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Zero run-off concept application in reducing water surface volume

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Abstract. Development due to population growth which is not followed by efforts to conserve water will obviously cause problems with water, situ, and the swamp area has been lost because of the construction of housing, offices and buildings. The addition of these buildings caused an increase in runoff water by many impermeable layers and reduced number of green open space, and the water could not absorb/infiltrate to soil otherwise become a surface run off. We need a way to manage and develop the storm water to overcome water runoff caused by rainwater. Zero delta Q policy is the requirement that each building should not result in an increase in water debit to the drainage system or river flow system. Water debit due to additional (runoff) development due to development) must be withheld so that the additional debit (ΔQ) is zero.

The aim of this study is to reduce the surface flow of an urban settlement area by applying technology from the concept of Zero Runoff in the area. The benefits of this research are to provide alternative solutions for how to absorb and accommodate the maximum flow of surface runoff into the ground with the application of Zero Runoff concept technology.

1. Introduction

Rain falling on the ground is strongly affected by land use. In forest and grassy areas, rain is infiltrated and used by plants themselves or seeps into ground water. On the contrary, most of the rain that falls on paved surfaces and roofs allows the absence of water to infiltrate, it caused high runoff and drain water directly into the city drainage channels and straight to sea.

Development due to population growth which is not followed by efforts to conserve water will obviously cause problems with water, situ, and the swamp area has been lost because of the construction of housing, offices and buildings. The ability of the land to accommodate, hold and store water into the soil has decreased due to the reduction of Green Open Space which functions as a catchment area.

The aim of this study is to reduce the surface flow of an urban settlement area by applying technology from the concept of Zero Runoff in the area. The benefits of this research are to provide alternative solutions for



how to absorb and accommodate the maximum flow of surface runoff into the ground with the application of Zero Runoff concept technology.

2. Literature Review

In general, in the Law of the Republic of Indonesia No. 26 of 2007 concerning Spatial Planning In relation to urban spatial planning, this Law mandates the need for the provision and use of green open spaces, the proportion of which is set at least 30 (thirty) percent of the area of the city, which is filled by plants, both grow naturally or intentionally planted.

2.1. Zero Delta Q Policy

In PP No. 26/2008 mentioned about "zero delta Q policy" which is the requirement that each building should not result in an increase in water debit to the drainage system or river flow system. Water debit due to additional (runoff) development due to development) must be withheld so that the additional debit (ΔQ) is zero. This is pursued by making 3 main components are rainwater storage system/rain water tank, pool infiltration and infiltration wells. The output of the application of the zero delta Q policy principle does not hold the run off in the area up to 100% or drain water outside the area to zero percent or zero run off. Therefore, it is necessary to support the building drainage system and technology and parcels and areas so that the output of the zero delta Q policy concept can be produced better, that is, can run off runoff outside the smallest area.

2.2. Method of Zero Runoff Technology

Runoff is when the intensity of rain falling in a watershed exceeds the infiltration capacity, after the infiltration rate is fulfilled the water will fill the basins on the ground surface. After the basins are full, then the water will flow (overflow) above the soil surface. The components of runoff come from three sources are surface flow, interflow and groundwater flow.

Below are some of the zero runoff methods that can be applied in the study area include:

1. Rainwater Collection Tank/rain barrels and water tank

Rainwater collecting tank is a container used to hold rainwater that falls on the roof of the building which is channeled through gutters. The collected water can be used for two purposes, namely daily needs and consumption. Some domestic uses of water are flushing toilets, watering gardens, cleaning dishes, and washing cars. If the rainwater stored in the tank is consumed, the tank design must be ensured that water is free of contaminants to prevent health problems related to the consumption of toxic chemicals.

Rainwater harvesting/collecting (RWH) in urban areas is a strategy that brings many benefits and may serve to cope with current water shortages, urban stream degradation and flooding.



Figure 1. Rainwater collection tank on the ground surface
(source: www.hyderabadwater.gov.in)



Figure 2. Rainwater collection tank under ground at Rajasthan, India
(source: <https://en.wikipedia.org/wiki/Taanka>)

2. Rainwater Infiltration Well

Infiltration wells / dry wells are excavated in soil filled with coarse aggregates such as gravel / stone to temporarily store rainwater runoff to seep into the surrounding soil. Can be directly or indirectly connected to gutters from the roof, collecting rainwater from the roof. Infiltration wells provide the function of infiltration, adsorption, capture, filtering and reduction of bacteria.

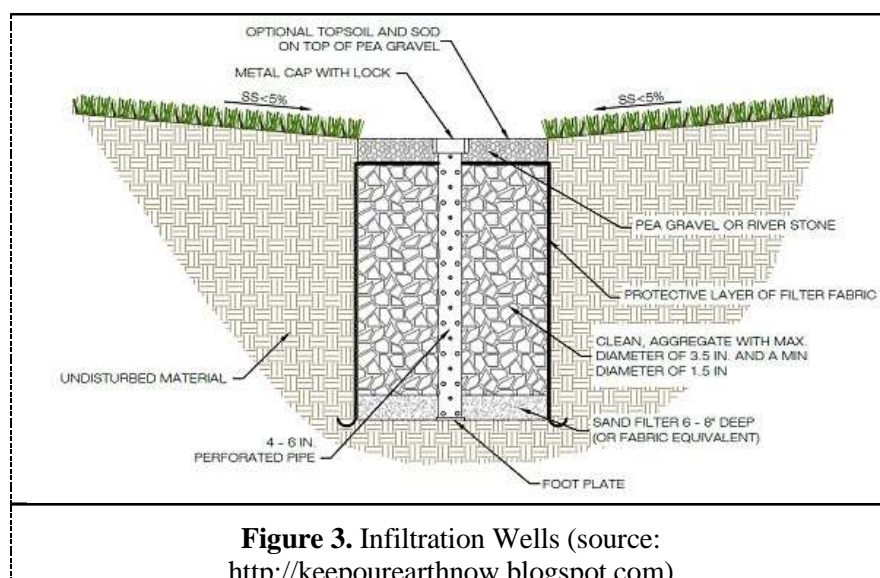


Figure 3. Infiltration Wells (source: <http://keepourearthnow.blogspot.com>)

3. Research Method

3.1. Study area

The research area is located in Taman Sari Housing Area in Sawangan, Depok city. The landscape of Depok City from South to North is a low-lying area to a weak undulating hill, with an elevation between +50 to +140 meters above sea level and a slope of less than 15%. Depok City has at least 3 (three) major rivers that flow through Depok City from South to North. The main rivers are Angke Pesanggrahan watershed, Cikeas Cileungsi watershed and Ciliwung watershed. Sawangan area is one of flood prone area in Depok. The drainage system in the study area consists of open channels in the main channel and closed channels on the secondary channel. Both channels have a type of square cross section.



Figure 4. Research Area

3.2. Hydrological Analysis

The research method used is hydrological analysis and zero runoff technology dimension calculation analysis. By using rainfall data design to calculate the flood discharge plan with the empirical method, analyzing rainfall intensity and calculating peak flow rates.

4. Result and Discussion

After hydrological analysis is carried out based on the annual 10-year annual rainfall data, the intensity of the rain produced is 51,5 mm/hour. The land characteristics of the Taman Sari housing area covering an area of 52,624 m² are considered to be an integrated multi-unit housing type, which refers to the Flow Coefficient Table (C) 0.60 - 0.75. The coefficient value is taken 0.75 to further enhance the security factor. The flow coefficient will then be used in calculating runoff discharge. Runoff debit calculation 0,416 m³/second and runoff discharge after application of zero run off technology is 0,013 m³/second, there is a runoff reduction of 0.402 m³ / second. Figure 5, 6, 7 are design of zero run off concept technology that can be applied in research area and any residential area.

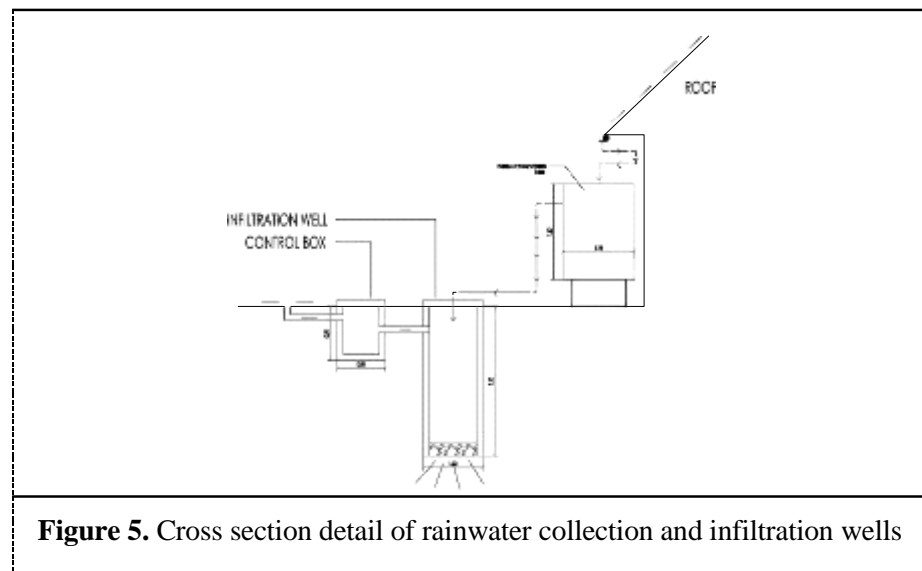


Figure 5. Cross section detail of rainwater collection and infiltration wells

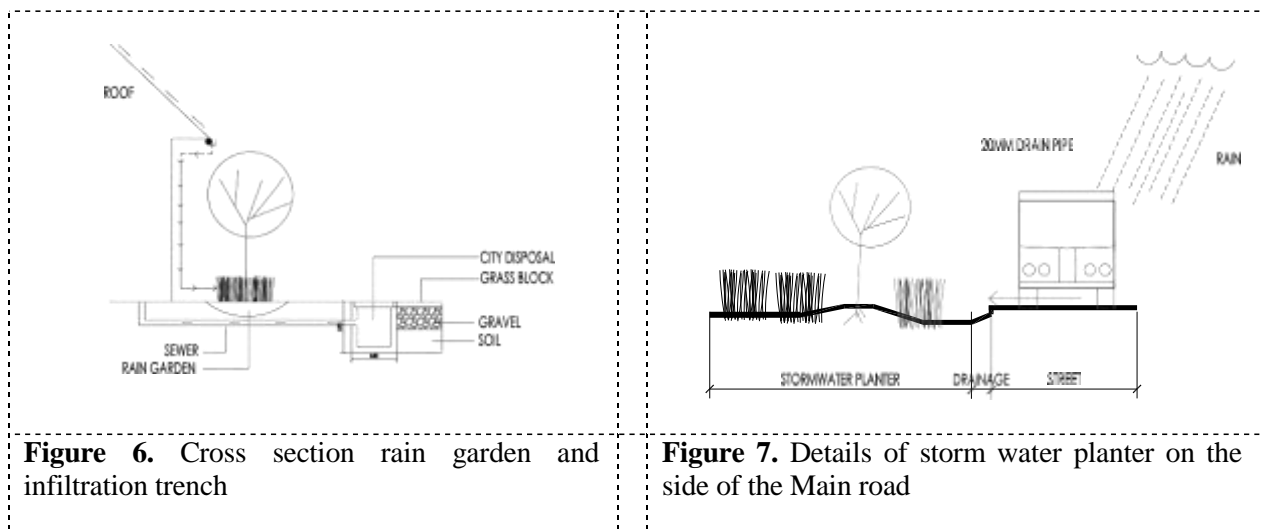


Figure 6. Cross section rain garden and infiltration trench

Figure 7. Details of storm water planter on the side of the Main road

From the results of the calculation analysis, it can be stated that the application of the Zero Runoff Concept is in Rain Water Collector technology, Rainwater Infiltration Well and Rain Garden can reduce surface runoff caused rainwater by 96.6% of the total land calculation discharge at Taman Sari Housing area. Whereas 3.4% was channeled to the environmental drainage channel. Zero Runoff concept technology that can be applied in this research are: Rainwater Collecting Pool, Rainwater Infiltration Well and Rain Garden. In facing climate change, flooding, drought, lack of clean water and environmental damage both physically and biologically, one way is to optimally utilize rainwater by using Zero Runoff concept technology by accommodating and absorbing rainwater into the soil. For further research should be reviewed the calculation of rainwater for daily needs to overcome the shortage of clean water during the dry season.

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