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Research Article

Water Conservation Planning at Telkom University Landmark Tower Bandung Campus

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Abstract

Telkom University makes efforts in developing higher education facilities and capacities by constructing new campus buildings. One of the supports for improving services is sanitation infrastructure in the form of installations consisting of clean water installations, wastewater installations and ventilation, and rainwater installations with the concept of installed clean water. Each building that will be built in the area of West Java Province applies the concept of green buildings and conservation air as regulated in the Regional Regulation of West Java Province 13 of 2013 concerning Buildings, including campus building builders so that business actors are required to implement water management which aims to maintain quality, quantity, and continuity of clean water in West Java Province. The implementation of the installation with the concept of green buildings and air conservation is carried out at the Telkom University Landmark Tower building, which aims to use clean water in the building which can be more efficient because the location of the building is in a clean water distress zone based on the basin map of West Bandung Regency. The implementation of water conservation that is planned is WAC-3 waste water recycling (water recycling) which can be used as a rinse and watering the garden. Construction of infiltration wells which functions to reduce rainwater runoff and increase groundwater reserves, WAC-5 rainwater storage (rainwater storage) which can be used as alternative raw water. The use of the WAC-2 water-saving sanitary device (water feature) uses water usage and PDAM water costs. The application of air conservation that ignores water is 17.5% in the dry season and 61.5% in the rainy season of the clean water need total.

Keywords: plumbing installation; water saving; water conservation

1. Introduction

The number of new students continues to grow every year, encouraging Telkom university managers to improve services, especially classroom facilities and other learning support facilities. The manager plans to add 2 study programs, namely the Faculty of Medicine and the Faculty of Tourism, Transportation, and Hospitality Industries. Both faculties will be placed in a building built under the name Telkom University Landmark Tower (TULT). The location of the building is in telkom education area of Bandung at Jalan Mengger Hilir No.162, Sukapura, Dayeuhkolot District, Bandung Regency. TULT building is planned to have an area of 18,936 m^2 and a structure of 49,129.8 m^2 consisting of 19 floors and one basement (DED TULT, 2020).

The location of TULT is in Dayeuhkolot Subdistrict, which is an area experiencing a clean water crisis. This location of clean water service from PDAM Tirta Raharja Bandung regency is minimal. The area adjacent to the industrial area causes groundwater depth in this area to reach 62.08 m bmt. The groundwater level in this area in 1994–2006 decreased at a speed of 3.35 m/year (Harnandi and Herawan, 2009). The survey results stated that the current condition both at Telkom University campus and student dormitories quality and quantity of water is not good. Lack of water availability and water quality that does not meet the physical parameters for clean water. The construction of the new

building will increase the need for clean water to require an alternative new water source. Based on The Regional Regulation of West Java Province No. 13 of 2013 concerning Building Buildings, stated in chapter 1 article 1 paragraph 17 namely "Green building is a building that is responsible for the environment and efficient resources from the planning, implementation of construction, restoration, maintenance, to deconstruction (West Java Government, 2013), TULT Building Construction will apply the concept of green building by the regulation.

The concept of green building is an effort made to create space for healthy and comfortable living and work and an energy-efficient building from the point of design, development, and use that impacts the environment very minimally (Environmental Protection Agency, 2009). Green Building or green building is interpreted as a concept in developing environmentally friendly and energy-efficient buildings, aiming to use water and energy more efficiently to reduce the impact of new buildings on the environment and human health. Water Conservation (WAC) is one of the six categories of Green Building. WAC consists of WAC 1 by reducing water use, WAC 2 with water feature, WAC 3 by water recycling, WAC 4 using alternative water sources, WAC 5 utilizing water reservoirs, and WAC 6 by streamlining the use of landscaping water (Environmental Protection Agency, 2009).

Based on this, the construction of the TULT Building will apply the concept of a water-saving green building. Water elevation has a target to save the use of clean water sourced from both PDAM Tirta Raharja and groundwater. Planned water conservation includes the use of water-saving features, dirty recycling water, and harvesting rainwater. This study aims to calculate how much water can be saved after applying the concept. The benefit of this study is that the use of clean water will be significantly more efficient because the WAC efforts involved from the idea of water-saving green building that is water use can be saved by installing a rainwater catchment system, recycling used water that can be used to water plants or flush toilets. Use of water-saving equipment, such as low-flow water sprays, and using water-saving toilets. Based on Green Building Council Indonesia, 2013, the total maximum criteria value of 6 WACs is 21 with information per category meets two requirements criteria, six credit criteria that the percent obtained from the total weight per category of WAC is 20.8% (Green Building Council Indonesia, 2013).

The same research has been conducted in several places, such as planning a clean water plumbing installation system, using aspects of WAC 2 and 3 water conservation in The Cibinong Apartment of Matoa Tower E Tower, which can save clean water by 33% or about 305.88 m3/day (Wahyudi and Wardhani, 2019). The same thing is done in Private University Building X, located in the Northern area of Bandung City. The concept of this plan is to compare water conservation during the rainy season with the dry season and the saving of water use from water-saving sanitary equipment. Based on the calculations, water conservation efficiency is 69.0% in the rainy season and 30.1% in the dry season (Choerunnisa et al., 2020). The potential for water savings through reuse of used water for toilet and urinal flushing needs as well as the installation of water meters at Deanate University X is 10,489 liters/day (Afrihani et al., 2020) and in the Building paghegar Resort Dago Golf-Hotel and spa is able to save water by 25% (Rinka et al., 2019). The results of this study are expected to answer the question of how much water can be saved by applying 3 aspects of water conservation, namely by using water-saving water-saving tools, recycling grey water, and utilizing rainwater sources as an alternative water source.

2. Methodology

The research method consists of four stages: the calculation of water needs, the onset of domestic wastewater, water-saving installation, and rainwater reservoirs. The data processing stage consists of calculating the building population to know clean water needs, first looking for a functional area by multiplying the area by %area effectively (Neufert, 2002). The population count is carried out by dividing the effective area that has been obtained by population standards (Neufert, 2002). The need for clean water is used to calculate the onset of wastewater, obtained by multiplying the number of

populations that have been obtained from previous calculations with the standard water needs (SNI 03-7065-2005). Finding wastewater discharge is done to get the onset of greywater to be recycled. Based on Permen-PUPR No. 4 of 2017, the ratio of wastewater produced in one building amounted to 80% of the total clean water needs. According to Cahyadi, 2008 the ratio of greywater amounted to 80% of the full discharge of wastewater. Equations for determining effective area, population, clean water needs, and the onset of greywater are presented in equations 1-5.

Broad effective = Area m^2 x % Broad effective (1)

Population $= \frac{\text{Broad effective } m^2}{\text{Standard Population } m^2/\text{person}}$ (2)

Clean Water Needs = Population x Standard of clean water consumption = (l/person/day) (3)

$Q_{Wastewater}$ = 80% x Total amount of clean water needs = (m^3/day) (4)

$Q_{grey\ water}$ = Q wastewater x 80% = (m^3/day) (5)

Greywater waste treatment is one aspect of water conservation. Grey water can be recycled using STP (Sewage Treatment Plant). STP planning consists of determining processing capacity, type of processing unit, and calculating the efficiency obtained by the formula presented in equation 6.

$$\text{Efficiency} = \frac{\text{Total recycled water}}{\text{Total recycled water needs}} x100\% \quad (6)$$

The application of water-saving plumbing tool installation is one aspect of water conservation aspect WAC2 (Water feature) which is also an effort to save water (GBCI, 2013). This stage consists of determining the water-saving plumbing tool and is done compared to conventional plumbing tools, water capacity in water-saving, and conventional plumbing tools based on plumbing tools sold in the market. The step to compare water usage per day in water-saving and traditional equipment of plumbing (GBCI, 2013) is by multiplying the total population that has been obtained at the data processing stage with %occupancy and usage factors in the standard water consumption as presented in Table 1 (GBCI, 2013) and also multiplying the discharge of plumbing tools. The last stage is to calculate the efficiency obtained from the application of aspects of WAC2. The calculation stage used in applying the water-saving plumbing tool feature is presented in equations 7-9.

Water usage = (Total Population x % occupancy) x Factor x plumbing device discharge = l/day (7)

Water saving (l/day) = Water consumption with conventional plumbing tools – water saving plumbing tools (8)

$$\text{Efficiency} = \frac{\text{Water saving l/day}}{\text{Water usage with conventional plumbing tool l / day}} \text{x}100\% \quad (9)$$

Table 1. Water consumption standards

No.	*Fixture Type*	Occupancy (%)	Factor	Unit
1	WC (Male)	50	0,30	Average usage per person per day
2	WC (Female)	50	2,30	Average usage per person per day
3	Urinal use	50	2,00	Average usage per person per day
4	No urinal	50	2,30	Wc usage per person per day
5	Duration of hand washing	50	0,15	Minutes/usage
6	Duration of shower usage	5	5,00	Minutes/usage
7	Tap usage	100	2,50	Per day

Source: GBCI, 2013

Rainwater shelter or harvesting is one aspect of water conservation from applying the concept of WAC5 (Rainwater Harvesting), which is also an effort to conserve water (GBCI, 2013). This stage

determines the catchment area for rainwater based on SNI 8153:2015, rainfall intensity data used to look for rainwater discharge. The calculation of rainwater discharge is presented in equation 10. Calculate the volume of tanks and infiltration wells for rainwater storage. The last stage is to calculate the efficiency obtained from applying aspects of WAC5 as presented in equations 11-14.

$$Q_{rainwater} = f.\ C \times I \times A \quad (10)$$

$$V_{tangki\ rainwater\ storage} = C_{atchment\ area} \times 0.025\ m \quad (11)$$

$$V_{\ infiltration\ well} = \text{Area catchment area} \times 0.025\ m \quad (12)$$

$$\text{Bersh water saving} = \text{Total clean water requirement} \times \text{Total rainwater discharge} \quad (13)$$

$$\text{Efficiency} = \frac{\text{Clean water savings}}{\text{Total clean water needs}} x100\% \quad (14)$$

3. Result and Discussion

TULT is a building consisting of 19 floors and one basement that serves as a means of lectures at the Telkom university campus. TULT has a land area of 18,936 m2, as presented in Table 3.1. Figure 3.1 shows the TULT planning location at Telkom University.

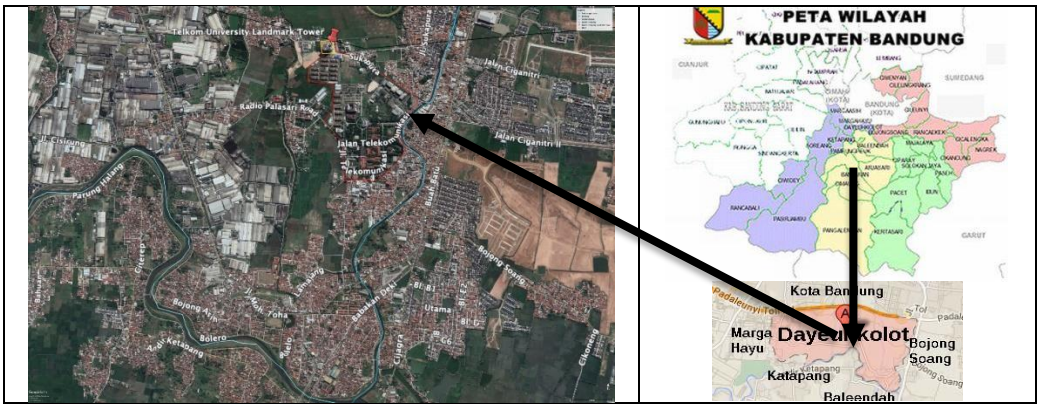

Figure 1. TULT planning location at telkom university

The provision of each floor is basement used for car parking and warehouse. The ground floor is intended as a student center, administration of the Faculty of Electrical Engineering and Industrial Engineering, health and consulting rooms, and control rooms &CCTV, and toilets. The 1st floor is intended for function rooms and bathrooms. The 2nd floor is designed for lecturer rooms, dean and vice dean rooms, head of department rooms, meeting/courtrooms, and toilets. Floors 3-14 are reserved for lecture halls and bathrooms. Floors 15-18 are also booked for lecture halls and bathrooms. The 19th floor is intended for the engine room and roof tank. The land to be used is divided into enclosed buildings, parking lots, parks, and generator rooms. The area of TULT roof used as rainwater area catchment has a total area of 2,627.3 m^2. The designation of each floor in the TULT Building is presented in Table 2.

Table 2. Function basement room

Floor	Room Function	Number of Rooms	Area (m^2)
Basement	Parking	1	1,323
	Warehouse 1	1	23.5
	Warehouse 2&3	2	13.8
	Lift Lobby	1	62
	Cleaning service room	1	16
	Panel Room	1	25.7

Source: TUTL, 2020

Table 3. Floor designation in TULT Building

Floor	Provisions
Basement	car park and warehouse
Ground floor	student center, administration of Electrical Engineering and Industrial Engineering Faculty, health & consulting room, and control room &CCTV, and toilet
1st Floor	function rooms, and toilets
2nd Floor	lecturer rooms, dean & vice dean rooms, kaprodi rooms, meeting/courtrooms, and toilets
Floors 3-14	lecture halls, and toilets
Floors 15-18	lecture halls, and toilets
Floors 19th	engine room and rooftank

Source: TUTL, 2020

TULT building consists of 19 floors and one basement with different uses per floor. The functions of each foot in TULT are as follows:

1. The basement floor is used as a car park area 1,323 m², Warehouse 1 with an area of 23.5 m², warehouse 2&3 with an area of 13.8 m², panel room with an area of 25.7 m^2, elevator lobby with an area of 62 m², cleaning service room with an area of 25.7 m². Table 3.2 presents the function of the basement room.
2. The ground floor is used as a student center with an area of 1,323 m^2, health room & consultation with an area of 32.4 m^2, administration FTE &FTI each has an area of 197 m^2, two musholla for men one and women one each has an area of 32.2 m^2, control room & CCTV with an area of 56.9 m^2, panel room with an area of 25.7 m^2, Warehouse with an area of 23.5 m^2, elevator lobby with an area of 62 m^2, cleaning service room with an area of 16 m^2, pantry with an area of 26.7 m^2, two male toilets each have an area of 16.8 m^2, two women's bathrooms each have an area of 10.8 m^2. Two disable toilets, one for men and 1 for women, each has an area of 5 m^2.
3. The 2nd floor is used as a waiting room with an area of 953 m^2, 2 meeting rooms / hearings each have an area of 151.1 m^2, 150 lecturer rooms each have an area of 4.8 m^2, FTE&FTI kaprodi room each has an area of 16.5 m^2, 2 dean rooms each have an area of 24.5 m^2, 6 vice dean rooms each have an area of 14.9 m^2, 2 mushola for men one and for women one each has an area of 32.2 m^2, panel room with an area of 25.7 m^2, Warehouse with an area of 23.5 m^2, elevator lobby with an area of 62 m^2, cleaning service room with an area of 16 m^2, pantry with an area of 26.7 m^2, two male toilets each have an area of 16.8 m^2, two women's bathrooms each have an area of 10.8 m^2. Two disable bathrooms, one for men and 1 for women, each has an area of 5 m^2.
4. Floors 3-14 are used as halls/corridors with an area of 1,279.8 m^2, 12 classrooms each have an area of 69.9 m^2, two mosques for men one and women one each has an area of 32.2 m^2, panel rooms with an area of 25.7 m^2, Warehouse with an area of 23.5 m^2, elevator lobby with an area of 62 m^2, cleaning service room with an area of 10.8 m^2. Two disable bathrooms, one for men and 1 for women, each has an area of 5 m^2.
5. Floors 15-18 are used as halls / corridors with an area of 1,279.8 m^2, 6 classrooms each have an area of 69.9 m^2, mushola for women with an area of 32.2 m^2, panel room with an area of 25.7 m^2, Warehouse with an area of 23.5 m^2, elevator lobby with an area of 62 m^2, cleaning service room with an area of 16 m^2, men's toilets each have an area of 16.8 m^2, women's toilets each have an area of 10.8 m^2, and difable toilets for women with an area of 5 m^2. Table 3.7 presents the function of the 15th-18th floor room.
6. The 19th floor is used as an engine room with an area of 86.2 m^2.

The need for clean water for TULT Building comes from PDAM Tirta Raharja and groundwater. Wastewater distribution is planned using a separate system between greywater and black water. Greywater will flow to STP for recycling, and black water will flow to septic tanks and infiltration fields. The clean water system in the TULT campus building consists of primary clean water systems

and secondary clean water. Direct clean water comes from the Regional Drinking Water Company (PDAM) for washing, ablution, and kitchen purposes. Secondary clean water derived from recycled water and rainwater processed to meet pure water quality is used for flush water and plant flush water. The clean water source is accommodated in the Ground Water Tank (GWT) located in the basement of TULT then pumped using a transfer pump to the Roof Tank (RT) located on the roof. The water that has been collected in RT is then distributed to the gravitational plumbing device and the pressurized system using a booster pump.

The total population in this building is 3,589 people with the composition of Basement 1 person, ground floor 32 people, 1st floor as many as 30 people, 2nd floor as many as 161 people, 3rd to 14th floor as many as 2,881 people, 15th to 18th floor as many as 482 people, and 19th floor as many as two people. Based on the results of the calculation can be concluded that the total population for the student center room is as many as 25 people. The way is also used to find the number of people for other spaces in the building. When compared with other researches that are used as a reference, for the study of clean water and wastewater plumbing installation system with the concept of water conservation in the learning center building Arntz Geise (PPAG) 2 Parahyangan Catholic University (UNPAR) Bandung, there is no significant difference due to the allocation of structures similar to this study. Still, in the research planning of clean water plumbing installation system, domestic wastewater sewage treatment plant in tower apartment Tower E Matoa Cibinong there is a difference in the %effective area used because of the allocation of buildings for apartments, for example in the calculation of the population for shophouses in the apartment % effective area used is 50-60% then with the difference can also affect the number of population obtained.

The steps to determine the number of plumbing tools needed can be known by comparing male and female populations. The percentage of comparisons used in this planning is based on the results of interviews with planning consultants. The male and female population ratio is 55:45%, with the number of men as many as 2,021 people and women as 1,954 people. In determining the needs of plumbing tools in buildings, SNI 8153:2015 adapted to the function of the building. Previously, it must be known to compare the number of male and female populations in the building so that it can be known the minimum number of plumbing equipment needs that must be in the building. The plumbing tools used in this planning are based on the existing architect's floor plan conditions. The number of plumbing tools obtained based on the comparison of the population is the minimum number of plumbing tools in the building. The number of plumbing tools based on existing conditions can be seen in Table 4.

It is recommended for the number of toilets on the ground floor men and women as much as one toilet. This method is used to find other plumbing tools, namely lavatory, urinal, faucet, and additional plumbing tools such as kitchen sinks and others. When compared with other researches that are used as a reference, for the study of the installation system of clean water and wastewater plumbing with the concept of water conservation in the building of the Learning Center Arntz Geise (PPAG) 2 Parahyangan Catholic University (UNPAR) Bandung, there is no significant difference due to the allocation of structures similar to this study. But in the research planning of the installation system of clean water plumbing, domestic wastewater sewage treatment plant in tower apartment Tower E Matoa Cibinong there is a difference in the number of plumbing tools needed because of the allocation of buildings for apartments, for example, in the calculation of the number of plumbing tools on the 1st-2nd floor that is intended as a shophouse with a ratio of women 60% and men 40% of the total population of 189 people obtained a total of 113 women and men 76 people arkan SNI 8153:2015 shophouse including trading facilities for the number of toilets that is one toilet for the number of 1-100 men and one toilet for the number of 1-100 women.

Table 4. Number of plumbing tools in TUTL

No	Floor	Closet		Urinal	*Lavatory*		Tap Water	*Jet Spray*	*Kitchen Sink*
		Man	Female	Man	Man	Female			
1	Basement	0	0	0	0	0	1	0	0
2	Ground floor	5	5	6	5	5	8	6	1
3	1st Floor	5	5	6	5	5	8	6	1
4	2nd Floor	5	5	6	5	5	8	6	1
5	Floors 3-14	60	60	72	60	60	96	72	0
6	Floors 15-18	20	20	24	20	20	32	24	0
7	Floors 19th	0	0	0	0	0	0	0	0

Calculating the need for clean water in a building is very necessary. The goal is to know how much water should be available to meet the water needs in the building. The amount of clean water needs in the building is determined by the building population and the type of building designation. In this case, the planned building is a campus building—recapitulation of water needs of each floor of the TULT building, which can be seen in Table 5.

Table 5. Recapitulation of clean water needs (liters/day)

No	Floor	Total Water Needs
1	Basement	50,00
2	Ground floor	2,350
3	1st Floor	763,00
4	2nd Floor	8,05
5	Floors 3-14	226,13
6	Floors 15-18	37,73
7	Floors 19th	100,00
8	Total Water Needs	275,22

Source: Arisitek, 2020

a. Application of Water Conservation (WAC)

The green building concept applied in TULT is WAC 2 (water feature), WAC 3 (water recycling), and WAC 5 (rainwater reservoir)

1.) *Water Conservation Water Feature* (WAC 2), Water feature used is a water-saving plumbing tool whose purpose is to reduce the use of clean water without eliminating the function of the plumbing tool, specifications of water-saving plumbing tools based on GBCI can be seen in Table 6. and standard water use conventional plumbing tools can be seen in Table 7.

Table 6. Water saving plumbing tool specifications based on GBCI

Water Output Tool	Water Output Capacity (L/***flush***)
WC Flush Valve	< 6
WC Flush Tank	< 6
Urinal Flush Valve	< 4
Lavatory	< 8
Wall Taps	< 8
Shower	< 9

Source: GBCI, 2013

Table 7. Conventional plumbing tool specifications

No	Plumbing tool name	Water usage for one-time use (liter)
1	Closet (with flush valve)	13.5-16.5
2	Closet (with flush tank)	13-15
3	Fireplace (with glostor valve)	5
4	Firecrackers, 2-4 people (with glazing tank)	9-18
5	Firecrackers, 5-7 people (with glazing tank)	22.5-31.5
6	Small hand wash basin	3
7	Lavatory	10
8	Sink with faucet 13 mm	15
9	Sink with faucet 20 mm	25
10	Bath Tub	125
11	Shows	24-60
12	Bath Tub Japanese Model	Depend on the size

Source: Noerbambang, 1984

The plumbing tool that will be used is a plumbing tool, brand X because brand X has also used water-saving technology compared to conventional plumbing tools in addition to being widespread in the market in Indonesia. The specification of plumbing tool brand X can be seen in Table 8. Calculation of water usage per day using a water-saving plumbing tool is determined based on the standard water consumption as stated in Table 9.

Table 8. Specifications of water saving plumbing tools with conventional

No.	Types of Plumbing Tools	X brand Water Usage	
		Eco Green	Conventional
1	Water Closet Tank	4.5/3 L/flush	6 L/flush
2	Urinoir	0.45 L/flush	1.5 L/flush
3	Lavatory	5 L/minutes	7 L/flush
4	Faucet	5 L/minutes	7 L/flush

Table 9. Water consumption standards

No.	*Fixture Type*	Occupancy (%)	Factor	Unit
1	Men's WC	50	0,3	Average usage per person per day
2	Women's WC	50	2,3	Average usage per person per day
3	Urinal use	50	2,0	Average usage per person per day
4	No urinal	50	2,3	WC usage per person per day
5	Duration of hand washing	50	0,15	Minutes/usage
6	Duration of shower usage	5	5,0	Minutes/usage
7	Tap usage	100	2,5	Per day

Source: GBCI, 2013

Calculation of water usage is done by comparing water-saving plumbing equipment with water-saving plumbing equipment, analysis of water needs with conventional plumbing tools can be seen in Table 10.

Table 10. Water needs using conventional plumbing equipment and water saving

Types of Plumbing Tools	Occupancy (%)	End	Duration Factor Use /person/ day	Discharge plumbing tool				Water Usage Using (L/day)	
				Conventional	unit	Save water	Unit	conventional plumbing tools	water saving plumbing tool
Men's WC	50	1,794	0.3	6	L/flush	3	L/flush	3,229.67	1,614.83
Women's WC	50	1,794	2.3	6	L/flush	3	L/flush	2,4760.80	12,380.40

Types of Plumbing Tools	Occupancy (%)	End	Duration Factor Use /person/ day	Discharge plumbing tool				Water Usage Using (L/day)	
				Conventional	unit	Save water	Unit	conventional plumbing tools	water saving plumbing tool
Urinal	50	1,794	2	1,5	L/flush	0.45	L/flush	5,382.78	1,614.83
Lavatory	100	3,589	0.15	7	L/minute	5	L/minute	9,419.87	6,728.48
Faucet	100	3,589	0.15	7	L/minute	5	L/minute	9,419.87	6,728.48
Total								52,212.99	29,067.03

Based on the calculation results, water usage using conventional plumbing equipment amounted to 52,212.99 L / day. Water use using plumbing equipment water saving by 29,067.03 L / day that the water-saving efficiency obtained by 23%.

2.) *Water Conservation Water Recycling* (WAC 3)

The utilization of wastewater in the Green Building concept aims to reduce the use of clean water for garden watering and sewerage for toilets and urinals. The water needs used in the application of WAC 3 are based on the population and water-saving plumbing tools. The amount of wastewater amounts to 80% of the total clean water needs consisting of 80% greywater and 20% black water. The efficiency obtained from the treatment of greywater waste by 80% by using STP from the amount of waste grey water so that the water obtained from the treatment of 141 m^3 / day. The number of processed water needs for garden flush needs can be seen in Table 11, and the requirements of processed water for the needs of grinding can be seen in Table 12. Knowing the needs of recycled water is used to determine the capacity of the recycling water storage tank, which will then be distributed to the roof tank for water distribution to each plumbing tool that requires recycled water.

Table 11. Garden flush needs

Garden Flush Needs	
Water needs (liter/m^2)	5
TULT park area (m^2)	675
Watering needs (liter/day)	3,375

Calculation of water needs for water flushing the park is water needs L / m^2 x Park area m^2 = 5 Liters / m^2 x 675 m^2= 3,375 Liters / day

Table 12. Needs for eviction

Population	Plumbing Tool	Population (Soul)	Flushing Frequency	Flushing Needs (liter/flush)	Recycled Water Needs (liter/day)
Official	WC	343	1	3	1,029
	Urinal		3	0.45	463.05
Student	WC	3,217	1	3	9,651
	Urinal		3	0.45	4,342.95
Visitors	WC	29	1	3	86
	Urinal		1	0.45	13
Total		3,589	Total Recycled Water Needs		15,584

Calculation of water needs search on flushing WC for employee population = Number of population x Flushing frequency x Flushing needs L/flush = 343 people x 1 x 3 L/flush = 1,029

L/day. It is also used to search for recycled water needs in plumbing tools and other population categories. Reduction of clean water needs from the application of water recycling for the use and flush of the park obtained as much as 141 m^3/day and has met the needs of recycled water so that the remaining greywater treatment results of 122 m^3/day, the remaining greywater treatment results will be utilized for the needs of firewater reserves.

Table 13. Recapitulation of garden search and watering needs

Population (Soul)	Flushing Needs (m^3/day)	Garden Watering Needs (m^3/day)	Water Treatment Results (m^3/day)	Remaining Grey Water Processing Results (m^3/day)
3,589	15.58	3.38	141	122

3.) *Water Conservation RainWater Reservoir* (WAC 5)

The application of WAC 5 aims as an alternative source of clean water use from the primary water source, where rainwater that falls on the roof of the building then flows through an upright pipe of rainwater gravitationally to the rainwater reservoir, which is then used as raw water to be used as primary clean water. Rainwater that has been accommodated is then processed to reduce pollutants contained in rainwater until it reaches the prevailing clean water quality standards. Furthermore, it is necessary to know the amount or volume of rainwater to see the efficiency of saving clean water, rainwater storage tanks, and infiltration wells used as reservoirs of running water from rainwater to reduce the burden of urban drainage and also for excess raw water that is not accommodated in the tank, infiltration wells are also used to deliver wastewater processed in the IPAL to meet the quality standards applicable to have flowed into the environment. In determining the debit of rainwater required rainfall data and area catchment area, the calculation of rainwater discharge obtained by 273.43 m^3/h, for the volume of rainwater storage tanks and the importance of infiltration wells that are attached by 61.04 m^3, the following is the calculation of the volume of rainwater storage tanks and the volume of infiltration wells:

- Volume of rainwater storage tank = Total catchment area x 0,025 = 2,441.46 m^2 x 0.025 = 61.04 m^3
- Infiltration well volume = Total catchment area x 0.025 = 2,441.46 m^2 x 0.025 = 61.04 m^3

The discharge of rainwater obtained by 273.43 m^3/h can then be determined the efficiency of water savings to the number of waters needs from the application of WAC 5. Calculation of clean water savings obtained by 154.14 m^3/day so that the efficiency of pure water savings obtained by 44 %, here is the calculation to find the efficiency of water savings:

- Qrainwater = C x I x A = 0.95 x 0.11789 m/hour x 2,441.46 m^2 = 273.43 m^3/Hour
- Qrainwater– Rainwater storage tank & Infiltration well = 273.43 m^3/Hour - 61.04 m^3 - 61.04 m^3 = 151,36 m^3/hour

Based on the total rainwater discharge obtained at 151, 36 m^3/day, the STP used is STP X with a processing capacity of 80% of the total water treated for a capacity of 200 m^3.

- Total rainwater discharge treatment = 151.36 m^3/day x 80% = 121.09 m^3/day
- Total clean water savings = Total need for clean water – Volume rainwater = 154.14 m^3/day
- Water saving efficiency = $\frac{Total\ clean\ water\ savings}{Total\ need\ for\ clean\ water}\ x\ 100\%$ = $\frac{121.09\ m^3/day}{275.22\ m^3/day}\ x\ 100\%$ = 44%

b. Efficiency of Water Conservation Implementation (WAC)

Selection of alternatives based on operations, the efficiency of grey water waste treatment system and saving clean water needs from the primary water source, recapitulation of water conservation planning can be seen in Table 14.

Table 14. Water conservation planning recapitulation

Clean Water Needs	Use of WAC 2	Use of WAC 2 and WAC 3	Use WAC 5
m³/day			
275.22	29.07	19	121.09

Table 15. Clean water savings in the rainy and dry season

Clean Water Savings			
Dry Season	Rainy Season	Dry Season	Rainy Season
m³/day		%	
106.07	227.16	17.5	61.5

The calculation to find the efficiency of water savings from the application of 3 aspects of water conservation in the GBCI concept, namely:

- Rainy season water saving = Clean water requirements – (Use of WAC 2 + Use of WAC 3 with WAC 2) = 275.22 m^3/day – (29.07 m^3/day + 19 m^3/day) = 106.07 m^3/day.
- Rainy season water saving = Clean water requirements – (Use of WAC 2 + Use of WAC 3 with WAC 2 + Use with WAC 5) = 275.22 m^3/day – (29.07 m^3/day + 19 m^3/day + 121.09 m^3/day) = 227.16 m^3/ day.
- Water saving efficiency = $\frac{Clean\ water\ savings}{Clean\ water\ needs}\ x\ 100\% = \frac{225.37\ m^3/day}{275.22\ m^3/day}\ x\ 100\% = 82\%$

Based on the calculation using the application of Water Conservation (WAC) in WAC 2, WAC 3, and WAC 5 can be concluded for the savings of clean water obtained in the dry season of 106.07 m^3/day or 17.5% and the rainy season of 227.16 m^3/day 61.5% 16from the total need for clean water. Judging from the condition of the building location and PDAM capacity that is not adequate, the concept of Green Building is very useful for water-saving and maintains the quality of groundwater.

4. Conclusions

The occurrence of liquid waste produced by the TULT building amounted to 220.18 m^3/day consisting of greywater 176.14 m^3/day and the black water of 44.04 m^3/day. With the application of WAC 2, the use of water-saving plumbing tool brand X can save clean water by 29,067.03 L/day or 23% of the use of conventional plumbing tools that is 52,212.99 L/day. Furthermore, with the application of WAC 3, grey water waste treatment obtained by 141 m^3/day with STP Biofive can save clean water, especially for the needs of 15.58 m^3/day and garden flush of 3.38 m^3/day, the remaining processed water obtained by 122 m^3/day will be used for hydrant and sprinkler reserves. Furthermore, the last is the application of WAC 5, the catchment area of 2,441.46 m^2 and rainfall intensity of 117.89 mm/h obtained rainwater treatment discharge of 121.09 m^3/h, the volume of the rainwater storage tank and infiltration wells of 61.04 m^3, and water-saving efficiency obtained by 44% of total clean water needs. The complete application of water conservation amounted to 106.07 m^3/day or 17.5% in the dry season and 227.16 m^3/day or 61.5% in the rainy season from the total clean water needs.

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