

# Experimental Study on Water Percolating Concrete



Ayapilla Narasimha Murthy

**Abstract:** This paper addresses two aspects namely a new method for manufacturing of percolating concrete blocks using different proportions of concrete mixture such as Portland cement, Coarse aggregates, fine aggregates, limestone, and water have been designed. Apart from this an attempt has also been made by adding small quantities of additives such as fly ash, rice husk ash etc. for its strength and suitability on par with the normal Concrete blocks. Another is a partial replacement of cement with supplementary cementation materials such as fly ash and metakaolin in different proportions for reducing high grade cement consumptions been proposed. The design of a Pervious Concrete is made in such a way that it allows the entire surface run off water to percolate down without retaining any drop/quantity in it. Thus, it is named as water percolating Pervious Concrete/ porous concrete. An alternative for reducing cement usage in concrete makes concrete eco-friendly. Thus, there comes an idea of partially replacing cement with supplementary cementations materials, The concern has been growing in recent years towards reducing the pollutants in water conservation and the environment. The continual urbanization has led to the increase in impervious surface area of the cities, further leading to blockage in percolation of precipitation from rainfall. This result is excess surface run off. To counteract this, pervious concrete is the solution. Hence, the pervious concrete having 15% to 35% interconnected pores by volume, allows direct infiltration of water through its structure. Since the strength of this block for highway suitability of roads is not yet tested. The main aim of this paper is to improve the strength characteristics of porous concrete. However, on comparison, with the published data it is suitable for foot paths/ pathways and parking lots and as driveways in the residential and small rural areas where less vehicular traffic. This will help in reducing the risk of water clogging and recharges the nearby ground water level. The Maintenance of the slab is also minimum and can be repaired and cleaned easily. Thus, it is worthy and useful in many ways.

**Keywords:** Aggregates, Clogging, Concrete, Limestone, Pervious.

## I. INTRODUCTION

The advancements in construction material are a part of Civilization in human life. Now with the advent of increasing population it is more so. The usage of a supplementary cementitious materials such as silica fume, Fly ash, Meta

kaolin, hypo-sludge, fly ash, rice husk, ash etc. is a new innovative usage in the concrete technology. The increasing amount of waste is a concerning reality to address the issues of sustainability of the environment. The production cost of cement is also a reason for innovation of this type of perforated cement.

The world scenario is that the Pervious concrete was first used in the 1800s in Europe as pavement surfacing and load bearing walls. In Scotland and England, it is popular in the 1920s for construction of two storied houses. It became increasingly viable in Europe after World war-II due to the scarcity of cement. It did not become as popular in the US until the 1970s In India it became popular since 2000. But the composition is different.

Nowadays it is common that during rainy season, flooding of roads in all the towns and cities takes place which is due to the retention of water as the metal roads are impervious. The problem is more acute during and after a heavy monsoon. This water clogging on the roads leads to danger to human life especially pedestrians and for vehicular movement. Further, the flooded water may contaminate the environment and nearby nallahs.

According to the published reports the problem is more acute in 20 major cities. Further, it is leading to lowering of the ground water level in summer. Around 100 million people face water crisis every year and many rural areas do not have supply of water in the country.

As the existing water management and conservation systems are inadequate, So the usage of percolating Pervious Concrete slabs for road making is the need of the hour to avoid threats.

## II. MATERIALS AND METHODS

The materials used during the experimental work are metakaolin, fly ash, cement, aggregates (coarse and fine) and water. First a 60x60 (inches) of Wooden frame with depth is 3 inches was taken, then Portland Cement and Coarse Aggregate (Gravel) using 470gms of cement and 2350gms of aggregate and 100 ml water (the cement and aggregates are in 1:5ratio approximately) a block is prepared. Carefully controlled amount of water and cementitious material are used to create a paste. the paste then forms a thick coating around aggregate particles. 20 to 80mm range sized coarse aggregate, fine aggregate of 1 to 15mm size, water cement ratio is 0.27 to 0.43 after 28 days the compressive strength is varying from 5 to 20MPa with a void ratio of 14 to 31% the permeability

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ranging from 0.025 to 0.6cm/sec to reduce the freezing limestone is added around 2kg/m<sup>3</sup>. The design of a Pervious Concrete is made in such a way that it allows the entire surface run off water to percolate down without retaining any quantity of water. The Slab Weighs about 18 to 20 (kilograms) without the wooden frame

### III. RESULTS AND DISCUSSION

Though there is a lot of research work done[1-4] on pervious concrete, but the problem of compressive strength is still unresolved. Thus, its usage was limited to pavements only. But now with the addition of these materials the strength has been increased. Pervious concrete has a strength varies from 600-1500 pounds per square inch (4.1-10.3 MPa). Since, there is no standardized test for compressive strength for the Pervious concrete, it is considered based on the unit weight of a sample of poured concrete using ASTM standard no. C1688. An acceptable tolerance for the density is plus or minus 5 pounds (2.3 kg) of the design density Slump and air content tests are not applicable to pervious concrete because of the unique composition. With this the strength up to 4000 psi (928MPa) could be achieved.

While using the pervious concrete blocks on flooded roads/ area it should be ensured that the pervious concrete is functioning properly through visual observation. Any further increase in strength, the permeability will reduce and thus the strength is directly proportional to permeability. it is observed that if the water to cement ratio increases void space will reduce. Water to cement ratio of 0.27 to 0.30, and 0.35 to 0.40 have been attempted. When too much water is added it will collapse the void space making the concrete block impermeable.

**Table- I: Variations of Porosity and Compressive Strength with variations in fine aggregate**

Percentage Fine aggregate	Porosity (%)	Compressive strength (MPa)
2	14.8	5
4	17	6
7	22	8
12	19	6
16	13	7

Though it is slightly costlier than the normal Concrete but, it has many advantages over Reinforced concrete. Further, the method of Reinforcement by using the metal grid during the process of the casting could increase the strength of the slab. The pervious concrete block also serves as shock absorbing platform. The partial replacement of cement with supplementary cementations materials, has been attempted with fly ash and metakaolin in range of 3%,6% and 10% by weight of cement 0.30 water cement ratio. The infiltration rate test, density, void ratio, and compression tests were carried out.

### IV. CONCLUSION

Pervious concrete beam will have advantages than conventional concrete and can prevent contamination of toxic elemental concentration of the environment in runoff water, repelling saltwater intrusion and apart from flooding of roads.

If the void ratio increases, compressive strength & flexural strength values were reduced. So, it is concluded that combination of metakaolin and fly ash give good compressive strength with cost effectiveness Compared to conventional mix. A large quantity of admixtures is required for pervious concrete. The partially replacing cement with supplementary cementations materials fly ash and metakaolin up to 3%, is an alternative method for reducing high grade cement consumption.

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**Dr. Ayapilla Narasimha Murthy**, obtained his Doctorate degree in Geology from Andhra University, Visakhapatnam in the year 1991. He has vast and diverse experience in Geology with over 28 years in industry & Government Department. He has Published more than 25 papers. His research interests are stable isotopic studies, geotechnical and civil engineering. Currently, he is working as a lecturer in Civil Engineering Department, SRM University, AP.