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Behavior of Pervious Concrete

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Abstract- ***Pervious concrete is being promoted to a greater extent due to this property, as it permits the entry of water into the surface and reduces the surface runoff on the surface. This property of pervious concrete makes it more useful in sustainable building processes. The mechanical properties of pervious concrete heavily depend on the mixture and the aggregate content. This article presents the results of an investigation carried out on pervious concrete of M25 grade and different percentages of sand content, i.e., 0%, 20%, 30%, and 50%. Literature and experimental study on the compressive strength characteristics of pervious concrete have been critically discussed and compared with respect to standard requirements pertaining to different M25 grades of concrete. Results of this investigation are highly useful in understanding different requirements and needs pertaining to pervious concrete mix.***

Keywords- ***Pervious Concrete, M25 grade Concrete, Sand content Variation, Compressive strength, Sustainable Construction, Permeable pavement***

I. INTRODUCTION

Among all the consumables in infrastructure, concrete is one of the most usable construction materials for building infrastructure like buildings, roads, pavements, and bridges. Traditional concrete is dense and impermeable; this gives high strength but develops some environmental problems in urban areas. Impervious surfaces of larger areas inhibit the rainwater from percolating in the soil and thereby cause water logging, flood, erosion of soil, and reduction in the ground recharge of water.

The problem, as previously explained, has led to various adverse effects in different ways, but there is a solution, which is innovative and sustainable, called pervious concrete. It is a type of concrete with minimal aggregate, hence aggregates free, which means it has enough room for water penetration. It can be used in stormwater management, groundwater replenishment, reduction of runoff, and urban heat island reduction. Therefore, it is mostly used for pavements, parking lots, sidewalks, and low-traffic volume roads.
Nevertheless, the disadvantage associated with the use of pervious concrete is that the method is characterized by lower compressive strength than that of the regular concrete it is meant to replace. An available method for increasing the compressive strength of pervious concrete is by partially replacing the fine aggregates instead of replacing the aggregates entirely. This is because it increases bonding properties.

In this project, M25 grade of concrete will be used by varying the sand content at 0%, 20%, 30%, and 50%, and the compressive strength tests will be carried out after 14 days of curing in order to observe the effect of varying the amount of sand on the strength of the concrete mixture. This lab-oriented project will help the students to understand the concept of concrete mix design and sustainable practices in construction and will contribute to the research of efficient utilization of pervious concrete.

II. IDENTIFY, RESEARCH AND COLLECT

First and foremost, the identification of a proper research idea is the stepping stone to complete the research work. In the context of the present review paper, the research idea was formulated after conducting a detailed study of the existing literature based on the current practices concerning pervious concrete and sustainable construction materials.

Initially, already published research papers, journal `articles, and conference publications on the subject of pervious concrete were studied to identify the trends in research, proportions most commonly adopted in the mix, and the existing research gaps. Most of the studies and published papers focused on the strength, permeability, and durability properties of pervious concretes possessing low percentages of fine

aggregates, which shows a need for further research on the effect of sand percentages on the outcome.

Apart from this, the literature searching continued on the Internet, where academic databases, Google Scholar, and other research-oriented websites were utilized to obtain the latest updates and research findings related to M25 grade pervious concrete.

This was further shaped by participation in technical conferences, workshops, and symposiums on concrete technology and sustainable infrastructure. These were useful platforms to understand practical insights into current and future research directions involving real-world applications and challenges of pervious concrete.

Furthermore, relevant scientific terms, standards, and technical terminology, which are related to concrete mix design, compression strength, and related characteristics of pervious concrete, were studied in detail. This helped in understanding the subject matter clearly, and accordingly, it was possible to frame the review paper based on standard technical practices.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

- Study Overview

1. Collection of materials (cement, sand, coarse aggregate, water).
2. Casting of M25 concrete with mix design (1:1:2).
3. Casting of concrete cube with 0%, 20%, 30% and 50% sand.
4. Curing of cube for 14 days.
5. Take compaction test on M25 cubes.
6. Take compaction test on 0%, 20%, 30% and 50% sand concrete cubes.
7. Comparison and analysis strength withM25 concrete.

- Findings

Successful Production of M25 Control Concrete
The control specimen will be the M25 concrete with the mix design of 1:1:2. This concrete should exhibit higher compactness and compressive strength characteristics compared to the pervious concretes. This is due to the consistent sand content and dense particle arrangements.

Effect of sand percentage on concrete structure

1. 0% sand-

The properties of the concrete will include high porosity, low density, and poor compaction. The properties of this mixture include very low strengths and high permeability, making it one of the properties of pervious concrete.

2. 20% sand-

Partial filling of the voids is beneficial for bonding between aggregates. There is an improvement in strength as well as compaction in comparison to 0% sand. However, the permeability is the same.

3. 30% sand-

The combination is likely to achieve the best balance between strength and permeability. The compactness is improved, along with a reduction in void content to an optimal level.

4. 50% sand-

An increased amount of sand material causes a considerable decrease in voids. The strength tends to approach conventional concrete strength; however, porosity is reduced because of decreased permeability.

IV. GET PEER REVIEWED

- Performance Evaluation of Pervious Concrete for Pavement Applications (Kevern et al., 2014) - The paper discusses the structural performance in pervious concrete pavements and how mix composition could affect load-bearing capacity.
- Research on Study on Pervious Concrete Properties and Design Methodology (Shreya, 2018) - The paper discusses some of the advantages associated with using pervious concrete in structural applications and also explains some of the materials used and methodologies involved in sieved analysis, specific gravity, water absorption tests, and aggregate impacting value tests.
- Properties of Pervious Concrete Containing Fly Ash (Aoki, Sri Ravindrarajah & Khabbaz, 2012) - It entails experimental evaluation of pervious

concrete with fly ash as partial replacement for cement to examine properties like density, porosity, compressive strength, permeability, and drying shrinkage of pervious concrete

- Evaluation of Permeability of Porous Concrete (Lian, Zhuge & Beecham, 2011) - The different techniques used in finding the water permeability of concrete are evaluated through comparisons between the constant head and falling head tests.

V. IMPROVEMENT AS PER REVIEWER COMMENTS

- Comment 1: Poorly reviewed literature of peer-reviewed sources

Improvement:
The literature review section has been expanded to recent peer-reviewed journal papers on pervious concrete and its mechanical behavior.

References added concerning the effects of fine aggregate content on strength and permeability characteristics of pervious concrete.

Included comparatives studying conventional concrete versus pervious concrete for the applications of sustainable construction.

- Comment 2: Lack of clarity in results and data interpretation

Improvement:
Presented compressive strength results in tabular and graphical forms for different percentages of sand.

Obviously, the results of the experiment have been compared with the standard requirements for the concrete strength of M25.

Added a detailed discussion explaining the trend in variation of strength with increasing content of sand and its influence on the behavior of pervious concrete.

- Comment 3: Abstract and introduction too general

Improvement
The abstract has been revised to reflect the purpose of the study, the approach used in the selection of the subject and the data collection, the main findings, and

Improved the introduction by defining the research problem, scope of work, and the significance of investigating sand variation in pervious concrete.

VI. CONCLUSION

This study present the important aspects and results obtained from various research papers related to pervious concrete, with special reference to M25 grade of concrete and the percentage of sand. According to the findings from various research papers, it can be concluded that the percentage of sand is important for determining the compressive strength.

A general trend from all these studies is that fine aggregate is added in limited quantities to improve strength through better particle interlocking and reduction in voids. There is a general agreement from the literature, however, on the detrimental effect of excessive quantities of sand in pervious concrete on permeability, which is characteristic of pervious concrete. While the overall consensus from different studies confirms the trade-off between strength and permeability, the consistency in these results can also depict the effect of different mix designs and testing methods.

The review also found specific gaps and limitations in the literature. For instance, there is relatively little concern for durability in the long term, field performance, and standard testing programs for pervious concrete. Also, the optimal percentage of sand in pervious concrete for both satisfactory strength and permeability is still a subject for further research. Accordingly, future research directions could be focused on long-term performance evaluations, durability aspects, and the use of admixtures or materials to improve the characteristics of pervious concrete. Further study will aid in finding the best mix design, which can be used in sustainable infrastructural developments.

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