JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

PERVIOUS PAVEMENT FOR STORM WATER MANAGEMENT

[1] Rajiv H. Pazare [2]Suraj Kumar [3]Joydeb Hawalder [4] Lokesh Waghmare [5] Vaishnavi Wagh
[1] Assistant Professor [2345] Research Scholar Department of Civil Engineering
Priyadarshini College of Engineering, Nagpur

Abstract: Urbanization and climate change have intensified the challenges associated with stormwater management, leading to increased urban flooding, water pollution, and erosion. To address these issues, sustainable stormwater management practices have gained prominence. Pervious pavement, a green infrastructure technique, has emerged as an innovative solution that combines traditional pavement functionality with stormwater management capabilities.

This abstract provides an overview of pervious pavement systems as an effective method for stormwater management. Pervious pavement is characterized by its unique porous structure, which allows rainwater to infiltrate through the surface and be naturally filtered and stored within the pavement layers, reducing runoff and enhancing groundwater recharge. The benefits of pervious pavement extend beyond water management, as it also mitigates heat island effects, improves air quality, and enhances aesthetics.

Keywords-Pervious pavement, aggregate size, w/c ratio, compressive strength.

INTRODUCTION

As urbanization continues to expand, the challenges of managing stormwater runoff have become increasingly apparent. Traditional impervious surfaces like concrete and asphalt have long dominated our urban landscapes, channeling rainwater into storm drains and often causing flooding, erosion, and water pollution. In response to these issues, engineers, urban planners, and environmentalists have been seeking innovative solutions to mitigate the adverse effects of stormwater runoff.

One such innovative solution is the utilization of permeable pavement, a sustainable and environmentally friendly approach to stormwater management. Permeable pavement offers a promising alternative to traditional impermeable surfaces, as it allows rainwater to infiltrate into the ground rather than running off into storm drains and waterways. This infiltration not only reduces the volume of runoff but also helps filter and treat the water, removing pollutants and contaminants beforethey can harm the environment. In this exploration of permeable pavement for stormwater management, we will delve into the varioustypes of permeable pavement systems, their design principles, benefits, and applications. We will also discuss the environmental and economic advantages of incorporating permeable pavement into urban infrastructure, as well as the challenges and considerations associated with its implementation. As we navigate through the realm of permeable pavement, it becomes evident that this innovative approach holds great promise in reshaping our urban landscapes for a more sustainable and resilient future.

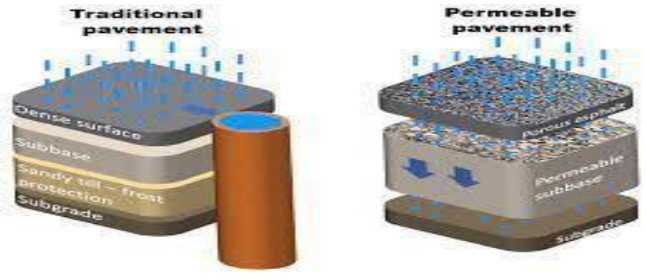

FIG: - Different layer of permeable and traditional pavement

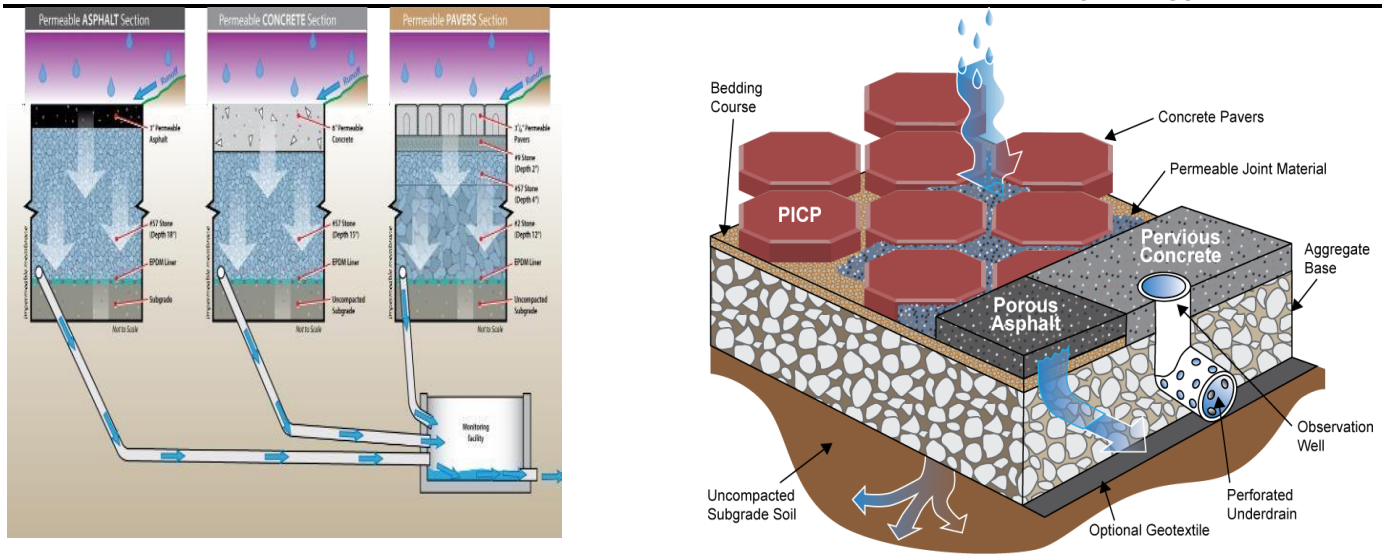

Fig: - Drainage System provided by permeable section

LITERATURE REVIEW

- **P. Rahul Goushis, N. Swathi (2019**)- Conducted a study on "design of eco-friendly permeable pavement with epoxy resin and titanium dioxide overlay along with ggbs concrete base". From the study it can concluded that the GGBS concrete is use as the base due to tis protection against sulphate and chloride attacks. And there is the use of the epoxy which have the greatest advantages due to its chemical and mechanical resistance that offer the performance and durability needed. Increase in the amount of the triethanolamine has the 30% replacement with the GGBS has the higher compressive strength.

- **Darshan Raval (2019) -** Conducted a study on "**A review on porous concrete**" study yielded the following conclusion: replacing natural aggregate with rubber particles significantly enhances concrete's toughness and ductility; moreover, it improves its damping capacity while reducing the compressive strength.

- **Shreekrishna Sharma, Dhruvil Bhandari, Ronak Paghada, Bhavin Tandel (2019)-** Conducted a study on "**evaluation of compressive strength of pervious concrete**". From the study it can concluded that there are total sample of the pervious casted having the proportion 1:3,1:4,1:5 w/c ratio recommended as 0.27& 0.29. the compressive strength after 7&28 days has taken out. From the paper it is reflected thatthe 0.27w/c gives more result than the 0.29 W/c. cement aggregate ratio 1:3,1:4 gives more strength than 1:5 and concluded that larger size of aggregate reduced the compressive strength of pervious concrete.

- **Sonali Gholave, Ketan Patil, Pankaj Godage, Sonali Salampure (2019)-** Conducted a study on "**Pervious concrete: For road pavement**". From the study it can be concluded that there is calcium chloride added and 3 different proportion of fine aggregate is added with the coarse aggregate in which the size if coarse aggregateis 20mm and 30mm in which is found after the 7&28 days. Greater the size of aggregate will give the less compressive strength as compare to the lesser size of aggregate and along with the $CaCl_2$ the compressive strength is gradually decreasing which is unfit for the concrete to be used.

- **Aiswarya Manikandan, Alen Reji, Archa Dileep, John Varghese (2022)-** Conducted a study on "**Experimental investigation of porous concrete using e- waste**". From the study it can be concluded that there is the use of electronic waste in concrete during the casting of concrete in which the coarse aggregate is replaced by the electronic waste by 5%,10%,15%,20%. After the 7&28 days the 10% use of electronic waste give the better result than the other specimen and it is concluded that there is maximum 10% of electronic waste can be use at time for the better result not more.

- **Mosoud Kayhanin, John T. Harvey in (2019)-** In their deliberations on stormwater runoff management and pollution prevention, they explored the use of perforated pavement on Highways. The major findings from these collective studies encompassed: hydraulic performance evaluation of permeable pavement; measurement of porous asphalts and previous concrete paved surfaces' permeability; assessment for clogging susceptibility in different types of permeable pavements - notably FDPP or Full Depth Permeable Pavement; as well as issues related to water quality control. They asserted that, moving forward, an integrated sustainable transportation program will incorporate various forms such as FDPP among other permeable pavements. If FDPP designs the property, it can serve as an alternative best management practice (BMP) for storm water runoff management; indeed, they affirm this. Throughout the life of pavements--so they claim--specific characteristics stem from FDPP. The surface pavement, highly permeable and unclogged; permits a minimal infiltration of captured runoff into sub-grade soil - provided there is no adverse impact on underground water.

- **Jannathul Thasni. P, JouharShareef, (2018)-** This paper summarizes research on porous concrete, a type of water-absorbing pavement. It explores potential solutions for low ground water levels and agriculture problems, as well as strategies to manage stormwater runoff. The discussion extends to the application and engineering properties of porous concrete; further studies examine materials such as cement, aggregates, water and admixture in relation to porous pavements. Moreover--the benefits: advantages versus disadvantages; durability issues are also emphasized along with its inherent strength – all these factors contribute significantly towards understanding more about this versatile construction material at hand! This paper discusses the replacement of cement by fly ash: a process that yields safe disposal materials in porous concrete. As a result, this eco-friendly paving pavement offers environmental benefits.

- **Saurabh Y. Kale, Amit P.Halwele, Kartik Rathod, Mayur A. Jirapure (2017)**, -The researchers actively engage in a study on the uses of Permeable Pavement Systems; their focus extends to Sustainable Drainage Systems, Porous Pavements, Storm Water Management and Sustainability. Additionally--with an emphasis placed upon Filtration methods, drains for effective water control–and even Geothermal Heating/Cooling technologies: these are all aspects critically examined within this research. The paper deliberates recent innovations' advantages and disadvantages; it underscores water quality control–a vital component of maintenance. This paper aims to demonstrate the effective application of permeable pavement in a sustainable urban drainage system; consequently, our focus remains steadfastly on this innovative solution.

- **Mr. Gaurav Uttam Shinde & Dr. S. S. Valunjkar (2015)-** This paper intentionally focuses on Cost and Time Control in Storm Water Management, utilizing Pervious Concrete as a study subject within metropolitan cities where it has been recently introduced as road pavement material. The authors assert that the application of pervious concrete for urban city pavements represents a novel concept due to challenges associated with low ground water table and effective stormwater management in such areas. This paper analyses a single case study; it evaluates the suitability of previous concrete--considering factors such as rainfall data, traffic volume data, and soil & geotechnical investigation results from a residential colony selected for this purpose. The analysis extends to cost comparison: specifically, between the conventional method of storm water management and one that employs previous concrete pavement. This paper states that, in metro cities cost.

MATERIALS

- Cement
- Fine aggregate
- Coarse aggregate
- Water
- Admixture

- **Cement-Grade 53** -Ordinary Portland Cement is used in concrete is used in concrete mixes. Different physical test on cement were carried out and below are the results. The Evaluation OPC provides a structure with high quality and sturdiness due to its ideal particle size distribution and superior crystallized structure. As a high-strength concrete, it offers numerous advantages wherever unique high-strength applications are required. For instance, this is evident in the construction of skyscrapers, bridges, flyovers - even chimneys or runways for that matter; not forgetting robust concrete roads designed specifically for heavy load-bearing structures.

Sr.no. `	Physical Properties	Result
1.	Fineness of cement (m^2/Kg)	320
2.	Standard Consistency in%	35%
3.	Initial setting time in min	90 MIN
4.	Final setting time in min	265 MIN
5.	Specific gravity of cement	3.15
6.	Grade of Cement (OPC)	43 Grade

- **Fine Aggregate-** Size of aggregate passing through 4.75mm sieve is known as fine aggregate.Used fine aggregate in this investigation is crushed sand.

Sr.no. `	**Physical Properties**	**Result**
1.	**Grain size analysis**	**2.6**
2.	**Specific Gravity**	**2.7**
3.	**Bulk Density(kg/m^3)**	**1425**

- **Coarse Aggregate-** Size of aggregate is more than 4.75mm is known as Coarse aggregate. Lessthan 25mm size of aggregate are used.

Sr.no. `	Physical Properties	Result
1.	Specific Gravity	2.78
2.	Water absorption in %	0.6
3.	Impact Test	37%

- **Water-** The water used for the study was free from chemical impurities and suspended solid which when present may have adverse effect on the strength of concrete

- **Admixture-** An admixture is a material other than water, aggregates, cementitious materials, and fiber reinforcement, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing.

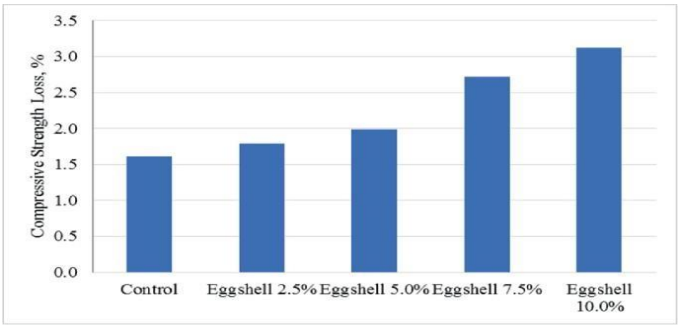

Fig: - Compressive strength w.r.t different percent of eggshell

METHODOLOGY

PREPARATION OF SPECIMEN-Pervious concrete specimen is prepared using 150mm x150mm x 150mm mould. After filling the mould plastic sheet is covered over the mould. The specimen cast is removed after 24 hours and again wrapped into plastic sheet for curing purpose.

Fig: - Plastic covering as curing method

Fig: - Pervious concrete demolded after 7 days

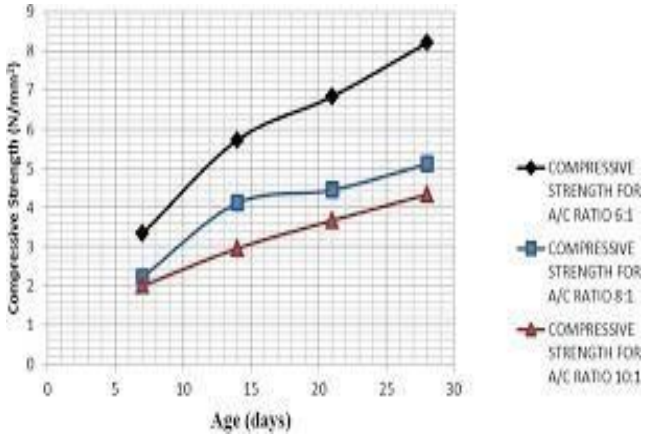

Fig: - Graphical presentation of compressive strength

Fig: - Filling of concrete to make porous concrete

CONCLUSION

TESTING

- COMPRESSIVE TEST-The compressive strength of pervious concrete is determined using hydraulic testing machine[1000KN capacity]

- SPLIT TENSILE TEST- The split tensile test is an indirect way of evaluating the tensile test of concrete. In this test, a standard cylindrical specimen is laid horizontally, and the force is applied on the cylinder radially on the surface which causes the formation of a vertical crack in the specimen along its diameter.

Fig: - Compression testing of porous concrete

Fig: - Spilt tensile test of porous concrete

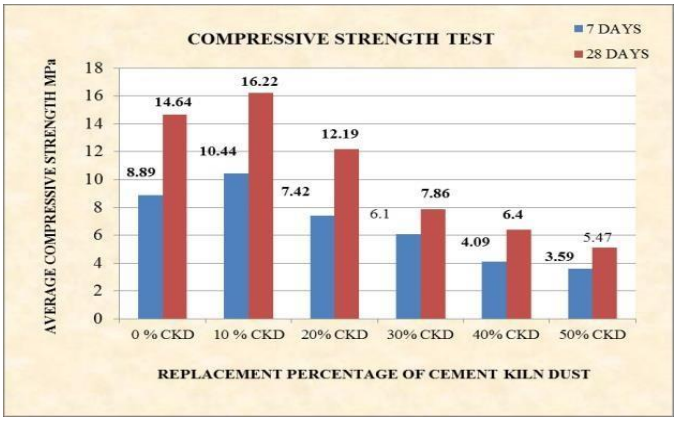

Fig: -Compressive Strength against replacement percent of cement klin dust

In conclusion, porous concrete pavement is a valuable solution for addressing stormwater issues, improving water quality, and promoting sustainable urban development. Its environmental benefitsand potential long-term cost savings make it a compelling option for various applications where stormwater management and environmental sustainability are priorities. However, proper design, installation, and maintenance are crucial for maximizing its effectiveness and longevity. The porous concert pavement offers enhanced water drainage, reducing surface runoff and minimizing flooding risks. Additionally, it promotes environmental sustainability by facilitating groundwater recharge. However, maintenance and potential durability concerns should be carefully considered for long-term vibe

REFERENCES

- https://www.ijres.org/papers/Volume-10/Issue-3/Ser-3/E10032738.pdf
- https://www.irjet.net/archives/V8/i5/IRJET-V8I5870.pdf
- https://www.academia.edu/43942425/A_PROJECT_REPORT_WATER_ABSORBING_PAV EMEN TS_BY_USING_POROUS_CONCRETE
- https://www.academia.edu/43942425/A_PROJECT_REPORT_WATER_ABSORBING_PAV EMEN TS_BY_USING_POROUS_CONCRETE
- www.ijres.org/papers/Volume-10/Issue-3/Ser-3/E10032738.pdf
- www.irjet.net/archives/V8/i5/IRJET-V8I5870.pdf
- www.researchgate.net/publication/341875031_Review_Paper_on_the_Study_of_Perforated _Concrete Pavement
- Dr. Ujjawal shah, Darshan Raval- "A review on porous concrete" International journal of research and analytical reviews (IJRAR) 2348-1269, vol.6, Issue1, March 2019.
- P. Rahul Goushis, N. Swathi – "Conducted a study on "design of eco-friendly permeable pavement with epoxy resin and titanium dioxide overlay along with ggbs concrete base". International journal of research and analytical reviews (IJRAR) 2349-5138, vol.6, Issue1, Feb2019.
- Shreekrishna Sharma, Dhruvil Bhandari, Ronak Paghada, Bhavin Tandel - "Evaluation of compressive strength of pervious concrete". International journal of research and analyticalreviews (IJRAR) 2348- 1269, vol.6, Issue1, March 2019.
- Sonali Gholave, Ketan Patil, Pankaj Godage, Sonali Salampure – "Pervious concrete: For road pavement" International journal of research and analytical reviews (IJRAR) 2348-1269, vol.6,Issue1, March 2019 5.
- Aiswarya Manikandan, Alen Reji, Archa Dileep, John Varghese- "Experimental investigation ofporous concrete using e-waste". International journal of research and analytical reviews (IJRAR) 2348-1269, vol.9, Issue2, May 2022.
- Mr. Tushar Patil, Mr. Abhijeet Rajput, Mr. Ejaz Shaikh - "A Review Study on Water Absorbing Pavement". - International Journal for Scientific Research & Development (IJSRD)2321-0163Vol. 8, Issue 12, 2021
- Manish kr. Upadhyay, Vikram kumar, Sunil kumar- "A STUDY ON WATER ABSORBING PAVEMENT USING PORUS CONCERTE" International conferences on recent development in engineering sciences, humanities and management (ICRDES-HM) 978-81-943584-9-7 ,25 JA