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Study on Controlled Low Strength Materials using GGBS with Dredged Soil and M-Sand

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Abstract. In general, CLSM mixtures contain common ingredients such as Portland cement, fly ash, good mixing and water. CLSM is forced to fill in the back material and not low-strength concrete, rather it can best be described as property which is designed as concrete and strength flow and strength as per requirement and used as a backfill to avoid soil issues. CLSM can be built with a variety of strengths and sizes, taking into account costs future requirements, low power CLSM will be required to allow future excavation, and if there is no space for future digging the energy can be high on the other hand, furthering the size of CLSM can be adjusted according to the cost and material requirements. However, some industrial products and recycled products are also accepted and promoted as long as they are available, costing a particular use and the necessary characteristics of a combination such as flow, power, extraction, and quantity are acceptable. The aim of this study was to test whether it was possible to apply red mud such as placing a portion of Portland cement in a low-power controlled (CLSM) component made of industrial-grade products. The control mixture was initially made from the Portland cement, fly ash, and water. Bleeding, flow, the initial time for the setting of new CLSM compounds is measured and subsequent complications include compression. Results-They performed well and complied with CLSM requirements at ACI 229 levels in terms of flow, bleeding rate, initial set-up time, uncompressed compression strength. Low power control devices (CLSM) remove the problems of ground receding to provide the strength of the supporting structure.

Introduction

Controlled Low Strength Material (CLSM) mixtures contain common ingredients such as Portland cement, fly ash, good mixing and water. CLSM is forced to fill in the back material and not low-strength concrete, rather it can best be described as property which is designed as concrete and strength flow and strength as per requirement and used as a backfill to avoid soil issues[1]. CLSM can be built with a variety of strengths and sizes, taking into account costs future requirements, low power CLSM will be required to allow future excavation, and if there is no space for future digging the energy can be high on the other hand, furthering the size of CLSM can be adjusted according to the cost and material requirements. However, some industrial products and recycled products are also accepted and promoted as long as they are available, costing a particular use and the necessary characteristics of a combination such as flow, power, extraction, and quantity are acceptable[2]. This project aimed to test whether it was possible to use GGBS with M-sand and dredged soil, as binding and filler materials. GGBS is a waste obtained from quenching molten iron slag from the blast furnace in iron manufacturing industries. CLSM is one of the environmentally friendly materials made using waste materials like GGBS, fly ash etc. and cement

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as an activator for pozzolanic reaction. In the present study, the ratio of GGBS to the cement is maintained as 3.5 and 2.8, water to binder ratio varied from 0.5, 0.55, 0.6, 0.65. The sand content of 1350 g and 1425 g were used for GGBS/cement ratios of 3.5 and 2.8 respectively. Fresh properties like density, flow ability, bleeding, and initial setting times are studied. It is observed that an increase in river sand content can lead to improved stability (bleeding rate) in the proposed CLSM operation. Increasing water content greatly influence the fresh properties in the proposed CLSM. The hardened properties like compressive strength and split tensile strength were studied [3]. It is observed that the increase in water content has a specific impact on the fresh and hardened properties of the CLSM using GGBS. The entire CLSM mixtures exhibit required strength as per ACI Committee 229. This research paved way for the usage of GGBS in controlled low strength materials and effective utilization of waste materials in a sustainable manner.

Literature Review

Backfills

The Ease of placing CLSM in restricted places without compaction facilitates the reduction in trench width or excavation.

Traditional methodology of backfilling in layers and compacting will never provide with the uniformity of density as facilitated by CLSM. CLSM can be placed in layers, allowing each layer to harden prior to placing the next layer.

Structural Fills

CLSM with higher strength can be produced to act as structural fills, in case of BC soil it can distribute structures load on greater area.

CLSM can provide a uniform and level surface for uneven sub-grades under foundation footings and slabs.

Utilities Bedding

CLSM gives a great sheet material to pipe, electrical, phone, and different sorts of conductors.

Erosion Control

Lab studies, just as field execution, have shown that CLSM opposes disintegration better than numerous other fill materials.

Void filling

Tunnel shafts and sewers—filling deserted passages and sewers, it is vital to utilize a stream capable combination.

A steady stockpile of CLSM will assist with keeping the material streaming and make it stream more noteworthy distances.

Methodology

Introduction
Literature review
Material collection & Testing on materials
Casting on mortar and concrete
Comparison on both concrete cubes
(Dredged soil & M-sand)

Figure 1. Methodology

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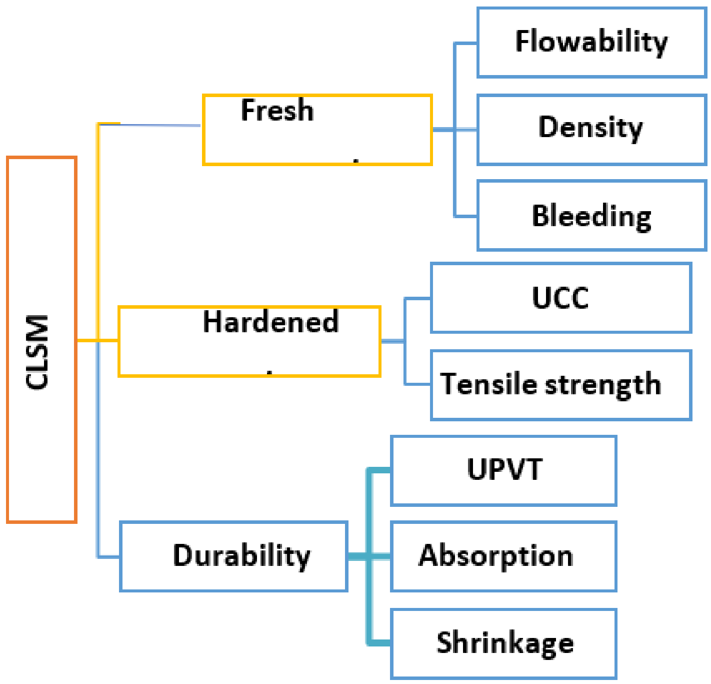

Figure 2. Schematic for the testing program

Materials

Common Portland concrete (solid) of 53 Grade out there in local market is utilized inside the examination. The solid which is utilized had tried for a very long time according to IS: 4031-1988 and situated to be affirming to shifted determinations of IS: 12269-1987 having explicit gravity of 3.0.Manufactured sand (M sand) is used as a substitute for normal stream sand in this audit[4]. Particles going through 4.75 mm sifter are used. Crushed exact sums of size 20mm and 10mm appearance express gravity 2.79 and 2.74 exclusively was used in the survey. Water for relieving and blending affirming to IS 456 was used.

Figure 3. Dredged soil

Gathering Dredged soil from the jungle gym as shown in the figure 3.. Particles going through 4.75 mm strainer are utilized. Squashed precise totals of size 20mm and 10mm appearance explicit gravity 2.79 and 2.74 separately was utilized in the review[5].

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Figure 4 Ground Granulated Blast Furnace Slag

Ground Granulated Blast Furnace Slag (GGBS) is a concrete substitute that further develops toughness and furthermore the natural certifications of substantial blends. It is a side-effect of the iron-production industry [6].

Experimental evaluation

The experimental evaluation of all the parameters for the present study is based on the ASTM standard procedure and the IS standard procedures. The details of the test and the codal provisions are given in Table 1. A tentative schematic is also provided for the methodology adopted for the present study [7].

Table 1 Details of the test and corresponding code provisions

S.No	Materials Property	Details of test	Procedure from Standard codes
1	Ash Content	Loss on Ignition	ASTMD1762-84
2	Gradation	Particle size distributions	ASTM D6913 / D6913M - 17
3	pH	pH Test	
4	Elemental Analysis	Atomic absorption spectroscopy	
5	Flowability	Flow Consistency	ASTM D6103 / D6103M - 17e1
6	Density	Density of the materials at fresh and hardened state	ASTM D6023 - 16
7	Unconfined Compressive strength	Compressive strength of the CLSM	ASTM D2166 / D2166M – 16
8	Ultra-Sonic Pulse Velocity	Homogeneity of the CLSM Materials	ASTM C597

Mix design for M sand & Dredged soil

The proportioning of the ingredients was as per IS10262:2009, with fly ash as the main ingredient and cement as supplementary material, further the focus of the mix design was to develop substitute for backfill which matches its rate but consist the advantages of CLSM, along with that GGBS as partial replacement of cement [8].Dredged soil sand as complete replacement of M sand. The design mix proportions were given in table 2 and 3.

Table 2 Mix design for M sand

S.No	Cement (g)	GGBS (g)	M sand (g)	Water (ml)
1	200	700	1350	450
2	200	700	1350	495
3	200	700	1350	540
4	200	700	1350	585
5	200	700	1425	475

Table 3 Mix design for Dredged soil

S.No	Cement (g)	GGBS (g)	Dredged soil (g)	Water (ml)
1	200	700	1350	450
2	200	700	1350	495
3	200	700	1350	540
4	200	700	1350	585
5	200	700	1425	475

The above design mix were casted into cubes for various tests which includes basic testing of materials, setting time, California Bearing Ratio (CBR), Slump Cone Test and Ultra sonic pulse velocity [9].

Figure.5 CLSM mould casting

Test on setting time

For deciding the typical consistency and the hour of setting of our blend, that comprise of bar gauging, having a needle in each end, and backing in outline with graduated scale to quantify the distance to which the needle infiltrates our blend as shown in the figure 5[10].

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Figure 6 Initial setting time and final setting time

California Bearing Ratio (CBR)

CBR test decides the relative bearing proportion and development qualities under realized additional charge weight of base, sub base and sub level soils for the plan of streets, asphalts and runways [11]. The CBR test is utilized broadly in determination of materials and control of sub levels [12].

Slump Cone Test

The concrete slump test estimates the consistency of new cement before it sets. A different test, known as the flow table, or slump-flow, test, is utilized for substantial that is excessively liquid (non-workable) to be estimated utilizing the standard slump test, in light of the fact that the substantial won't hold its shape when the cone is eliminated [13].

Figure 7 Flow-ability tests on CLSM

Ultrasonic pulse velocity

It is used to measure the transit time, velocity and parameter of evaluating concrete. To check the quality of concrete and to measure the velocity of an ultrasonic pulse passing through a concrete [14]. The test has been performed for both the samples such as M-sand and dredged soil. The comparison value were tabulated in table 4

Table 4 Comparison Result of UPV test

S.No	Pulse Velocity by Cross Probing for M sand (Km / Sec)	Pulse Velocity by Cross Probing for Dredged soil (Km / Sec)
1	2.61	1.72
2	2.72	1.79
3	2.78	1.86
4	2.96	1.92
5	3.2	1.98

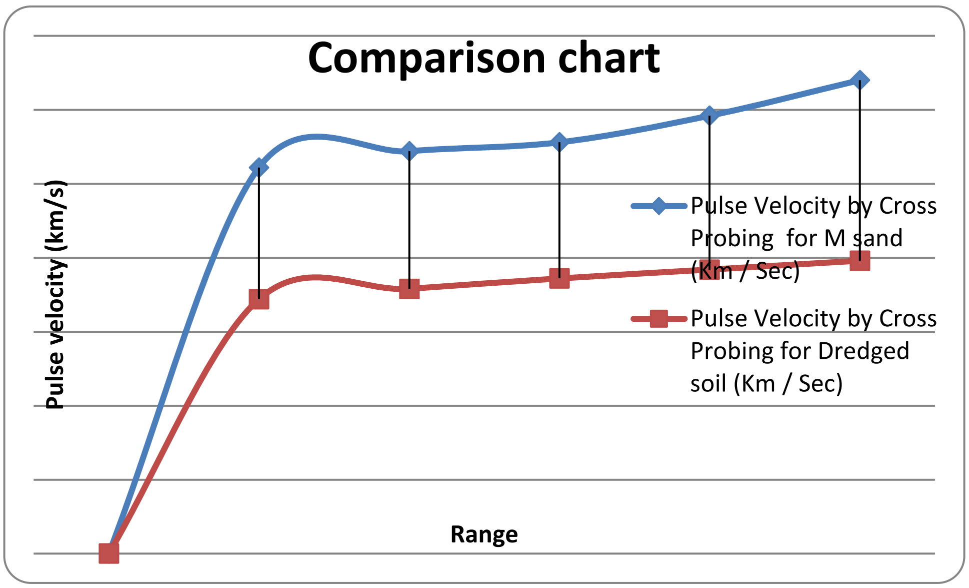

Figure 8.Comparison Result of UPV test

The figure 8 shows the values of ultra sonic pulse velocity ratio for different ratios with different samples [15]. The result may vary according to the strength of the soil and

Conclusion

From the observation of various test results, it clearly shows that increase in M-sand & Dredged soil content can lead to improved stability (bleeding rate) and speed up the setup process in the proposed CLSM operation. Finally, in terms of strength within 28 days, the most powerful CLSM can be produced. All in all, it is important to know that M sand & Dredged soil can be potential in CLSM production. soil or soils developed / compacted with pre-defined gradation (GSB, WMM) are in the past it was used for recycling, (both completed / non-completed structures), mortar foundations, empty filling etc., with its natural limits of air, durability, need for congestion, inclination of water, tendency to settle.

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