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Recycling Of Construction Materials from the Debris of Demolished Structure

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Abstract

The amount of construction and demolition waste generated in the country has increased considerably in recent years due to rapid pace of development. There is no uniform and systematic process followed in determining the total quantity of C&D waste generated or in collection, transportation and disposal of C&D waste anywhere in India. A study was thus carried out to determine the potential reuse of construction debris as a brick making material. The study investigates the potential for reusing construction debris as a replacement for sand. The brick characteristics, both strength and aesthetic tests such as water absorption test, compressive strength test and efflorescence are to be conducted on bricks made using construction debris and normal bricks which are to be compared. This project will thus be very useful in an eco- friendly environment.

In this minor project work, test on normal bricks is to be performed and data for various properties of bricks would be recorded. A set of ply mould will be used to produce rectangular bricks. Waste plywood's would be used to accommodate size of 200mm x 100mm x 100mm. Construction waste is to be collected from nearby sources and bricks were to be made from clay, plastic fibre and powdered debris by 0%, 10%, 20%, 40% debris by weight. The clay/debris/fiber were to be mixed together by hand & kneaded into the moulds in thin layers by applying the hammering motion using a steel rod in order to compact it. The wet bricks were to be left over to air-dry in the moulds for over seven days in the sun. Finally, the completely sun dried bricks were placed into a clamp. Compressive strength is to be determined for the 0%, 10%, 20%, 40% debris containing bricks using a UTM testing machine. A loading was applied to the bricks until they failed and maximum loading rate was recorded. The compressive strength was taken as the average result from a set of 3 tests for each respective brick type. Results will be incorporated and conclusion will be obtained.

Keywords: debris, bricks, water absorption, compressive strength, efflorescence

INTRODUCTION

The construction industry contributes substantially to the generation of solid waste in almost all the countries. All over the world, the construction and demolition waste contributes around 25 – 40% of the total waste generated depending upon the region. The Construction Materials Recycling Association (CMRA) has conducted a study on construction and demolition waste, related to the

buildings and it was estimated to be around 136 million tonnes of waste material. Also, it was reported that apart from the building waste, a millions of tonnes of waste is coming from road, bridge, and airport construction and renovation. In developed countries the annual per capita building and construction waste generation were 500 – 1000 kg and in some countries the building and construction waste was estimated to be around 175 million tonnes per year. The construction and demolition waste generation scenario in Asian countries is also in the same trend. It was reported that Asia alone generates about 760 million tonnes of construction and demolition waste every year. According to the annual report of Dubai municipality's Waste Management Department, there was about 27.7 million tonnes of construction waste, generated from various construction sites in the city in 2007. This was recording growth in construction waste generation of 163% in comparison to the waste generated in 2006.

According to the tenth five year plans the materials cost was around 40 – 60% of the total project cost. The construction and demolition waste in India was estimated to be approximately 14.5 million tonnes per year (Pappu *et al*. 2007). The Central Pollution Control Board (CPCB) had estimated the total solid waste generation as 48 million tonnes per year for the year 2001 and out of which 12 – 14.7 million tonnes from the construction industry alone and by 2010, this was their own destroyed architectures either due to war or due to natural disaster to construct expected to be around 24 million tonnes (TIFAC Ed 2005). In addition, the new zoning bye-laws, legitimization of squatter settlements and increase in the urban population due to industrial development have led to the demolition of structures in the larger cities.

Objective of the Present Dissertation:

The objective of the present thesis is "*the characterization of recycled coarse aggregate and study the macro, micro and structural behaviour of recycled aggregate concrete*."

i) To study over the reduction on the volumes of waste being diverted to landfill.

ii) To determine the potential reuse of construction debris as a brick making material.

iii) To compare the various properties of bricks made using construction debris and normal bricks.

iv) To assess remark on the use of construction debris as a replacement of sand in the manufacturing of bricks.

v) To recycle the waste material as eco friendly material.

Methodology

A plywood mould was used to produce rectangular bricks (200mm x 100mm x 100mm) as shown in figure 1. Bricks were made from clay and powdered debris by 0%, 10%, 20%, 40% debris by weight as shown in figure 2 and 3. The clay and debris were mixed together by hand. Water was added according to the optimum moisture content before the mixture was kneaded into the moulds in thin layers by applying a hammering motion using a steel rod in order to compact it. The wet bricks were left to air-dry in the moulds for over three days in the sun at temperatures varying from 350 C to 400C as shown in figure 4. Slow drying was necessary to prevent the bricks from cracking or internal steam formation. Finally, the completely sun dried bricks were placed into a kiln. It is important to burn bricks to remove the water accumulated by crystallization and to activate chemical reactions in the ingredients of clay.

The slow burning of bricks was done to prevent the bricks from cracking. Compressive strength was determined for the 0%, 10%, 20%, 40% debris containing bricks using a UTM testing machine. A loading was applied to the bricks until they failed and maximum loading rate was recorded. The compressive strength was taken as the average result from a set of 3 tests for each respective brick type.

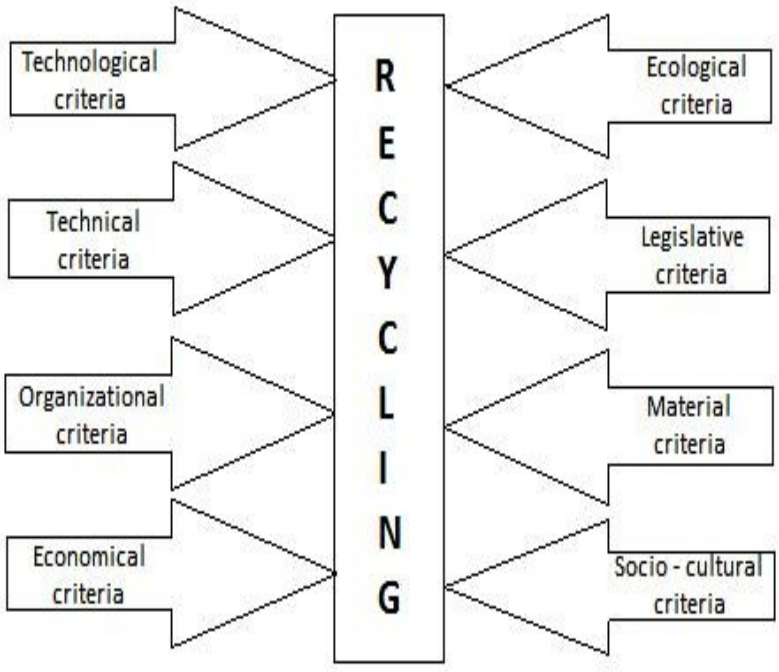

Figure. 1 Criteria in recycling process

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RESULT

The bricks produced using construction debris is observed for its various physical characteristics such as colour, shape, size, texture and hardness. The performance is also tested by finding their compressive strength developed, water absorption, and the effect of efflorescence for mix proportion of bricks. The results obtained are discussed in detail in the following sections.

WATER ABSORPTION TEST

The test was carried out by immersing the bricks in cold water for 24 hours after that its change in weight is calculated for water absorption test as shown in figure 5.Water absorption percentage after 24 hrs immersion in cold water is given by the formula,

$$W = \{(M2- M1)/ (M1)\} \times 100$$

The water absorption of bricks produced using debris for various mix proportions used in this study are determined as given in the table 1.

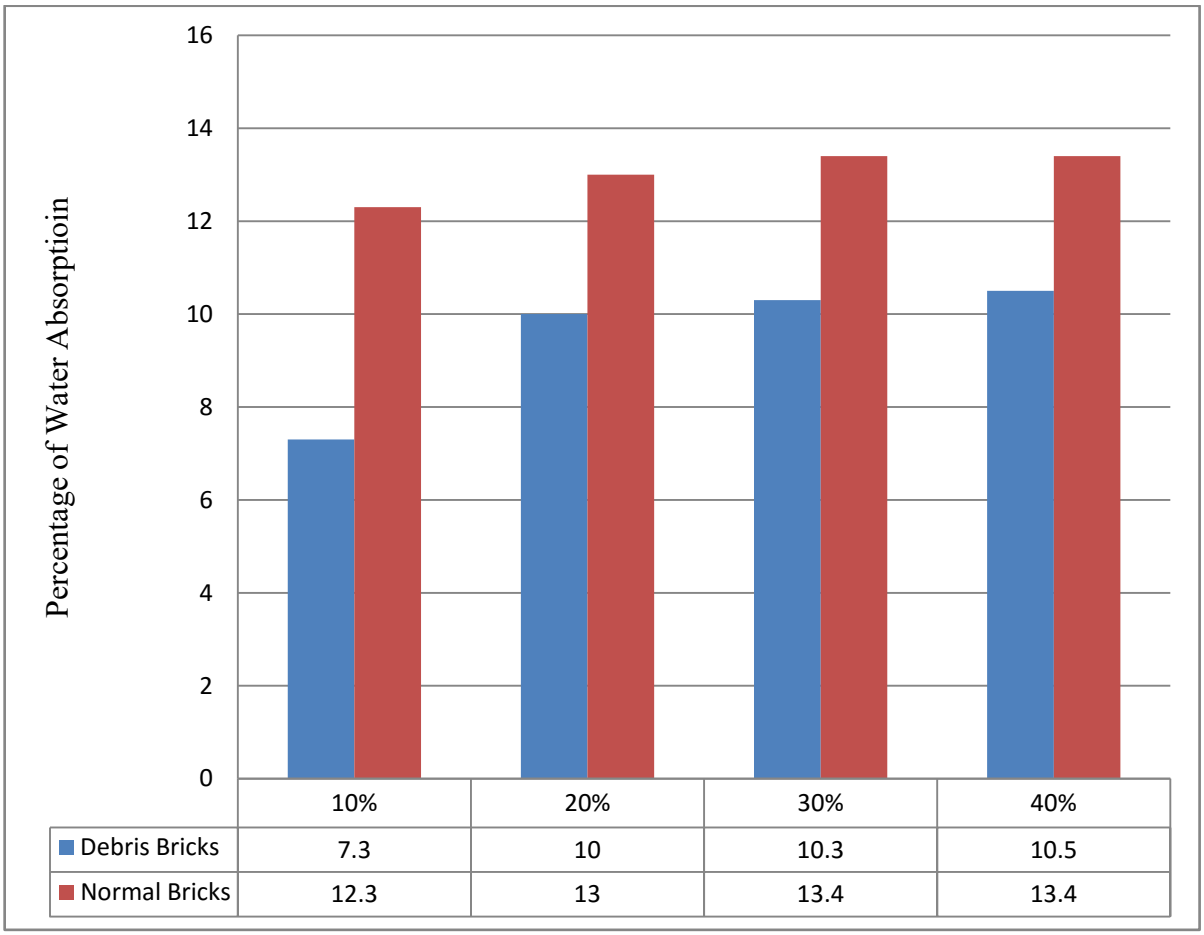
Table- 1: Water absorption for various percentage of debris

Weight of bricks	Percentage of debris			
	0	10	20	40
Initial weight in kg	3.018	3.104	3.112	3.124
Final weight after 24 hours in Kg	3.237	3.417	3.432	3.471
Water absorption (%)	7.3	10	10.3	10.5

From the test results we can observe that there is minimal increase in water absorption with respect to increase in percentage of bricks produced using debris. The water absorption value for different mix proportions

Table- 1: Water absorption for Normal Bricks

Weight of bricks	Percentage of debris			
	0	0	0	0
Initial weight in kg	3.1	3.15	3.15	3.2
Final weight after 24 hours in Kg	3.5	3.6	3.6	3.6
Water absorption (%)	12.3	13	13.4	13.4



Compressive strength test

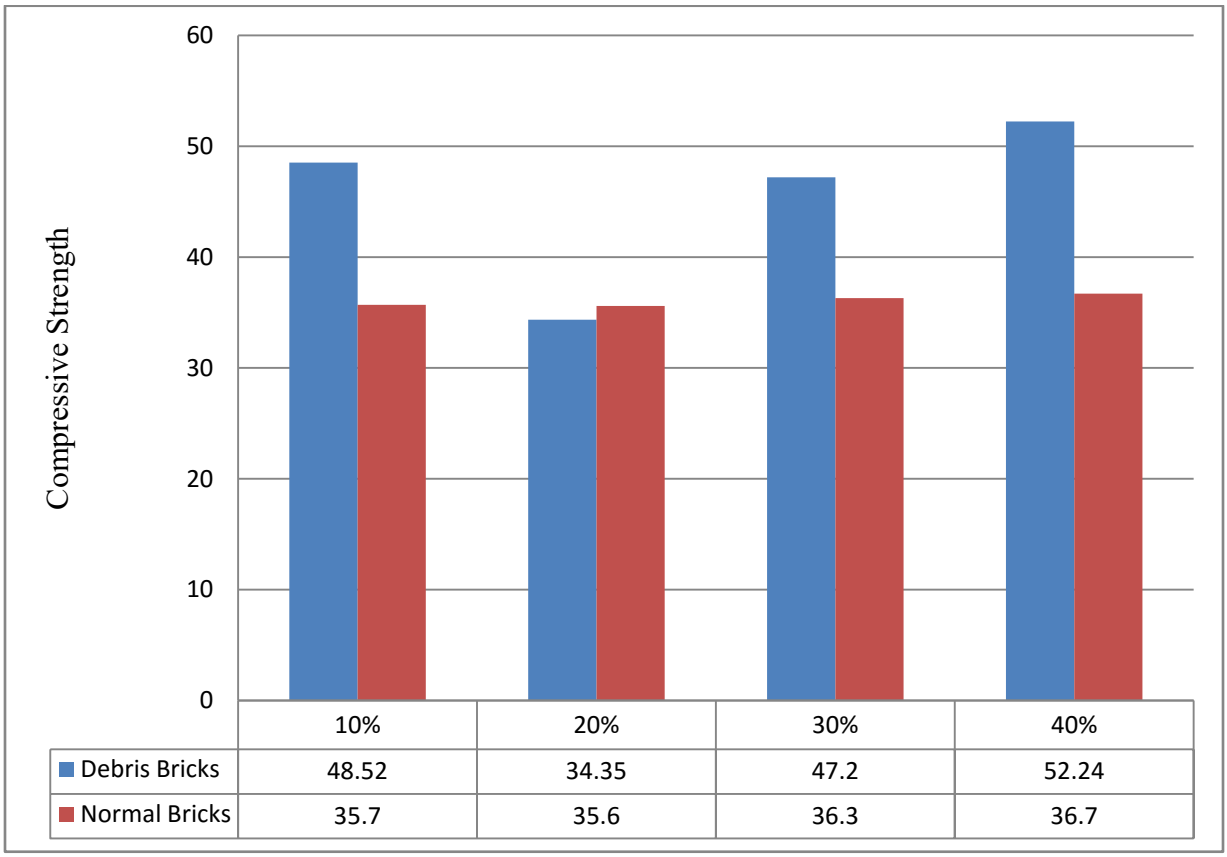
The compressive strength of bricks produced using debris with various mix proportions are tested by using Universal Testing Machine. Average compressive strength of the given bricks.

Compressive strength = {maximum load at failure (N)}/ {average area of bed face mm²)}

Percentage of debris	0	10	20	40
Compressive strength of bricks in kg/cm²	48.52	34.35	47.20	52.24

Compressive strength = {maximum load at failure (N)}/ {average area of bed face mm²)}

Percentage of debris	0	0	0	0
Compressive strength of bricks in kg/cm²	35.7	35.6	36.3	36.7



Conclusions

The various types of wastes that are currently recycled in bricks manufacturing have been

reviewed through literature survey. The effects of all those wastes on the bricks parameters and characteristics are reviewed. Verifying the performance so that the recycled material is found to be suitable under environmental and an economical brick neither consumes energy resources nor emits pollutant gases gives an economical option to design the green building. Certain bricks are produced without firing which is an advantage over other manufacturing of bricks in term of low embodied energy material. The study in turn is useful for various resource persons involved in using industrial or agricultural waste material to develop sustainable construction material. This project study is done to find out if construction debris can be utilized or substituted instead of sand in the manufacturing of burnt clay bricks. From the tests conducted the results obtained are as follows:

Mixture with of debris used to manufacture a brick as the brick bursts down into pieces shows efflorescence effects.

The color, shape, size and texture of the bricks were found to be satisfactory.

The brick gives a perfect sound when banged with each other

The hardness & crushing strength of the bricks are found to be satisfactory.

The water absorption property of all the bricks manufactured with construction debris is similar to the water absorption value of normal burnt clay bricks. It is in accordance with IS code standards.

The compressive strength of the bricks manufactured with construction debris is found to be equally strong as compared to the normal burnt clay bricks.

The amount of efflorescence is found to be mild in all the bricks as compared to the normal burnt clay brick where no efflorescence is found.

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