International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 4
April 2017

Flood Harvesting with reference to Permeable Road Pavements

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Abstract

Runoff is the excess water flowing over the roads after satisfying all the losses. This runoff is effectively utilized in lean season. This concept is related with internal roads of Dr. J.J.Magdum College of engineering, jaysingpur. It represents how to store the water which is flowing over the roads. In rainy season lot of water get wasted and also flooding of internal college of roads takes place. To avoid this flooding we will provide the porous concrete over the shoulders of road surface. The water which is collected during rainy season that should be flowing through gutters provided at the side of roads. This water is collected at the end of roads according to slope of roads and finally collected into underground water tank. This water can be used in lean season or day to day use. To make the collected water potable it is decided to provide conventional filter. Due to the use of porous concrete road, flooding of roads is avoided. Thus, by following the concept approximately 70% of water demand is satisfied. As well as municipal charges of extra water is avoided.

1.INTRODUCTION

Flood water harvestingcan be defined as the collection and storage of creek flow for irrigation use.Water is essential to all life – human, animal and vegetation. It is therefore important that adequate supplies of water be developed to sustain such life. Development of water supplies should, however, be undertaken in such a way as to preserve the hydrological balance and the biological functions of all ecosystems. This is crucial for marginal lands. Consequently, the human endeavor in the development of water sources must be within the capacity of nature to replenish and to sustain.

As land pressure rises, more and more marginal areas in the world are being used for agriculture. Much of this land is located in the arid or semi-arid belts where rainfall is irregular and much of the precious water is soon lost as surface runoff. Recent droughts have highlighted the risks to human beings and livestock, which occur when rains falter or fail. While irrigation may be the most obvious response to drought, it has proved costly and can only benefit a fortunate few.

Actual run-off percent and the recharge percent are very small and in most cases will be substantially less that 10 percent of the total rainfall. In a lot of these cases, the waterfalls and is absorbed in the top layer of soil and then it evaporates over time, some of it is directly intercepted by vegetation just falling on leaves and such and evaporating directly. That water doesn't go anywhere in terms of improving your water supply; it isn't available to you.

It falls, goes back up into the atmosphere and is lost; thus the water is unavailable. Think about the way urban development works: you come in and build houses, you pave areas, and you turn the landscape runoff, which has a natural sponge that may be taking up 80+ percent of your precipitation. The runoff piece of the pie dramatically increases in these cases, especially as imperviousness increases. What can we do with that water?

How can we use that? That leads me to the rest of the presentation on is rainwater harvesting; getting water into the ground in such a way that it could potentially be useable or recoverable later on.

To collect the extra water which flows over the road surface that should be collected. This can be achieved by using different porous materials as road pavement. The different porous materials are porous concrete, porous asphalt, plastic grids and porous paving block. By using these materials the overflowing water can be collected and stored to make effective utilization.

2.OBJECTIVES:-

1. To reduce runoff losses.
2. To avoid flooding of roads.
3. To meet the increasing demands of water.
4. To raise the water table by recharging ground water.
5. To supplement ground water supplies during lean seasons.

3.LITERATURE REVIEW:-

1)Author Name:- **Vaikko Allen**

Title :- Rainwater harvesting and recharge techniques for flood control and improved storm water quality

Published:- DEC 2010

There are lots of ways to do surface infiltration. A lot of options are out there; these option are exactlythe same as regular asphalt or concrete wouldbe, they just remove the fi nes from the mix andyou have a relatively porous top surface. Belowthat, there is a bed of washed stone that has a30-40 percent void ratio and usually a fabric linerunderneath that, which acts as a reservoir. So whenit rains, it acts like a permeable surface, the watergoes into the ground and is able to percolate intothe native soil. This is not accomplishing much asfar as water supply, but it will satisfy stormwaterrequirements. There are also plastic grids thatare sometimes used with turf on them. However,around here let's avoid turf if at all possible in lightof our conservation goals. You can use gravel withthe idea that essentially you are reinforcing thedriving surface so that it can support much moreload; it is like a snowshoe, it supports a load over awider area so you don't destroy the driving surface.Also, if it rains, it is a much more durable surfacebecause the water canflow through and you don'tend up with ruts.

2) Author Name :-**ThusharaPriyadarshana**

Title :- Pervious concrete- A sustainable choice in civil engineering and construction.

Pervious concrete (no-fines concrete) is a concrete containing little or no fine aggregate; it consists of coarse aggregate and cement paste. It seems pervious concrete would be a natural choice for use in structural applications in this age of 'green building'. It consumes less raw material than normal concrete (no sand), it provides superior insulation values when used in walls, and through the direct drainage of rainwater, it helps recharge groundwater in pavement applications. The first pervious concrete has been used in Europe and the United Kingdom since 1930s for the building of single story and multistory houses, but had found little acceptance in rest of the world. In recent years, however, due to increased awareness of the need for conservation of nonrenewable mineral resources, increased consideration is being given to the use of pervious concrete in most countries. Even though, it is not yet widely used in Sri Lanka, pervious concrete is generally used for light-duty pavement applications, such as residential streets, parking lots, driveways, sidewalks, channel lining, retaining walls and sound walls. This paper discuss the art of pervious concrete; materials and possible mix proportions, properties such as compressive strength, flexural strength, shrinkage, permeability with initial tests done at Innovation & Application Center of Holcim (Lanka) Limited, and the principal advantages, major disadvantages and principal applications in Sri Lankan construction industry.

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4.METHODOLOGY:

It is the case study over the internal roads of Dr.J.J.MAGDUM COLLEGE OF ENGINEERING, JAYSINGPUR.

1) Collection of rainfall data of jaysingpur city from shirolTahsildar office

Month	June	July	Aug	Sept	Oct	Avg
year						
2008	68	99	187	261	261	175.2
2009	57	247	287	515	666	354.4
2010	163	334	375	454	486	362.4
2011	68	129	170	228	228	164.6
2012	32	153	209	336	440	234
2013	45	130	265	505	648	318.6
2014	73	150	165	60	95	108.6
2015	118	17	40	74	-	62.25
2016	79	287	133	-	-	166.33

2) Calculation of demand of water for college

Sr No	Description	Numbers	Demand in lit/day	Total demand
1	Student	1980	15	29700
2	Staff	304	15	4560
3	Laboratory	-	2000	2000
4	Canteen	-	2000	2000
5	gardening	-	1000	1000
			Total	39260

3) Survey of roads

Name of road	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
length(m)	76.9	53.00	110.1	70.0	47.2	37.80	29.40	73.4	19.55	17.00
Width(m)	23.7	4.6	4.8	2.5	2.5	2.5	4.6	4.8	2.5	17.80
slope	1.71:100	2.84:100	4.61:100	2.44:100	3.52:100	2.55:100	1.49:100	2.11:100	0.66:100	0.95:100
Area (sq.m)	1822.53	243.8	528.48	175	118	94.5	135.24	352.32	48.87	302.6

4) Generation of runoff during rainy season

Runoff = coeff. Of concrete xavg . rainfall x area of roads

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Sr no	Catchment area	Area	Collection of water in liters (in 120 days of rainy season)
1	R1	1822.53	257898.23
2	R2	243.8	36906.93
3	R3	528.48	80002.35
4	R4	175	26491.85
5	R5	118	17863.07
6	R6	94.5	14305.59
7	R7	135.24	20472.9
8	R8	352.32	53334.90
9	R9	48.87	7398.08
10	R10	302.6	45808.19
		Total	560482.09

Total runoff collected per day =4670.684 liters.

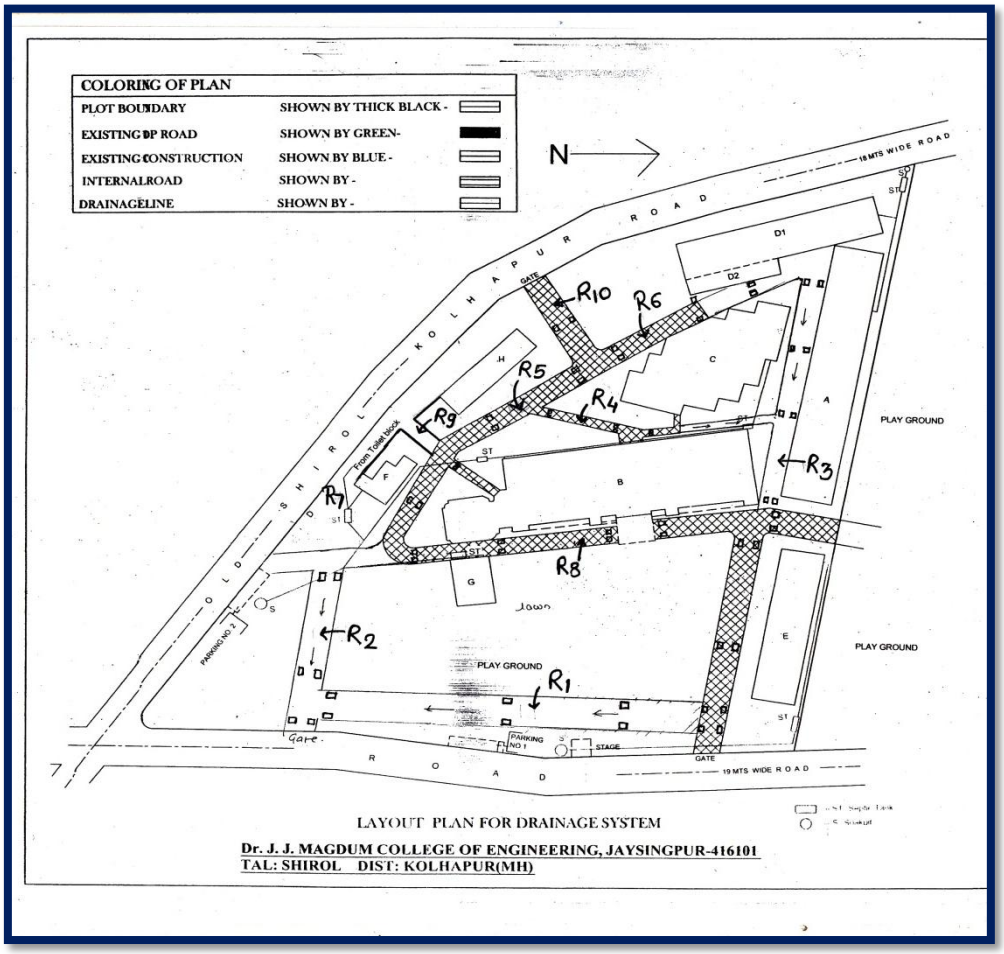

Fig 4.1 layout of roads

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4) Chambers:-

As per the runoff generated over the road surfaces it has been decided to design the chambers of 0.2m x 0.2m x 0.5m. Under the guidance of IRC SP 050-1999, the spacing between two chambers is 10m to 20m, hence provide spacing of 15m.and total number of

5) Filter:-

The most of the larger size particles are gets separated from the runoff due to provision of pervious concrete. So as to make the turbid water potable provide conventional gravel filter of variable gravel size and sand.

Tests:-

Porosity test:-

Procedure:-

- Taking the oven dry weight (W2) at 105^0 c.
- Taking weight of blocks under water with the help of spring balance (W1).
- Measure the volume of blocks (V).
- Putting all the values in below formula gives the % of void contents which shows porosity of concrete.
- Formula:-

$Vr = [1- ((W2- W1)/ \rho w\ V) \times 100]$ *(in %)*

Where,
Vr = porosity
W1 = weight under water of concrete block
W2= oven dry weight of concrete block
V =volume of sample
ρw =density of water

RESULTS:-

Sr no	Volume (cum)	Aggregate size (mm)	Dry weight (kg)	Wet weight (kg)	Porosity(%)
1	0.15X0.15X0.08	4.75-10	3.63	2.1	91.33
2	0.15X0.15X0.08	10-12.5	3.55	2.075	91.64
3	0.15X0.15X0.08	12.5-20	3.50	2.15	92.35

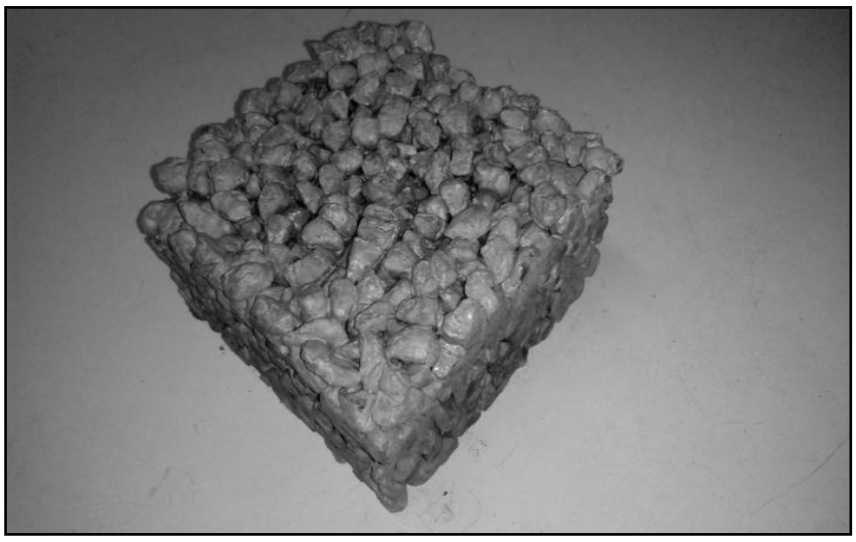

Fig 4.2 porous concrete block

Fig 4.3 porosity test on porous concrete block

6. CONCLUSION:-

From this paper it is found that the excess of runoff from road pavement after fulfilling all the losses goes waste without any utilization. This condition comes in existence as the existing roads are impermeable and the runoff overflows over it. So as to avoid wastage of runoff it is decided to provide precast porous concrete blocks over the shoulders and the drains are also precast below the shoulders. Due to the porous property of concrete some of the impurities gets separated and only turbid water joins the drain. This water from drains reaches to conventional filter so as to make the turbid water as potable water and finally to storage tank.

As the worlds demand for water is increasing day by day, by adopting this technique some of the water which goes waste can be effectively utilized so as to satisfy the demand. As per the case study, the total demand of case study is 39,260 liters/day out of which 4,670.684 liters/day can be satisfied by adopting this technique.

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