UTILIZATION OF CRUSHED MARBLE AND WASTE PLASTIC IN PAVER BLOCK PRODUCTION

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Abstract: The rapid accumulation of plastic waste and the increasing demand for sustainable construction materials have prompted innovative approaches to recycling and resource utilization. This study investigates the production of paver blocks by incorporating plastic waste as a binding material and crushed marble as a partial replacement for coarse aggregates. The primary objective is to develop an eco-friendly alternative to conventional paver blocks while addressing the critical issues of plastic waste management and marble waste utilization. Laboratory experiments were conducted to determine the optimal mix proportions, assess mechanical properties, and evaluate durability performance. The results indicate that the integration of plastic waste enhances the paver blocks' binding strength, while crushed marble contributes to improved compressive strength and aesthetic appeal.

The study demonstrates that these composite paver blocks meet the standard requirements for pedestrian and light vehicular traffic, offering a sustainable and cost-effective solution. This research highlights the potential of integrating industrial and post-consumer waste materials into construction practices, reducing environmental pollution, and promoting a circular economy.

Keywords: Plastic waste, Paver blocks, Crushed marble, Durability, Compression strength, waste utilization.

1. INTRODUCTION

The demand for sustainable construction has led to research on alternative materials. The construction industry uses many natural resources, while plastic and marble waste cause pollution. Using these wastes in paver blocks can solve both problems. Plastic waste, which is non-biodegradable, can be recycled as a binder, improving strength and flexibility. Crushed marble, a byproduct of the marble industry, can replace coarse aggregates, reducing waste and enhancing durability. This eco-friendly approach helps in waste management and sustainable construction.

1.1 Need and Necessity:

- Reusing waste plastic and crushed marble in construction helps in several ways. It reduces pollution by keeping plastic and marble waste out of landfills.
- These materials can be used to make strong and durable paver blocks, improving their quality.
- Using waste materials also decreases the need for natural resources like sand and stone, which helps protect the environment.
- Recycling plastic and marble is cost-effective, saving money and energy compared to new materials.
- Finally, it supports sustainability by creating eco-friendly construction solutions for roads, footpaths, and gardens.

1.2 Objectives:

- To explore an effective way to reduce plastic waste and to determine the suitability of crushed marble in the development of paver blocks.
- To evaluate the compressive strength and durability of paver blocks
- To analyze the economic benefits of using alternative materials in paver block compared to conventional block.

2. System Development

2.1 Material selection and its properties

For Manufacturing of ordinary as well as plastic paver blocks cement, sand, coarse aggregates, water and waste plastic bags are essential materials. Here in case of ordinary concrete paver blocks, waste plastic is not used and on other hand plastic paver blocks manufactured without use of water as it contains waste plastic content. After

performing various tests on used materials following observations are made.

Material	Test	Observations	IS values
Cement	1.Specific gravity 2.Initial setting time 3.Final setting time 4.Standard consistency	3.13 45 min 480min	3.1-3.16 30 mins 600mins
M-sand	1.Sieve analysis 2.Specific gravity	Zone II 2.61	2.73
Crushed marble	1.Sieve analysis 2.Specific gravity	2.66 9.16%of 20mm 97.73%of10mm	2.5-2.7 0.5%-0.6% 0.61%

Table-1: Test and observation of material

Waste Plastic: A material which contains one or more number of polymers having large molecular weight. Solid in its finished state or same state will manufacturing or processing into finished articles is known as Plastic. Waste management in respect to plastic can be done by recycling. If they are not recycled then they will become big pollutant to the environment as they not decompose easily and also not allow the water to percolate to the soil and they are also poisonous.

Fig-1:Plastic waste

India generates 9.8million metric tons of plastic waste annually. On the basis of physical properties, plastic can be classified as thermoplastic (remoulded) and thermosetting material which shares 80% and 20% respectively in total plastic waste generation. Polyethylene Terephthalate (PETE or PET), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low density polyvinyl chloride,

(LDPE)Polypropylene (PP), Polystyrene or Styrofoam (PS) are some examples of thermoplastic which can be recycled and which are used for making plastic paver blocks. Plastic used for making plastic paver block is collected from various sources. The classification of Thermoplastic and its sources is tabulated as below.

2.2 Concrete Mix Design

It is the process of selecting suitable ingredients of concrete to achieve specified strength and durability of at its 28th day curing. For this study design mix is prepared for M20 grade as per IS 10262-1982 and by IS 456-2000 for both ordinary and plastic pavement blocks. Water cement ratio taken for ordinary concrete is 0.5 and for plastic paver block no moisture is added. For casting of blocks, three Round Dumble mould were prepared which has volume of 0.00205m^3 each. The quantity of materials required per cubic meter is determined by IS method. Depending on the capacity of paver mould amount of each material for both ordinary and plastic paver block is found to be as follows.

Material	Plastic paver block
Cement	1.14 kg
M-sand	1.60 kg
Crushed marble	2.80 kg
Waste plastic	600 gm

Table-2: Amount of constituents

For the present study three cubes of 0.00205 m^3 volume are to be casted. Concreting process includes batching, mixing, placing followed by curing for number of days. But in case of

Fig.-2: Plastic melting process

plastic paver blocks burning and melting of waste plastic is to be done. In this process plastic collected from different sources burnt in a close chamber and melt it to the liquid state. And then that liquid plastic added into other ingredients for making plastic paver block.

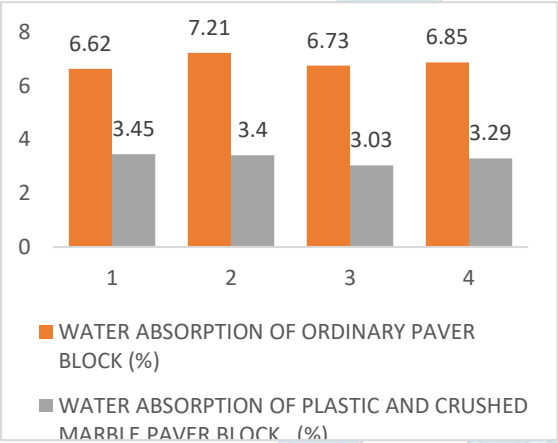
3. Result & discussion:

After sufficient curing of both ordinary and plastic concrete block it has to be checked under compression testing machine (CTM) to know its compressive strength under gradually applied compressive force on the specimen. After placing the paver block on the platform and applied the load on a smooth surface steadily and uniformly at the rate of 35N/sq.mm/minute

till the block failed. Noted the load at which it failed and divided it by the crosssectional area of paver block gives the compressive strength of the specimen.

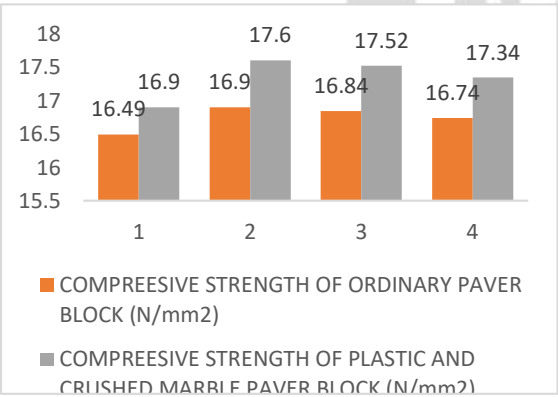
Test results of the ordinary concrete block and plastic paver blocks after 7 day curing are tabulated below

Graph-1: Compression strength of paver block for 7days



Graph-2: compression strength of paver block 28 days

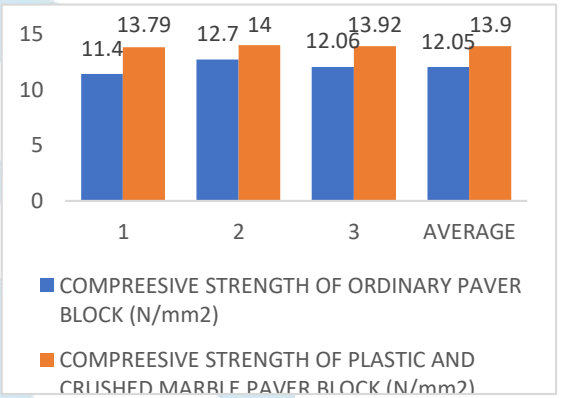
The above test results describe that average compressive strength of ordinary concrete paver block on its complete curing of 28th day is 19.55N/mm^2 where in case of plastic paver block it is 19.81N/mm^2.



Graph-3: Water absorption on paver block

5. Conclusions:

- The use of waste plastic and crushed marble in the production of paver blocks represents a Sustainable and innovative approach to construction.
- This method addresses two major environmental challenges: the accumulation of non- biodegradable plastic waste and the disposal of marble processing residues.
- The experimental results indicate that incorporating waste plastic as a binder and crushed marble as a replacement for coarse aggregates can lead to paver blocks.
- These blocks improved compressive strength, water resistance, and flexibility compared to conventional SSl blocks, making them suitable for various applications, including pedestrian pathways, parking areas, and landscaping.



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