REVIEW PAPER ON DESIGN OF PERMEABLE PAVER BLOCK

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Abstract- **In this project, we intend to review on design a permeable paver blocks that allow water to pass through them and reduce the risk of runoff. They are designed with gaps or opening that allow rain water to infiltrate into the ground instead of surface runoff. Three sample were prepared: one using nominal mix design of M10 with cement, sand, coarse aggregate; another with admixture; and a third with no fine aggregate, in a 60mm thickness of tri-hexa mould. Compressive strength test, infiltration rate measurements, permeability test and flexural strength test were carried out for the design mix proportions. The results clearly indicated that the sample containing only admixture, cement and coarse aggregate had the highest compressive strength as compared to other two samples. The applications of these permeable paver blocks in pedestrian ares and garden areas offers an opportunity to enhance water infiltration and reduce runoff.**

Key Word: **Permeability; infiltration; environment sustainability; groundwater recharge**

I. INTRODUCTION

General

Stormwater runoff poses significant challenges to environmental sustainability. Traditional impervious surfaces exacerbate this problem by hindering natural drainage and increasing the risk of flooding. In response to these challenges, permeable paver blocks have emerged as a sustainable paving solution designed to mitigate the adverse effects of stormwater runoff. Permeable paver blocks feature openings that allow water to infiltrate through the surface, promoting natural drainage and reducing the risk of flooding. Unlike conventional paving materials, these blocks offer a porous surface that facilitates water infiltration into the underlying soil, thereby replenishing groundwater reserves and reducing strain on drainage systems. This introduction sets the stage for exploring the role of permeable paver blocks in sustainable land management. By addressing issues related to stormwater runoff and environmental impact, permeable paver blocks offer a promising solution for enhancing water management practices and promoting eco-friendly development. In this review paper, we will delve into the characteristics, applications, benefits, and challenges associated with permeable paver blocks, highlighting their significance in modern construction.

Properties of permeable paver blocks

Permeable paver blocks are special because they let water go through them. They're usually made of materials like concrete and are designed to fit together tightly for strength. These pavers are great for managing rainwater because they clean out dirt and let the water soak into the ground. They come in lots of sizes, shapes, and colors, so they look good and are useful too. It's really important to put them in properly so they work well and to keep them clean and in good shape. Also, it's important to follow the rules where you live to make sure they're good for the environment and meet building standards. Overall, permeable pavers are a smart and eco-friendly choice for landscaping projects.

II. METHODOLOGY

The process begins with the collection of materials such as aggregates and admixtures for examination. Initial tests are conducted on these materials to assess their suitability for use in the mix. Tests on aggregates, including water absorption, impact value, crushing value, and Los Angeles abrasion, are performed to confirm their characteristics. Once the suitability of the materials is established, the design of permeable paver blocks commences. This involves determining the appropriate proportions of aggregates and admixtures to achieve the desired properties in the final product. Subsequently, three samples of paver blocks are prepared using different proportions to explore various mixes and assess their performance.

Permeable paver system:-
When it comes to permeable pavement solutions, various types of permeable paver block systems are available, each with its unique characteristics and installation requirements. Proper installation procedures and adherence to specifications are crucial for ensuring the effectiveness and longevity of permeable pavement systems. Skilled personnel play a significant role in facilitating the installation process and optimizing the performance of these systems (Atul S. Kurzeker & jayale, 2017).

1.Porous Concrete Block: Porous concrete, also referred to as permeable concrete, gap-graded concrete, or enhanced porosity concrete, is engineered to allow water to drain through it effectively. This type of concrete is characterized by reduced sand or fine materials content, which creates voids or pores, enabling water infiltration.

Figure 1:- Porous Concrete Block

2. Plastic Reinforcement Grid Pavers (Geocells): Plastic reinforcement grid pavers, commonly referred to as Geocells, are composed of flexible plastic interlocking units. These units come in various shapes, facilitating water permeation into the ground. Typically, gravel and sand fill the gaps between the units. Geocells boast impressive water percolation rates, ranging from 90% to 99%. However, their ability to sustain heavy loads is limited, making them unsuitable for road construction. The percolation capacity heavily relies on the filter media used over the flexible plastic. Despite this limitation, plastic grid systems are popular among homeowners due to their affordability, easy installation, and versatility (Atul S. Kurzeker & jayale, 2017).

Figure 2:- Plastic Reinforcement Grid Pavers (Geocells)

3. Interlocking Concrete Pavers: Permeable interlocking concrete pavers offer not only functional benefits but also enhance architectural aesthetics. These concrete units feature small openings between joints, typically comprising 5% to 15% of the paver surface area. These gaps are filled with highly permeable material, facilitating water infiltration. Unlike plastic reinforcement grid pavers, interlocking concrete pavers can withstand heavy loads, making them suitable for various applications. However, they are not recommended for high-speed vehicular roads or areas with high traffic volume due to their permeable nature. (Asawale, 2018)

Figure 3:- Interlocking Concrete Pavers

4. Pavers with holes: Permeable paver blocks have gained significant attention in recent years due to their ability to manage stormwater runoff effectively while providing durable and aesthetically pleasing pavement solutions. This review paper focuses on the utilization of rice husk ash (RHA) as a partial replacement for cement in the production of permeable paver blocks. The inclusion of RHA offers several benefits, including reduced weight, improved strength, and enhanced permeability. This paper evaluates the properties and performance of permeable paver blocks incorporating RHA, discussing their manufacturing process, structural characteristics, water permeability, and environmental impact. Additionally, it examines the economic viability and availability of RHA as a sustainable alternative material for permeable pavement construction.

Figure 4: Pavers with holes

Mix proportioning

Three samples were designed in different proportions.

a) **Permeable paver block** : This sample used a basic mixture of 10mm aggregate, cement, and water. It serves as a reference point to understand the fundamental properties of the paver blocks without any additional additives.

b) **Paver block with Admixture**: An admixture, which is a substance added to the mixture to improve its properties, was included along with cement, aggregate, and water. Air-entraining admixtures are additives that create tiny air bubbles in concrete during mixing.

c) **Paver block with Sand mix**: This sample followed a specific mix design, in this case, grade M10 (1:3:6), which means one part cement, three parts sand, and five parts aggregate, without the use of admixture. This particular mix design is formulated to achieve a certain level of strength and durability suitable for paver blocks.

III.APPLICATION OF PERMEABLE PAVER BLOCKS AT PARKING LOTS AND GARDEN AREAS

Permeable pavers are a great solution for parking lots and garden areas because they allow rainwater to pass through them, reducing runoff and helping to prevent pollution. In traditional parking lots, rainwater can't soak into the ground and instead flows over the pavement, picking up pollutants like oil and chemicals, which then end up in nearby water sources like retention ponds. This can cause environmental damage and erosion. Researchers at the University of Washington found that when they replaced traditional pavement with permeable pavement in six different locations, the results were impressive (Atul S. Kurzeker & jayale, 2017). Even during heavy storms, the permeable pavement allowed rainwater to seep into the ground with minimal runoff. They only observed runoff at specific times during the day. Not only did permeable pavement reduce runoff, but it also improved the quality of the water that was absorbed into the ground. Compared to runoff from traditional pavement, the water absorbed by permeable pavement was cleaner. This means that permeable pavement not only helps prevent flooding and erosion but also protects water quality, making it a win-win solution for parking lots and garden areas.

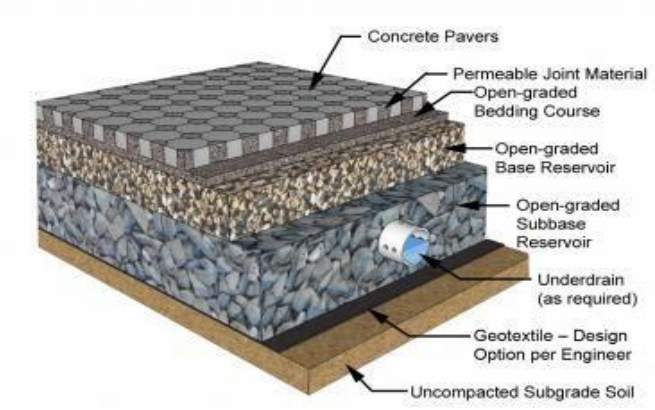


Figure 5: Cross section of permeable paving system

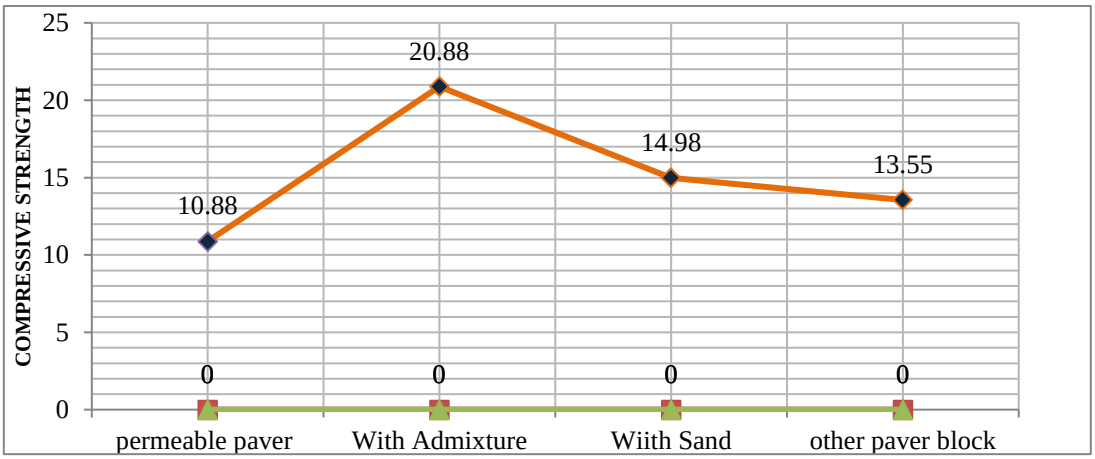
IV.RESULT AND DISCUSSION

1. Compressive strength test :

The compressive strength test evaluates a material's ability to withstand axial loads by subjecting a meticulously prepared sample to gradual compression using a specialized testing machine. This test is commonly employed for materials such as concrete, rock, and specific metals. It involves monitoring the applied load and corresponding deformation until failure transpires. The ultimate compressive strength is ascertained by dividing the maximum load at failure by the cross-sectional area of the specimen. This test holds immense significance in industries like construction, as it ensures that materials adhere to required specifications, thereby enhancing the structural integrity and safety of diverse applications (Atul S. Kurzeker & jayale, 2017).

Compressive strength Result

Sample	Area of sample	Applied load	Compressive strength
permeable paver block	28059.22(mm²)	300.81 KN	10.81 N/(mm²)
Admixture mix	28059.22(mm²)	586 KN	20.88 N/(mm²)
Sand mix	28059.22(mm²)	418.79 KN	14.98 N/(mm²)
Other traditional paver block	31763.83 (mm²)	430.4KN	13.55 N/(mm²)



V. CONCLUSION

The design of permeable paver blocks offers a sustainable solution for various paving applications. The permeable nature of these blocks allows rainwater to infiltrate the ground, reducing surface runoff and aiding in groundwater recharge. This not only helps in mitigating stormwater runoff issues but also contributes to the overall health of the ecosystem Permeable paver blocks are versatile and can be used in various settings such as parking lots, driveways, walkways, and even in urban landscapes. Their ability to manage water runoff effectively minimizes the risk of flooding and erosion, making them a valuable asset in stormwater management practices. (Veerakumar, 2018).

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