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A Brief Review on Pervious concrete Designing and Modelling

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A B S T R A C T

Hydraulic cement, coarse aggregate, admixtures, and water make up pervious concrete, which is a zero-slump, open-graded material. Pervious concrete is also referred to as "no-fines" concrete since it includes little or no fine particles such as sand. The open cell structures in pervious concrete paving allow storm water to pass through the pavement and into the underlying soils. Although its primary use is in pavements, such as residential roads, alleys and driveways, low volume pavements, low water crossings, sidewalks and pathways, parking areas, tennis courts, slope stabilization, sub-base for conventional concrete pavements, and so on, pervious concrete can be used in a wide range of applications, including: residential roads, alleys and driveways, low volume pavements, low water crossings, sidewalks and pathways, parking areas, tennis courts, slope stabilization, sub-base

Keywords: Zero slump, Hydraulic cement, No fine concrete, perforated heavy duty pipe, Pervious concrete.

Introduction

A uniform mixture of cement, aggregate / gravel, and water is used to make pervious concrete. When examining the status of existing structures, one of the new parameters in developing a construction is concrete durability. The concrete had a lower compressive strength (5 to 20 MPa) than standard concrete, and the filtration capacity was shown to be inversely proportional to the concrete's strength. A system odf subgrade and reinforcement must be provided to ensure the system's stability. We know that standard concrete mix design follows the stages outlined in IS 10262:2009 [7]. For traditional concrete, the proportions are 1:1.5:3. (M20). The cement content of 375 kg/m3 was finalized based on trial mixtures. The study used a 1:4 mix percentage for pervious concrete with no fine particles. To ensure adequate voids, 50 percent 12.5 mm aggregates and 50 percent 10 mm aggregates were used in the course aggregate. For all of the samples, a water cement ratio of 0.3 was used. To guarantee consistent mixing, all ingredients are mixed in a tilting drum concrete mixer.

The filter had four layers with 6.3, 2.0, and 1.18 mm diameter holes and powdered charcoal for filtration, and it will be connected to the exit pipe built beneath the concrete pavement, and the filter water will be kept in a tank using hydraulics and then used as needed.

It will perform well in terms of smell, hardness, and chloride removal. However, filtered samples will show an increase in conductivity, which could be linked to charcoal's propensity to enrich water with components like salt and potassium. In addition, the pH of the sample before filtering was acidic (i.e. 5.7), but after filtration it climbed to 7.7, which is appropriate for drinking water. As a result, it is suggested that charcoal filters be employed to generate high-quality water in this case.

Literature Review:

T. Joshi and U. Dev (CE Dep. Nirma University Gujrat):

They demonstrated the procedure of constructing pervious concrete stretch in their case study. Small developers can easily execute the construction methods presented in this study because they are labor-intensive and do not require any mechanically advanced machinery or tools. The material's strength was demonstrated in laboratory trials, which supported its use in a waterlogged location to quickly drain water off the pavement. For the production of a pervious concrete mixture with a 20% void ratio, it is advised that cement content (375 kg/m3), cement aggregate ratio (1: 3.97), w/c

ratio (0.4), and coarse aggregate size (4.75 mm – 10 mm) be used. Infiltrated water can be channeled into the percolation well by equipping the PCP with a bottom impermeable layer..

G.M. Kim. J.G. Jang, Hammad R. Khalid , H.K. Lee a(Dep of CE , Korea Advanced Institute of Science and Technology, and Korea Institute of Geoscience and Mineral Resources, Republic of Korea):

The case study investigated the water purification and mechanical properties of pervious concrete. OPC and CSAC wereused as binder materials, and pervious concrete with P/G ratiosranging from 30% to 40% were examined. Furthermore, the adsorption characteristics of the binder materials were investigated in batch adsorption tests, and the results were discussed with the physicochemical characteristics of the binder materials.

Siddharth Talsania1, Prof. Jayeshkumar Pitroda2, Prof. Chetna M. Vyas3:

In this case study the effect of Rice husk ash (RHA) as a partial replacement of cement in pervious concrete was investigated. In their research study the (OPC) cement has been replaced by RHA accordingly in the range of 10% and 20% by weight of cement for 0.30, 0.35, and 0.40 water/cement ratio. The compressive strength test and flexural strength test was carried out for 7, 14 and 28 days to measure the compressive strength and flexural strength of concrete, so the aim of the investigation is to study the behaviour of pervious concrete while replacing the RHA with different proportions in concrete. Test results have reflected, the compressive strength achieved up to 10% replacement of cement with RHA will be optimum without effecting properties of fresh and hardened concrete.

K.S.Elango, V.Revathi (Dep. of C.E, K.S.R. College of Engineering, Tiruchengode, India):

They reported a study on pervious concrete made with Portland Pozzalona cement (PPC) as a binder. The mix proportions were prepared with different coarse aggregate sizes. The size of coarse aggregate (CA) ranging from 6 mm to 12 mm was used in this study. Aggregate to binder ratio and water to binder ratio was considered as 3.3 and 0.35. Properties such as compressive strength, flexural strength and permeability were examined and relationships between aggregate size vs strength parameters, coefficient of permeability, void ratio and density properties of PPC binder pervious concrete were drawn to evaluate the influence of CA sizes in pervious concrete. The results indicates that increase in aggregate size leads to decrease in strength values and increase in permeability properties.

Anandh Babu Malayali and Ramesh Babu (Dep. of C E, School of Environmental and Construction Technology Kalasalingam) :

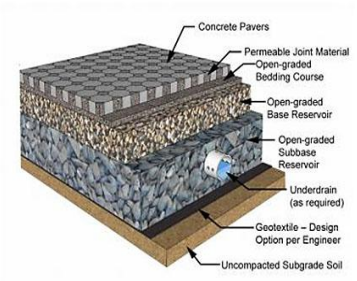
The case study investigated the development of geopolymer pervious concrete using Ground Granulated Blast furnace slag (GGBS) as raw material and sodium hydroxide and sodium silicate solution as activator and studying the mechanical properties of concrete. Five mix proportions have been developed by varying the GGBS content such as 450, 460, 470, 480 and 490 kg/m3.

Omkar Deo, Narayanan Neithalath:

In the research they studied that the properties of pervious concrete are strongly dependent on its pore structure features, porosity being an important one among them. Different pore structure for pervious concrete was proposed and subjectedto static compression tests. The compressive stress-strain response of pervious concretes, a model to predict the stress-strain response and its relationship to several of the pore structure features are outlined. A statistical model was used to relate the compressive strength to the relevant pore structure features.

Methodology

- The pervious concrete shows less strength then the traditional concrete due to the absence of fine aggregate.
- In order to give desirable strength to the concrete we are using OPC 53 grade cement.
- Testing the materials for the desirable results i.e aggregate test and cement test.
- The material that are required to make the concrete itself a filter are not available in India.



- We are attaching it with an external filtration unit, it's a simple charcoal – sand filter and will filter the percolated water for non drinking purposes.
- The percolated water is sent to the filtration system with the help of perforated heavyduty pipes.

Materials required:

Concrete system:

1. Coarse Aggregate (10mm, 20mm and 40 mm)
2. Cement 53 grade
3. Superplast E5/ Silica Fume
4. Heavy duty perforated pipe

Filtration Unit:

1. Charcoal
2. Gravel
3. Coarse sand
4. Fine sand
5. Frame

Experimental block sample; Specification:

Materials	Proportions
Cement	1.68kg
Aggregate	5.49kg
Water	759ml
Cement : Aggregate	1:3
Water : Cement	.45

Advantages:

1. It reduces the storm water runoff
2. Eliminates the need for detention ponds and other costly storm water management practices.
3. Mitigates surface runoff
4. Replenishes the aquifers and water table
5. Allows more efficient land development
6. Prevents water from entering into the stream and also prevents it from being polluted
7. Green building alternative suitable for many applications.
8. Protects streams and lakes and allows local vegetation to thrive.
1. It eliminates detention ponds that are costly for stormwater management practices.
2. Also permits for extra environment-friendly land growth.
3. It prevents warm and polluted water from getting into streams.

Limitations:

1. Re While this thirsty pavement is an excellent option for certain situations, it may not always be a viable choice.
2. The main reason pervious concrete is not used for high-traffic pavements, such as highways, is surface revealing," says Youngs, who notes that tire sheer can loosen the aggregate at the surface.
3. 3.The compressive strength of the nominal pervious concrete is around 20MPa. So this can't be installed for the heavy load traffic situations.
4. Runoff from adjacent areas onto pervious concrete needs to be prevented.
5. The parking areas are generally limited to auto parking and occasional trucks.
6. If reinforcement is required, epoxy-coated bars should be used.
7. Concrete has variable permeability.
8. Over-vibration significantly reduces permeability.

Conclusion:

Pervious concrete is a green construction technology which can be used to harvest rain water without using extra space and it helps prevent water clogging in areas which are used by walkers and light vehicles, hence reduce the chance of accidents.

It is like a hybrid soil which have both strength as well as high percolation capacity.

Various methods are present to make a pervious concrete which can be used to optimize the strength and percolation capacity of the concrete, the concrete can be made itself a filtration unit but due to unavailability of proper materials in India, we are using perforated heavy duty pipe system and a separate filtration unit to filter and harvest the percolated water and to use it for various purposes.

REFERENCES

[1] CONSTRUCTION OF PERVIOUS CONCRETE PAVEMENT STRETCH, Ahmedabad, India – Case study Tejas Joshi, Urmil Dave. Construction and Building Materials Published by Elsevier Ltd. Accepted 14 July 2021 2214-5095/© 2021.

[2] WATER PURIFICATION CHARACTERISTICS OF PERVIOUS CONCRETE SOUTH KOREA- Case study by G.M. Kim. J.G. Jang, Hammad R. Khalid, H.K. Lee. Construction and Building Materials Published by Elsevier Ltd. Accepted 7 January 2017.

[3] EFFECT OF RICE HUSK ASH ON PROPERTIES OF PERVIOUS CONCRETE Gujrat India- Pitroda et al, International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974. Int. J. Adv. Engineering. Res. Studies/IV/II/Jan.-March,2015/296-299.

[4] PROPERTIES OF PPC BINDER PERVIOUS CONCRETE Tiruchengode, India- Revathi et al., International Journal of Advanced Engineering Technology E-ISSN 0976-3945.). Int J Adv Engineering Tech/Vol. VII/Issue II/April-June,2016/444-448.

[5] MECHANICAL PROPERTIES OF GEOPOLYMER PERVIOUS CONCRETE Tamil Nadu, India- International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 11, November 2018, pp. 2394–2400, Article ID: IJCIET_09_11_239.

[6] International Journal of Civil Engineering and Technology (IJCIET) Volume 7, Issue 4, July-August 2016, pp. 276–284 Article ID: IJCIET_07_04_023 , Print: 0976-6308 and ISSN Online: 0976-6316 © IAEME Publication .

[7] Fact Sheet © 2018 Oregon State University. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties. Oregon State University Extension Service is an AA/ EOE/Veterans/Disabled. Published June 2018.

[8] Pervious concrete an overview, Article in Indian Concrete Journal · August 2010, All content following this page was uploaded by Karthik Obla on 26 July 2017, Research gate Publication.

[9] The Advanced concrete Pavement Technology (ACPT), Tech Brief DECEMBER 2012 | FHWA-HIF-13-006ACPT, U.s department of transportation (Federal Administration).

[10] Case study: The impact of the welded wire mesh as internal reinforcement on the flexural behaviour of RC beams exposed to elevated temperature, Contents lists available at ScienceDirect Case Studies in Construction Materials, Received 1 June 2021; Received in revised form 5 July 2021; Accepted 12 July 2021, Availableonline13July2021 2214-5095/© 2021 The Author(s). Published by Elsevier Ltd.

[11] Moisture and ion mobilization and stratification in post-tensioned (PT) grout during hydration, Contents lists available at ScienceDirect Case Studies in Construction Materials, Received on 10 May 2021; Received in revised form 14 July 2021; Accepted 27 July 2021, Availableonline2August2021 2214-5095/© 2021 The Author(s). Published by Elsevier Ltd.

[12] Case study Numerical investigation for failure load and contact stress beneath RC square footing resting on cohesionless soil, Contents lists available at ScienceDirect Case Studies in Construction Materials, Received 26 March 2021; Availableonline18August2021 2214-5095/© 2021 The Author(s). Published by Elsevier Ltd.

[13] Pervious Concrete: Mix Design, Properties and Applications,Received: 15 December 2016 / Accepted: 21 December 2016 / Published onlin e: 29 December 2016 © The Author(s) 2016. This article is published with open access, RILEM Technical Letters (2016) 1: 109 – 115 .

[14] DESIGN OF ECO FRIENDLY PERVIOUS CONCRETE, International Journal of Civil Engineering and Technology (IJCIET), ISSN 0976 – 6308 (Print), ISSN 0976 – 6316(Online), Volume 6, Issue 2, February (2015), pp. 22- 29 © IAEME.

[15] Reference book- “Properties of Concrete” by A M Neville, “CONCRETE TECHNOLOGY” by M L Gambhir.