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EcoBrick: A Waste Plastic Used As Construction Material

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Abstract: ***In this project we try to overcome the problem associated with plastic waste. In India huge amount of plastics are used for various purposes such as for making of water bottle, soda bottles & bag etc. which are not disposable. Because of these various problems occurs so we use waste plastic bottles for making of bricks by the various ways which are discussed below. After studying the problem we developed the effective way to overcome this problem. Bottle brick are light in weight and withstand high amount of load or pressure. Eco-bricks, polyethylene terephthalate (PET) bottles filled with mixed inorganic waste, have become a low cost construction material and a valid recycling method to reduce waste disposal in regions where industrial recycling is not yet available. Because Eco-bricks are filled with mixed recovered materials, potential recycling of its constituents is difficult at the end of its life.***

Keywords: Plastic Waste, Eco-Bricks, PET Bottles, Construction Material, Recycling Method, Light Weight, Reduce Waste, Better Recycling Option.

I. INTRODUCTION

A global increased awareness of plastic pollution, and the consequences of not addressing said problem, has led to increased interest and adoption of eco-bricks as a building material. Eco-bricks consist of any size plastic beverage bottle, densely filled with dry, non-recyclable plastic. As a result, places such as schools, shops and crèches around the world are collecting them and using them as an infill material in the construction of private and municipal projects. Construction projects incorporating eco-bricks involve placing the plastic bricks inside a timber or reinforced concrete frame. The frame is sometimes covered with steel mesh ("chicken wire") and plastered with various plaster-mixes. Eco-brick structures have gained popularity, with over 200 schools in Guatemala having been built using eco-bricks. With plastics being highly flammable, it is important that the construction and fire engineering industries understand how they may perform when exposed to fire.

Recently there have been drives to increase awareness regarding the usefulness of plastic waste. A movement known as 'eco-bricks' has started to use waste in construction as an infill building material in walls to provide insulation and in turn provide a use for what would be landfill materials. An eco-brick is any size plastic bottle, densely filled with dry, clean, non-recyclable plastic. Usually, a two-litre cool drink bottle is used and is then filled with plastic wrap (cling-wrap), plastic printed labels, shopping bags and other plastics (Global Eco-brick Alliance, 2020). Figure 1-1 shows an example of walls being constructed using eco-bricks. Eco-bricks are a relatively new initiative and building material, which started to become popular between 2009 and 2014 in the Northern Philippines (Dieleman & Maier, 2018).

The movement has led to a large number of non-profit Organization (NPO) promoting eco-bricks as a building material to make stools, outdoor benches, raised garden beds and an infill material in buildings (Maier et al., 2015). Two of the most common methods for using eco-bricks as an infill material is arranging them in a horizontal or vertical pattern. One construction specification consists of laying eco-bricks horizontally between cob (a clay-straw-sand-mortar mix), where the process. The alternative is to stack them vertically and encase them with a mesh and plaster. The top images of Figure 1-1 show the process of encasing the eco-bricks in a mesh and applying a cement plaster. Organization are teaching residents of low-income communities that plastic.

II. METHEODOLOGY

The source of the grey water used for this study was the waste streams of shower, laundry and washbasins discharged into a single outlet pipe of a 150-female dormitory at the jordan university campus. The outlet pipe was retrofitted so that it discharged the wastewater, 7 m3, directly into the pilot plant. An auto-sampler collected daily composite samples from the inlet pipe of the pilot plant. The autosampler (isco, 6712), consisting of 24 1 l bottles, was programmed to withdraw every 15 minutes 250 ml of grey water.

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For analysis a daily composite sample was prepared on-site, by mixing the content of the 24 bottles in one container of which 3 litres was taken for analysis, performed on the same day. In this way 60 composite grey water samples were collected and analyzed over a period of 2 years.



III. BRIEF HISTORY OF THE ECO-BRICK

Eco-bricks were not created by a single individual, but was rather concurrently pioneered by various activists. One of these pioneers is Susana Heisse, an eco-activist and founder of Pura Vida, who became inspired, to utilise non-recyclable plastics as a building material to solve the local waste situation, by a woman who built her house with plastic bottles filled with plastic waste (Lenkiewicz, 2016). Many of the eco-brick pioneers aimed to utilise the local solid waste materials, which usually end up in ravines or rivers as they have no, or poor, municipal waste management (Rodic-Wiersma & Bethancourt, 2012). Since then, eco-bricks have become a popular tool for collecting unrecyclable plastics as well as a teaching aid to make the users aware of the single use plastics they purchase on a daily basis (Mostert, 2019).

Eco-bricks, which reuse solid, non-recyclable, often petroleum-based waste, previously disposed of in landfills, repurpose waste to create furniture or be used as infill material in the construction of garden beds and benches, or even buildings (LeFevre, 2021). An example of a bench is shown in Figure 3-1 where it was built in Noordhoek, Cape Town by Earth & Co and Project Noordhoek using 800 eco-bricks. A popular use for eco-bricks, which creates awareness of single use plastics as well as is a free building material, is building schools and homes with them as an infill material in the construction industry. This is true for projects in Guatemala, Philippines, and SouthAfrica which are either run partially, or in-full, by non-profit organisations such as Hug It Forward, Pura Vida and Eco-Brick Exchange (Hopkins, 2014).

IV. LIMITATIONS

Importance, but must be addressed in future research, and are limitations of this work:

1) How should joints be designed such that they do not open up during a fire?
2) How should penetrations through walls be designed?
3) How should the insurance industry address eco-brick structures?
4) Can design codes be developed for eco-brick homes?

Overall, it is a cause for significant concern that these structures are being widely rolled-out without the necessary building regulations being in place. By answering the questions, it should enable eco-bricks (people who create eco-bricks and build with them) to be able to produce safe homes, and to provide the technical data for fire safety practitioners to be able to assess such structures.

A. *Advantages of Eco-Bricks*

Eco-bricks are a perfect way to recycle plastic that doesn't break down, end up in the ocean or worse still, in the landfill. But there are several other great things about eco-bricks:

1) Plastic is a very useful material, but we generate too much of it and dispose it in an unsustainable manner. The very qualities that make plastic so difficult to dispose of, like toughness, longevity and water resistance, are exactly what makes it a brilliant building material.
2) Everyone urges us to decrease plastic waste. When you see the amount of rubbish you put into an eco-brick, you'll see how much you throw away. This process also helps you be more careful about what you buy and create less waste in the end.
3) Eco-bricks also stop harmful waste from being incinerated, as well as keep from ending up in the ocean. Plastic releases CO2 when burnt, increasing carbon emissions and leading to global warming.
4) The main advantage of eco-bricks is that they take something that would have had a detrimental effect on the environment and turn it into something that helps local communities, like fly ash.

B. *Disadvantages*

Despite their apparent advantages, some fear that making structures out of plastic might not be good for the earth in the long run. These non-recyclable plastics are manufactured from inorganic chemicals and, as the eco-bricks are exposed to the sunlight, they can leech into the natural environment. This could cause immediate damage to the soil and ultimately hit the water table, where aquatic plants and animal life will get adversely affected.

Photo-degradation also makes the plastic fragile and vulnerable to breakage, releasing micro-plastics into the area, is known to be harmful to animal and human health. There is criticism that eco-bricks are not a permanent solution to the plastic crisis and that they simply postpone the issues for a few more years.



Figure 3-1 Construction process of a bottle school built by Hug It Forward in Guatemala 1) Completed school, plastered and painted (2019)

V. OBSERVATIONS AND SUMMARY

The results from the experimental tests in Section 4.3 varied greatly amongst the wall samples. Some walls, such as the horizontal orientated eco brick sample with cob or cement performed well while another sample was not even tested due to poor building. The following section serves as a summary of the experimental results as well as includes the observations made during the testing.

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VI. TEST FAILURE CRITERIA

The plastic melting failure criteria used to analyse the experimental results was considered to ensure that the eco bricks do not contribute to the fuel load of the building, as shown in Table 5-3. It is also specified to meet the insulation and integrity criteria of SANS 10177-2, as shown in Table 4-4. In the section that follows a number of failure criteria are considered to try quantify the fire resistance of the samples using different metrics, such that ultimately a single fire resistance rating could be assigned to them.

The first criteria looks at the temperature at which the lid, usually made from HDPE, and the bottle, usually made from PET, melt at. These temperatures are 130℃ and 260℃ respectively, as discussed above. The second criteria is an average plastic ignition temperature of 360℃. The temperatures were measured with 1.5 mm thermocouples, at five positions, at the back of the 40 mm plaster layers against the eco bricks. To simplify, the time taken to reach the different criteria temperatures are colour coded to indicate if the temperature was reached in less than 30 min, between 30 min and 60 min or above 60 min. These are shown in red, yellow and green respectively.

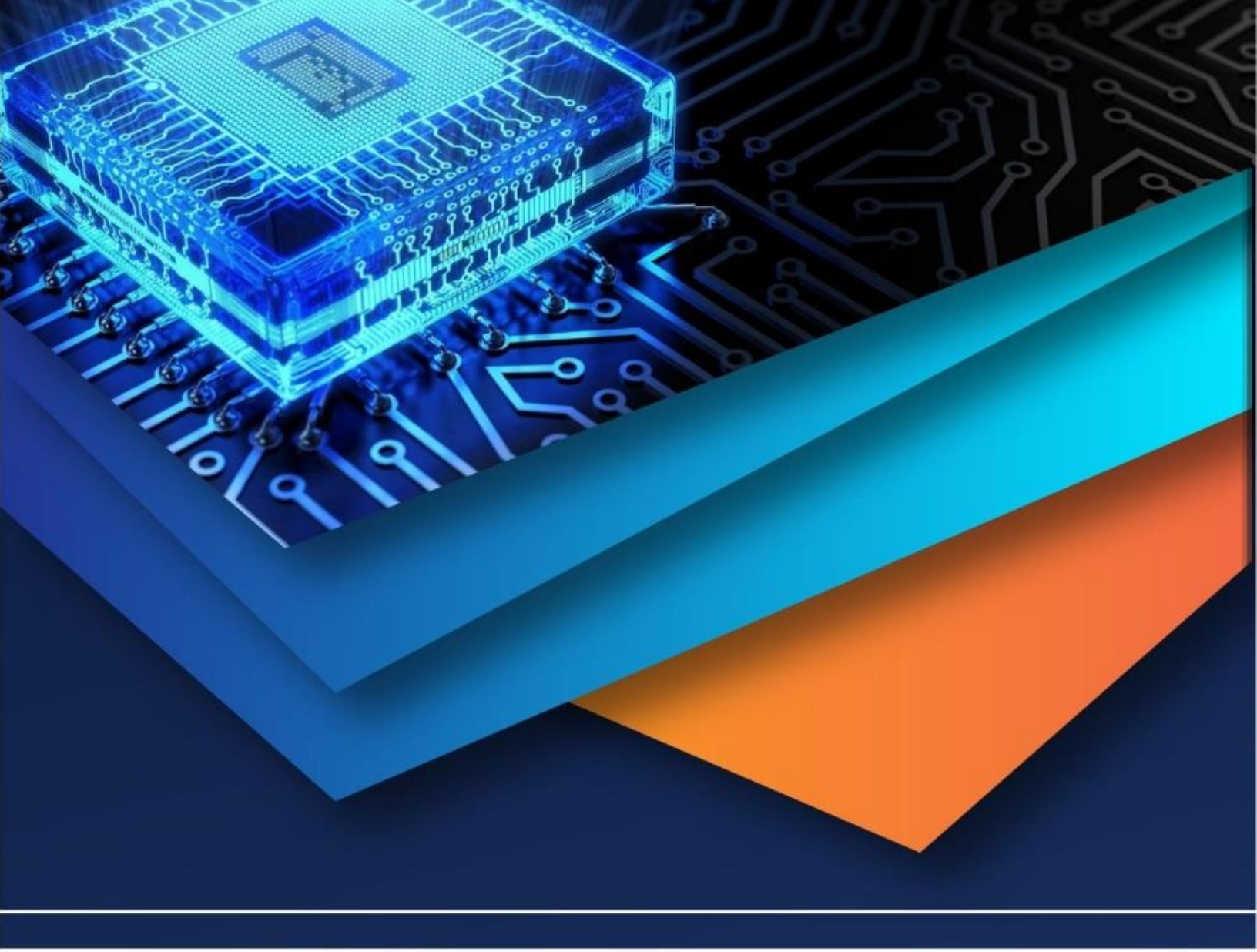
VII. CONCLUSION

Eco-brick is the recyclable material of plastic. It is low cost material. This Eco-brick used as construction materials. It is stronger, cheaper and easy to build. ECO-BRICK is good for environment usually, when thrown away, plastic breaks down into tiny pieces and polluted the area .Eco-Bricks seal the plastic in the bottle preventing the build-up of toxic gases emitted during the degradation of the plastic, such as methane. And pollution will be decreased automatically. Eco-brick is the earthquake resistant material.

This technique of using waste PET bottles as bricks has become popular in low income communities around the world. In the current study, the bottle bricks were found to be stronger than conventional bricks and concrete cylinders. These bottle bricks are also Tk. considering the strength and the relatively low cost of construction, they can very successfully become the next construction material of choice for Bangladesh too. These houses would be a positive change in our urban fringe and slum areas' landscape.

It can be concluded that many research work has been carried out on use of PET bottles in construction as the Eco-Bricks i.e., the PET bottles filled with sand, soil, fly-ash or any other material like household plastic waste when well compacted can be used as a building material replacing traditional bricks. The strength parameters of filled plastic bottles are on a higher end as compared to traditional bricks. The eco-bricks are light in weight and possess same thermal properties as of traditional bricks. The eco-bricks have high sound reduction index as compared to concrete blocks. Eco-bricks also do not permit light to pass through then as when seen by naked.

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