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# Analysis of Low-Cost Plastic Bottle Resting Room

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## Abstract

Now a days disposal of non-biodegradable substance has become a major issue. On earth surface plastic garbage has been created in many bases. Recycling process also not fully satisfactory result gives us we can say only one or two in the ten plastic bottles are recuycled. Furthermore, we can find that poverty level in India is very high, every civilization not been constructed a proper concrete house because of high cost. Therefore, it is very innovative approach to construct house with the help of plastic waste, which is suitable approach for this situation. Plastic material are cheaply available in our society and it's became a regular urban junk in everywhere, so we can use this junk (plastic bottles) in the place of brick for construction purpose. In this paper, one of the basic concerns is comparison the cost between plastic bottle and bricks-based construction and focused to make a sustainable development to lead the application of plastic bottle in building construction. It also mentions some ways for self-standing and insulating them and some positive points which this material has versus others.

**Keywords:** Sustainable material, plastic bottle, construction material.

## Introduction

Nowadays, human has so many potential ways for development. We have so many resources to develop what is need but the environment gets effected, and human is always seeking broader sources with lower price. On the other hand, waste of today can be produced wherever human footprints beexisted. Humans are not chosen appropriate method for exploitation of the nature.

At the present time, people have so many developments, but harming environment can create problem to think each and every person about the future of the new born children because environment get effect badly and lost so many useful abstract,therefore, it is important to think about renewable resource like wind, solar, geothermal and many more for developmentof this science for making process.

Plastic makers have vowed to optimize manufacturing process with smart manufacturing. The industries, in response, maximize energy efficiency and build up flexible customization constantly. A clear picture, the forum will showhow the machinery creates a new business model via digital transformation and sustainable innovation.

Population growth today create the main problem for utilization of tradition materials, human need to the building

has increased day by day and to response to this demand the countries tend to use the industry building materials.

As per the demand increased cost automatically increased in that way and the human

whose needs actually the resting house can demolish to make their home. Due to the cost effect, detrimental effects come regular, and human can choose different wrong path to fulfill their one of the needs for survival.

There are some factors that like increasing high-cost building, goods material rates and long transportation can affect middle and low class people.

Solution for this type of problems is: -

Use affordable recycled material in the building which can easily be available in the market in the lowest prize.

There are two alternative and best solutions against the plastic bottle disposal are recycling process and reusing process.

In the process of Recycling, its needs addition energy to treat the material for producing something usable material. Apart from this, recycling produces wastewater and air pollutants, which can affect our environment. We can say once we are saving the environment from this non bio degradable waste, on the otherhand its effect the environment more by this recycling process.

The best solution is reusing the plastic bottle, it's not requiredaddition energy and does not contribute to pollution.

Therefore, when we reuse plastic, we are helping to save the obtained energy which would otherwise be wasted, its required more human power and machine resources as well.

It is important that when thinking goes to financial aspect thenenvironmental aspect is that much important. Plastic is non-renewable source which can form by oil, a lots of energy is required for the conversion of this which not only affect the environment but also contribute to make pollutant which is harmful.

By considering both method and to understand this method reuse is effectual in mitigation of environmental impacts relating to plastic and plastics are an innovative material for building. So, reuse plastic bottles is proper solution for replacement of conventional materials.

The use of plastic bottle has been c0onsifered for exterior wall(shear wall), interior wall, ceiling of the building etc.

The objective of this paper is to investigate the using of plasticbottle on the place of brick can affect cost and positive characteristics of this product and benefits obtained by using it in building. The characteristics of plastic bottle can lead bricks, ceramic and concrete block. Plastic bottle contains so many positive characteristics such as versatility, lightness, resistant to chemical, water, impact and hardness. Plastic bottle can easily can collect in lowest prize in urban and ruralareas because it is most disposable martials in the modern world.

There are some consequences of the plastic facts are as follows: -

- Plastic bottle is estimated that 100 million tons ofplastic are produced each year.
- 20,000 and more plastic bottles are needed to obtainone ton of plastic.
- Many of the plastic bottle sacks are made from 65%recycled plastic.

- The average European throws away approximate35Kg or more of plastic each year.
- Plastic packaging consumption are approximately42% or more.
- In 1960's, according to ENSO, plastic based material specially bottles were one of most demanding things. Plastic was banned by many countries by saw the detrimental effect in the environment. But now plastic bottle demand is increased again.

## Literature Review

Nowadays, as per demand is increased many mor item s are packed and filled in plastic bottle such as oil, water, juice, ice-cream etc. it's because plastic is the light in weight and easily can transported one place to other placeswith safety measure consideration. People are not aware about to how to dispose these bottles and there thrown them. Its create a detrimental effect on the environment by throwing them openly and let them free, apart from this many animals, birds, fish etc. can eat these materials for some different reason that can have detrimental effect on their life.

- ***William F.Peck***-The fires bottles house was built using 1000 glass beer bottles by William F. Peck in 1902 in Tonopha, Navada.
- ***Andreas Forese***-The next one newer innovative techanics were using by using plastic bottle by replacing glass bottles.
- Andreas Forese was first African whose using plastic bottles for construction purpose in the village Yelwa in Nigeria. He using plastic bottles instead of brick and using plaster for binding purpose.

Mr. Andreas Froese who is the founder of Eco- Technical Environment (ECT) give innovative solution for such type of ecofriendly and effective way to using junk which is form a development bast project.

ECT teams recognized the plastic bottle house constructedin many places in different countries and found that its suitable in every situation or its have detrimental effect. And Froese says that plastic bottle even works as share wallso its construction as outer wall is also suitable, therefore, the cost of the house get downward as the cost of concrete house.

This idea is more effective and fuller of worth by providing a cost-effective construction method for pauperized third world countries by reusing the plastic bottles due to their not indecomposable characteristics.

Nowadays consumption of plastic in many ways like rapping, easy transport, light weight closed bottle, people are using its huge numbers which can have impact humans and/or environment. Andreas Froese, the founder of Eco-Tec Environmental Solution, in searching for finding an inventive solution to waste of plastic called junk, established the mineral fraction.

More other institutions have initiated the concept of reusing the plastic bottles for building construction. All over the countries this technology can spread in speediest however, various kinds of homes have been built from plastic bottles.For example-

- ***Honduras-*** this ecological house is constructed but 8000 plastic bottles.
- ***Tomislav Radovan-*** this house is constructed in Serbia by using plastic bottles.
- ***Misiones-*** PET bottles are used for construct a house. This is one type of ecological house, in which 1200 PET bottles were used.

***Basic construction Materials and properties: -***

Plastic bottle reusing techniques requires some of the basicmaterials, which required for stability of the structure also ecofriendly structure. Materials used for bottle wall masonry construction are: -

Soil Plastic CementWater

## Soil

In the study, to examine the strength and mechanical properties of the soils, different laboratory tests were conduct. The determination of index properties of unestablished soil and slandered Procter compaction and Resilient modulus for stabilized soil.

Soil is the basic element in any site project, construction project or many project so before using soil in this project we have to know the properties of the soil and the project demand so that it can help for construction time that this soil is suitable of such type of project. The three main important properties are SoilTexture, Soil Colloids and Soil porosity.

***Soil Texture:*** - this is one the most important physical properties can have a profound effect. These properties of the soil are distinguished by size and make up the fine mineral fraction. Sand, silt and clay are three mineral properties which proportion in fine texture of the soil.

***Soil Colloids: -*** this is one the most important property to understand for construction. It refers finest clay for soil frication. The finest clay has no gap between the particle and so that particle is attached with one other. Displacement of the soil also not find easily after the live load and dead load work in the construction project.

***Soil Porosity:*** - it refers many important soil processes takeplace in soil ores like air or water filled spaces between theparticles. Porosity is defined the void available in the soil There are two types of soil can identify, if soil has coarse size particle than the gap between the particles is bigand water or air can easily take places in that places sometimes soil can replace on their place however when theproperties of soil is fine then the soil ingredient are stick to each other so that void between the particles are very less so this settlement of the soil proportion decreased.

***Plastic Bottle*** -plastic bottles are thermos plastic type of polymer which can find by with and without branching and cross linking.

Thermoplastic materials like plastic bottle and other plastic are required heat or we can say high temperature and it can change its shape and size by applying pressure and without pressure. So, these properties are important of plastic bottle: -Heat resistance

Chemically stableTransparent Flexible
Odorless.

***Cement:*** Cement properties are important for plasticbottle construction because the plastic can slip when thecontact to each other so the per potion of cement and wateris required thicker than mortar used in brick constructionhouse. The following properties is required for cement Fineness

***Soundness Strength Setting time***

***WATER:*** -Water is one of the important components for this project because for making a mixture of cement or mortar water content is important. Its is necessary that water is chemically free and the workability of water can be defined by the volume base or weight based by determine the weight or volume of cement in terms of water.

For the consistency of the fresh mortar, one is slump test and other one is flowtest were conducted to evaluation.

# Methodology

***Construction Process***

Collect the plastic bottles from nearby shops, near waste industry and from nearby houses and cleaning the bottlesby using water and clothes.

Clean the area where the construction was planned. Identified the same size of bottle size so that constructionbecame easy.

Filled the all cleaned bottle with the sand that make bottleheavier.

***Placed all bottle to the construction site.***
***Construction***

1. For the stability foundation is necessary so provide 2 cm of cement onto the foundation.
2. Place plastic bottle on the bottom cement layerwith 1cm gap between two bottles.
3. Make the slurry of cement to pour it top of the bottle and gap being filled by this slurry of cement as well.
4. Next layer of bottle is placed such a way so bottles create a strong bond between layer to layer, so next layer of bottle are placed in between in below bottles.
5. After filling all the gap between the bottles,
6. applying the next layer of cement by cement
7. slurry above the bottle approximately 2cm.
8. Repeat these steps for the desired wall height.7- Take it aesthetic looks by coloring and designing.

# Cost and Estimation

***No of bottle in foundation: -***
We are making a shade which is totally open from frontside.
So, the total area covered = 2.5m* 2m

- Bottle required in 2.5 m length: -Area of one bottle with mortar

= (2*3.14*4 (4 + 8) = 301.44 $cm^2$)
Total area at that side = (250 * 51) $cm^2$
= 12750 $cm^2$
Total no of bottles = 12750 / 301.44
= 42 bottles

- Other side also required = 42 bottles
- Bottles required in 2 m length side: -Area of one bottle with mortar

= 301.44 $cm^2$
Total no bottles = (200*51) $cm^2$/ 301.44
= 34 bottles
Total no of bottles required in foundation =(42 +42+34)
= 118 bottles

- Because we are provide two layer of bottles , sothat total no bottle are

= (118 +118)
= 236 bottles

***No** of bottles in wall*

We give height of construction work for wall and theheight of wall is 6 feet.
Total area of one side wall is = 250 * 25
= 6250$cm^2$
One bottle area = 301.44$cm^2$ Total no bottles = 6250/301.44
= 21 bottles per layer.
Meaning of 6 feet = 6 * 30.48 = 182.88 cmOne bottle height = 9cm with mortar
Total no layer of bottles = 182.88/ 9 = 20If in one layer have 21 bottles.
So, in 20 layer = 21 * 20
= 420 bottles.

- On the other side same bottles are required = 420bottles.
- Total area of one side wall is = 200 * 25

= 5000cm$^2$

- One bottle area = 301.44cm$^2$
- Total no bottles = 5000/301.44
- = 17 bottles per layer.
- Meaning of 6 feet = 6 * 30.48 = 182.88 cm

One bottle height = 9cm with mortar Total no layer of bottles = 182.88/ 9 = 20If in one layer have 22 bottles.
So in 20 layer = 17 * 20
= 340 bottles.

- Total bottle required in wall

=(420+420+340)
= 1180 bottles.

- Total bottles required in fully construction =1180 + 236

= 1500 bottles

Material for 1:6 brick work

Volume of brick masonry: - Area x Thickness of wall

- For one side wall Area = (2*2.5) Thickness = 23 cm

Volume of brick masonry = 2 *2.5*.23
= 1.15 m$^3$
Volume of wet mortar = volume of brick masonry- actualvolume of brick in brick masonry

- Actual volume of brick masonry

= 450* (0.19*0.09*0.09)
= 0.646 m$^3$
Volume of wet mortar= (1.15 – 0.646) m$^3$
= 0.503 m$^3$
For gap of brick (frog) filling, cut brick for bonding, wastage etc.increase this quantity 15%

Volume of wet mortar= 1.15 * 0.503
= 0.579 $m^3$
Volume of dry mortar =1.25 * 0.579
= 0.724 $m^3$
Because we are using 1:6 brick work: - Quantity of cement: - (1/7) *0.724*1440
=148.94 kg
= 148.94 / 50 = 2.92 bags
Quantity of sand = (6/7) * 0.724
=0.621 $m^3$

- Other wall also has same dimension so same noof bags required.
- Third wall dimension is (2*2)

Volume of wet mortar= (0.920 – 0.523)
=0.396$m^3$
For frog filling,
Volume of wet mortar = 1.15 * 0.396
= 0.456 $m^3$
Volume of dry mortar = 1.25 * 0.456
= 0.570 $m^3$
Quanitity o cement = (1/7)* 0.570 *1440/50
=2.34 bags
Quantity of sand = (6/7)* 0.570
= 0.488 $m^3$
Total no of cement bags required= (2.97+2.97+2.34)
=8 bags
Total no sand required = (0.621+0.621+0.488)= 1.73 $m^3$

| S.No. | Name ofproduct | Quantity | Rate | total |
|---|---|---|---|---|
| 1 | Plasticbottle | 1500 | 0.50 /- perbottle | 750/- |
| 2 | Cement | 8 | 370 perbag | 2960/- |
| 3. | Sand | 1.73 | 250 | 432.5 |
| 4. | Bottlefilling | 4 labour for 4 days | 300 perday | 4800 |
| Total | | | | 8942.5/- |

= 4000$cm^2$

- One brick area = (20 * 10 ) = 200$cm^2$
- Total no bottles = 4000/200
  = 20 bottles per layer.
- Meaning of 6 feet = 6 * 30.48
= 182.88 cm

One brick height = 10cm with mortar Total no layer of bottles = 182.88/ 10 = 18If in one layer have 22 bottles.
So in 20 layer = 20 *18
= 360 bricks.

- Total bottle required in wall =

(558+558+360)

***No of brick in foundation***
We are making a shade which is totally open from frontside.
So, the total area covered = 2.5m* 2m

- Bottle required in 2.5 m length: -Area of one brick with mortar

= (20 * 10 = 200 $cm^2$)
Total area at that side = (250 * 51) $cm^2$
= 12750 $cm^2$
Total no of bricks = 12750 / 200
= 64 bottles

- Other side also required = 64 bottles
- Bottles required in 2 m length side: -Area of one brick with mortar

= 200 $cm^2$
Total no bricks = (200 * 51) $cm^2$/ 200
= 51 bottles
Total no of bottles required in foundation = (64 +64+ 51)
= 179 bottles

- Because we are provide two layer of bottles, sothat total no brick are

= (179 +179)
= 358 bottles

***No of bricks in wall***
We give height of construction work for wall and theheight of wall is 6 feet.
Total area of one side wall is = 250 * 25
= 6250$cm^2$
One brick area = (20 * 10) = 200$cm^2$Total no bottles = 6250/200
= 31 brick per layer.
Meaning of 6 feet = 6 * 30.48 = 182.88 cmOne brick height = 10cm with mortar Total no layer of brick = 182.88/ 10 = 18 If in one layer have 27 bottles.
So in 20 layer = 31 * 18
= 558 bricks.

- On the other side same brics are required = 558bottles.
- Total area of one side wall is = 200 * 20

= 1476 bricks.
- Total bricks required in fully construction = 1476
+ 358
= 1834 bricks
Material for 1:6 brick work
Volume of brick masonary:- area x thickness of wall

- For one side wall Area = (2*2.5) Thickness = 23 cm
- Volume of brick masonry = 2 *2.5*.23

= 1.15 $m^3$

- Volume of wet mortar = volume of brick masonry- actualvolume of brick in brick masonry
- Actual volume of brick masonry

= 450* (0.19*0.09*0.09)
= 0.646 $m^3$

- Volume of wet mortar= (1.15 – 0.646) $m^3$

= 0.503 $m^3$
For gap in the brick (frog) filling, cut brick for bonding, wastage etc. increase this quantity 15%
Volume of wet mortar= 1.15 * 0.503
= 0.579 $m^3$
Volume of dry mortar =1.25 * 0.579
= 0.724 $m^3$

- Because we are using 1:6 brick work: - Quantity of cement: - (1/7) *0.724*1440

=148.94 kg
= 148.94 / 50 = 2.92 bags
Quantity of sand = (6/7) * 0.724
=0.621 $m^3$

- Other wall also has same dimension so same noof bags required.
- Third wall dimension is (2*2)
- Volume of wet mortar= (0.920 – 0.523)

=0.396$m^3$
For frog filling,

Volume of wet mortar = 1.15 * 0.396

= 0.456 $m^3$

Volume of dry mortar = 1.25 * 0.456

= 0.570 $m^3$

Quanitity o cement = (1/7) * 0.570 *1440/50

=2.34 bags
Quantity of sand = (6/7) * 0.570
= 0.488 $m^3$
Total no of cement bags required= (2.97+2.97+2.34)
=8 bags
Total no sand required = (0.621+0.621+0.488) = 1.73 $m^3$

| S.No. | Name of product | Quantity | Rate | total |
|---|---|---|---|---|
| 1 | brick | 1834 | 8 per brick | 14672/- |
| 2 | Cement | 8 | 370 perbag | 2960/- |
| 3. | Sand | 1.73 | 250 | 432.5/- |
| Total | | | | 18064.5/- |

***Benefit of plastic bottles as a masonry wall***

The important difference with benefits of these alternative alternative innovation material compared to conventical material is:

1- Good construction ability: - The wight of the bottlesis light as compared to the brick so that it's used in the earthquake zone area make good response in thatsituation.

Bottles filled with sand have compaction of the material inside it so that load compatibility of plastic with sand is 25 times higher compared to brick. Therefore, theses compaction makes plastic bottles to be prevented from passing these shot that makes building as a bulletproof shelter.

1. Low cost: - the construction of bottles is required non skill labor, instead of this the construction a house by plastic bottle used the walls and concrete column that offers 45% diminution in the final cost.
2. Plastic bottle some get free if there are not requirement and collect easily in many numbers so that transportation coast and labor cost for also deduct.
3. Non-brittle characteristic: - plastic bottle and brick both are non-brittle material so due to the easily broken properties of brick, bricks create more construction waste as compare to the plastic bottles.
4. Absorbs abrupt shock loads: - plastic bottles are not fragile, they can be flexible and easy tolerates sudden load without failure. It can define good bearing capacity of building against earthquake.
5. Green construction: - due to reuse of these bottle expect recycling, plastic bottle can cause green construction or sustainability by saving energy and resources.
6. This can good way to save energy and enhance the green environment productivity.

## Conclusion

Use of plastic bottle as construction material help to clean the environment and making more designable house in low cost.

Bottles are fully compared with sand which makes its outerside stronger than brick wall.

By using plastic bottle in the place of brick, it also reducescost of the project. That helps poor people and give new innovation idea for making house in low cost.

Because we know that plastic bottles are not properly recycled so that it effects environment so we can make such type of houses, resting room, seating branches etc. by reuse the plastic bottle instead of recycling the plastic and many other innovative projects that help our environment and describe engineering projects.