

Utilization of Waste Plastic in Manufacturing of Paver Blocks

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Abstract - Concrete is the most widely used construction material in the world. Using waste and recycled materials in concrete mixes for paver blocks becoming increasingly important to manage and treat both the solid waste generated by industry and municipal waste. These blocks were rectangular in shape and had more or less the same size as the bricks. During the previous five decades, the block shape has relentlessly developed from non-interlocking to somewhat interlocking to completely interlocking to multiple interlocking shapes. Use of plastic waste which is non biodegradable is rapidly growing in the surroundings and becoming threat to environment in many aspects. This study demonstrates use of waste plastic for manufacturing the concrete paver blocks and with this efficient disposal way of plastic waste is possible.

Key Words: Plastic waste, plastic paver blocks, compressive strength etc.

1. INTRODUCTION

Solid waste management is one of the major environmental concerns in India. Landfills are becoming scarce and the cost in building landfill sites are increasing. During transportation of wastes from homes and industries by these transfer station to the dumping sites some fallout from the trucks into gutters. But generally the level of plastics in waste composition is high. The largest component of the plastic waste is polyethylene, followed by polypropylene, polyethylene Terephthalate and polystyrene. Fortunately, there are various ways in which waste plastics could be reuse or converted to other products. High density polyethylene (HDPE) waste is used in making bags and dustbins. Polymer modified pavement blocks has applications in road construction and buildings. Hence waste plastic bags can therefore, be mixed in concrete mass in some form, without significant effect on its other properties or slight compromise in strength. In this project waste plastic bags collected from municipal solid waste and used in the production of pavement blocks which generally used in the park, roadside footpaths and in the yard of buildings.

1.1 Concrete Paving Blocks

Concrete blocks are mass manufactured to standard sizes. This block has excellent interlocking characteristics, durability and has great aesthetics. Brick pavers, concrete paver, granite paver, rubber paver and stone pavers are

various types of pavers widely used. But for manufacturing plastic paver blocks, cement, quarry dust, crushed aggregates, coarse aggregates and plastic waste are essential. Both ordinary and plastic paver blocks are design for same grade and compared by its durability and compressive strength. The study by typical concrete paving blocks has one smooth

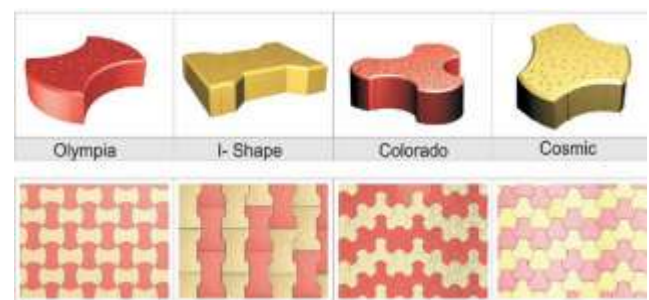


Fig. No- 1: Different shapes of paver blocks

face and one rough, although some paving blocks so come with reversible surfaces (can be used both sides). The performance characteristics of concrete paving blocks make it suitable for the heaviest duty applications, able to support substantial loads and resist shearing and braking forces. These blocks come in different colours. The colours typically come from metallic oxides. Paving blocks are the most preferred choice for laying of pavements, driveways as it can be immediately open to the traffic after fixing up.

1.2 Objectives

- To determine the suitability of waste plastic bags in the development of pavement blocks for construction and to reduce the burden of waste plastic by reusing into pavement.
- To evaluate the performance of plastic concrete for paver blocks for use in pavements and other application areas.
- To evaluate compressive strength and durability for ordinary concrete paver blocks, the same have been studied for various plastic paver block.
- To produce cost-effective paver block which a common person can afford easily.

2. System Development

2.1 Material selection and its properties

For Manufacturing of ordinary as well as plastic paver blocks cement, Quarry dust, 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.

Table -1: Properties and observations of materials

Cement	Properties of cement		Observations
	Specific gravity		3.15
Consistency		33%	
Fineness		7	
Initial Setting Time		45 minute	
Final Setting Time		480 minutes	
Quarry Dust	Specific gravity		2.60
	Grading zone		Zone II of soil
	Fineness modulus		2.952
	Water absorption		1.80
Coarse Aggregate	Specific Gravity	20mm	2.44
		10mm	2.60
	Water Absorption	20mm	4.0
		10mm	3.0

Moisture content of the coarse aggregate was found 1% for both sizes and potable water of 28-30°C used for the mixture of concrete for ordinary paver block.

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. No- 2: Municipal Solid Waste

India generates 5.6 million 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.

Table -2: Waste plastic and its sources

Waste Plastic	Origin
Low-Density Polyethylene (LDPE)	Carry bags, sacks, milk pouches, cosmetic and detergent bottles
High Density Polyethylene (HDPE)	Carry bags, bottle caps, house hold articles etc.
Polyethylene Terephthalate (PET)	Drinking water bottles etc.
Polypropylene (PP)	detergent, biscuit packets, microwave trays for readymade meal etc.
Polystyrene (PS)	bottle caps. Foamed polystyrene: food trays, egg boxes, disposable

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 0.00205m³ 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.

Table-3: Amount of constituents

Material	Ordinary Paver Block	Plastic Paver Blocks
Cement	1.14Kg	1.14Kg
Quarry Dust	1.60Kg	1.60Kg
10mm Coarse Aggregate	2.08Kg	2.08Kg
Water	440gm	NA
Waste Plastic	NA	600gm

For the present study three cubes of 0.00205 m³ volume are to be casted. Concreting process includes batching, mixing, placing followed by curing for number of days. But in case of



Fig. No- 3: Plastic melting process & **Fig. No- 4:** 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. Results and 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 cross sectional 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

Table-4: Compressive strength for 7 day curing

Blocks	Compressive strength of Ordinary paver block	Compressive strength of Plastic paver block
1	11.45	10.79
2	12.39	10.92
3	12.06	11.10
Average	11.96	10.93

From the above table it is clear that average compressive strength for ordinary paver block is 11.96 N/mm² and for plastic paver block it is 10.93 N/mm² which is slight less than ordinary block so plastic paver blocks can be the alternative for it.

Similarly compressive strength checked for the paver blocks after 28 day curing for both the samples. The test result found to be as follows.

Table-4: Compressive strength for 28th day curing

Blocks	Compressive strength of Ordinary paver block	Compressive strength of Plastic paver block
1	19.54	15.35
2	19.55	16.03
3	19.55	16.78
Average	19.54 N/mm²	16.05 N/mm²

The above test results describe that average compressive strength of ordinary concrete paver block on its complete curing of 28th day is 19.54 N/mm² where in case of plastic paver block it is 16.05N/mm².

4. Conclusions

1. From the obtained results it is clear that plastic paver block has almost equal strength as that of ordinary one.
2. From the obtained results it can be concluded that plastic paver block can be used in the park, footpath and yards of the residential as well as commercial building because the compressive strength is sufficient for the smooth utility of user.
3. The utilization of waste plastic in production of paver block has productive way of disposal of plastic waste.
4. It reduces up to 600 kg plastic over 1000 blocks.
5. It reduces plastic in municipal solid waste and significant reduction of land filling is possible if it this project takes place on a large scale.

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