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Parametric study of grout mix design using admixture

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ABSTRACT

This paper is part of the dissertation work in which an experimental investigation is carried out to study the performance of the grout mixtures subjected to different types of curing regimes. Different grout mixtures have been designed varying the water/solids ratio and the dosage of the admixtures. The grout mixtures were then tested to study the mechanical property i.e Compressive strength of the various grout mixes thus designed and subjected to two different curing regimes i.e Air curing and water curing (full immersion curing).

Index Terms—*Water solids ratio, water cement ratio, curing regime*

1. INTRODUCTION

Grout is a cementitious material primarily composed of Portland cement, fine aggregates , possibly coarse aggregates and in some cases lime. These ingredients are combined with sufficient amount of water to prodouce a fluid, flowable mixture.

Grout is neither a concrete nor a mortar. The big difference between concrete, mortar or grout is their plasticity or fluidity in the initial stage. Grout although having the same ingredients as that of concrete has a fluidity or plasticity far greater than that of normal concrete. This amount of fluidity is required to allow the grout to flow through the grout space. The latter being dependent upon the purpose for which the grout is used i.e masonry units, tile joints, annual spaces in pipe joints, surrounding the reinforcement bars to develop a good bond between the reinforcement bars and masonry units etc. Different types of grout are used currently. These include cement, cement and sand, cement clay, slag-cement, fly ash-cement and epoxy resin grout.

In the present experimental work grout mixture has been prepared using Fly Ash as a partial substitute for Portland cement and full substitute for sand. Fly ash contributes to the use of recycled materials and besides improving the strength the fine spherical properties of fly ash enhance the flow and pumpability properties of grout.

2. Experimental Program

A . Raw Material Used:

The raw materials that were used to prepare the various grout mixes are mentioned below:

Cement- Ordinary Portlant cement (OPC) of 53 grade was used to prepare the fluid based grout confirming to IS:12269:1987.

Fly Ash- Class F fly ash with low calcium obtained from the wanakbori Thermal Power Station, Gujarat was used a partial replacement to cement and full replacement for sand..

Water- The normal tap water was used for the mixing and curing of the grout.

Admixture- SUPER P RA20 R in fluid form was used by varying its dosage in percentage by weight of cement. It is brown liquid base on sulfonated Naphthalene it confirms to IS Code 9103:1999.

B . Proportions:-

Individual quantities of the ingredients involved were calculated by designing the grout mix. The varying parameters included the Water / solids ratio and the dosage of the admixtures. The water solids ratio is the ratio of the water to the total weight of solids i.e (cement + fly ash). The cement: fly ash ratio was taken as 1:4. Five different grout mixtures were prepared for five different water/solids ratio i.e 0.3,0.35,0.4,0.45 & 0.5. Dosage of admixture in percentage by weight of cement was taken as 0.5%, 0.75%,1.0% & 1.25%.

C . Mix Procedure:-

First the OPC and fly ash were dry mixed in a clean dry pan for about 3 minutes until they were blended uniformly and intimately. All the lumps of fly ash were properly broken down by hands so that it results into a uniform mix. Then the tap water measured on the base of water/solids ratio was added to the dry mix along with the measured quantity of the admixture. Grout was again mixed thoroughly by help of trowel to get a uniformly coloured mix. The mixed grout was then filled into the cube moulds of size 7.07 cm. All the moulds before filling were oiled with the greasing agent. The edges of the moulds were tamped so that any air bubbles are forced out. When filling the mould, sufficient material was used so that mould is slightly over filled. The extra material was then

striked off with the edge of the trowel. After 24 hours, the cubes were carefully stripped off from the moulds to be subjected to different curing conditions and then tested at 7 days.

D . **Curing & Testing :-**

The curing conditions adopted in this experimental program were

(i) Type-I : Air curing until the time of testing the cubes

(ii)Type- II :Full immersion curing i.e continuous water curing

(iii)Type-III : 4 hrs air drying after the cubes were taken out from curing tank.

These cubes were then loaded in the Compression testing machine and were loaded until failure. The compressive strength for each batch of grout mix was recorded.

4. RESULTS & OBSERVATION TABLE

Figures 1 to 5 represent the average compressive strength of the cubes of the grout mix for varied dosage of admixtures and three different curing regimes as mentioned above.

Table -1 : Cement :Fly ash = 1:4 Water/solid = 0.30

Dosage of Admixture	Compressive strength of grout mix After 7 day (in N/mm²)		
	Type-I curing	Type-II curing	Type-III curing
0.50%	6.94	6.20	6.67
0.75%	6.94	6.27	6.77
1.00%	7.94	6.87	7.54
1.25%	8.87	8.14	8.77

Fig-1 : % Admixture to comp.strength graph for W/S = 0.3

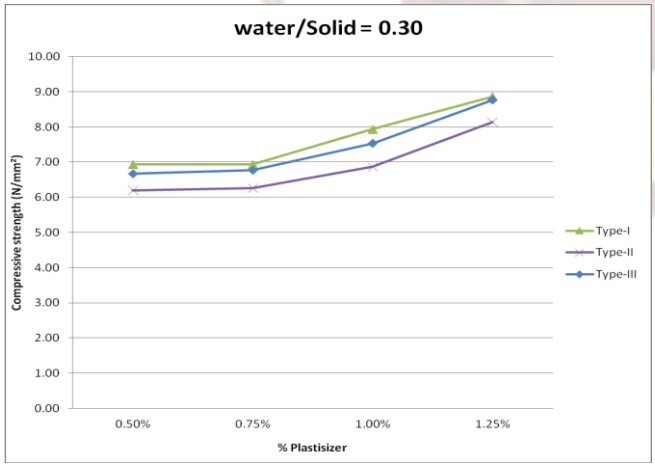


Table-2 : Cement :Fly ash =1:4 Water/solid =0.35

Dosage of Admixture	Compressive strength of grout mix After 7 day (in N/mm²)		
	Type-I curing	Type-2 curing	Type-3 curing
0.50%	3.30	2.80	3.03
0.75%	2.93	2.52	2.85
1.00%	3.30	2.97	3.17
1.25%	4.13	3.20	3.80

Fig-2: % Admixture to comp.strength graph for W/S= 0.35

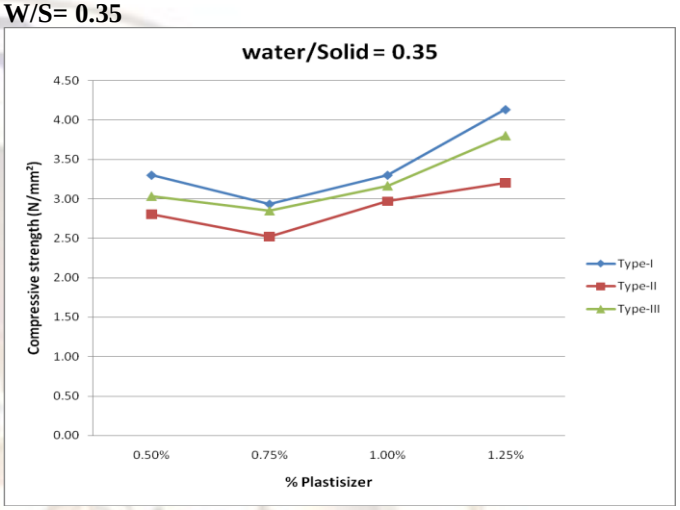


Table-3 : Cement: Fly ash = 1: 4 Water/solid = 0.4

Dosage of Admixture	Compressive strength of grout mix After 7 day (in N/mm²)		
	Type-I curing	Type-2 curing	Type-3 curing
0.50%	2.42	2.17	2.25
0.75%	2.60	2.20	2.23
1.00%	2.20	1.88	1.97
1.25%	2.40	2.00	2.33

Fig-3: % Admixture to comp.strength graph for W/S= 0.40

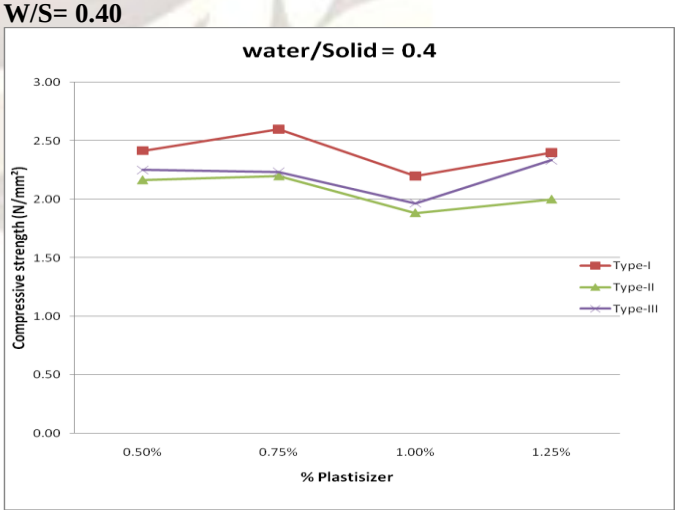


Table-4 : Cement : Fly ash=1:4 Water/Solid =0.45

Dosage of Admixture	Compressive strength of grout mix After 7 day (in N/mm²)		
	Type-I curing	Type-2 curing	Type-3 curing
0.50%	2.47	1.87	1.95
0.75%	2.43	1.85	2.30
1.00%	2.43	2.03	2.18
1.25%	2.13	1.85	2.00

Fig-4: % Admixture to comp.strength graph for W/S= 0.45

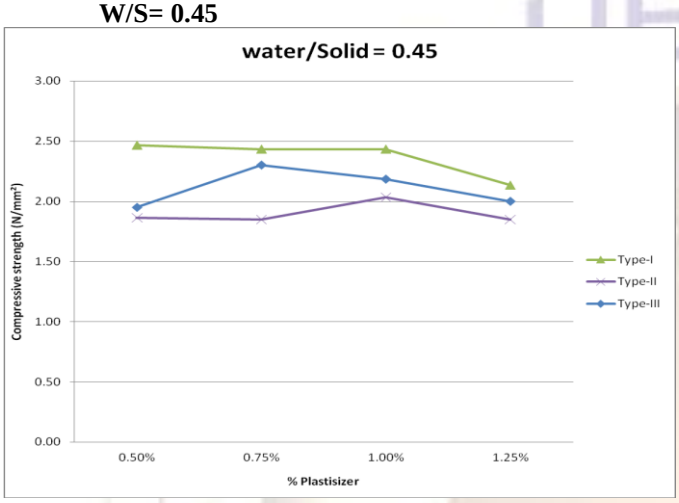
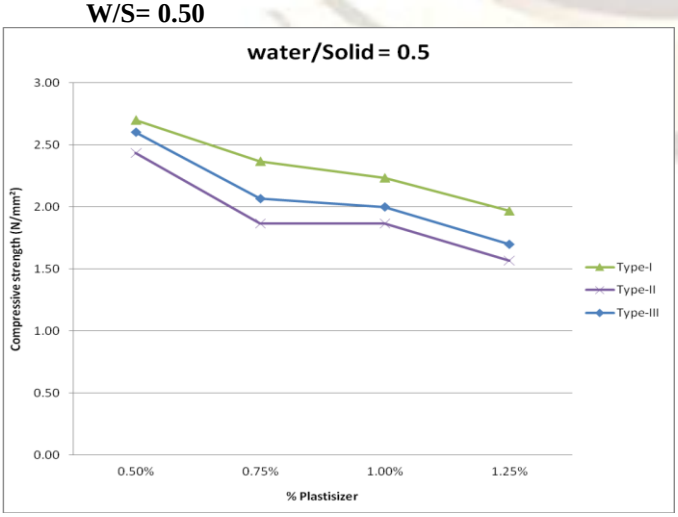


Table-5 : Cement : Fly ash=1:4 Water/Solid =0.50

Dosage of Admixture	Compressive strength of grout mix After 7 day (in N/mm²)		
	Type-I curing	Type-2 curing	Type-3 curing
0.50%	2.70	2.43	2.60
0.75%	2.37	1.87	2.07
1.00%	2.23	1.87	2.00
1.25%	1.97	1.57	1.70

Fig-5: % Admixture to comp.strength graph for W/S= 0.50



5. CONCLUSIONS:

Figures 1 to 5 shows the 7-day initial compressive strength of the samples subjected to different curing conditions. From the values calculated and the graphs following conclusions shall be derived

(1) Compressive strength of grout mix increases with decrease in water/Solid ratio for all types of curing conditions.

(2) For water/solid ratio of 0.3 and 0.35 compressive strength increases with increase in dosage of admixture for all types of curing conditions.

(3) For water/solid ratio of 0.4 onwards compressive strength shows the mixed trend.

(4) Average compressive strength of grout mix in descending order is found as below

Type I > Type III > Type II.

The initial increase in temperature accelerates the hydration process and hence gives higher strength. Where else in case of water curing, the excess of water present in the pores weaken the specimen and results into less strength.

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