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PLANNING OF CLEAN WATER DISTRIBUTION PIPELINE NETWORK AT UNIVERSITAS JAMBI KAMPUS PINANG MASAK MENDALO

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Abstract

In 2021 it is estimated that there are 19,836 people at Universitas Jambi Kampus Pinang Masak Mendalo. One of the most important aspects to support activities in Universitas Jambi Kampus Pinang Masak Mendalo is a clean water supply. This study aims to determine clean water needs, to analyse hydraulic factors such as water discharge, flow speed, water pressure, and head loss using EPANET program, and to calculate the budget required to build a water distribution pipeline system. The results of water distribution pipeline network design are clean water needs at Universitas Jambi Kampus Pinang Masak Mendalo as much as 665,910 liters/day or 18.4975 liters/second and at the maximum daily needs as much as 732,500 liters/day or 20.3472 liters/second in the projected year of 2031. Analyses of hydraulic factors in the pipeline distribution system using EPANET program and manual calculation give the same results, but there are some pipe segments that do not fulfill of flow velocity standard, that are on pipe A1 = 0.15 m/s, B1 = 0.08 m/s dan pipa B2 = 0.25 m/s. The cost required to build a clean water distribution pipeline network at the Universitas Jambi Kampus Pinang Masak Mendalo, is amounting Rp238,252,263.00,-

Keywords: Clean Water Needs, Pipeline Network, EPANET, Hydraulic Factors

Introduction

Improving the quality of the education system at universities is the main goal of all academics. To support the activities of the academic community, infrastructure facilities are needed at the university, either in the form of a clean water supply system (Kusumajati & Solichin, 2016; Priyambodo, 2016), transportation (Kamal et al., 2021), drainage (Pania et al., 2013), waste water treatment (Hariyadi et al., 2020), as well as waste management (Nursalim & Adib, 2020).

In the effort to provide clean water, water treatment plants (IPA) and clean water distribution pipelines are important to support the teaching and learning process (Sudjoko & Setianingsih, 2019). Therefore, it is necessary to plan a clean water treatment and distribution system that is centralized and integrated in order to provide clean water continuously.

In various studies and designs, the level of water demand for each person in Indonesia refers to the guidelines issued by the Director General of Cipta Karya PU (Karya, 1996). Publication of articles in Indonesia regarding demand analysis by directly measuring water consumption is still small, including in the city of Medan (Simanjuntak et al., 2021), and in large and metropolitan cities (Kurniawan et al., 2021; Sutjahjo et al., 2011). While abroad, many analyzes of water needs at universities have been carried out, including at a campus location in Europe (Wichowski et al., 2019), in Malaysia (Daud & Abdullah, n.d.), South Asia (Lekamge et al., 2016), and Latin America (Medina & Miranda, 2021). In fact, an analysis of changes in water needs was carried out during a pandemic (Tesgera et al., 2022).

In 2021 Universitas Jambi, Pinang Masak Mendalo Campus has 7 (seven) faculties and consists of 91 (ninety one) study programs from various disciplines with a total academic community and workforce of 19,836 people (Statistik Universitas Jambi Dalam Angka, 2021). In the University of Jambi Strategic Plan (RENSTRA) for 2020-2024, Universitas Jambi has not yet had plans to build a Water Treatment Plant (IPA) at Universitas Jambi, Pinang Masak Mendalo Campus, as well as plans for a clean water distribution pipeline network. The distribution pipeline network is a pipe segment that carries (distributes) clean water from the reservoir to the service area or consumers (Karya, 2016).

The clean water supply system at Universitas Jambi, Mendalo's Pinang Masak Campus, is generally managed and regulated by each faculty. So far, the fulfillment of the need for clean water at Universitas Jambi, Mendalo's Pinang Masak Campus, has been obtained from wells (bore) or groundwater. The problems of the well water (bore) or ground water are varied, including cloudy water, smells of iron, and sometimes there is no water during the dry season.

To carry out this planning, distribution pipeline network analysis software is needed. One such software is EPANET which is issued publicly by the US EPA (United States Environmental Protection Agency). This software uses the principles of mass conservation and energy conservation while taking into account major and minor losses (Limbong et al., 2022; Waspodo, 2017). The use of this software to analyze and plan distribution systems has been carried out in various areas, including urban areas (Nugroho et al., 2018; Ramana et al., 2015), district area (Armanto, 2016), as well as districts (Sari, 2021; Syahdinar & Kacong, 2020).

In planning the distribution network, it is necessary to be equipped with mapping software, including QGIS (Muller et al., 2019; U.S.A.I.D., 2009). EPANET's use in various publications has been recognized since 1998 (Antonowicz, 2018; Georgescu, 2017; Oktafianto & Wibawa, 2019). Li & Li, (2021) analyzed publications published from 1998-2019 on the use of this software in relation to climate change, energy efficiency, and water quality.

Research Methodology

Planning Location

Universitas Jambi Mendalo's Pinang Masak Campus which is located at Jl. Jambi-Muaro Bulian No. Km 15, Mendalo Darat Village, Jambi Outer City District, Muaro Jambi District, Jambi Province.

Data Collection Technique

1. Primary data obtained from a survey conducted at the planning location. The primary data collected is in the form of the existing condition of the location such as the existing buildings and facilities and their quantity, and the existing water demand based on the available water reservoirs.
2. Secondary data in the form of data on the number of academics and teaching staff at Universitas Jambi in the initial year as well as other data obtained from journals, references and supporting information for planning clean water pipelines, such as pump specifications, material prices and work costs, etc.

Planning Stages

Calculation of the Projected Increase in The Number of Students

Calculation of the projected increase in the number of students can be calculated with the same rate of growth in the number of students each year, which is 6% per year (RENSTRA UNJA). The equation that can be used to calculate the projected number of students is as follows.
Total number of student year x = total number on first year + (total number on first year × 6%) … (1)

Calculation of the Ratio of the Number of Lecturers and the Number of Students

Based on Government Regulation no. 4 of 2014 concerning Implementation of Higher Education that the ideal ratio between the number of lecturers and the number of students is 1: 20 for exact sciences and 1: 30 for social sciences.

Calculation of the Ratio of the Number of Teaching Staff and the Number of Students

According to Nurul, (2015) The number of teaching staff at tertiary institutions can be determined by finding the ideal ratio between the number of education staff and students, the value of this comparison is 1: 40.

Calculation of the Amount of Clean Water Needed

The amount of clean water needed is obtained from data on the number of academics and teaching staff at Universitas Jambi, then multiplied by the standard for clean water needs. Based on the standard planning criteria for the use of clean water for educational buildings of 10 liters/person/day (Karya, 1996). The calculation of the need for clean water refers to the guidelines or technical instructions and the Urban Clean Water Manual issued by the Director General of Cipta Karya in 1996.

Q = number of people × standard of clean water needed … (2)
Q production = (Q + % water loss) × F md … (3)
Q distribution = Q × ((1 day)/(36,000 seconds (10 hours))) × F md … (4)

Notes:
Q : Clean water needed (liter/day)
% water loss : Water loss due to pipe leaking (20 – 30 %)
F md : Maximum Daily Factor (1,1 – 1,3)

Determination of Pipe Diameter

The diameter of the design pipe can be calculated by assuming the value of the water flow velocity in the PVC pipe that is tolerated is in the range of 0.3 - 4.5 m/sec (Dirjen Cipta Karya, 2007). Clean water distribution systems generally use PVC type pipes with a PVC pipe diameter that can be determined by the speed of the water flow when distributing water.

The following is an equation that can be used to determine the diameter of the distribution pipe.

$$Q = A \times v \ldots (5)$$

Note:
Q : Water flow rate (m^3/s)
A : Pipe cross-sectional area (m^2)
v : Water flow rate (m/s)

EPANET Simulation

EPANET simulation aims to facilitate distribution pipeline development plans and describe the hydraulic conditions of water flowing in the distribution pipeline network. The hydraulic factors that need to be considered are discharge, velocity, pressure, and head loss in the pipe (Rossman, 2000).

Analysis of Hydraulics Factors

Hydraulics factor analysis aims to prove or check whether the results of the EPANET program analysis have errors or not. The hydraulic factors that will be analyzed include flow rate in the pipe, flow velocity, pressure, and head loss (Dwi & Santosa, 2021). Hydraulic factor analysis can be calculated and checked manually with the following equations.

1. Check the water flow rate
   Water flow rate is a quantity that shows the amount of fluid volume that passes through a cross section in a certain time. The water flow rate equation is (Triatmodjo, 2008; Trifunovic, 2006; Young et al., 2010).

   $$Q = \frac{V}{t} \ldots (6)$$

   Note:
   Q : Water flow rate (m^3/s)
   V : Volume of flowing fluid (m^3)
   t : Time of flowing fluid (s)
2. Check flow rate

   $$v = \frac{4.Q}{\pi.D^{\wedge}2} \ldots (7)$$

   Note:
   v : Flow speed (m/s)
   Q : Flow rate (m^3/s)
   D : Pipe diameter (m)
3. Check for loss of water pressure
   Loss of pressure (hf) in the pipe occurs due to friction or friction between the fluid and the surface of the pipe. Water loss can be calculated using the following Head loss mayor formula (Kay, 2017; Swamee, 2008):
   Hazen-William:

   $$Hf = \frac{Q}{0{,}2785 \,.\, Chw \,.\, D^{2{,}63}}^{1{,}852} L \ldots (8)$$

   Note:
   Hf = Major Losses along a straight pipe (m)
   L = Length of pipe (m)
   Q = Debit (liters/second)
   Chw = Hazen-William pipe roughness coefficient
   D = Pipe diameter (m)
4. Check the water pressure at the end of the pipe
   Finding the water pressure at the end of the pipe is divided into 3 (three) conditions and can be calculated using the following equation: (1) If the upstream elevation of the pipe m > the downstream elevation of the pipe m, then P downstream pipe m = P upstream pipe m + (h upstream pipe m – h downstream pipe m) – Hf value of pipe m; (2) If the upstream pipe elevation m < downstream pipe elevation m, then P downstream pipe m = P upstream pipe m - (h upstream pipe m – h downstream pipe m) – pipe Hf value m; or (3) If the upstream pipe elevation m = downstream pipe elevation m, then P pipe downstream m = P upstream pipe m + (0) – pipe Hf value m.

Design Drawings

This clean water distribution pipe network design drawing was created using 2 (two) supporting applications, namely EPANET to analyze clean water distribution simulations and the AutoCAD application to draw distribution pipe networks along with pipe network details, pipe excavation profiles, and pump station units.

Budget Planning

The Budget Plan contains details and calculations for the construction of clean water distribution pipelines at Universitas Jambi, Mendalo's Pinang Masak Campus.

Results and Discussion

Table 1. Recapitulation of the increase in the number of lecturers, teaching staff, and students in each faculty

No.	Faculty	Early Year (2020)			Planning Year (2031)		
		Total Lecturers	Total Teaching Staffs	Total Students	Total Lecturers	Total Teaching Staffs	Total Students
1.	Teacher Training and Education Science	191	89	6,480	615	308	12,301
2.	Economy and Business	128	58	3,387	214	161	6,430
3.	Agriculture	98	64	2,791	265	132	5,298
4.	Law	84	64	3,558	225	169	6,754
5.	Animal Husbandary	73	52	1,101	105	52	2,090
6.	Science and Technology	88	27	1,312	117	62	2,491
	Total	**662**	**354**	**18,629**	**1,541**	**884**	**35,363**

Projection of the Academic Community and Educators in 2031

This projection of the number of academics and teaching staff is useful for assisting in pipeline planning. In order for this pipeline network to work to distribute water over a long period of time in order to achieve time and cost efficiency, a pipeline network plan has been determined to work in the long term. the next 10 years, namely until 2031.

Calculation of the projected number of academics and teaching staff is only carried out in buildings used for lecture activities.

Projected Increase in the Number of Students

The results of calculating the projected number of students in each faculty can be seen in table 1 based on the 2020 – 2024 Strategic Plan (Renstra) of the University of Jambi, the target is to increase the number of students per year, namely as much as 6% per year. Table 1 shows the number of students at Universitas Jambi, the Pinang Masak Mendalo Campus, in the 2031 projection year of 35,363 people.

Calculation of the Ratio of the Number of Lecturers and the Number of Students

The increase in the number of lecturers or instructors in each faculty in the 2031 projection year can be seen in table 1. In table 1 it is known that the ideal number of lecturers at Universitas Jambi, the Pinang Masak Mendalo Campus in the 2031 projection year, is 1,541 people.

Calculation of the Ratio of the Number of the Teaching Staff and the Number of Students

The addition of teaching staff in each faculty in the 2031 projection year can be seen in table 1. According to (Nurul, 2015), the number of teaching staff at tertiary institutions can be determined by finding the ideal ratio between the number of teaching staff and students, the comparison value is 1: 40.

Recapitulation of the Number of Academics and Teaching Staff

The estimated number of academics and teaching staff at Universitas Jambi, Mendalo's Pinang Masak Campus from 2021-2031 can be seen in table 1. In table 1 it can be seen that the total number of academics and teaching staff at Universitas Jambi, Pinang Masak Mendalo Campus in the projected year 2031, is 37,796 people.

Calculation of Clean Water Needs

To calculate the water needs, they are divided into 2 (two) calculation, namely:

Table 2. The need for clean water in lecture buildings

No.	Building	Water Needed Year 2031 (liters/day)
1.	Faculty of Teacher Training and Education Science	84,670
2.	Sendratasik Study Program	21,470
3.	Porkes Study Program	17,880
4.	PAUD Study Program	8,220
5.	Faculty of Economy and Business	68,040
6.	Faculty of Agriculture	41,980
7.	Forestry Study Program	14,980
8.	Faculty of Law	49,720
9.	Sipol Study Program	21,760
10.	Faculty of Animal Husbandary	22,470
11.	Faculty of Science and Technology	26,770
	Total Needs	**377,960**

Table 2 shows that the total need for clean water for lecture buildings on the Pinang Masak Mendalo Campus is 377,960 liters/day.

The Need for Buildings and Non-Class Facilities

Recapitulation of clean water needs in non-university buildings and facilities can be seen in table 3 below.

Table 3. The need for clean water in non-lecture building

No.	Building or Non-Lecture Facilities	Clean Water Needed (liters/day)
1.	Laboratory	37,000
2.	Mosque	22,800
3.	Bureaus, Institutions, and UPT	2,320
4.	Dormitories	17,990
5.	Farm UNJA Experimental Garden (*T&RF*)	1,720
	Livestock Facilities	1,556
6.	UNJA Hospital	93,600
	Total Needs	**176,965**

Recapitulation of Clean Water Needs

Recapitulation of clean water needs in lecture buildings as well as non-lecture buildings and facilities can be seen in table 4 below.

Table 4. Recapitulation of clean water needs

Parameter	Planned Year 2031
Lecture building needs (liters/day)	377,960
Need for buildings and non-class facilities (liters/day)	176,965
Total clean water requirement (liters/day)	554,926
Leakage (20%) (liters/day)	110,985
Daily average water requirement (liters/day)	665,910
Daily average water requirement (liters/second) (10 hours)	18,4975

In table 4, the total clean water requirement for Universitas Jambi, Pinang Masak Mendalo Campus, is 665,910 liters/day or 18.4975 liters/s.

Clean Water Use Fluctuations

Maximum Daily Requirement

The maximum daily requirement at Universitas Jambi, Pinang Masak Mendalo Campus, is 732,500 liters/day or 20.3472 liters/second.

Distribution of Clean Water Distribution Zones

The distribution of clean water at the University of Jambi, the Pinang Masak Mendalo Campus, is divided into 14 zones, where each zone is determined based on the presence of each adjacent building or facility so that the discharge of clean water that will be distributed to each zone can be determined. The following is the distribution of clean water zones in Jambi, the Pinang Masak Mendalo Campus.

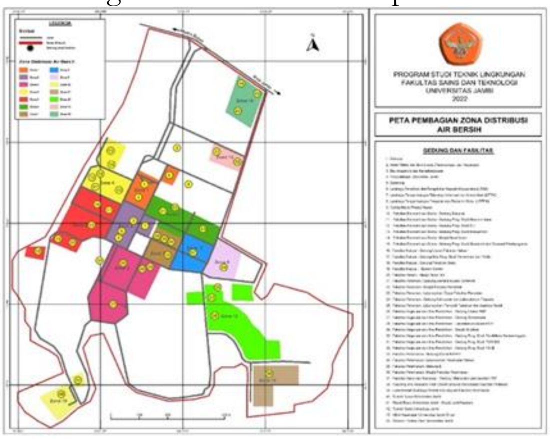

Figure 1. The distribution of clean water at the Mendalo Pinang Masak Campus

Distribution Zone of Clean Water Needs

The need for clean water for each distribution zone can be seen in table 5 below.

Table 5. Total distribution of clean water per zone in the planned year of 2031

Zone	Distribution debit (10 hours)	
	liters/day	**liters/second**
1	1,597	0.222*
2	1,465	0.204*
3	153,305	4.258
4	93,509	2.597
5	98,050	2.724
6	68,086	1.891
7	44,972	1.249
8	44,576	1.238
9	25,054	0.696
10	36,947	1.026
11	2,054	0.285*
12	4,910	0.682*
13	34,452	0.957
14	123,552	3.432
Total	**732,500**	**21.462**

*) for distribution for 2 hours (7,200 seconds)

In the 2031 projection, it is known that the need for clean water distribution at the University of Jambi, Pinang Masak Mendalo Campus, is as much as 665,910 liters/day or 18.4972 liters/second, and for the maximum daily need, that is as much as 732,529 liters/day or 21.462 liters/second.

Pipe Diameter Determination

The design pipe diameter can be seen in table 6.

Table 6. Design pipe diameter

Zone of Pipe Distribution	Code	Diameter (inch)	Diameter (mm)
1,2,3,4,5,6,7,8,9,10,11,12,13,14	A0	4”	114
1,2,3,4,5,6,7,8,9,10,11,12,13,14	A1	4”	114
1,2,3,4,5,6,7,8,9,10,12,13,14	A2	4”	114
1,2,3,4,5,6,7,8,9,10,13,14	A3	4”	114
8,13,14	A4	3”	89
13,14	A5	2 ½”	76
14	A6	2”	60
1,2,3,4,5,6,7,10	A7	3”	89
6,7	A8	2”	60
1,2,3,4,5,10	A9	3”	89
1,2,4,5,10	A10	3”	89
1,2	A11	2”	60
4,5,10	A12	3”	89
4,5	A13	3”	89
1	B1	2”	60

Zone of Pipe Distribution	Code	Diameter (inch)	Diameter (mm)
2	B2	1”	32
3	B3	2”	60
4	B4	2 ½”	76
5	B5	2”	60
6	B6	2”	60
7	B7	2”	60
8	B8	2”	60
9	B9	1”	32
10	B10	2”	60
11	B11	1”	32
12	B12	1”	32
13	B13	1 ½”	48
14	B14	2	60

The distribution of clean water in this distribution pipeline network uses AW type PVC pipes with pipe diameters that vary from the largest diameter of 4 inches and the smallest diameter of 1 inches.

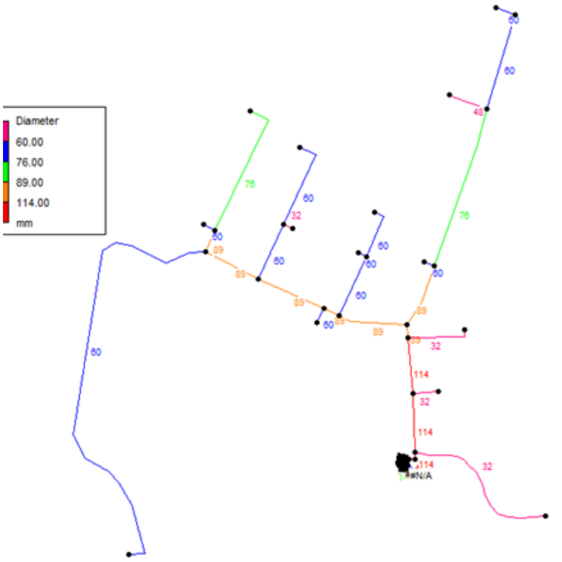

Figure 2. Planning for a clean water pipeline network for Campus Pinang Masak Mendalo using EPANET

Information:
Red : 4 inches (114 mm)
Green: 2 ½ inches (76 mm)
Orange : 3 inches (89 mm)
Blue : 2 inches (60 mm)
Purple : < 2 inches (< 60 mm)

Pipe Installation

Pipe installation at the Pinang Masak Mendalo Campus uses 2 (two) types of pipe materials, namely GIP (Galvanized Iron Pipe) and PVC (Poly Vinyl Chloride) pipes. The GIP pipe was chosen for the distribution pipe installation from the direct pump so that the pipe can withstand high pressure and the type of PVC pipe used is the AW type which is the thickest pipe on the market which can withstand pressures of up to 10 kg/cm2. This type of pipe is suitable for distributing clean water. The description of pipeline planning using the EPANET application can be seen in Figure 2.

Analysis of EPANET Simulation Results

The Epanet 2.0 software is used as a tool to prove the results of hydraulics simulations (Sari, 2021). In addition, EPANET is becoming the most popular and convenient for the effective design of complex pipelines (Ramana et al., 2015). There are 4 factors that need to be considered in the analysis of this distribution pipeline network, namely flow rate in the pipe, flow velocity, pressure, and head loss (Dwi & Santosa, 2021).

Table 7. EPANET simulation results of discharge, velocity, and head loss

No.	Pipe Code	Flow (l/d)	Velocity (m/s)	Head loss (m/km)
1.	A2	21.18	2.07	30.99
2.	B12	0.68	0.85	26.03
3.	A7	14.17	2.28	49.62
4.	A8	3.14	1.11	20.71
5.	B7	1.25	0.44	3.74
6.	A4	5.63	0.90	8.97
7.	B8	1.24	0.44	3.68
8.	A5	4.39	0.97	12.11
9.	B13	0.96	0.53	6.76
10.	A6	3.43	1.21	24.29
11.	B14	3.43	1.21	24.29
12.	A9	11.03	1.77	30.93
13.	B3	4.26	1.51	36.21
14.	A10	6.77	1.09	12.53
15.	A11	0.43	0.15	0.51
16.	B2	0.20	0.25	2.78
17.	A12	6.35	1.02	11.11
18.	A13	5.32	0.86	8.02

No.	Pipe Code	Flow (l/d)	Velocity (m/s)	Head loss (m/km)
19.	B5	2.72	0.96	15.83
20.	B10	1.03	0.36	2.60
21.	B6	1.89	0.67	8.05
22.	B1	0.22	0.08	0.15
23.	B4	2.60	0.57	4.58
24.	B11	0.28	0.35	5.17
25.	A1	21.46	2.10	31.76
26.	Inlet Pump 1	10.68	2.35	95.00
27.	Inlet Pump 2	10.78	2.38	96.73
28.	Outlet Pump 1	10.68	3.78	300.45
29.	Outlet Pump 2	10.68	3.81	305.45
30.	A0	21.46	2.10	41.40
31.	A3	20.49	2.01	29.16
32.	A3.1	19.80	3.18	91.36
33.	B9	0.70	0.87	27.03

For values of flow velocity and pressure in the distribution pipeline network, the plan refers to the distribution pipeline network criteria, Regulation of the Minister of Public Works No. 18 of 2007 concerning Implementation of Development of Drinking Water Supply Systems.From the simulation results of the EPANET program, it is obtained that the discharge varies in each pipe. The biggest discharge is in pipe pipe code A1 of 21.46 liters/second. Pipe A1 is the main pipe that sends all clean water debits to all parts of the distribution pipeline network. The smallest discharge is in pipe code B2 of 0.20 liters/second. Pipe B2 is a tertiary pipe that sends water to the Rectorate building Universitas Jambi.

From the simulation results of the EPANET program in table 7, the velocity of the water flow varies in each pipe. This varying flow rate is closely related to the size of the pipe diameter used. According to Sultan, (2020), the greater the cross-sectional area of the pipe, the smaller the velocity of fluid flow in the pipe, but the greater the pressure.

From the simulation results of the EPANET program in table 7, the largest head loss is found in the A7 pipe code of 49.62 m/km. And the smallest head loss is in pipe code B1 of 0.15 m/km.

Table 8. EPANET results of pressure simulation

No.	Junction (Junc)	Pressure (m)
1.	Junc 1	32,95
2.	Junc 2	29,14
3.	Junc 3	21,92
4.	Junc Zone-9	23,44
5.	Junc Zone-11	32,06
6.	Junc 4	21,92
7.	Junc Zone-8	21,89
8.	Junc 5	15,97
9.	Junc 6	14,15
10.	Junc Zone-7	14,12
11.	Junc Zone-6	14,18
12.	Junc 7	15,47
13.	Junc Zone-3	15,04
14.	Junc 8	13,31
15.	Junc 9	14,77
16.	Junc Zone-2	14,75
17.	Junc Zone-1	15,25
18.	Junc 10	12,84
19.	Junc 11	12,71
20.	Junc Zone-5	12,65
21.	Junc Zone-4	12,92
22.	Junc Zone-10	12,57
23.	Junc 12	20,13
24.	Junc Zone-13	19,86
25.	Junc 13	19,86
26.	Junc Zona-14	32,95
27.	Junc Zona-12	29,14
28.	Junc 14	21,92
29.	Junc 15	23,44
30.	Junc 16	32,06
31.	Junc 17	21,92
32.	Junc 18	21,89
33.	Junc 19	15,97
34.	Junc 20	14,15
35.	Junc 21	14,12
36.	Reservoir	14,18

From the simulation results of the EPANET program, the pressure varies in each pipe. This varying pressure is closely related to the size of the pipe diameter used. This drop in pressure is caused by changes in pipe diameter or pipe bends that disrupt normal flow. This causes the pressure energy on the water flow in the pipe to decrease (Kustanto, 2013).

The greatest pressure is at junction 17 of 34.20 meters of water pressure or 3.420 atm. This node is right at the outlet of the distribution pipe which is near the flow energy source or pump. The smallest pressure is at the junction or junction zone 10 of 12.57 meters of water pressure or 1.269 atm which distribute water to Jami' As-Salam Mosque and Rusunawa.

Budget Planning

A list of job descriptions and costs for the construction of a clean water distribution pipeline network at Universitas Jambi, Campus Pinang Masak Mendalo can be seen in table 9 below.

Table 9. Type of work and budget plan

No.	Type of work	Budget
1.	Heavy equipment rental	Rp57,337,600
2.	Initial work	Rp7,200,000
3.	Piping installation work and accessories	Rp22,255,000
4.	Procurement work for pumps, pipes and accessories	Rp134,603,950
5.	Pump station unit work	Rp16,855,713
	Total	**Rp238,252,263**

The cost required to carry out the construction of a clean water distribution pipeline network at Universitas Jambi, Mendalo's Pinang Masak Campus, is Rp. 238,252,263.00.

Conclusion

The total demand for clean water at Universitas Jambi, Pinang Masak Mendalo Campus, is 665,910 liters/day or 20.3472 liters/second (10 hours) in the 2031 projection year. From the analysis of the hydraulics aspect, these include discharge, speed and pressure. Most of the distribution pipes are in accordance with the standard Criteria for Distribution Pipes, Minister of Public Works Regulation No. 18 of 2007 concerning Implementation of Development of Drinking Water Supply Systems. The hydraulic aspects of the pipes that are not in accordance with the Distribution Pipe Criteria standards include only pipes that distribute water to zone 1 and zone 2, namely Pipe Codes A11, B1, and B2 with flow velocities below 0.3 m/s. However, this does not affect the failure of the distribution of clean water. Therefore, the design of a clean water distribution pipeline network is feasible to implement. The cost for carrying out the work on the construction of a clean water distribution pipeline network at Universitas Jambi, Mendalo's Pinang Masak Campus, is Rp. 238,252,263.

For further research, there needs to be further research to determine the need for clean water in existing buildings and facilities as well as new buildings and facilities to be built so that it is more precise in determining the need for clean water. It is necessary to test the distribution of clean water in open pipelines before backfilling the excavation with fill, so that leaks can be seen in the pipes if the results of this study are realized. There needs to be a more detailed calculation on the Budget Plan (RAB). In future research, you can include minor head loss values in total head loss if needed.

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