RAINWATER HARVESTING AND REDUCING WATER LOGGING PROBLEM
BY USING PERMEABLE CONCRETE

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Abstract- Pervious concrete is a relatively a new concept for rural road pavement, with increase into the problem in rural area related to low ground level, first used in 1852 in residential walls in Europe when sand and other fine aggregates were not readily available. Previous concrete has introduced in rural road 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 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. So that in rural areas costly storm water management practices is not applicable. A previous concrete pavement is unique and effective means to meet growing environmental demands. By capturing rainwater and allowing it to seep in the ground and store the rain water. This pavements technology creates more efficient land use by eliminating the need for retention ponds, swells, and other costly storm water management devices.

Keywords- Permeable Concrete, Casting Procedure, Mix Design, Strength of Pervious Concrete, Application of Pervious concrete, Model Making to Show its Application.

I. INTRODUCTION

Over a past few years cities and suburbs have become larger and densely populated. Area is used to be covered vegetation have now been replaced by infrastructure such as buildings, street, side blocks. The absence of this natural surface is greatly disrupted natural water cycle. The excessive use of impervious covering has left series with challenges of increase in runoff volume, back erosion flooding, and deputation of water poverty. Today this problems post considerable risk to the sustainable development of cities and suburbs. It series matter that day requires immediate attention and available solution. As we are civil engineer we are using more impervious covering on natural surfaces so that it’s our responsibility to do something for society by finding out solution on these problems. Permeable is simple and lasting solution that imitates original hydrological conditions.

Permeable concrete is special type of concrete with high porosity use for concrete flatwork application that allows water from precipitation and other resources to pass through it, thereby reducing the runoff from a site and recharging ground water levels. Permeable from tarmac offers a practical, cost effective, long-lasting, sustainable drainage solution that minimizes the risk of surface water flooding and improves water quality.

Permeable can play a fundamental role in the majority of sustainable urban drainage system (suds) designs, providing a practical, long term answer to surface water flooding that can be implemented quickly and cost effectively. A few new fast draining concrete pavement solution, it rapidly directs excess water away from streets, parking surfaces, drive ways and walk ways. Unlike conventional concrete, it has a high void content of between 20 – 35%. This allows surface water to
drain through into the sub-strata and dissipate naturally, reducing the risk of surface water flooding and water course contamination. Permeable concrete is a concrete paving solution with improved permeability characteristics compared to conventional permeable concrete. Offering a porosity of up to 30% an average flow rate of 36000 mm/hr./m² with compressive flexural strengths of 10-20 N/mm² and 1.5-3 N/mm² respectively. A permeable solution offers significant benefits over traditional solutions. The combinations of trafficking surface and drainage system in a single element creates benefits in construction process and in construction and environmental costs.

II. LITERATURE REVIEW

Darshan S. Shah et al. “Pervious Concrete: New Era For Rural Road Pavement”(Aug 2013) International Journal of Engineering Trends and Technology (IJETT) – Volume 4 PP 3495-3499 [1] In this paper Pervious concrete is a relatively new concept for rural road pavement, with increase into the problems in rural areas related to the low ground water level, agricultural problem. Pervious concrete has introduced in rural road as a road pavement material.

Mr. V. R. Patil et al. “Use of Pervious Concrete In Construction of Pavement For Improving Their Performance” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) PP 54-56 [2] Our cities are being covered with building and the air-proof concrete road more and more. In addition, the environment of city is far from natural. Because of the lack of water permeability and air permeability of the common concrete pavement, the rainwater is not filtered underground.

S.O. Ajamu et al. “Evaluation of Structural Performance of Pervious Concrete in Construction” [May 2012] International Journal of Engineering and Technology Volume 2 No. 5 PP-829-836 [3] In this paper permeability and strength of pervious concrete depend on the particle sizes and proportions of the constituent materials of which the concrete is made of. In this paper, structural property and permeability of pervious concrete made with different coarse aggregate sizes is presented.

A.K. Jain et al. “Effect Of Shape And Size Of Aggregate On Permeability Of Pervious Concrete” [Dec 2011] Journal of Engineering Research and Studies PP-48-51 [4], In This paper presents the laboratory results of the study undertaken to determine the effect of shapes and size of aggregates on permeability of pervious concrete. Shape of aggregate is measured in terms of their angularity number. Angularity or absence of rounding of the particles of an aggregate is an important property because it affects the porosity, surface area in contact with each other in the matrix of ingredients and ease of handling of a mixture of aggregate and binder.

Alireza Joshaghani “Mechanical Characteristic of Pervious Concrete Considering the Gradation and Size of Coarse Aggregates” [September 2014] Research Journal of Environmental and Earth Sciences 6(9): 437-442 PP-437-442 [5], In This Paper Pervious concrete is a kind of sustainable pavement with high permeability which is becoming more common as a storm water management. The purpose of this study was to investigate the effects of coarse aggregate on physical and mechanical properties of the pervious concrete such as density, strength, porosity and permeability at 7, 28, 56 days.

III. OBJECTIVES

1. Rain water harvesting under pervious concrete.
2. Drain of water to avoid water logging and optimization of rain water.
3. To reduce problem with traditional surface water drainage system.
4. To minimize risk of surface water flooding.
5. Use of stored water for various purposes. (Farms, domestic use, small construction site)

IV. METHODOLOGY

1. Collecting information about permeable concrete.
In this we came to know what is permeable concrete? Where it can be used? What are the technical properties of the permeable concrete and its casting procedure?

2. Selection of standard quality material.
- Portland Pozzolana cement, Angular Aggregates, Domestic water and Admixture. (Silica Fume And Marble Dust)

3. Preparation of Mix design. Casting a cube of permeable concrete with various size of aggregates as per mix design.
- For getting more permeable concrete we have used different aggregates size (20mm, 16mm, 12.5mm etc). We have reduced the aggregates size to get smooth surface and to get strength as designed for M20 grade. For getting strength we used Admixture (Silica fume, Marble dust)

4. Test for compression strength-
- We have made a cube of 150*150*150mm and made curing for 28 days after that we took test on compression testing machine.

5. Comparative statement of conventional concrete with permeable concrete.
- Cost of permeable concrete is less than conventional concrete. (25-30% economical than conventional concrete)

6. Smart model making for showing its application for rain water harvesting.
- These is a fully AutoNation box. We create a model of size (2ft* 1.5ft* 2ft) with base as an impermeable layer then boulders are used as sub-base layer. Also perforated pipe is used in that sub-base layer for drainage purpose. On top layer permeable concrete is used. The water from the permeable concrete goes down and water is collected through the perforated pipe. That water can be stored and reused for various purposes. This type of concrete is more useful where there is less rain and it also can be used where there is heavy rainfall it can drain off up to 350-400 liters/min/square meter. And it also helps to reduce the runoff. The fig (4.1) below shows the model of permeable concrete.

![Permeable Concrete Model](image)

**FIG 4.1 Permeable Concrete Model.**

V. MATERIAL REQUIRED FOR PERVIOUS CONCRETE

**Cement:**- Portland Pozzolana Cement (PPC).
PPC is manufactured by the intergrinding of OPC clinker with 10 to 25% of pozzolanic material.
Specific Gravity 2.85

**Coarse Aggregates:**- Size 12.5mm.
Angular Aggregates, Specific Gravity 2.75

**Water:**- Domestic water.
Admixture:- Silica fume, Marble dust.

VI. MIX DESIGN

Mix Design Type:- Indian Standard.
Proportion:- Cement : Water Content : Coarse Aggregate
\[ \frac{1}{0.36} : \frac{2.70}{1} \]

VII. APPLICATION

1. This type of concrete can be used in the parking area from where water can be stored in the storage tank and then can be used for gardening, car washing etc.
2. It can be also used in the courtyard in front of home as well as lawns.
3. It is used on the boundaries of swimming pools the water coming out from pool is again stored in the pool.
4. It can be used in Pedestrian and Tennis court.

VIII. ADVANTAGES

1. Permeable concrete is evacuate water faster than conventional concrete.
2. Storm water management and Environmental management are done by using permeable concrete.
3. Cost of permeable concrete is less as compare to conventional concrete.

VIII. TEST RESULT ANALYSIS

Compression Test:- Cubes of 150*150*150mm.

We have prepared 3 cubes with the proportion as given above of cement, coarse aggregates, water. We have adopted the I.S standard for mixing the proportion, transporting, placing, compaction, curing for 28 days. As admixture we have used marble dust. Following table shows compressive strength of permeable concrete:

| Cube No | Cube Size               | Compressive strength (N/mm²) |
|---------|-------------------------|------------------------------|
| 1       | 150mm X 150mm X150mm   | 21.31                        |
| 2       |                         | 27.16                        |
| 3       |                         | 24.7                         |
|         | Average                 | 24.39                        |
IX. CONCLUSION

Comparative statement between Permeable concrete and conventional concrete:

1. As there is no use of fine aggregate in permeable concrete, so the cost of permeable concrete is less as compared to conventional concrete. (25-30% less)
2. For strength purpose in permeable concrete we use marble dust as an admixture which is economical.
3. As compared to conventional concrete water drains out quickly in permeable concrete and avoid water logging problem which we face during heavy rainfall especially in metropolitan cities.
4. As compared to conventional concrete the surface of permeable concrete is less smooth but to get more smoothness we can use paving blocks on the surface of permeable concrete.

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