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# Reducing Water Logging Problem by Using Permeable Concrete

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**ABSTRACT:** This manuscript based on pervious concrete, it is a relatively a new concept for low volume roads, footpath and parking lot, with this is related to low ground water level. This concrete initially used in 1852 for residential walls in Europe when sand and other fine aggregates were not readily available. Previous concrete has introduced in low volume roads as a road pavement material. Previous concrete as a paving material has seen renewed interest due to its ability to allow water to flow through itself to store rain water and also reduce water logging problem with minimize storm water runoff. This introduction to pervious concrete pavements reviews its application and engineering properties, including environmental benefits, structural properties, and durability. In rural area cost consideration is the primary factor which must be kept in mind. From this concept can reduce the cost of storm water management in the rural area as well as urban area. A pervious concrete pavement is unique and effective means to meet growing environmental demands. Concept of this concrete capturing rainwater and allowing it to seep in the ground and store the rain water in the ground. This pavements technology creates more efficient land for the farming process as well as improve or increase the water level in ponds, wells, and reduce the costly storm water management

**KEYWORDS:** Permeable concrete, Ground water Recharging, Effective storm water management, improve water logging problem

## I. INTRODUCTION

Permeable concrete is a special type of concrete made with controlled amounts of cement, coarse aggregates, water, and additives. This pavement lets rainwater and runoff seep into the soil, managing stormwater effectively. It brings environmental benefits by potentially cooling hot days, cleaning stormwater, replenishing groundwater, and reducing flooding. Overall, permeable pavement is a win for the environment. It contains minimal or no sand, leaving plenty of open space. When the right amount of paste coats the aggregate particles, it forms a network of highly porous gaps, allowing for swift drainage. Low water-to-cement ratios are crucial for strength and to keep the paste from filling these gaps. The performance of porous concrete relies on getting this ratio right.

Relevance:

- Permeable pavement helps handle urbanization's challenges like flooding, erosion, and water pollution by reducing runoff and enhancing water quality. It's a vital solution for the environment.
- As cities focus more on sustainability, water-absorbing pavement plays a crucial role. It helps by lessening environmental harm and making better use of resources. This aligns perfectly with the sustainability goals of urban development.
- Water-absorbing pavement plays a crucial role in enhancing public safety. With the potential risks of flooding and erosion threatening both safety and property, this innovative pavement solution steps in to mitigate such hazards effectively. By significantly reducing the chances of flooding and erosion, it creates a safer environment for roads and sidewalks, ensuring the well-being of pedestrians and motorists alike.
- Taking on a permeable concrete pavement project demonstrates a dedication to innovation and leadership in urban development. This commitment can elevate the reputation of the individuals or organizations involved.
- Choosing a permeable concrete pavement project can be driven by goals like addressing environmental issues, promoting sustainability, improving public safety, and showcasing leadership and innovation.

## II. OBJECTIVE

- To study permeable concrete roads.
- To design M25 grade concrete by changing air content (15%, 20%, 25%).
- To study the results of concrete block and find optimum mix design of permeable concrete.
- Experimental study on model of water absorbing roads.

## III. METHODOLOGY

In this present study use M25 grade permeable concrete, this concrete capturing rainwater and allowing it to seep in the ground and store the rain water in the ground. This pavements technology creates more efficient land for the farming process as well as improve or increase the water level in ponds, wells, and reduce the costly storm water management. For this process changing air content in the concrete and getting tests on fresh concrete and harden concrete in that slump cone test and compressive test respectively. Prepare and submit same proposal by making model. This work done by using following steps.

Step 1: Collecting information about permeable concrete and selection of standard quality material. Step 2: Conduct the test on material and find result.

Step 3: Preparation of Mix design for M25 grade concrete by changing air content (15%, 20%, 25%). Step 4: Casting a cube of permeable concrete as per mix design.

Step 5: After casting the concrete block carried out compression strength test on concrete block. Step 6: Making model as per the optimum mix design.

The procedure for making permeable concrete blocks involves several steps:

I. Materials Needed: Ordinary Portland cement (53 grade)

Aggregate (15mm and 20mm) Sand (retained on 2.36mm sieve) Water (Portable water)

Admixtures (for enhancing permeability or strength) Mold (150 x 150 x 150mm size)

II. Mix Design: Determine the mix proportions based on the desired permeability, strength, and durability of the blocks. Aim for a mix with a low water-to-cement ratio to enhance strength while maintaining permeability.

III. Aggregate Preparation: Clean and sort the aggregate to remove any debris or fines that could affect permeability.

IV. Mixing: Combine the Portland cement, aggregate, water, and any desired admixtures in a concrete mixer.

V. Mold Preparation: Prepare the mould of 150 x 150 x 150 mm desired dimensions of the permeable concrete blocks. Apply a release agent like oil to the mould to prevent the concrete from sticking.

VI. Casting: Pour the mixed concrete into the mould, filling it completely to the top. Use a shovel or scoop to distribute the concrete evenly. Tap the sides of the mould with a rubber mallet to remove extra trapped air content and ensure proper consolidation.

VII. Surface Finishing: Use a trowel or screed to level the surface of the concrete block, removing any excess material. Pay attention to the edges and corners to ensure they are well-defined and free of defects.

VIII. Curing: Allow the concrete blocks to cure in the mold for a minimum of 24 to 48 hours. Concrete block place in water tank for curing after completing 48 hours. Maintain adequate moisture levels during curing to prevent shrinkage and ensure proper strength development.

After completing 7 days we taken first compressive strength on concrete block. After completing 14 days we taken second compressive strength on concrete block. After completing 28 days we taken third compressive strength on concrete block.

### A. Test on material

Testing concrete materials is crucial for ensuring the quality, strength, and durability of concrete structures. These tests are performed to assess various properties of concrete, including compressive strength, durability, workability, and consistency.

Test on cement – Fineness of cement

Test on fine aggregate – Silt content, Water absorption, Fineness modulus

Test on coarse aggregate – Water absorption, Fineness modulus, Aggregate impact value.

TABLE I. MATERIAL RESULT ANALYSIS

Name of Test	Result Range Between	Material Test Result
Fineness of Cement	Less than 10 mg	6.5 mg
Silt Content in F.A.	2 to 9%	8.16%
Water Absorption of F.A.	Less than 3%	1.376%
Water Absorption of C.A.	Less than 2%	1.085%
Fineness Modulus of F.A.	2.2 to 2.6	4.80
Fineness Modulus of C.A.	2.9 to 3.2	2.45
Aggregate Impact Value	Less than 30%	5.93%
Specific Gravity of F.A.	2.5 to 3	2.61 N/mm <sup>2</sup>
Specific Gravity of C.A.	2.5 to 3	2.749 N/mm <sup>2</sup>

B. Concrete design: Concrete mix design as per IS: 10262 - 1982

a. Mix Design of Impermeable concrete. Use M25 grade concrete.

- Volume of Mould =  $0.15 \times 0.15 \times 0.15 = 0.003375 \text{ m}^3$  We have casted 3 mould for test  
Then,  $= 0.003375 \times 3 = 0.010125 \text{ m}^3$

- Dry volume = add 52% extra  
 $= 1.52 \times 0.010125 = 0.01539 \text{ m}^3$

- Volume of cement bag = Dry volume/Add. of proportion =  $0.01539 / (1+1+2) = 3.8475 \times 10^{-3}$

- No. of cement bag = volume of cement/ volume of 1 bag  
 $= 3.8475 \times 10^{-3} / 0.035 = 0.109 \text{ bag} = 0.11 \text{ bag} = 5.5 \text{ kg}$

- Volume of sand =  $5.5 \times 1 = 5.5 \text{ kg}$

- Volume of aggregate =  $5.5 \times 2 = 11 \text{ kg}$



Fig.2 Concrete fill in mould and put in the water for curing

b. Mix design for permeable concrete.

In this concrete use same grade that is M25 but change air content 15%, 20% and 25% for make a porous concrete. Following table shows mix design of concrete for one cubic metre concrete.

TABLE III. MATERIAL RESULT ANALYSIS

Material Name	Quantity required 15% air content	Quantity required 20% air content	Quantity required 25% air content
Cement Content (kg)	639	639	639
Water (kg)	212	211	209
Fine Aggregate (kg)	498	461	423
Coarse Aggregate			
Coarse Aggregate (20mm) kg	471	713	654
Coarse Aggregate (15mm)	514	475	436

Permeable concrete fill in the mould before that oiling the mould after that well mixed fresh concrete fill in the mould. Permeable concrete done with well proportion cement, coarse aggregate, fine aggregate and water only in that change in design air content for make proper porous concrete.



Fig. 1 Permeable concrete in fresh and hard condition

#### IV. RESULT AND DISCUSSION

The present study is to understand the permeable concrete performance. For this concrete all material required in well quantity. After 7, 14 and 28 days curing concrete block are tested. Result and discussion in terms of compressive test on permeable concrete block. Also making the model of permeable concrete behaviour.

Compressive Test: For this test prepare the specimen according to standard dimensions. Place the specimen between the plates of a compression testing machine. Apply a gradual load at a constant rate until the specimen fails. Record the maximum load applied and the corresponding deformation.

Calculate the compressive strength using the formula:  $\text{Compressive Strength} = (\text{Load}(\text{kg}) \times 9.81) / \text{Cross section of concrete block}(\text{mm})$ .



Fig. 4 Place the concrete block between two plates



Fig. 5 Gradually release pressure

A. 15% Air content in permeable concrete:  
At w/c ratio = 0.3 and their slump = 270mm



Fig.6 15% air content cube after compressive test

B. 20% Air content in permeable concrete:  
At w/c ratio = 0.3 and their slump = 276mm



Fig.7. 20% air content cube after compressive test

C. 25% Air content in permeable concrete:  
At w/c ratio = 0.3 and their slump = 282mm



Fig.7. 20% air content cube after compressive test

Following table shows that compressive strength after 7 days, 14days and 28 days by changing air content in concrete inpercentage of 15%, 20% and 25%.

TABLE IIIII. COMPRESSIVE STRENGTH TEST (N/MM<sup>2</sup>)

Curing Days	15% Air content	20% Air content	25% Air content
After 7 days	11.91	12.20	10.75
After 14 days	16.93	18.80	14.67
After 28 days	20.59	26.59	21.43

Following are the graphical representation of compressive strength test by varying percentage of air content in concrete mixdesign. Varying air percentage 15%, 20% and 25%.



Fig. 2 Compressive strength analysis



Fig. 2 Model of pervious concrete

#### IV. CONCLUSIONS

- A. The Water-absorbing pavements mitigate urbanization's impact on the hydrological cycle by decreasing runoff, enhancing water quality, minimizing flood risk, and promoting groundwater recharge, making them superior to conventional pavements for fostering sustainable urban development.
- B. Water-absorbing pavements have demonstrated in experiments their ability to reduce runoff in urban areas, leading to improved water quality and decreased flood risk; although initially more costly, their long-term cost-effectiveness is highlighted by lower flood damage and reduced need for flood mitigation measures.
- C. The effectiveness of water-absorbing pavements in urban areas hinges on factors such as pavement type, area size, and maintenance levels, underscoring the necessity for thorough planning and design to ensure their success.
- D. Water-absorbing pavements offer a promising approach for sustainable urban development by reducing flood risk and improving water quality; further research and experimentation are needed to optimize their performance across diverse urban environments.

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