

Performance Analysis of Waste Plastic Bottle Masonry in Building Construction

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ABSTRACT

High cost is primary requirement for constructing the house in places where people are poverty lines, is becoming one of the most significant problem of peoples. Eco friendly architectural principles are being incorporated into more building every day in the world but they are still out of reach of many people due to lack of knowledge and awareness. On eco-friendly environment that could still be built at very low cost, with waste materials that is plastic bottle, providing adequate thermal comfort while being sustainable.

This paper consist of use of plastic bottle waste in construction as a brick which is filled with compacted sand or mud and other material , method and technique of use , its relative advantages over traditional bricks in this way plastic waste of bottle can be removed and reused safely for construction.

Keywords: Waste Plastic Bottle Masonry, Recycled waste, Brickwork, Construction

I. INTRODUCTION

Plastic bottles are dangerous to environment due to chemical used to manufacture, improper used and disposal. The quantity of plastics of all types consumed annually all over the world has increased substantially. The manufacturing processes, municipal solid wastes (MSW) and service industries generate a large amount of waste plastic materials. With a continuous growth for over 50 years, the global production of plastics rose from 204 million tons in 2002 to 299 million tons in and is ever increasing. The worldwide production of PET exceeds 6.7 million tons/year and shows a dramatic increase in the Asian region due to recent increasing demands in China and India.

This is increasing at a rate of 1.5 to 2% annually. Plastics comprise 12.3% of total waste produced most of which is from discarded PET water bottles. Disposed PET bottles are treated by landfill and burning, which creates serious environmental problems and hence creates waste disposal and management issues. Recycling is one of the ways to reduce the environmental impact of the waste PET bottles. But the biggest problem with plastic recycling is that it is difficult to automate the sorting of plastic waste and so is labor intensive.

Statistics show about 25% of the plastic produced in the US is recycled that only.

II. Litreature Review:

1) **Aditya Singh Rawat¹, R. Kansal, PET Bottles as Sustainable Building Material: A Step Towards0 Green Building Construction, Journal of Civil**

Engineering and Environmental Technology Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 1, Number 6; August, 2014 pp. 1-3.

In research we implemented system based on eco-friendly environment & more advanced technologies that built in very low cost with waste materials. Being a non-biodegradable substance compose toxic materials, plastic polluter air & water. PET is used for high impact resistance container. The only 15 to 27% PET only recycled annually.

2) **Jayaprakash M C¹, Deeksha I and Soumya M R, PET Bottles for Eco-friendly Building in Sustainable Development, International Journal of Current Trends in Engineering & Research (IJCTER)e-ISSN 2455-1392 Volume 2 Issue 5, May 2016**

This paper proposes the use of waste plastic PET (Polyethylene Terephthalate) bottles as constructions entity to standardized bricks. As plastics are non-biodegradable its disposal as always been a problem. This is an environmental issue as waste plastic bottles are difficult to biodegrade and involves processes either to recycle. In this research paper two methods are mentioned:-

- 1) Recycling waste plastic bottle
- 2) Reuse of waste plastic bottle.

III.OBJECTIVES

Objectives of plastic bottle in construction are follows:-

- 1) Study about cost comparison between brick-wall and plastics wall
- 2) To study proper method of construction.

- 3) To use the waste plastics bottle
- 4) We want to minimize plastic bottles waste from environment and society.
- 5) Plastic bottles is non degradable waste in environment therefore only reuse of plastic is the best way to dispose effectively.

IV. MECHANISMS

Construction procedure of plastic bottle house:-

- 1) Firstly collect the PET bottles which have proper shape and which are not damaged from any side from municipal waste.
- 2) Collected bottles are cleaned properly from inside and outside.
- 3) Fill the soil in the plastic bottles and tamped properly.
- 4) Then properly tight the cap of plastic bottles.
- 5) Foundation will laid down with soil filled plastic bottles and the bottles will arrange properly.
- 6) According to design construct the column and wall using soil filled plastic bottles in proper manner.
- 7) Then position of beam holding roof and roofing with cemented sheets
- 8) According to design leveling of floor with plastic bottles.
- 9) Then finishing plastering & painting of wall of house.



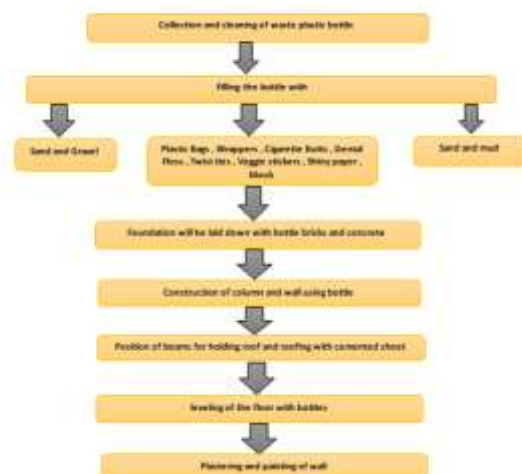
Fig 1. Plastic Bottle Construction



Fig 2. Plastic Bottle Constructed Wall

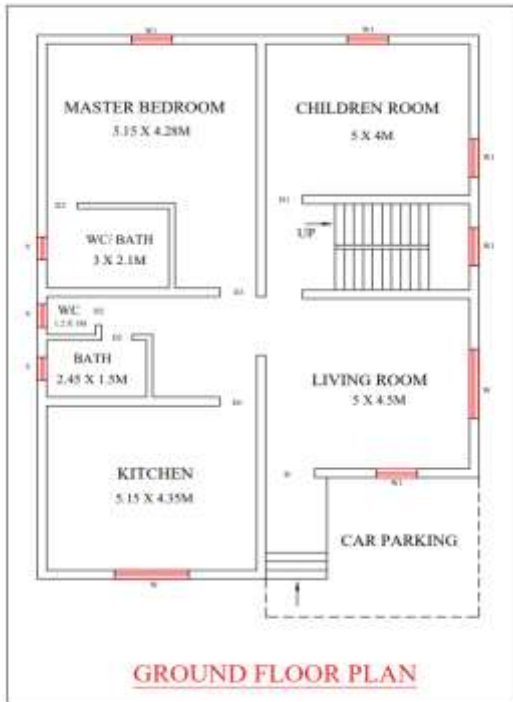
V. METHODOLOGY

METHODOLOGY FOR CONSTRUCTION OF PLASTIC BOTTLE



VI. ANALYSIS FOR AN BUNGALOW

Consider the plan of an bungalow as shown in the figure below, the analysis of conventional brick masonry and plastic bottle masonry for quantities for 68 m² is as below.



CALCULATIONS

A. Brick masonry work calculation of quantities for 68 m².

Brick masonry wall :-

1. Number of bricks :-

Actual size of bricks = 19cm x 9cm x 9cm.

Normal size of brick = 20cm x 10cm x 10cm.

(with mortar joint)

Volume of brick masonry = Area x thickness of wall

$$= 68 \times 0.23$$

$$= 15.47 \text{ m}^3.$$

No. of brick = Volume of brick mason / Volume of 1 brick with mortar

$$= 15.47 / 0.2 \times 0.1 \times 0.1$$

$$= 7735$$

2. Mortar:-

Actual volume of brick in masonry

$$= 7735 \times (0.19 \times 0.09 \times 0.09)$$

$$= 11.10 \text{ m}^3$$

$$\text{Volume of wet mortar} = 15.47 - 11.10$$

$$= 3.57 \text{ m}^3$$

For frog filling, cut brick for binding wastage increase this quantity by 15%

$$\text{Volume of wet mortar} = 3.57 + (3.57 \times 0.15)$$

$$= 4.10 \text{ m}^3$$

Volume of dry mortar reduced by 25% when water is added

$$\text{Volume of dry mortar} = 4.10 + (0.25 \times 4.10)$$

$$= 5.12 \text{ m}^3$$

3) Material for 1:3 brick work:-

Quantity of bricks = 15.47 m³

Proportion = 1:5

Volume of dry mortar = 5.12 m³

Cement = $1/6 \times 5.12 = 0.855$, $0.855 / 0.035 = 25$ bags

$$\text{Sand} = 5/6 \times 5.12 = 4.26 \text{ m}^3$$

Material	Quantity	Rate	per	Amount (Rs.)
Brick	7735	11	1 no	85085
Cement	25	320	1 bag	8000
Sand (crush)	1.50 brass	3000	1 brass	4500
Total =				Rs. 97585

B. Plastic bottle masonry work calculation of quantities for 68 m²

1. Number of bottles :-

Actual size of bottle = 24cm x 8cm

Normal size of bottle with mortar joint = 24cm x 9cm

Volume of bottle masonry = Area x thickness of wall

$$= 68 \times 0.24$$

$$= 16.15 \text{ m}^3$$

No. of bottles = Volume of bottle masonry / 1 bottle with mortar joint

$$= 16.15 / 0.24 (\pi/4 \times 0.09)$$

$$= 10577 \text{ bottles}$$

2. Mortar :-

Actual volume of brick in brick masonry

$$= 7735 \times (0.19 \times 0.09 \times 0.09)$$

$$= 11.90 \text{ m}^3$$

$$\text{Volume of wet mortar} = 16.15 - 11.90$$

$$= 4.25 \text{ m}^3$$

For frog filling cut brick for bonding wastage increase quantity by 15%

$$\text{Volume of wet mortar} = 4.25 + (4.25 \times 0.15)$$

$$= 4.88 \text{ m}^3$$

Volume of dry mortar reduced by 25% when water is added

$$\text{Volume of dry mortar} = 4.88 + (0.25 \times 4.88)$$

$$= 10.01 \text{ m}^3$$

3. Material for 1:3 brick work :-

Quantity of brick 16.53 m³

Proportion = 1:5

$$\text{Cement} = 1/6 \times 10.01 = 1.663 \text{ m}^3$$

$$= 1.663 / 0.035$$

$$= 47 \text{ bags}$$

$$\text{Sand} = 5/6 \times 10.01 = 8.34 \text{ m}^3$$

$$\text{Soil} = 8.34 \text{ m}^3$$

4. No of labour required :-

One labour can made 400 bottles per day

Total no of bottle = 10577 bottle

$$= 27 \text{ labours.}$$

Material	Quantity	Rate	per	Amount (Rs.)
Plastic bottle	10577	2.5	1 bottle	26442
Cement	47	315	1 bag	14805
Sand	2.93brass	3000	1 brass	8760
Soil	11.40m ³	200	1m ³	2280
Labour work	27	300	1 person	8100
Total =				Rs. 60387

VII. Comparison between the Wall by Plastic Bottle & Brick Wall

Factor	Consideration	Plastic bottle wall	Brick wall
Time and speed of execution	5 person team one working day	15% faster	120 m ³
Material and equipment cost	Implementation and installation of material and equipment	Saving in cement, water, grinder and fitting	More weight and more materials
Transportation cost	Displacement in the building	Lighter and higher volume, easy and cheap displacement	Greater weight and less volume, hard and costly displacement
Execution cost	Using calculation of panel	Less manpower and indigenous	More human resource the higher cost
Strength and load capacity		20 times more than	Great wall

		brick	thickness, lower strength
Resistance to earthquake	Earthquake has a direct relationship with the weight of each structure	Low and integrated weight without falling debris	High weight and loss of materials
Cleanliness and beauty of work		Very clean execution, no construction waste	High volume of construction waste
Flexibility		High flexibility	Low flexibility
Material waste		No wastage	High and unusable

VIII. Conclusion

1) The use of Plastic Waste for construction application will solve both the solid waste management problem and depleting deposits of raw materials used for construction purposes and also the use of Plastic Waste in different construction applications support the sustainability trend of circular economy.

2) The use of Plastic Waste for construction applications creates a pathway to use these wastes for long term applications compared to short term ones such as recycling into new products which will end up as waste within a short period of time.

3) The possible use of Plastic Waste as binder, aggregates and fibers makes it a viable replacement for all components in cementitious composites, with somewhat acceptable detrimental effects on the performance of the resulting composite.

4) The use of Plastic Waste for various construction application will lead to various revenue generation Opportunities.

5) The cost comparison for brickwork shows for same area Plastic Bottle masonry cost is very much less and economical as compared to Conventional masonry.

VII. References

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