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Reuse of Plastic Waste in Pedestrial Paver Blocks

Mr. Apoorv Tiwari[1], Mr. Anushman Baghel[2], Prof. Rekha Shinde[3]
[1, 2] *Department of Civil Engineering, Shri Vaishnav Institute of Technology and Science, Indore*
[3]*Assistant Professor, Department of Civil Engineering, Shri Vaishnav Institute of Technology and Science, Indore*

Abstract: ***The aim of this project is to replace the fine aggregate by quarry dust & plastic granules and coarse aggregate by plastic chips partially for the construction of pedestrial paver blocks. Plastic waste is added in the form of chips in proportion of 10%, 15% and 20% in volume of coarse aggregate, Quarry dust & Plastic granules in proportion of 30% and 10% in volume of fine aggregate respectively. Coir is also added in proportion of 2% by weight. The compressive strength & flexural strength was determined at the end of 7 days, 14 days and 28 days. Disposal of plastic in environment is a big problem due to low biodegradability. In recent studies it is found that industrial plastic wastes from tubs, pallets, crates, polypropylene (PP) can be used as partial replacement for aggregate of concrete. By using plastic waste and coir, this project shows the eco friendly nature.***
Keywords: Polypropylene, plastic, Coir, Aggregate, Cement, Sand, Quarry dust.

I. INTRODUCTION

Sustainable development, looking up to the extent by which natural resources have degraded, has now become call of duty. Construction has now become our way of civilization of colonies. The design mix we use for purpose of construction uses river sand as fine aggregate which is now depleting at very high rate. This in turn increases the cost of river sand as the demand increases and availability decreases. This pertains among others to environmental issues and the conservation of natural resources. The beginnings of this awareness are difficult to pinpoint, but it is clear that it is not only in India, where a public accustomed to an abundance of natural resources was relatively late to realize the limits of these resources and the real costs associated with their wasteful exploitation.

Natural resources are depleting worldwide at the same time the generated wastes from the industry and residential area are increasing substantially. For creating sustainable development we partially replaced conventional ingredients of concrete with our day to day waste materials like plastic waste materials (plastics granules as fine aggregate and plastic chips as coarse aggregate), quarry dust which is available abundantly at very low price and coconut fibre.

Polypropylene is one of the mostly used type of plastic (after polyethylene) and it is used in packaging and labeling. In 2013, the global market for polypropylene was about 55 million tones. The dumped waste pollutes the surrounding environment. As the result it affects both human beings and animals in direct and indirect ways. Hence, it is necessary to dispose the plastic waste properly as per the regulations provided by our government.

The significance of the project is to not only determine the optimum quantity of coarse and fine aggregate to be replaced but also to compare the strength characteristics with normal concrete. It is done for achieving economy in construction.

II. MATERIAL SPECIFICATION

A. Cement

Cement used in the experimental work is Portland Pozzolana Cement:

TABLE □: Properties of Cement

S.NO.	Characteristics	Test Result	Standard Result (as per IS code)
1	Consistency	40%	30%
2	Initial Setting Time	30 min	Not less than 30 min
3	Final Setting Time	600 min	Not less than 600 min
4	Specific Gravity	3.15	3.15
5	Fineness Modulus	5%	Not more than 10%
6	Compressive Strength	46N/mm2	Not less than 43N/mm2

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B. Fine Aggregate

1) *River Sand:* It is used as a major component that is 60% of the total fine aggregate. It was purchased from the market and it satisfies the required property of fine aggregate. The specific gravity and fineness modulus were 2.60 & 2.80 respectively. It was in zone □.
2) *Quarry Dust:* It is the second major component used in the fine aggregate by proportion that is 30% of the total fine aggregate. It was collected from the site. The specific gravity and fineness modulus were 2.58 & 2.95 respectively. It also conforms to zone □.
3) *Polypropylene Granules:* It is the minor component used in the fine aggregate by proportion that is 10% of the total fine aggregate. Plastic granules making machine is used for converting the waste polypropylene plastic into granular size according to the need for the fine aggregate. The specific gravity and fineness modulus were 1.5 & 3.2 respectively.



Fig. 1 Plastic granules

C. Coarse Aggregate

The coarse aggregate used here are of two types, namely:

1) *Crushed Aggregates*: The crushed aggregates used were 20mm passing and retaining on 10mm sieve. The sieve analysis was done as per IS 383:1970 for graded aggregate. It is taken in major proportion of total coarse aggregate by 90%, 85% and 80% in proportion. The specific gravity and fineness modulus were 2.73 & 6.8 respectively.
2) *Polypropylene Chips*: The minor component used as a partial replacement of coarse aggregate by 10%, 15% and 20% was Polypropylene chips (a waste material). Plastic scrap grinder machine is used for grinding the plastic into the desired size needed for the partial replacement of coarse aggregate. The specific gravity and fineness modulus were 1.5 & 7 respectively.



Fig. 2 Plastic chips

D. Plastic

The plastic used here is polypropylene plastic. It is second most widely used type of plastic and it is bit dense as compared to polyethylene. Polypropylene is the cheapest plastic in the market. It is used in Automotive Industry, Industrial Applications, Consumer Goods, and Furniture Market. It is used for better strength and maintaining economy. It is not only light in weight but also non toxic in behavior.

TABLE □: Properties of polypropylene plastic

S.NO.	Characteristics	Test Result
1	Tensile strength	35 Gpa
2	Specific gravity	1.5
3	Water absorption	0.01%

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E. Water

The water used for mixing should not contain undesirable organic substances or inorganic constituents in excessive proportions. Clean potable water is used in this project.

F. Coconut Fibre (Coir)

Coconut fibre is used by weight 2% to enhance the flexural strength of the paver block.

III.RESULTS AND DISCUSSIONS

A. Workability

The workability of concrete is determined by slump cone test.

TABLE □: Slump cone test

S.NO.	Quarry Dust, Plastic granules And Plastic Chips %	Slump Size (cm)
1	0	26
2	30, 10 & 10	24.5
3	30, 10 & 15	23
4	30, 10 & 20	21

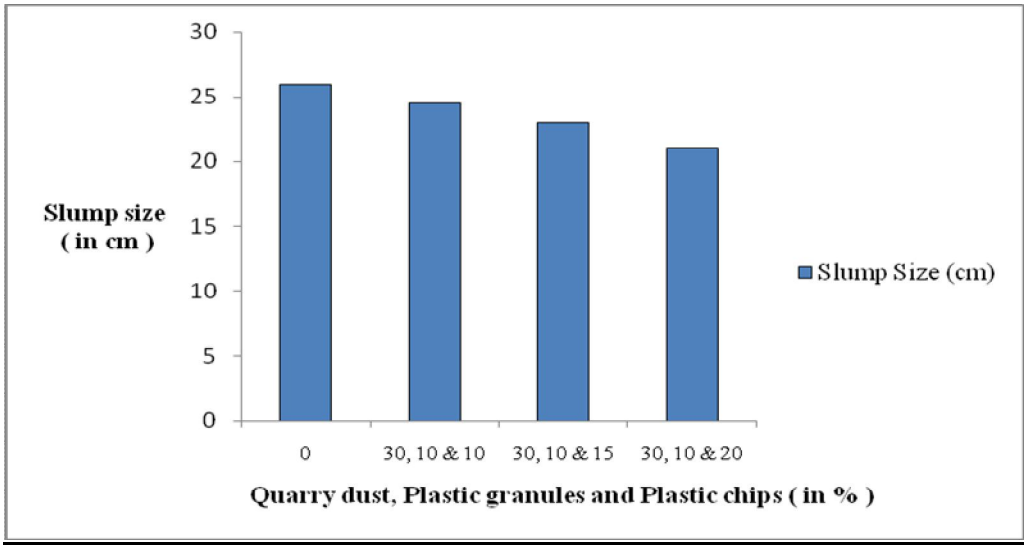


Fig. 3 Result of Slump Cone Test

B. Compressive Strength Test

Compressive strength test of the concrete is that value of the uni-axial compressive strength obtained, when the material falls entirely. It is done for the determination of compressive strength. The cube size taken is 150mm X 150mm X 150mm by casting mould.

TABLE □: Compressive Strength Test

S.NO.	Quarry dust, Plastic granules and Plastic chips (in %)	Compressive strength at 7 days (Mpa)	Compressive strength at 14 days (Mpa)	Compressive strength at 28 days (Mpa)
1	0	19.25	22.56	26.80
2	30, 10 & 10	16.80	20.66	22.90
3	30, 10 & 15	14.22	17.33	20.09
4	30, 10 & 20	11.62	14.59	17.53

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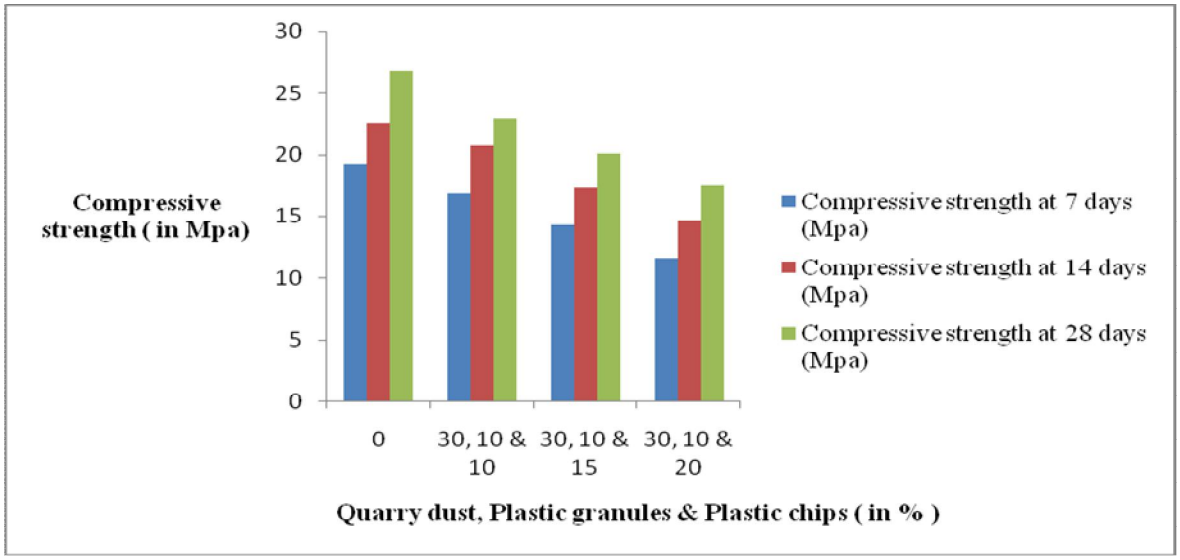


Fig. 4 Result of Compressive Strength Test

C. Flexural Strength Test

Since the compressive strength obtained was not good enough for the 15% and 20% partial plastic waste replacement, So, flexural strength test was not conducted for them. It is done for finding out the tensile strength indirectly. It is the maximum amount of stress experienced within the material at the time of yielding. The results of this test is expressed as modulus of rupture which is denoted as (MR) in MPa or psi.

TABLE □: Tensile Strength Test

S.NO.	Percentage Replacement (%)	Flexural Strength or Load (KN)
1.	10	39.7

IV. CONCLUSIONS

The Based on the study carried out on the strength behaviour of concrete with partial replacement of plastic chips as coarse aggregate and partial replacement of quarry dust and plastic granules as fine aggregate, following conclusions are drawn:

A. The addition of plastic waste and quarry dust in PPC concrete decreases the compressive strength of the paver block.
B. As we increase the percentage of plastic waste and quarry dust in PPC concrete, the compressive strength decreases.
C. Optimum replacement level of plastic waste in concrete is 20%, after that concrete does not give adequate strength.
D. The use of quarry dust & plastic granules and plastic chips as fine aggregate and coarse aggregate respectively decreases the unit weight of paver.
E. The cost of paver block is reduced when compared to that of concrete paver block.
F. It can be used in non traffic roads and pedestrial walking such as building premises, footpaths, Railway platforms, Malls, public garden, bus stand, etc.
G. There is a positive projection in the availability of plastic waste and quarry dust for its demand and flexibility in use.
H. The use of plastic waste in concrete paver which is the best option for disposal of plastic and ultimately reduces the plastic pollution in the environment.

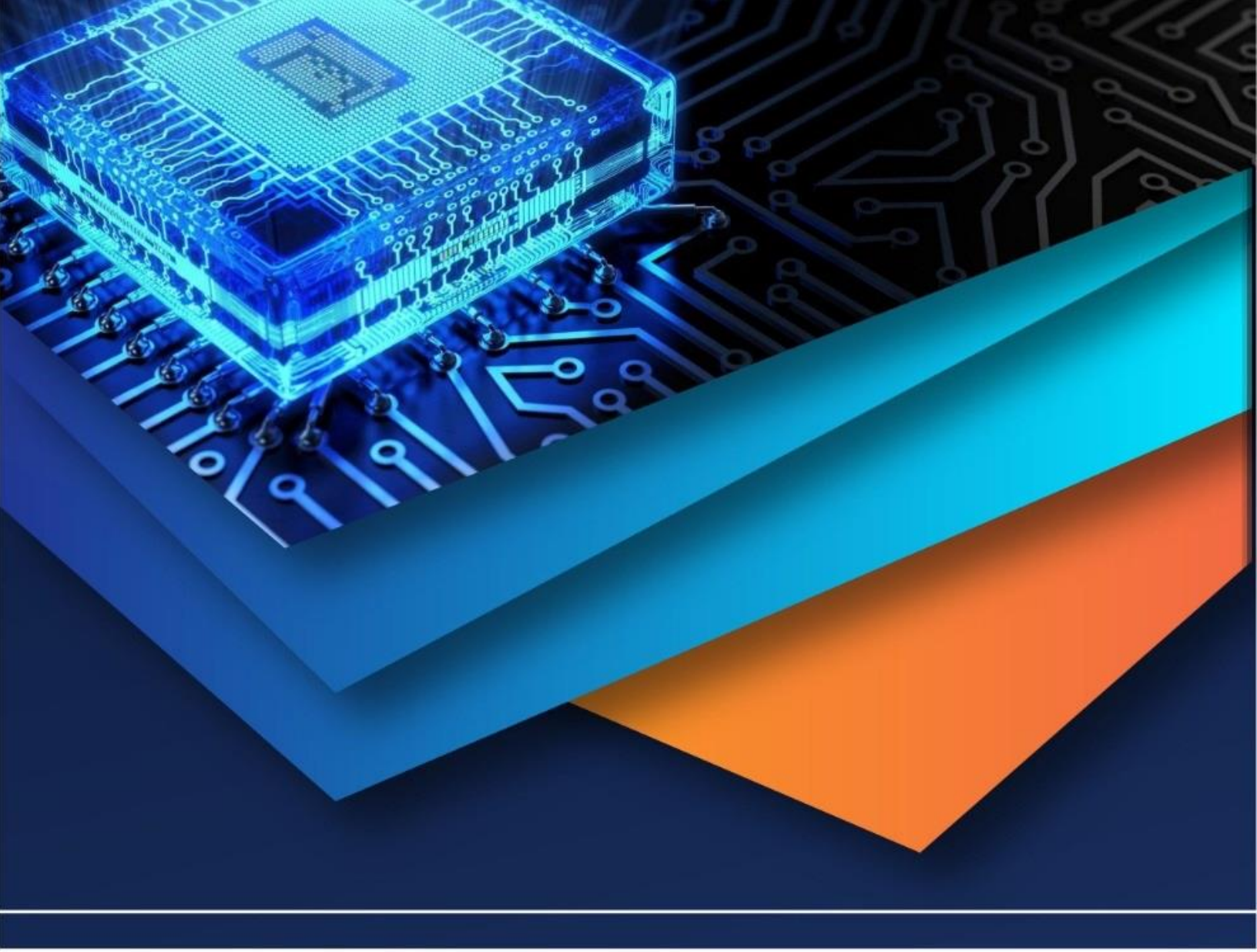
Plastic waste and quarry dust is an industrial waste produced in large quantity which is a total waste, causing many environmental problems, recycling and using this waste quarry dust & plastic granules partially as a fine aggregate and the plastic chips as partial replacement of coarse aggregate. In future wastes like plastic and quarry dust can be used in construction to reduce the construction cost providing appropriate strength, workability, and other properties of cement. It is not only economically feasible but can also be easily layed and produced. So in future, it can be used.

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