Speed of Infiltration using Rooter System Four Direction Technology

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Abstract: The increasing growth of the city has led to increased growth of other asphalt and concrete buildings . This results in an increase in direct surface flow and a decrease in the quantity of water that seeps into the soil, which results in flooding. This study aims to control flooding in flood-prone areas by using 4-way rooter system technology with an environmentally friendly concept in Sunggal District, Deli Serdang Regency. The results showed that the rooter technology of the 4-Way system was very influential on the decrease in water level, where on an area of 50 m2 which was fitted with 16 pipes and filled with 40 cm of water it could absorb water into the ground within 2 hours, while without rooter system technology 4 directions takes longer to absorb water into the ground, which is 6 hours.

1 INTRODUCTION

High urban growth every year causes changes in land use. One of the impacts is an increase in direct surface flow and a decrease in the quantity of water that seeps into the soil, resulting in flooding during the rainy season and the threat of drought in the dry season. So far, the concept of drainage that is widely applied in cities is the drainage system of the regional arrangement. This concept in principle states that all rainwater that falls in an area must be quickly discharged into the river. The philosophy of throwing inundated water as fast as possible into the river causes the river to receive a load that exceeds its capacity, while there is not much water that can seep into the ground (Wahyuningtyas, Hariyani and Sutikno, 2011).

Rooter system technology is a technology that is used to hold and absorb water into the ground through a pipe designed like the root of a tree where the pipe is implanted into the ground 2 meters deep with a slope of 45^o. Rainwater is collected and absorbed into the soil. Rooter system technology only holds rain water instead of wastewater. Rooter system technology is a well or hole in the surface of the ground that is made to hold rainwater so that it can seep into the ground. This study aims to calculate the speed of loss of standing water due to the use of 4-way rooter system technology.

2 METHODS

This research was carried out in Sunggal District, Deli Serdang Regency, North Sumatra Province. The research was conducted from January 2018 to March 2018. The tools used in this study included 4 inch long PVC pipes with 16 pipes, ground drill, hoes, buckets, hammers, hacksaws, wrenches, water pump machines, burlap filled with sand, meter, camera.

The material used for this study included swamps which were modified in such a way as to be used as research material. The land area is 6 meters x 5 meters with criteria always flooded during the rainy season (Ningsih, 2013).

2.1 Research Procedure

2.1.1 Prepare Tools and Materials

The tools used in this study are 4 inch paralon pipe with a length of 2 meters where the edge of the pipe is perforated by using a drilling machine with a width of 5 inches as many as 16 pipes, ground drill, hoe, bucket, hammer, hacksaw, wrench, water pumping machine, sand filled burlap. The material used for the research is waterlogged land, where the land used in this study has a size of 6 meters x 5 meters of land on the land which is less capable of absorbing water on the ground.

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2.1.2 Installation of 4-Way Rooter System Technology

Soil drill using a ground drill machine with a depth of 2 meters and a width of 5 inches with the treatment we want as many as 16 holes (adjust to the land you want to observe), as for the treatment or method of drilling the soil we want, namely with a 45° slope. After the soil drill process, the next activity that we do is to insert a 4-meter long PVC pipe into the ground. The pipe that we use must actually enter the ground with a length of 2 meters and is designed with the provisions of 1 point 4 directions in the ground, adjusted to the surface of the soil layer. The distance between 1 point and another point is 5 meters.

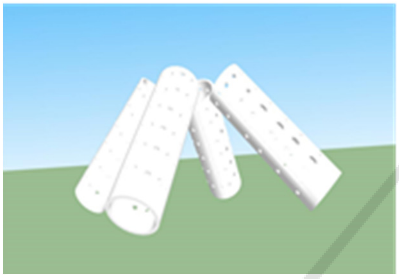

Figure 1: Installation of four-way rooter system

2.1.3 Observation

The observations carried out include analysis of the location of the research site, water level at the research location, land area affected by floods, the length of time the soil absorbs water face that does not use 4-way rooter system technology, long time the soil absorbs water using 4-way rooter system technology. calculate the discharge of water entering the soil using either rooter system or land technology that does not use rooter system technology.

2.1.4 Data Analysis

The purpose of the data analysis carried out in this study is to compare the rate of infiltration rate on land using rooter system technology and with land that does not use rooter system technology. The formula used in data analysis in this study are as follows:

Volume (cm^3) = Length (cm) x Width (cm) x Height (cm)

$$\text{Debit} = \frac{\text{Flow Volume}}{\text{Flow Time}}$$

$$\text{Flow Time} = \frac{\text{Flow Volume}}{\text{Debit}}$$

3 RESULTS AND DISCUSSION

Installation of 4-way rooter system technology is carried out in Sunggal District, Deli Serdang Regency, North Sumatra. Based on observation and data retrieval. Location is an area that has a high intensity of rainfall, uncontrolled urban development, not in accordance with regional spatial planning and is not environmentally sound, causing a reduction in catchment areas and water reservoirs so that it often experiences flooding that causes disadvantaged communities around farmers (BMKG, 2013)

3.1 Infiltration Rate without Rooter System

Before going to the observation process, the research location that had been installed with rooter system technology and not using rooter system technology was given water by using a pump machine until the water level in the land reached 40 cm, then the observation was carried out for 3 times. observations carried out included analysis of the study site soil, water level in the study location, land area affected by flooding, length of time the soil absorbed the water face that did not use 4-way rooter system technology, long time the soil absorbed water using 4-way rooter system technology, counting the flow of water that enters the ground using either rooter system or land technology that does not use rooter system technology. Observation of the volume of water entering the soil without the installation of a 4-way rooter system in Sei Mencirim Village can be seen in Figure 2.

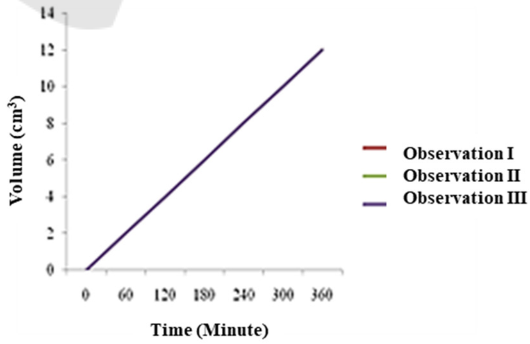

Figure 2: Observations I, II, and III of the volume of water entering the soil without the installation of 4-way rooter system technology in the Sei Mencirim village

From Figure 2 it can be seen that without the installation of 4 rooter system technology the direction of absorption of water by the soil lasts quite a long time, both in observations I, II, and III which are 360 minutes. There is no significant difference between observations I, II, and III on land that does not use 4-way rooter system technology. The more volume of water, the longer it takes the soil to absorb water. When the volume of water as much as 12 m3 takes 360 minutes for the soil to absorb water on the surface. This is because the soil holds too much water so that the soil experiences a saturation point which causes the soil to no longer be able to absorb water from the surface, this is consistent with (Arsyad, 2000), stating that the higher the water content in the soil it gets smaller. Decrease in infiltration rate can be caused because the soil layer has a lot of water so that the soil water content becomes higher than before so that the ability of the soil to infiltrate decreases, the infiltration rate decreases for a long time so the soil will be saturated so that the soil unable to continue water which causes the infiltration rate to be constant. This is because the soil is getting saturated so that the water decreases its movement space.

From the condition of the land at the location also affects the length of time the process of absorption of water by the soil, where in the study location the soil conditions do not have vegetation on the surface of the soil which affects the absorption of soil against surface water. This is in accordance with the statement (Ichwana and Erina, 2008) stating that the ability of land to pass water into the surface of land on land surface area varies, as well as the ability of soil on the surface that is vegetated with residential areas has different infiltration capabilities, this is due to the different biophysical conditions of the soil. In vegetated areas the texture class of dusty clay has a greater infiltration capability than in the area tends to have more clay fractions which causes small infiltration capabilities. On coarse-textured soils allow water to escape quickly so that the soil aerates well. The pores also allow air to escape from the soil so that water can enter.

3.2 Infiltration Rate using Rooter System Technology

According to Asdak (2000) the rate of water infiltration can be influenced by several factors, namely: soil texture, soil organic matter, soil density, type and amount of vegetation. Another thing that can cause water difficulty to seep into the soil is the permeability of the soil

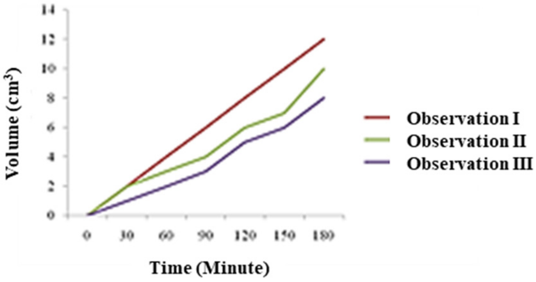

Figure 3: Observations I, II and III of the volume of water entering the soil with 4-way rooter system technology

In Figure 3, observation I shows the volume of water entering the ground with the 4-way rooter system technology experienced a significant change from the previous observation, where the volume of water entering the soil using 4-way rooter system technology did not increase but decreased, which initially in the previous observation with 150 minutes, the volume of water entering the soil was 12 m3. However, in observation I of Figure 3, it shows that the volume of water entering the soil by 12 m3 using rooter system technology takes 180 minutes with an additional time of 60 minutes from the previous observation. In observation II Figure 10 also shows a significant difference from observation I where in observation II within 180 minutes it was only able to drain 9 m3 and at observation III the same location also showed a decrease in pipe function where within 180 minutes the volume of surface water that could be flowed into the ground at 7 m3. This is due to the condition of the land which is a rice field that has a muddy soil texture where the texture of muddy soil has dense soil pores according to the statement (Hardjowigeno, 2005) which states that overall soil lubrication causes the nature of the soil to become: (1) unstructured soil, (2) coarse pores are reduced while fine pores increase in number, (3) the power to hold water increases due to the increasing number of micro pores in the soil and in the pipe the rooter system is found in mud and garbage so that the pipe cannot function properly as before. So from that so that rooter system technology can function properly as expected system rooter technology requires maintenance or maintenance and modification again so that the mud and organic and non-organic waste cannot enter the pipe which can cause the pipeline to clog and not function properly again it can even cause damage to the 4-way rooter system technology pipeline.

According to Suharta and Prasetyo (2008) this permeability is a measure of ease of flow through a media porous. Quantitatively, permeability is given a limit with the permeability coefficient. The intrinsic permeability of an aquifer depends on the effective porosity of rocks and unconsolidated materials, and the free space created by faults and solutions. Effective porosity is determined by the size distribution of the granules, the shape and roughness of each particle and its combined arrangement but because these properties are rarely uniform, the hydraulic conductivity of a developing aquifer is limited by permeability of layers or individual zones, and may vary quite depending on the direction of the water movement. Soil permeability has upper and lower layers. The upper layer ranges from slow to rather fast (0.20 - 9.46 cm at 1 hour) while in the lower layer is classified as rather slow to moderate (1.10 - 3.62 cm at 1 hour). The factors that influence permeability are: soil texture, soil structure, orbit, viscosity, gravity and drainage.

4 CONCLUSIONS

Rooter system technology has a big effect on the process of reducing water levels where rooter system technology is designed like tree roots that are useful for flowing water into the soil so that the soil surface water can be absorbed effectively. The infiltration rate using rooter systems can be accelerated to four times faster than without the use of this technology.

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