STUDY ON DEVELOPMENT OF PERVIOUS CONCRETE

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Abstract *Pervious Concrete enhances porosity in concrete and has found to be a reliable storm water management tool. By the definition, pervious concrete is a mixture of gravel or granite stone, cement, water, little to no sand (fine aggregate). When pervious concrete is used for paving, the open cell structures allow storm water to pass through the pavement, into the underlying soils. In other words, pervious concrete helps to protect the surface of the road and is eco friendly. Also, the constituents of pervious concrete are the same as that of conventional concrete, 15 to 30% of its volume consists of interconnected voids which allows water to pass through it. Europeans have also used pervious concrete for paving. Stories have passed down through the years which tell us that soldiers didn't mind walking on pervious roads during World War II because their feet would remain dry. After World War II, Pervious concrete was brought to the United States. Also, pervious concrete is light in weight, (1600 - 2000 kg/m3), due to presence of voids. It also results in a very high permeable concrete that drains water through it quickly.*

Pervious concrete has an ample range of applications, even though its prime use is in pavements which are in residential roads, low water crossings, low volume pavements, sidewalks and pathways, parking areas, alleys, and driveways, slope stabilization, sub-base for conventional concrete pavements etc., Private companies use it to free up valuable real estate for development, other than using expensive retention ponds to save water. Pervious concrete is also a unique and effective means to face important environmental issues and sustainable growth. When it rains, pervious concrete automatically acts as a drainage system, thereby putting water back to the groundwater table. Pervious concrete has a greater advantage in many applications. But still, it has its own limitations which must be put in effective consideration when planning its use. Structurally when higher permeability and low strength are required, then pervious concrete can be used. In this study the workability, density, compressive strength of M30 grade is determined by varying fine aggregates and fine aggregates ratio.

Key words: *Pervious concrete, pavement, durability, strength, workability*

1. INTRODUCTION

Pervious concrete was 1stemployedin 1800s in Europe however the analysis thereon begun in America& Japan since Nineties. Pervious concrete is a mixture of cement, coarse aggregate and water. The pervious concrete is otherwise called as porous concrete or no fine concrete because of the absence of fine aggregate. The pervious concrete is completely different from other traditional concrete because it is only suitable for pavement purpose, it cannot be used for structural members.

The strength and porosity of pervious concrete depends upon the shape and size of aggregates, and the grade of cement, and water cement ratio. The need and the demand for the river sand have been increasing with the development era of construction industry. Therefore the use of river sand is substituted by the alternative material GGBS in lower amounts as a fine aggregate in the Pervious concrete in this study. A zero – slump open-grade material consisting of a mixture of Portland cement, uniform coarse aggregate, and water. Appropriate amounts of water and cementations material are employed to create a paste that forms a thin coat around aggregate particles but leaves free spaces between them. Thus, pores are formed in the Pervious materials. The void content

can range from 18 to 35% with typical compressive strengths of 400 to 4000 psi (2.8 to 28MPA).

Applications of pervious concrete

Common applications using pervious concrete are Parking lots, patios, swimming pool decks, shoulders, greenhouses, zoo areas, noise barriers, building walls, sub-base for conventional concrete pavements, artificial reefs, sidewalks, pathways, walls, hydraulic structures, pavement edge drains, slop stabilization, low-volume pavements, low-water crossings, residential roads, alleys, driveways, sewage treatment plant sludge beds, beach structures, seawalls, bridge embankments, rigid drainage layers under exterior mall areas, solar energy storage systems, wall lining for drilled water wells.

Objectives of the study

For this study the following objectives were made

1. The primary object of this investigation that get a maximum compressive strength without any change in permeability characteristic of the pervious concrete.
2. To design the concrete mix for pervious concrete with and without fine aggregate.
3. To study the strength and workability characteristics of pervious concrete
4. To study the performance and behavior of the open structure of pervious concrete in Indian Climatic Condition.
5. To study the strength properties of conventional concrete with pervious concrete

2. LITERATURE SURVEY

B.V.R.Murthy[1], G.Rajeswari[2], et al.,(2018) Pervious concrete is a concrete containing little or no fine aggregate provides direct drainage of rainwater, helps to recharge groundwater in pavement applications. The objective of this work is to improve compressive strength at which the strength achieves better permeability. From this study it was concluded that in this present study the strength of pervious concrete is improved by adding 5% robo sand as fine aggregate and 100%(80%s1+20%s2) coarse aggregate in the mix.

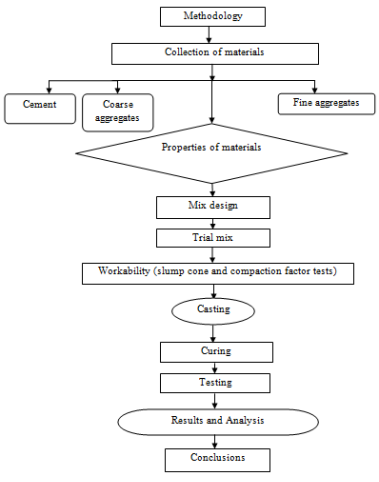
N.Swaminathen[1],N.Saravana Kumar[2], et al.,(2016)

Pervious concrete is a porous concrete which allows water and air to pass through it. The strength properties of pervious concrete often refer to the Compressive Strength, Flexural Strength and Split Tensile Strength. This paper mainly explains about the compressive strength of pervious concrete with different samples. From this study it was concluded that the pervious concrete with addition of sand increases the strength and decreases in porosity. Hence the strength and porosity is inversely proportional to each other.

Praveen kumar Patil[1], Santosh M Murnal[2], et al.,(2014) Pervious concrete is a form of light weight porous concrete, obtained by eliminating the sand from the normal concrete mix. The advantages of this type of concrete are lower density, lower cost due to lower cement content, lower thermal conductivity, relatively low drying shrinkage, no segregation and capillary movement of water. From this study it was concluded that M20 Pervious is designed by ACI522Rdesign code. The compressive strength of pervious concrete increases as the water/cement ratio decreases up to optimum w/c ratio of 0.38.

3. METHODOLOGY OF THE STUSY AND MATERIALS USED

Methodology of the project shown in the below specified chart



Project methodology

Materials used in the study

Cement (OPC 53 Grade)

The most customarily used cement for pervious cement is Ordinary Portland Cement of 53 evaluations. The concrete before use is testicles for its properties according to Indian Standard Specifications. The properties, for instance, typical consistency, starting setting time, last setting time, explicit gravity, fineness, and sufficiency of cement, are tried to affirm that they lie in the standard interims.

Cement Sample

Fine aggregates

Fine aggregate are basically sands won from the land or the marine environment. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 4.75mm sieve. The fine aggregate used in this study is river sand which is obtained from local company and shown in figure.

Fine aggregates

Coarse aggregates

The porosity in PC is made by the end of fine aggregate and the usage of coarse aggregate with a thin or uniform evaluating to permit generally low molecule pressing. The porosity and pores interconnectivity is influenced by the sort, size, and degree of aggregate, glue volume, and union vitality. The pore size in concrete is likewise a significant parameter as it influences properties, for example, porousness and sound retention. Aggregate evaluating commonly utilized in PC is regularly either single-sized coarse aggregate or reviewing somewhere in the range of 10mm and 20mm.

Coarse aggregates sample

Water

Quality of water affects the strength, it is necessary for us to go into the purity and quality of water. A popular yard-stick to the suitability of water for mixing concrete is that, if water is fit for drinking it is fit for making concrete. Carbonates and bi-carbonates of sodium and potassium effect the setting time of cement. Salts of Manganese, Tin, Zinc, Copper and Lead cause a marked reduction in strength of concrete. A turbidity limit of 2000ppm has been suggested. Locally available potable fresh water which is free from concentrations of aid and organic substances has been used in this experimental program for mixing and curing.

Mix design of concrete

M30 grade of conventional concrete mix was done by using IS456-2000 and IS 10262:2009 codes. Final trial mix for M30 grade concrete is 1:1.86:2.89 at w/c of 0.50

The following are the mix ratios used in the current project

1. **Mix 1:** 60 CA: 40 FA
2. **Mix 2:** 70 CA: 30 FA
3. **Mix 3:** 80 CA: 20 FA
4. **Mix 4:** 90 CA: 10 FA

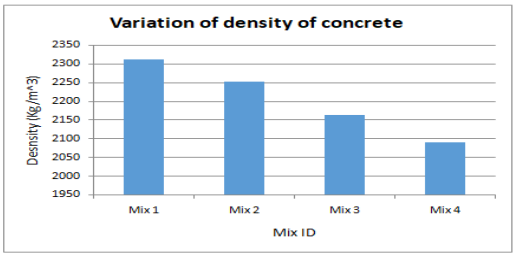
Tests to be conducted on the concrete

The following are the major tests conducted to study the pervious concrete

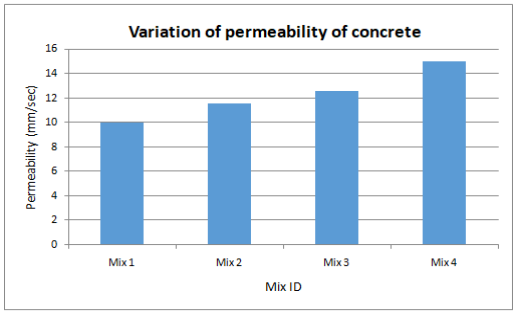
1. Density of concrete
2. Permeability
3. Slump cone test
4. Compressive strength
   a. 3 days curing
   b. 7days curing
   c. 28 days curing

4. RESULTS AND ANALYSIS

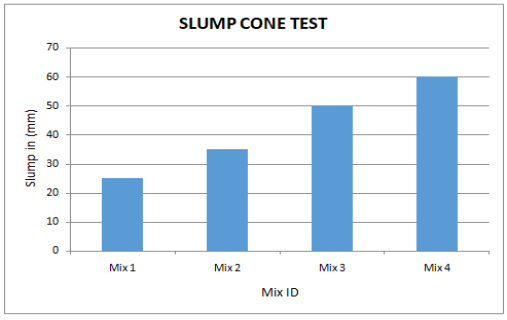
Density of concrete



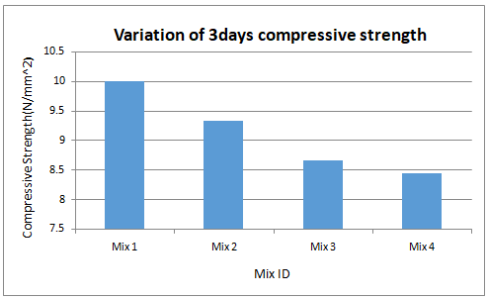
Permeability of concrete



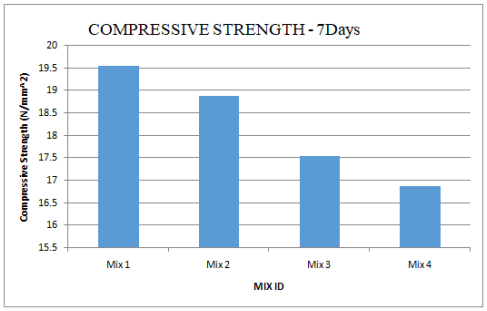
Slump cone test of concrete



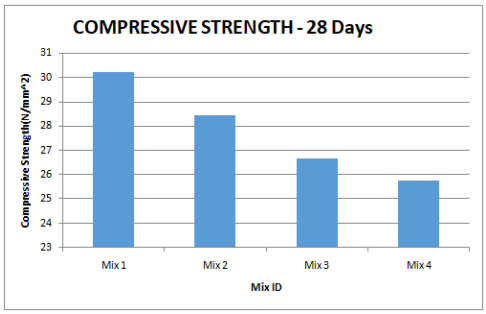
Compressive strength of concrete



Variation of 3days compressive strength



Variation of 7days compressive strength



Variation of 28days compressive strength

5. CONCLUSIONS

The following are the conclusions and recommendations made by this study. According to the experimental results, it has been observed that,

1. 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.
2. Water absorption, abrasion resistance are good property of pervious concrete, it is an eco friendly concrete material.
3. The value of density decreases with increase in the proportion of coarse aggregates from 60% to 90% from Mix 1 to Mix 4.

4. The value of permeability increases with increase in the proportion of coarse aggregates from 60% to 90% from Mix 1 to Mix 4.
5. The value of slump cone increases with increase in the proportion of coarse aggregates from 60% to 90% from Mix 1 to Mix 4.
6. By increase in the coarse aggregates proportion from 60% to 90% for pervious concrete the values of compressive strength at 3days, 7days and 28 days decreasing.

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