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ENVIRONMENTAL FRIENDLINESS EXPERIMENTAL RESULTS ON THE USE OF RECYCLED PLASTIC BOTTLES IN VOIDED CONCRETE

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Abstract: The current plastic garbage situation in India is excessive. The amount of plastic trash dumped into the ocean each year is close to thirteen million metric tonnes. Due to their long lifespan, plastics cannot be broken down by nature. A big problem for the environment has emerged from the dumping of massive amounts of plastic bottles (PET bottles), and recycling these bottles is challenging since they are not biodegradable. The fact that plastic does not decompose naturally means that the quantity of trash from this material is only going to grow. Bottles made of plastic have sustainability qualities and might be used as a substitute for more conventional construction materials like bricks. In areas where plastic bottle garbage is abundant, it is possible to construct a large number of housing units to meet the needs of India's urban poor, who are experiencing a severe lack of affordable housing. Slabs often use U-Boot voided technology to reduce volume-Boot A two-way voided slab or raft may be made using beton, a recycled polypropylene formwork. Its first country of implementation is Italy. When working with layer soil that has a limited capacity, Uboot beton is the easy way to install slabs and foundations. It can take the place of raft foundations, which employed slabs to transfer loads to deeper soils, and work just as well. However, with U-boot technology, we use U-boot buttons to shift weights to deeper grounds. This report compared the u-boot beton cube to the conventional cube and examined research on u-boot technology analysis.

KEYWORD'S: u-boot technology, Pet bottle, compressive strength

1. INTRODUCTION

Plastics are typically made from petroleum, which is a non-renewable resource. Plastic is regarded a significant waste and environmental pollution because it is non- biodegradable and lasts for more than 300 years in nature. It also saves energy and raw materials in the creation of new plastic. The use of plastic bottles as a building material can result in a more sustainable building material and a lower overall cost of the project. With today's world's population development, the requirement for construction has increased, resulting in increased energy consumption. Increased demand and energy consumption can lead to an increase in building costs, which can make it difficult for people to meet their fundamental demands. We can create a tremendous opportunity for poor individuals to meet their basic need for shelter if we can reduce the overall cost of the construction in some way. bricks are the fundamentalunit of any structure, lowering the cost of bricks lowers the overall cost of the structure. Because lowering the cost of a brick is time-consuming, we can consider an alternative material to utilise in

place of bricks to lower the project's cost. Plastic is inexpensive and long-lasting, it can be a superior option to bricks in a variety of construction projects, such as foundations and partition walls. Bottles have been used to construct a variety of dwellings, including an Eco-Tec home in Bolivia made of PET bottles and wine bottles, and an ecological building near the Iaquazu Falls made of 1200 PET (Poly Ethylene Terephthalate) plastic bottles for walls. Plastic bottles are also used to construct the Samarpan School in India. Plastic bottles are now commonly used to package liquid items such as mineral drinking water, juice, milk, and medicine. Only a small number of bottles are discarded after use in a trash can, which is subsequently collected by the municipality and transported for recycling or final disposal. A great deal of research has been done in

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various regions of the world to look at the feasibility of employing plastic bottles in concrete blocks.public has questioned the strength of bottle bricks because they are manufactured from plastic bottles. This doubt is dispelled, however, because bottle bricks are both stronger and bulletproof than regular bricks. Buildings made out of plastic bottles give thermal comfort as well as a healthy environment with all of these considerations in mind, we attempted to investigate the relative strength and cost of bottle bricks against traditional bricks.

Fig 1. Plastic bottle waste

1.2 U-BOOT TECHNOLOGY:

The U-BOOT beton technology is a recycled polypropylene formwork that is utilised in building. The slab's top and bottom reinforcements are separated by void formwork. It results in a more lightweight and cost-effective design for structures such as slabs and rafts. It's utilised to make slabs with longer spans or that can carry heavy loads without the use of beams. As a result, key advancements in reinforced concrete have centred on increasing the span. With U-Boot technology, slabs with a greater span are generated, allowing floors to be thinner while keeping the strength of reinforced concrete slabs .Other technologies, like as prefabricated slabs and post tensioned steel, can be coupled with U-Boot technology. The hollow slabs with post tensioned steel technology minimises slab weight and thickness. It is appropriate for high-rise buildings, hospitals, and parking management in both residential and commercial structures.

U-Boot technology is environmentally friendly and long-lasting, resulting in less dead weight, less concrete usage, and lower costs. We decided to build the slab utilising hollow cylindrical plastic slabs after considering all of these aspects of U-Boot technology (using U-Boot technology).

Fig 2. U-Boot beton formwork

Fig 3. U-Boot technology in slabs

1.3 AIM OF THE PROJECT:

The project's major goal is to evaluate the strength of a pet plastic bottle room built using U-Boot Voided slab technology to a pet brick room built with conventional slab.

• To lower the construction's overall cost.

1.4 NEED OF THE PROJECT

• To keep the interior of the building cool (since plastic bottles have good isolation properties)
• To reduce environmental effect by reusing or recycling plastic bottle waste.
• To strengthen the building's stress resistance, red charred bricks were replaced with environmentally friendly plastic bottles.
• To minimise the thickness of the slab and the structure's overall load.

1.5 ADVANTAGES

- The technology used is compact and simple to use.
- The structure's overall load is reduced.
- The building materials are sourced locally.
- Natural resources are not depleted.
- The total amount of garbage produced can be minimised.
- Improved acoustic performance.
- Slab thickness has been reduced.
- Environmentally friendly and long-term.

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- Decreases pollutants to a certain extent.
- Weather is less of a factor.
- Less concrete is used.
- Reusable and bioclimatic.

1.6 DISADVANTAGES

- The Eco-friendly brick structure is just temporary.
- It is not appropriate to provide plumbing and power lines.
- The structure is indestructible.
- Significant promotional and informational activities have a positive influence.
- Heat resistance is reduced.

2. LITERATURE SURVEY

PET Bottles Eco-friendly Building in Sustainable Development**, Jayaprakash M C1, Deeksha I M2, and Sowmya M R**, Industrial Journal of Current Trends in Engineering Research (IJCTER)e-ISSN 2455-1392 318-326 in Volume 2 Issue 5 (May 2016): suggests using PET (polyethylene terephthalate) bottles as a construction entity for uniform bricks. Plastics have always been difficult to dispose of since they are non-biodegradable. This is a problem for the environment because waste plastic bottles are difficult to biodegrade and must be recycled or reused. Green building is a term that refers to a regenerative process in which the site and its surrounding environment are improved and restored.

The ideal "green" project protects and restores habitat that is essential for life, and instead of being a net consumer of resources, materials, energy, and water, it becomes a net producer and exporter. Green building is the technique of creating or changing structures in such a way that they are ecologically responsible, resource-efficient, and sustainable throughout their life cycle. As a result, to include sustainable development and energy consumption in the construction of green buildings for quality living concepts in order to meet the country's development paradigm. The current approach may provide a solution for building construction by utilising waste plastic PET bottles that have been discarded on open terrain. It may be possible to repurpose discarded plastic PET bottles as a cost-effective resource to reduce solid waste in the form of eco-friendly green-buildings concepts for living.

Simanshu P. Pandey, Sakshi Gotmare, Prof.S.A.Wankhade 'Waste Plastic Bottle as Construction Material' International Advanced Research Journal in Science, Engineering and Technology, 3 January 2017 **:** The disposal of non-biodegradable materials has become a major concern in recent years. On the earth's surface, mounds of plastic waste have accumulated. The disposal of waste plastics, which is plentiful in laterite quarry waste, is the greatest challenge. Only one out of every six bottles is recycled effectively. On the other hand, one of the most major challenges that people face is the high cost of primary requirements for constructing houses in areas where people are poor. Using some element of the vehicle is a good option in this circumstance.

Materials for building construction must be made out of urban trash or garbage. Plastic bottles are considered urban trash, however because of their sustainable properties, they can be utilised as a construction material instead of traditional materials like bricks in building construction. This study will look into the use of plastic bottles, which are a type of urban garbage, in building construction and how they may assist in the development of environmentally friendly structures.

Z Muyen, TN Barna, MN Hoque, Strength properties of plastic bottle bricks and their sustainability as construction materials in Bangladesh, ISSN: 1017-8139: With global solid waste creation rates increasing at a higher rate than ever before, urban development experts warn that growth will peak this century and will not begin to drop until radical changes in how we use and reduce materials are made. In a 2012 research, the World Bank's urban development experts Danie Hoornweg and Perinaz Bhada-tata estimated that global municipal solid waste (MSW) generation levels were around 1.3 billion tonnes per year. They predicted that by 2025, the levels will have risen to almost 2.2 billion tonnes per year. The rate of worldwide solid waste generation per capita is expected to climb from more than 3.5 million tonnes per day in 2010 to more than 6 million tonnes per day in 2025, according to the report. One of these inventions is the "bottle brick." In a number of nations throughout the world, waste polyethylene terephthalate bottles filled with other dry solid wastes or sand and earth have been effectively employed. The strength properties of trash PET bottles filled with fine sand were investigated in this study. The compressive strength of five various sizes of discarded PET bottle bricks (250, 500, 1250, and 2000ml) was evaluated, and the largest bricks had a compressive value of 17.44MPa.

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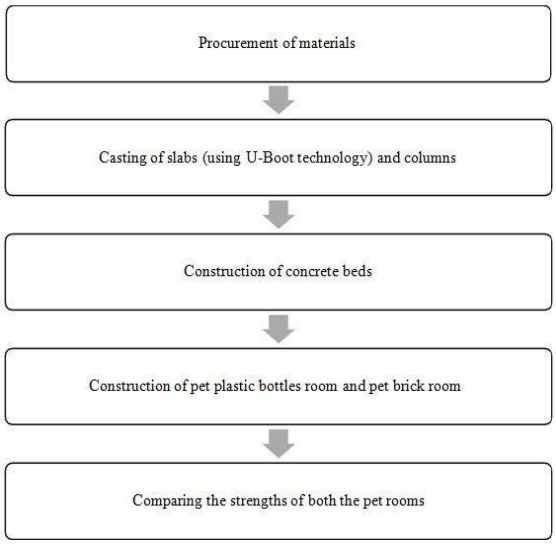
3. METHODOLOGY



3.1 MATERIAL PROCUREMENT

- Cement
- Fine Aggregate
- Coarse Aggregate
- Bricks
- Plastic bottles
- Steel reinforcement
- Bottle bottom or hallow cylindrical plastic caps
- water

3.2 PLASTIC BOTTLES:

A high-density plastic bottle is referred to as a plastic bottle. Water, soft beverages, motor oils, cooking oils, pharmaceuticals, shampoos, milk, and ink are all commonly stored in plastic bottles. PET resin is extensively utilised in the production of carbonated beverages, water bottles, and food packaging. PET has excellent alcohol and essential oil barrier qualities, as well as excellent chemical resistance, impact resistance, and tensile strength. Various investigations have revealed that sand and other inorganic elements can be found in trash PET plastic bottles. Where plastic trash management or recycling is ineffective, such as in low-income neighbourhoods; it can be used as a viable building material. The plastic block was created.

Fig 4. PET plastic bottles (waste)

Table 1. Properties of PET bottle

RESINS	POLYETHYLENE TEREPHTHALATE (PET)
Clarity	Clear
Moisture barrier	Fair to good
Oxygen barrier	Good
Resistance to Impact	Good to Excellent
Resistance to Heat	Poor to Fair
Resistance to Cold	Good
Resistance to Sunlight	Good
Rigidity	Moderate to High
Maximum commercial use Temperature	120ºF

4. EXPERIMENTAL APPROACH

4.1 PLANNING AND SCALE REDUCTION:

In our project, we have constructed two pet rooms by reducing the scale to 1m × 1m on the ground and height of 0.5 m from ground i.e. one pet room with red burnt bricks and the other with PET (Poly Ethylene Terephthalate) bottles. In this project, we have decided to pre-cast the slab using U-Boot technology The main objective of our project is to compare the strengths of both plastic bottle room with U-Boot technology slab and

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brick room with normal slab i.e. which of the both have more strength to resist the load. According to the scale, we have marked the dimensions using tape to construct the pet rooms.

4.2 SITE SELECTION:

- We have chosen the place behind CT lab of our college, to execute our project i.e. to construct the pet rooms.
- We have cleaned the place and then marked the slots to start the construction of both the pet rooms.
- After marking the slots, we have chipped the surface, where the concrete bed is to be constructed. We have done chipping using chisel and hammer.

Chipping:

Chipping is the process of removing weld spatter, rust, or old paint from a surface. Chipping is commonly used to improve adhesion to a smooth surface.

Fig 5. Chipping

4.3 FABRICATION OF MOULD FOR CASTING CONCRETE BEDS:

- In order to construct the concrete beds i.e. the base for the buildings, we have fabricated the moulds of dimensions 1.35m × 1m × 0.055m.
- We have fabricated the mould using flat and long plastic strips.
- We have bent them into required dimensions and fixed them using screws (nails) with the help of drilling machine.
- We have placed these moulds on the slots, according to the dimensions plotted.

Fig 6. Plastic strips

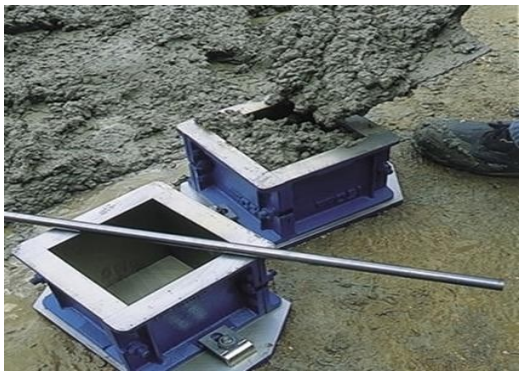

Fig 7. Mould preparation

4.4 INTRODUCTION TO PLASIC BOTTLE BUILDING

Plastic bottles are a low-cost and environmentally beneficial building material. Today's packaging and plastic bottles are limitless. Reusing plastic bottles is a more cost-effective option than recycling. The usage of recycled materials in construction projects has grown in popularity. They are easily available and serve as a cost-effective construction material. Bottles can be used for a variety of construction projects depending on the sort of material they are made of

4.5 PET BOTTLES COLLECTION (ECO-FRIENDLY BRICKS)

- Usually PET bottles are used to store liquids such as water, milk, oil, medicine, soft drinks etc., it provides good chemical resistance and tensile strength. It can bear a maximum temperature of 200°C. The biggest advantage of PET bottles over glass is their resistance to breakage.
- In our project we have collected two hundred, 250 ml capacity bottles. After collecting these PET bottles we have cleaned them.
- The gathering phase is the simplest, and we have measured the dimensions of the plastic bottles and noted them.

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- After measuring the dimensions of the bottles, we have filled the bottles with fine aggregate. We have filled the bottles with sand in three layers and each layer has been compacted 25 times.
- Thus, Eco-Friendly bricks are made.

Fig 8. Filling the bottles with sand

Fig 9. Compacting the bottles

Fig 10.Coco cola plastic bottle

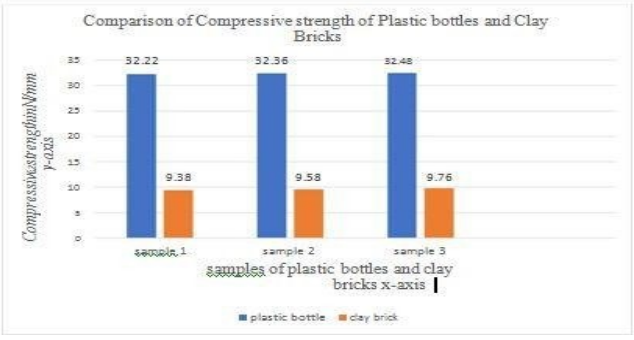
Fig 11. Construction of pet plastic bottle room

5. RESULTS AND DISCUSSIONS

Table 2. Compressive strength of plastic bottles and clay bricks

S.no	Compressive strength of brick in N/mm2	Compressive strength of plastic filled bottle with sand in N/mm2
1	9.38	32.22
2	9.58	32.36
3	9.76	32.48

Graph



Graph1. Comparison of strengths of plastic bottle and clay brick

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Results: From the compression test, the maximum average compressive strength that can be achieved by 250 ml bottle is 32.37 N/mm^2 and the maximum average compressive that can be achieved by clay brick is 9.57 N/mm^2.

COMPARING THE STRENGTH OF PET BRICK ROOM AND PET PLASTIC BOTTLE ROOM USING PLATE LOAD TEST

Weights in kg	Loads bared by pet plastic bottle room in kg	Loads bared by pet brick room in kg
50 (W1)	50	50
100 (W2)	100	100
150 (W3)	150	150
200 (W4)	200	200
250+4 cubes of weight 7.4 kg each (W5)	257.4 (cracks appeared)	279.6
279.6+2 cylinders of weight 11.8 kg each (W6)	------	303.2 (cracks appeared)

Table 3. Weights added on pet plastic bottle room and pet brick room

6. CONCLUSION

- The cost of a bottle wall is around half that of a traditional brick wall.
- Bottle houses are generally designed to be bio-climatic, which means that while it's chilly outside, it's warm inside, and vice versa.
- The bottle's compressive strength was found to be significantly higher than that of a typical brick.
- Repurposing plastic bottles as construction materials can save embodied energy by using them instead of bricks in walls and reduce CO2 emissions from clay brick manufacturing.
- The ability of avoided slab to span a greater distance results in more advantageous open space and greater design freedom.
- The technology is eco-friendly and long-lasting.
- Filling the bottles with fine aggregate increases the strength of the bottles, which is 20 times that of a standard brick.
- Because plastic bottles take a long time to degrade, the structure may persist for a long time.
- As a result, we can infer that the notion of replacing traditional bricks with plastic bottles and traditional slab with U-Boot voided slab is cost-effective, energy-efficient, and can assist to improve our environment's quality.
- As a result, these technologies should be adopted and used more frequently in the future.

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