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“Overview of waste pet bottle application in a building construction at kolhapur.

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Abstract: In this study, moto is to reuse the waste PET bottle as a brick in a building construction replacing the burned clay brick, waste foundry sand is found excess in Kolhapur city as it is the second largest hub for the foundry industry, the waste foundry sand is been compacted in the bottle that helps to improve the compressive load on the PET bottle brick as compared to burned clay brick, also environmental perceptive is been promoted by minimizing the waste plastic bottle and reusing it in building construction, comparative analysis is been done for how reusing plastic bottle can be environmental friendly then recycling it and releasing the harmful gases like carbon monoxide in the nature. Findings-In this study several parameters are been experimented like cost analysis and strength analysis by constructing prototype model of burned clay brick and plastic bottle masonry.

Index Terms – PET plastic bottle, foundry sand, burned clay brick.

I. INTRODUCTION

Due to domestic activities by the human population, and using of advance technology in construction industry, release of harmful gases is been increased, as per a present report, carbon dioxide added to essentially 77% of the total ozone exhausting substance outpouring in the year 2022” WWA (worldwide association)

Building construction industry is only one who gives out maximum air pollutants and leads to global warming, i.e., 52% of carbon dioxide is been released (Himanshu Sharma 2017).

Amongst all, in building industry material used for walls are greater in quantity as it is the only things that covers the periphery of the building, and in Kolhapur burned clay brick is still popular as it is easily available at outskirts of Kolhapur

“Indian block industry (burned bricks) is second biggest makers of mud terminated blocks, creating over 10% of worldwide creation” (Himanshu Sharma 2017). There are many disadvantages towards air pollution for production of clay burned brick as it uses coal, coal is non-renewable fuel source, so excess of uses of coal will lead to depletion of sources. According to the survey, clay production industry gives out lot of air pollutants like carbon dioxide and carbon monoxide, that leads to global warming, and also, it hammers the labours life which gives out lot of health issues for e.g., respiratory related illness.

“162 gram of carbon dioxide and carbon monoxide is been released by the 1 kg of burned brick in the brick kiln, so every day this industry gives lot of air pollutants within air” (Himanshu Sharma 2017).

So, there is a need to find alternate sustainable material for partition in a construction industry that can be possible trough maximum plastic waste generated in Kolhapur.

II. NEED OF STUDY

Plastic waste is increasing day by day, it should be having a solution somewhere so why not to reuse or recycle it, recycling leads to maximum release of harmful gases when heated that leads to air pollution, so reusing plastic PET bottle can be a solution that can help depletion of air, Plastics are produced from the oil that is considered as non-renewable resource. Because plastic has the insolubility about 300 years in the nature, it is considered as a sustainable waste and environmental pollutant (kharwade 2017), so there is need to study how we can reuse the PET plastic bottle as a brick as a walling material in building construction and minimize the plastic waste from Kolhapur. In Kolhapur in addition 4 tons of plastic jugs squander are gathered each day i.e., “124 tons of plastic jug squander month to month.

Let’s see what happens when we reuse and recycle plastic container as a block in a development industry from above examination

Table 1- comparison between recycling and reuse of plastic waste

Description	Reuse waste bottle plastic as brick	Recycling by melting plastic to a brick	Recycling plastic by compressing method to a brick
Procedure	Waste pet bottle filler material or sand	Shredding plastic waste melting 250 degree +foundry sand+ bitumen 20%	Shredding plastic waste melting 100 degree compressing it with desirable wait
Equipment	Not required	Shredding machine+fuel+furnace+mould	Shredding machine+fuel+furnace+mould+compressor
Energy	Not required	Energy required for shredding+heating	Energy required for shredding+heating compacting
Environmental impact	No harmful impact on environment	Create carbon monoxide when heated	Create carbon monoxide when heated
Cost	Approximately negligible	Energy cost fuel cost bitumen	Initial investment is high

From above comparison, we can say that reusing the plastic waste is more energy productive and harmless to the ecosystem then, at that point, reusing plastic waste in development industry.

“To be sure, when we reuse garbage, we are assisting and assuring with saving the lot of energy savings which would somehow be squandered that doesn't harm the biological cycle and global warming and now a days public should encourage reusing the product then recycling the product that leads to thinking towards global warming. It is cantered around the monetary perspective, environmental perceptive as well as the ecological angle, that leads to good biological cycle” says (Ranjit nikam 2017)

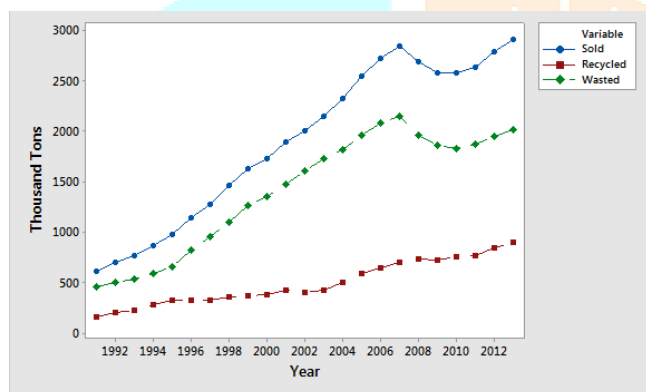


Figure 1-plastic bottle sold, wasted and recycled, source-CPCB

III. MATERIAL

Material selected for a brick bottle is waste PET bottle and waste foundry sand

Waste PET bottle:

Full form of PET and molecular formula is $C_{10}H_8O_4$ Structure Composition is Polyester of Terephthalate acid and ethylene glycol. PET is used for high impact resistant container for packaging of soda, edible oils etc. (kharwade 2017)

Maharashtra is top most state to create plastic waste that is 4,69,098 tones waste per year, according to survey in Kolhapur addition 5 tons of plastic bottles is gathered each day i.e., “150 tons of plastic bottle squander month to month”

Have chosen waste PET bottle amongst plastic waste is because it has definite shape and size to be easily reused as a brick when combined with a filler material in it.

Waste foundry sand:

Waste foundry sand is known as a burned black sand where pure sand is used as a mould for preparing different metal parts and is converted into waste when hot melted metal is poured in a sand mould, waste foundry sand is toxic to nature because of its toxic quality and excess of silica content in it, so reusing it in building construction can be a solution then depleting agricultural land.

There are roughly 4,500 foundry units inside the country out of which 90% are regularly delegated limited scope units, 8% as medium-scale units, and several as enormous scope units. The foundry business is scattered across different geological bunches, of which the Kolhapur group is one among the primary ones. Kolhapur was generally an agro-based economy. Interest for oil motors and agrarian executes developed with industrialization inside the district.

All over India there are many states with foundry cluster like Punjab, Gujarat, Maharashtra, Tamil Nādu, Karnataka and west Bengal, And in Maharashtra, Kolhapur is the only major hub for foundries with 300 units so here we can say that maximum waste foundry sand can be collected and found in Kolhapur that is hazardous for nature and depletion of agricultural land with its toxicity, waste foundry sand can be a filler material in waste pet bottle and converted as a brick in a building construction

IV. CASE STUDY

Scoobys kennel-house of pet bottle-panshet, pune

To get more acquainted with concept of bottle brick construction, an ongoing work of G+1 residential building project based in pune is selected. This project is owned by AR. Rajendra Inamdar. The name of selected project for case study is Scoobys kennel-house of pet bottle.

Rajendra Inamdar –the man behind the plastic bottle, located in the mist of nature, constructing the home using more than 70,000 plastic bottles, instead of using conventional bricks, he used plastic bottle brick, and the reason behind it is, to reduce and recycle the plastic bottle waste, he collected the plastic waste bottle from and around the site and sigh gad fort, his requirement was 1 litre bottle, mineral water bottles, that is maximum available around as a waste, as compared to other waste plastic bottle.

Construction process-Water is mixed with cement and crushed sand 1:6 ratio, the mixture is then filled to the brim in this plastic bottle, once the mixture sets in 3 to 4 days, the bottles are then stacked, into the walls of the house, every part of 2 storied house is constructed with plastic bottle as a brick, the walls, the stairs, the swimming pool, and also the amphitheatre where cultural activities are performed for the public, there are also many kennels for the pets, wall thickness of the plastic bottle house is more than brick wall, that acts as a insulation within the building, for some parts of the house, architect has used bamboo and earthen pots instead of steel bars to make it and cost effective and eco-friendly. Compressive load of bottle brick is 3 time more than conventional burn brick, the filler material used in the bottle is water, cement and crushed sand, and let stay it for 3 days before laying it, per skilled labour can fill 450 bottles per day, the ratio for the mortar used is 1:5, according to the AR. Inamdar sir, for 3mx3m wall we need 1400 bottle brick, according to the architect's survey 20% cost is reduces in comparison with plastic bottle house and conventional burned brick house

Table 2:outcomes of case study

Name	Bottle house-scooby kennel
Year of execution	In process
Number of bottles used	70,000
Filler material used	Crushed sand, cement, water, 1:6
Type of structure	Load bearing
Labor charges per day	250 Rs
No. of bottles filler per labor	250 to 300 bottles

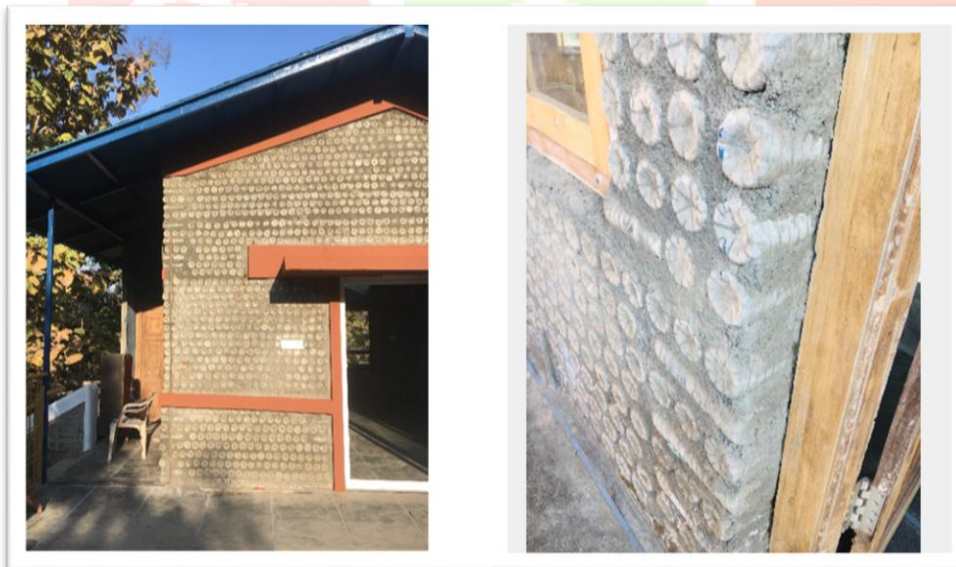
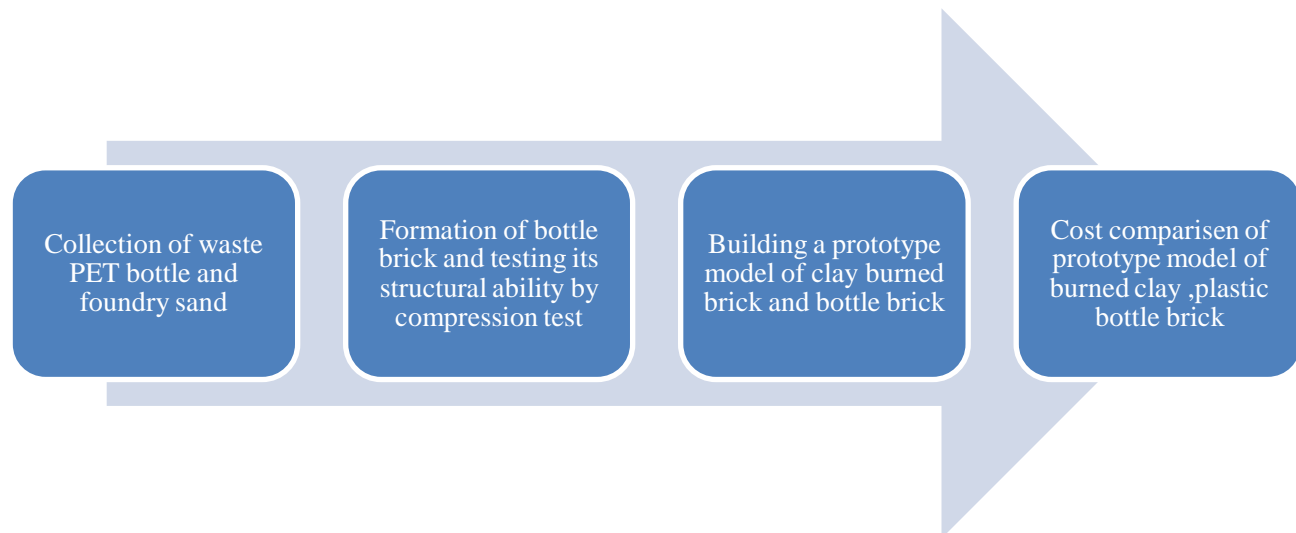


Figure 2: Photograph of bottle brick house, Pune

V. STUDY ELOBARATION

5.1 CONSTRUCTION METHODOLOGY



For experimenting the exact comparison between brick masonry and bottle brick masonry, had decided to construct a prototype model of actual material of size are as follows,

Outer dimension	0.80 X 0.90 M
Inner dimension	0.35 X 0.45M
thickness	0.23 M (1 brk thk wall)
height	0.23 M

Table 3: dimensions for key structure



Figure 3: photograph of fillin waste foundry sand in PET bottle



Figure 4: photograph of bottle brick



Figure 5: photograph of bottle brick masonry



Figure 6: photograph of burned clay brick masonry

5.2 SELECTION OF BOTTLE

Various waste plastic bottle is available, but directly collection of soft cold drink bottles from the hotels in Kolhapur can be easy process to utilise the waste PET bottle in a construction, according to the survey 750 ml PET waste bottle in found in maximum quantity, which is high density polyethylene Terephthalate.

5.3 STRENGTH ANALYSIS

For analysing the strength parameters, compressive test is been conducted between plastic bottle brick and burned clay brick in the civil lab, resulting compressive test for burned brick examined is 0.80 N/mm² and for plastic brick compressive test is examined with result of 1.43 N/mm².

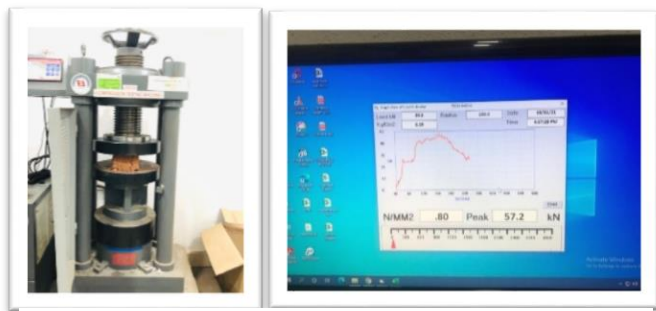


Figure 7: photograph of testing compression on burned clay brick

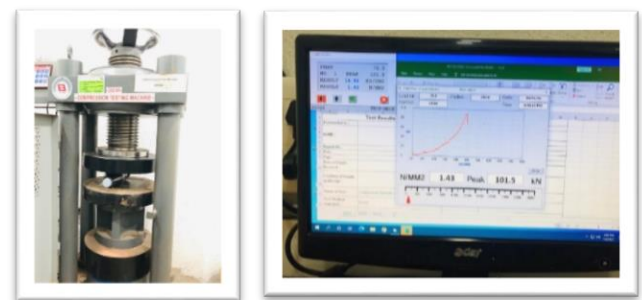


Figure 8: photograph of testing compression on plastic bottle

5.4 COST ANALYSIS

Cost calculation including the labour charges for construction for prototype build with burned clay masonry is 954 Rs and calculation done including labour charges for filling the waste foundry sand in a bottle for construction of prototype model of plastic bottle brick is 690 Rs.

Results and outcomes from the experiment

Factors	Conventional brick	Bottle brick
Compressive load	0.80 N/mm ²	1.43 N/mm ²
Cost	954 Rs	690 Rs
Durability	Less	More
Weight per brick	2.48 kg	1.36 kg
Mortar ratio	1:6	1:6

VI. CONCLUSION

From the above analysis it is clear that compressive strength of plastic bottle brick is more than burned clay brick, and also the weight of plastic bottle brick is less i.e., 1.36 kg to burned clay brick i.e., 2.48, automatically dead load will decrease by using plastic bottle brick during building construction, cost of plastic bottle brick is lesser than burned clay brick, using plastic bottle brick can be a solution for cost effective structure in Kolhapur.

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