STUDY ON PERVIOUS CONCRETE FOR MITIGATING WATER LOGGING PROBLEM FROM OUR CITY

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ABSTRACT

Water logging is becoming a serious issue in our country nowadays. At present, this problem is increasing at an alarming rate in our urban areas. The main reason for water logging in city areas is the covering of surfaces by concreting or using paved surfaces that are impermeable. In parking zones, walking roads, footpaths, and open spaces, it is not necessary to use impermeable concrete surfaces. Rather, pervious concrete is very acceptable in those cases. However, pervious concrete poses lower compressive strength, which is the main disadvantage. In this study, pervious concrete is designed with medium compressive strength, which is the big obstacle that is trying to be offset here. High hydraulic conductive concrete is prepared in the laboratory for compressive strength in between (600-2500) psi. The result of this study is quite satisfactory. Lastly, the wide range of applications of pervious concrete is properly investigated here. The compressive strength found for the pervious concrete tested in the laboratory is 1552.39 psi. The hydraulic conductivity or permeability of pervious concrete is very high. This type of permeable concrete is very effective for reducing the waterlogging problem in our city. Pervious concrete is prepared with a permeability or hydraulic conductivity coefficient of 3.11 cm/s, which is very high compared to the conventional concrete permeability coefficient of 10^{-8} to 10^{-12} cm/s. In our developed city, huge areas are being concreted for parking zones, pedestrian movement, and aesthetic views in children's parks. This type of pervious concrete is highly recommended. Also, the application of pervious concrete in our concrete drain and drain cover may be the best solution to the waterlogging problem that decreases runoff truly.

Keywords: *Water logging, pervious concrete, permeability, hydraulic conductivity, strength.*

1. INTRODUCTION

Pervious concrete is a special type of concrete that allows water to penetrate through it, unlike conventional concrete. It is made of stone, cementitious material like cement, and water. The ratio of larger stone pieces to the other components is much higher than conventional concrete, resulting in large voids running through the material. These voids allow water to flow through it rapidly, making it ideal for areas where flooding or pooling water can be risks. Pervious concrete is suitable for flat work applications such as patios, driveways, sidewalks, walkways, and parking lots (Darshan S.Shah et al., 2013).

The main benefit of pervious concrete is that it allows water to flow into the soil rather than into stormwater drains. This can be particularly helpful in areas where undersized drainage systems can get overwhelmed by rainfall. Pervious concrete often doesn't require sealers like conventional concrete, which results in fewer contaminants in stormwater runoff. However, the voids also make it weaker than other types of concrete. Figure 1 shows pervious concrete prepared in the laboratory for this research.
The study has several objectives that describes below:

a. To make lightweight concrete with medium compressive strength.
b. To investigate the use of pervious concrete for reducing water logging problem from city.
c. To decrease runoff and recharging groundwater.

Figure 1: Highly porous concrete

2. MATERIALS COMPOSITION

Pervious concrete is prepared with less amount of water, cementitious ingredients and coarse aggregates. The cementitious materials make a thick covering around the coarse aggregates. Figure 3 shows cement. The mixture has contain water-to-cement ratio of 0.28 to 0.40.
The size of coarse aggregates or stone chips should be 9.5 mm to 12.5 mm rather than finer elements. Figure 2 shows coarse aggregates of respective size. In comparing between conventional concrete and pervious concrete, the mixture contains little or no sand resulting in a high void percentage between 15% and 25%. Figure 4 is the mixture of pervious concrete.

Figure 2: Coarse aggregate

Figure 3: Cement

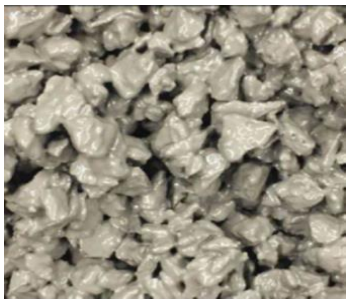

Figure 4: Concrete mix

3. MANUFACTURE OF PERVIOUS CONCRETE

Pervious concrete was cast in a laboratory for this study, and some provisions are given in article 3.1 for commercially production of pervious concrete.
Here, pervious concrete was cast in **4**" × **4**" cube mould (according to ASTM standard). For laboratory casting the steps followed are described below:
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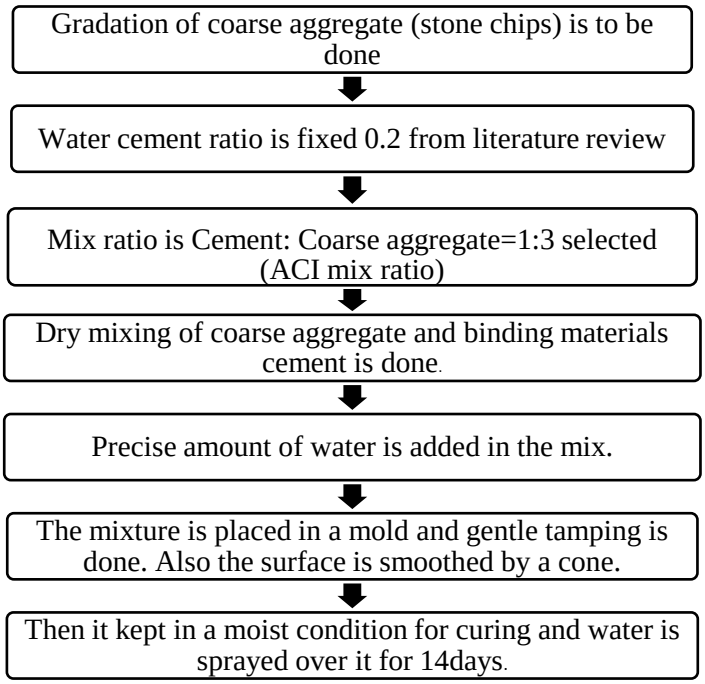

Figure 5: workflow diagram

3.1 For manufacture in field

Pervious concrete is prepared in mixing plant and supplied to construction site. Also it can be prepared in construction site.

Concrete is levelled with a vibratory roller. Also pervious concrete is compacted by this roller subsequently.
Since water content is low in pervious concrete, it is covered with plastic sheet to maintain moist at least 7 days so that desired strength can be achieved.

4. DIFFERENT TEST OF PERVIOUS CONCRETE

Several tests were done in the laboratory to ensure the quality of pervious concrete.

4.1 Strength of Pervious Concrete

Pervious concrete has a compressive strength that ranges from 600 to 2500 psi normally, but it can reach up to 4000 psi. In laboratory tests, the compressive strength was found to be 1552.39 psi. Improved placement techniques can enhance the compressive strength by increasing point-to-point contact between all aggregates to maintain the required void content.

Table 1: Compressive strength of Pervious concrete

Concrete type	Compressive strength(psi)	Average Compressive Strength(psi)
Pervious concrete with no sand	1527.08	1552.39
	1550.09	
	1580.00	

Figure 6: 4" × 4" pervious concrete cube

Figure 7: Compressive strength test

4.2 Hydraulic conductivity of Pervious Concrete

High hydraulic conductivity is the most important characteristics for pervious concrete. Here hydraulic conductivity is presented in Table 2. This type of highly porous concrete is recommended for resurfacing areas where heavy load carrying capacity is not required.

Table 2: Permeability coefficient

Concrete type	**Hydraulic conductivity or permeability coefficient**
Plain concrete	10^{-8} to 10^{-12} cm/s.
Pervious concrete	3.11cm/s

5. WHERE TO USE?

Pervious concrete should be used in parking lots, low traffic volume areas, residential areas, footpath, sidewalks and green houses. It is a critical applications of sustainable development for its less durability.

Figure 8: Parking Zone

Figure 9: Pervious pavement

6. ADVANTAGES OF POROUS CONCRETE

Some advantages of pervious concrete that make it exceptional are:
Groundwater recharge: Rain water can pass through pervious concrete, which will recharge groundwater and increasing the groundwater level.
Reduction in surface run-off: Storm water runoff is the main reason for waterlogging, which can be reduced by using pervious concrete.
Reduction of sewers: Since pervious concrete allows water to pass through it, the discharge from a catchment is significantly reduced. For reducing discharge, the size of the sewer is also reduced. Hence, the cost for the construction of sewers is also reduced.
Development of trees: Pervious concrete permits rainwater to infiltrate, which increases the moisture content of the soil and helps to grow trees. Also, the voids allow more oxygen, nitrogen with air for roots to breathe, creating a healthier environment for trees.
Filtering of storm water: Pervious concrete acts as a filter media, and dirt and pollutants are trapped in the pore. For aesthetically present landscape texture, pervious concrete is very suitable and also reduces the cost of construction, enhances durability, and requires minimum cost of construction.

7. DISADVANTAGES OF PERVIOUS CONCRETE

Pervious concrete cannot be used in heavy traffic volume areas: For heavy traffic load compressive strength should be high.
Requires longer curing time: Pervious concrete requires long curing period and it can delay construction projects.
Difficult to select water cement ratio for pervious concrete: Slump test results give us idea about workability of conventional concrete whereas it's difficult to select for pervious concrete.
Special construction practice: It requires special construction practices. Due to different construction procedures pervious concrete needs skill workmanship which may be increased the cost of

Construction. Also,
Compressive strength of pervious concrete is less than conventional concrete. Durability of pervious concrete is also less.
Corrosion of reinforcement is a major issue for pervious concrete since water absorption property of pervious concrete.

8. CONCLUSIONS

Several concluding remarks are found from the above study. Pervious concrete was prepared in the laboratory and tested for compressive strength, which was found to be 1552.39psi. The use of pervious concrete for reducing water logging problem from city is thoroughly investigated and presented in article 6. If this type of concrete is widely used where only resurfacing is required that will decrease runoff and recharge groundwater. Pervious concrete is an innovative approach to controlling, managing, and treating storm water runoff.

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