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EXPERIMENTAL STUDY OF PERVIOUS CONCRETE

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ABSTRACT

Pervious concrete is a unique form of concrete with a high porosity that is used for concrete flatwork applications and allows water from precipitation and other sources to pass straight through it, decreasing runoff and permitting groundwater recharge. This paper's main goal is to determine the strength of pervious concrete made from industrial waste and locally accessible resources. The results of an experimental inquiry on pervious concrete are given and analyzed in this overview. The use of industrial waste (fly ash) has lowered the quantity of general-purpose portland cement used, and aggregates have been substituted with varied sizes of aggregates. Steel fiber is also utilized to improve the strength and make cost-effective pervious concrete. Pervious concrete mix designs are created, concrete specimen samples are created, and tests are done on pervious concrete specimens to determine the strength of pervious concrete and compare it to conventional concrete.

Keywords: Pervious Concrete, Porosity, Strength, Super Plasticizer.

I. INTRODUCTION

Porous concrete, by definition, is a composition of gravel, granite stone, cement, water, and little to no sand. It is also referred to as no-fines concrete, porous concrete, gap-graded concrete, and permeable concrete (fine aggregate). Rainfall can penetrate through the porous cell wall structure from porous concrete and through the underlying soils. In other terms, porous concrete helps to protect the surface of the pavement including its surroundings. Pervious concrete is also a novel and successful method of addressing critical environmental challenges and promoting long-term growth. When it rains, pervious concrete serves as a drainage system, directing water back to its proper place. Pervious concrete is rough-textured and has a honeycombed surface, with a substantial amount of surface raveling that happens on frequently used highways. To make a paste, precise proportions of water and cementitious material are combined. Using just enough paste to cover the particles, creates a network of linked gaps that allows water and air to pass through. The absence of sand in pervious concrete produces an extremely abrasive mix that has a severe impact on mixing, delivery, and installation. Furthermore, because of the large void content, pervious concrete is light in weight (about 1600 to 2000kg/m3). The permeable concrete void concept collects pollutants while simultaneously adding substantial structural strength. Pervious concrete can be used in a variety of applications, the most common of which are pavements in side roads, alleys, and parking lots, light traffic pedestrian walkways, low water crossings, streets and pathways, parking areas, athletic fields, slope stabilization, sub-base for conventional concrete pavements, and so on.

II. MECHANISM OF SUPERPLASTICIZER

CICO PLAST SUPER-190A is a new generation concrete admixture based on modified sulphonated naphthalene formaldehyde and other organic polymers that combine the properties of a superplasticizer with a high degree of slump retention characteristics, a high range water reducer, and also acts as a concrete waterproofer. It complies with IS9103, ASTM C-494, and BS 5075. CICO PLAST SUPER-190A is used to make exceptionally flowing concrete, pumped concrete, pre-stressed, pre-cast high strength, and denser concrete, as well as industrial/commercial flooring and floor toppings. This product is best suited to concrete grades ranging from M10 to M35. For a higher quality of concrete, visit a local CICO specialist to pick an appropriate CICO product.

III. LITERATURE REVIEW

Patil V.R et al.in (2010)

The purpose of this article was to look into the "Use of pervious concrete in the building of pavements to improve their performance." Nowadays, cities are surrounded by airtight and waterproof concrete roads and structures. Furthermore, the city's environment is far from natural. Rainwater is not filtered beneath due to the absence of air permeability and impermeability of typical concrete pavement, making normal plant growth impossible. Aside from that, the earth has a tough time exchanging heat and moisture with the surrounding air. As a result, in major cities, the temperature and humidity of the earth's surface cannot be controlled, resulting in hot spots. Pervious concrete is also frequently used as a surface course for highways in Europe and Japan to increase skid resistance and minimize traffic noise. Because of the significant porosity, the material's strength is relatively low. The material's compressive strength ranges from 3 - 30 MPa. Squares, pathways, parking lots, and park trails are the only sites where pervious concrete can be used.

Shah darshan s. et al.in(2013)

This research looked at "Pervious Concrete: A New Era in Rural Road Pavement." Pervious concrete pavement in rural regions becomes more suited to satisfy the requirements of the rural area, such as lowering stormwater runoff and boosting groundwater levels, in order to minimize costly stormwater management measures. Based on the case study, we infer that there is a significant savings of around 29Rs/m3 or 193Rs/m2 or 18Rs/feet2 for the building of a 1m*1m*0.15m size pavement. Pervious concrete is a relatively new concrete for rural pavement construction that provides cost advantages. Pervious concrete is widely utilized globally because of its environmental, hydraulic, and durability features.

Vikram et al.in (2015)

The focus of this research was "Experimental Study Of Pervious Concrete Pavement." The qualities of fresh and hardened pervious concrete have been studied using different mix proportions by substituting cement with silica fume (6%), as well as the inclusion of superplasticizers (0.13 percent and 0.25 percent). In the current investigation, a concrete mix containing cement, a coarse aggregate ratio of 1:4, and a water-cement ratio of 0.34 were used as the control mix. The slump test, compaction factor, and flow table test was used to determine the workability of the concrete mix. The inclusion of silica fume (6 percent content) and 0.13 percent superplasticizers reduced the slump of the concrete mix. The workability of the paste and concrete improved with the addition of 0.13 % and 0.25 % superplasticizers because the sulfonic acid groups contained in them were responsible for neutralizing the surface charges on the cement particles and reducing the viscosity of the paste and concrete.

Murthy B.V.R. et al.in (2018)

This article looked at "Study on Strength Improvement of Pervious Concrete." Individual tests on cement and coarse aggregate were conducted in this article. Which cement, Robo sand, coarse aggregate (25mm passing and 16mm retained, and 10mm passing and 6mm retained), and water were used. Mixtures were made, and compressive strength and permeability tests were performed. The strength of pervious concrete was increased by using 5% Robo sand as a fine aggregate and 100% coarse aggregate in the mixtures.

Rahangdale Sourabh et al.in (2017)

This research looked at the "Study of Pervious Concrete " Aggregates, cementitious material, and admixture were employed in this case. Cubes and cylinders were constructed, and compressive, tensile, and permeability values were determined after 7, 21, and 28 days. Compressive strength was found to be 18.7Mpa, 24.9Mpa, and 26.9Mpa after 7, 21, and 28 days, respectively, as well as the tensile strength of 1.18Mpa, 1.38Mpa, and 1.5Mpa and permeability of 6.9 mm/sec.

Y.Aoki et al.in (2012)

This study looked at the "properties of pervious concrete containing fly ash." The major features of pervious concrete containing fly ash were researched in this publication. The density, porosity, compressive strength, water permeability, and drying shrinkage of several previous concrete samples were meticulously examined. A number of conventional 100mm diameter by 200mm height cylinders were formed in steel moulds and tested for compressive strength and water permeability on hardened concrete at various ages. Seven different pervious concrete mixes with 0 percent, 7.5 percent, and 10% fine aggregates were evaluated. When manufactured using up to 50% fly ash as a partial substitute for portland cement, the physical qualities of environmentally friendly pervious concrete are in the acceptable range for restricted usage.

Jongvivatsakul P.et al. in (2016)

The "Properties of pervious concrete aiming for LEED green building rating system credits article" was examined in this study. The right mix percentage yields high LEED points as well as strong mechanical characteristics. Cement was replaced with fly ash (20% to 60%) and coarse aggregate was replaced with recycled aggregate (20% -100%). Pervious concrete properties such as permeability, void content, compressive strength, and splitting tensile strength were examined in relation to LEED credits and design values. The results revealed that the mix proportions of cement substituted by 40% and 60% fly ash produced the greatest LEED credit points while still providing adequate mechanical qualities.

Kumar S.R.et al. in (2015)

The "Characteristics research on pervious concrete" was explored in this work. The research looks at the impact of fine aggregate on the strength and durability of pervious concrete. A total of 42 specimens were cast, cured, and evaluated for compressive, flexural, and void ratio. This study includes seven distinct combinations. Various design combinations were employed. Some were cast with fine aggregate, whereas others were cast without. In addition, for the mixed purpose, two different sizes of coarse aggregates were employed, one 12mm and the other 20mm. The fine aggregate came in two varieties: regular river sand and crushed stone sand. Various design mixes were replicated in order to determine the qualities of the pervious concrete derived from the various mixtures. For the test, a total of seven mixes were created. The following information was gathered by examining the various attributes of different mixes as the voids ratio, compressive strength, and flexural strength values increased.

Rakesh S.et al. in (2017)

He conducted research on "An experimental investigation on the performance of permeable concrete." The primary goal of the research is to analyze the permeability of concrete's distinctive qualities such as compressive strength and split tensile strength, as well as to manufacture strong and durable permeable concrete utilizing various sizes of coarse aggregate and cement. In this publication, they utilized conventional portland cement of grade 53, coarse aggregate with angular shapes of 10mm and 20mm in size, and water with a ph value ranging from 6 to 8. They employed cast concrete cubes of 150mm*150mm*150mm to measure the compressive strength of concrete, as well as cast cylinders of 15cm dia and 30cm length, which were then tested after 7 days, 14 days, and 28 days. They had attained the requisite strength of M15 grade concrete after conducting tests on cube and cylinder.

Bhutta M.A.R.et al. in (2012)

He researched the issue of Evaluating the qualities of high-performance porous concrete. The purpose of this laboratory investigation was to assess the qualities of high-performance porous concrete. Slump, slump-flow, void ratio, coefficient of permeability, compressive and flexural strengths, and strength development rate were all tested on this concrete. In addition, a test to investigate the effects of high water-reducing and thickening (cohesive) agents on the self-compaction of high-performance porous concrete was proposed. Its toughened qualities were to be evaluated from the standpoint of practical use. The development of novel freely dropping methods has a substantial impact on the apparent density, compaction, total void ratio, coefficient of permeability, and compressive strength of HPPC. The examination of the workability of HPPC using this approach is successful. The apparent density is about the same in different places, indicating a compaction index of greater than 80%. By using the freely dropping approach, the permeability of HPPC is acceptable. However, when HPPC was created with varying aggregate sizes, the permeability values varied.

IV. APPLICATION

1. Pervious concrete helps to regulate runoff and is often regarded as the greatest stormwater control approach. Pervious concrete is primarily used in the construction of pavements.

2. Because porous concrete is light in color, thus it assists in energy savings. Because the concrete reflects light, the demand for illumination at night is decreased.

3. More water is directed at the trees and landscape, reducing the requirement for irrigation water.

4. It minimizes the quantity of untreated runoff water that enters storm sewers by improving infiltration at the location.

5. Pollutants are kept from polluting the watersheds, protecting vulnerable ecosystems.

V. CONCLUSION

This review article investigates the many criteria and characteristics utilized by various studies on previous concrete. The following conclusions were obtained from prior studies on previous concrete:

1. Pervious concrete is becoming increasingly used as an effective stormwater runoff management solution across the world. As a result, the performance of pervious concrete, as well as the economics, as well as the economics are achieved.
2. The article studied the qualities of pervious concrete such as compressive strength, split tensile strength, permeability, and durability.
3. The major attribute of pervious concrete is that it allows water to run through it immediately. As a result, runoff from the site is reduced, and groundwater levels are recharged.
4. According to the papers, when cement is substituted by diverse industrial waste, the compressive strength, flexural strength, split tensile strength, and permeability of pervious concrete for various mixes depends on the kind of waste material.
5. Many researchers are working on pervious concrete research in order to achieve high pervious concrete strength.
6. Pervious concrete has a high permeability, thus there are numerous gaps to allow water to pass through, however, the primary difficulty with pervious concrete is its strength due to voids.
7. The cost of producing concrete is decreased by using waste material as a partial replacement for cement in pervious concrete.

VI. FUTURE SCOPE

Pervious concrete can be utilized in buildings to provide cooling. We can create simple water passages by employing flaky aggregate without requiring an additional drainage system. We can reach the water where we need it and give a channel to the water so that groundwater level and aquifer recharge may be enhanced by enabling the water to permeate by utilizing pervious concrete. Pervious concrete may be used in a variety of settings, including highway borders, subterranean parking lots, parks, and low-traffic highways. A prior concrete system is a key long-term and cost-effective system.

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