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Design of Clean Water Pipes in Bangga Village, South Dolo District, Sigi Regency

Wahiduddin Basry, Dewi Ayu Setiawati, Andi Rizal, Rajindra, Ahmad Yani

***Abstract**: This study is to provide an overview of the design of clean water pipelines in Bangga Village, South Dolo District, Sigi Regency. The limitation in this design is to analyze the availability of water/discharge mainstay of the Bangga River using the F.J Mock method and calculate the need for clean water in Bangga Village according to the estimated population for the next 27 years. The design method is carried out using meteorological data collection methods, data on population density, topographic data, and rainfall data, then calculates the need for clean water and is compared with the reliable discharge. The result is obtained a minimum mainstay of the Bangga River discharge (Q_{and} 0.282 m3 / sec) to meet the needs of clean water in the service area until 2040 required a water debit of (6,295 ltr / sec). From the water requirements, 2 (two) design methods were designed which included 1 (one) clean water pipeline design and 2 (two) clean water pipeline design. From the design results obtained a maximum pressure of 4.2662 kg / cm2 which occurs at the node / pipe connection P.15 this does not exceed the maximum allowable limit of 10 kg / cm2, while the maximum speed obtained at 1.1688 m / sec which occur at vertices P, 6 and P. 12 this does not exceed the maximum limit of 3 m / sec. For the number of pipe requirements needed in this design are 1747 sticks, where for Ø 8 "17 sticks, Ø 6" 259 sticks, Ø 4 "108 sticks, Ø 3" 760 sticks, Ø 1 "565 sticks, Ø ½ "38 sticks.*

***Keywords**: Pipe design, maximum pressure.*

I. INTRODUCTION

Water is the essential thing in human life in every activity needs clean water, for this reason, it is necessary to provide clean water that meets applicable standards and in terms of quantity and continuity must be able to meet the needs of people in an area so that the activity can run well [1]–[3].

Existing water resources need to be managed in a sustainable water resources management system (sustainable water management system) is a water resource management system that is designed and maintained and contributes fully to current and future community (social and economic) goals, while still preserving the ecological aspects [4].

Various attempts were made by humans to obtain water sources that would be used to meet their daily needs. Water sources can be springs that can be found at one location in the hilly or lowland areas where the soil is porous, or the rock formation is fractured, allowing water to flow above/below ground level. The water flow forms a surface runoff so that when it gathers with the flow of water from other springs, it creates a river flow [5].

Bangga Village, which is used as the study area, is ± 65 km from Palu City, administratively located in the field of South Dolo Subdistrict. Sigi Regency is geographically located at 01 ° 14 '35 "South Latitude and 119 ° 54 '35" East Longitude. The village has not received clean water services from the Regional Drinking Water Company (PDAM). So far, the community has only relied on well water and local village springs. The topography of the village, which consists of flat land and mountains, influences the potential of raw water from existing spring sources that cannot yet be maximized, so an evaluation of clean water needs in the village is needed to project the demand for clean water services for the next few years — then planned several clean water facilities and infrastructure including pipeline design, SPAM, and utilization of existing water sources [6], [7].

The formulation of the problem raised in this paper is how to design clean water pipelines to meet the needs of the community of Bangga Village based on the projected needs of the city for the next few years.

Based on the problems outlined above, the author intends to conduct a study that is by designing clean water pipelines in Bangga Village by utilizing the potential of existing raw water sources to overcome the problem of lack of freshwater in Bangga Village. In the design of clean water pipelines based on projections of community needs for the next few years.

Based on the considerations outlined above, the author agreed to conduct a study on connecting pipelines in Bangga Village by utilizing existing raw water sources to overcome the problem of limited clean water in Bangga Village. In the design of clean water pipelines about the design of community needs for the next few years [4], [8].

The results of this design are expected to provide benefits such as: Provide scientific information about the pipeline system, the required airflow, the strength of the pipe against air pressure, the maximum speed of air in the pipe, and the number of pipes needed as a reference material for further research that discusses the problem of designing clean water pipes.

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* Correspondence Author
Wahiduddin Basry*, Faculty of Engineering Universitas Muhammadiyah Palu, Palu, Indonesia. Email: wahiduddinbasri@yahoo.com
Dewi Ayu Setiawati, Faculty of Engineering Universitas Muhammadiyah Palu, Palu, Indonesia
Andi Rizal, Faculty of Engineering Universitas Muhammadiyah Palu, Palu, Indonesia
Rajindra, Faculty of Economics Universitas Muhammadiyah Palu, Palu, Indonesia
Ahmad Yani, Faculty of Public Health Universitas Muhammadiyah Palu, Palu, Indonesia

Taking into account the background and formulation of the problem above, the problems in this studio are as follows: a) Calculate the need for clean water in Bangga Village according to the estimated population until 2040. b)

Design of water pipelines in the service area using a drainage system for facilitating ways. c) The design of the water pipe network only up to the public faucet, while the design of the building manager and other facilities are not equipped with this design.

II. METHOD

The method used in this study is as follows: Collecting secondary data in the form of meteorological data related to the watershed in Bangga Village which is used to determine the mainstay of river discharge, Topographic data used to determine elevation and determination of network schemes, population for analysis of water needs, and land use used for determination loading the service area, all of the data is basically for the analysis process of planning calculations. Read and study previous literature relating to research material. Field observations are in the form of direct observations in the field to find out the actual situation at the planned location, which is expected to make it easier to design clean water pipelines.

The data used in this paper are secondary data that can be grouped according to their use. Monthly rainfall data for the South Dolo region. This data is required for the mainstay debit calculation method, F.J Mock. This data was obtained from the Balai Sungai Region III Hydrology unit in Central Sulawesi Province [9]. Meteorological data, this data is needed for calculation of potential evapotranspiration. This data was obtained from the Meteorology, Climatology and Geophysics Agency in Central Sulawesi Province. Data on total population density to determine the distribution capacity of clean water in each region according to the estimated population density. This data was obtained from the Central Statistics Agency of Central Sulawesi Province. Topographic data used to determine elevation and determine clean water distribution network schemes. This data was obtained from the Department of Public Works. Cipta Karya Central Sulawesi Province.

The calculation analysis used is mainstay discharge analysis, analysis of clean water requirements. Discussion of the results of the analysis are the mainstay discharge calculation results using the *FJ Mock Method*, the capacity of the clean water system of the distribution of clean water in each region according to the estimated population density, and planning a clean water distribution network in the service area in the Village of Proud by using a drainage system by means of gravity and a branched pipe system.

All data to support this writing were obtained from the relevant agencies, namely the Central Statistics Agency of Central Sulawesi Province, River Region Agency III of Central Sulawesi Province, Regional Planning and Development Agency of Central Sulawesi Province and the Meteorology, Climatology, and Geophysics Agency of Central Sulawesi Province.

III. RESULTS AND DISCUSSION

Calculation of Potential Evapotranspiration (*Eto*)

In calculating potential evapotranspiration (*Eto*), the penman modification method is used. In this case, temperature, humidity, wind, and sunlight become parameters in the method, the formula used in calculating potential evapotranspiration (*Eto*) with the Penman Modification method is equation (2.2) and (2.3):

Eto = c x Eto*

Where :

ETo* = W {(0.75 Rs – Rn1) + (1 – W) f(u) (ea-ed)}

Example calculation:

January Data on average monthly temperature / air temperature. for January obtained t = 26.10ºC

For the value of t = 26.10ºC by interpolation:

ea = 33,810 mbar

W = 0,751

1 – W = 0,249

f(t) = 15,920

Data on average monthly relative humidity. For January obtained RH = 77.00%

Based on the ea and RH values, for the f (*ed*) values obtained:

Ed = 33,810 x 79,00%

= 26,034%

Based on the value of ed, for the value of f (*ed*) obtained:F(*ed*) = 0,34 – 0,044√Ed

= 0,34 – 0,044√26,034

= 0,34 - 0,044 x 5,102

= 0,116

Latitude location data = 01°14′ LS

Based on the location of latitude = 01 ° 14′ LS, interpolation for Ra values is obtained:

Ra = 15,30 mm/hari

Monthly average solar radiation data. for January obtained n/N = 56,00% = 0,560

Based on the Radan n / N value or calculated by the formula, for the value of Rs obtained:

Rs = 0,25 + 0,54(n/N) x Ra

= 0,25 + 0,54 (0,560) x 15,30

= 8,452

Based on n / N values calculated by the formula obtained:

F (n/N) = 0,1 + 0,9 (n/N)

= 0,1 + 0,9 (0,560)

= 0,604

Monthly average wind speed data

u = 1,542 m/detik

Based on the u value calculated by the formula, the f (*u*) value is obtained:

f(u) = 0,270 (1+u x 0,864)

= 0,270 {1+(1,542) x 0,864}

= 0,270 x 2,332

= 0,630

Based on the values of f (t), f (ed) and f (n / N) using the formula, then the value of Rn1 for January is obtained:

Rn1 = f(t) x f(ed) x f(n/N)

= 15,920 x 0,116 x 0,604

= 1,111

The correction number (c) from the table in appendix 7 for January obtained the value

c = 1,10

Based on the values of W, (1-W) Rs, F (u), ea and ed, then by using equation (2.3) for the value of Eto * in January we get:

Eto* = W (0,75 Rs – Rn1) – (1-W) f(u) (ea-ed)

= {0,751 (0,75 (8,452)-1,111)-(0,249)(0,630)(33,810-26,034)}

= 2,70695

Based on the value of Eto * = 2.70695 and the value of c = 1.1, then using equation (2.2) for the value of Eto in January obtained:

Eto = c x Eto*
= 1,1 x 2,70695
= 2,978 mm/hari
= 92,307 mm/bulan

Mainstay Water / Debit Availability Analysis

In determining the availability or mainstay discharge on the Bangga river, the F.J Mock method is used every year for 12 years. The data that are the parameters in determining the mainstay discharge include Data on average monthly rainfall. Potential Evapotranspiration data calculated by the Penman Modification method [10].

Estimated Total Population

In planning a clean water supply system, the most appropriate calculation is the number of residents who will inhabit the area to be planned in the future, then estimate the amount of clean water in general, which covers up to the determination of the period in which the projected population is calculated.

To project the population in an area, it is estimated that population data from the area for the previous few years. Then from these data obtained an average percentage increase in population every year. Thus the projected population for the next few years can be known.

Estimating the population in the Bangga Village at the end of the design year, the authors use the Geometric method because it can be seen that the largest population projection is 3164 inhabitants.

Calculation of Clean Water Needs

In determining household water needs based on a large amount of water usage as well as the percentage of the population served. The use of clean water is based on house connections and public connections and based on data from the Public Works Department of the Directorate General of Human Settlements that for a plan, it should be divided into 80% house connections and 20% for public taps.

Standard use of clean water needs for planning until 2040 is 100 liters /person/day with 80% of the total population getting clean water through house connections, and 20% of the population served through public taps with a standard 30 liters /day/person.

From the calculation results, the total need for clean water for households and public taps is 272.090 m3 / day or 3.149 liters/second.

To calculate the amount of clean water needed for industrial and commercial facilities in the future is estimated based on the need for clean water for each worker. The number of industrial workers in 2013 was 16, meaning 0.69% of the population.

I am considering that the percentage of the number of workers to the population is permanent, and the need for clean water for workers is 40 liters /day/person workers — commercial buildings such as shops, repair shops, services, etc. Fifty-one are assumed to increase by three units annually, and three units per worker per unit and each needs 6 liters of water /person/day.

The number of religious buildings in the village of Bangga is 4. The number of people worshiping is 30 people per unit. From the calculation table, the water demand is 9.30 m3 / day.

The number of health facilities in the Bangga village of 4 units is assumed to increase by 1 unit every two years and the number of people treated and caring for as many as 20 people per unit. From the calculation table, the water demand is 72.00 m3 / day.

There are nine education facilities in Bangga Village, with 770 students and teachers. This means that the number is 33.29% of the total population. Based on the consideration that the percentage of the number of teachers and students to the total population is fixed. The standard use of clean water for education is 20 liters /day/person [11].

The amount of water loss used is 20%, which is 75,541 m3 / day. Water needs in a community group are not the same, vary, and depend on daily use activities. Whether it's in every week, month and year, there is more water usage than normal days. Based on the peak hour factor, it can be seen that the need for clean water at peak hours is 6.295 liters/second.

IV. CONCLUSION

This study concludes that with the discharge of service requirements obtained by 0.0062951 m3 / sec, the capacity of existing water sources is sufficient to meet the minimum value with the available river mainstay discharge, which is equal to 0.288 m^3 / sec. Two clean water pipeline designs based on permitted requirements. The design of the network is called the design of clean water pipelines 1 (one) and 2 (two). 1 (one) network design is used for the next plan because the design plan is considered better than the 2 (two) network design. The reasons for these considerations are the type of pipe used assuming a lower cost, the amount of residual energy produced at each network node, and the magnitude of the water pressure capability generated at each network node so that it can distribute water to the secondary network. The maximum pressure achieved by network design 1 (one) of 4.2662 kg / cm^2 means that the pressure does not exceed the specified permit pressure of 10 kg / cm^2. The maximum speed reached 1.1688 m / s and did not exceed the permissible speed limit in the pipe of 3 m / s. The number of pipes needed is 1747 sticks.

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It is optional. The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (S.B.A.) would like to thank ... ." Instead, write "F. A. Author thanks " *Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page*.

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