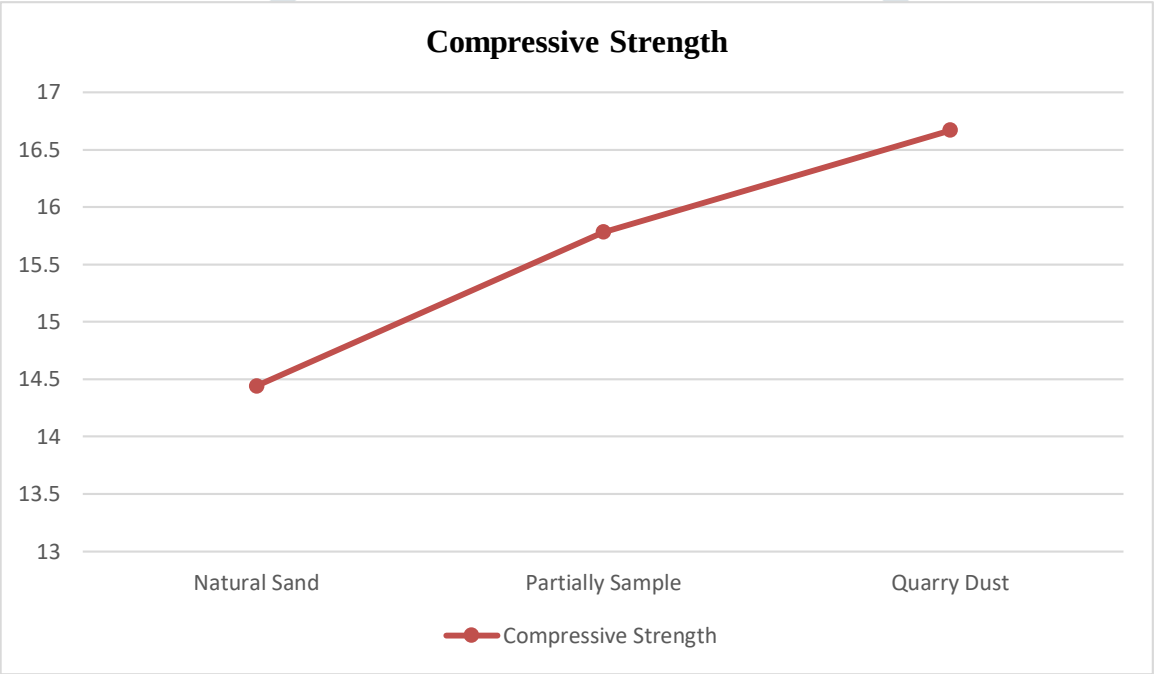


COMPRESSIVE STRENGTH IN 14 DAYS

Sr. No.	Sample	Weight	Compressive Strength (N/mm^2)	Average Compressive strength

				(N/mm^2)
1	Natural sand	8.34 kg	15.55	14.44
		8.40 kg	13.33	
2	Partially	8.30 kg	16.89	15.78
		8.38 kg	14.67	
3	Quarry Dust	8.34 kg	17.78	16.67
		8.36 kg	15.56	

GRAPH OF COMPRESSIVE STRENGTH IN 14 DAYS

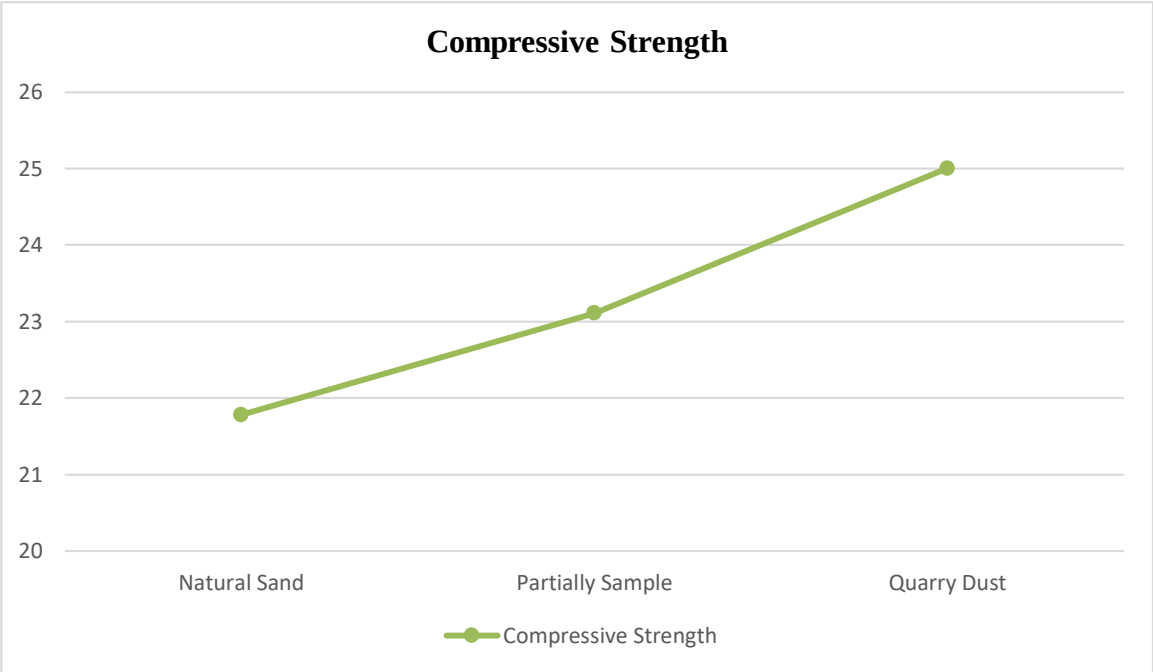


COMPRESSIVE STRENGTH IN 28 DAYS

Sr. No.	Sample	Weight	Compressive Strength (N/mm^2)	Average Compressive strength (N/mm^2)
1	Natural sand	8.34 kg	22.5	21.78

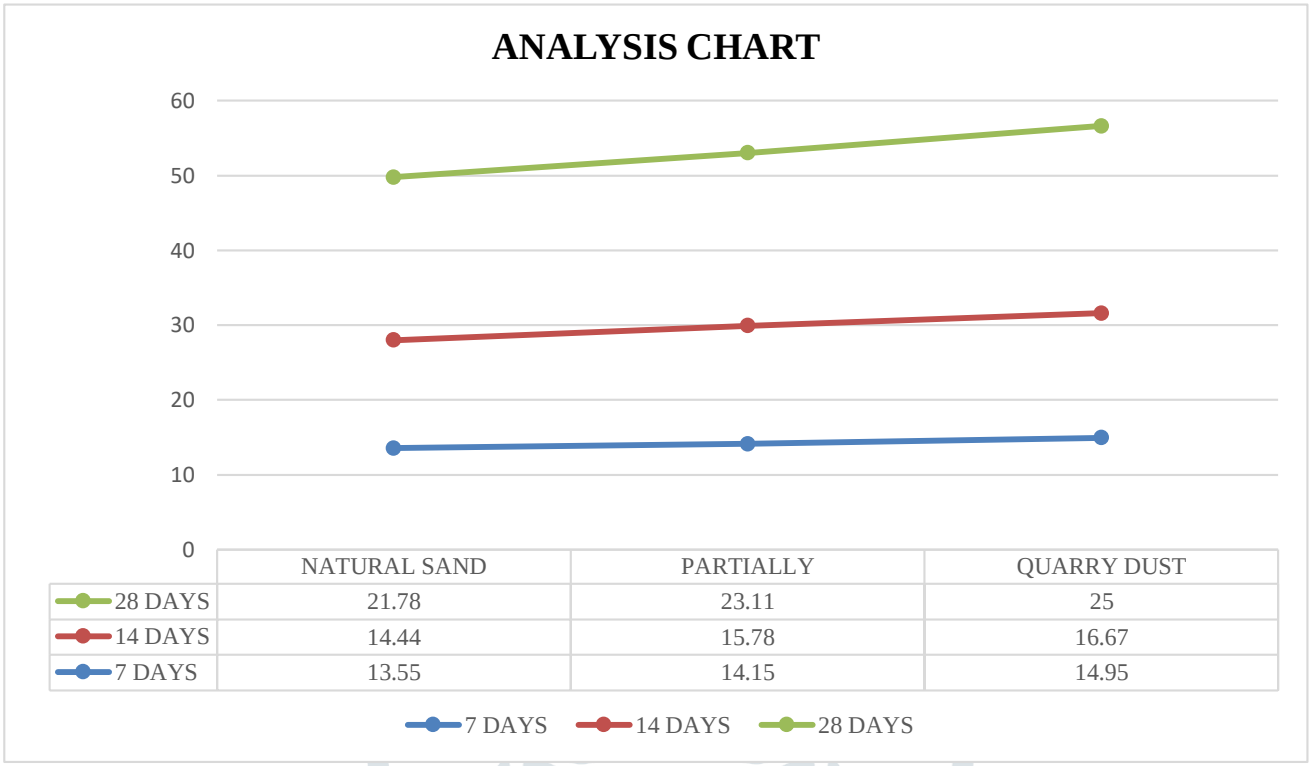
		8.40 kg	21.34	
2	Partially	8.30 kg	23.56	23.11
		8.38 kg	22.67	
3	Quarry Dust	8.34 kg	25.56	25
		8.36 kg	24.45	

GRAPH OF COMPRESSIVE STRENGTH IN 28 DAYS



IV. CONCLUSION

Compressive strength of M20 grade concrete with 0%, 50%, & fully replacement for 7, 14, and 28 days.
The compressive strength results of quarry dust concrete (cubes) were obtained in the second series, where M20 grade of concrete with 0%, 50%, fully replacement of quarry dust tested for 7 days, 14 days and 28 days is studied, and the results are presented.
With observation of 50% of quarry dust (7 days) the average compressive strength is 14.15 N/mm² whereas that for natural sand is 13.55N/mm² and observation of fully quarry dust the average compressive strength is 14.95 N/mm². With observation of 50% of quarry dust (14 days) the average compressive strength is 15.78 N/mm² whereas that for natural sand is 16.67 N/mm² and observation of fully quarry dust the average compressive strength is 16.67N/mm². With observation of 50% of quarry dust (28 days) the average compressive strength is 23.11 N/mm² whereas that for natural sand is 21.78 N/mm² and observation of fully quarry dust the average compressive strength is 25N/mm². Hence, quarry dust can b effectively used to replace natural sand, without reduction in the strength of concrete. The slight variation is observed in compressive strength for 7 days, 14 days and 28days age in concrete. As the age of the concrete increases, the compressive strength of fully replacement of quarry dust also increases. The partial replacement of quarry dust gave a 28 days' peak compressive strength at 30% replacement level. That the compressive strength of M20 grade also was observed with varying age of concrete by replacement level up to 30%.



	NATURAL SAND	PARTIALLY	QUARRY DUST
28 DAYS	21.78	23.11	25
14 DAYS	14.44	15.78	16.67
7 DAYS	13.55	14.15	14.95

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