A EXPERIMENTAL STUDY ON WATER ABSORBING ROADS

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Abstract

Due to enormous improvement in construction industry and infrastructure, maximum metrocities in India are getting covered with impermeable concrete pavements. Concreting tends to environmental problems such as fall of recharge of rainwater into the ground hence continuous reduction in water table which leads to water crisis during summer. Installing Pervious Concrete pavement instead of impervious concrete for low traffic volume, we can solve the reduction of water table issue. Pervious Concrete is a low impact, environmentally friendly and sustainable paving option.Pervious Concrete is an unusual type of concrete made by the mixture of water, cement and open graded coarse aggregate. Typically it has very little to no fine aggregates content and has just enough cementations paste to coat the aggregate particle while maintaining the interconnectivity of the voids. Pervious concrete is also known as porous concrete, permeable concrete, no-fines concrete, gap graded concrete, enhanced porosity concrete. In the pervious concrete the void content is in the range of 15 to 22% compared to 3 to 5 % in conventional impervious concrete pavements.This paper represents the experimental methodology and experimental results related to compressive strength, void content and infiltration rate. Testing various mix designs of Pervious Concrete, results were determined and analyzed. Cube size of 16*9*6cm is prepared to investigate compressive strength, void ratio and infiltration rate. Different concrete mix proportion such as 1:8 with different size of gravels such as 2mm to 8mm should be used to check these properties of pervious concrete.

Keywords— Pervious concrete pavement, compressive strength, voids ratio, infiltration rate

1.INTRODUCTION

Pervious concrete is also known by the other name like porous concrete, permeable concrete, no fine concrete and porous pavement as all above mention concrete are the special concrete in comparison to normal concrete as it high porosity for concrete flatework applications that allow water from hydrologic cycle (precipitation) and other source to pass directly through there by reducing the runoff from a site and help full in recharging the ground. The reason behind pervious concrete absorb water is a pervious concrete have a large interconnection of voids and voids ratio help water conveyed through the surface and allowed to infiltrate. A pervious concrete can be made from a mixture of cement, course aggregates and water like normal concrete but it contain little or no sand, which make concrete in which water can pass. Pervious concrete becoming a need in a rural areas and effective means to achieve important environmental issues. It also support for keeping clean and safe environment.

2.OBJECTIVE

This project aims to review and analyze the potential of using porous concrete in the construction of road. To achieve this aim, the following are the objectives:

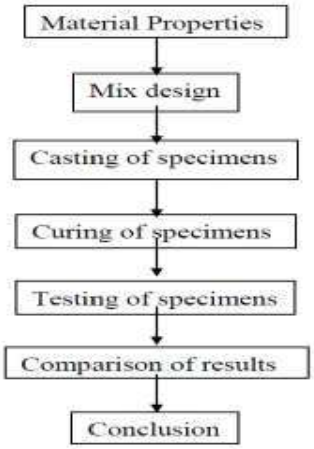
* The experimental study of water absorbing roads.

* To test strength and permeability of pervious concrete.

* To give a good appearance to the pervious concrete.

3.METHODOLOGY

Following steps were undertaken as an approach towards this study:



3.1 MATERIAL PROPERTIES

Table Shows Nature of Testing with Values

S.NO.	Nature of testing	Values
1	Grade of Cement	43
2	Fineness	5.38%
3	Fineness Modulus Of Aggregate	5.13
4	Fine Aggregate	Not used

Table Shows Specimen and Sample Description

S.No.	Specimen	Sample Description
1	Size Of Specimen	16*9*6 Cm
2	Ratio of C:A	1:8
3	% Replacement Of cement	5%
4	Water-Cement ratio	0.40
5	Machine Used	Compressive Strength Testing machine

Pervious Concrete is a mixture of Cement, Aggregate / Gravel and Water. No Fine Aggregates are used for making pervious concrete. Sometimes retarders and admixtures are used to achieve adequate strength and durability of pervious concrete. In this paper, Pervious Concrete has been casted with mix proportion of 1:8 and 2mm to 8mm gravel size with OPC 43 Grade Cement. And wood ash is also used as a cementious material in the replacement of 5% of cement. The benefits connected with pervious concrete have actually inspired numerous researchers in the past to get results onto it by performing different methodologies. Some of the methodologies to be mentioned which has inspired us to take the Pervious Concrete Research a step ahead. Ordinary Portland cement has used for casting all the Specimens in the following researches, discussed in this study. Drinkable water has been utilized in all functions. Pervious concrete specimens were filled in three layers. Mixing was done by machine mixing to obtain uniform and homogenous pervious concrete. Compaction has actually attained by hand with the standard tamping rod. Cubes of specimen of size 16*9*6cm are prepared for each mix. All specimens were de-molded after twenty-four hours and kept in drinking water until the age of examination. Compressive strength test had been carried out relating to ASTM C39. Test for compressive strength was performed on cube. For specimens with irregular surfaces, capping had been used to reduce the impact of stress concentration.

Materials

- ➢**Cement**: Evaluation OPC gives high quality and sturdiness to structure in light of its ideal molecule size conveyance and prevalent crystalized structure. Being a high quality concrete, it gives various preferences any place cement to unique high quality application is required, for example, in the development of high rises, spans, flyovers, fireplaces, runways, solid streets and other overwhelming burden bearing structures.
- ➢**Aggregate**: Aggregate was utilized as an essential fixing in making the penetrable cement. Bigger aggregate give a more unpleasant surface. Ongoing utilizations for pervious cement have concentrated on parking garages, low-traffic asphalts, and walker walkways. For these applications, the littlest estimated total attainable is utilized for stylish reasons. The sizeof aggregate which is used in the experiment is of 2mm to 8mm.
- ➢**Water**: Water to cementitious materials proportions between 0.34 and 0.40 are utilized routinely with appropriate incorporation of compound admixtures, and those as high as 0.45 and 0.52 have been utilized effectively. The connection among quality and water to cementitious materials proportion isn't clear for pervious cement on the grounds that not at all like ordinary cement, the all-out glue content is not exactly the voids content between the totals.
- ➢**Wood ash**:Wood Ash has many properties such as great strength,lightweight,shockresistance and workability due to their good strength and experience it is used as a cementious material in the replacement of cement in many construction.

4. TESTING OF PERVIOUS CONCRETE

Examination of specimen were carried out in two phase

I) Compressive Strength test using Compression testing machine and

II) Properties Related to Transmission of water which confirms its abilityof water absorption as well as infiltration

(a) Void Ratio

(b) Rate of Infiltration

(I) Compressive Strength Test Result

S.No.	Cement Aggregate ratio		Avg. Compressive Strength in 7 days MPa		Avg. Compressive Strength in 14 days MPa		Avg. Compressive Strength in 28 days MPa	Range
1	1: 8(without ash)	7.28	7.26	7.28	7.38	7.28	7.58	4-9 MPA
		7.18		7.18		7.18		
		7.20		7.20		7.20		
2	1: 8(with ash)	7.1	6.93	7.1	7.14	7.5	7.39	
		6.9		6.9		7.2		
		6.8		6.8		6.8		

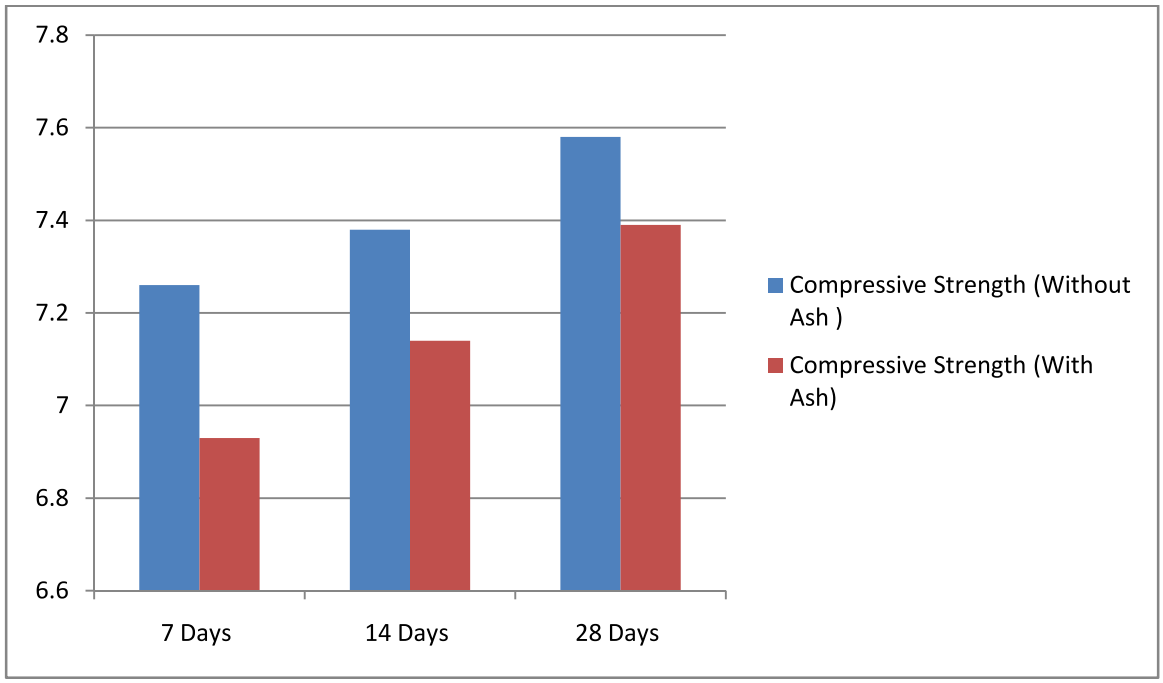


Fig 1:- Compressive Strength of Sample Without Ash & With Ash after 7 Days,14Days,28 Days.

II) Properties Related to Transmission of water which confirms its abilityof water absorption as well as infiltration

(a) Void Ratio Results

Cement Aggregate ratio	Void ratio(%)	Range
1: 8(without ash)	14.51	6% to 20%
1: 8(with ash)	16.73	

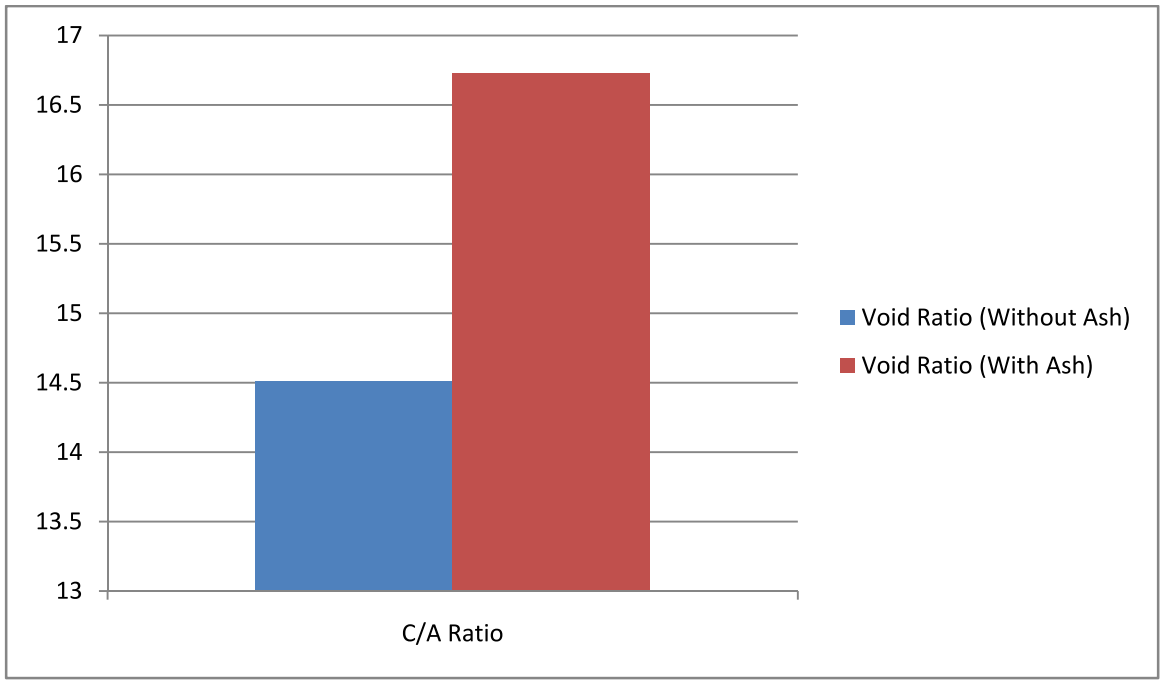


Fig 2- Void Ratio Without Ash /With Ash

(b) Rate of Infiltration Results

Cement Aggregate ratio	Avg. Infiltration rate (m^3/min/m)	Range
1: 8(without ash)	1.584	1.5 M^3/min/m2 and 1.8 m^3/min/m2
1: 8(with ash)	1.758	

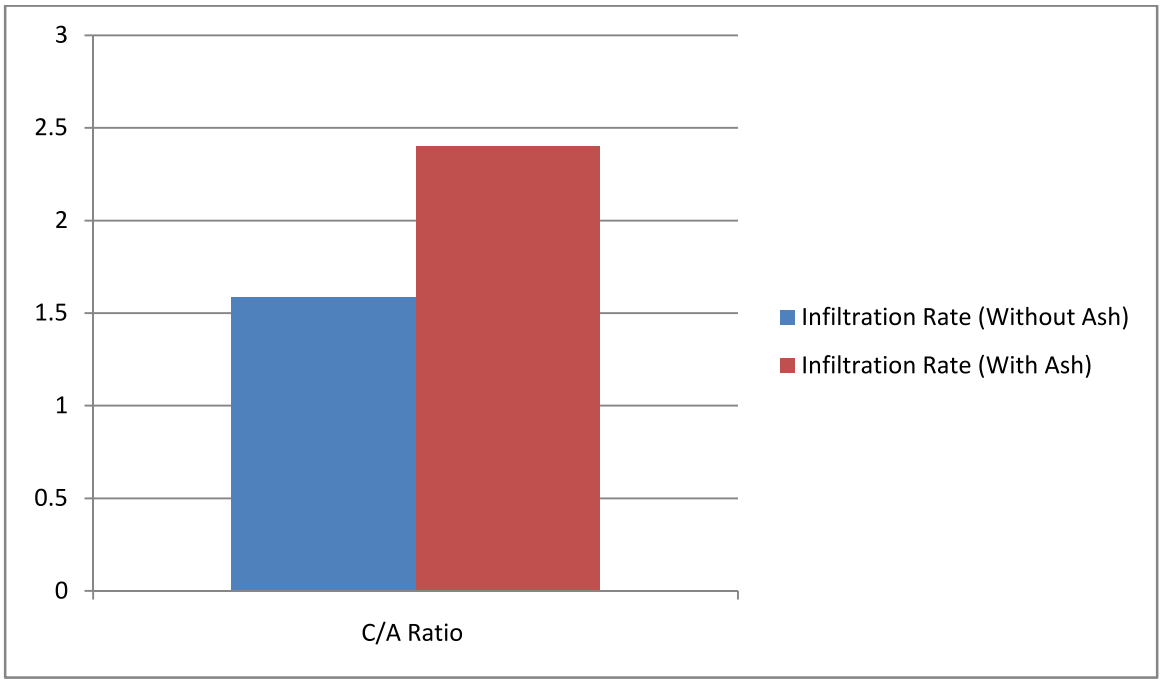


Fig. 3- Rate of infiltration Without Ash /With Ash

- ***Results of Compressive Strength of Sample After 7 Days,14 Days,28 Days, Void Ratio, Infiltration Rate Without Ash & With Ash 28 Days***

Cement Aggregate ratio	**Compressive strength in 7 days (mpa)**	**Compressive strength in 14 days (mpa)**	**Compressive strength in 28 days (mpa)**	**Void ratio(%)**	Infiltration rate (m^3/min/m)	Range
1: 8(without ash)	7.26	7.38	7.58	14.51	1.584	1.5-1.9
1: 8(with ash)	6.93	7.14	7.39	16.73	1.758	

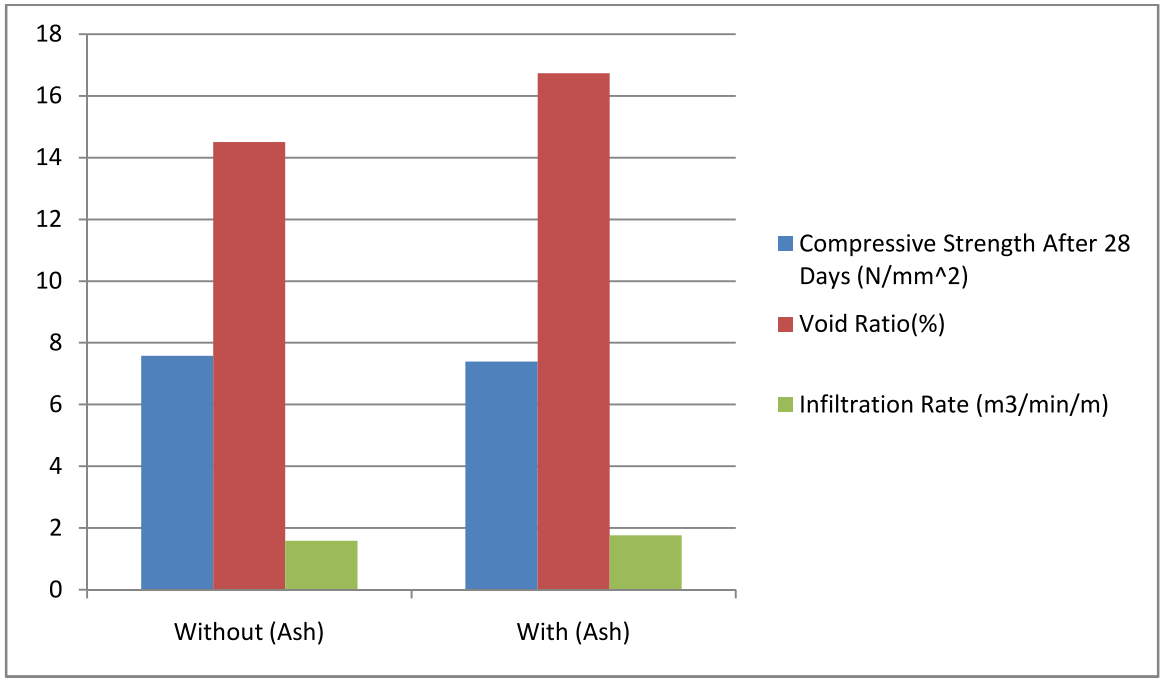


Fig 4:- Compressive Strength of Sample After 28 Days, Void Ratio, Infiltration Rate Without Ash & With Ash 28 Days.

7. CONCLUSION:

Based on the previous studies which has been done on pervious concrete specimen were made and various observation has been done seeking the properties of strength and transmissibility which leads infiltration capacity and advantages integrated concludes that pervious concrete could be used economically as construction material, and by doing compression test suitable material for construction can be designed. The size of coarse aggregate, w/c proportion and aggregate to cement ratio has a crucial role in strength of pervious concrete. Using smaller size aggregate (upto 8mm) can enhance the compressive strength of pervious concrete. As the aggregate size goes up, the voids ratio of the concrete also improves due to which the compressive strength of the concrete decreases. An experimental study evaluating strength and permeability characteristics of a pervious concrete mix design is presented. The experiments were performed on specimens of size 16*9*6cm cube. For a particular mix examined, compressive strength ranges between 6MPa and 9MPa with an average of about 7MPa. Similarly void ratio ranges between 6% to 20% with an average of about 14%. Infiltration rate ranges between 1.5 m^3/min/m^2 and 1.9m^3/min/m^2 with an average of about 1.7 m^3/min/m^2.Overall it is observed that when void ratio increases, infiltration rate also increases and compressive strength decreases and vice versa. Strength of Pervious concrete is less than that of conventional concrete of nearly same mix design but pervious concrete has very high degree of permeability as compared to conventional concrete's which is nearly zero. The pervious concrete is suitable only for low volume road pavement like foot path, parking slots. Due to voids in pervious concrete it is difficult obtained required compressive strength

8. References

[1] Darshan S. Shah, Prof. Jayesh kumar Pitroda, Prof.J.J.Bhavsar "Pervious Concrete: New Era For Rural Road Pavement"ISSN: 2231-5381(2013).

[2] Sonawane, Y. N. (2017). Experimental Study on Pervious Concrete: An Eco Friendly Concrete Pavement. International Journal of Advanced Engineering Research and Science, 4(4), 231–233.

[3] Swaminathen, A. N., & Kumar, N. S. (2016). Experimental Study on Strength Properties of Pervious Concrete. International Research Journal of Engineering and Technology, 03(11), 133–135.

[4] Manan, A., Ahmad, M., Ahmad, F., Basit, A., & Khan, M. N. A. (2018). Experimental Investigation of Compressive Strength and Infiltration Rate of Pervious Concrete by Fully Reduction of Sand. Civil Engineering Journal, 4(4), 724.

[5] Darshan S. Shah, Prof. J.R.Pitroda, "Assessment for use of Gravel in Pervious Concrete", International Journal of Engineering Trends and Technology (IJETT) ISSN No. 2231-5381, Volume: 4, Issue: 10, Octomber 2013, Page: 4306 - 4310