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COMPARTIVE STUDY OF RAMMED EARTH USING WASTE PRODUCTS

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ABSTRACT

The purpose of this experiment is to compare the study of rammed earth using waste products which give an overview of the efficiency of rammed earth using waste product over conventional rammed earth to reduce the cost and to improve its performance. Coconut fibre are used as waste products which are from dumping. Coconut fibre and cement can be easily incorporate into the soil mixture which adds strength and durability to the structure. This experiment highlights the salient observation from a systematic investigation on the effect of coconut fibre on the performance of stabilized rammed earth blocks. The analyzation of the result recommends the use 0.8% fibre and 5-10% cement by weight of soil to achieve consideration strength. This project may add a value in the area of green & sustainable housing, waste utilization.

INTRODUCTION

Many Construction work is done with the availability of earth materials. Thousands of years passed, the construction techniques have been changed and many modern methods has been adopted. Rammed earth construction gives a strong and durable monolithic wall by dynamically compacting sub soil. This method of construction is increasing day by day and it has an excellent advantage as it is ecologically friendly construction. Normally earth is utilized in the construction of floors and roofs in addition to walls. Normally in the construction of rammed earth cement is used at 5-10% as a cement stabilizer and soil as a binder to stabilize the properties of clay. So the rammed earth properties can be changed with the different proportion addition of cement i.e., if cement content increases the strength of the rammed earth construction. The compressive strength of unstabilized rammed earth wall ranges from 1.5 to 2N/mm^2, whereas the compressive strength characteristics improves with stabilization of soil.

EXPERIMENTAL INVESTIGATION

MATERIALS USED: -

- **Natural soil: -**

Natural soil sample were collected and SC type of soil, falling in the range of Sand & Gravel:45-80%, Slit:10-30%, Clay:5-20%, LL:35-45% & PI:20-30% was selected.

- **Coconut fibre: -**

The use of coconut fibre can lead to improvement in properties of cement stabilized rammed earth which also act as an environmental friendly. It is called environmental friendly because the

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disposal materials are used. In this study coconut fibre of 50mm were added as 0.6,0.8 and 1 percentages by weight of soil. Three types of mixes were created by adding different proportion of fibres to locally available soil and compacting the mix at constant compaction energy in three layers with proctor rammer.

PRELIMINARY TEST ON SOIL

The following test were conducted:

➢ **SIEVE ANALYSIS**

The soil was classified as silty sands and clayey sands and the symbol are SM-SC.

➢ **ATTERBERGS LIMITS TEST**

It is important to classify the soil by atterbergs limits test and to find the suitability for rammed earth construction. The recommended value for these limits are LL to be below 35-40% and plasticity index to be below 10-30. To find these test the following soil test was done:

- **Liquid limittest:**
  The liquid limit of the given soil is 36%
- **Plastic limit test:**
  The plasticity index is 8.3
- **Unconfined Compression Test:**

  The results obtained from the Unconfined Compression Test shows that the soil under test is suitable for rammed earth construction.

➢ **CASTING AND CURING: -**

The soil mixture for conventional rammed earth is normally done for adding 10% as cement weight and 10% as water. Normally natural soil is added around 80%, so totally 100%. Then the mixture is put in the mould and compacted with proctor rammer. Totally 3 cubes are prepared for conventional rammed earth. Same is prepared by using waste product as 0.6%,0.8% and 1% of coconut fibre in the soil and same process for moulding and compaction with proctor rammer. Totally 9 cubes were made i.e., 3cubes of 0.6%, 3cubes of 0.8% and 3 cubes of 10% were prepared. Then the compressive strength is checked for 7,14 and 28 days.

TEST ON CUBES

➢ **Compressive strength test:**
Compressive test was done for 7, 14, & 28 days for both conventional rammed earth and rammed earth using waste product and the results are tabulated below: -

1.**Compressive test strength on conventional rammed earth:**

Sno:	Curing	Size of cube(mm	Max Load	Compressive load (P/A)
	period	)	(KN)	
	7 Days	150X150	$83X10^3$	$3.59N/mm^2$
	14Days	150X150	$96X10^3$	$4.20N/mm^2$
	28Days	150X150	$102X10^3$	$4.57N/mm^2$

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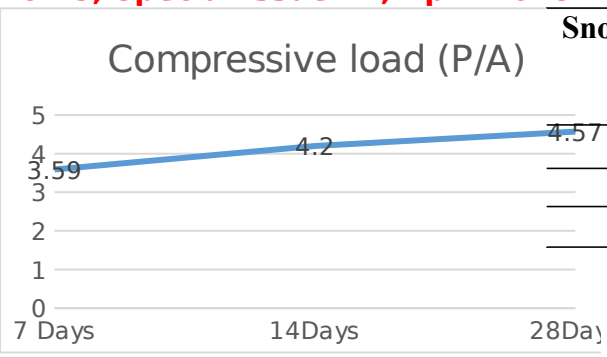
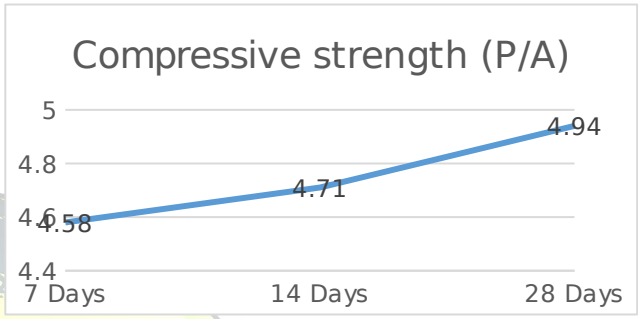


Sno:	Curing Period	Size of cube (mm)	Max Load (KN)	Compressive strength (P/A)
	7 Days	150X150	$95X10^3$	$4.58N/mm^2$
	14 Days	150X150	$107X10^3$	$4.71N/mm^2$
	28 Days	150X150	$112X10^3$	$4.94N/mm^2$

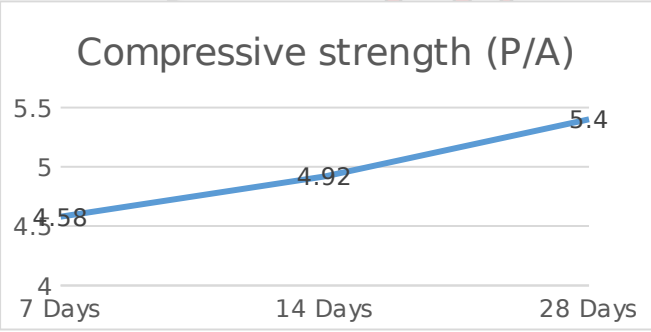


2.Compressive test on Rammed Earth using waste products: -

- Compressive test on rammed earth with 0.6% of coconut fibre:
- Compressive test on rammed earth with 0.8% of coconut fibre:

Sno:	Curing Period	Size cube (mn
1	7 Days	150X1
2	14 Days	150X1
3	28 Days	150X1

Sno:	Curing Period	Size of cube (mm)	Max Load (KN)	Compressive strength (P/A)
1	7 Days	150X150	$80X10^3$	$3.58N/mm^2$
2	14 Days	150X150	$91X10^3$	$4.09N/mm^2$
3	28 Days	150X150	$96X10^3$	$4.29N/mm^2$



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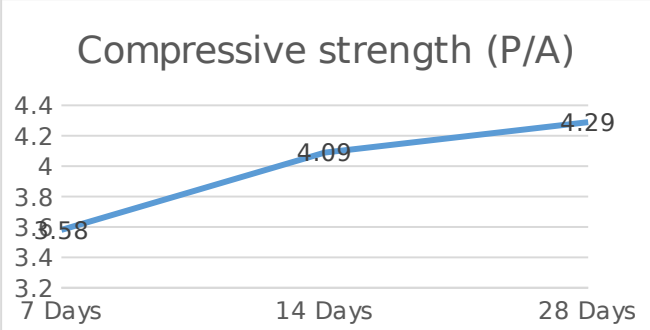
- Compressive test on rammed earth with 1.0%of coconut fibre:



RESULTS

Compressive strength was done on convention rammed earth and on rammed earth using waste and comparison was done based on compression strength and the results were tabulated: -

- Comparison between Conventional Rammed Earth and Rammed Earth using waste products: -

Casting of Cubes	Conventional Rammed Earth			Rammed Earth using waste Products		
Materials used	1.Natural soil (80%) 2.Cement (10%) 3.Water(10%)			1.Natural soil (80%) 2.Cement (10%) 3.Water (10%) 4.Coconut Fibre (0.6%,0.8% & 1.0%)		
% of Coconut fibres	Nil			0.6%	0.8%	1.0%
Compressive Strength	1	7Days	3.59N/mm^2	4.58N/mm^2	4.58N/mm^2	3.58N/mm^2
	2	14Days	4.20N/mm^2	4.71N/mm^2	4.92N/mm^2	4.01N/mm^2
	3	28Days	4.56N/mm^2	4.94N/mm^2	5.40N/mm^2	4.29N/mm^2

So we finally came with a result that 0.8% of coconut fibre when used give more strength as compare to the other percent addition.

CONCLUSION

The following conclusions were made: -

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- The conventional rammed earth gives maximum strength of 4.56N/mm^2, butby the addition of coconut fibre the maximum strength obtained was 5.40N/mm^2 at the end of 28 days.
- The maximum compressive strength obtained by using waste product was at 0.8% of coconut fibre.
- Using coconut fibre is also environmental friendly.
- The coconut fibre reinforcement provides a secondary benefit of keeping material bond together after failure and increase residual strength.
- The preliminary test on the soil is fit for the construction of the rammed earth structure.

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