

Clean Water and Dirty Water Plumbing Planning at Delivery Center Pos Medan Office

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ABSTRACT

The construction of multi-story buildings requires comprehensive sanitation planning, including the design of clean water supply and wastewater drainage systems. Plumbing system planning aims to ensure that the supply of clean water and the disposal of wastewater are managed effectively and in accordance with technical standards. This study aims to analyze the clean water and wastewater plumbing installation requirements for the Pos Medan Delivery Center Office Building. The planning is based on the Indonesian National Standard 03-7065-2005, which outlines the procedures for plumbing system design. The clean water source is provided by deep well, which supplies water that is pumped into a rooftop storage tank. From there, water is distributed to each plumbing fixture using a gravity-fed system. Based on the planning calculations, the daily water demand for 77 employees is 4.62 m³/day. The estimated volume of blackwater (wastewater) generated is 3.12 m³/day, while the volume of greywater is 1.68 m³/day. The clean water piping system utilizes Polyvinyl Chloride pipes with the following dimensions ½ inch for individual plumbing fixtures, ¾ inch for distribution to 2–3 fixtures, 1 inch for distribution to 3–4 fixtures, 1¼ inch for distribution to 4–5 fixtures, 1½ inch for vertical risers and distribution to 5 or more fixtures. For the greywater and blackwater piping system, PVC pipes are also used with the following dimensions 1½ inch for discharge from washbasins, 2 inch for discharge from urinals, 2½ inch for floor drain discharge, 3 inch for vertical stacks collecting greywater from floor drains, washbasins, and sinks, 4 inch for toilet discharge, 6 inch for the main discharge line carrying blackwater from urinals and toilets to the bioseptic tank. This plumbing system design ensures an efficient and standardized distribution and disposal network, supporting the overall functionality and hygiene of the building.

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1. INTRODUCTION

In this modern era, the increasing number of building constructions to support various sectors particularly for office purposes necessitates the development of standardized building designs. These standards ensure that each structure aligns with its intended function.

The growth of urban areas as active and dynamic communities presents challenges for designers in developing efficient plumbing systems (Gupta, 2016). This is due to building density, limited land availability, and the drive for innovation in developing efficient plumbing systems, which in turn increases public demand for effective water supply and building drainage functions. A well-designed clean water and wastewater piping system is essential to maintaining a healthy and functional environment (World & World, n.d.). In a building construction project, planning is required not only in terms of the building's structure and construction but also in the design of the plumbing system (Ramachandran, 2016). Plumbing system planning must carefully consider its integration with the building's structural components and other installed equipment within the building. (Suhardiyanto, 2016).

The plumbing system is an integral part of building construction. Therefore, the planning and design of the plumbing system must be aligned with the building's function and adhere to existing standards. Proper plumbing planning in multi-story buildings is crucial to ensure the safety and well-being of occupants, as well as to maintain the structural integrity of the building (World Health Organization, 2006).

The objective of this study is to determine the water supply requirements and ensure appropriate water pressure, which are essential aspects of clean and wastewater plumbing system planning. Plumbing design in multi-story buildings is crucial for developing a comprehensive clean and wastewater system plan that meets all regulatory requirements and ensures efficient system operation. (ASPE, 2017; ICC, 2018; BSN, 2015). The calculations were carried out based on the reference book "Perencanaan dan Pemeliharaan Sistem Plambing" by Soufyan M. Noerbambang and the Indonesian National Standard (SNI) for building plumbing systems.

Selecting the appropriate pipes and fittings for a building's plumbing system is crucial to prevent leaks and ensure efficient water flow throughout the structure. The distribution of clean and wastewater requires careful consideration of the building layout, water usage needs, and design specifications to develop a system that meets all necessary requirements and delivers optimal performance. Factors such as pipe size, material, and placement must be thoroughly evaluated to ensure the system operates effectively and efficiently. By prioritizing the design and installation of a high-quality plumbing system, the long-term success and sustainability of the building can be ensured. Careful planning and installation can help prevent leaks, clogs, and other issues that may result in high repair costs and prolonged operational downtime. Furthermore, anomalies such as clogs and water leaks in the sanitary piping system can also lead to secondary problems such as corrosion, foul odors, mold growth, and insect infestation. (Gurmu, 2023).

Implementing proper ventilation in the wastewater disposal system is essential to ensure the health and safety of building occupants. Adequate ventilation helps prevent the accumulation of hazardous gases such as methane and hydrogen sulfide, which can pose serious health risks if not

properly expelled. The vent system designed for waste pipes must be capable of circulating air within the pipes to ensure smooth flow and prevent blockages in the drainage system (ICC, 2018).

Although a building's drainage system is designed separately from the public sewer system, fluctuations in external pressure and ventilation conditions can affect its performance. Several key factors are involved in the integration between above-ground and underground systems, such as air pressure and airflow movement (Swaffield, 1995; Jack, 2000), and ventilation (Lu, 2018).

2. METHOD

The plumbing design process begins with obtaining architectural data, which provides the necessary information for data processing. This data includes details such as building specifications, the quantity, and the layout of the plumbing fixtures to be installed.

The next stage after obtaining the architectural data is the Literature review, which involves studying relevant materials to support data processing. The reference materials used for this stage include the book "Perancangan dan Pemeliharaan Sistem Plambing" by Soufyan M. Noerbambang and the Indonesian National Standard SNI 03-7065-2005 "Tata Cara Perencanaan Sistem Plambing" (Plumbing System Design Guidelines).

After the literature review and gathering of reference materials, the next stage is data processing. In this stage, calculations are performed to determine the daily clean water demand, the capacity of the supply pump, the clean water storage capacity, and the diameters of the vertical distribution pipes for clean water, wastewater, and rainwater for the Pos Medan Delivery Center office building. These calculations are based on the reference book "Perancangan dan Pemeliharaan Sistem Plambing" by Soufyan M. Noerbambang. The data processing is carried out based on the number of occupants and the number of plumbing fixtures (PT. Dafs Mekto Enjiniring, 2024).

The equations used for data processing include the following :

- 1) Daily clean water consumption

$$Q_d = (\text{Number of person} \times \text{water consumption}) \times 1.2 \quad (1)$$

Where:

Q_d = Daily clean water demand (m³/day)

1.2 = safety factor

- 2) Average water consumption

$$Q_h = \frac{Q_d}{T} \quad (2)$$

Where:

Q_h = Average water consumption (m³/hours)

T = Average daily water usage (hours)

- 3) Peak hourly water consumption

$$Q_{h\text{-max}} = (C_1) \times (Q_h) \quad (3)$$

Where:

Q_{h-max} = Peak hourly water consumption (m³/hours)

C_1 = Adjustment factor with a value range of 1.5–2.0 (Noerbambang, 2005)

4) Peak Water Consumption

$$Q_{m-max} = \frac{C_2 \times Q_h}{60} \tag{4}$$

Where:

Q_{m-max} = Peak minute water consumption (m³/minute)

Q_m = Peak water consumption (m³/minute)

C_2 = Adjustment factor with a value range of 3,0 – 4,0 (Noerbambang, 2005)

5) Wastewater Capacity

$$V_{waste\ water} = Q_{waste\ water\ plumbing\ equipment} \tag{5}$$

6) Rainwater Calculation

1. Average water percentage

$$P = \frac{1 \times 100}{n+1} \tag{6}$$

Where:

P = Percentage (%)

n = Number of average rainfall data points

2. Average rainfall value

$$R_r = \frac{R_{total}}{n} \tag{7}$$

Where:

R_r = Average rainfall (mm/day)

R_{total} = Total rainfall

n = Number of average rainfall data points

3. Difference between maximum rainfall and average rainfall

$$(R_i - R_r)^2 \tag{8}$$

4. Standard deviation

$$S = \sqrt{\frac{\Sigma(R_i - R_r)^2}{n-1}} \tag{9}$$

Where:

R_i = Rainfall value from the obtained data

n = Number of average rainfall data points

5. Frequency Factor

$$K = \frac{Y_t - Y_n}{S_n} \tag{10}$$

Where:

K = Frequency Factor

Y_t = Reduced variate value (refer to the table relating to return period)

Y_n = Mean of reduced variate (refer to the table related to the number of rainfall data points)

S_n = Standard deviation of reduced variate (refer to the table related to the number of data points)

6. Determining the rainfall based on time

$$R_t = R_r + (K \times S) \tag{11}$$

Where:

R_t = Planned rainfall with a time scale (mm)

S = Standard deviation

7. Rainfall Intensity

$$I_t = \frac{R_t}{24} \times \left(\frac{24}{t} \right)^{\frac{2}{3}} \tag{12}$$

Where:

I_t = Rainfall Intensity (mm/hours)

t = rainfall duration

8. Rainfall discharge

$$Q = 0.278 \times C \times I_t \times A \tag{13}$$

Where:

C = runoff coefficient (dense urban area 0,7 – 0,9)

A = Area

7) Planned number of rooftop rainwater drainage outlets

$$\text{Number of Roof drain} = \frac{\text{Rainwater flow rate}}{\text{Capacity of Roof drain}} \tag{14}$$

After data processing, the results will include the daily clean water demand, the capacity of the supply pump, the clean water storage capacity, as well as the volumes of wastewater and rainwater.

The next stage, after obtaining the data processing results, is to conduct a discussion with the planner to evaluate whether the results are accurate and relevant. The benchmark used for this evaluation is based on previously completed projects handled by the planner.

After the discussion with the planner is completed, the next step is to conclude whether the data processing results are relevant. If they are deemed relevant, the process is considered complete. If not, a review and revision of the data processing will be carried out. Once the results are validated as relevant, analysis and conclusions can be drawn.

3. RESULT AND DISCUSSION

Based on the data obtained, the Pos Medan Delivery Center Building functions as a two-story office building with a total of 77 employees. The number of plumbing fixtures to be installed in the building includes 5 flush tank toilets, 4 urinals, 4 washbasins, 6 faucets, and 2 kitchen sinks.

3.1 Calculation of Clean Water Demand Based on Number of Occupants

In this plumbing demand calculation, the process follows the reference book "Perancangan dan Pemeliharaan Sistem Plambing" by Soufyan M. Noerbambang. According to the clean water usage table in SNI 03-7065-2005, the daily clean water consumption for office buildings is 50 liters per employee per day. Therefore, the water usage for the Pos Medan Delivery Center Building, based on the number of occupants, is as follows:

- 1) Daily clean water consumption

$$Q_d = (50 \text{ Litre/employee/day} \times 77 \text{ employee}) \times 1.20 = 4.62 \text{ m}^3$$

- 2) Average water consumption

$$Q_h = \frac{4.62 \text{ m}^3}{8 \text{ hours}} = 0.58 \text{ m}^3/\text{hour}$$

- 3) Peak hourly water consumption

$$Q_{h-max} = 2 \times 0.58 \text{ m}^3/\text{hours} = 1.16 \text{ m}^3/\text{hours} = 19.33 \text{ lpm}$$

$$Q_{m-max} = 4 \times \frac{0.58 \text{ m}^3}{60} = 0.038 \text{ m}^3/\text{minute} = 38 \text{ lpm}$$

The adjustment factor is assumed to be at its maximum value, considering that water usage within the building is expected to be frequent and intensive.

3.2 Calculation Based on the Number of Plumbing Fixtures

The following are the plumbing fixtures to be installed in the Pos Medan Delivery Center office building:

- Flush Tank Toilets = 5 units
- Flush Urinals (open Type) = 4 units
- Washbasins (Lavatory) = 4 units
- Faucet = 6 units, and Kitchen Simks = 2 units
 - Flush Tank Toilets: 13 Litre x 5 x 6 times = 390 Litre/hours
 - Flush Urinals (open type): 5 Litre x 4 x 12 ktimes = 240 Litre/hours
 - Washbasins (Lavatory): 10 Litre x 4 x 6 times = 240 Litre/hours
 - Faucet: 10 Litre x 6 x 6 times = 360 Litre/hours
 - Kitchen Sink: 15 Litre x 2 x 6 times = 180 Litre/hours

After determining the water usage for each plumbing fixture, it was found that there are 4 flush valve-type fixtures and 17 standard plumbing fixtures. These totals are then multiplied by their respective usage factors:

Table 1 Usage Factor (%) and Number of Plumbing Fixtures

Plumbing Equipment	1	2	4	8	12	16	24	32	40	50	70	100
Plumbing Type												
Flush valve type fixtures	1	50 satu	50 2	40 3	30 4	27 5	23 6	19 7	17 7	15 8	12 9	10 10
standard plumbing fixtures	1	100 dua	75 3	55 5	48 6	45 7	42 10	40 13	39 16	38 19	35 25	33 33

(source: Soufyan M. Noerbambang)

1) Water Consumption

Based on Table 1, the water usage is obtained as follows:

$$1170 \text{ Litre/hours} \times 44,62 = 522,05 \text{ Litre/hours}$$

$$240 \text{ Litre/hours} \times 50 \% = 120 \text{ Litre/hours}$$

$$Q_h = 522,05 \text{ Litre/hours} + 120 \text{ Litre/hours} = 642,05 \text{ Litre/hours}$$

Total Water Consumption Based on the Number of Plumbing Fixtures

$$Q_h = 642,05 \text{ Litre/hours} = 0,6 \text{ m}^3/\text{hours}$$

$$Q_d = 0,6 \text{ m}^3/\text{hours} \times 8 \text{ hours/day} = 4,8 \text{ m}^3/\text{day}$$

2) Peak Water Consumption

$$Q_{h-max} = 2 \times 0,6 \text{ m}^3/\text{hours} = 1,2 \text{ m}^3/\text{hours} = 20 \text{ lpm}$$

$$Q_{m-max} = 4 \times \frac{0,6 \text{ m}^3}{60} = 0,04 \text{ m}^3/\text{minute} = 40 \text{ lpm}$$

The adjustment factor is assumed to be at its highest value, based on the estimation that water usage within the building will be frequent and intensive.

3.3 Calculation of Wastewater Capacity

The calculation of the wastewater tank capacity is based on the total discharge from plumbing fixtures that generate blackwater (toilets and urinals), as the waste from these fixtures must be treated before being discharged into the drainage system. Therefore, the required septic tank capacity for the Pos Medan Delivery Center office building is as follows:

- Flush Tank Toilets: 13 Litre x 5 x 6 times = 390 Litre
- Flush Urinals (open type): 5 Litre x 4 x 12 times = 240 Litre

Based on the simultaneity Table 1, the total discharge from plumbing fixtures that produce blackwater is as follows:

$$390 \text{ Litre/hours} \times 70 \% = 273 \text{ Litre/hours}$$

$$240 \text{ Litre/hours} \times 50 \% = 120 \text{ Litre/hours}$$

Total Water Consumption Based on the Number of Plumbing Fixtures

$$273 \text{ Litre/hours} + 120 \text{ Litre/hours} = 393 \text{ Litre/hours} = 0,39 \text{ m}^3/\text{hours}$$

Therefore, the calculation for the generated wastewater is as follows:

$$V_{\text{Air Kotor}} = 0.39 \text{ m}^3/\text{hours} \times 8 \text{ hours} = 3,12 \text{ m}^3$$

3.4 Pipe Size

The clean water pipe size is determined based on the flow rate and flow velocity, with a recommended velocity range of 0.9 m/s to 2 m/s according to SNI 03-7065-2005. Therefore, the pipe diameter is selected based on the expected flow rate. The following are the pipe size calculations for each floor:

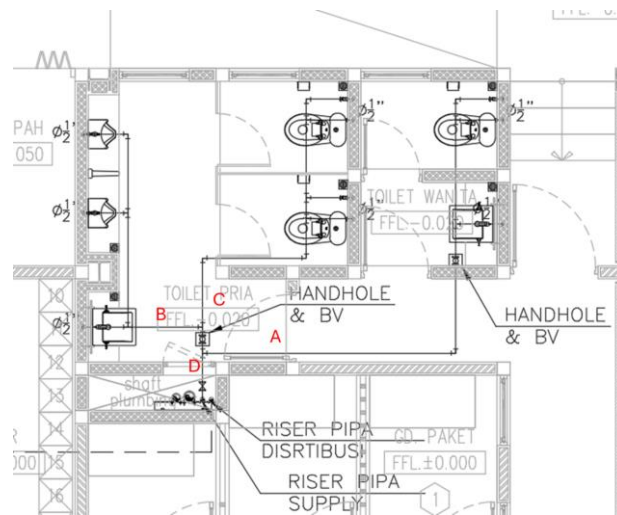


Figure 1. Plumbing Fixture Installation Layout First Floor

Pipe size calculation on first floor:

- 1) Point A: a unit flush tank toilet + an unit washbasin (lavatory)

Length of Pipe A to the end of the fixture unit: 7 meters

Total Flow Rate:

$$(15 \text{ lpm} + 15 \text{ lpm}) \times 100\% = 30 \text{ lpm} \approx 0,0005 \text{ m}^3/\text{second}$$

Therefore, the required pipe diameter for point A:

$$\text{Diameter} = \sqrt{\frac{4 \times 0.0005 \frac{\text{m}^3}{\text{second}}}{\pi \times 1 \text{ m/s}}} = 0,025 \text{ m} \approx 25 \text{ mm}$$

- 2) Point B: two unit of flush urinals (open type) + an unit washbasin (lavatory)

Length of Pipe B to the end of the fixture unit: 4 meters

Total Flow:

$$60 \text{ lpm} \times 50\% = 30 \text{ lpm} \approx 0,0005 \text{ m}^3/\text{second}$$

$$15 \text{ lpm} \times 100\% = 15 \text{ lpm} \approx 0,0002 \text{ m}^3/\text{second}$$

Total flow on point B = 0,0007 m³/second

Therefore, the required pipe diameter for point B:

$$Diameter = \sqrt{\frac{4 \times 0.0007 \frac{m^3}{second}}{\pi \times 1 m/s}} = 0,0298 m \approx 30 mm$$

3) Point C: 2 units Flush Tank Toilet

Length of Pipe C to the end of the fixture unit: 4,5 meters

Total Flow:

30 lpm x 100% = 30 lpm \approx 0,0005 m³/second

Therefore, the required pipe diameter for point C:

$$Diameter = \sqrt{\frac{4 \times 0.0005 \frac{m^3}{second}}{\pi \times 1 m/s}} = 0,025 dm \approx 25 mm$$

4) Point D (total): 3 units Flush Tank Toilet + 2 units Washbasins (lavatory) + 2 units Flush Urinals (open type)

Pipe D length: 1 meter

Total Flow:

(45 lpm + 30 lpm) x 70% = 52,5 lpm \approx 0,0008 m³/second

60 lpm x 50% = 30 lpm \approx 0,0005 m³/second

Total flow on D Pipe = 0,0013 m³/second

Therefore, the required pipe diameter for point D:

$$Diameter = \sqrt{\frac{4 \times 0.0013 \frac{m^3}{second}}{\pi \times 1 m/s}} = 0,04 m \approx 40 mm$$

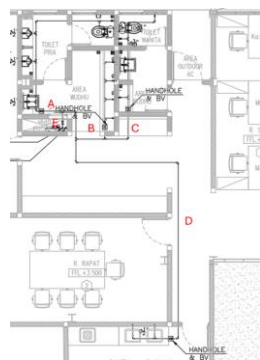


Figure 2. Plumbing Fixture Installation Layout Second Floor

Pipe size calculation on second floor:

1) Point A: 1 unit Flush tank toilet + 1 unit Washbasins (Lavatory) + 2 units Flush Urinals (open type)

Length of Pipe A to the end of the fixture unit: 7 meters

Total Flow:

$$(15 \text{ lpm} + 15 \text{ lpm}) \times 100\% = 30 \text{ lpm} \approx 0,0005 \text{ m}^3/\text{second}$$

$$60 \text{ lpm} \times 50\% = 30 \text{ lpm} \approx 0,0005 \text{ m}^3/\text{second}$$

$$\text{Total flow on point A} = 0,001 \text{ m}^3/\text{second}$$

Therefore, the required pipe diameter for point A:

$$\text{Diameter} = \sqrt{\frac{4 \times 0,001 \frac{\text{m}^3}{\text{second}}}{\pi \times 1 \text{ m/s}}} = 0,035 \text{ dm} = 35 \text{ mm}$$

- 2) Point B: 4 Units Faucet (Assumed to be the same as a hand washbasin)

Length of Pipe B to the end of the fixture unit: 5 meters

Total Flow:

$$60 \text{ lpm} \times 75\% = 45 \text{ lpm} \approx 0,0007 \text{ Litre/second}$$

Therefore, the required pipe diameter for point B:

$$\text{Diameter} = \sqrt{\frac{4 \times 0,0007 \frac{\text{m}^3}{\text{second}}}{\pi \times 1 \text{ m/s}}} = 0,0298 \text{ dm} \approx 30 \text{ mm}$$

- 3) Point C: 1 Unit Flush Tank Toilet + 1 Unit Washbasins (lavatory) + 2 Units Faucet (Faucet Assumed to be the same as a hand washbasin)

Length of Pipe C to the end of the fixture unit: 5,7 meters

Total Flow:

$$(15 \text{ lpm} + 15 \text{ lpm} + 30 \text{ lpm}) \times 75\% = 45 \text{ lpm} \approx 0,0007 \text{ m}^3/\text{second}$$

Therefore, the required pipe diameter for point C:

$$\text{Diameter} = \sqrt{\frac{4 \times 0,0007 \frac{\text{m}^3}{\text{second}}}{\pi \times 1 \text{ m/s}}} = 0,0298 \text{ dm} \approx 30 \text{ mm}$$

- 4) Point D: 2 Units Kitchen Sinks

Length of Pipe D to the end of the fixture unit: 11 meters

Total Flow:

$$30 \text{ lpm} \approx 0,0005 \text{ m}^3/\text{second}$$

Therefore, the required pipe diameter for point D:

$$\text{Diameter} = \sqrt{\frac{4 \times 0,0005 \frac{\text{m}^3}{\text{second}}}{\pi \times 1}} = 0,025 \text{ m} \approx 25 \text{ mm}$$

- 5) Point E (total): 2 Units Flush Tank Toilet + 2 Units Washbasins (Lavatory) + 2 Units Flush Urinals (open type) + 6 Units Faucet + 2 Units Kitchen Sink

Pipe E length: 0,5 meters

Total Flow:

$$(30 \text{ lpm} + 30 \text{ lpm} + 90 \text{ lpm} + 30 \text{ lpm}) \times 48\% = 86,4 \text{ lpm} \approx 0,0014 \text{ m}^3/\text{second}$$

$$60 \text{ lpm} \times 50\% = 30 \text{ lpm} \approx 0,0005 \text{ m}^3/\text{second}$$

$$\text{Total flow on E Pipe} = 0,0019 \text{ m}^3/\text{second}$$

Therefore, the required pipe diameter for point E:

$$\text{Diameter} = \sqrt{\frac{4 \times 0,0019 \frac{\text{m}^3}{\text{second}}}{\pi \times 1 \text{ m/s}}} = 0,049 \text{ m} \approx 49 \text{ mm}$$

The minimum dimensions for plumbing fixture wastewater pipes are specified by SNI 03-7065-2005.

3.5. Clean Water Pipe Dimention each Floor and Riser Pipe

The dimensions of the branch pipes are calculated based on the planned piping layout design for each floor. The determination of the clean water piping route is based on the position of the plumbing fixtures shown in the floor plan of each level. The piping routes are established by connecting each fixture that will receive a clean water supply. In determining the pipe routing, bends, branches, and the use of fittings are minimized as much as possible to reduce flow resistance. The piping layout for the first floor is shown in Figure 3, while the clean water piping layout for the second floor is shown in Figure 4. The planned pipe diameters include both the branch (horizontal) pipes and the vertical riser pipes. Branch pipes are installed horizontally above the ceiling to distribute water from the roof tank to each plumbing fixture, while the vertical riser pipes transport water vertically, connecting the branch pipes on each floor.

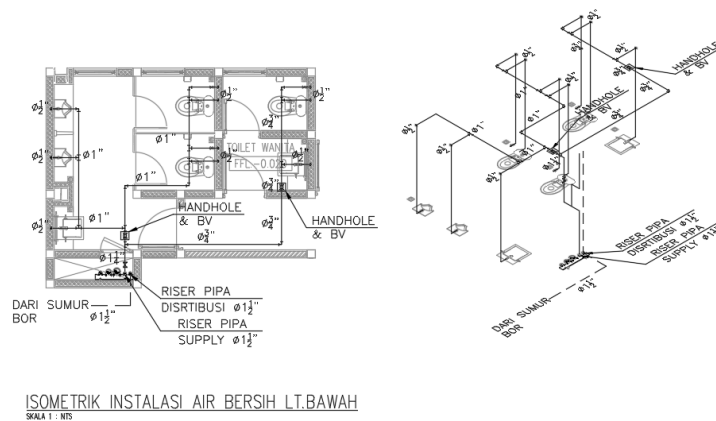


Figure 3. First Floor Clean Water Pipe Line Installation Plan

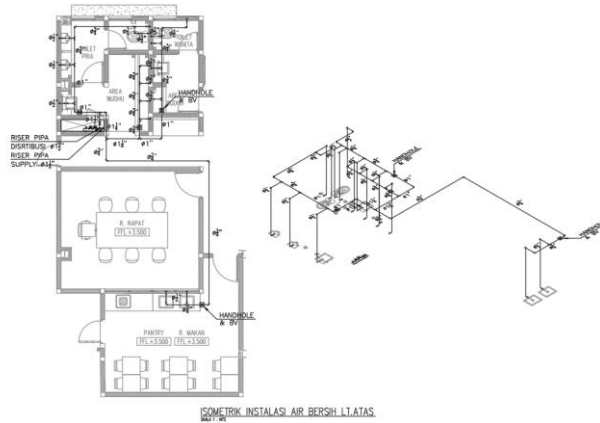


Figure 4. Second Floor Clean Water Pipe Line Installation Plan

3.6 Wastewater Pipe Dimention each floor

The calculation begins with the design of the greywater pipe routing. Greywater is discharged from plumbing fixtures such as floor drains and lavatories, which is then directed to the building’s drainage system. The pipe diameter is determined based on the total fixture unit load of each plumbing fixture, referring to SNI 03-7065-2005, starting from the fixture located farthest from the vertical stack. The greywater and blackwater piping routes, along with their respective dimensions, are shown in Figure 6 for the first floor and Figure 7 for the second floor.

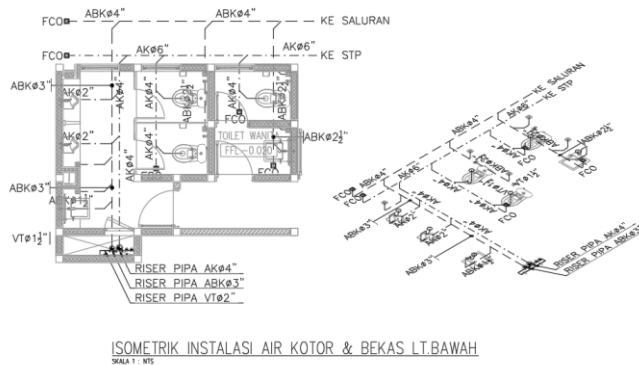


Figure 5. First Floor Waste Water Pipe Line Installation Plan

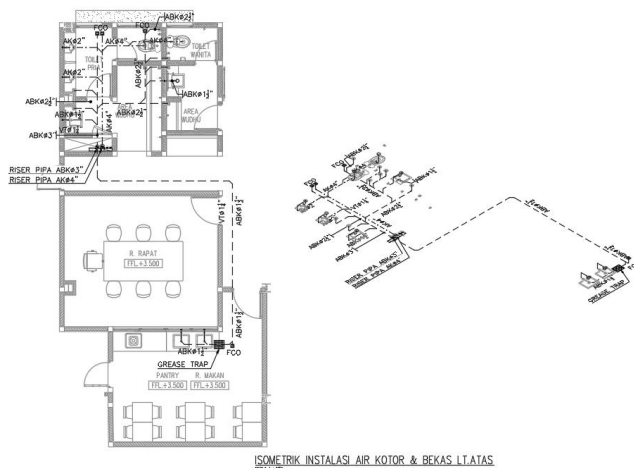


Figure 6. Second Floor Waste Water Pipe Line Installation Plan

3.7 Rainwater Calculation

The method used in this calculation is the Gumbel method, which is a statistical approach for estimating future rainfall discharge based on historical rainfall data collected over several previous years.

Table 2 Average Annual Rainfall

Tahun	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Rata-rata (mm)	233	179	234	236	266	265	275	311	267	291

- 1) After determining the average, the percentage value is then calculated.

$$P = \frac{1 \times 100}{10 + 1} = 9,09\%$$

- 2) The next step is to determine the average rainfall value, resulting in the following average:

$$R_r = \frac{(233+179+234+236+266+265+275+311+267+291)}{10} = 256 \text{ mm/day}$$

- 3) The next step is to calculate the difference between the maximum annual rainfall and the average rainfall for each year, then rank the values from the highest to the lowest. The results are as follows:

Table 3 Difference Between Maximum Rainfall and Average Rainfall

No	Rainfall	Percentage	Ri-R average	(Ri-R average) ²
1	311	9,1%	55	3039
2	291	18,2%	35	1257
3	275	27,3%	19	379
4	267	36,4%	11	131
5	266	45,5%	10	103
6	265	54,6%	9	89
7	236	63,6%	-20	392
8	234	72,7%	-22	486
9	233	81,8%	-23	512
10	179	90,9%	-77	5871
TOTAL				12259

- 4) Determining the standard deviation

$$S = \sqrt{\frac{12259}{10 - 1}} = 36,91$$

- 5) Determining the mean of the reduced variate (Y_n) and the standard deviation of the reduced variate (S_n) depends on the value of n and is based on the Gumbel variate table:

Table 4 Values of Y_n and S_n for n (Gumbel Method)

n	Y_n	S_n
10	0.4592	0.9496
11	0.4996	0.9676
12	0.5053	0.9933
13	0.5070	0.9971
14	0.5100	1.0095
15	0.5128	1.0206

Given that $n = 10$, the variate values are:

$$Y_n = 0,4592$$

$$S_n = 0,9496$$

- 6) To determine the design rainfall return period, the return period variation function (Y_t) is obtained by consulting the Gumbel method
- 7) After obtaining the design rainfall, the rainfall intensity can be calculated.
- 8) And the following table presents the calculation of the design rainfall discharge and the number of drainage channels required:

Table 5 Rooftop Rainfall Discharge and Drainage Channel Calculations

	Rain Water				
1	Roof Area	346	m ²	0.0003	km ²
2	Maximum Rainfall	118	mm/jam		
3	Debit hujan $Q = 0.278 CIA$	0.0102	m ³ /detik	613	liter/menit
4	Diameter pipe riser-Roof Drain	100	mm		
5	Roof Drain Capacity	122	liter/menit		
6	Quantity of Riser-Roof Drain	5	buah		

4. CONCLUSION

Based on the plumbing design data processing for the Pos Medan Delivery Center Office, serving 77 employees and incorporating 5 flush-tank toilets, 4 flush-valve urinals, 4 hand wash basins, 10 faucets, and 2 kitchen sinks, the following was determined: the required fresh water storage capacity is 4,8 m³, the fresh water tank filling pump capacity is around 40 lpm, the necessary wastewater tank capacity is approximately $\pm 3,1$ m³ and for rainwater planning, five vertical pipes with a diameter of 100 mm are needed to convey rainwater from the roof to the drainage system.

The clean water distribution system uses PVC pipes with diameters ranging from ½ inch to 1½ inches, while the wastewater system uses PVC pipes with diameters ranging from 1½ inches to 6 inches. The clean water supply system is sourced from a deep well, and distribution from the rooftop tank to each fixture unit is supported by a booster pump.

5. REFERENCES

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