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SPRINGS CONSERVATION ENGINEERING IN SENGI VILLAGE, DUKUN DISTRICT, MAGELANG REGENCY

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Abstract

Problems related to the sustainability of water resources often occur, both from the impact of the erratic change of seasons, the reduction in water catchment areas, to the many cases of water pollution in Indonesia. However, the main problem of all that lies in the community itself where awareness of the importance of conservation and management of water resources is still low. The selected study was located in Sengi Village, Dukun District, Magelang Regency, Central Java Province. The local community utilizes springs as the main water supply source, but the water management carried out by the community is still classified as less than optimal. Therefore, there is a need for conservation efforts so that the sustainability and function of these springs can be maintained properly. The results of the study showed that spring conservation was carried out by constructing a spring reservoir with a volume of 2 m^3 for spring 1 and a spring reservoir with a volume of 5 m^3 for spring 2. In addition, a social approach to the community in the local area regarding the preservation of the condition of the springs was also carried out. affixed area.

Keywords: *Springs, Springs Quantity, Domestic Water Needs, Springs Conservation.*

INTRODUCTION

Water is one of the main natural resources that are needed by humans. Water on Earth is divided into two main parts, namely salt water as much as 97% and fresh water as much as 3% of all water on this earth. More than two-thirds of the fresh water is in the form of ice and is located at the poles, the rest is a source of water that can be used by humans for daily needs. These water sources are divided into water sources that are on the surface or below the earth's surface or commonly called groundwater (Firizqi, 2019). Water is an important component in nature, but due to the uneven distribution of water it can cause problems for human life (Maria, 2015). One source of clean water that can be used by humans is groundwater. Groundwater is water that moves in the soil layer contained in the space between the soil grains (Wahyudi, 2009).

In hydrogeology, a spring is a point or small area where groundwater emerges from an aquifer (Kodoatie, 2012). Meanwhile, according to Hendrayana (2013), springs are the emergence of groundwater to the surface in various ways which are generally controlled by local geological conditions. There are also those who say that springs are events where groundwater appears to the ground surface caused by the presence of a cut groundwater level, so that at that point groundwater will come out as springs or seepage (Pradana, 2018).

The crisis of water resources is starting to be felt in many areas due to the drying up of springs (Setyowati, 2017). Water problems can occur due to seasonal variations, namely the occurrence of a surplus of water in the rainy season but a water deficit in the dry season. So that the increasing demand for water cannot be matched by the availability of water in the dry season (Aslamia, 2012). Another factor that has a lot of impact on changes in spring discharge is the reduced protected area as a water catchment area that is there. The increasing number of critical lands also causes the loss of land functions as a medium for regulating water management. This caused a drought to hit several hamlets in Dukun District during the dry season (Aurita, 2017). However, the main problem of all that is actually in the community itself where awareness of the importance of conservation and management of water resources is still low. Communities in the study area use springs as the main water source to meet their daily needs. Therefore, there is a need for conservation efforts to maintain the sustainability and potential of these springs (Aurilia, 2021). This study aims to evaluate spring conservation techniques that can be applied appropriately to springs in Sengi Village, Dukun District, Magelang Regency.

LITERATURE REVIEW

Measurement of the discharge of a spring can be obtained by collecting flowing water using a bucket/container. The calculation of the spring discharge can be obtained using volumetric calculations, namely by calculating the volume of water that has accumulated into the container divided by the time it takes until the water fills the container using a stopwatch media. Discharge is volume per unit time, debit measurement uses the following formula:

Formula : **Q = V/t (L/sec)**

Information : Q = spring discharge (m3/second)
V = volume of measuring cup (m^3)
T = time (seconds)

Measurement of discharge under other conditions can be calculated by measuring the difference in water level in a cross section that makes a certain area. This measurement can be carried out in spring conditions with a small reservoir.

Formula : $\mathbf{Q = \frac{H \times A}{t}}$ **(L/sec)**

Information : Q = spring discharge (L/second)

A = cross-sectional area / reservoir (m^2)
H = change in water level (m)
t = time (seconds)

The population projection is used to find out how the spring discharge for the next 10 years can still meet the needs of the local community or not. The projected population is calculated based on data on the percent of population growth each year. This calculation uses the Geometric Method (multiple interest) with the following formula:

Formula : **Pn = Po(1+r)n**
Information : Pn = Number of population in year n
Po = original population
r = Population growth rate (%)
n = Number of intervals (Said, 2014).

This geometric (multiple interest) method is used with the assumption that the population growth rate (r) is the same for each year. The population growth rate based on BPS data from Dukun District is 0.79%.

Based on the Technical Guidelines for the Development of Simple SPAM, the population's water needs are calculated based on the number of water users that have been projected for the next 5-10 years and the water needs of each person are set at 30-60 L/Person/Day. This study utilizes the assumption of maximum projection results for the next 10 years with a maximum water requirement of 60 L/Person/Day. The calculation of the population's water needs can be done with the following formula:

Formula: **Qn = Pn x q**
Information : Qn = Water Requirement
Pn = Number of users in year n
q = Water consumption per person per day

Good spring management can be done by planning, monitoring and evaluating springs. The management of the springs is adjusted based on the standards that have been set so that the water that will be consumed by the community is suitable for use in meeting their daily needs (Aslamia, 2012). Spring conservation is carried out in an appropriate manner so that the condition of the springs can be managed properly, one approach that can be taken on spring conservation is by making a spring reservoir. The design of the spring reservoir was chosen based on direct observations in the field which showed how the condition of one of the springs did not have a water reservoir system so that the water that came out was not used optimally.

Table 1. Size of the Springs Container

People Service	Discharge <0.5 L/sec	Discharge 0.5-0.6 L/sec	Discharge 0.7 – 0.8 L/sec	Discharge >0.8 L/sec
200 – 300	5 m^3	2 m^3	2 m^3	2 m^3
300 – 400	10 m^3	5 m^3	2 m^3	2 m^3
400 -500	10 m^3	10 m^3	5 m^3	2 m^3

(Source: Technical Instructions for Implementation of Simple Drinking Water Infrastructure in 2007 in the Minister of Public Works Regulation No. 39 of 2006)

RESEARCH METHOD

The research methods used include field survey methods, mathematical methods, and evaluation methods. Survey and field methods are methods used to review in the field related to geophysical components and other supporting data that have been obtained from secondary data. Mathematical methods are methods used in various calculations during research. The evaluation method is the method used to analyze and evaluate the results of the research data processing that has been carried out. The steps of the research carried out are as follows.

1) Preparation Phase: literature study and secondary data collection for field purposes.
2) Field Work Phase: survey and mapping, measurement of spring discharge, documentation.
3) Studio Work Phase: field data processing and mathematical calculations.
4) Final stage: evaluation of research results and preparing management directives.

RESULTS AND DISCUSSION

Measurement of spring discharge in this study was carried out at 2 spring locations for 4 consecutive months. Measurements start from September 2020 to December 2020. The calculation of the discharge is done by calculating the volume of water that enters the bucket divided by the flow time measured using a stopwatch. The discharge measurement data can be seen in the following table.

Table 2. Spring Discharge

No.	Water springs	Spring Discharge (L/sec)				Average Discharge (L/s)
		September	October	November	December	
1	Spring 1	0.537	0.624	0.745	0.608	0.629
2	Spring 2	0.117	0.196	0.224	0.187	0.181

(Source: Field Observations and Studio Analysis, 2021)

Based on the table, it can be seen that spring 1 (spring without a tub) has an average discharge of 0.629 L/s while spring 2 is lower with a value of 0.181 L/s. The quantity of springs is quite influenced by several factors, one of the factors that has a major influence on the condition of the quantity of springs is the intensity of rainfall that occurs in the local area.

The population projection is used to determine whether the spring discharge for the next 10 years can still meet the needs or not. Projection of population using the geometric method or multiple interest. The population growth rate according to BPS data from the Dukun District in 2010-2020 has an average population growth rate of 0.79%.

Table 3. Projected Population

No.	Water springs	Spring user 2020 (Soul)	Growth Resident	Year	Assumed Number of Users
1.	Spring 1	15	0.79%.	2021	15,119
2.	Spring 2	56	0.79%.		56,442
1.	Spring 1	15	0.79%.	2022	15,238
2.	Spring 2	56	0.79%.		56,888
1.	Spring 1	15	0.79%.	2023	15,358
2.	Spring 2	56	0.79%.		57,338
1.	Spring 1	15	0.79%.	2024	15,480
2.	Spring 2	56	0.79%.		57,791
1.	Spring 1	15	0.79%.	2025	15,602
2.	Spring 2	56	0.79%.		58,257
1.	Spring 1	15	0.79%.	2026	15,725
2.	Spring 2	56	0.79%.		58,707
1.	Spring 1	15	0.79%.	2027	15,849
2.	Spring 2	56	0.79%.		59,171
1.	Spring 1	15	0.79%.	2028	15,975
2.	Spring 2	56	0.79%.		59,639
1.	Spring 1	15	0.79%.	2029	16,101
2.	Spring 2	56	0.79%.		60,110
1.	Spring 1	15	0.79%.	2030	16,228
2.	Spring 2	56	0.79%.		60.585

(Source: Field Observations and Studio Analysis, 2021)

Based on the table above, it can be seen that the number of user assumptions will continue to increase every year. This is possible because the number of population growth that will continue to grow is always followed by the number of their needs which in this study are more focused on the use of springs by local residents. The data above shows how the number of springs users is increasing every year with the assumption that the population growth rate for the next 10 years will remain the same so that the assumption of the population of springs users in the next 10 years can be obtained.

The population's water needs are calculated based on the Technical Instructions for the Development of Simple SPAM where the water needs of each person are assumed to be with a maximum standard of 60 L/Person/Day. This calculation is intended to determine the availability of springs for the user community by comparing the water requirements needed by users with the water discharge produced by the springs in a predetermined time period.

Table 4. Water Needs Based on Regulations

No.	Water springs	*Water Needs (Liter/ Person/ Day)	Number of Users (2030)	Water Demand in 2030 (Liter/ Day)	Water Demand in 2030 (Liters/ Year)	Spring Discharge (Liters/ Year)	Water Availability in 2030 (Liters/ Year)
1.	Spring 1	60	16	960	350400	193361886	193011486
2.	Spring 2	60	61	3660	1335900	55621440	54285540

(Source: Field Observations and Studio Analysis, 2021)

Based on the calculation table above, it can be seen that the population's water needs in the next 10 years where spring 1 shows a water demand of 350400 L/year and spring 2 results in 1335900 L/year. Looking back from the population projections that have been obtained, the population of spring 1 users is still relatively small, even the number of people who use springs for the next 10 years is still relatively stable without any significant increase. This spring is very unfortunate considering the large amount of discharge is not utilized more optimally by the local community. Spring 2 has a larger population of spring users so the need for water will also increase over time. Nevertheless,

Conservation of springs is done by making a reservoir for the springs. The design of the spring reservoir was chosen based on direct observations in the field which showed how the condition of the springs that did not have a suitable water reservoir system so that the water that came out was not utilized optimally. The design of the reservoir for the springs is adjusted to the flow of the springs and the number of residents who use the springs based on the Technical Instructions for the Implementation of Simple Drinking Water Infrastructure in 2007 in the Minister of

Public Works Regulation No. 39 of 2006. Based on the results of population projections for the next 10 years, spring 1 is known to have 16 users with a water discharge of 0.629 L/second, so the dimensions of the selected spring reservoir are 2 m^3. Spring 2 is known to have a total of 61 users with a water discharge of 0.181 L/second, so the dimensions of the selected spring reservoir are 5 m^3. The dimensions of the spring reservoir design can be seen in the following table.

Table 5. Size of the Spring Reservoir according to Standard

No	Water springs		Number of Users	Discharge (L/sec)	*Volume of the Reservoir (m^3)	*Dimension of Reservoir (LxWxH) cm
1	Spring 1		15	0.627	2	100x200x100
2	Spring 2		56	0.181	5	250x200x100

(Source: Field Observations and Studio Analysis, 2021)

Note: *Determining the Volume and Dimensions of the Tub based on the Technical Instructions for the Implementation of Simple Drinking Water Infrastructure in 2007 in the Minister of Public Works Regulation No. 39 Year 2006

Spring 1 is a spring without a reservoir that is used by several local communities. The utilization of this spring is good enough by using a simple building with a water outlet pipe to make it easier for the community to use the spring. However, there are drawbacks to this utilization, namely that a lot of water is wasted due to the absence of a reservoir for the springs and also the large potential for entry of pollutant substances from outside the springs. Therefore, it is necessary to make a technical conservation step by making a spring reservoir. The reservoir for the springs was made to adjust several provisions, such as the number of spring users ranging from 200-300 people with a spring discharge of 0.5-0.6 L/second, so that the springs that will be made in accordance with the provisions have a water storage capacity of 2 m^3. The design of the reservoir can be seen in the following figure.

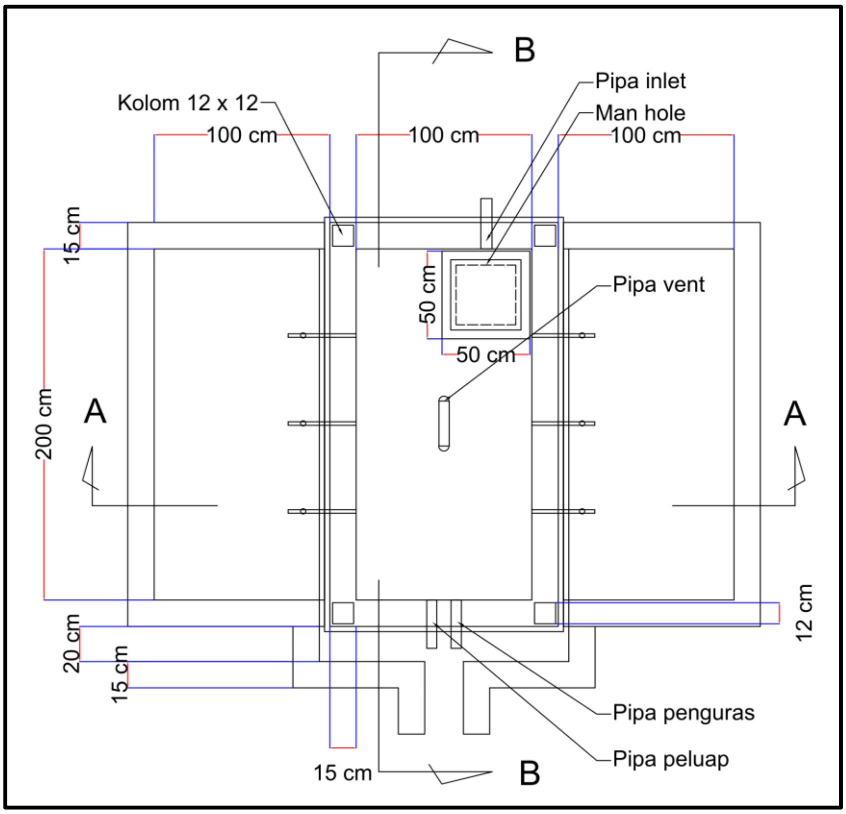

Figure 1. (2 m³) Spring Water Reservoir Top View

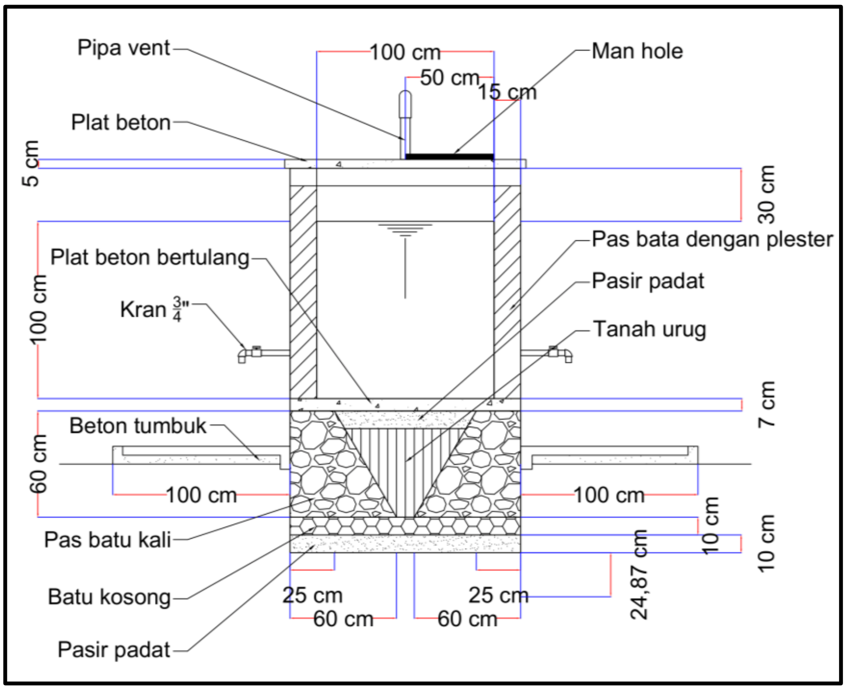

Figure 2. (2 m³) Spring Reservoir Tank A-A

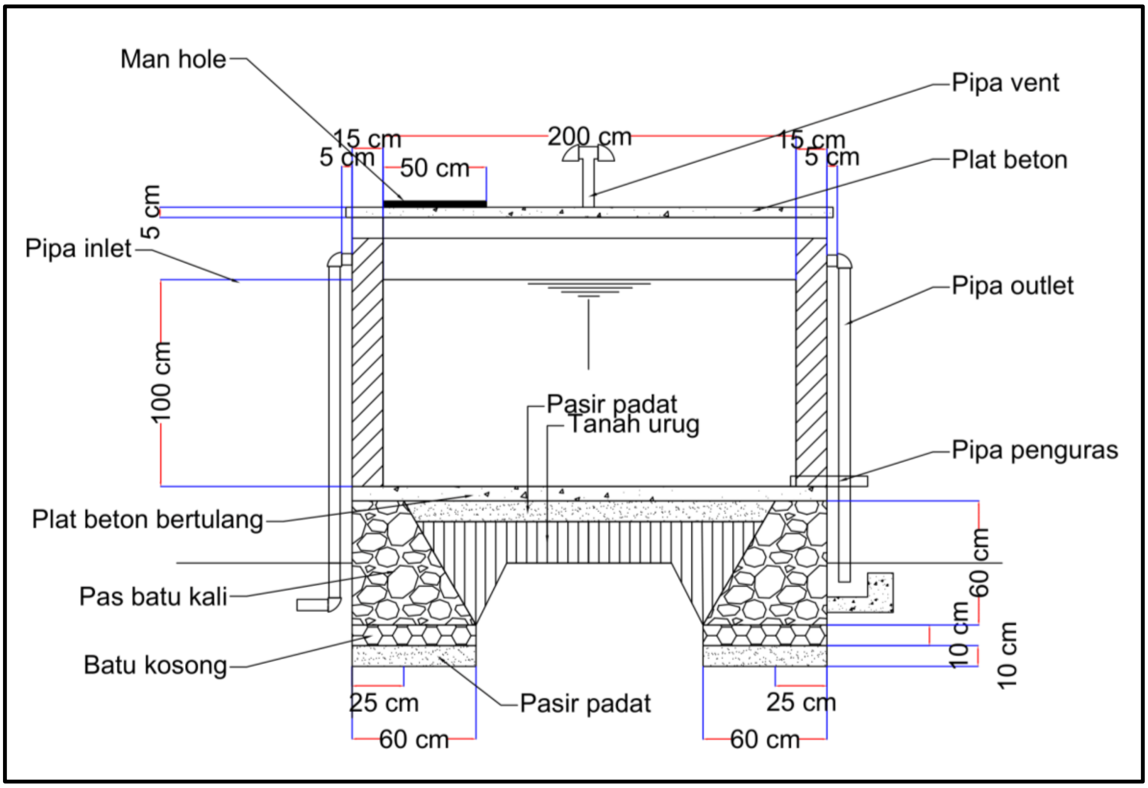

Figure 3. (2 m^3) Spring Water Reservoir Body Cut B-B

Spring 2 is a spring that has often been used by the community by making use of a simple water reservoir. This reservoir is made using a concrete cover which is only made on each side of the tub, while for the bottom of the tub no management is carried out using only soil as a water barrier medium. This is very unfortunate because the water that has been stored will be infiltrated and absorbed into the ground so that the function of the tub as a reservoir for springs does not function effectively and sometimes seepage water is found coming out of the bottom side of the reservoir. Therefore, it is necessary to make technical conservation measures by making a more suitable spring reservoir. The spring reservoir that is made adjusts several provisions, such as the number of spring users ranging from 200-300 people with a spring discharge of <0.5 L/second, so that the spring reservoir that will be made in accordance with the provisions has a water storage capacity of 5 m^3. The design of the reservoir can be seen in the following figure.

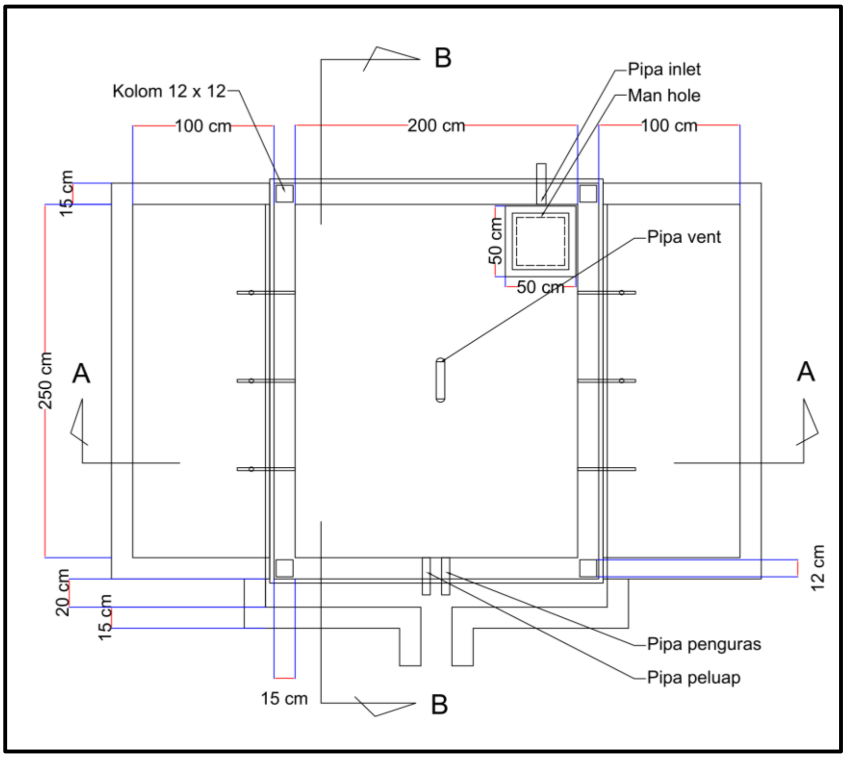

Figure 4. (5 m³) Spring Water Reservoir Top View

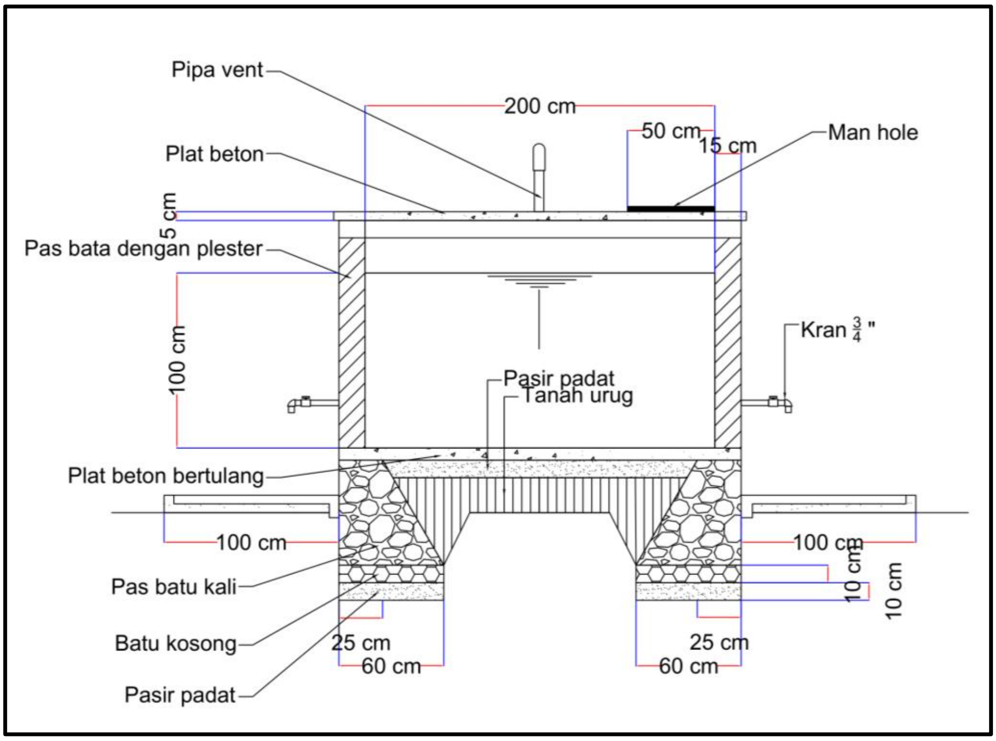

Figure 5. (5 m³) Spring Water Reservoir Body Cut A-A

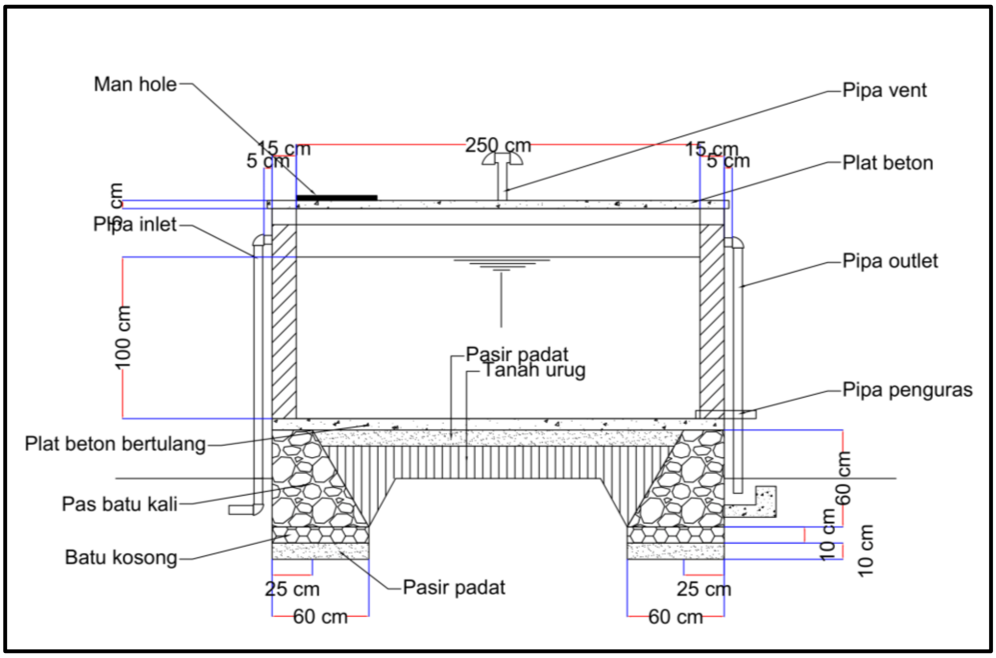

Figure 6. (5 m^3) Spring Water Reservoir Body Cut B-B

Conservation itself is not limited to technically making tubs, but it is also necessary to convey input and socialize to the community so that the springs they use daily can be preserved and maintained as well as possible as a source of basic needs for common property. It is often found that people only care about fulfilling their need for clean water, but from the community itself there is still a lack of concern for the care and preservation of the condition of the springs. In connection with this, it is important to take maintenance actions by the community, especially in this case to maintain the condition of the spring tub that has been made so that it continues to function properly.

CONCLUSION

The results of the research that have been carried out have concluded that in terms of quantity, the availability of springs is still quite good to meet the local community. Technically, spring conservation is carried out by constructing a spring reservoir with a volume of 2 m^3 for spring 1 and a spring reservoir with a volume of 5 m^3 for spring 2. Non-technical spring conservation is carried out with a social approach related to the importance of preserving their springs.

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