Experimental Study for Improving the Strength for Pervious Concrete

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Abstract

Groundwater declination is one of the significant difficulties in our nation. The primary reason is confining the infiltration of water into the ground because of development of concrete roads. Studies show that pervious concrete will permit water from rainfall and different sorts of sources to go through it legitimately which diminishes overflow from a site and permitting groundwater revive. The strength of pervious concrete is increasingly significant as penetrability attributes; its strength is less than ordinary concrete and will just help light traffic loadings. The significant highlights of pervious concrete are its strength andproperties, similar to density, porosity and permeability. The pervious concrete is a solid which is having porosity over 30% which will encourage water to penetrate. So to build its basic properties with no impact on hydrological properties fibers are added to the design mix which will expand the strength of pervious cement. So coir which is regular asset and conservative will be utilized to give better outcomes. Coir is available in huge amount, which makes it as a very feasible as a strengthening material in pervious concrete. This study gives the variation in the strength behavior of pervious concrete fortified with coir at different fiber substance and compares it with pervious concrete. The different strengths examined are the flexural and compressive strength of the pervious concrete strengthened with coir at different percentages of fiber.

Keywords: *Penetration, Pervious Concrete, Permeability, Coir's, Strength.*

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INTRODUCTION

This concrete's primary goal is to create a high-porosity solid that lets rainwater flow through and investigate how different sources of water behave through coir and tile powder replaced cubes, thereby reducing runoff and restoring ground water levels. Over the past few decades, there has been an increase in contamination and spillover issues as a result of the development of infrastructure and an increase in urban storm water [1].The majority of precipitation ends up falling on impermeable surfaces, such as stopping territory, driveways, sidewalks, and roadways, rather than into the ground, as more and more accessible land in major urban areas is covered in asphalt. As a result, ecological problems like disintegration, a decrease in the ground water table, and contamination of streams and coastal waters arise as a result of the pavement's surface-to-surface flow of oil, grease, and chemical fertilizers. Pervious concrete should make it possible to permeate common water into the earth, which would be a better option for these problems.

A blend of uniform coarse Portland cement, water, and either a small amount or no fine sand are used to make pervious concrete, which is also known as porous concrete. Pervious cement typically has a porosity between 15% and 25%, allowing for the passage of 3-5 gallons (0.014m3 to 0.0237m3) of water per minute. The primary benefit of pervious cements is that they are able to move a lot of water through their structure, reducing or eliminating problems with storm water overflow. This material also has the ability to reduce tire-to-pavement interaction noise, reduce contamination levels in groundwater, and lessen the effects of urban heat islands on the environment. In contrast to traditional cement, pervious cement was initially popular in Europe in the nineteenth century due to its lower cement content.

Fig1 Pervious concrete

Dehusking the coconut between the skin and the shell exposes the fiber. These are hard, coarse, and inflexible lignocelluloses made up of multiple cells from organic material. Agro-sustainability, biodegradability, a good balance of strength, length, extensibility, dampness recovery, and high durability or resistance to sunlight, saline water, microorganisms, and so forth are among its highlights. The coarseness, variable length, and somewhat hardened and harsh nature of coconut fiber are ominous features. It is the thick, coarse fiber of the coconut husk, which is nevertheless a strong fiber. Coir's flexural strength is abundant.

Fig 2 Coir mixture

REVIEW OF LITERATURE

- A low-cost alternative to paving is pervious concrete. This concrete has a void content of between 15% and 22%, compared to between 3% and 5% in typical impenetrable cement pavements [1].
- Pervious concrete is used in areas such as stopping areas, private lanes, walkways, and so on. In comparison, the percentage of void substance in this concrete is between three and five percent in typical impenetrable cement pavements. It has important implications for long-term growth. It aims to consider the properties and demonstrate the significance of banana fiber-strengthened pervious cement in the ground.[2]
- The compressive strength is unaffected by adding a small amount of additives. According to the testing of the penetrability and porosity, adding a small amount of

additional substances will not significantly affect the penetrability or porosity. For the additional mix design, the quantity of added substances could be increased. The fact that layered blend produced a slightly higher strength demonstrates that the strength of porous concrete can also be improved without adding any additional substances.[3]

- Given that pervious concrete lacks both compressive and flexural strength, it should primarily be used for a wide range of applications, including walkways, parking garages, sports surfaces, pool decks, and carports.[4]
- The mix with three parts cement and three parts aggregates has the highest strength. For the water to drain, the mix had to have a certain percentage of voids. The top 16 cm of the pervious concrete are laid down. At that point, the 18 cm-thick subsurface layer is provided. At that point, a filter texture layer of two centimeters thick is laid. The new concrete will be fully utilized as pavements in this manner.[5]
- In comparison to other aggregates, ordinary Portland cement's 18.75 mm aggregate has a higher water absorption value (1.08%) than other aggregates' 9.375 mm aggregate has a higher water absorption rate (0.68%).When compared to other concrete, 18.75 mm size with 1 in 6 extent of ordinary Portland cement is more durable (0.34%) and 9.375 mm gravel with 1 in 6 blend extent of ordinary Portland cement is more durable (0.36%).
- Pervious pavement in provincial regions becomes increasingly appropriate to meet the rural region's need, for example, to reduce storm water and to build the subsurface water level to overcome the costly storm water management [6].
- Pervious concrete is the ideal solution for controlling storm water, energizing soil water, and flood or overflow control at downstream, and undergo land management. Due to its low cost, if it is used in the Indian setting, then it demonstrates to be the extremely helpful to illuminate natural and water logging issues in India. For the construction of a pavement measuring 1 meter by 1 meter by 0.15 meter, there is a significant cost savings of about 29 rest/m3 or 193 rest/m2 or 18 rest/ft2.Pervious concrete is usually brand-new concrete that is used to build pavement in rural areas [7].
- It saves money [8] and is important in development because it makes the materials stronger. For streets with low traffic, we could make blends of pervious concrete that are strong and good. The effects of squashed stone and alluvial sand, two types of aggregate, on various characteristics of pervious concrete were taken into consideration. In contrast to conventional concrete blends, the ratio of fine to coarse was 1:5:720.The weight of the concrete varied from 300 kg/m3.Ten distinct blends of pervious cement were created, one for each level of concrete and one for each kind of fine aggregate. Additionally, steel fiber was used to construct the strength parameter. The effects of such a minute difference in the properties of pervious concrete blends were looked at [9].
- The typical pervious concrete is not meant to be penetrable unless there are extremely heavy precipitation events; In line with this, it is recommended to increase the material's compressive and flexural strength at the expense of its permeability. The risk of clogging increases when the strength of pervious concrete is increased by reducing its penetrability. In light of the outcomes of this investigation, clogging typically reduces the penetrability of materials with a void percentage of less than 33%. [10].

Determination of Quantity of Materials For3% of Coir:

Cement =1.64kg
Coarse aggregate =5.90kg Coir=50.7gm
Tile powder= 230.4gm Water cement=768ml

Determination of Quantity of Materials For6% of Coir:

Cement=1.59kg
Coarse aggregate=5.40kg
Coir=101.01gm

Tile powder=230.4gm
Water cement=768ml

Determination of Quantity of Materials For9% of Coir:

Cement =1.54kg
Coarse aggregate =5.40kg
Coir =152.01gm
Tile powderr = 230.4g
Water cement = 768ml
Thus the cubes of different categories are castedas per the design

Result and Analysis

Trial No	W1 (gms)	W2 (gms)	W3 (gms)	W4 (gms)	Specific Gravity
1	632	1232	2035	1655	2.72
2	634	1363	2118	1654	2.75

Table 2 Fineness of Cement

S.No	W1 (gms)	W2 (gms)	Fineness %
1	50	1	2
2	50	0.9	1.8
Average			1.9

Table 3 Standard Consistency Test

Trial	Penetration	Water Content	Trial
1	7mm	0.25	1
2	29mm	0.26	2
3	38mm	0.28	3

Table 4 Initial Setting Time of Cement

S.No	Time (mins)	Reading of Pointer (mm)
1	0	0
2	5	9
3	10	14
4	15	25
5	20	28
6	25	31
7	30	34

Initial Setting Time = 30mins

Table 5 Final Setting Time of Cement

Sl.No	Time (mins)	Reading of Pointer (mm)
1	0	0
2	30	0
3	60	21
4	90	24
5	120	25
6	150	25
7	210	25
8	270	25
9	330	25
10	390	25
11	450	25
12	510	25
13	570	25
14	610	Hardened

Final Setting Time = 10 hrs 10 mins (610 mins)

Table 6 Water Absorption of Coarse aggregate

S.No	**Weight of Aggregate (gms)**	**Wet Aggregate (gms)**
1	125.2	126
2	126.3	127.4

Table 7 Specific Gravity of CoarseAggregate

Trial No	**W_1(gms)**	**W_2(gms)**	**W_3(gms)**	**W_4(gms)**	**Specific Gravity**
1	632	1232	2035	1655	2.72
2	634	1363	2118	1654	2.75

Specific Gravity of Coarse Aggregate =2.735

Table 8 Aggregate Impact Test

1	422	86	20.37%
2	400	80	20%
3	350	65	18.5%

It indicates that the aggregates areexceptionally strong and suitable for pavements.

Slump Cone Test: 30mm slump where water

Table 9 Compressive Strength

Category	7 days (N/mm^2)	14days(N/mm^2)	28days(N/mm^2)
Nominal	8.5	13.33	19.2
3%	12	25	28.8
6%	13.33	15	21
9%	12	10	13.33

Maximum strength is achieved by adding 3% ofcoir and 12% of partial replacement of cement .

CONCLUSION

In this study an alternative has been proposed for delivering pervious concrete utilizing coir and tile powder. It was found that pervious concrete made with coir and tile powder has good compressive strength and water penetrability when contrasted with nominal pervious concrete.

1. From the above experiment results, it is found that usage of 3% coir and 12% tile powder gives better compressive strength.
2. Use of tile powder reduced the cement content and also acted as active pozzolana.
3. This type of pervious concrete can be implemented in pavements, sidewalks and also in gardening area which can withstand loads.
4. Thus it is finally concluded that this type of pervious concrete can be utilized in any spacious areas like side area of the roads, parking areas and also wherever normal pavement is unwantedly laid. This will generate ground water recharge and can solve environmental problems like controlling storm water run-off and noise reduction.
5. By this experimental result, it is proved that the mix proportion gives the required strength of M20concrete and also it is given the required void ratio for water seepage.

REFERENCE

[1] Gaurav UttamShinde., S.S.Valunjkar"An Experimental Study on Compressive Strength, Void Ratio and Infiltration Rate of Pervious Concrete", International Journal Of Technology Volume 04, Issue 04 (April 2015),ISSN:2278-0181

[2] Aiswarya Gopinath., Amala D., Anjitha G Nath., Drisya Vasudev A.& Justin Thomas "Fibre Reinforced Pervious Concrete Using Banana Fibre"Int. Journal of Engineering and Management Research,Volume-7., Issue-2., March-April 2017. ,ISSN (ONLINE): 2250-0758

[3] Investigation on the Effect of Various Additives on the Strength of Environmentally Friendly Permeable Concrete

[4] Dharshan.S. Shah.,Jayeshkumar Pitroda(2014) "An Experimental Study on Hardened Properties of Pervious Concrete",Journal of International Academic research for multi disciplinary impact factor 1.393.,ISSN;2320 - 5083,Vol 2, Issuse-3

[5] M.Harshavarthanabalaji(2015)"Design of Eco Friendly Pervious concrete"Int. J. of Civil Engineering and Tech. ISSN 0976-6308 Volume-6,Issuse 2.

[6] Darshan.S.Shah, (2014) "An Experimental study on durability and water absorption properties of pervious concrete,Int. J. of Research Engg. & Tech. EISSN:2319-1163.

[7] Neetu.B., Yaadhav., Jayesh.A.Shah. &Rushabh.A.Shah (2013) "Pervious Concrete - Solution for low cost construction" Int. J. of Innovative Science and Modern Engineering.

[8] Darshan.S.Shah(2013)"Pervious Concrete- New Era for Rural Road Pavement"- Int. J. of

Engineering Trends &Technology.
[9] V.R.Patil., A.K.Gupta, & D.B.Desai(2009)"Use of pervious concrete in construction of pavement for improving their performance" - IOSR J. of Civil Engineering.
[10] Yungmin Joung., Zachary. C. Grasely, (2008) "Evaluation &Optimization of Durable Pervious Concrete for Use in Urban Areas" Govt.Research Report of Southwest Region Univ. Transportation Centre Texas Transportation Institute.