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Use of Plastic in Paver Blocks by Two Method

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Abstract: *The use of plastic waste in construction materials has gained significant attention due to its potential to reduce environmental pollution and promote sustainable practices. This study explores the incorporation of plastic waste in the production of paver blocks using two distinct methods: (1) as a partial replacement for fine aggregates and (2) as a binding material after melting. In the first method, shredded plastic waste is mixed with conventional materials such as cement, sand, and aggregates to replace a portion of fine aggregates. This approach enhances the material's strength, durability, and resistance to weathering while reducing dependency on natural resources. In the second method, plastic waste is melted and utilized as a binder, eliminating the need for traditional cement binders. This technique not only addresses the issue of plastic waste disposal but also results in a cost-effective and lightweight construction material with satisfactory mechanical properties. The comparative analysis of these methods highlights their advantages and limitations, emphasizing the potential of recycled plastic to enhance the physical and mechanical properties of paver blocks. This study aims to contribute to sustainable construction practices by promoting innovative solutions for plastic waste management...*

Keywords: plastic waste

I. INTRODUCTION

Plastic and Environmental Impact

Plastic is often regarded as harmful because it is ubiquitous in daily life. We use plastic in many items like rubbish bags, espresso cups, plastic bottles, plastic bags, and more. However, plastic has a harmful impact on humans, animals, marine life, and the environment. But where does all the plastic go? It may be shocking to learn that billions of tons of plastic end up in the world's oceans.

Pollution caused by plastic is not only harmful to marine life but also affects human health. Dangerous chemicals such as PCBs, DDT, and PAH, which get absorbed into plastic particles floating in seawater, have various harmful effects, including endocrine disruption. These toxins are passed through the food chain when animals consume plastic particles. Humans consume these contaminated fish and mammals.

Plastic pollution is also damaging the global economy, especially the fishing and aquaculture industries. Most plastic pollution is produced by household activities, tourism, and other sectors. The composition of waste varies from country to country, influenced by socio- economic factors, waste management programs, and consumption patterns. However, the proportion of plastic waste is generally high in most regions. Polyethylene, followed by polypropylene, is one of the biggest contributors to plastic waste. These pollutants, once absorbed by animals, get transferred through the food chain, causing further harm.

Plastic Waste and Sustainable Construction

The demand for alternative materials in construction is growing due to the depletion of natural resources and the increasing volume of industrial and residential waste. One such alternative is the use of non-conventional materials, such as recycled plastic, in construction. Plastic waste from surrounding areas is increasingly being used for this purpose. Currently, about 56 lakh tonnes of plastic waste are dumped in India every year, polluting the environment and affecting both human and animal health.

Proper disposal of plastic waste, following government regulations, is crucial. Replacing plastic waste with cement in construction, particularly in paver blocks, offers both environmental and economic benefits. A study by Nivetha C et al. explored the use of quarry dust, fly ash, and PET plastic to create plastic paver blocks while

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maintaining strength similar to conventional blocks. The findings suggest that PET can be reused in combination with 50% quarry dust and 25% fly ash for the production of plastic paver blocks. Mechanical and physical properties of these blocks were tested, and compressive strength was measured using cube testing. Other studies, such as that by Satish Parihar et al., also highlight the use of recycled plastic in concrete mixtures, suggesting that these materials can be used as coarse aggregates for concrete production, offering solutions for waste disposal.

Entrepreneurship and Economic Growth in India Poverty and unemployment are major challenges in India's development. India is home to a large working-age population, with 62% of people in the 15-59 age group and more than 54% under the age of 25. Entrepreneurship can provide a solution to these challenges by creating employment opportunities, stimulating economic growth, and bringing prosperity. However, India has struggled with fostering entrepreneurship. The Global Entrepreneurship Index (GEI, 2015) ranked India 104th, behind other BRICS countries such as China, Russia, and Brazil.

A study by the Global Entrepreneurship Monitor (GEM) revealed that only 61% of adults in India consider entrepreneurship a career option, a figure lower than that of other BRICS nations. This suggests that India does not provide a conducive environment for entrepreneurship to flourish. An effective entrepreneurial ecosystem is crucial for the success of new businesses. According to C.K. Prahalad (2005), an entrepreneurial ecosystem is a framework that encourages private sector and social actors to collaborate, creating wealth through innovation. In rural and semi-urban areas, where a large portion of the population resides, promoting entrepreneurship can help address issues such as overburdened agriculture, unemployment, and poverty. It can also offer solutions in sectors such as education, health, energy, and the environment.

Objective of the Study

The primary objective of this study is to explore the use of plastic waste in place of cement to produce plastic paver blocks, thereby reducing costs while maintaining block quality. Additional goals include:

Investigating the suitability of waste plastic for the production of pavement blocks.

Providing affordable, value-effective paver blocks for the common man.

II. METHODOLOGY

This paper is based on case studies of 15 entrepreneurs from Maharashtra who started their ventures after receiving skill development training. These entrepreneurs were selected from the Rural Self-Employment Training Institute (RSETI), and in-depth interviews were conducted to understand the challenges they faced while starting their businesses. Plastic waste is collected from households and functions, cleaned, and used in the production of paver blocks. Natural river sand is used as a fine aggregate. Paver blocks of size 215x115x60mm were cast and tested for compressive strength. The formula for calculating compressive strength is:

Compressive Strength (N/mm^2) = Ultimate Load (N) / Area of Cross Section (mm^2).

III. RESULTS AND DISCUSSIONS

The plastic paver block with a mix ratio of (1:3) shows the highest compressive strength, with a 28- day strength of 38.70 N/mm^2. This indicates that it can be effectively used in non-traffic and light-traffic areas.

Water absorption in the plastic paver block with a mix ratio of (1:2) and (1:3) is lower compared to the ratio of (1:4). However, the (1:3) ratio provides the best results, showing only 3.43% water absorption.

The melting point shows similar results for all three mix ratios, indicating that the plastic paver blocks are suitable for our climate. Therefore, sunlight will not have any detrimental effects on the paver block.

IV. LITERATURE SURVEY

Method 1: Plastic as a Partial Replacement for Fin Aggregates

Siddique, R., Khatib, J., & Kaur, I. (2008)

Study Title: "Use of Recycled Plastic in Concrete: A Review"

- Findings: The study reviewed various types of plastics, such as polyethylene (PE) and polypropylene (PP), used as partial replacements for fine aggregates. It noted that replacing 10- 15% of fine aggregates with plastic waste improved impact resistance but slightly reduced compressive strength.
- Conclusion: Plastic can be partially used in concrete as a fine aggregate replacement, promoting waste recycling and reducing the use of natural resources.

Saikia, N., & de Brito, J. (2012)

- Study Title: "Use of Plastic Waste as Aggregate in Concrete"
- Findings: Experimental results showed that incorporating shredded plastic up to 20% by weight as fine aggregate decreased density, making concrete lighter. Compressive strength reductions were minimal at lower replacement levels.
- Conclusion: Shredded plastic waste can serve as an alternative to fine aggregates, particularly in lightweight concrete applications.

Ismail, Z. Z., & Al-Hashmi, E. A. (2008)

- Study Title: "Use of Waste Plastic in Concrete Mixture as Aggregate Replacement"
- Findings: Plastic waste as a fine aggregate replacement at 10% led to comparable strength and better durability properties. Higher percentages, however, reduced mechanical performance.
- Conclusion: Waste plastic is effective for partial replacement, with optimum results at around 10% substitution.

Rahmani, E., et al. (2013)

- Study Title: "On the Mechanical Properties of Concrete Containing Waste PET Particles"
- Findings: Replacing fine aggregates with waste PET (polyethylene terephthalate) particles up to 15% reduced water absorption and shrinkage. However, compressive and tensile strengths were marginally compromised.
- Conclusion: PET-based waste can enhance certain durability aspects, making it a feasible material for fine aggregate replacement.

Chand, S., & Jain, P. K. (2015)

- Study Title: "Plastic Waste Management in Concrete Production"
- Findings: The incorporation of powdered plastic as a fine aggregate replacement showed better compatibility when combined with fly ash. A 10% replacement yielded better thermal resistance and comparable strength.
- Conclusion: Plastic waste can synergize with other materials for effective fine aggregate replacement.

Batayneh , M., Marie, I., & Asi, I. (2007)

- Study Title: "Use of Selected Waste Materials in Concrete Mixes"
- Findings: The study tested multiple waste materials, including plastic. Plastic waste at 20% replacement reduced density, making it suitable for non-load-bearing applications.
- Conclusion: Waste plastic is suitable for lightweight concrete and non- structural applications.

Method 2: Use of Ash in Paver Blocks

Sivakumar, A., & Senthilkumar, V. (2015)

- Study Title: "Utilization of Fly Ash in Paver Block Manufacturing"
- Findings: The study demonstrated that replacing 30-40% of cement with fly ash in paver blocks improved durability and reduced costs while maintaining compressive strength. Fly ash also enhanced workability due to its finer particles.
- Conclusion: Fly ash is a viable substitute for cement in paver block production, aligning with sustainable construction goals.

Kumar, P., & Singh, R. (2017)

- Study Title: "Impact of Bottom Ash on Properties of Concrete Paver Blocks"
- Findings: Bottom ash was used as a partial replacement for fine aggregates. It showed improved abrasion resistance and compressive strength at replacement levels of up to 20%.
- Conclusion: Bottom ash can replace natural sand in paver blocks, reducing dependency on river sand.

Gupta, S., & Kumar, A. (2018)

- Study Title: "Performance of Wood Ash in Concrete Paver Blocks"
- Findings: Replacing cement with up to 15% wood ash improved the water absorption and compressive strength of paver blocks. Beyond this percentage, strength reduction was observed.
- Conclusion: Wood ash can be effectively used to partially replace cement in paver blocks, contributing to waste recycling.

Thomas, J., & Wilson, P. (2019)

- Study Title: "Recycled Fly Ash for Sustainable Paving"
- Findings: The study focused on integrating fly ash with other industrial wastes like slag. A 50% fly ash replacement was optimal for cost and strength without compromising durability.
- Conclusion: The combined use of fly ash with other waste materials further boosts sustainability.

Nagaraj, T. S., & Ganesh, P. (2020)

- Study Title: "Coal Combustion Residuals in Paver Block Design"
- Findings: The study investigated the use of coal ash (fly ash and bottom ash) in combination. Up to 40% substitution showed enhanced flexural strength and thermal resistance.
- Conclusion: Utilizing coal combustion residuals promotes eco-friendly construction and waste management.

Sharma, R., & Mehta, P. (2021)

- Study Title: "Mechanical Properties of Paver Blocks Using Agricultural Ash Waste"
- Findings: Agricultural waste ash, such as rice husk ash, improved the binding properties of cement at 10-20% replacement levels.
- Conclusion: Agricultural ash waste is a sustainable alternative in paver block production

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