A STUDY ON THE STRENGTH OF CONCRETE BYPARTIAL REPLACEMENTOF FINE AGGREGATE WITH QUARRY SAND

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ABSTRACT: Concrete is the most widely used construction material in civil engineering industry because of itshigh structural strength and stability. The concrete industry is constantly looking for supplementarycementitious material with the objective of reducing the solid waste disposal problem.Quarry sand (QS) are among the solid wastes generated byindustry. To overcome from this crisis, partial replacement of Natural Fine Aggregate (NFA) with Quarry Sand (QS) can be an economic alternative.It is observed thatwhen natural sand is partially replaced with 60% quarry sand maximum strength is achieved.

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Keywords: Compressive strength, Concrete, Quarry sand(QS), Split tensile strength and flexural strength,NFA(Natural fine aggregate)

1. INTRODUCTION

Concrete is a heterogeneous mix of cement, aggregates and water. The global consumption of natural sand is too high due to its extensive use in concrete. The demand for natural sand is quite high in developing countries owing to rapid infrastructural growth which results supply scarcity. To overcome from this crisis, partial replacement of natural sand with quarry sand is economic alternative.

In the construction industry, Quarry Sand is used as an aggregate substitute especially for sand in a concrete mixture. The application of Quarry Sand can reduce the cost of construction. In SethSihla (Malaysia), the Centre for Housing Planning and Building built a number of low cost houses using Quarry Sand. The research done for the cost of construction proved that using Quarry Sand is cheaper than sand. Quarry Sand is also used in the construction of sub base in highways.

1.1 Quarry Sand or Stone Dust

Quarry Sand is a waste material obtains from crusher plants during the process of making of coarse aggregate of different sizes, about 175 million ton Quarry Sand is produced every year, which is discarded as waste. This enormous quantity of Quarry Sand requires a suitable disposal site for its easy and safe disposal, as a large land area is required to accomplish the requirement which would again be a great problem in a country of thickly populated like India. Quarry Sand, being final part of a coarse aggregate is an inert material and may be used in concrete making as partial replacement of fine aggregate

1.2 Merits of Quarry Sand as a Fine Aggregate:

Quarry Sand reduces the cost of construction. Helps to reduce the impact of the environment by consuming the material generally considered as a waste product. Stone crusher dust can be used in concrete without significant difference in strength and workability compared to concrete with natural sand.

- The Quarry Sand has potential as fine aggregate in concrete structures with

reduction in the cost of construction of concrete by about 20% compared to conventional concrete. Quarry Sand provides stronger bond with cement.

2. Experimental Details

2.1 Purpose of the Experiment

In the present paper work, it is planned to conduct lab Experiment using both mineral and chemical admixtures in different proportions, for two concrete grade areM_{30}.The main benefit of this Experiment is to develop the properties of the construction material to use mineral and chemical admixtures in a relevant proportions in civil engineering constructions.

The following Experimental tests were conducted on the concrete specimens:

- Compressive strength
- Split tensile strength
- Flexural strength

2.2Materials Used in Present Project and their Properties

2.2.1 Cement

Cement is a binding material, which is the combination of two raw materials called calcareous and argillaceous materials. Birla Super 43-grade Portland pozzolana cement grade

S. No	Property	Test results
1	Normal consistency	30%
2	Specific gravity	3.12
3	Initial setting time	90 minutes
4	Final setting time	330minutes

Table 1. Properties of Cement

ordinary Portland cement confirming to IS: 12269-1987 was used in concrete.

2.3Aggregates

Aggregates are the important constituents of the concrete. They give body to the concrete,reduce shrinkage and effect economy. The mere fact that the aggregates occupy 70-80% of the volume of the concrete

Table 2: Physical Propertiesof Aggregate

Specific gravity of coarse aggregate	2.48
Specific gravity of fine aggregate	2.64
Specific gravity of quarry sand	2.55

2.4 Results and Discussion

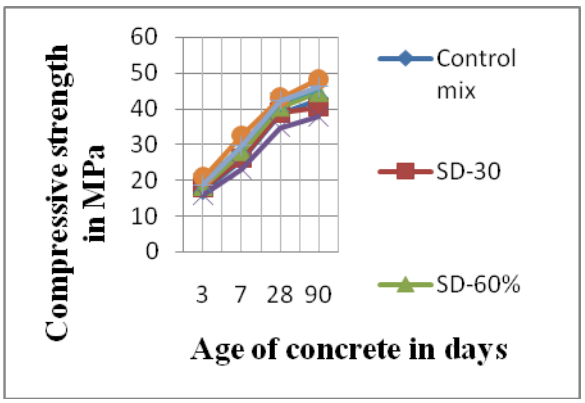
2.4.1Compressive Strength Test

The compressive strength test was conducted on concrete cubes at 3, 7, 28 and 90 days after curing.compressive strength of concrete prepared with replacement of natural fine aggregate with QS(quarry sand) by 0%, 30%, 60% and 100%

S. No	Type of concrete	Compressive strength in MPa				% Variation at age of 28 Days	Gain in strength between days		
		3 days	7 days	28 days	90 days		3-28 days	7-28 days	28-90 days
1	Control mix	17.1	25.8	38.5	42.4	-	55.5%	32.9%	10.1%
2	SD-30%	17.8	26.1	38.9	42.5	1.0%	54.2%	32.9%	9.25%
3	SD-60%	18.2	28	40.4	44.6	4.9%	54.9%	30.69%	10.3%
4	SD-100%	15.9	23.1	34.8	37.9	-9.6%	54.3%	33.6%	8.90%

.Table 4: Compressive strength of M_{30} grade of concrete at 3, 7,28 and 90 days

Graphical Representation for M_{30} grade of concrete 3,7, 28,90 days



2.6 Split Tensile Strength (M_{30} grade of concrete):

The split tensile strength test was carried out according to IS 5816-1999, to obtain the splitting tensile strength of concrete. The test results of various types of concrete mixes are presented in the Table 5. The splitting tensile strength of control concrete is 3.73N/mm^2. Results indicate that as the QS content increases more than 60%, the tensile strength decreases.

Table 5: split tensile strength of $_{30}$ Grade of Concrete at 28 days

S.No	Concrete type	Split Tensile Strength in MPa	% Variation at the age of 28 days
		28 day	
1	**Controlled concrete**	**3.725**	**--**
2	SD-30%	3.9	4.69
3	**SD-60%**	**4.01**	**7.65**
4	SD-100%	2.83	-24.02

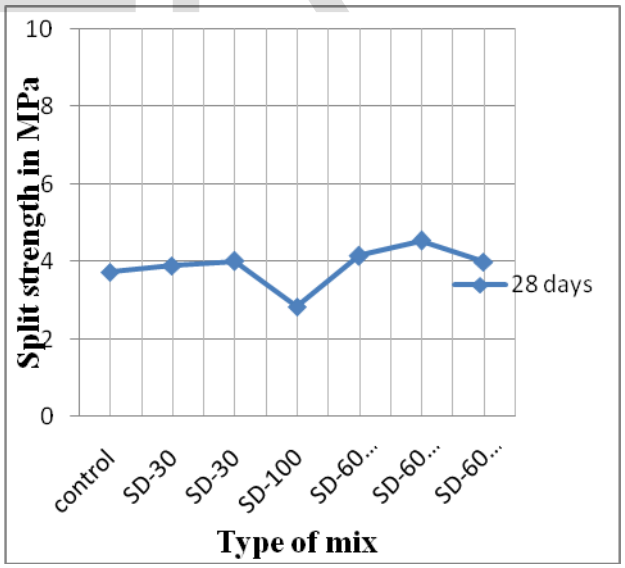
2.7 Flexural Strength (M_{30} grade of concrete)

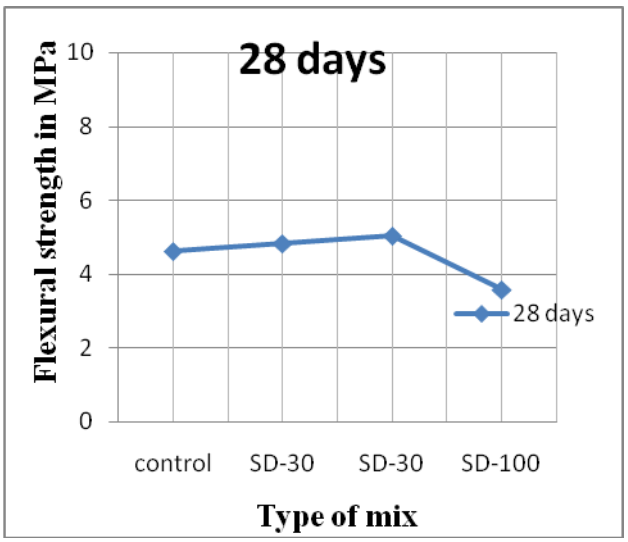
The test results of flexural strength of design mix M_{30} on standard 500mmx100mmx100mm of beam at 28 days age obtained are tabulated in the table.The results are graphically represented in the figure. Shows the comparison of tensile strength for different combination of silica fume concrete.

S.No	Concrete type	Flexural Strength in MPa	% Variation at the age of 28 days
		28 day	
1	**Controlled concrete**	**4.62**	**--**
2	SD-30%	4.83	4.54
3	**SD-60%**	**5.04**	**9.09**
4	SD-100%	3.58	-22.51

Table 6:Flexure strength of $_{30}$Grade of Concrete at 28 days

Graphical Representation for M_{30} grade ofconcrete at 28 days(split&Flexure)





3. CONCLUSION

Based on the experimental results, it can be concluded that:

1. It is observed from the table the gain in strength between 3-28 days is same in the range for all the mixes.The gain in strength between 7-28 days is moderately same for all the mixes.The gain in strength between 28-90 days is varying.
2. The strength gain at SD-60% is more i.e 10.3% comparing to other mixes.
3. Results indicate that as the QS content increases more than 60%, the tensile strength decreases.
4. The flexural strength of control concrete is 4.62 N/mm^2. From the results it can be observed that replacement of 60% stone dust the flexural strength is increased to 5.04 N/mm^2.
5. Results indicate that as the QS content increases more than 60%, the flexure strength decreases
6. However, concretes with higher levels of GGBS will not always achieve sufficient strength , particularly at lower temperature.
7. The addition of 60% Quarry sand replacement in natural fine aggregate shows the improved mechanical properties of concrete.

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