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# A General study of the Permeable Paver block incorporated with Waste Materials – Review

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**Abstract -** *Paver blocks are most commonly used all over the world. The stagnation of water in streets and the waste disposal generating from various sectors are the problem emerging now-a-days. Water stagnation leads to high maintenance cost and repair cost. The improper disposal of wastes leads to spread of various infections. Along with these the cost of construction materials is raising drastically, so alternative solutions is to be identified. To overcome this problem the waste materials are incorporated in the paver blocks production to reduce the disposal cost and the water stagnation in the streets are reduced by the voids provided in the permeable paver block. Through various references the properties of the waste materials in the permeable paver blocks are studied and listed.*

***Key Words*: Permeable Paver block, Waste Materials, Compression Strength, Tensile Strength, Flexural Strength.**

## 1. INTRODUCTION

Paver blocks being versatile and being popularly used now-a-days. It is aesthetically attractive, functioning well. But during raining season due to its impervious nature the water gets clogged in-between them the maintenance cost and repair cost increases. To reduce the cost and the water clogging effects new technique was produced in the production of the paver block.

Permeable paver blocks are the concrete blocks in which the voids are incorporated into block. The concrete is prepared by the combination of the cement, sand, coarse aggregated, in permeable paver block the fine aggregates (sand) is completely or partially eliminated to obtain the voids in the concrete so that water can flow through it easily thus reduces the water logging on the streets.

Wastes are also produced in the enormous amount, along with that the emission of the $CO_2$ also increased due to the OPC production. Hence the consumption of the cement is to be reduced. In accordance with the above two points the waste materials are also incorporated in the production of the permeable paver block now-a-days.

## 2. PROPERTIES OF PERMEABLE PAVER BLOCK

According to the structural aspect the important point of the permeable paver block should possess properties like density, compressive strength, porosity and the skid resistance. The size of aggregates used for the permeable paver block determines the strength and the porosity of the permeable concrete paver block. If the aggregates size increases the porosity increases and the strength decreases. It also absorbs the noise that is produced due to the vehicles tyre on the road surface. Normally the mix ratio adopted for the permeable paver block is 1:4, 1:6, 1:10. The properties of the pervious concrete are listed in Table 1.

**Table -1:** Properties of pervious concrete

| | |
|---|---|
| Unit weight | 1680 to 1920 kg/m$^3$ |
| Compressive strength | 3.5 to 28 MPa |
| Flexural strength | 1.5 to 3.2 MPa |
| Air voids | 2 mm to 8 mm |
| Porosity | 15% to 30% |
| Stiffness | 8000 to 15000 MPa |

### 2.1 Advantages of permeable paver block

(i) Light weight (ii) Reduces the storm water runoff (iii)Reduces the waste disposal work (iv) Increases the ground water level (v) Economical due to elimination of fine aggregates. (vi) The maintenance cost and the repair cost in the permeable paver block is reduced.

## 3. REVIEW OF LITERATURE

Amol S. Khamkar, Ajay B. Phalke, Atul C. Kale, Mahesh B. Jaykar, Prof. Suhas A. Pawar (2019) analyzed the paver block prepared by using the GGBS (formed when molten iron blast furnace slag is rapidly chilled by immersion in water) and Baggage ash (obtained from sugarcane industry).They concluded that the workability of the concrete increased by the GGBS and it is decreased by Baggage ash. The cost of the block is reduced. They found that the strength of the concrete is reduced to about 30% when compared to the conventional concrete paver block.

Ch. Sravan Kumar Reddy, Bendapudi Sarath Chandra Kumar, SS.Asadi (2019) evaluated the properties of the

paver block prepared using the plastic waste (polyethylene). LDPE (Low density polyethylene) plastic bags are recycled and used as total replacement for cement to prepare paver bricks. The properties of LPDE are Density 0.95gm/cc and Melting point 105ºC to 115ºC. The compressive strength of the plastic paver brick is high than the conventional brick.

Piergiorgio Tataranni (2019) evaluated the alkali activation process in the concrete paver block by recycled waste powders (waste ballast powder). The block with ballast powder confirmed the requirements of the EN 1338. It has good mechanical properties and the alkali activation process is verified.

M.P.Karthik,Dr.V.Sreevidya, R.Kesavamoorthi, T.Sivaganesan (2018) the properties of pervious Concrete Paver Block with inclusion of swarf (lathe waste) was studied. For conventional one with mix ratio 1:1.81:1.64 and for no fine concrete 1:5 ratio was adopted. The compression test and the abrasion test were conducted for both conventional concrete and no fine concrete. The conventional concrete has higher values. The abrasion test was conducted as per IS 15658-2006. The compression strength was higher at 10% replacement and the abrasion test was higher for 25% replacement of swarf.

Samadhan Pawar1, Sachin sangde, Akshay shinde, Shreyash patil, Abhi patil, Shubham Arthmwar (2018) conducted the comparison test between the normal conventional paver block with the block made with the wastes. They used the rubber waste and the recycled paver block material waste as the waste materials in the paver block. In Compression strength test of paving block of 0.2% rubber waste give optimum result. Demolished paver block aggregate has higher compressive strength. The flexural strength of paving block of 0.3% rubber waste gives maximum result waste is minimize (tyre waste, broken paver blocks).

Truptimala Pattnaik, Nihar Ranjan Mohanta, Niharika Patel, Paresh Biswal & Rajat Kamal Moharana (2018) was experimentally done various cubes with waste materials like fly ash and glass powder as mineral admixture. The test values obtained are almost equal to the conventional concrete paver block. Higher compressive strength and flexural strength was achieved when 20% cement was replaced by equal proportion of fly ash and glass powder. Compressive strength, Flexural strength, tensile strength, abrasion resistance test are determined in accordance to IS 15658: 2006.

Avinash Patel K L, Dinesh S Magnur et al. (2017) studied the properties of the pervious concrete. They determined the density, compression strength, split tensile test and the permeability test for the pervious concrete. They considered it as an eco friendly material and they listed the benefits obtained from the previous concrete.

B. Shanmugavalli*, K.Gowtham, P. Jeba Nalwin , B. Eswara Moorthy (2017) done the experiment work using the plastic waste along with(quarry dust and ceramic waste) in the concrete paver block The blocks showed the good heat resistant properties. They found that the compression strength of the block with waste has low strength compared to the conventional block. They made three cubes with different mix proportions, compressive strength (13.03 $N/mm^2$) was found to be higher for Plastic waste=1, Quarry dust= 1.5, Gravel = 2, Ceramic waste = 0.75.

Pravin S Patil1*, IP. Sonar2, Sudhir Shinde (2017) described the properties of the no fine concrete made with the Portland cement, coarse aggregates and water. Strength of the concrete was found to be higher in 1:4 mix ratio compared to other two proportions with water-cement ratio 0.35 for 16 mm size aggregated and 0.40 for 10mm size aggregates. They proved that the aggregate size influences the strength of the concrete. The water-cement ratio above 0.40 makes the cement to get settled at the bottom of the specimen. They also suggested to utilize the no fine concrete in parking places and in low volume traffic areas.

1Mohammed Abas Abdela Salem, 2R. K. Pandey (2017) the air entraining agents are used in the concrete mixture thereby the content of cement, fine aggregates and coarse aggregates is reduced and the water to cement ratio is also reduced considerably which proves to be economical the compressive strength is checked by preparing the cubes is found to be 294 $kg/m^2$.the air entraining agent increases the voids content in the block hence it can be utilized in the permeable paver block.

Sneha N. Kole1, Shyam R. Suryawanshi 2 (2017) listed the properties of the polystyrene. The properties of the polystyrene are specific gravity – 0.016, water absorption – 0.0 moisture content - 0.0 fineness modulus- 3.5. They added the polystyrene in the block instead of fine aggregates. The partial replacement of fine aggregate with polystyrene reduces the compressive strength and tensile strength of concrete. This polystyrene based concrete is best suitable for non-structural elements which do not require high compressive and tensile strength also after this study; it has proven better way for disposal of polystyrene.

G.Pragna, P.M.S.S.Kumar (2017) improved the strength of the concrete paver blocks by adding fly ash GGBS and Glass fiber. The compressive strength and flexural strength increased by the addition of 0.4% glass fibers with 30% replacement of cement with fly ash and GGBS. The cost of the block also decreased with the enhancement in the properties of the block by the combination of the fibers and mineral admixtures in the paver block.

Nor Farah Atiqah Ahmad1, Siti Nooraiin Mohd Razali1, Suhaila Sahat1, Masiri Kaamin1 (2016) the Polymer bottles was recycled and used in concrete as a fine aggregate. The PS was replaced in 2%, 5% and 10% and the compressive strength of concrete and tensile strength is found by British

standard method. The compressive strength and tensile strength is found to be 35.98kN/mm² and 3.29kN/mm²for 1.5% of replacement.

A.Murugesan et al. (2015) conducted and determined the properties of the concrete paver made with the utilization of the polystyrene. They found that the density was decreased up to 10%. The test results made them to conclude that the compressive strength, flexural strength and the tensile strength reached the maximum value at 10% replacement.

Thomas Tamut1, Rajendra Prabhu, Katta Venkataramana, Subhash C Yaragal (2014) investigated the properties of the paver block using the Expanded Polystyrene Beads. They conducted test to found the compression and tensile strength of the blocks. They concluded that the compressive of the concrete is reduced after adding the EPS in the concrete. But the EPS in the concrete showed good workability. The concrete with the EPS beads can be easily compacted and finished. The cost of the block is also reduced. Compression testing of the cube specimens was carried, as per IS 516-1959 and split tensile test as per IS 5816: 1999. .

Ravi Kumar C. M, Anil Kumar, Prasanth. M. H and D. Venkat Reddy (2012) investigated the properties of paver block with the inclusion of the iron ore. Specific gravity of Iron-ore tailing was 3.3. The strength obtained was more in case of actual area compared to plan area, indicating the more conservative value for the compressive strength in the plan area. The use of iron ranges between 5% to 15% has shown increase in the compressive strength of the concrete compared to normal concrete.

Kalingarani.K1, Harikrishna Devudu.P, Jegan Ram.M , Sriramkumar.V for this purpose various industrial wastes such as copper slag, fly ash, phosphogypsum, and sludge were selected and their physical and chemical properties were studied. The final mix was 1:1.36:2.42 where the first part was 70% cement, 30% fly ash, second part was copper slag and the third part was coarse aggregate. The properties of the concrete block were finalized by conducting the test according to IS15658:2006 standards. The compression strength of the conventional specimen is higher than the block with replacement but the flexural strength and tensile strength was higher for the blocks with the waste than the conventional specimen.

## 3. CONCLUSION

The properties of pervious paver block along with inclusion of various waste materials are discussed in this paper. The permeable paver block is proved to advantageous though it has less compressive strength. Polymers can be used as the replacement material because it enhances the properties of the block and with that the polymers can also be used instead of cement (it has good binding capacity).the cost of the pervious block is less and it reduces the repair and maintenance cost.

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