iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 Issue: V Month of publication: May 2026

DOI: https://doi.org/10.22214/ijraset.2026.82111

Sustainability of Life Saving Concrete Block by Using PET Bottle in Construction

Sudarshan P[1], Vasantha Prakash R[2], Manikandan R[3], Kannappan PL[4], N. Nisha[5]
[1, 2, 3, 4]Student, [5]Associate Professor, Department of Civil Engineering, SRI Sairam Engineering College, West Tambaram, Chennai, Tamilnadu, India

Abstract: The risk of gas leaks in homes and businesses has gone up because cities are getting denser and more people are using piped and cylinder-based fuel systems. These kinds of things often cause dangerous situations, like explosions. This study presents a sustainability-focused Composite PET Concrete Block (CPCB), created by integrating recycled Polyethylene Terephthalate (PET) bottle material into the concrete matrix. This innovative masonry unit aims to improve safety and environmental performance in construction.

The CPCB is designed to have a controlled porous microstructure that lets air and gases pass through it only a little bit. This permeability lets leaked gases slowly spread through the masonry system, lessening the chance of gas building up in closed spaces, which lowers the risk of disasters. Adding PET particles to the cementitious matrix helps create networks of interconnected voids that make it easier for gas to move through the block while also lowering its overall density. An experimental study was done to see if the proposed CPCB system could be built. It looked at important physical and mechanical properties that are important for masonry construction.

The amount of PET was changed from 10% to 30% by volume replacement so that its effect on the blocks' performance could be measured. The experimental program followed standard masonry testing procedures and included tests for compressive strength, water absorption, density, and efflorescence. These tests were done to see if adding PET would have an effect while still keeping the structure strong enough for building.

Keywords: PET, CPCB, Permeability, compressive strength, LPG

I. INTRODUCTION

Lately, the rising number of gas leaks in homes and businesses has become a major safety issue that needs immediate and creative action. Our research project is focused on creating a revolutionary solution: a "smart brick." This advanced material is designed to work as a membrane that lets some things through. Its unique porous structure is made to help gas escape from closed spaces, like a room, into the outside air in a controlled way. This important mechanism greatly lowers the risk of dangerous gas buildup, which greatly lowers the chance of serious injuries and huge explosions. To do this, we are making a block that is M10 strong (10 MPa or 10 kN), using only normal materials like cement, coarse aggregates, and fine aggregates. This journal has used Indian Standards (IS code book) to find the compressive strength and other important strengths. This new material has many benefits, but its main job is to stop gas leaks. It improves ventilation, which improves indoor air quality, adds to the architectural appeal of buildings, and raises the overall safety standards of construction.

II. SOURCE OF WASTE

Polyethylene Terephthalate (PET) waste used in this study was collected from authorized recycling dump yard sites. The waste concrete was processed and segregated to obtain fibers ranging from 10 to 12 mm for the production of concrete.

III. LIFE SAVING CONCRETE BLOCK

The life-saving block is made from the following steps staring from the initial batching of material for the preparation of block and the materials include the fine coarse aggregate of 6mm size, cement , PET flakes and Steel fibers and these are mixed in the proper ratios to attain the required strength for workability, compression strength. This block represents the perforations or holes in it so that the gas molecules can able to escape through it as holes provided in it these holes help to transfer the gas from inside room to the outside environment

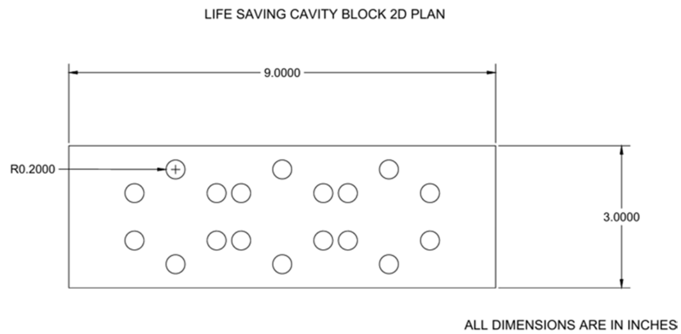


FIG1: LIFE SAVING CONCRETE BLOCK

IV. CAVITY BLOCK AS LIFE SAVING MATERIAL

The cavity block represents a major step forward in combining structural integrity, life safety, and sustainability into a single, innovative construction material. Unlike conventional solid blocks, This means that there are systematically designed perforations that completely go through the thickness of the block. This creates a network of channels for ventilation. The channels provide a means for the free movement of air and, more critically, the free escape of leaked LPG gas molecules. This ensures that in case of gas leakage, there is an escape route for the gas, which would otherwise accumulate in an enclosed space. This could expose the structure to the risk of fire and explosion hazards, which are common in structures with combustible gases. This means that the block works as a life-saving element, which improves the safety of the occupants. Another important aspect of the cavity block is its role in enhancing indoor air quality. The openings allow for the circulation of air from the outside to the inside, thus preventing stagnation of air and the formation of harmful substances. The end result is a healthier environment since there is no suffocation, respiratory problems, or other health implications related to air quality. Since natural ventilation does not require the use of machines, the block saves on the cost of operating air exhaust machines, thus saving on energy. This results in the sustainable construction pratices and boosts to the greeny and smart building solution

V. GAS DISSIPATION MECHANISM

The proposed CPCB gas dissipation unit works on the principle of safely trapping any leaked LPG and directing it through a controlled duct system, which can store the gas for future use. Since LPG is heavier than air, any leaked gas will settle near the ground surface instead of dissipating in the atmosphere. Considering the rectangular CPCB gas dissipation unit in the image, there are multiple perforated holes on the front surface, which act as gas-intake points. When there is a collection of LPG near the device, the difference in pressure between the surroundings and inside the CPCB gas dissipation unit will allow the gas to migrate through these holes naturally. Behind these holes, a duct-shaped internal chamber is provided, which acts as a second component in this image. This duct helps in directing the gas in a controlled manner, so there is no turbulence in the movement of the gas inside this component. At the rear end of this duct, a motor-based suction fan is provided, which helps in creating a continuous negative pressure, directing any leaked LPG into this enclosed duct system. These ducts are provided in a series, which helps in creating a sequential system for gas

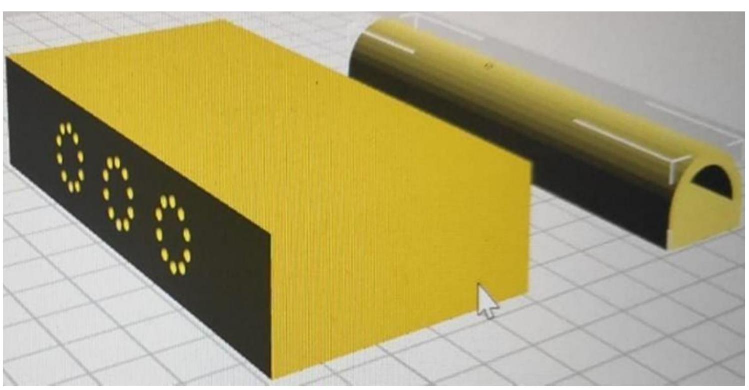


FIG 2 CROSS SECTION OF CPCB

VI. MIX DESIGN

A mix design for M10 is a method of calculating the amount of coarse aggregate, fine aggregate, cement content and water content is calculated by using the experimental values obtained

Parameter	Value/Assumption
Mix ratio (C:S:CA)	1:4:1
Target Block Volume	1 m³ (for calculation basis)
Bulk Density of Cement	1440 kg/m³
Bulk Density of Sand	1600 kg/m³
Bulk Density of Coarse Agg.	1500 kg/m³
PET flakes replacement	10% volume of total aggregate (sand + coarse agg.)
Steel fibres addition	0.75% volume of total mix
Water-Cement ratio (w/c)	0.5
Air content assumed	2%

A. *Mix Ratio*

MATERIAL	QUANTITY
CEMENT	240
SAND	960
COARSE AGRREGATE	225
PET FLAKES	79
WATER	12L0

The mix proportion of M10 is found to be:

Cement		Fine aggregate		Coarse aggregates
473 kg		646kg		1039 kg
1	:	1.3	:	2.1

VII. EXPERIMENTS

The following experiments that conducted are compressive strength, workability, flexural and split tensile for the structural integrity and safety of composite perforated concrete block

A. *Workability Test*

The workability test is conducted for testing the ease with which fresh concrete can be mixed. Transported, placed, compacted and finished without segregation so the slump values are:

PET FLAKES	SLUMP VALUE
10	90
20	80
30	75

So the maximum workability of the CPCB is achieved at 10 percentage of PET replacement

B. *Split* Tensile *Test*

The spilt tensile test is conducted to determine the tensile strength of the Composite perforated Concrete Block is calculated by applying the compressive load along the vertical diameter of cylindrical specimen (150mm X 300mm X 200mm) applied until failure of the cylinder. so the following inference are:

CURING PERIOD	%REPLACEMENT	LOAD	SPILT TENSILE STRENGTH
7DAYS	0	85	1.10
	10	90	1.27
	20	95	1.30
	30	100	1.35
28 DAYS	0	180	1.50
	10	190	1.80
	20	200	2.17
	30	205	2.22

C. Flexural *Test*

Standard beams of size100mmx100mmx500mm are used to determine the flexural strength. The specimens are placed in the machine such that the load is applied to the top surface. Mark the specimen along two sides spaced 13.33cm apart and 5cm from both ends. Two-point loading method is used for loading. The load is applied until the specimen failed and the maximum load applied to the the test is recorded. Also failure crack distance from nearer support is also measured and this value (a) is noted down.

CURING PERIOD	%REPLACEMENT	LOAD	FLEXURAL STRENGTH
7DAYS	0	4.20	2.14
	10	4.35	2.16
	20	4.44	2.25
	30	4.80	2.30
28 DAYS	0	5.05	4.10
	10	5.15	4.20
	20	5.20	4.35
	30	5.30	4.50

D. *Compressive Strength*

The compressive strength of M40 concrete with varying percentages of C&D waste replacement (0%, 10%, 20%, and 30%) was tested at 7, 14, and 28 days of curing. The tests were performed using a standard compression testing machine, and the average values were recorded. These results were compared with the strength of conventional M40 concrete at the same curing intervals.

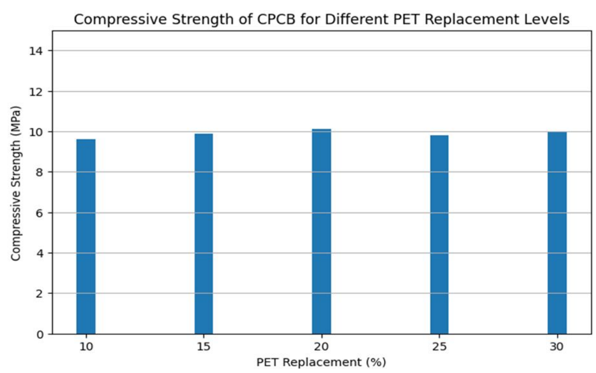


Fig. 3 Compressive Strength of M40 Concrete with PET Replacement

The compressive strength of M40 concrete with varying percentages of PET Fiber waste replacement (0%, 10%, 20%, and 30%) was tested at 7, 14, and 28 days of curing. The tests were performed using a standard compression testing machine, and the average values were recorded. These results were compared with the strength of conventional M40 concrete at the same curing intervals.

VIII. APPLICATIONS

The incorporation of PET waste as a partial replacement in concrete block production enhances sustainability, reduces environmental impact, and provides structurally reliable masonry units.

Owing to their improved durability, reduced weight, and adequate compressive strength, these PET-modified concrete blocks can be effectively utilized across multiple building sectors.

Thus, the different type of building that can be used are:

1) Residential building
2) Commercial Building
3) Industrial Buildings

So incorporating this in the building can able to improve the overall safety for the occupants so that they are protected from fire explosions and accidents Also this can improve the life structure of the buildings resulting in the reduced maintenance and expenditure of the building

IX. FUTURE DEVELOPMENT

The Future development for this project has been planed into the following stages:

1) Stage 1: Current Stage
2) Stage 2: Development of motor fans and pipelines beyond the brick so that see connects like a system and serves the exact function
3) Stage 3: Incorporation of Artificial intelligence so the sensor could detect the possibility of gas leak and could switch on the fans automatically so that there is no need for the human activities to be involved
4) Stage 4: Collection of these gases and storing them in the container and using it again for cooking and other purposes

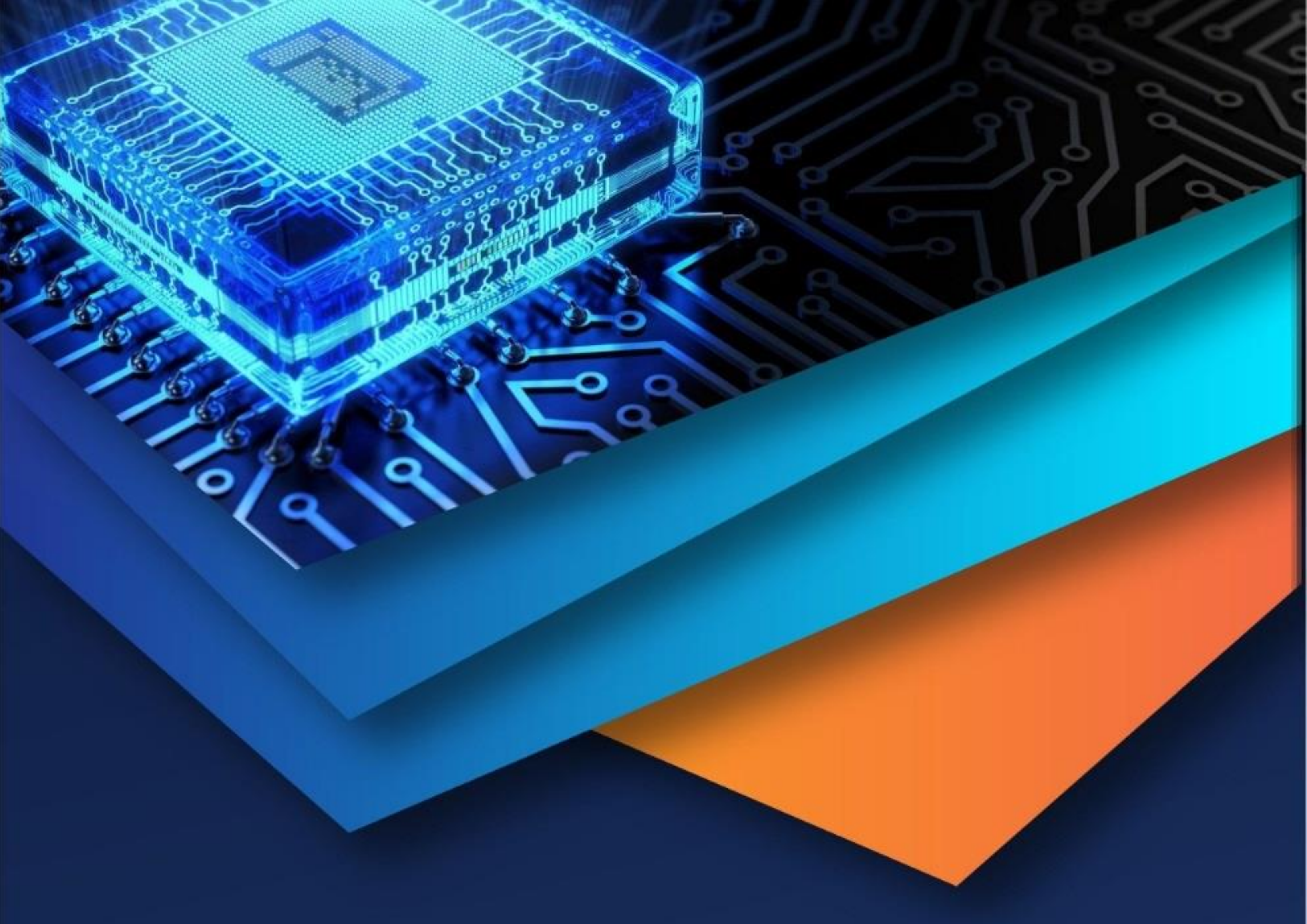
X. CONCLUSION

This study focuses on the development of a life-saving concrete block engineered to facilitate the safe dissipation of hazardous gas molecules through controlled permeability. The material was designed using PET-modified concrete to enhance sustainability while improving indoor safety conditions. To evaluate its performance, the following tests were conducted: compressive strength test, dry density test, water absorption test, and efflorescence test. Each test offered vital insights into the mechanical characteristics, durability, and functional efficiency of the block. The results of each test, along with the inferences drawn from these results, clearly prove that the developed block meets the required performance criteria. The influence values and interpretations for all tests have been discussed in detail in the sections above.

REFERENCES

[1] M. B. Schaffer, Prefabricated Building Systems, McGraw-Hill, New York, USA, 2010.
[2] M. Panjehpour and A. A. A. Ali, “A review of prefab housing and relevant issues,” Construction Innovation, vol. 15, no. 1, pp. 60–77, 2015
[3] A. Baghchesaraei, M. V. Kaptan, and O. R. Baghchesaraei, “Using prefabrication systems in building
[4] S. D. Auti and J. R. Patil, “Prefabrication technology: A promising alternative in construction industry,” International Journal of Engineering Research and Technology, vol. 4, no. 9, pp. 1–5, 2015.
[5] P. Muthukumar, P. Bharath Kumar, Pradeep, and S. Ramesh, “Exper imental study of pre-engineered wall panels,”
[6] International Journal of Civil Engineering and Technology, vol. 8, no. 4, pp. 1025–1032, 2017.
[7] N. Li, Y. Feng, J. Liu, X. Ye, and X. Xie, “Research on the modular design and application of prefabricated components based on KBE,”
[8] Automation in Construction, vol. 72, pp. 222–234, 2016.
[9] Y. Jin, J. Zhang, and L. Sun, “Safety risk assessment of prefabricated building construction based on Bayesian network,” Journal of Civil Engineering and Management, vol. 25, no. 5, pp. 435–447, 2019.
[10] Y. Duan and G. Li, “Analysis on the quality problems and preventive measures of prefabricated building construction,” IOP Conference Se ries: Materials Science and Engineering, vol. 371, pp. 012064, 2018.
[11] H. Wang, Y. Zhang, W. Gao, and S. Kuroki, “Life-cycle environmental and cost performance of prefabricated buildings,” Energy and Buildings, vol. 183, pp. 87–98, 2019.
[12] S. Wang, C. Wang, W. Li, and D. Zhao, “Study on the operational efficiency of prefabricated building industry bases in Western China based on the DEA model,” Sustainability, vol. 12, no. 1, pp. 1–18, 2020.

[13] Y. Gao and J. Li, "Research on information management of prefabricated buildings under EPC mode," Advances in Civil Engineering, vol. 2019, Article ID 7468273, 201
[14] S. T. Sharon, K. Abey, and B. Anand, "Embodied energy comparison of prefabricated and conventional building construction," International Journal of Engineering Research and Technology, vol. 6, no. 6, pp. 1–6, 2017.
[15] T. Zhong, Y. Zhang, and X. Wu, "Application research on prefabricated construction promoting modernization development of construction in dustry," Journal of Engineering Management, vol. 31, no. 4, pp. 45–52, 2017.
[16] P. Paudel, S. Dula, M. Bhandari, and A. K. Tomar, "Study on prefab ricated modular and steel structures," International Research Journal of Engineering and Technology, vol. 7, no. 5, pp. 2341–2346, 2020



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY