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Strength Property Study on Paver Block Made with Recycled Concrete Aggregates – An Experimental Review

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ABSTRACT

With increase in population and urbanization, demand of raw materials such as cement and aggregate has increased in the construction industries. Further it has been recognized that waste from construction &demolition sectors are of large volume and this volume is increasing every year. Utilization of demolished waste offers not only the solution of disposal problems but also helps to conserve natural resources for meeting increased demand of aggregates and save energy. This study deals with the fabrication of concrete paver blocks using construction and demolition (C&D) waste as a replacement of natural aggregates.

Keywords: Paver blocks, Fine aggregate replacement, C &D waste, Strength Property Study.

1. INTRODUCTION

Cement and aggregates are the most indispensable constituents used in concrete production. These has leads to a continuous and increasing demand of natural materials, waste materials and by product are being generated in vast quantities causing detrimental effects. Recently there have been successful applications of using local waste materials as a partial replacement for cement (or) aggregates in manufacturing concrete paver blocks. One of the alternative source of coarse aggregate is Recycled Concrete Aggregates (RCA) which are obtained from the Construction and Demolition (C &D) waste. During and after the demolition of any concrete structures, the demolished concrete waste is taken to a recycling plant and there crushed into the required sizes which is called the Recycled Concrete Aggregate.

Paving blocks using C&D waste made a fast in road into the construction industry and have almost become the defector choice. Most construction firm nowadays prefers paving blocks over slabs, asphalts, stone (or) clay. Mass production of paving blocks has reduces their price and made easily affordable. It has become even simples to complete their laying.

OBJECTIVES

- The main objectives of this project are to encourage contractors to reduce, reuse and recycle C & D wastes. The reuse of C & D waste is very common in many countries.
- C & D wastes can be used as an aggregate replacement in concrete paver blocks. Recycled aggregates can also be used in structural concrete by applying special mixture, curing and casting methods.

SCOPE

- The performance characteristics of concrete paver blocks may suitable for the heaviest duty applications.
- Paver blocks are extensively used in the footpaths, parking areas and for minor road construction.
- The structural applications of C &D waste with various replacement percentages are studied.

LITERATURE STUDY

General

This chapter describes the review of literature on paver block using C & D waste and briefly narrates the investigations carried by various researchers in the area of utilization of C & D waste in the paver blocks in eco-friendly manner.

LITERATURE REVIEW

1. Osman Gencel, et al., (2012) had dealt with the waste marble in the manufacturing of paver blocks. In this study the marbles are partly replaced with the fine aggregate (cement) in the paving block. Physical and mechanical test were performed on the blocks. The test results concluded that water demand of the mixtures increases with the increase in marble content. Dry density of the block is affected differently on marble content. If the marble content in the mixture compressive strength decreases the blocks gives the satisfactory strength value after 28 days. Abrasive resistance of the paver block is strongly influenced by the marble content. Cement type has more effect than marble aggregate on elasticity modulus of the concrete. Finally they conclude that incorporation of marble waste provides concrete paving blocks of sufficient quality.
2. Cassiano Rossi Dos Santos, et al., (2013) had conducted experiment on the coal waste in paving blocks. The aim of this work is to study the use of coal waste to produce the concrete paving blocks. It is estimated that more than 300 million tons of coal waste exists in the south of Brazil, generating environmental impacts and economic costs. The extraction of sand from river bed may cause adverse effect on the environment. The result showed that it is possible to process the coal waste. Concrete blocks for paving produced with 25% and 50% of recycled coal waste in substitution of river sand. The use of coal waste as fine aggregate for concrete blocks paving manufacture presents the technical viability and environmental benefits. The demand by sand deposits can be minimized and a part of coal tailing can be used, reducing the volume in coal waste deposits.
3. Ganjian, et al., (2014) had studied that mineral waste are used for reducing the cement content. In the production of conventional paver block it is usual to use a minimum of 210 kg/m3 of cement. This paper investigates the use of waste and by- product materials such as Run-of-Station Ash (ROSA), Basic Oxygen Slag (BOS), Ground Granulated Blast Furnace Slag (GGBS), Plasterboard Gypsum (PG), and By-pass Dust (BPD) to reduce the amount of cement in paving blocks. It has been verified that cementations mix containing ROSA up to 60%, GGBS up to 55%, BPD up to 25% and PG up to 5% by weight can replace Portland cement without any substantial impact on the strength of the blocks. It concluded that the split tensile strength of OPC/GGBS/BPD was higher than 3.6 Mpa. The other mixes did not satisfy the minimum requirement. On the other hand the water absorption test should show the result of less than 6%.

4. ShishirBansal and S. K. Singh (2014) had dealt with the sustainable approach on C and D waste. The situation has forced us to explore aggregate from alternate source. It is essential that to identify and segregate more and more reusable material in debris. The work in this paper has explained the reuse and recycling potential different C and D waste products. Reusing does not require any further processing to convert into a useful product. The strength properties may also increase due to the addition of C and D waste in the paving block. The cost of construction will also reduce by utilizing the demolition waste in the paving blocks. It is time that recycled aggregate are permitted for use in concrete constructions.

5. Eric AbabioOhemeng, et al., (2014) had conducted the experiment on low density polyethylene in paver block. The main objective of this research was to investigate the feasibility of using waste low density polyethylene as partial replacement for sand in the production of concrete pavement blocks. The plastic was used to replace the sand by volume at 0%, 10%, 20%, 30%, 40%, 50%, and 60%. It was observed that density, compressive strength, flexural strength, and splitting tensile strength decreased as the plastic content increased. However, the water absorption increased as the plastic content increased. The amount of waste plastics being accumulated in the world created a big challenge for their disposal. Utilizing them in concrete pavement blocks will help to mitigate their effects.

6. M. C. Nataraja and Lelin Das had conducted the study paver block from unconventional material. In this investigation, various properties such as compressive strength, split tensile strength, bending strength and water absorption of paver blocks consisting of crushed granite, unconventional materials such as kadapa and broken paver for various percentage replacements of coarse aggregate. They also studied the effects of aggregate-to-cement (A/C) ratios and types of aggregates (natural crushed aggregate (NCA), recycled crushed aggregate (RCA) and recycled crushed glass (RCG)) on the properties of pre-cast concrete blocks. It was found that the compressive strength of the paving blocks decreased as the A/C ratio increased. The results showed that the strength was directly proportional to the crushing strength of the aggregates. The water absorption of the blocks had a good correlation with the water absorption ability of the aggregate particles.

7. Juliana Guerra Sgorlon, et al., (2014) had investigated on the paver block using electroplating waste. The macrostructural properties of concrete paving blocks produced with partial replacement of cement was the objective of this work. The results showed that blasting dust has high percentage of silica in the composition. Thus results showed the potential use of blasting dust in the manufacture of concrete paving blocks, using the technique of solidification/stabilization of the waste in the cement matrix However, for the reuse of this waste is effectively carried out, there must be a joint effort between university, industry of interlocking blocks and electroplating industries, so that the technologies developed in academia are used by society to achieve not only economic paybacks, but mostly environmental benefits.

8. SomNathSach Deva, et al., (2014) had studied on the fly ash in paver block. This paper discusses the results of an experimental study conducted on Fly Ash Concrete with the aim to report its suitability for concrete paver blocks. The result concluded from the study is water to cementations material ratio reduces for all mixes and for all same level of workability. Cube compressive strengths at 7-days and 28 days for all the four mix designs with different proportions of fly ash are found to slightly decrease as compared to the control mix with no fly ash. Cube compressive strength at 90 days for all the four mixes with different proportions of fly ash is found to slightly increase as compared to the control mix with no fly ash. Their results shows that the fly ash in high proportion can be

easily used in this cost effective and ecological manner in the manufacture of paver blocks for use in pavement and other similar areas of application.

9. R. C. Yeole and Dr. M. B. Varma (2014) had dealt with the Concrete plays the key role and a large quantity of concrete is being utilized in every construction practices. In this paper, a parametric experimental study for producing paving blocks using waste steel aggregates is presented. Waste steel bearings are added in concrete of paver blocks in various percentages. Rubber pads are also used below the paver blocks. Impact strength of paver blocks with various percentages of waste steel aggregates and using rubber pads is investigated. Test results show that combination of using rubber pads and adding various percentages of waste steel aggregates in paver blocks gives upto 50% more impact strength than ordinary paver blocks. The density of paver block increases as the percentage of steel aggregate increases. Impact test on paver block using rubber pads gives 5 to 7 times more impact value than paver blocks without using rubber pad. Impact strength of paver block increases as density increases.

10. Ashish V. Talati and Vaishakti A. Talati (2014) had dealt with the present scenario use of paver blocks is increasing day by day. Disposal of such material waste is a major problem as it may contain harmful chemicals which may affect Environment. The Aim of study is use of material waste in manufacturing of paver blocks & making the Paver Blocks Economic without compromising with Strength Parameters. Sand is replaced by fly ash, foundary sand, abrasive waste and silica fumes. The result has observed that the fly ash compressive strength of paving block is little less than the compressive strength of conventional brick. Same as fly ash, use of foundry sand gives little more compressive strength than conventional block. Little economy can be achieved & waste may utilized save the land from dumping of non-degradable material. Other two waste material silica fume & Abrasive waste, silica fume give less compressive strength & Abrasive waste gives more compressive strength than the conventional block.

11. Neeraj Jain and MridhulGarg (2015) had conducted an experiment on this study deals with the laboratory investigations for fabrication of M-35 grade concrete paving blocks using recycled coarse and fine aggregates as a replacement of natural aggregates from 25 to 100 % level by weight and results were compared with control. The test results of blocks showed that the replacement of natural aggregates by recycled aggregates at the level of 25% had little effect on the compressive strength and it decreased beyond these levels. As compare to natural aggregates, the flexural strength of paving blocks was higher using recycled aggregates. Durability performance of blocks like water absorption, density and abrasion resistance was also improved using washed recycled coarse aggregates. The density decreases up to 7 % with an increase in recycled aggregates content from 25 to 100 % as compared to control specimens. However, paving blocks prepared with washed recycled aggregates show improvement in density and it is about 2 to 4 % higher than those prepared with unwashed recycled aggregates.

12. S. Vanitha, et al., (2015) had studied on the reuse of waste plastics as partial replacement of coarse aggregate in M20 concrete waste plastics were incrementally added in 0%, 2%, 4%, 6%, 8%, and 10% to replace the same amount of aggregates. Test were conducted on coarse aggregate, fine aggregate, cement and waste plastics to determine their physical properties. Paver block of size 200 mm*150mm*60mm were casted and tested for 7, 14, and 28 days. From the test results it was observed that the compression value of concrete mix decreased with the addition of waste plastics more than 4% of waste plastics so we can add waste plastics in concrete blocks. This will help to reuse the plastics in concrete blocks. The cost of construction will reduce and also helps to avoid the general disposal

techniques of waste plastics namely land filling and incineration which have certain burden on ecology. The utilization of waste plastics reduces the environmental effects.

CONCLUSIONS

From these journals we have learnt about various materials used for the manufacturing of paver blocks. Then the properties and strength of these materials used in the journals were studied. The waste materials like waste marbles, fly ash, coal waste, polyethylene, electroplating waste, mineral waste, etc…. are studied for the strength properties. Various properties like compressive strength, flexural strength, water absorption, abrasion resistance of paver blocks made with different materials are studied from these journals.

After the completion of all the tests, it was observed that the mechanical properties of paver blocks, cubes and cylinders were increased with the addition of construction and demolition (C&D) waste. The micro structural properties like water absorption for paver blocks were also identified.

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Conflict of Interest

None of the authors have any conflicts of interest to declare.