

# Testing compress sieve strength of colloiddly mixed grout

## Abstract

This section presents the introductory contents related to the subject of Seminar. Firstly, it discusses the basics and then its various details.

**Keywords:** strength, structures, colgrout masonry, durability, bleeding, setting time, strength

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Ajit Ambekar,<sup>1</sup> Shrikant M Harle<sup>2</sup>

<sup>1</sup>B.E final year student, Prof Ram Meghe College of Engineering and Management, India

<sup>2</sup>Department of Civil Engineering, Assistant professor, Prof Ram Meghe College of Engineering and Management, India

**Correspondence:** Shrikant M Harle, Department of Civil Engineering, Assistant professor, Prof Ram Meghe College of Engineering and Management, Badnera, Maharashtra, India, Email shrikantarharle@gmail.com

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## Introduction

Colgrout is colloidal grout is mortar mix grout whose solid particles are in a fixed suspension. Colcrete is nothing but the Colloidal Concrete. Colloidal concrete means concrete that is mix of aggregates and colloidal grout. In other words we can say concrete whose aggregate is bound by colloidal grout. Colloidal concrete is differ from ordinary concrete in many significant ways. The grout is composed of Portland cement, sand, water and is hardened by hydration of cement. Grout injection is sealing or strengthening the ground in order to prevent water entrance or any failure after excavation. In its initial phase of flow it exhibit great density and adhesiveness. Due to this tough and sticky consistency allow for a longer working period for the mixture to flow effectively into a desire placement location. The formula also provides a much greater degree of self compression and compacting during the curing phase. It is mainly used for soil improvement, such as dam curtain walls using jet grouting methods for masonry wall crack repairs or for preplaced- aggregate concrete applications The main characteristic of colgrout is bleeding, setting time, strength, and viscosity With the name of colgrout we also used mixer called as paint mixer to the mix the grout that means we perform experiment for preparation of grout and colgrout by using mixer which having the power of 1200 watt and 500– 550 rpm hence it mix grout and make it as a colloidal grout (colgrout) That mixer gives well mix concrete and grout as compare to traditional hand mix . Colgrout Masonry is one of them which satisfies the requirement of strength and durability and at the same time, being impervious, is particularly suitable for water retaining structures in Indian conditions.

## Literature survey

Yoo et al. reported that the compressive strength of colloidal grout decreased after 7 days due to surface cracking by self- restraint of shrinkage as a result of water evaporation. Lam et al. studied the strength effect of SF and FA with different w/c ratios. According to their findings, a 15% SF and a 25% FA replacement increased the compressive strength of grout considerably at the end of 28 day. Tan et al. investigated the effects of bentonite, fly ash, and silica fume on the bleeding using Taguchi approach and found the silica fume as the most efficient additive among the above additives for bleeding reduction. Shannag outlined 26% strength increasing with 15% pozzolan and

15% SF after 28 day. Compressive strength of the concrete without SF was found to be lower than the compressive strength of the SF concrete for mixes with a w/c ratio of 0.35. In 1992, both Krizek et al. and Liao et al. performed experimental research using a grout with a mixture of ultra fine cement and sodium silicate, found that the compressive strength increased with the cured grout age As per IS 269:1989<sup>1</sup> Specification for 33 grade ordinary Portland cement it gives the Ordinary Portland cement, Portland slag cement, Portland pozzolona cement and Sulphated cement used for colgrout masonry work in dams. A per IS 2116:1980<sup>2</sup> Specification for sand for masonry mortars is used.

## Theoretical aspect

This section presents the introductory contents related to the subject of Seminar. Firstly, it discusses the basics and then the different possible systems.

## About of mixer

Paint mixer consists of a high torque motor with a robust gear box, with electronically variable continuously variable speed. So that different speeds and power output can be selected for different viscosity materials, due to this speed control. There is no splashing of the fluid It also use for mixing putty, cement & concrete This machine having power of 1200w/120v/50hz ,height of machine blade is 550 mm also its speed is 580 rpm hence it mixes the concrete mix faster (Figure 1).

## Method of operation

First of all we have to mix the cement, aggregate, fly ash, water, sand in certain proportion in any container then tend paint mixer in that mix and start the machine by giving it electric supply, computes amounts and weights of water, other contained required from standard formula, and pours the specified amounts water into mix. Starts mixer and allows it to run for prescribed time to attain better mix and then after stop machine.

## Characteristics of grout mixture

There are four main characteristics for a grout mixture including bleeding, setting time, strength, and viscosity. The main characteristics

for cement-based grouts by which the efficiency of a grout is examined can be mentioned as follow.

**Bleeding:** The appearance of water on the surface of grout after it

has consolidated is known as bleeding. It is the form of segregation in which the layer of water migrates to the surface of grout during the initial stage of cement hydration process.



**Figure 1** Shows the mixer and its characteristics.

**Initial setting time:** Setting is the stiffening of the cement paste after water is mixed. The time at which cement paste loses its plasticity is called as initial setting time or the time when the cement water paste attains a certain degree of hardness. For OPC, it should not be less than 30 minutes. Rapid setting time is often desirable when injection is under water table so that the grout will set before being excessively diluted or washed away.

**Compressive strength:** It is the capacity of material or structure to withstand loads tending to reduce its size. It is the resistance of a material to breaking under compression. This test is performed to know how much compressive load a material can bear or resist. In some grouting projects, however, especially those in connection with water control, strength is not of much importance.

### Priority of grout characteristics

It is important to note that the priority of importance between the above-mentioned characteristics is first belonged to bleeding, second to setting time, third to strength i.e. compressive strength, and finally to viscosity. The reason for this fact is that one may build a grout mixture with noticeable strength but not acceptable bleeding or setting time. Therefore, apart from the high strength, the grout mixture cannot be considered. Besides, there are some projects with only purpose of sealing.

### Material and methodology

This section presents the material needed for the experiment and process to perform the experiment. From the research papers study, the effects of many admixtures on grout through the researcher's experimental study are discussed below.

### Materials used in the experiment

#### Material

**Cement:** Ordinary Portland cement, Portland slag cement, Portland

pozzolona cement and Super Sulphated cement used for colgrout masonry work in dams and other massive structures shall comply with the requirements of IS: 269- 1976, IS: 455, IS: 1489- 1976 and IS: 6909 respectively. Special cements may also be specified for use in dam masonry.

**Mineral admixture:** Fly Ash.

**Water:** Water used for mixing mortar, grout and also for washing the stone and curing masonry shall conform to the requirements of IS 456.

**Sand:** The sand shall conform to IS 2116:1965 and IS 383:1970.<sup>3</sup>

### When mixer use to create grout

#### Preparation of grouting mixture using mixer

The colgrout mortar shall consist of cement, sand, water and other approved admixtures, mixed in the proportions as may be defined, by weight. The proportions of materials entering into the mortar shall be based on laboratory studies. The moisture content of the sand shall be taken into accounting proportioning the mix. The fineness modulus of sand shall be 2.6 to 3.0. Pozzolanic material may also be mixed; the mortar shall be mixed in big container (Figure 2).

Mixer should not be loaded in excess of the rated capacity of mixer. Following general principles shall be followed:

- i. The speed of mixer should be 500 to 550 rpm.
- ii. The thoroughness of mixing and adequacy of mixing time so as to give colloidal state to the mortar shall be tested at the start of the job and at intervals as may be considered necessary.

The minimum mixing time generally specified is as follows:

Mixing cement and water in first container –30 to 50 seconds  
 mixing of cement slurry and sand in container –80 to 100 seconds.  
 Overall time for one mix of colgrout mortar –100 to 130 seconds.



**Figure 2** Preparation of grouting mixture using mixer.

### When mixer is not used to create grout

#### Preparation of grouting mixture by hand mix

The colgrout mortar shall consist of cement, sand, water and other approved admixtures, mixed in the proportions as may be defined, by weight. The proportions of materials entering into the mortar shall be based on laboratory studies. The moisture content of the sand shall be taken into accounting proportioning the mix. The fineness modulus of sand shall be 2.6 to 3.0. Pozzolanic material may also be mixed; the mortar shall be mixed in big container. There is no mixer used to mix the grouting mixture. Preparing mix using traditional hand mixing (Figure 3).



**Figure 3** Preparation of grouting mixture using hand mixing method.

### Methodology

The grout was prepared by using mineral admixture i.e. Fly Ash (FA) in 34% by the weight of cement and adding water in it with W/C ratio of 0.4 Those prepared grouting mixtures were filled in mould of 150mmx150mmx150mm and put it for 24 hours in mould for drying, then was taken out from mould after 24 hours and put them for curing. With three different types of grouting mixtures and three different curing time's i.e.3 days, 7 days and 28 days compressive strength of grouting mixtures were determined. There is ratio of 1:2:4 of Cement, Sand, and Aggregate is used. For 250 g of cement, 500 g of sand of size 2.36 mm, 1kg of aggregate of size 6 mm is used to create single mould of grout and water contained is taken as 12% in it (Figure 4).



**Figure 4** Grouting mixtures were filling in mould & filled cubes.

### Testing

Compressive strength test was performed in this study. Their description is as follows.

#### Compressive strength test

150mmx150mmx150mm cubic specimens were cast for each grout mixtures type and compressive strength tests were conducted using these specimens. A digital compression testing machine was used for compressive strength testing. The load was constantly applied without shock until failure and the load present on the grout cube at the time of failure was noted down. That load was considered as the compressive strength of that grouting mixture cube. Compressive strength grouting mixtures for 3 days, 7days and 28 days were taken.<sup>4,5</sup>

## Testing results

**Testing results of grout:** The test specimens of compressive strength were tested after 3, 7, 28 days of curing times Compressive Strength results of both grouts i.e. using mixer and hand mix method were found with the help of Digital Compression Testing Machine. Results

**Table 1** Compressive Strength results of grouts

Sr. No.	Grout	Cubes no.	3 days curing	Average	Compressive Strength in N/m <sup>2</sup>			
					7 days curing	Average	28 days curing	Average
1	Using mixer	1 <sup>st</sup>	8.1	8.2	9.8	10.9	14.5	14.7
		2 <sup>nd</sup>	8.4		10.9		15.2	
		3 <sup>rd</sup>	8.1		11.6		14.1	
2	Hand mixing	1 <sup>st</sup>	5	5.6	8.2	7.78	9.6	10.1
		2 <sup>st</sup>	5.6		7.2		10.2	
		3 <sup>rd</sup>	6.2		7.9		10.1	

**Table 2** For initial and final setting time

Sr. No	Time min	Initial reading	Final reading	Settlement of needle	Penetration mm
1	10	46	8	37	
2	20	46	10	36	35
3	30	46	11	34	
4	40	46	12	33	

**Table 3** Bulking of sand test results

Sr. No	% Water	Height (h1)	Height (h2)	% Bulking
1	4	12.9	13.9	7.75
2	6	11.9	13.9	16.8
3	10	11.7	13.9	18.83

## Discussion and conclusion

1. In hand mixing the does not proper give proper mix because it contains pores in it.
2. In use of paint mixer gives a proper mix because it does not contains pore in it.
3. Hence The compressive strength obtained by the grout mixture prepared by using mixer having more strength as compare to mixed by hand mixing method..
4. We can conclude that the mineral admixtures can be used for high– strength and low cost grout in tunneling applications. In addition, the use of waste materials can contribute to the resolution of environmental problems.
5. Also by preparing colgrout we also conclude that it is much

are in the table below (Table 1).

**Testing results of cement test:** Table 2 shows the initial and final setting time.

**Testing results of sand:** Table 3 shows the bulking of sand test results.

durable and strengthening as compare to other grouts and concrete hence it is beneficial for water retaining structures.

## Acknowledgements

None.

## Conflict of Interest

The author declares there is no conflict of interest.

## References

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