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Experimental Study on Glass Fibre Reinforced Concrete with Partial replacement of Fine Aggregate by Quarry Dust

Dinesh[1], Mukesh Kumar[2], Pardeep Kumar[3]
M.Tech. Scholar[1], Assistant Professor & Head[2], Assistant Professor[3]
Department of Civil Engineering
Prannath parnami institute of management & Technology, Hisar, India [1, 2]
M I T M, Jevra, Hisar, India[3]

Abstract:
The concept of replacement of natural fine aggregate by quarry dust which is highlighted in the study could boost the consumption of quarry dust generated from quarries. By replacement of quarry dust, the requirement of land fill area can be reduced and can also solve the problem of natural sand scarcity. The availability of sand at low cost as a fine aggregate in concrete is not suitable and that is the reason to search for an alternative material. Quarry dust satisfies the reason behind the alternative material as a substitute for sand at very low cost. It even causes burden to dump the crusher dust at one place which causes environmental pollution. From the results of experimental investigations conducted, it is concluded that the quarry dust can be used as a replacement for fine aggregate. It is found that 35% replacement of fine aggregate by quarry dust gives maximum result in strength than normal concrete and then decreases from 50%. The compressive strength is quantified for varying percentage and grades of concrete by replacement of sand with quarry dust. This Experimental work shows the investigation on M30 grade due to incorporation of quarry dust. In this Experiment, we used the quarry dust at various percentages as 0%,15%, 25% , 35%, 45%, by the weight of concrete on M30 grade of mix proportion (1:1.82: 3.41) with water cement ratio 0.50. . In this Experiment, we used the glass fibres of Filament diameter 14 microns with aspect ratio 857 at various percentages as 0%,0.4%.0.8%,1.2%.1.6 by the weight of concrete .Hence, in this research the Experimental investigations and analysis of results were conducted to study the compressive, tensile and flexural behaviour of composite concrete with varying percentage of quarry dust added to it

Keyword: Quarry Dust, Glass fibre, Compressive strength test, Split tensile strength test, Flexural strength test.

I. INTRODUCTION

Concrete plays a very important role in the construction industry. It is widely used in the worldwide due to its durability, versatility and low cost. For a concrete mix, fine aggregate is an essential component of the concrete and the most commonly used fine aggregates is the river sand. The demand of natural sand in the field of construction is increasing day by day due to extensive use of concrete, the price was increasing which resulting a huge reduction in the sources of sand. Natural River sand takes a million of years to form and it is not replenish able. Because of its limited supply and excessive cost of transportation from natural source, The developing country like India facing shortage of good quality of natural sand and particularly in India, natural sand deposits are being used up and causing serious threat to environment as well as the society. Therefore it becomes more necessary to find alternative sources of fine aggregates to minimize river sand extraction. Therefore, an investigation is required to find a suitable substitute which is eco-friendly and inexpensive. Quarry dust has been proposed as an alternative to river sand that gives the additional benefits to the strength of the concrete. Quarry waste fine aggregate, which is generally considered as a waste material after the extraction and processing of rocks to form fine particles less than 4.75mm, causes an environmental load due to disposal problem Hence, the use of quarry waste fine aggregate in concrete mixtures will reduce not only the demand for natural sand but also the environmental burden . Moreover, the incorporation of quarry waste fine aggregate will offset the production cost of concrete. In brief, the successful utilization of quarry waste fine aggregate will turn this waste material into a valuable resource. Glass fibre reinforced concrete (GFRC) comprises hydration products of cement, or cement plus sand, and the glass fibres. Glass fibres are used are used as reinforcement for concrete. Glass fibres are available in the form of continuous roving's, chopped strand mats, cranette, wool, ropes and woven fabric. Glass fibres coated with epoxy resin compounds have also been tried out to protect them from alkali attack by Portland cement.

Figure.1. Quarry Dust

Figure.2.Glass Fibre

II.MATERIALS AND THEIR PROPERTIES

A. Cement

Ordinary Portland cement of 53 grade has been used in this experimental work. OPC 53 grade of ULTRATECH cement has been used after investigate the strength of cement at 28 days as per IS 4031-1988. The Standard consistency is 33% where as the initial and final setting time is 38 min. and 490 min. respectively. The specific gravity of cement is 3.04 and its compressive strength after 28 days is found to be 32.90 Mpa

Table.2.1 Characteristics Properties Of Cement

Sr.No.	Characteristics	Experimental value	Specified value as per IS:8112-1989
1	Consistency of cement (%)	33%	---
2	Specific gravity of cement (%)	3.04	3.15
3	Initial setting time (minutes)	38	>30 As Per IS 4031-1968
4	Final setting time (minutes)	490	<600 As per IS 4031-1968
5	Compressive strength (N/mm2 (i) 7 days (ii) 28 days	23.80 32.90	>30
6	Soundness (mm)	1.00	10
7	Fineness of Cement	6%	10% As Per IS 269-1976.

B.Coarse Aggregate:

Coarse aggregate of maximum size 20mm is used throughout the concrete. The specific gravity of course aggregate is 2.96.

C.Fine Aggregate:

Fine aggregate is used in this experimental study for concrete is river sand conforming to zone- II. The specific gravity of fine aggregates 2.64.

D. Water:

The water used in the concreting work as well curing purpose was the portable water which is free from impurities

Table.2. Physical properties of aggregates

Sr. No.	Properties of Material	
1	Specific Gravity of Cement	3.04
2	Specific Gravity of quarry dust stone	2.57
3	Specific Gravity of Coarse Aggregates	2.96
4	Specific Gravity of fine aggregate	2.64
5	Free Moisture Content	2.61%
6	Water Absorption	1.82%

III. EXPERIMENTAL PROGRAM

Standard cubical moulds of size 150mm×150mm×150mm and cylinder mould of depth 150mm ,height 300mm and dia of 100mm and beam mould of 150mm×150mm×700mm made of cast iron were used to cast concrete specimens to test compressive strength ,split tensile strength and flexural strength respectively. The quantities of cement, fine aggregates, coarse aggregates, and water for each batch were weighted to an accuracy of 1kg separately. Sand and quarry dust is added to this mixture in dry form. Finally, coarse aggregates were added and thoroughly mixed to get a uniform mixture throughout the batch. Required dosage of water was added in the course of mixing. The inner surfaces of moulds were oiled so as to avoid the sticking of concrete. Concrete was then filled in previously prepared moulds with controlled vibration to the concrete. Surface of concrete was finished level using a trowel and date along with batch number was marked properly on it. Finished specimens were left to harden and removed from moulds approximate after 24 hours of casting. They were then placed in water tank containing portable water and were left for curing.

Figure.3. fine aggregate & quarry dust

Figure.4. addition of glass fibre into mix

Table.3.3. Compressive, split tensile and flexural strength of glass fibre quarry dust concrete

Sr. No	% of quarry dust	No. of cylinder	No. of Cube	No. of Beam
1	0	6	6	6
2	15	6	6	6
3	25	6	6	6
4	35	6	6	6
5.	45	6	6	6

IV. TESTING OF CONCRETE

The test was conducted on cubes according to IS code 516-1959. Specimens were taken out from curing tank at the age of 7 and 28 days of moist curing and were then tested. Specimens were tested on 1000 tones capacity of universal testing machine (UTM). The load was applied gradually without any shock and increased at constant rate of 14 N/mm²/minute until failure of specimen takes place, thus the compressive strength

of specimen was found out by dividing the compressive load to area under compression.

Figure.5. testing of sample

Table.4. Compressive strength by adding Glass Fibre Quarry Dust Concrete.

Sr. No.	%Glass Fibre	%Quarry Dust	Compressive strength in 7 days	Compressive Strength in 28 days
1	0	0	24.29	38.59
2	0.4	15	24.74	39.18
3	0.8	25	25.11	39.85
4	1.2	35	25.56	40.44
5	1.6	45	24.67	40

Table.5. Split Tensile Strength by adding Glass Fibre Quarry Dust Concrete.

Sr. No.	%Glass Fibre	%Quarry Dust	Split Tensile strength in 7 days	Split tensile strength in 28 days
1	0	0	1.92	3.61
2	0.4	15	1.96	3.70
3	0.8	25	1.98	3.75
4	1.2	35	2.01	3.84
5	1.6	45	1.98	3.75

Figure.6. Sieve Analysis

Table.6. Flexural strength by adding glass fibre quarry dust concrete.

Sr. No.	%Glass Fibre	%Quarry Dust	Flexural strength in 7 days	Flexural Strength in 28 days
1	0	0	2.17	3.56
2	0.4	15	2.43	3.96
3	0.8	25	2.71	4.52
4	1.2	35	2.91	4.93
5	1.6	45	2.76	4.73

4.1 INTERPRETION OF TEST RESULTS

4.1.1 Compressive strength

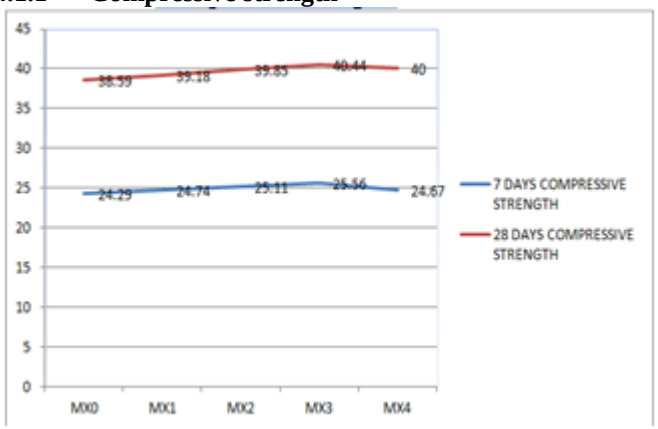

Figure.7. Graph comparing compressive strength for 7 and 28 days

4.1.2 Flexural Strength

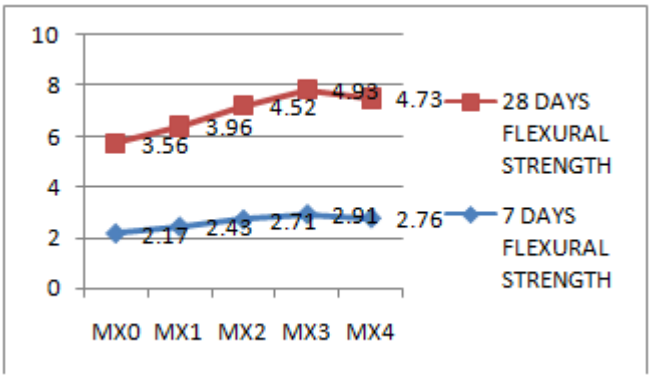

Figure.8. Graph comparing Flexural strength after 7 & 28 days

4.1.3. Split Tensile Strength

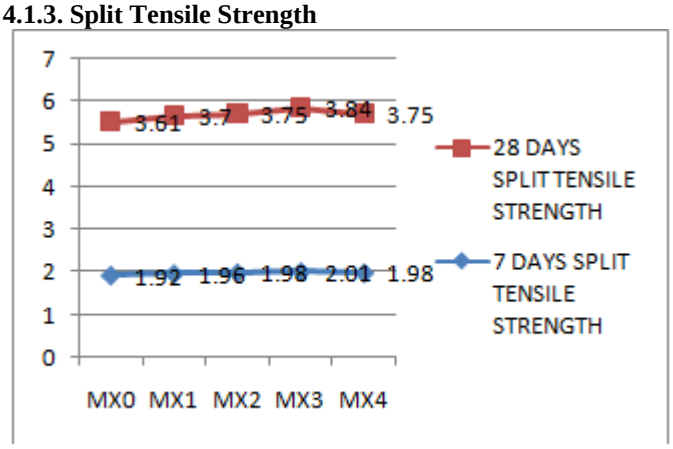

Figure.9. Graph comparing Spilt Tensile strength for 7 and 28 days.

V. CONCLUSION

From the results of the present investigation the following conclusion may be drawn:-

- The Experimental work shows that properties of concrete M30 gets improved due to incorporation of quarry dust and Glass fibres.

- The Experimental work shows that workability of GFQDC decreased significantly as we increased the quarry amount.

- It can be concluded that the compressive strength of GFQDC gets increased with 35% quarry dust as compared to plain concrete.
- It is observed that the addition of quarry dust and Glass fibres into reinforced concrete improves the Compressive strength at 28 days.
- It is observed that the Flexural strength of GFQDC gets increased up to 35% replacement as compared to plain concrete.
- It can be concluded that Flexural strength of the GFQDC gets increased continuously and it increases till the case of 35% quarry amount.
- It is also observed that the Split Tensile strength of quarry dust reinforced concrete gets increased increases up to 35% replacement quarry dust as compared to plain concrete.
- The loss of compressive strength in ordinary concrete mixes are more than quarry dust concrete mixes..
- Quarry dust reinforced concrete is very effective in resisting flexural tensile stresses as compared to compressive stresses.
- By addition of quarry dust in concrete reduces the cracks causing interconnecting voids to be minimum.
- From the experimental investigation, it has been found that the flexural strength of GFQDC increases very much as compared to compressive strength.
- The compressive strength, flexural strength, and Tensile Strength of concrete goes to decreasing order at 45% replacement of quarry dust in fine aggregate.
- The performance of GFQDC increased with regard to durability.

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