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# An Experimental Investigation on Construction of Tree Bench by Using Plastic Bottles as Eco Bricks

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**ABSTRACT:**The main objective of this project is to use the waste plastic bottles in tree bench construction which reduces the environmental pollution. Eco-bricks are a simple, low-tech solution to our plastic that follows the Earth's ancient example in carbon care. Waste Polyethylene Terephthalate (PET) bottles packed with manufacturing sand has been successfully used in making Plastic bottle as eco bricks. Experimentally Eco Brick is given more Compressive strength when compared to Mud clay burned brick . The Project is adopted with the complete 1:3 cement mortar , 0.4 water cement ratio and also conducted Compressive strength at 7,14,28 Days for cement mortar cubes .For outdoor purpose, we constructed an Tree Bench with eco bricks. Comparing the cost estimation with Eco Bricks its saving half of the amount in Conventional mud bricks.

**KEYWORDS:**Waste Polyethylene Terephthalate (PET), Conventional mud bricks, Eco Bricks.

## I. INTRODUCTION

Throughout the world, plastic waste disposal is a major concern since it is being nonbiodegradable in nature and hazardous, because of its potential harmful effect on human health and to the environment. Taking into account the increase of pollution new concept of eco bricks has been introduced. When these bottles are filled with sand, gravel and cork or wood particles, they have great insulating capability. An ecobrick must...Be a short-term building block that can be indefinitely reused in the short term.Compact, secured and store plastic safely out of industry and out of the biosphere for the long-termResult in more plastic and CO<sub>2</sub> being subtracted from the biosphere than was added by the processRaise the individual and collective ecological consciousness of those involved in the processContributing to the maintenance and encouragement of biodiversity

## II. RELATED WORK

**Mojtaba et al. [1]** Concluded that reusing the plastic bottles as the building materials can have substantial effects on saving the building embodied energy by using them instead of bricks.

**Shilpi et al. [2]**Plastic is non-biodegradable, toxic, highly resistant to heat and electricity (best insulator) and not recyclable in true sense, plastic PET bottles use in bottle brick technique.

**Puttaraj et al. [3]** examined that efficient usage of waste plastic in plastic-soil bricks has resulted in effective usage of plastic waste and thereby can solve the problem of safe disposal of plastics. It has been proven that the use of plastic bottles as innovative materials for building

**Pratima et al. [4]** studied that plastic bottles wall have been less costly as compare to bricks

**VikramPakrashi et al. [5]** examined Eco-brick is a viable resource for construction purposes with a number of possible applications. The bricks are relatively easily manufactured with controlled weight and packing.

**YahayaAhmade et al. [6]** said that the structure has the added advantage of being fire proof, bullet proof and earthquake resistant, with the interior maintaining a constant temperature of 18 degrees C which is good for tropical climate.

III. METHODOLOGY

1. PET BOTTLES-ECO BRICK STANDARDS

- The ecobrick is made using a transparent PET bottle
- The ecobrick is only packed with sand
- The ecobrick’s density is higher than 0.33g/ml
- The ecobrick must have a density of 0.70g/ml or less
- The ecobrick is sealed tight with a screw down lid.



a. Eco Bricks

2. CEMENT

Ordinary Portland cement of 53 grade (Conforming to the requirements of IS: 12269) was used in all these investigations. This cement, in general, also confirms to the provisions of Type I cement as per ASTM.

Table-1 Test conducted on cement

S.NO	Tests on cement	Cement
1	Fineness of cement	4 %
2	Specific gravity	3.15
3	Normal constituency	30%
4	Initial setting time	20 minutes
	Final setting time	560 minutes



b. Normal Consistency of cement

3. M-SAND

In the present work locally available manufactured sand has been used as fine aggregate. Other unwanted matter present in the sand has been separated before use. The sand was sieved through 4.75mm sieve to avoid the presence of pebbles and organic matter.

**Table - 2: Properties of Manufacturing sand**

Material	Manufacturing sand
Specific Gravity	2.53
Bulking of sand	4 %



c. Specific gravity of fine aggregate

**4. MIX PROPORTION**

➤ For the complete project we are assuring 1:3 mix proportion to make a cement mortar by following the Indian standards like IS 2250-1981(Reaffirmed 2000)

**5. COMPRESSIVE STRENGTH FOR CEMENT MORTAR :** Compressive strength is the ability of material or structure to carry the loads on its surface without any crack or deflection. A material under compression tends to reduce the size, while in tension, size elongates. The unconfined compressive strength test was carried out on 50 mm cube in the compressive strength testing machine of 2000 kN capacity. A loading rate of 2.5kn/s was applied which approximately equals to the 140 kg/cm<sup>2</sup>/minute as given in the IS: 516 – 1959. The test was performed at the age of 7, 14 and 28days for cement mortar cube . The mortar cube specimens were kept in water until the time of testing and the tests were carried out on the surface dry specimens. Compressive strength formula for any material is the load applied at the point of failure to the cross-section area of the face on which load was applied.

$$\text{Compressive Strength} = \text{Load} / \text{Cross-sectional Area}$$



d. Compressive Strength On Cement Mortar Bricks

**6. COMPRESSIVE STRENGTH FOR CONVENTIONAL BRICK :** Measure the dimensions of the top surface (frog side) of the brick to the nearest 1 mm. Remove any unevenness observed on the bed faces (i.e., frog side and on the opposite side) by grinding. Immerse the brick in water for a period of 24 hours. The specimen should be then removed and excess water is drained out at room temperature. The frog portion and voids on the top surface if any has to be filled with cement mortar (1 cement, 1 clean coarse sand of grade 3mm and down). Store the brick under a damp jute bag for 24 hours. Following this immerse the brick in clean water for a period of 3 days. Remove and wipe out any traces of moisture in the brick. Place the specimen prepared with flat faces horizontal and mortar filled faces (i.e., frog face) upwards between two 3mm plywood sheets and carefully centred between plates of testing machine. The plywood sheets will ensure that the load is

transferred uniformly. Now apply axial load at a uniform rate of 14 N/mm<sup>2</sup> (or 140 kgf/cm<sup>2</sup>) per minute till failure occurs. Note the maximum load at failure and repeat the procedure for other specimens



e. Compressive Strength On Normal Bricks

7. **COMPRESSIVE STRENGTH FOR ECO BRICK :** The brick was between loading plates of the machine. The bottles didn't break but did deform. The load was increased until the reading showed a sudden drop of force. The load at which it started to drop was recorded as the maximum load.



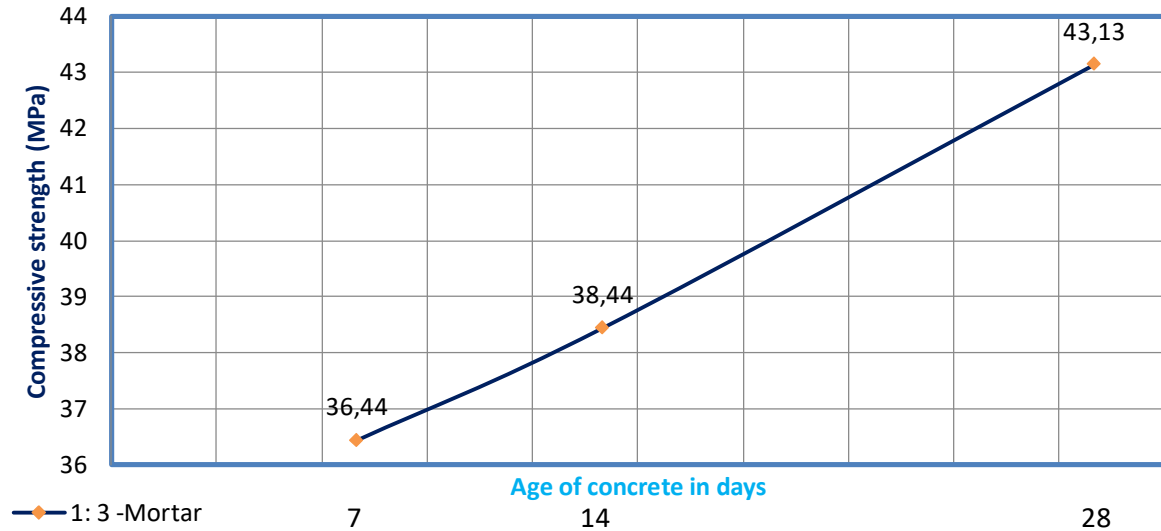
f. Compressive Strength On Eco Bricks

#### IV. EXPERIMENTAL RESULTS

##### 1. COMPRESSIVE STRENGTH FOR CEMENT MORTAR CUBES

TABLE: 3 CEMENT MORTAR COMPRESSIVE STRENGTH

S.No	Days	Load (KN)	Area (mm <sup>2</sup> )	Compressive Strength (N/mm <sup>2</sup> )	Average Compressive Strength (N/mm <sup>2</sup> )
1	7 DAYS	180	70.6 x 70.6	36.11	36.44(N/mm <sup>2</sup> )
		185	70.6 x 70.6	37.11	
		180	70.6 x 70.6	36.11	
2	14 DAYS	190	70.6 x 70.6	38.11	38.44 (N/mm <sup>2</sup> )
		195	70.6 x 70.6	39.12	
		190	70.6 x 70.6	38.11	
3	28 DAYS	220	70.6 x 70.6	44.13	43.13 (N/mm <sup>2</sup> )
		210	70.6 x 70.6	42.13	
		215	70.6 x 70.6	43.13	



g. Compressive strength of cement mortar

The compressive strength of cement mortar goes on increasing with an increase in 7 days, 14 days and 28 days . after 28 days it got enhanced to 43.13 N/mm<sup>2</sup>

**2. COMPRESSIVE STRENGTH FOR CONVENTIONAL BRICKS**

**TABLE: 4 COMPRESSIVE STRENGTH-CONVENTIONAL BRICK**

S.No	Load (KN)	Area (mm <sup>2</sup> )	Compressive Strength (N/mm <sup>2</sup> )	Average Compressive Strength (N/mm <sup>2</sup> )
1	220	190 x 90	12.86	12.27(N/mm <sup>2</sup> )
	200	190 x 90	11.69	
	210	190 x 90	12.28	

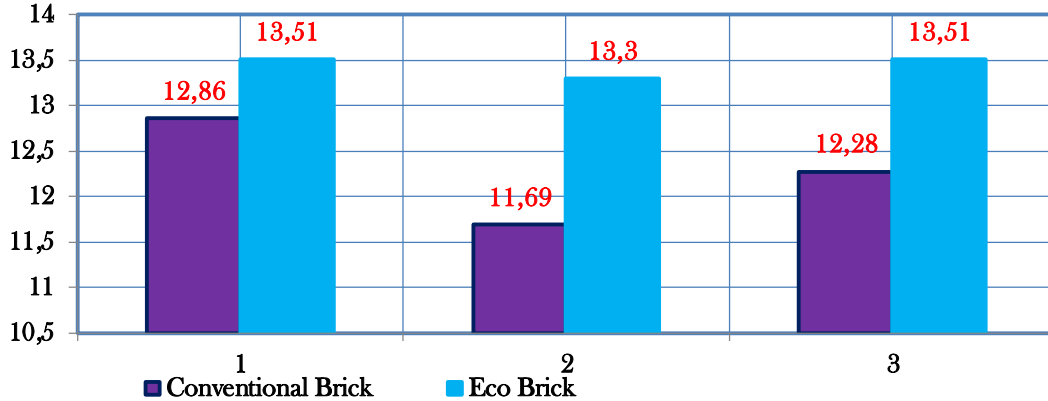
**3. COMPRESSIVE STRENGTH FOR ECO BRICKS**

**TABLE: 5 COMPRESSIVE STRENGTH-ECO BRICKS**

S.No	Load (KN)	Area (mm <sup>2</sup> )	Compressive Strength (N/mm <sup>2</sup> )	Average Compressive Strength (N/mm <sup>2</sup> )
1	320	296 X 80	13.51	13.44(N/mm <sup>2</sup> )
	315	296 X 80	13.30	
	320	296 X 80	13.51	



4. COMPARISON OF COMPRESSIVE STRENGTH OF ECO BRICKS & CONVENTIONAL BRICKS



h. Compressive strength of Conventional & Eco Brick

The Compressive strength of Eco Brick is increased by 9.53 % when compare with Burned Clay mud brick

5. COMPARISON OF COST OF ECO BRICKS & CONVENTIONAL BRICKS

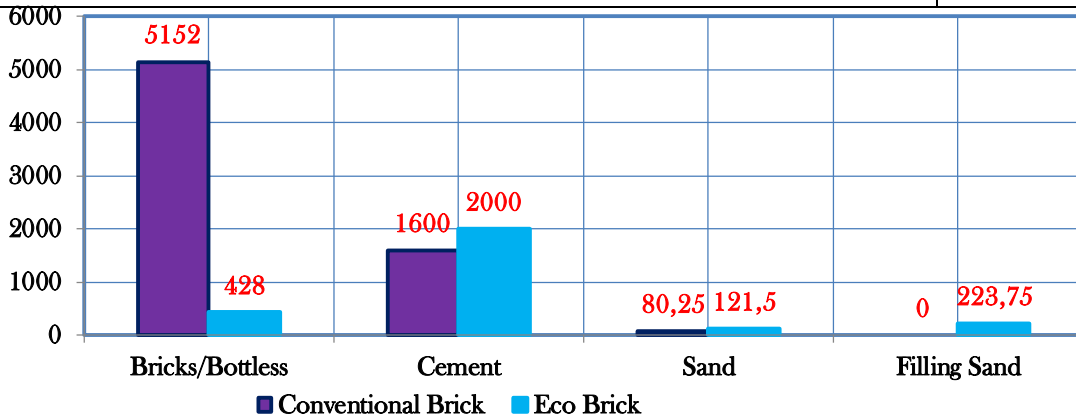
Cost comparison between bottles wall is roughly half than conventional brick masonry. i.e., Total cost of around Brick tree bench is Rs. ₹6832.25 and total cost of around Eco brick tree bench is Rs. ₹2773.25

TABLE: 6. COST ESTIMATION OF TREE BENCH-CONVENTIONAL BRICKS

Sl.no	Material	Quantity	Rate	Per	Amount (Rs)
1	Bricks	644	8	1ns	5152
2	Cement	4	400	1ns	1600
3	Sand	0.321	250	1m <sup>3</sup>	80.25
Total					₹6832.25

TABLE: 7. COST ESTIMATION OF TREE BENCH ECO BRICKS

SL.NO	Material	Quantity	Rate	Per	Amount
1	Plastic bottle	214	2	1ns	428
2	Cement	5	400	1bag	2000
3	Sand	0.486	250	1 m <sup>3</sup>	121.5
4	Filling Sand	0.895	250	1 m <sup>3</sup>	223.75
Total					₹2773.25



i. Cost comparison of Eco brick & Conventional Brick-Tree Bench

**ECO BRICK-LAYOUT**



j. Eco bricks

**CONSTRUCTION OF TREE BENCH-LAYOUT**



k. Tree Bench Construction





1. Tree Benches

## V. CONCLUSION

1. Use of innovative materials with sustainable application such as plastic bottles can have considerable benefits including finding the best optimization in energy consumption of the region, reducing environmental degradation.
2. Cost comparison between bottles wall is roughly half than conventional brick masonry. i.e., Total cost of around Brick tree bench is Rs. ₹6832.25 and total cost of around Eco brick tree bench is Rs. ₹2773.25
3. Strength comparison between conventional & Eco Brick. The Compressive strength of Eco Brick is increased by 9.53 % when compare with Burned Clay mud brick
4. PET Bottles also have a durability of more than 300 years which is more as compared to the standard bricks and these bricks are very thick.
5. Aspect point of View Eco brick tree bench is more attractive compared to normal bench.

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