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A Performance Study of Paver Block with Copiously Recycled Concrete

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ABSTRACT:
This project presents the performance study of paver block made with recycled concrete. In India, interlocking paver blocks usage has been highly improved from the past decades. Now a days parking, pedestrian area and vehicle moving areas are filled by paver blocks. Paver Blocks are the pre-cast blocks that are used in the construction for various types of pavements. To increase the applications of concrete paving blocks with recycled concrete, greater understanding of locally available materials. To overcome this problem, due to the scarcity of raw materials, an idea of full replacement of recycled concrete aggregates is focused. This is an innovative eco-friendly process for reuse in a non-structural concrete application. To encourage the people to reduce, recycle and reuse the waste materials, in many countries are giving infrastructural laws relaxation for increasing the use of recycled aggregates. The aim of our project is to analyze the properties and characteristics of concrete specimen produced using recycle concrete aggregates and to conduct analysis in ABAQUS software.

KEY WORDS: *Crushed concrete cubes, recycled coarse aggregate, Recycle fine aggregate, Paver Blocks*

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I. INTRODUCTION

One of the major challenges of our present society is the protection of environment. Some of the important elements in this respect are the reduction of the consumption of energy and natural raw materials and consumption of waste materials. These topics are getting considerable attention under sustainable development nowadays. The use of recycled aggregates from construction and demolition wastes is showing prospective application in construction as alternative to primary (natural) aggregates. It conserves natural resources and reduces the space required for the landfill disposal. Any construction activity requires several materials such as concrete, steel, brick, stone, glass, clay, mud, wood, and so on. However, the cement concrete remains the main construction material used in construction industries. For its suitability and adaptability with respect to the changing environment, the concrete must be such that it can conserve resources, protect the environment, economize and lead to proper utilization of energy. To achieve this, major emphasis must be laid on the use of wastes and by products of concrete used for new constructions. The utilization of recycled aggregate is particularly very promising as 75 per cent of concrete is made of aggregates. The enormous quantities 2 of demolished concrete are available at various construction sites and many laboratories, which are now posing a serious problem of disposal in urban areas. This can easily be recycled as aggregate and used in concrete. Research & Development activities have been taken up all over the world for proving its feasibility, economic viability, and cost effectiveness. Make it used to construct for a light weight concrete structures and non structural members.

II. LITERATURE REVIEW

The focus is on the use of Basalt Fiber Reinforced Polymer (BFRP) laminates to strengthen fire-damaged geopolymer reinforced concrete slabs. The behaviour of BFRP reinforced concrete elements, ductility, flexural capacity, and other parameters were studied using data collected from various journal papers in various approaches and aspects in order to fully utilised the effectiveness and properties of BFRP in the strengthening process.

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 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.

Cassiano Rossi Dos Santos, et al., (2013) had conducted 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.

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%.

Shishir Bansal and S. K. Singh (2014) had dealt with the sustainable 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 .the reuse and recycling 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.

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.

Nataraja and Lelin Das (**2014**) 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.

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.

Yeole and Varma (2014) had 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.

Ashish Talati and Vaishakti Talati (2014) had dealt with the use of paver blocks is increasing day by day. 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.

Neeraj Jain and MridhulGarg (2015) had conducted an experiment with the laboratory investigations for 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.

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.

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 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 this 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.

2.1.2 LITERATURE REVIEW ON RECYCLED AGGREGATES

Okorie Austine Uche (2008), studies the influence of recycled aggregate concrete (RCA) as a substitute for virgin coarse aggregate in the compressive strength of `plain concrete and concluded the use of recycled concrete aggregates (RCA) as alternative to natural or virgin aggregate in structural concrete reduces the strength development of the concrete.

Ismail Abdul Rahman et al (2009) presented the effects of size of Recycled Aggregate on compressive strength and found that the compressive strength has been improved. . **Mirjana Malešev et al (2010)** performed comparative analysis of the experimental results of the properties of fresh and hardened concrete with different replacement ratios of natural with recycled coarse aggregate and the author found the results on the basic properties of concrete with three different percentages of coarse recycled aggregate content (0%, 50% and 100%). He found that workability of concrete with natural and recycled aggregate is almost the same if water saturated surface dry recycled aggregate is used. Bulk density of fresh concrete is slightly decreased with increasing quantity of recycled aggregate. Concrete compressive strength mainly depends on the quality of recycled aggregate.

Parekh D. N. et al (2011) studied the basic properties of recycled fine aggregate and recycled coarse aggregate. He also compares these properties with natural aggregates and resulted that recycled aggregate concrete has better resistance to carbonation than natural aggregate concrete.

Katrina Mc Nei et al (2013) studied about the properties of the RCA, the effects of RCA use on concrete material properties, and the large scale impact of RCA on structural members and found that aggregate properties are most affected by the residual adhered mortar on RCA due to less density and more porosity of the RCA. They also investigated that the RCA particles are more round in shape and have more fines broken off in L.A. abrasion and crushing testes.

Jitender Sharma et al (2014) studied about the introduction and production of recycled concrete aggregates and its various applications in the construction industry and they found that when the water cement ratio used in recycled aggregate mix is reduced, tensile strength and modulus of elasticity are improved.

Jitendra Kumar Tanaji Mohite et al (2015) studied about the different test on the natural aggregate, recycle aggregate and blended aggregate and compare results and found that the strength of the recycled

aggregate concrete is slightly less for the same condition as that of the natural aggregate. The amount of the reduction depends on the parameters such as amount of blending of the recycled aggregate, w/c ratio, quality of the processed recycled aggregates.

Prabhat kumar et al (2016) presented a review of existing literature work for understanding thoroughly about RCA and the concluded from various studies that Natural aggregate can be used with recycle aggregate with a ratio of 80:20 and 70:30. Higher ratio of Recycle aggregate can worsen the properties and strength of mix and due to use of recycled aggregate in construction industry it can slow the impact of waste on environment. Also it will promote sustainable growth.

Anurag Gautam et al (2017) presented the effect of replacing river sand partially by quarry dust. The proportions of quarry dust replacing by 0%, 25%, 35%, 45% and 55%. The materials testing, workability, compressive and tensile strength of concrete were examined at 7th, 14th and 28th day of curing of M20 grade of concrete. They examined that the results are comparatively good by replacing partially with natural sand. The replacement of quarry dust up to 45% gives better result. The compressive strength and tensile strength of 45% replacement gives 31.92 N/mm2 and 3.85 N/mm2 respectively at 28th day of curing.

Tahar et al (2017) Investigated the effect of type of cement and admixture on fresh and hardened properties of concrete with coarse and fine recycled aggregates (RA) and the fresh (slump, air content and density) and hardened (compressive strength and elastic modulus) properties of recycled aggregates concrete (RAC) are analyzed and compared with those of natural aggregates concrete (NAC). In results of this experimental investigation they conclude that the slump of RAC decreases when the percentage of RA Increases and the slump of RAC with RS is almost constant when the percentage of RA is lower than 30%. However, there is significant slump loss beyond 30% of substitution and the density of RAC decreases with the increase in percentage of RA for different combination of cement and admixture.

Guo, et al.,(2018) Explain the effects of use of RA on durability of concrete. The durability of RAC is usually weaker than NAC due to the adhered mortar on the RA. For this reason, the performance of RAC can be improved by enhancing the properties of RA or adding mineral admixtures. In this paper, the durability of RAC including the impermeability, chloride penetration resistance, carbonation resistance, frost resistance and alkali aggregate reaction is critically reviewed and Understanding the durability of concrete with RA. From these they conclude that the higher the amount of adhered mortar of RA, the higher the porosity and water absorption, leading to poor durability performance of RAC.

Abids et al (2018) Investigated the strength and durability characteristics of concrete made with gypsum contaminated fine and coarse RCA with different replacement dosages ranging from 0 to 100%. The source of the contaminated recycled aggregate was crushed gypsum-plastered concrete cubes. The investigated properties were expansion, compressive strength, splitting tensile strength, and modulus of rupture. From the results of the experimental The compressive strength was lower with increasing the replacement level of virgin aggregate by contaminated RCA and The splitting tensile strength and flexural strength generally exhibited trend similar to compressive strength.

Thomas et al (2018) This research intends to analyse Strength and durability properties of concrete made with recycled concrete aggregates (RCA) they studied by an experimental investigation. The variables considered in the study are water-cement ratio, cement content and percentage of replacement of coarse aggregate (CA). Compressive strength, splitting tensile strength, modulus of elasticity and flexural strength are evaluated to study the influence of replacement of stone aggregates with recycled concrete aggregates in concrete. The durability properties such as water absorption, acid attack resistance and chloride permeability they also determined. In result it is found that the replacement ratio of aggregates has a significant eff ect on the strength properties of concrete

Damdelen, (2018), there are 2 concrete groups to investigate and compare the effects of 30% RCA and the main aim helps to Study of strength and durability parameters of concrete with partial replacement of natural use 30% RCA content in buildings for controlling CO2 emissions. This research carries out a thorough investigation of fresh & hardened RCA concrete, the thermal performance (thermal properties & thermal dynamic properties) with 30% recycled coarse aggregate content. In Experimental result found that When RCA is added to the concrete mix, it makes the concrete lighter than natural aggregate concrete mix and It decreased the thermal conductivity and thermal diffusivity but this mixture useful than the ordinary concrete.

III. CONCLUSION

Following are the major conclusions derived from the literature study,

- A list of literatures for both Paver Block and Recycled Concrete Aggregates has been collected, analysed and the summary of the literatures has been obtained. The raw materials required for the casting of paver blocks were collected. Three conventional cubes were cast and their compressive strength has been found at the end of 7 and 28th day.

- From the literature review, various types of waste materials such as silica fume, steel slag, polythene bags and tyres are is used to replacing natural aggregate and it has significant effect on the paver block.
- In Recycled concrete, the recycled aggregate are mixed in various proportion and it reduces the strength. but effective size of the aggregate has improving the strength of concrete.
- The compressive strength of the RCA is mainly depends on the quality of the recycled aggregates.
- It has better resistance to carbonation than natural aggregates.
- The recycled concrete properties have a less density, more porosity, water cement ratio is reduced , the tensile and compressive strength is improved, slump value decreases, poor durability, and it decreases the thermal conductivity.

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