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Overcoming an Urban Flood by Utilizing Rain Gutters and Absorption Wells

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Abstract

Utilization of rainwater is useful in dealing with water that occurs in urban areas and as a form of conservation system to support the resilience of water resources. Utilization of rainwater in urban areas besides being used as an alternative to clean water, harvesting rainwater can be used to replenish water so that groundwater levels are maintained and reduce the volume of rainwater runoff that can cause flooding. This research uses guttering pipes and infiltration wells to tackle long-scale wastage of rainwater in the dry season. In this study, it can help the community to overcome flooding in residential areas, especially urban areas.

Keywords: *Rainwater; Gutters; Infiltration Wells*

Introduction

Flooding in urban settings is generally avoided by regulating the natural phenomenon of flowing and seeping water. More water seeps into the ground, while the remainder is drained into the sea. When absorption and water flow are inadequately regulated, there is a greater volume of water running on the ground surface. The catchment area in big towns is shrinking, limiting the amount of water that can soak into the earth. Saputra and Setyobudiarso (2019), stated that the demand for water in urban areas is getting bigger due to the increase in population and the lack of land for absorption so that runoff rainwater is only channeled into sewers and then dumped into urban drains. As a result, the volume of water flowing over the surface of the earth increases. Floods occur when the water flow cannot be accommodated in the existing drainage channels. Another effect of the lower amount of water that seeps into the soil is a decrease in groundwater, which causes the well's depth to rise.

One way to prevent flooding in an urban area is to install rain gutters. Rain gutters are rainwater channels that are commonly installed on the roof as part of a building's water drainage system. Gutters are a common household component that receives little attention. Even while gutters serve a crucial function in managing rainwater circulation, they are especially important in Indonesia, which happens to

be a country with a lot of rain. Gutters serve as a rainfall distribution conduit, allowing rainwater to fall where it should while without interfering with the building's humidity level. The house becomes more durable as the gutters perform properly, and the roof does not leak as easily. The gutters come in a range of designs and materials; their use is determined by the property owner and is tailored to the existing conditions.

Absorption wells are also highly useful in dealing with floods in metropolitan areas in order to maximize flood prevention. Absorption wells are engineering water conservation strategies in the form of buildings that imitate the shape of a dug well with a specific depth and serve as a collection point for rainwater collected on the roof of the house and absorbed into the ground (Dinas Kehutanan, 2007).

According to Yulistyorini (2011), providing clean water is a key challenge in developing countries like as Indonesia, because water is a basic requirement and vital to human life and health. Rainwater that has been absorbed and regulated through gutters and infiltration wells can provide us with clean water. If the water supplied by absorption wells in our surroundings is plentiful, there are numerous advantages. Our water supply will be plentiful, so humans will not have to worry about running out of water during the dry season. By making absorption wells can take many advantages. Now it is just a matter of how humans take steps to be able to always enjoy water which is a basic human need

According to the Ministry of Forestry (2007), the benefits that can be obtained by constructing water absorption wells include: (1) reducing surface runoff and preventing waterlogging, thereby reducing the risk of flooding and erosion; (2) maintaining the groundwater level and increasing the supply of ground water to reduce or restrain the occurrence of sea water intrusion for areas adjacent to coastal areas preventing land subsidence or subsidence as a result of excavating.

These water absorption wells help to raise or lower groundwater levels, reduce flood waterlogging, avoid seawater intrusion, and preserve and save water resources over time (Nurroh et al 2009; Darmayanti & Tarigan 2013; Wibowo 2013; Suwardi 2016; Susilo & Budiningrum 2019; Walihuddin 2019). As a result, infiltration wells must be constructed, particularly in the construction of buildings, houses, and shops. Absorption wells' purported benefits may become part of Indonesian culture. When the dry season begins, gutters and absorption wells can be used as water reserves for human everyday living.

Flood protection activities are possible if the government and the community work together to overcome the problem. The government can establish regulations for the use of gutters and the construction of absorption wells, and then publicize it to the people living in Indonesia. Improving the quality of materials, as well as gutter producers', is important in helping the community to save more when using water and utilizing rainwater as a source of assistance for people's daily lives that have been filtered by absorption wells. Thus, the government and the community can overcome flooding in urban areas and at the same time can use rainwater to save water disposal in daily activities.

As cities grow and develop, the use of gutters and available acreage for water infiltration decreases. One of the things that still need to be explored is the phenomenon of wasteful rainwater disposal during the rainy season in Indonesian territory. People continue to ignore rainwater, resulting in flooding in metropolitan areas. People have a tough time getting clean water during the rainy season because of a lack of public awareness. People purchase water during the dry season and do not consume or conserve rainwater during the rainy season. One way to prepare for these issues is to instill a flood-prevention culture in Indonesian families by incorporating rain gutters and absorption wells.

System Planning

Rainwater storage is the notion of collecting rainwater that falls on the roof directly through rainwater harvesting system components such as gutters and water storage tanks, as depicted in the figure 1 below.

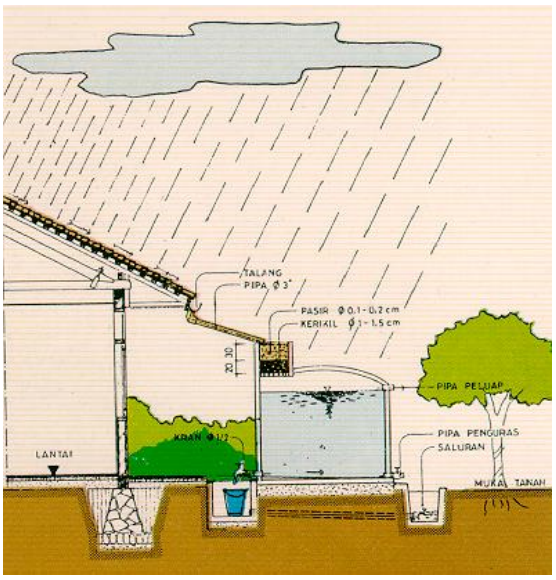


Figure 1. Water Storage
(Source : 2009 Minister of PU data)

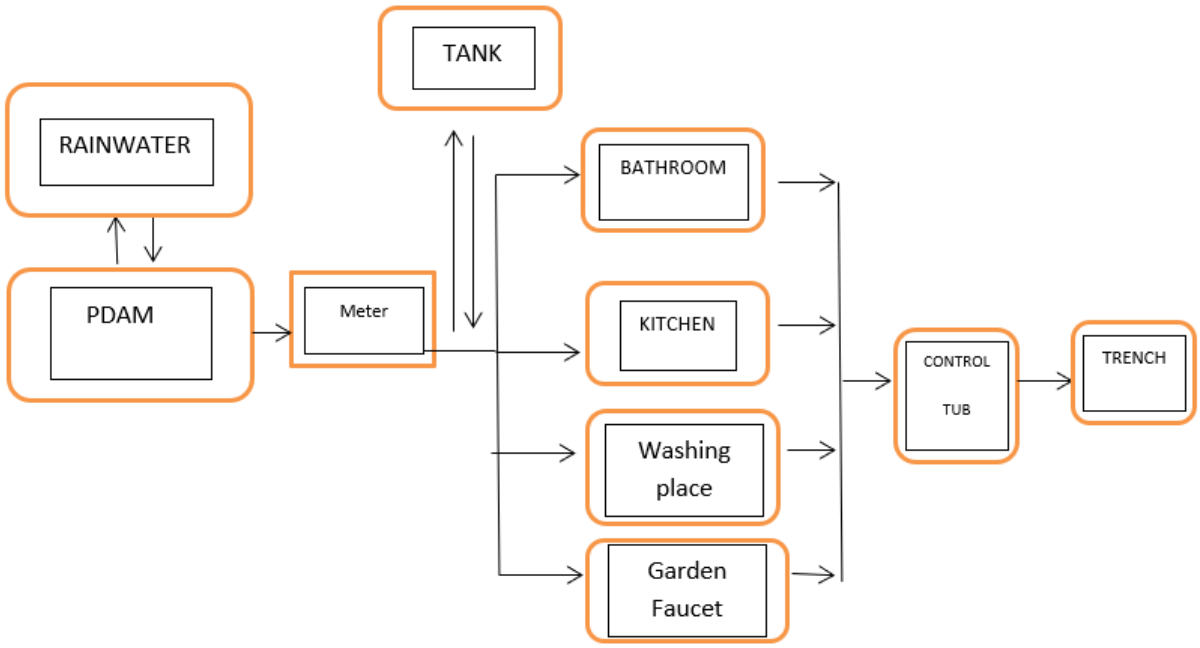
Calculating the size of the rainwater reservoir, selecting the type of water reservoir, locating the reservoir, constructing a water distribution system to the reservoir, and constructing a water distribution system out of the reservoir are the steps involved in the construction of rainwater reservoirs.

Gutter Tools and Materials

Gutter material type:

- PVC and uPVC gutters
- Aluminum gutters
- Copper and Metal gutters
- Concrete / Cast Gutters
- Gavalum gutters
- Mild Steel Gutters
- Zincalume gutter
- Zinc gutters

Work procedure A from PDAM



Types of Rainwater Gutters

Gutter Types Commonly Used Based on Shape/Model Gutter Box / Square Gutter Semicircular Gutter Trapezoidal. Various Sizes of Gutters Gutters have various sizes but the following are the most commonly used gutters: 4 inch or 10.1 cm 4.7 inch or 12 cm 6 inch or 15.2 cm 8 inch or 20.3 cm 9 inch or 22.8 cm.

Absorption Wells

According to the Indonesian National Standard (SNI), there are some general requirements in building or constructing absorption wells. Here is the procedure for planning rainwater absorption wells for yard land.

1. Absorption wells must be located on flat land, not on sloped, steep or unstable soil.
2. Absorption well is at least 5 meters from the landfill and septic tank and at least 1 meter from the building foundation.
3. The depth of the absorption well can be up to sandy soil or a maximum of 2 meters below the ground water level. The depth of the water table (water table) is a minimum of 1.50 meters in the rainy season.
4. The soil structure must have a soil permeability (soil ability to absorb water) of at least 2.0 cm per hour which means that in one hour it is able to absorb puddles as high as 2 cm.

Absorption wells can be rectangular or cylindrical in shape, with a specific depth and a bottom that is above ground water level.

How to Make Absorption Wells

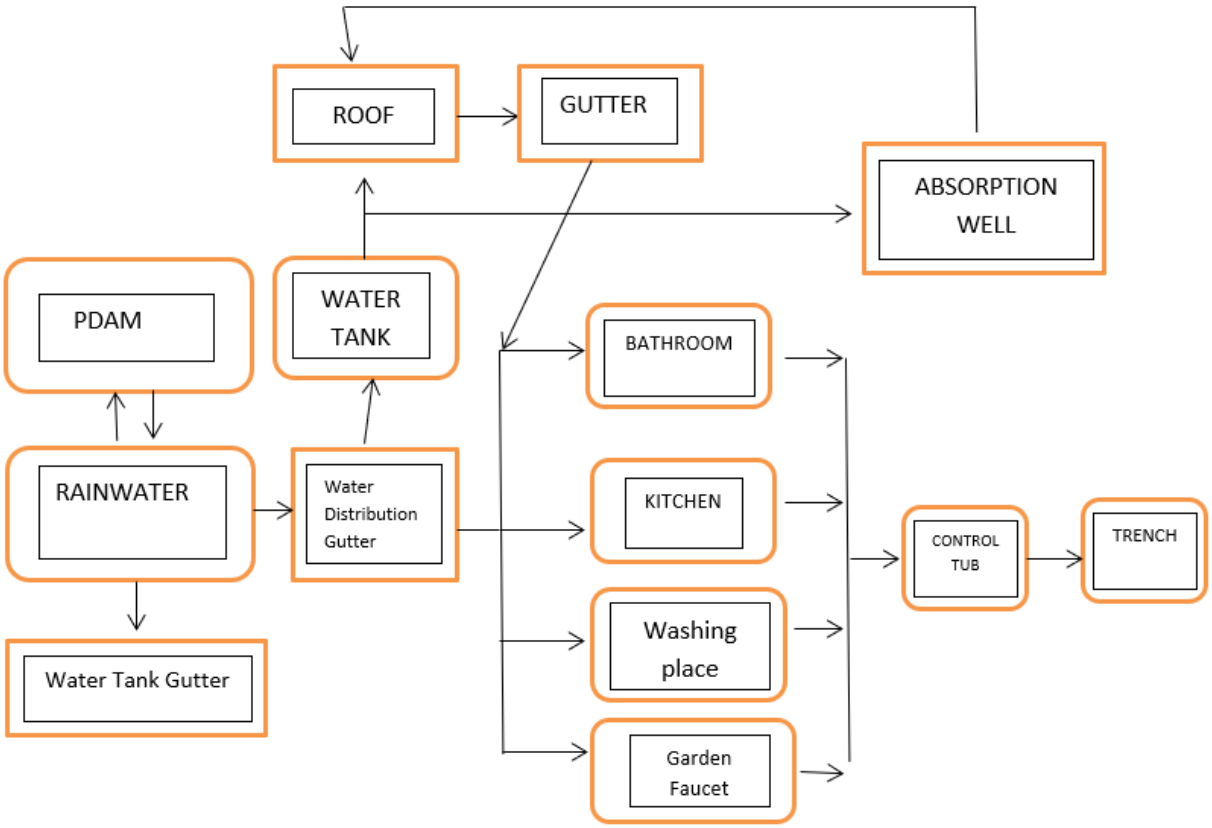
1. Make a wellbore with a diameter of 80 - 100 cm as deep as 1.5 m. Care must be taken so that this depth does not reach or exceed the groundwater table.

2. Reinforce the walls of the well, using concrete, masonry blanks (without plastering) or masonry blanks. This is to keep the walls of the well from falling and sliding.
3. Make a water inlet channel that drains rainwater from gutters into absorption wells using a paralon pipe.
4. Make a water outlet drain from the absorption well to the ditch. This channel functions to remove excess water when the absorption well has excess water. The height of the drain pipe must be higher than the water level in the gutter. This is so that when it rains heavily, sewer water does not flow into absorption wells.
5. Fill the bottom of the absorption well with 15 cm thick coral.
6. Cover the top of the absorption well with a concrete slab. On top of this concrete slab can be filled with soil.

Result and Discussion

Rainwater can be used to meet household water needs, reducing the use of PDAM. In the dry season, even rainwater held in absorption wells might be used. Because the peak point of rainfall produces around 5 m^3 of water, three water tanks and two m^3 absorption wells are required. Like an aquarium system, the water in the absorption well will be pumped back to the top/roof. As shown in the diagram below.

Work Procedure B Rainwater



The rainwater source is directed to the gutter of the water tank and water distribution, as shown in the diagram above. The water is filtered before entering the water tank and then supplied to bathrooms, kitchens, washing areas, and garden faucets via a filtration process that includes removing coarse waste from the roof and fine filtration. Below is a link to the Screening Image.

Figure 2. Gutter Coarse Filtration

Figure 3. Water Fauchet (Rain Water & PDAM)

Rainwater collection begins on the building's roof, and it is subsequently directed through gutters to serve as conventional water distribution. Based on the picture above, which acts as a filter for rainwater entering the tendon / tank following a two-stage filtering method. First, coarse filtering, which involves inserting a wire at the end of the filter pipe to separate leaves or roof debris. Second, the rainwater is filtered before being directed to the tank or directly to the water faucet, which is connected to the rainwater pipe and PDAM pipe as illustrated in Picture3. However, as illustrated in Picture 4 below, there existed previously a fine filter that was useful for removing fine sand from pure water.

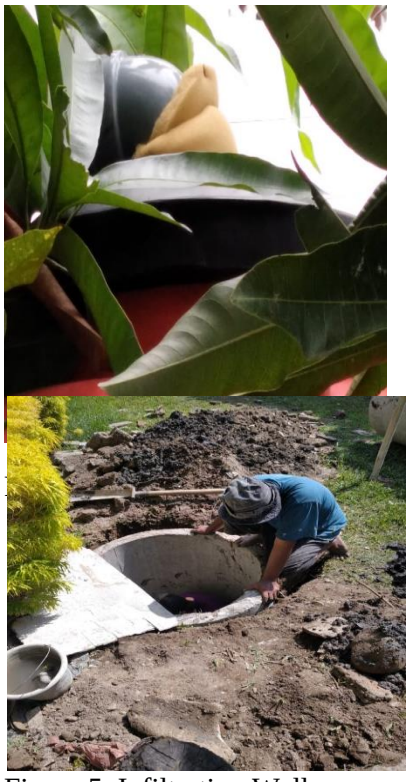


Figure 5. Infiltration Wells

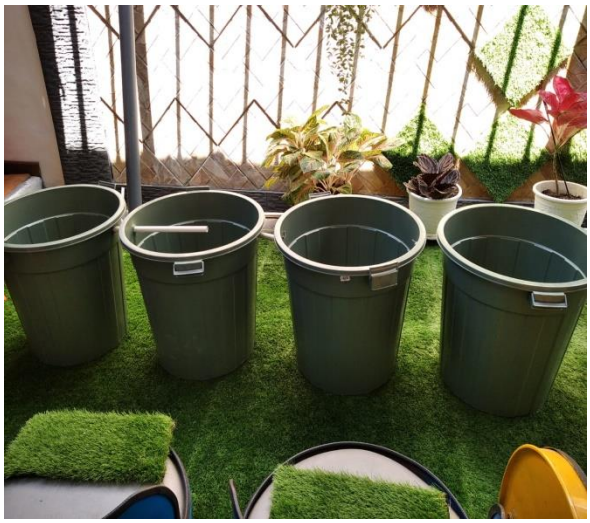


Figure 6. Water Tank

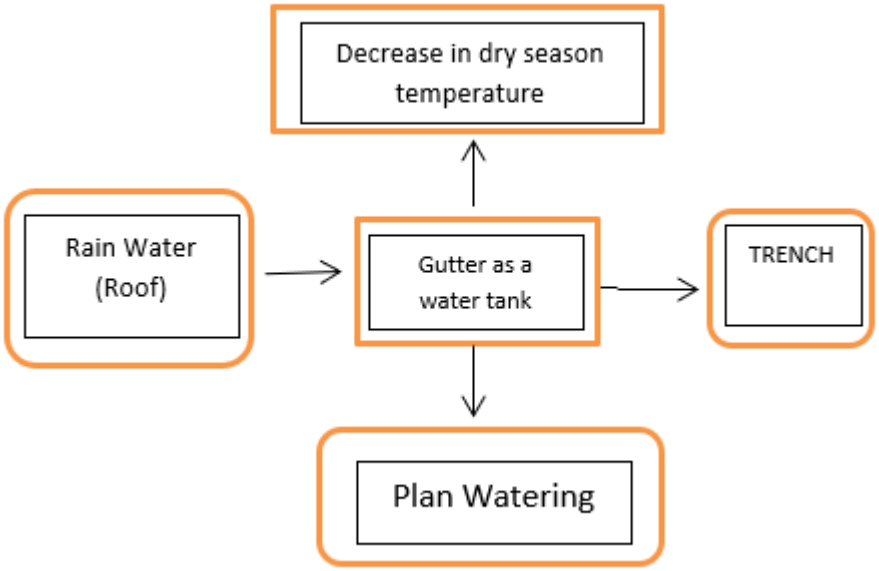
After the water tank is full, the remaining rainwater is diverted into absorption wells, which serve as the final water reservoir that can be reused at any time, with a pump on the roof acting as a rain substitute. If the absorption well is full and all house need have been met, the remaining water from the absorption well / residual unclean water from the bathroom and kitchen will be moved to the control tub and eventually to the ditch.

Second, gutters serve as tendons / temporary water tanks in which water is temporarily held in gutters so that it can be used at any moment for home uses such as restroom needs, watering flowers, washing motorcycles, and lowering temperature. A little pipe has been installed beneath the gutter, which serves as a flower sprinkler as well as lowering the temperature. The chart below depicts the process of purifying rainwater from the roof and storing it in the gutter as a water tank.

Figure 7. Small Pipes and Gutters as Water Tanks

In figure 7, the gutter has the addition of a small pipe to the gutter which functions as a watering can for the Bungan as well as to lower the temperature. The process of filtering rainwater from the roof to the gutters which act as water tanks can be seen in the chart below.

Gutter as a Water Tank



Conclusion

In conclusion, we can minimize the use of PDAM water by filtering rainwater from gutters and storing it in absorption wells. There are results from the gutter design and a new pipe connection designed expressly as a water tank. Utilization of rainwater is useful in overcoming water inequality that occurs in urban areas and as an alternative form of conservation system to support the resilience of water resources. Rainwater harvesting can be used to replenish groundwater and minimize the volume of rainwater runoff that can cause flooding in metropolitan areas, as well as to provide an alternative to clean water.

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