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# PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH PLASTIC IN PAVER BLOCKS

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## ABSTRACT

The aim of this project is to replace coarse aggregate with plastic and plastic waste partially in paver block and to reduce the cost of paver block. It also increases the lifetime and serviceability of paver block. At present nearly 56 lakhs tons of plastic waste is produced in India per year. The degradation rate of plastic is also a very slow process, and the plastic pollutes the surrounding environment. Thus we planned to replace the coarse aggregate. Three replacement levels of plastic by 20%, 30%, 40 % in preparation of mortar which equals the strength of conventional blocks. The paver block which is made of partial replacement of plastic in coarse aggregate helps to reduce the production of plastic bags and improve the tensile properties of paver block. The major objective is to reduce the usage of aggregate content which leads to economical usage. It also helps in contributing towards environment for safe disposal of plastic which reduces the pollution.

**Keywords:** Cost reduction, Eco-friendly, Partial replacement, Contribution towards society, Serviceability.

## I. INTRODUCTION

Plastic is material consisting of any of a wide range of synthetic or semi synthetic organic compounds that are malleable and so can be molded into solid objects. Plasticity is the general property of all materials which can deform irreversibly without breaking but, in the class of moldable polymers, this occurs to such a degree that their actual name derives from this specific ability. Plastics are typically organic polymers of high molecular mass and often contain other substances. They are usually synthetic, most commonly derived from petrochemicals , however, an array of variants are made from renewable materials such as polylactic acid from corn or cellulosic's from cotton linters. Due to their low cost, ease of manufacture, versatility, and imperviousness to water, plastics is used in a multitude of products of different scale, including paper clips and spacecraft. They have prevailed over traditional materials, such as wood, stone, horn and bone, leather, metal, glass and ceramic, in some products previously left to natural materials. In developed economies, about a third of plastic is used in packaging and roughly the same in buildings in applications such as piping, plumbing or vinyl siding .Other uses include automobiles (up to 20% plastic), furniture, and toys. In the developing world, the applications of plastic may differ 42% of India's consumption is used in packaging. Plastics have many uses in the medical field as well, with the introduction of polymer implants and other medical devices derived at least partially from plastic. The field of plastic surgery is not named for use of plastic materials, but rather the meaning of the word plasticity, with regard to the reshaping of flesh. Plastics that, when heated, do not undergo chemical change in their composition and so can be molded again and again. Examples include: Polyethylene (PE), Polypropylene (PP), Polystyrene (PS) and Polyvinyl Chloride (PVC). Common thermoplastics range from 20,000 to 500,000 amu, while thermo sets are assumed to have infinite molecular weight.

**Fig 1- Plastic waste**

## 1. MATERIAL TEST

**CEMENT:**

**Table 1 - Specific gravity of cement**

| S.no | Description (gm) | Trial 1 | Trial 2 | Trial 3 | Mean |
|---|---|---|---|---|---|
| 1 | Weight of empty bottle ($M_1$) | 670 | 670 | 675 | |
| 2 | Weight of bottle +cement ($M_2$) | 1305 | 1300 | 1311 | |
| 3 | Weight of bottle +cement+kerosene ($M_3$) | 1780 | 1782 | 1783 | 3.01 |
| 4 | Weight of bottle+ kerosene ($M_4$) | 1410 | 1400 | 1401 | |
| 5 | Specific gravity of cement | 2.93 | 3.01 | 3.1 | |

**Specific gravity of cement = 3.01**

**FINE AGGREGATE:**

**Table 2 – Specific Gravity of Fine Aggregate**

| Description | Trial 1(g) | Trial 2 (g) |
|---|---|---|
| Mass of empty Pyconometer ($M_1$) | 455 | 455 |
| Mass of Pyconometer and dry soil ($M_2$) | 1095 | 1120 |
| Mass of Pyconometer, soil and water ($M_3$) | 1685 | 1710 |
| Mass of Pyconometer and water ($M_4$) | 1290 | 1295 |

**Average specific gravity of Fine Aggregate = 2.64.**

## II. EXPERIMENTAL ANALYSIS

**CASTING:**

The conventional paver block is casted by mixing the cement, fine aggregate and coarse aggregate. As a next step the coarse aggregate is replaced by the plastic in the order of 20%,30% and 40% and the partially replace paver blocks has been casted. The casted paver block is subjected to curing. Once the curing period is over it is used for testing.

**Fig 2 – Hand mixing**

**Fig 3 – casted paver blocks**

**COMPRESSIVE STRENGTH TEST**

**Table 3 – Compressive strength test of cubes**

| SPECIMEN NO | % Plastic | LOAD (KN) | AREA OF BLOCK ($mm^2$) | COMPPRESSIVE STRENGTH = P/A ($N/mm^2$) |
|---|---|---|---|---|
| Conventional | 0% | 1200KN | 38925 | 30.40 |
| 1 | 20% | 1350KN | 38925 | 35.18 |
| 2 | 30% | 870KN | 38925 | 23.12 |
| 3 | 40% | 720KN | 38925 | 18.49 |

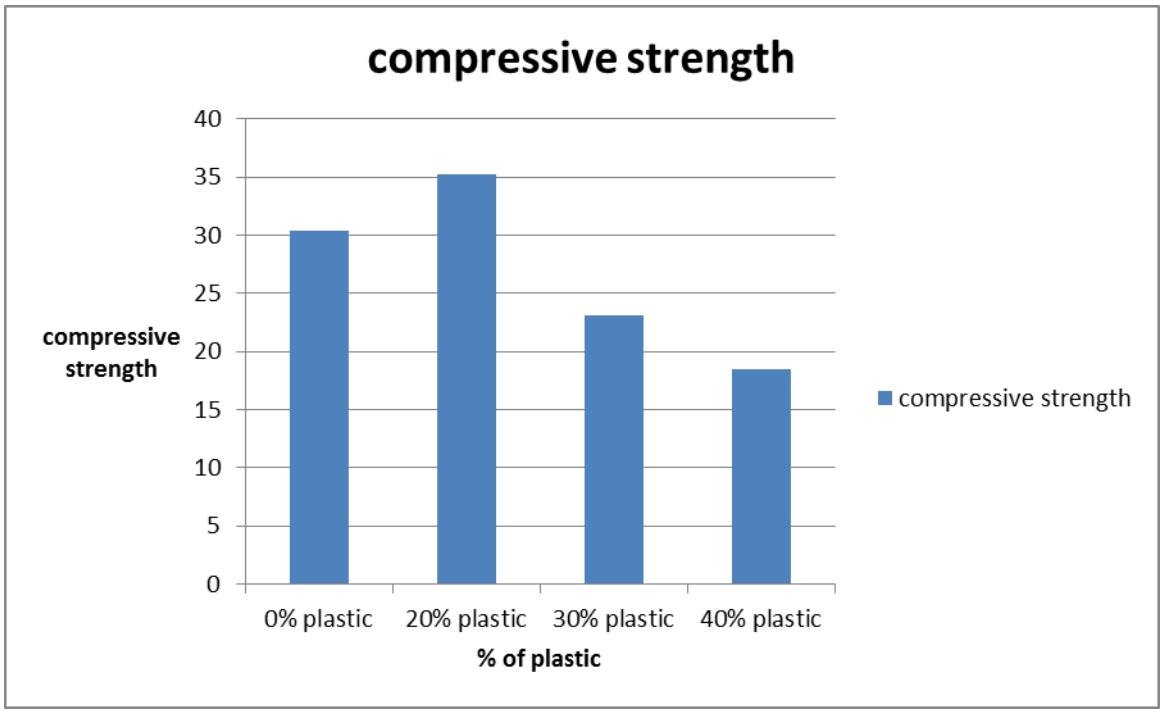


**Fig 4 – Graphical representation of compressive strengths of paver blocks**

**WATER ABSORPTION TEST:**

Dry the specimen in a ventilated oven at a temperature of 105 °C to 115°C till it attains substantially constant mass. Cool the specimen to room temperature and obtain its weight (W1) specimen too warm to touch shall not be used for this purpose. Immerse completely dried specimen in clean water at a temperature of 27+2°C for 24 hours. Remove the specimen and wipe out any traces of water with damp cloth and weigh the specimen after it has been removed from water (W2)

**Table 4 - Paver block addition of 20% plastic**

| Trial No | Dry weight ($w_1$) | Wet weight($w_2$) | Increase in weight ($W_2$-$W_1$ ) (kg) | Increase weight in % |
|---|---|---|---|---|
| 1 | 4.400 | 4.518 | 0.026 | 2.6 |
| 2 | 4.320 | 4.419 | 0.022 | 2.2 |
| 3 | 4.382 | 4.490 | 0.024 | 2.4 |
| Average | 4.360 | 4.475 | 0.026 | 2.6 |

**Table 5 -Paver block addition of 30% plastic**

| Trial No | Dry weight ($w_1$) | Wet weight($w_2$) | Increase in weight $(W_2-W_1)_1$ (kg) | Increase weight in % |
|---|---|---|---|---|
| 1 | 4.480 | 4.555 | 0.016 | 1.6 |
| 2 | 4.445 | 4.519 | 0.025 | 2.5 |
| 3 | 4.310 | 4.440 | 0.030 | 3.0 |
| Average | 4.411 | 4.504 | 0.021 | 2.1 |

**Table 6 - Paver block addition of 40% plastic**

| Trial No | Dry weight ($w_1$) | Wet weight($w_2$) | Increase in weight $(W_2-W_1)$ (kg) | Increase weight in % |
|---|---|---|---|---|
| 1 | 4.550 | 4.650 | 0.035 | 3.5 |
| 2 | 4.550 | 4.700 | 0.032 | 3.2 |
| 3 | 4.750 | 4.915 | 0.034 | 3.4 |
| Average | 4.616 | 4.721 | 0.023 | 2.3 |

**Table 7 - Conventional block**

| Trial No | Dry weight ($w_1$) | Wet weight($w_2$) | Increase in weight $(W_2-W_1)$ (kg) | Increase weight in % |
|---|---|---|---|---|
| 1 | 4.500 | 4.670 | 0.037 | 3.7 |
| 2 | 4.500 | 4.660 | 0.035 | 3.5 |
| 3 | 4.550 | 4.715 | 0.036 | 3.6 |
| Average | 4.516 | 4.681 | 0.036 | 3.6 |

**Consolidated Results:**

Water absorption of different blocks is
Conventional block = 3.6%
20% plastic = 2.6%
30% plastic = 2.1%
40% plastic = 2.3%

## III. RESULTS & DISCUSSIONS

The partially replaced concrete paver blocks can be used at habitation areas on rural roads. The compression strength of the partially replaced paver block is more or less equal to that of conventional paver block. Cost of the partially replaced paver block is cheaper than that of the conventional paver block.
Cost of 36 conventional paver blocks = Rs 2650.
Cost of 36 partially plastic replaced paver block = Rs 1980.
If these partially replaced blocks are used at habitation areas of rural roads, their construction cost, maintenance will be economical when compared to conventional blocks and concrete roads. It will give a good aesthetic view when compared to cast in situ concrete roads. The utilization of waste plastic in production of paver block has found its productive way of disposal. The cost of paver block is reduced when compared to that of concrete paver block. Though the compressive strength is low when compared to the concrete paver block it can be used in gardens, pedestrian path and cycle way etc. It can also be suggested in the places wherever the traffic is less and also it can be used in streets.

## IV. CONCLUSION

Here by we conclude our project on partial replacement of coarse aggregate with plastic in paver block by following points:

- The compressive strength of 20% plastic paver block is 35.18N/mm$^2$ where as the compressive strength of conventional block is 30.40N/mm$^2$. Therefore 20% plastic block has high compressive strength than the conventional block.
- The water absorption value of 20% block is 2.6% where as the water absorption of conventional block is should not more than the 6%.Hence the water absorption value is less than that of conventional block.
- Hence 20% plastic paver block is better than that of other block at the same time 20 % posses lesser quality of materials when compared to conventional block.
- The cost of construction will be reduced and also helps to avoid the general disposal technique of waste plastics namely, land filling and incineration which have certain burden on ecology.
- By using the plastics in pavement block, it reduces the weight up to 15%. We also find that plastic pavement block is economical and has several advantages when compared to the concrete pavement block.
- We conclude our project by suggesting the replacement of coarse aggregate with plastic in paver blocks up to 20% and it is the optimum percentage for replacement of coarse aggregate with plastic. Also it is one of the best methods to dispose the plastic waste.

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