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DRAINAGE OF AGRICULTURAL LAND THROUGH PERFORATED PIPES

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Abstract - *Agriculture is major source of income of majority of people in India. Farmers here face the issues like water logging, increase in salinity of soil, Rise in water table, etc. as a result of heavy rains or excess irrigation. All these factors pose threat to agricultural lands by making land barren and decreasing fertility and productivity of soil. Drainage facilities can be used to overcome these issues. Drainage is the removal of excess surface and sub surface water from, including the removal of dissolved salts from the soil Which further helps to maintain the soil Fertility. Drainage can be either artificial or natural. Subsurface drainage is a type of drainage which can be used to drain water. Drainage through perforated pipes is one of the types of subsurface drainage. A perforated pipe is designed to allow water to enter or exit through small holes or slots along the pipe. Black cotton soil deposits in India are boon to farmers. Approximately one third of the surface deposits of the country is black cotton soil and so we have conducted our project considering black cotton soil. The results may enhance new development in agricultural sector.*

Key Words: **Agriculture, Drainage, subsurface drainage, perforated pipes, black cotton soil.**

1. INTRODUCTION

Drainage for agriculture deal with drainage of agricultural land with special emphasis on irrigated agriculture. When irrigation is introduced in an area to improve crop production two important risks on natural environment are those of water logging and salinization. These two risks are caused due to a] excessive application of irrigation water, b] lack of adequate drainage. Water logging is the accumulation of excess water in root zone of the soil. Salinization is the accumulation of soluble salts at the surface, or at some point below the surface of soil profile, to levels at which they have negative effects on plant growth or soils. Of the estimated 235 million ha of irrigated land in the world, 10 to 15 percent has been affected by salinization. To overcome the issues of water logging, salinity and to optimize irrigated water drainage is necessary.

Drainage is the removal of excess surface and sub surface water from the land to enhance growth of crop, including the removal of dissolved salts from the soil. A drainage system is an artificial system of land forming, surface and sub surface drains, related structures, and pumps by which excess water is removed from an area. Sub surface drainage is the removal of excess water and dissolved salts from soils via ground water flow to the drains, so that the water table and root zone salinity are controlled. Perforated pipe is one of the mediums for draining of Agricultural land.

1.1 SUBSURFACE DRAINAGE

Subsurface drainage indicates the need for drainage in irrigated area. It gives an overview of the system that are available to drain irrigated land and explains the soil and hydrological drainpipe-envelope concept. Subsurface drainage lowers the high-water table which are caused by precipitation, irrigation water, leaching water, seepage from higher lands or irrigation canals and ditches.

1.2 PERFORATED PIPE

The pipe with small perforation spaced at certain distance for the drainage of water in subsurface drainages is defined as perforated pipes. The inflow of a perforated pipe depends upon number and size of perforations, amount of water used for irrigation. The discharge at the outlet of this pipe depends upon the gradient of the pipe, size of the pipe, water head variation and pipe hole percentage. Type of flow through this pipe can be determined by Reynolds number.

1.3 BLACK COTTON SOIL

Black soils, locally called regards or black cotton soils, and internationally known as 'tropical black earth' or 'tropical chernozems' have been developed by the weathering of the deccan lava in major parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, Rajasthan, Tamil Nadu and Uttar Pradesh. According to Krebs the regur soil is essentially a mature soil which has been produced by relief and climate rather than by a particular type of rock. It occurs where the annual rainfall is between 50-70 cm and number of rain days is from 30-50 cm.

2. LITERATURE REVIEW

There are many research papers which shows the study related to the drainage through agricultural lands. **H.P. Ritzema** studied "Drainage for agriculture"(2015), his study shows the issues which occur due to lack of drainage like water logging, salinization, increase in water table and how different types of drainage facilities are available which can tackle such issues. **Neveen B. Abdel-Mageed, Fahmy W.A**

studied "The hydraulic performance of perforated pipe"(2018), The study shows the effect of perforated pipe length on the collected discharge of subsurface drainage system. Perforated pipes are used for subsurface drainage which are installed beneath the ground surface to release and convey infiltrated runoff or groundwater. **B. J. Bailey** studied "Fluid flow in perforated pipes"(2016), his study shows distribution of fluid through perforated pipes is problematic thing while designing, distributors are used in case for irrigation lines in agriculture. It is required to provide uniform distribution of fluids in case of agriculture. **Hassan I. Mohamed and Gamal A.A. Abouzeid** "flow behaviour around perforated tile drainage pipe"(2005), The assumptions of ideal drain performance are taken into consideration in the design and modelling of subsurface drainage system.

3. METHODOLOGY

3.1 UNDERSTANDING THE SOIL

Soil is a complex physical system. A mass of soil includes accumulated soil particles or soil grains and the void spaces that exists between the particles. The void spaces may be partially filled with water or some other liquid. Void spaces not occupied by water or any other liquid are filled with air or some other gases. The basic terminologies related to soil are as follows

Permeability: Permeability is the ease with which the water flows in the soil which basically depends upon the properties of Porosity and Voids ratio.

Procedure:

1. The soil sample is saturated, and the standpipes are filled with de-aired water to a given level'
2. The test then starts by allowing water to flow through the sample until the water in pipe reaches given lower limit.
3. The time required for the water in the standpipe to drop from the upper to lower level is recorded.
4. The standpipe is refilled, and the test is repeated for couple of times
5. The recorded time should be the same for each test within an allowable variation of about 10 percent.

K= [2.3a. L/ (A. DELTA t)].log(h_U/h_L)

L: the height of soil sample column

A: the sample cross section

A: the cross section of the standpipe

DELTA t: the recorded time for the water column to flow through the sample h_U and h_L: the upper and lower level in the standpipe measured using the same water head reference.

Specific Gravity: Specific gravity is the ratio of the density of the substance to the density of standard substance.

The values were found with standard procedures.

Procedure:

1. Take 200gm of dry mass of sample in a 500cc constant volume bottle of distilled water.
2. Measure the mass of empty bottle (M1)
3. Calculate the mass of dry sample plus bottle (M2).
4. Fill the bottle completely with sample and water till the tip. And measure the mass (M3).
5. Now fill the bottle completely only with water and then measure the mass (M4)

The specific gravity is defined as

G = (mass of dry soil)/ (mass of volume of water)

G = (M2 - M1)/ {(M4 - M1) - (M3 - M2)}

3.2 DESIGN OF MODEL

Model of 2 feet*2 feet*2 feet was prepared. Model was made to show the applicability of subsurface drainage. The model was made of glass fiber. 7 holes for passing the perforated pipes were made. The test on model was on trial-and-error method.

Fig -1: A glass fiber model of 2 feet*2 feet*2

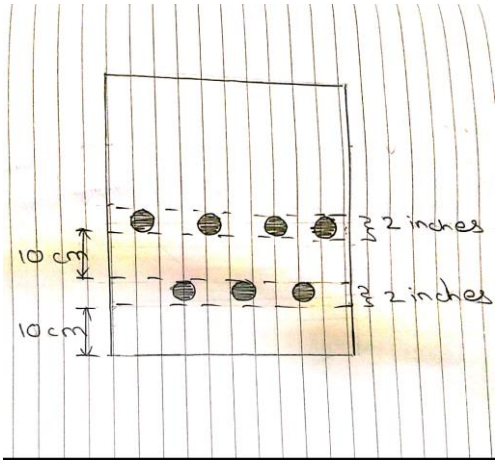

Fig -2: Position of holes

Fig -3: Holes drilled for passing of pipes through the model face

3.3 MATERIALS TO BE USED

Perforated PVC pipes

Perforated PVC pipes have underground life of 50 years. Use of PVC pipes lowers the cost of transportation and. PVC drainage pipe is adhered to the expansion and contractions due to temperature change. Therefore, the bonding process should be preferred where temperature is not of much difference.

Fig -4: Perforated PVC pipe

DESIGN OF DRAINAGE FACILITY

The design of actual drainage facility depends on many factors like coefficient of permeability and the distance of pipe from impervious strata.

$S^2=4K/R[H^2-2hd+2Hd-h^2]$

d= depth to the impermeable layer from the drain bottom

h=height of water in the drain

OBSERVATIONS AND RESULTS

1. The specific gravity of black cotton soil tested was found to be **2.5**
2. The permeability of black cotton soil was found to be **$4.5*10^{-3}$ cm/second**.
3. The discharge observed while checking of functionality of model was satisfactory, but number of trials were to be conducted.
4. Calculations for no. of different field conditions showed different alignments for the subsurface drainage facility.

4. CONCLUSIONS

1. Permeability of black cotton soil is very less.
2. Deeper the drain, wider the spacing, lesser the number of drains required.
3. Spacing of pipes depend on the location of impermeable strata, coefficient of permeability and hydraulic gradient.
4. Suctions Pumps should be provided at one end of perforated pipes.

5. Providing facility of subsurface drainage highly depends on the actual field conditions which vary from area to area, season to season and many such factors.

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