

Development of Sustainable Pavement Block by using Waste Plastic

MAYURI A. CHANDAK¹, KUSHWANT WAKODIKAR², SHUBHAM SAHARE³, BINOY ROY⁴,
PRAJWAL CHOPKAR⁵

^{1,2,3,4,5}Department of Civil Engineering, Priyadarshini College of Engineering, Nagpur, India

Abstract- Plastic is very harmful to nature. It's a very remarkable human invention; nevertheless, due to its non-biodegradable nature, it has several severe environmental effects. And the development of concrete jungles also harms nature. After demolishing they fill into the useful lands. From filling the properties of land can be decreased causes global warming. We have decided to reduce plastic and demolish concrete. From using these two harmful environmental types of materials sustainable pavement blocks by using plastic waste. The goal of this research paper is to investigate plastic and demolished concrete and developed pavement blocks. And reduce the cost of pavement blocks.

Index Terms- Waste plastic bottles, Demolished concrete, Properties of Material, cost-efficiency, etc.

I. INTRODUCTION

Plastic is a nevertheless investigation of humans. Causes so many types of pollution like water pollution, air pollution, land pollution, etc. They harm the environment, humans, and all types of living beings. The use of plastic in daily life increases day by day. And the plastic cannot be reused or it cannot be destroyed.

The development of concrete jungles increases day by day it cannot be decreased. From the increase of concrete jungle, the demolished concrete also creates. This demolished concrete can be placed into useful land. This filling of concrete affects to properties of land and it create land pollution.

From studying these two harmful materials, we decided to reduce the plastic and demolish concrete to develop pavement blocks. For using plastic and demolished concrete we are reducing the uses of cement, sand, and aggregate used for pavement blocks. After using useless materials to make pavement blocks the cost of pavement blocks can be

reduced and save our environment from these two harmful materials.

II. MATERIALS

The materials used for the development of pavement blocks are waste plastic bottles and demolished concrete. All the materials are the waste materials we use in pavement blocks.

A. *Waste Plastic Bottles:* - Plastic is a very remarkable human invention; nevertheless, due to its non-biodegradable nature, it has several severe environmental effects. Plastic pollution has become the largest substantial danger to our society, causing environmental damage and pollution. The large volume of plastic through into the environment can harm the ecosystem. Directly effect on marine species and environmental sustainability.

Sr. No.	Particular	Values
1.	Melting Point	150 ⁰ c
2.	Density	0.910-0.940 kg/m ³
3.	Tensile Strength	0.20-0.40 (N/mm ²)
4.	Thermal Coefficient of Expansion	100-200X10 ⁻⁶

Table 1: - Properties of Waste Plastic Bottles

B. *Demolished Concrete:* - The demolished concrete is used as fine aggregate it lies between 2.5mm to 4.75mm demolished concrete as a fine aggregate. Demolished concrete used as coarse aggregates lies between 4.75mm to 10mm demolished concrete is used as a coarse aggregate. The demolished concrete used for this study was taken from college M20 and M25 grade cube Blocks.

III. METHODOLOGY

- A. Collection of waste plastic bottles.
- B. Cleaning and Drying
- C. Collection of demolished Concrete.
- D. Sieve analysis of demolished concrete
- E. Mix Proportion
- F. Melting of plastic.
- G. Adding Demolished Concrete
- H. Molding
- I. Waiting for Setting.
- J. Unmolding.
- K. Testing.
- L. Analysis.

A. *Collection of waste plastic bottles:* - The manufacturing of plastic paving blocks requires a huge plastic. The plastic is very lightning in weight so the quantity required of the plastic is very large. Plastic waste used in the casting of paver blocks was collected from the college canteens and campus area.

B. *Cleaning and Drying:* -All bottles have some types of liquid like juice, water, etc. It will be cleaned using clear water after cleaning it will be dried naturally in sun light up to 10 to 15 days. It will be moisture-free and fungal infection-free.

C. *Collection of demolished Concrete:* -Collect all the demolished concrete from the campus area. We are using tested concrete cubes from the college laboratory. There are two types of concrete cubes used M20 and M25 grade.

D. *Sieve analysis of demolished concrete:* -After Crushing the concrete we do a sieve analysis of demolished concrete. We used 20mm, 12.5mm, 10mm, 4.75mm sieve for coarse aggregate. 4.75mm, 2.36mm, 1.18mm, 600micron, 300micron, 150micron, pan for fine aggregate.



Figure1: - Sieving of Demolished Concrete



Figure 2: - Grading of Demolished Concrete

E. *Mix proportion:* - We are designing proportion for the plastic pavement block. Were,

P = Weight of Waste Plastic Bottles.

FA = Fine Aggregates (Demolished Concrete less than 4.75mm).

CA = Coarse Aggregates (Demolished Concrete more than 4.75mm).

Sr. No.	Ratio (P:FA:CA)	Design Strength
1.	1:1:1	15N/mm ²
2.	1:1:2	10 N/mm ²

Table 2: - Mix Proportion of Pavement Block

F. *Melting of Plastic:* -Melt the plastic in an iron container from heat. The temperature of melting of plastic is 100⁰c to 150⁰c.



Figure3: - Melting of Plastic

G. *Adding Demolished Concrete:* -Add partially demolished concrete in melted plastic. Add partially at the same time mixing the mixture well. There is no segregation in it.

H. *Molding:* -After mixing material pour the material in a mold. The size of the mold is 200mm X 100mm X 60mm. At the same time pour the compact material using compacting rod. There are no air voids present in the mold.



Figure4: - Molding of Materials

- I. *Waiting for Setting* -The plastic is fast set. The setting time of plastic is 120 minutes.
- J. *Unmolding*: -After setting material the unmolding the pavement block. Take caution for the corners of the block cannot be broken. And the pavement blocks in proper size and shape.



Figure5: - Unmolding, Final Pavement Block

- K. *Testing*: -After unmolding there are testing is performed. There are various types of testing to check the quality of pavement blocks. Compressive test in compressive testing machine to determine the compressive strength. Melting point in the oven to determine the melting point of the pavement block. Water absorption to determine water absorption of pavement blocks.
- L. *Analysis*: -After testing all tests there will be an analysis of the pavement blocks. Taking out the results, outcome, and conclusion on pavement block.

IV. EXPERIMENTAL WORK

A. *Compressive Test*: -In the Compression testing machine, the compressive bearing strength of the concrete bricks and cubes is determined. It is also known as UTM i.e. universal testing machine or CTM i.e. compression testing machine. Usually, the test is conducted till the failure in the specimen occurs. It can be achieved by crushing the block or by reaching the final predetermined maximum compressive load. The maximum load at which the compressive strength of the specimen, the results are expressed either in MPa

i.e. megapascals, or N/mm² i.e. Newton per millimetre square.

B. *Water Absorption*: - The Water Absorption test has been performed to determine the water absorption of blocks, bricks, pavement blocks, etc. To determine the water absorption the blocks were immersed in the water for 24hr. After 24hr it will be removed from the water. After it will be placed into the oven for 24hr. At every step, we can note the weight of the blocks. After we calculate the final result.

C. *Melting Point*: - The Melting Point Test has been performed to determine the melting point of the blocks. Blocks directly come into contact with the sun. After assembly, they cannot melt from increasing temperature. Before placing the melting, point tests are performed. The block was placed in the oven for the 120minutes. In different temperature. In which the temperatures block has been melted. The result is noted down.

V. RESULTS

A. COMPRESSIVE STRENGTH

Plastic paver block of size 200mm×100mm×60mm. The maximum load is taken by block. And the taken all readings the average compressive strength is calculated.

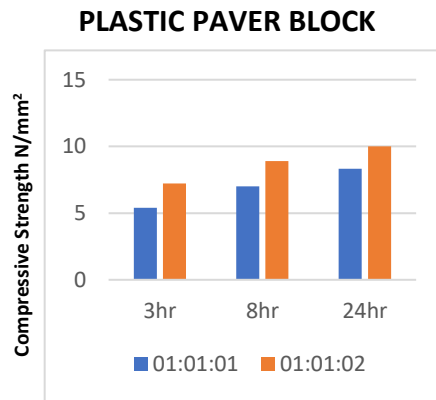


Table3: - Compressive Strength

B. WATER ABSORPTION

In this test, pavement blocks are weighed in dry condition. Then immersed in fresh water for 24 hrs. After 24 hrs. of immersion, these are taken out from the water and wiped out with a damp cloth. The weight of water absorbed by blocks. The percentage of water is calculated.

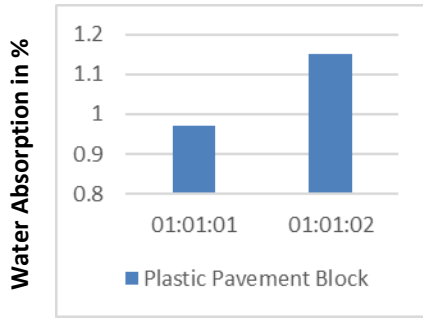


Table4: - Water Absorption

B. MELTING POINT

To know the melting point of plastic paver block we kept it in the oven for 120 minutes. After 120 minutes

Block NO.	Temperature	Result
1	50 ⁰ c	No Change
	100 ⁰ c	No Change
	150 ⁰ c	Melt
2	50 ⁰ c	No Change
	100 ⁰ c	No Change
	150 ⁰ c	Melt

we are checking the condition of the pavement blocks.

Table5: - Melting Point

CONCLUSION

1. Based on the experimental study we found that the plastic is as useful as concrete pavement blocks.
2. Plastic is a very hard-polluted ingredient in nature so used in paving blocks to reduce pollution in the area.
3. As we can see the utilization of waste plastic in the production of paver blocks is a productive way of disposal of plastic waste.
4. The finishing, shape, interlocking, and appearance of the plastic paving block are as good as a conventional concrete paving block.
5. The strength of the block is much less than the concrete block, so these blocks are not used in heavy traffic.
6. Concrete pavement block is more costly than plastic pavement block. The cost of plastic pavement blocks is less.

REFERENCES

- [1] B.iishanmugvalli, K.Gowtham, P.JebaiiNalwi, "Reuse of plastic waste in paver blocks" 2017.
- [2] P.Tharuniikumar, R.Selvaraman, R.Sujithara, Mr.N.Thirugnanasambantham, P. Bharathi "Manufacturing and testing of plastic sand brick" 2017.
- [3] M.Achitra, R. Ambika Rajashre, R.Vijaylaxmi Pandit, V. Saranya,2018.
- [4] Dinesh A., Kirubakaran K., Dinesh S., "In the manufacturing of paver blocks and bricks to Utilization of waste plastic" January 2016.
- [5] Singh Lairenlakpam Billygraham, "Manufacturing bricks from waste plastic and sand plastics, March 2017.
- [6] R. Vasudevan, A. Ramalinga Chandra Sekar, B.Sundarakannar, R. Velkannadi, (2012).
- [7] Mageshwaram, Satish Kumar, Vijay Kumar, Praveen Kumar, "Effective utilization of waste plastic with sand in addition with nylon grids in paver stones 2018
- [8] SK, SKB. Prasad, Afroz Sultana, "Use of waste plastic in bituminous concrete mix" 2012.
- [9] Sarang Shashikant Pawar, Shubhankar Anantbujone "Use of fly ash and plastic in paver block" (2017).
- [10] Muhammad Maqbool Sadiq, Muhammad Rafique Khattak "Different Plastic Waste Materials use in Concrete.
- [11] Ramesh Kumar Batra, Poonam Sharma, Cement Concrete Paver Blocks for Rural Roads. IJCESR, ISSN: 114-121. Vol 3, Issue: 01(2016).
- [12] Ravikant Talluri. Joel Santhosh. Use Fly Ash and Glass Powder to Manufacture of Interlocking Concrete Paving Blocks. IJCIET, ISSN:55-64, Vol:06, Issue:04 (2015).
- [13] Nivetha, C. Rubiya, S. Vaijayanathi, M. Shobana, Use Solid Waste to Production of Plastic Paver Blocks. ARPN Journal of Engineering and Applied Science. G. ISSN.1819-6608: Vol.11 Issue 02 (2016).
- [14] R.L. Rame, Recycled plastics used as coarse aggregate for constructional concrete, project reference no 37S1114, ISSN:2319- 8753, Vol:02, Issue: 03, March (2013)

- [15] Ganesh Tapkire. Satish Parihar. Pramod Patil. Hemra, R. Kumavat, Recycled Plastic used in Concrete Paver Block. IJRET, ISSN:2321-7308: Vol.3, Issue 09, (2014)
- [16] B. Eswara Moorthy, B.Shanmugavalli, Production of Paver Block to Reusing of Plastic Waste ISSN:2278-0181: Vol. 6 Issue 02, February- (2017).
- [17] Raghatate Atul M, Use of plastic in concrete to improve its properties, ISSN2249–8974 IJAERS/Vol. I/ Issue III/April-June, 2012/109-111
- [18] Praveen Mathew et al, Utilization of plastic bags in concrete block, Literature Review, Volume 2, Issue 6 JETIR ISSN-2349- 5162.June(2015)
- [19] Mohan D.M, Vignesh, Utilization of plastic bags in pavement blocks. Volume:119, No15,1407-1415 ISSN: 1314-3395.,(2018)
- [20] V. Natraj “Partial Replacement of Coarse Aggregate in Concrete Blocks for Utilization of Waste Plastics, ISSN:0994-5645, Vol:08, Issue:12, June (2015).