



## PERVIOUS CONCRETE

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**Abstract :** Pervious concrete is a special type of concrete mainly used in less load bearing areas to provide a passage to surface water to penetrate into ground and thus recharge the ground water table. Thus pervious concrete is a quite efficient product for rainwater harvesting. In addition to this, pervious concrete also reduces the surface runoff during floods hence, enhancing flood protection measures. The working principle of pervious concrete is the absence of fines, which creates interconnected voids between interlocked uniform sized aggregates. This creates a path for water to flow through it. Pervious concrete is traditionally used in footpaths, parking pavements, walkways in parks and society compounds. Primary objectives of pervious concrete are: Ground water recharge, Reduction to surface runoff, Flood protection Reduction of heat island effect

### I. INTRODUCTION

Pervious concrete is an emerging technology in the field of civil engineering projects. It has a void ratio ranging from 14% to 30%. The quantity of fines is almost zero percent in pervious concrete. Due to this, the strength of pervious concrete is always less than that of the respective conventional mix. The key binding agent is Portland cement and the strength is provided by the coarse aggregates. Due to lack of fines, the resulting mix is very harsh. To increase its workability very minute quantity of fines can be added. It also results in increased strength of concrete and helps in reducing the water content. To increase the workability of mix without increasing the fines, pozzolanic materials such as Fly Ash, Silica Fume or Rice Husk Ash can be added. They can reduce the cement quantity form 15 to 20%. However the Portland Pozzolana Cement (fly ash based) already comes with 15 to 30% fly ash content. So, there is no need of adding the above compounds. Our primary objective is to develop a pervious concrete which provides adequate strength and permeability.

### II. RESEARCH METHODOLOGY

#### 2.1 Materials Used

2.1.1 Cement: - Portland Pozzolana cement (fly ash based) of Ambuja Cement with fly ash content of 20%

2.1.2 Aggregate: - Three types of aggregates are used with sizes ranging from

1. 10mm to 12.5mm
2. 12.5mm to 16mm
3. 16mm to 20mm

#### 2.2 Testing Cubes

Size: 150mm x 150mm x 150mm

Volume: 0.003375 m<sup>3</sup>

No. of samples: 3

#### 2.3 Mix Proportions

For 1m<sup>3</sup> volume of concrete

Cement: 488kg/m<sup>3</sup>

Water: 0.1778m<sup>3</sup>

Volume of cement:  $488 / (3.15 \times 1000) = 0.1550\text{m}^3$

Volume of aggregate:  $1 - (0.1552 - 0.1778) = 0.667\text{m}^3$

Mass of aggregate:  $2.65 \times 1000 \times 0.667 = 1767.55\text{kg/m}^3$



Fig. 1

#### 2.4 Mix Design

The mix design of PCPC (Portland cement pervious concrete):

Cement : Aggregate :: 1 : 3

w/c ratio : 0.35

We used 1.65kg cement and 5.1kg aggregates of different sizes mentioned in 2.1.2. The quantity of water was kept 600ml for all the samples.

### 2.5 Permeability Test

Permeability of the pervious concrete is determined by covering the four sides of the cube with cement paste such that water flows only from top to bottom, rather than from sides. 1 liter of fresh water is to be poured on the top side and the time taken by the water to flow is noted. The sample with lesser time ensures greater permeability.

### 2.6 Compressive Strength

Compressive strength is dependent on size of coarse aggregate, void ratio, bond between mortar and coarse aggregate. In 7 days cubes of permeable concrete gain 30% of its strength, in 21 days of permeable concrete gain 70% of its strength, and for 28 days it gains 95% strength.



Fig. 2

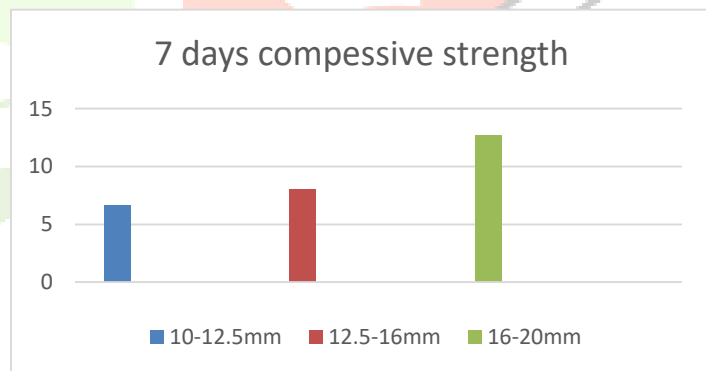
## III. RESULTS AND DISCUSSION

### 3.1 Compressive Strength

7 days Compressive strength of samples according to the aggregate sizes:

Table 3.1

S.No.	Aggregate Size	Compressive Strength
1.	10-12.5mm	12.67N/mm <sup>2</sup>
2.	12.5-16mm	8.05N/mm <sup>2</sup>
3.	16-20mm	6.67N/mm <sup>2</sup>



### 3.2 Permeability Observations

- i. Sample with 10-12.5mm aggregates showed highest permeability.
- ii. Sample with 16-20mm aggregates showed least permeability.
- iii. Sample with 12.5-16mm aggregates showed moderate permeability.

## IV. CONCLUSIONS

- 1) Lesser is the size of aggregate, more number of voids will be there, but the size of voids is small which results in increase of permeability.
- 2) Reduction in the aggregate size decreases the porosity because of its inter relation with no fine aggregate property.
- 3) Porous concrete is unsuitable for heavy duty roads.
- 4) If water cement ratio is increased to make the mix more workable, it will result in settling of cement at the bottom and the aggregate will lose adhesion with cement. It will leave the aggregate exposed to the atmosphere, which is harmful for the concrete.
- 5) Excess tamping increases the strength, but segregates the cement and decreases the porosity.
- 6) Permeability of porous concrete is influenced by the porosity
- 7) The surface is generally rough, that's why pervious concrete is unsuitable for vehicular roads. It is suitable only for lesser working load pavements.
- 8) Continuous seepage of water through the pervious concrete might choke the pores due to inclusion of dirt particles. For regenerating its functionality, pressure wash or pneumatic blowers will be required time to time.
- 9) Levelled surface would result in covering of surface pores by cement and will cause failure of the entire purpose.

## V. FUTURE SCOPE

- 1) Pervious concrete can be used in building for rainwater harvesting as well as for cooling purpose by providing permeable wall.
- 2) Strength of pervious concrete can be increased by adding small amount of fines. Though it reduces porosity for some extent, yet its industrial use can be increased.
- 3) Flaky aggregate can be used to provide easy passes of water without any extra drainage system provided. (Flaky aggregate have more strength). Water can be filtered and stored as fresh water below the ground.
- 4) Water logging of railway underpasses is a great problem nowadays. It can be prevented by use of pervious concrete on the underpass pavement. For this purpose, the pervious concrete has to be made to withstand vehicular loads by adding super plasticizers and fine aggregates in small amounts.
- 5) Further experiments can be done to increase its porosity by introducing air entraining mixtures.

## REFERENCES

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