Experimental Studies on Reinforced Brick

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Abstract: ***From the industrial activities, an enormous amount of solid wastes is generated, which can cause adverse effects on the environment. Among these wastes, steel scrap is one of the important solid wastes which is obtained from the lathe industries, disposed of an open ground makes an unhealthy environment and soil contamination. The past studies confirm the utilization of steel scrap wastes used in the construction industry as well as in transportation and highway industry. This project emphasis on the innovative use of steel scrap in the manufacturing of soil cement reinforced bricks. To study the properties of soil cement reinforced bricks, compressive strength test, water absorption test and weight comparison were performed on bricks with different proportions of steel scraps. From the results, it is observed that the compressive strength of brick increased and the water absorption rate is decreased upon increasing the percentage of steel scrap content.***

Keywords: Steel scrap, compressive strength, water absorption.

I. INTRODUCTION

Compressed Earth Blocks (CEB) were found in early 19th century and has been used for low cost construction. To achieve the strength of CEB, high pressure is needed during the production of CEB [1]. In order to simplify this work, soil cement has been introduced as an alternative for CEB.

The soil cement brick also known as Stabilized mud blocks and it is a mixture of soil, Portland cement and water [2]. The proper combination of these ingredients optimizes strength as well as water absorption rate. The other factors influencing the strength of bricks such as the Atterberg limits of clay, fineness modulus and types of clay minerals also be considered. The type of mortar used in the construction of soil cement bricks masonry is any one of cement mortar, lime mortar, lime pozzolana mortar or mud mortar [3]. Mortar selection is based on the strength, nature of work and the bond between the mortar and bricks [4]. Soil cement is frequently used for soil cement pavements, masonry wall constructions and slope protection [5].

Dumping of waste in an open ground causes a huge negative impact to environment, so recycling of wastes is very important to protect the environment. In India, Computer

Numeric Controlled Lathe machines generates around 5 million tonnes of steel scrap every year [6]. Even though the steel scrap has high recycling potential, the lesser dimension of steel scrap is usually left as waste.

The literature review shows that, when the fine aggregate is replaced by steel scrap, compressive strength has been increased up to 3% [7]. In this project the steel scrap waste is incorporated with soil cement bricks to enhance the strength properties of bricks as well as the reduction of water absorption.

II. MATERIAL PROPERTIES

Soil: The soil sample is taken from 0.5 to 1 feet depth after the top layer is removed in the BIT college campus. Sieve analysis and Atterberg limits were performed on the collected soil. Typically, the good soil consists of 15 percent gravel, 50 percent sand and 35 percent silt and clay together. The comparison of properties of collected sample with the standard soil used for soil cement bricks are tabulated in Table1.

Table 1: Properties of Soil

Features Requirement (%)	Obtained
% soil passing in 4.8 mm sieve	100
% soil retaining in 0.075 mm sieve	49.2
Liquid limit	41.3
Plasticity limit	17.2

Cement: OPC 43 Grade cement was used for the making of bricks. As per IS 4031-part 5 (1998), the Initial and final setting time tests were performed for the cement and the results are tabulated in Table 2.

Table 2: Properties of Cement

Test	Permissible Value as per 1S: 8221, 1989	Obtained
Initial Setting time	30 mins(max)	22 mins
Final Setting time	600 mins (max)	498 mins

CNC lathe waste: Waste steel scraps collected from lathe shop inside the college campus is shown in Figure 1. Mild steel scrap of average dimensions 1.5 mm thickness, 25-30 mm length and 2 mm wide of mild steel scrap were used in the production of bricks. The shape of the fibre varies normally spiral or rectangular.

Figure.1: Waste Steel Scrap

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III. METHODOLOGY & TESTING

3.1 Mix Proportion

To study the influence of steel scrap in the bricks, the soil is replaced with the steel scrap by 2%, 4%, 6% and 8% by weight of soil. The dry mix of the soil, cement and steel scrap is shown in Figure 2 and the details of mix proportion are tabulated in Table 3.

Figure 2: Dry mix of soil, cement and steel scrap

TABLE 3: Mix Proportion

Soil		Cement	Steel scrap	
%	Kg	kg	%	kg
90	2.631	0.292	-	-
88	2.573	0.292	2	0.058
86	2.514	0.292	4	0.116
84	2.456	0.292	6	0.175
82	2.3944	0.292	8	0.233

3.2 Production of Reinforced Bricks

The soil was first air dried by spreading in an open space and the lumps were removed from it. The required quantities of steel scraps and cement were added to the dry soil and mixed uniformly. Only after homogenization, water is added in adequate amounts. After the preparation of mix in adequate consistency, the mould is placed on sand sprinkled flat surface and inner edge of mould is free from sticking by applying oil. Finally, the mix is poured into the mould by means of three layers with proper compaction and the top surface is levelled. For calculating the average strength, three bricks (B1, B2 & B3) were prepared for each and every test. After 24 hours the specimen is removed from mould and allowed for curing. The removed specimen from the mould is shown in Figure.3

Figure 3: Production of bricks using wooden mould

3.3 Curing

For curing purpose, the blocks were placed on a flat, non-absorbent surface in a shady environment. The blocks were spaced far enough apart so that they do not touch each other. Then these moulded bricks were covered by gunny bag. The bricks during curing and after curing are shown in Figure 4.

Figure 4: During curing and after curing

IV. RESULTS & DISCUSSIONS

4.1 Compressive Strength Test

After curing, the bricks were tested in compressive testing machine and the average compressive strength were tabulated in Table 4.

TABLE 4: Results of compression test

Proportion (Lathe-waste replacement)	B1 (kg/cm^2)	B 2 (kg/cm^2)	B 3 (kg/cm^2)	Average compressive strength (kg/cm^2)
0%	17.83	18.14	18.34	18.1
2%	26.5	26.5	26.7	26.56
4%	38.73	39.95	39.75	39.47
6%	41.22	41.32	40.98	41.17
8%	42.5	42.1	43.1	42.5

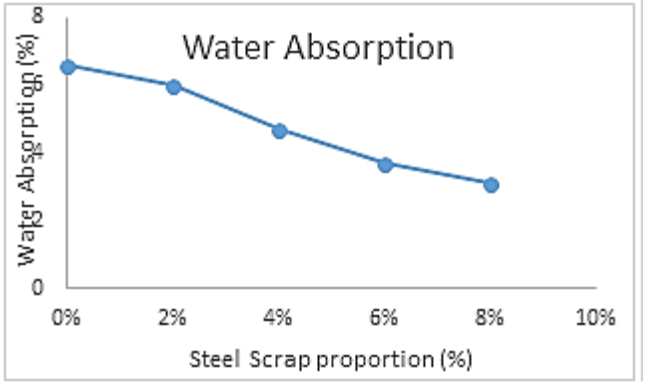
4.2 Water absorption Test

To study the water absorption property of brick, the dried specimen was completely immersed in clean cold water for 24 hours. After 24 hours the specimen is removed from the water and wipe out any traces of water with damp cloth. The soaked specimen is weighed and the results are tabulated in Table 5.

TABLE 5: Results of Water Absorption

Proportion	Initial Wt. B1 (kg)	Final Wt. B1 (kg)	water absorption %	Initial Wt. B2 (kg)	Final Wt. B2 (kg)	water absorption %	Initial Wt. B3 (kg)	Final Wt. B3 (kg)	W.A%	average W.A (%)
0%	3.094	3.294	6.5	3.102	3.312	6.8	3.088	3.294	6.7	6.6
2%	3.145	3.33	5.9	3.156	3.346	6.0	3.148	3.343	6.2	6.0
4%	3.287	3.446	4.8	3.189	3.342	4.8	3.202	3.345	4.5	4.7
6%	3.397	3.528	3.9	3.388	3.511	3.6	3.401	3.526	3.7	3.7
8%	3.548	3.662	3.2	3.552	3.662	3.1	3.549	3.66	3.1	3.1

As per IS: 3495 (Part II)-1976, average water absorption shall not be more than 15 percent by weight and the absorption rate is shown in Figure 5 and shall have a minimum average compressive strength of not less than 20 kg/cm2 for Class 20 and 30 kg/cm2 for Class 30. From the results, it is shown that the compressive strength of soil reinforced bricks satisfied the codal provisions and the comparison of compressive strength for different proportions shown in Figure5.



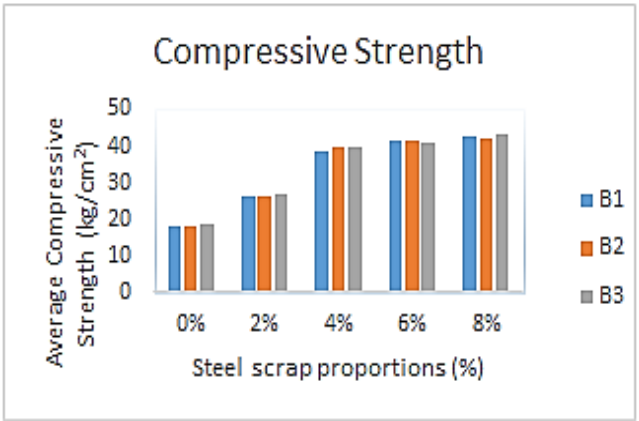


Figure 5: Water absorption and Comparison of compressive strength for different proportions

V. CONCLUSIONS

The experimental study concluded that the addition of steel scrap increases the compressive strength and decreases the water absorption rate when compared with conventional brick. This recycled method reduces the negative impact to the environment by utilizing the waste and also this process requires no fuel consumption which is also economical.

REFERENCE

1. Ozkan, E, A-Herbish, M. S, (1995), An Experimental Study on the Critical properties of pressed and stabilized earth bricks, Architectural Science Review, 38, 59-73.
2. Jijo James, P. Kasinatha Pandian, K. Deepika, J. Manikanda Venkatesh, V. Manikandan, and P. Manikumaran, (2016) Cement Stabilized Soil Blocks Admixed with Sugarcane Bagasse Ash, Hindawi Publishing Corporation Journal of Engineering , Article ID 7940239,
3. Kabiraj.K, Mandal.U.K, (2012), Experimental investigation and feasibility study on stabilized compacted earth block usinglocal resources, International Journal Of Civil And Structural Engineering Volume 2, No 3.
4. Walker,P., VenkataramaReddy,B.V., Mesbah,A., and Morel,J.C.,(2000). The case for compressed earth blocks construction.Proc., 6th Int. Seminar on Structural masonary for developing countries, Bangalore, India,27-35
5. J.Poovizhi E. T. Aarthi, R.Gowthami, (2015), An experimental study of soil cement bricks and characteristics compressive strength of brick masonry wall , international journal of science and engineering research (ijser), vol 3 issue 2.
6. Abdul Rahman1 , Syed Mustafa Ali , Syed Azeemuddin (2017), Performance Analysis of Steel Scrap in Structural Concrete, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, 42-47.
7. Pooja Shrivastavaa , Dr.Y.p. Joshi, (2014), Reuse of Lathe Waste Steel Scrap in Concrete Pavements Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 12(Part 4), 45-54.