

Investigating the Use of PET Bottles as a Sustainable Material in Construction

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Abstract: India is one of the country having major amount of population and creating serious attention about Poverty. At present India is second largest country in the world with population about 1,285,730,000. Such a huge number is going to increase with day to day life. The survey suggests major part of total number is under poverty due to lack of education and employment. Constructing a house for such people is a major problem and cost of construction is the very important factor for them. On other hand if look towards urbanization, a trend of use of non-renewable products like plastic bottles have been increased. But with the increase of such product, destroying or recycling is the major issue. If such a bottle incinerated, the huge amount of toxic fume are produced which are very harmful to human, animals and nature also. So, it makes serious attention to find an alternative solution. Such PET products can be used in a single storey house construction. This paper describes good alternative to improve the construction techniques.

Keywords – bricks, plastic bottles, sustainable material, etc.

1. Introduction

Today urbanization is very rapid in its way. The urbanization delivering modernization for human life but changing the environmental aspects. At present environment around us is completely filled with toxic plastic waste posing serious problem to nature. The generation of particular amount of PET tends to recycling of only 1-2% of that amount.

Plastic bottle are considered as non-renewable sources. It has insolubility about 300 years perhaps if it is used in walls with cement it can play as sustainable material. So it is very necessary to take a creative action toward the concept of bottles in place of conventional bricks in construction.

The objective of this paper is to introduce characteristics of this product and respective benefits in building construction. The detailed comparison of characteristics with conventional bricks, mortar and cost of brick with brick bottle with plastic bottles is done. Today the technology developed in great scale that the utilization of renewable resources is made possible which protect environment. Also if technology permits bottles in construction, the carbon emission happens during baking of an ordinary Indian standard bricks can be reduced.

2. Indian Standard Brick vs Plastic Bottle

Preparation required for clay brick, time and energy used starting from mixing the clay to baking it in kiln is very length and time, energy consuming. While if we take the bottle is more energy efficient and no such tedious labor work is required.

Heat generation from cement factories can be reduced as this method uses only 5% cement. In this construction method it provide thermal storage. This inherent thermal mass storage keeps inside temperature relatively consistent with natural temperature. Once thermal mass storage charges gets heat the plumbing in house would never freezes in spite of outside temperature below 0 degree Fahrenheit.

Some advantages bottle over other construction materials-

1. Low cost
2. No-brittle unlike bricks
3. Absorbs abrupt shock load (can easily take heavy loads without failure)
4. Bioclimatic
5. Reusable and less construction material
6. Easy to build
7. Green construction

3. Literature Review

William F. Peck [1] 1902 He suggest the first bottle built by him at Tonopha, Navada by using 1000 glass beer bottles. After this innovative concept the use of plastic bottle got promoted instead of glass bottles which was cost efficient in construction.

Andreas Forese [2] was the first to construct plastic bottle house in village of Yelwa of Nigeria. He used this bottle as brick and made the bonding with help of strings and plastered it.

Mojtaba et al. [3] concluded that there is huge effect on saving energy and reduce CO₂ emission by using small percentage of cement.

Sjoerd Nienhuys Kathmandu, Nepal November 2014 [4] Concluded that plastic can be used as good thermal insulation as it can easily insulate water piping of solar water heaters and warm water piping inside houses.

Singh Rawat, R. Kansal Aditya [5] He investigated the mechanical behavior of the unit and compare the compressive strength of brick bottle with brick and concluded that using the concept of brick bottles is cost effective, energy efficient and commercially feasible and termed as Green construction.

Vikram Pakrashi et al. [6] He examined Eco-brick and concluded that the Eco brick have good compressive strength than the concrete cubes. They appear to have light but have high bearing strength. The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities.

4. Plastic Bottle Preparation

Step1:-search for dry and unused Plastic bottle and collect.

Step2:- Fill the bottle with sand, fly-ash, wood-husk, combination and even soil also. Compact material in bottle well with proper tamping. The tamping can be done by sticks or wooden spoon. Following are some examples of used material to compact bottles.

Sand

Sand with proper compaction can be used in framework for walls or pillars.

The bottles prepared and tested on UTM for compression strength and fracture behavior of each bottle and compared with Indian standard bricks.

It is observed that bottle can bear up to 7260kg when filled with sand which is the weakest filling material.

Fly Ash and Sand

Fly ash is a waste product produce by thermal power plant which can also be used in various aspects related to concrete. Other than this it can be used as a filler material partially with sand with different proportions. Use of fly ash with sand reduces the weight with increases in strength.

Fly ash and wood particles

Fly ash can be added with wood particles. Use of such combination decreases the weight and gives good insulation properties.

Step3:-After filling bottle with proper compaction cap it and allow for squeeze test if unsatisfactory then again fill with material and again compact it.

Step4:-Testing and comparison of results.

Step 5:-Start collecting finished bottles as bricks to build an earth bench.



Fig. 1: Bottles filled with Sand



Fig. 2: Bottles filled with Fly ash

Filling Material in Bottle and proportion	Compressive Strength (Kg)
Sand	7260
Fly Ash + Sand (1:2)	18,000
Fly Ash + Sand (1:3)	20,400
Fly Ash + Sand (1:1)	21,840
Fly Ash + Sand (2:1)	22,000

Table 1: Compressive Strength

It is seen that bottles gives more compressive strength than the traditional Indian standard bricks. Bottles as such are used in many situations and can be collected easily and with bottles if start using in place of bricks it will help people to make their shelter at affordable low cost. New generation engineers should think about new ideas that can be incorporated in the area of poor people so that it will one of the way which can make clean and beautiful India.

5. Experimental Work

The compressive strength is capacity of material or structure to withstand loads. Compressive strength can be measured by plotting applied force against deformation in testing machine called universal testing machine.

In formulation,

$$\text{Compressive strength} = P/A$$

Where,

$$P = \text{applied force}$$

$$A = \text{area subject to deformation}$$



Fig. 3: Compression Test on Bottle filled with fly ash

6. Result and Discussion

The compression test on UTM was performed on bottles with different proportions. Table 1 shows the values of compressive strength obtained.

Table 2 writes some major advantages for bottles over Indian standard bricks.

Sr. No.	Parameters	Use of Bottle	Use of Cement/ Clay Bricks
1	Material & Equipment Cost	Saving in cement, water	More Quantity depend on weight
2	Transportation Cost	Light and easy weight so less cost (No such manufacturing plant is necessary)	High Transportation Cost applied from manufacturing plant to site
3	Strength	20 times more than bricks	Low strength causing various factors
4	Aesthetics	Clean and attractive appearance	Not so attractive compared to bottles
5	Earthquake Resistance	Low impact with/without falling debris	High impact even can cause death to survivor
6	Wastage	No wastage (Filling Bottles destroys the waste)	High wastage and unusable

Table 2: Advantages over concrete block

7. General Conclusion

- a) The overall study and experimentation shows the possible use of PET bottles in construction.
- b) Such technology reduces the carbon emission during the baking of an ordinary Indian standard brick.
- c) Use of bottles makes clean and beautiful India as this method helps in reducing or destroying unwanted wastes.
- d) The method is relatively easy to implement and no requisition of skilled labors.
- e) The method is helpful to create positive implication for the economic, social and environmental aspects of the society.
- f) Such creativity will be successful if embraced by local villagers as a valid building material.

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