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“Waste pet bottle infill walling” a possible remedy for cost effective management in building construction at, kolhapur.

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Abstract: Find the possibility to reduce the air pollution (co₂) from the industry of burned clay brick and find the alternative from waste that will minimize the waste plastic bottle that is in larger quantity that have accumulated in nature and causes pollution in Kolhapur, promoting waste pet bottle to reuse with a waste foundry sand as a filler material in it, as a brick in building construction. waste foundry sand is in maximum quantity as Kolhapur being second largest hub for foundry industry, adding waste plastic bottle with waste foundry sand can make a plastic bottle brick for walls in building construction at Kolhapur, the strength and cost analysis is done by comparing traditional brick i.e., burned clay brick and bottle brick. Resulting bottle brick is cost effective as compared with burned clay brick and also strong enough to carry the external load. So, waste PET bottle is the sustainable waste that can be used to infill walling in building construction.

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

I. INTRODUCTION

Improvement in building industry in India is presumably going to foster by a speed of 7% every year, population will increase to 2.67 billion till 2051 (Himanshu Sharma 2017). According to lifestyle, waste will also increase as population increase in INDIA, 80% of environment habitat is already accumulated with waste that is created by human in India. parallely new materials are arriving because of rapid development which leads to air pollution, water pollution, soil erosion etc, it turns out directly affecting to the global warming, Today's condition, as already ozone layer is depleted due to global warming having maximum holes that directly sends harmful rays on the earth and affecting the life cycle

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

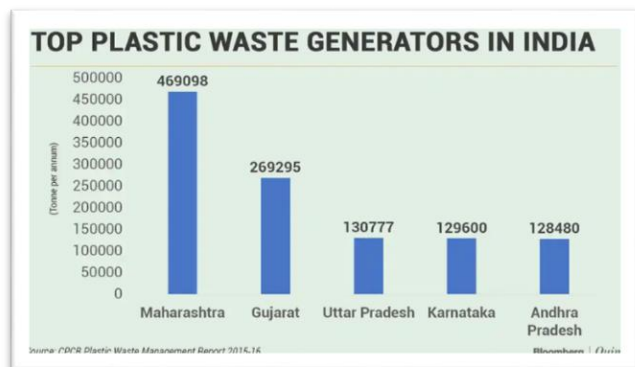
Plastic waste is increasing day by day, it should be having a solution somewhere so why not to reuse or recycle it, recycling leads to maximum release of harmful gases when heated that leads to air pollution, so reusing plastic PET bottle can be a solution that can help depletion of air, Plastics are 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.

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 C10H8O4 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)



(Source-CPCB)

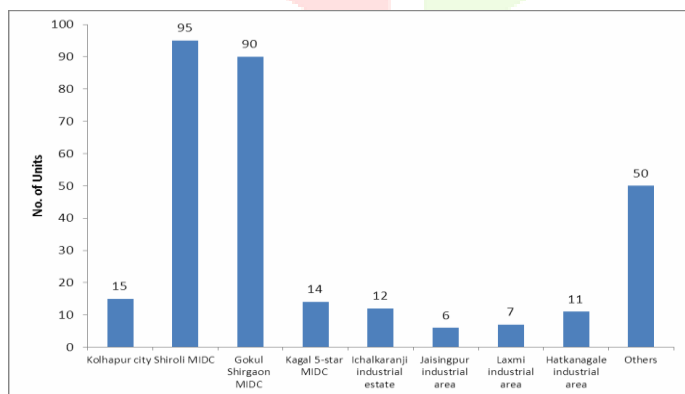
Maharashtra is top most state to create plastic waste that is 4,69,098 tones waste per year, according to survey in Kolhapur addition 5 tons of plastic bottles is gathered each day i.e., “150 tons of plastic bottle squander month to month”

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 executives developed with industrialization inside the district.



(Source-CPCB)

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.HISTORY

In 1905, at 76 years old, Mr. Tom Kelly began the bottle structure in Rhyolite, Nevada. He utilized more than 30,000 lager bottles that were held along with adobe. Being that Rhyolite was a gold Rush town, he experienced no difficulty gathering the brew bottles from the nearby cantinas. He finished the house in less than a half year however he never really lived in the home. All things considered; he gave away passes to win the home.



(Source-<https://buildabroad.org/2014/07/09/history-bottle-structure>)

Froese, is a founder and organiser of Eco-Tec Environmental Solution 2001, in looking for finding a creative reaction from garbage and waste material, that can be reused in different ways

He sets up and also motivator and promoter for the improvement of building structural strength by plastic container pet bottle houses. Plastic compartments house is initially invented or experimented in Africa, Nigeria

Froese involved in the practice the sustainable construction like using waste plastic bottles like for wall he uses the plastic compartments rather than blocks, that forms a plastic bottle brick masonry that will transfer into a load bearing wall bound the holders close by string and around the end applied the mortar.

Eco-Tec Africa is the organisation that is taking care of Nigeria's lodging issue of poorly needy people

“The Eco-Tec, promotes the practice that are different affiliations and social events that have already started reusing the plastic compartments for building, educating people for same practice and spreading the awareness for reusing the practice”

“Regardless, these days, the idea has spread to homes and people of many nations all over place on the world”. There are many techniques for Different sorts of homes have been worked by the organisers and influencers from plastic compartments as a construction material, for example, regular house made involving 8000 holders in Honduras likewise they have made homes for homeless people for free just by teaching them few construction techniques in Bolivia collected utilizing the PET and wine bottle. Due to 2 materials together, the construction is held strong as compared to brick construction. one more example like in Serbia by Tomislav Radovan.” plastic holder i.e., pet bottles with wine bottles in between technology is used for the building. Biological holder house created involving total 1220 PET plastic in total for compartments for the dividers, number of pet bottle depends upon the volume of the bottle bigger capacity bottle a smaller number of bricks will be required”



(Source-<https://buildabroad.org/2014/07/09/history-bottle-structure>)

V. 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 , maximum waste water bottle is available within the waste, as water is consumed more as compared to any other drinks

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 3to 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 1: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

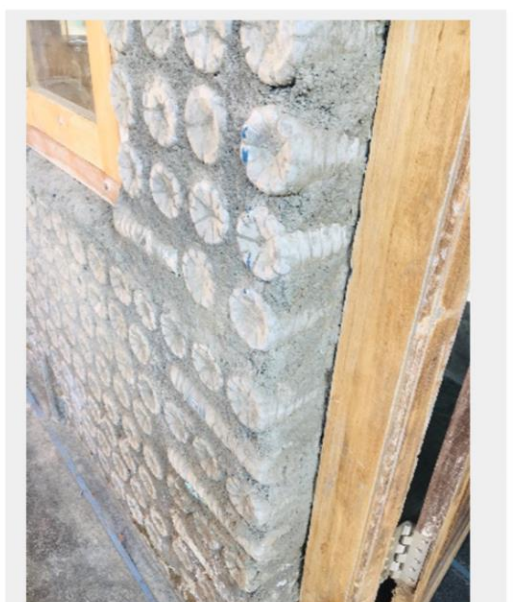


Figure1: Photograph of bottle brick house, Pune

VI. AIM AND OBJECTIVE.

Aim:

To reduce solid waste generated in the form of pet bottle, foundry waste and explore the possibility to reuse the same as wall in building construction thus managing the solid waste for environmental protection.

Objectives:

The objectives of this study are to try and reduce the cost of the masonry wall with an equal strength of conventional masonry. The objectives set to address the above aim are as follows:

- To study the possibility of reuse waste PET bottles and waste foundry sand.
- To experiment key structure of PET bottle wall and burn clay masonry wall.
- To investigate the mechanical behaviour of the pet bottle and foundry sand.
- To compare cost of bottle brick masonry with burned brick masonry for analysing the cost-effective management.

Methodology:

Methodology that will be adopted for the study will be as follows:

- To study the possibility of reuse waste PET bottles and waste foundry sand through background study and case studies
- To experiment by building key structure of PET bottle brick masonry and burn clay brick masonry, a prototype model should be constructed on site using burned clay bricks and bottle bricks.
- To investigate the mechanical behaviour of plastic bottle brick and burned clay brick using compression test method.
- To compare cost of prototype model of bottle brick masonry with burned clay brick masonry, cost comparative analysis method is used for cost effective management

VII. EXPERIMENT

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 2: dimensions for key structure



Figure 2: photograph of filling of waste foundry sand in PET bottle



Figure3: photograph of bottle brick



Figure 4: photograph of bottle brick masonry

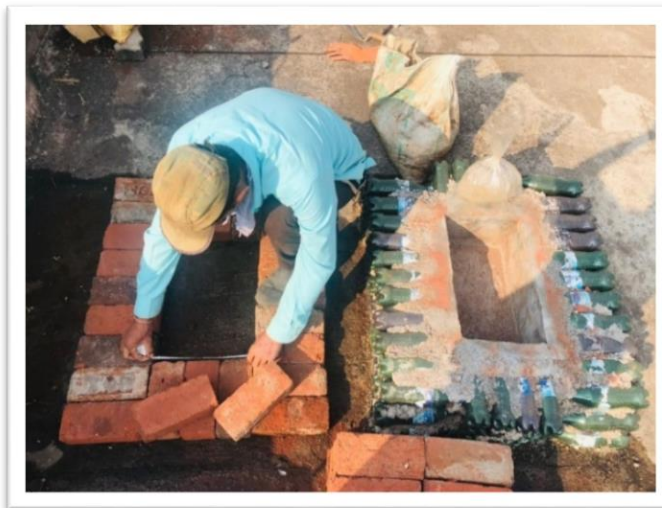


Figure 5: photograph of burned clay brick masonry

7.1: cost analysis

Cost of brick wall masonry

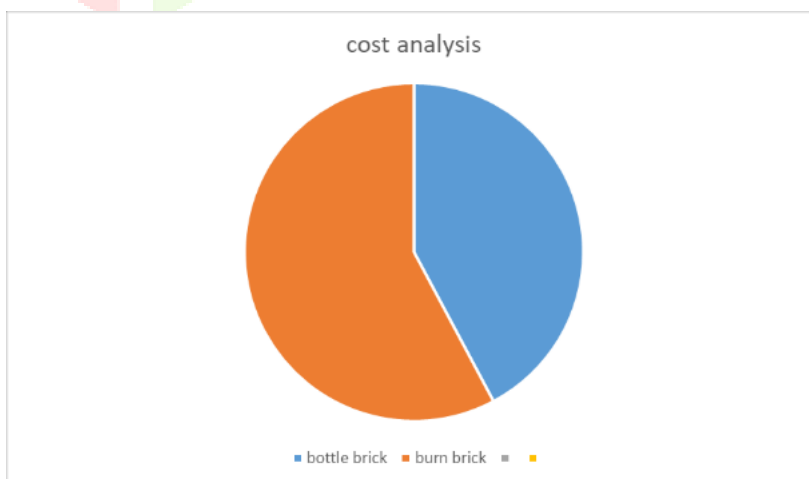
Sr.no	material	quantity	rate	per	Amount (Rs)
1	Brick	72	7	1	504
2	cement	20 kg	10	1 kg	200
3	Crushed sand	2.5 Pati	20	1 Pati	50
4	Labour cost	0.25 day	800	1 day	200
Total					954

Table 3: cost estimate of key brick structure

Cost of plastic bottle wall masonry

Sr.no	material	quantity	rate	per	Amount (Rs)
1	Pet bottle	105	0.50	1	52.5
2	Foundry sand	120 kg	0	1 kg	0
3	Crushed sand	3.5 Pati	20	1 Pati	70
4	cement	25 kg	10	1 kg	250
5	Labour charge for filling the bottle	0.5 day	250	1 day	125
6	Labour charge for masonry work	0.25 day	800	1 day	200
Total					697.5

Table 4: cost estimate of key bottle brick structure



Graphical representation of cost analysis

7.2: Analysis

Analysis of Compression test

compressive tests are conducted on burn clay brick as well as plastic bottle bricks. The data obtained from the tests on bottle brick i.e., compressive strength values are presented in table shown below.

Compressive test of burned clay brick and bottle brick

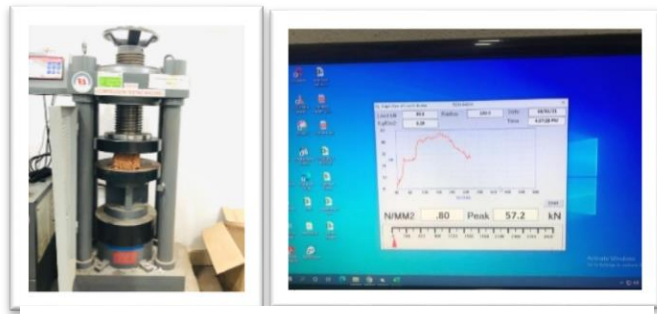


Figure 6: photograph of testing compression on burned clay brick



Figure 7: photograph of testing compression on plastic bottle

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	697 Rs
Durability	Less	More
Weight per brick	2.48 kg	1.36 kg
Sustainability	Can't reuse	Can reuse
Transportation	Delicate and Heavy material, displacement is costly	Light material, displacement is less
Mortar ratio	1:6	1:6

VIII. 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 management.

REFERENCES

- [1] CPCB, (2009), "Central Pollution Control Board Notification, in the Gazette of India, Extraordinary, New Delhi, 18th November, 2009.
- [2] Prof. A. M. Kharwade 2017 "Application of Plastic Bottle Brick In Green Building Construction"
- [3] Himanshu Sharma (2017), "Innovative and Sustainable Application of PET Bottle a Green Construction Overview", 136-143.
- [4] worldwide association (WWA)
- [5] Chima Ichendu, Dennis Ejike Amadi 2020 "Quantitative analysis of the impact of using plastic bottle brick for wall construction on solid waste management "
- [6] S.Premalatha 2016 "UTILIZATION OF WASTE PET BOTTLES AND INDUSTRIAL BY-PRODUCTS AS A CONSTRUCTION MATERIAL"
- [7] Kolhapur Municipal Corporation, (2016), "Environmental Status Report",
- [8] R. K sharma 2018 "Investigating the Compressive Strength of Pet Bottles as Masonry"