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Experimental Study on Partial Replacement of Materials like Industrial Waste & Rice Husk with Clay Mortar

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Abstract: ***Ancient peoples were used mud mortar for their stone houses. The result was a stone home that was both solid and warm and lasted for lifetimes. Mud made houses creates wonderful warm houses as compared to concrete made houses. In the history of construction, clay mortar was followed by lime mortar. Cement manufacturing is one of the major contributors in global warming and climate change. Also fine aggregate is the natural resource and it is limited in nature, thus industrial sand can be alternative for fine aggregate. We are going to use PPC cement because PPC cement resist sulphate attack more than OPC cement and also it is quite cheap. The setting time of the PPC cement is more than OPC cement but when it settled completely then it gives more strength more than OPC cement. Also they used river sand in there project and nowadays there is shortage of river sand that's why we are going to use foundry sand partially replacement with sand. Foundry sand is a industrial waste sand so we can save money by using foundry sand. The mortar with the alternative fine aggregate, mixed with different combinations of binding materials. We take White clay to River sand proportion as 1:1. In that we partially replace white clay with PPC cement and in other hand River sand partially replaced with Industrial waste(Foundry sand) and also with Rice husk and that mix proportions was tested for 28 days Compressive strength & after curing of 28 days ,cubes cured in acid & alkali solution for Durability strength. The mortar with 20% PPC cement + 80% white clay & 40% foundry sand + 60% river sand (proportion of white clay to river sand is 1:1) has compressive strength in the range of 4.38MPa (Compressive strength) & 4.42Mpa (Compressive strength after Durability test) and these mixes compared with 1:6 conventional mortar proportion, which is acceptable as per the IS code 2250-1981 specification, the minimum strength requirement of mortar to be 3 MPa. Therefore, the use of stabilized mud mortar in construction would prove to be sustainable as well economical.***

Keywords: Mud mortar, Foundry sand, PPC cement, Compressive strength, Durability test.

I. INTRODUCTION

A mud mortar is prepared by simply mixing soil with water until it is in a plastic (workable) state. Once applied, a mud mortar sets quite rapidly on drying without the need for elaborate curing procedures. Now to reduce the use of cement we are going to partially replace the cement with white clay. We are using the white clay because there are quite similarities in cement & white clay also it is naturally available materials &white clay has low heat of hydration as compared to cement therefore it is eco- friendly & also economical.

II. MATERIALS

Table 1: Materials and tests

Material	Property	As per IS	Laboratory work
White clay	Specific gravity	2.58 - 2.63	2.71
	Liquid limit	40 - 50	46%
	Plastic limit	18 - 25	30%
Fine aggregate	Water absorption	2%	2%
	Sieve analysis	2.2-2.6	2
PPC Cement	Specific gravity	3.08	3.15
	Standard consistency	25-35%	36%
	Initial setting time	30 min	35 min
	Final setting time	600 min	615 min

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III. PREVIOUS RESEARCH WORK

A. An Experimental Investigation On Stabilized Mud Mortar With Yellow-White (Grey) Soil

In this paper, the mortar with 50% replacement of sand, 12% cement and 2 % fly ash has compressive strength in the range of 5.22 MPa which is acceptable as per the IS code 2250 specification the minimum strength requirement of mortar to be 3.0 MPa. Therefore, the use of stabilized mud mortar in construction would prove to be sustainable.

B. Utilization Of Foundry Waste Sand As A Masonry Mortar

Foundry waste sand is finer than local sand, fineness modulus of all the three waste foundry sands are nearly same. Chloride content of local sand and FWS is nearly same. Chloride content of all the sands are within the limits of BS: PART 1: 1985

C. Stabilized Mud Mortar

In this paper, the mortar with 50% replacement of sand and 12% cement has compressive strength in the range of 4.25MPa which is acceptable as per the IS code specification, the minimum strength requirement of mortar to be 3 MPa. Therefore, the use of stabilized mud mortar in construction would prove to be sustainable as well economical.

D. Experimental Study On Rice Husk As Fine Aggregates

Rice Husk was used to replace sand by weight and by volume respectively. The percentage replacement was 5%, 10%, 15%, 20%The research also revealed that there is the possibility of replacing fine aggregate with rice husk in the production of structural concrete. It is recommended that volume batching should be used in works involving Rice Husk.

E. Properties Of Cement Mortar Consisting Raw Rice Husk

In this paper the experimental on the properties of cement mortar consisting raw rice husk which focused on the porosity and density. Specimens were prepared by incorporating different percentage of rice husk with mortar. Summation of 10 mixes has been investigated to determine the compressive strength, density, porosity and water absorption. From that study, they concluded that the higher percentage of rice husk used will decreased the compressive strength and density and increased the porosity of rice husk cement mortar.

F. Beneficial Reuse Of Waste Foundry Sand In Concrete & Mortar

In this paper, they can increase compressive strength with replacement of Waste Foundry Sand (WFS)in the range of 0%,5%,10%,15%,20%,25% & 30% .According to this paper, for 1:6 mortar proportion **40%** of natural sand can be replaced by waste foundry sand to obtain the required strength for the mortar for 28 days and which is suitable for plastering as per IS 2250-1981.

IV. METHODOLOGY

In this project, the following methods are to be used as,

A. Mix Design And Proportion

The mix proportion adopted 1:1 as for White clay to River sand. For white clay we partially replaced with PPC cement and also for River sand we partially replaced Foundry sand and Rice husk. The PPC cement partially replaced for White clay as 5%, 10%, 15% and 20%. In other hand, Foundry sand and Rice husk partially replaced with River sand as **10%, 20%, 30% and 40%**. Then the compressive strength compared with normal cement mortar with **1:6** proportion.

B. preparation of mortar proportions

1) Mix all the elements by chisel.
2) Mix the all replacements in required proportions.
3) Add portable water as per requirement.
4) Mixing the wet mixture at 10 -15 minutes.

Table 2: Mix proportions

Mix	Cement	White clay	River sand	Foundry waste/sand	Rice husk
M1	_	100%	-	-	-
M2	-	100%	100%	-	-
M3	5%	95%	90%	10%	-
M4	10%	90%	80%	20%	-
M5	15%	85%	70%	30%	-
M6	20%	80%	60%	40%	-
M7	5%	95%	90%	-	10%
M8	10%	90%	80%	-	20%
M9	15%	85%	70%	-	30%
M10	20%	80%	60%	-	40%

V. RESULT AND DISCUSSION

A. *Compressive Strength*

Table 3: Compressive strength

Mix proportions	M1	M2	M3	M4	M5
28^{th} day Compressive Strength(MPa)	1.15	1.95	1.27	2.08	2.89
Mix proportions	M6	M7	M8	M9	M10
28^{th} day Compressive Strength(MPa)	4.38	0.59	0.85	1.87	1.50

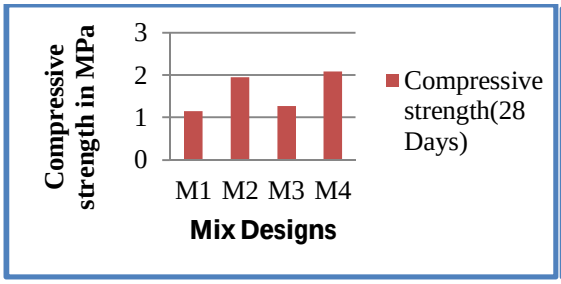

Fig. 1: Compressive strength (28 thday) test by UTM of M1, M2, M3 & M4 designs

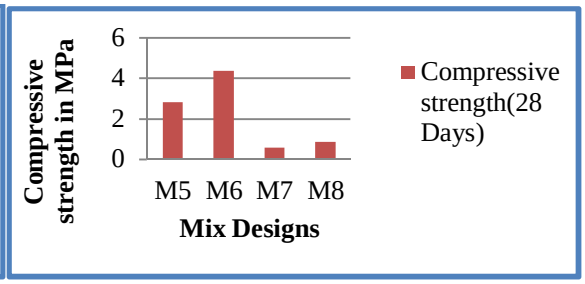

Fig. 2: Compressive strength test (28thday) by UTM of M5, M6, M7 & M8 designs

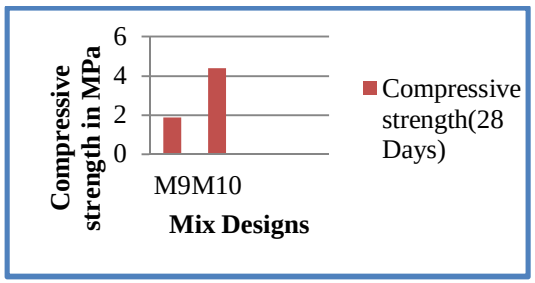

Fig. 3 : Compressive strength (28 thday) test by UTM of M9& M10 designs

B. Durability Strength

Table 4: Durability strength

Mix propertion	Compressive strength (MPa)	
	Acid(H_2SO_4)	Acid(H_2SO_4)
M3	0.62	0.77
M4	0.91	1.58
M5	2.81	2.27
M6	4.42	1.01
M7	0.31	0.39
M8	0.63	0.70
M9	0.97	1.10
M	0.58	0.86

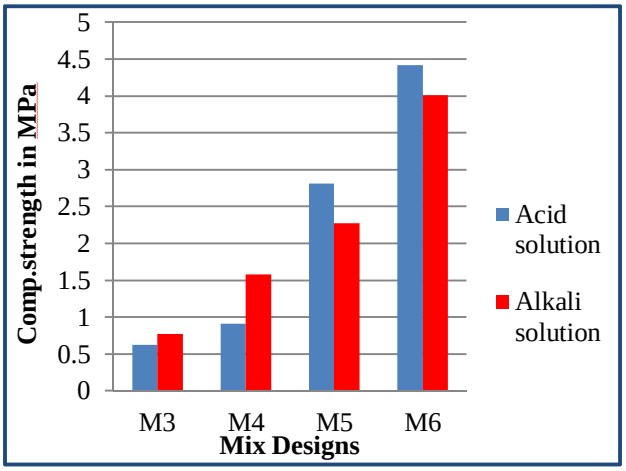

Fig. 4 : Durability strngth of Mix M3, M4,M5 & M6 by Acid and Alkali attack

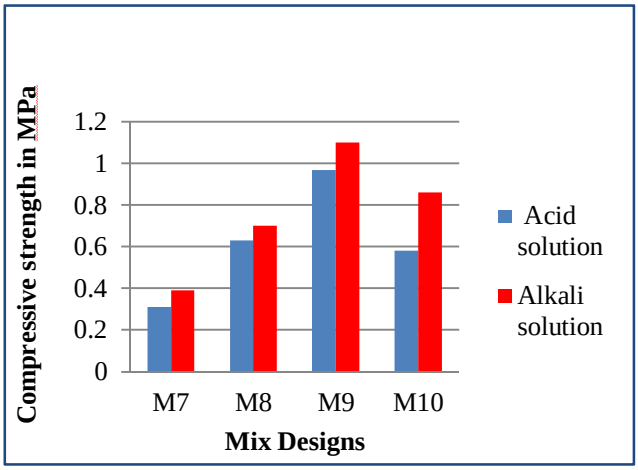

Fig. 5 : Durability strngth of Mix M7, M8,M9 & M10 by Acid and Alkali attack

VI. ECONOMICAL COMPARISON

For 1 Cubic meter mortar, rate analysis as follows:-

Table 5: Rate analysis

Materials	Rate analysis	
	Conventional Mortar (1:6)	Conventional Mortar (1:6)
Cement	Rs.1859	Rs.1340
White clay	-	Free of cost
River sand	Rs.4830	Rs.1690
Foundry sand	-	Free of cost
Rice husk	-	-
Grand Total	Rs.6689	Rs.3030

VII. CONCLUSION

Mud mortar was prepared using yellow-white (grey) clay, cement, natural sand, foundry sand and rice husk and tested after 7days and 28 days for compressive test, respectively to durability test after 30 days. It comes to the following conclusions:-

A. The mix proportion of 20 % cement with 80% white clay And 40% foundry sand with 60% natural sand has the highest compressive strength of 4.38 MPa , so this proportion is best suitable for masonry mortar

B. The compressive strength of mix M6 at 28^{th} day is 4.38 MPa & after acid attack is 4.42 MPa therefore the mix proportion is best for acid resistance.

C. The mix designation of Cement(20%)+White clay(80%)&Foundry sand(40%)+Sand(60%) is more economical and sustainable as compared to mortar with 1:6 proportion.

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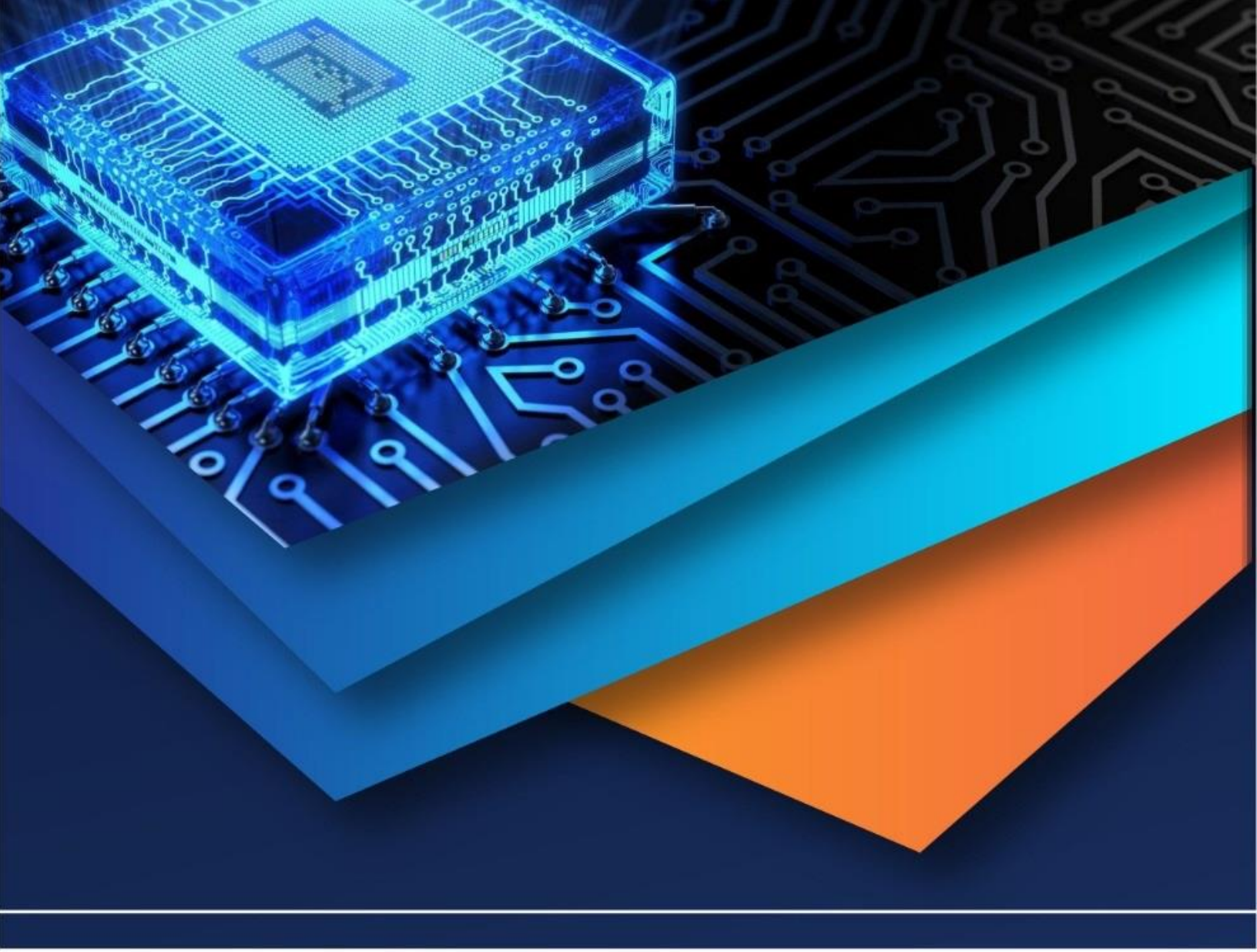

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