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CONCRETE MIX DESIGN

Dr. S. K.Dubey
Department of Civil Engineering, SSVP's B. S. Deore College of Engineering, Dhule, India
* dubey.dgule@radiffmail.com

Prof. P. R. Hedgire
Department of Civil Engineering, A. G. Patil Institute of Technology, Solapur, India
* p_hedgire@radiffmail.com

Prof. V. M. Bhogade
Department of Civil Engineering, A. G. Patil Institute of Technology, Solapur, India
* shivabhogade@gmail.com

ABSTRACT

The compressive strength of hardened concrete which is generally considered to be an index of its other properties, depends upon many factors, e.g. quality and quantity of cement, water and aggregates; batching and mixing; placing, compaction and curing.
The requirements which form the basis of selection and proportioning of mix ingredients are :
a) The minimum compressive strength required from structural consideration
b)The adequate workability necessary for full compaction with the compacting equipment available.
c) Maximum water-cement ratio and/or maximum cement content to give adequate durability for the particular site conditions
d) Maximum cement content to avoid shrinkage cracking due to temperature cycle in mass concrete
The reduction in the sources of natural sand and the requirement for reduction in the cost of concrete production has resulted in the increased need to identify substitute material to sand as fine aggregates in the production of concretes especially in Concrete. Quarry dust, a by-product from the crushing process during quarrying activities is one of such materials. Granite fines or rock dust is a by-product obtained during crushing of granite rocks and is also called quarry dust. In recent days there were also been many attempts to use Fly Ash, an industrial by product as partial replacement for cement to have higher workability, long term strength and to make the concrete more economically available. This present work is an attempt to use Quarry Dust as partial replacement for Sand in concrete. Attempts have been made to study the properties of concrete and to investigate some properties of Quarry Dust the suitability of those properties to enable them to be used as partial replacement materials for sand in concrete.

INTRODUCTION

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability, and workability as economically as possible, is termed the concrete mix design. The proportioning of ingredient of concrete is governed by the required performance of concrete in 2 states, namely the plastic and the hardened states. If the plastic concrete is not workable, it cannot be properly placed and compacted. The property of workability, therefore, becomes of vital importance.
The actual cost of concrete is related to the cost of materials required for producing a minimum mean strength called characteristic strength that is specified by the designer of the structure. This depends on the quality control measures, but there is no doubt that the quality control adds to the cost of concrete. The extent of quality control is often an economic compromise, and depends on the size and type of job. The cost of labour depends on the workability of mix, e.g., a concrete mix of inadequate workability may result in a high cost of labour to obtain a degree of compaction with available equipment.
The function of the fine aggregate is to assist in producing workability and uniformity in the mixture. The river deposits are the most common source of fine aggregate. Now-a-days the natural river sand has become scarce and very costly. Hence we are forced to think of alternative materials. The Quarry dust may be used in the place of river sand fully or partly. A comparatively good strength is expected when sand is replaced partially or fully with or without concrete admixtures.
It is proposed to study the possibility of replacing sand with locally available crusher waste without sacrificing the strength and workability of concrete.

PROPERTIES OF MATERIAL USED

A. Cement:

The cement used for this project work is Bharti 53- grade Portland pozzolana cement. The various properties of cement are tabulated in Table 1.

Table 1 Properties of Cement

Sr. No.	Type of Test	Result
1	Fineness	2%
2	Specific Gravity	3.05
3	Normal Consistency	30%
4	Initial setting time	35 min
5	Final setting time	450 min

B. Aggregates:

1. Fine Aggregate (Natural Sand-source-Bhima River and Quarry Dust-from local Quarry) :
The natural sand for the concrete mix is tested for the following test and the results are as tabulated in table 2.

Table 2 Properties of Fine Aggregates

Sr. No.	Type of Test	Result	
		Natural Sand	Quarry Dust
1	Specific Gravity	2.56	2.54
2	Sieve Analysis	3.20	2.80
3	Voids Ratio	0.54	0.40
4	Density	1.66 gm/cc	1.76 gm/cc

2. Coarse Aggregate:

The crushed granite aggregate of size passing through 20mm and retaining on 12.5mm standard sieve is used as coarse aggregate. The various properties of coarse aggregate are presented in Table 3.

Table 3 Properties of Coarse Aggregate

Sr. No.	Type of Test	Result
1	Specific Gravity	2.88
2	Sieve Analysis	6.25
3	Density	1.64 gm /cc

C. Water: Potable water with pH value 7 is used for mixing and curing throughout the experiment.

METHODOLOGY ADOPTED

Fresh concrete workability :

To determine consistency of concrete, Slump test was conducted with varying water content and a particular water cement ratio (w/c) which gives the slump of 60mm was selected from graph. The various w/c for different proportions of sand and quarry dust was presented in Table 4.

Table 4: Workability of concrete (slump 65mm)

Fine Aggregate: Quarry dust	Water Cement ratio for M 20 mix
100 : 0.00	0.45
50 : 50	0.50
0.00 : 100	0.55

Compression test :

The cube specimens were tested for compressive strength at the end of 7 days and 28 days. The specimens were tested after surface of the specimen dried. The load was applied on the smooth sides without shock and

increased continuously until the failure of the specimen. The maximum load withstand by the specimens is noted, mean compressive strength is determined and presented in Table 5.

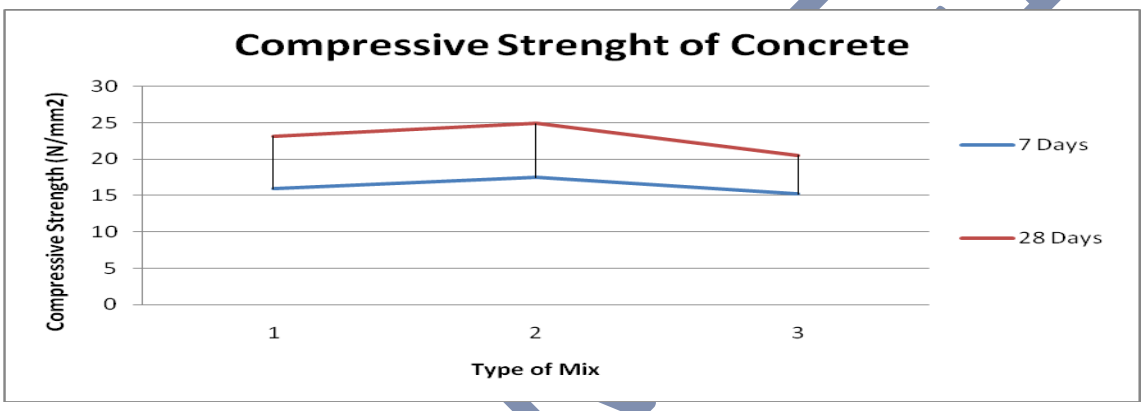
Table 5: Mean Compressive strength of concrete (in MPa)

Fine Aggregate: Quarry dust	Mean Compressive strength of M20 concrete (N/ mm^2)	
	7 Days	28 Days
100 : 0.00	15.90	23.15
50 : 50	17.50	24.90
0.00 : 100	15.20	20.54

ANALYSIS OF TEST RESULTS

A. Compressive strength

From the Table 5, it is observed that both the 7 days and 28 days compressive strength is increased for the 50% replacement of sand at considerable level. The variation in compressive strength is represented in following graph.



Graph: 1 Compressive strength of concrete in 7 days and 28 days

CONCLUSIONS

1. The Replacement of the sand with quarry dust shows an improved in the compressive strength of the concrete.
2. As the replacement of the sand with quarry dust increases the workability of the concrete is decreasing due to the absorption of the water by the quarry dust.
3. The specific gravity is almost same both for the natural river sand and quarry dust. The variation of the physical properties like particle size distribution and bulking is much varying parameter that which effect the mix design of the concrete.
5. The percentage of the replacement of sand with the quarry dust is 50 % in case of compressive strength.

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